A Case Study In Object-Oriented Development: Code Reuse For Two Computer Games

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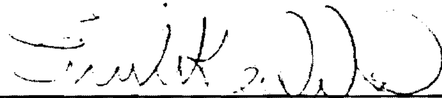

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(ABSTRACT)

A case study of the object-oriented development of two computer games using commercially available products was conducted. The games were constructed for use on Apple Macintosh computers using a C++ like programming language and an accompanying object-oriented class library.

Object-oriented techniques are compared with procedure oriented techniques, and benefits of object-oriented techniques for code reuse are introduced. The reuse of object-oriented code within a target domain of applications is discussed, with examples drawn from the reuse of specific functions between the two games.

Other reuse topics encountered in the development effort which are discussed: reuse of operating system routines, reuse of code provided by an object-oriented class library, and reuse of code to provide functions needed for a graphical user interface.

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I. Introduction

Many years since its introduction, object-oriented programming has grown into a widely used technique. I had heard much about this method of organizing software development after reading articles about the subject and encountering object-oriented design methodology in a graduate level class; but prior to this project, had not had the opportunity to actually use it. The purpose of this project, therefore, is to design and develop an application using object-oriented techniques, and gain a first hand appreciation for any advantages or disadvantages of their use.

This case study consists chiefly of the development of an application used to play a game of Chess on Macintosh computers over a network. The application does not produce moves in the guise of a computer opponent, but instead the game (hereafter called ChessNet, which stands for chess on a network) provides an on-screen chessboard and pieces, with which the user can play an opponent running another copy of the game on a second Macintosh. The two machines are connected via an AppleTalk network.

A method was then devised to reuse the ChessNet design and code to develop a completely new application. This second application is a computer version of the game of Battleship[1], which will also be a networked game played with two connected computers. The ChessNet application was developed using object-oriented design and coding techniques, and was implemented with the THINK C programming environment and its included Class Library. The development effort also required knowledge of Macintosh Toolbox routines (including QuickDraw drawing routines), and techniques for coding chess games.

This paper describes the design and construction of the ChessNet application. A preliminary non-object-oriented design is first contrasted with the object-oriented approach from the view of the application developer. Then the paper focuses on a frequently cited advantage of the object-oriented approach: ease of code reuse between applications. Meyer makes this claim: "Object-oriented design is the most promising technique now known for attaining the goals of extendibility and reusability."[1] Methods to reuse code using the object-oriented approach are introduced. In particular,

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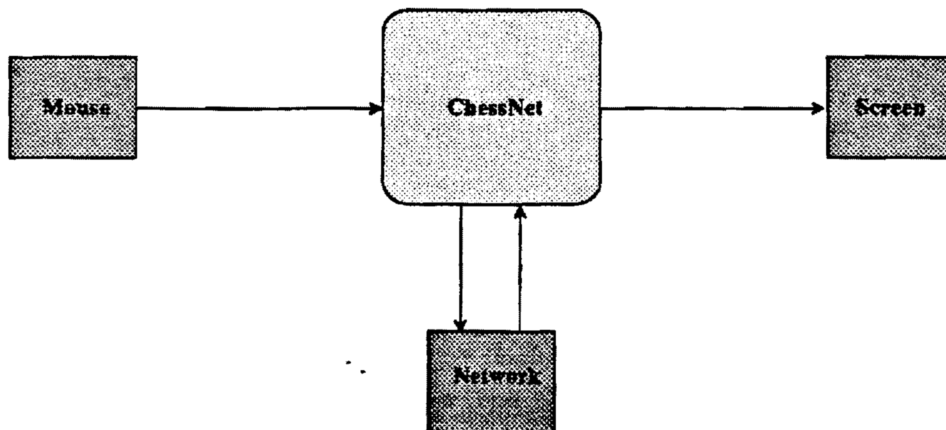
[1] A popular board game, trademark of the Milton Bradley Company.

ways to reuse the design and code from the chess game to create the Battleship game are discussed. This second application involves two opponents taking turns attempting to sink each other's ships, placed strategically upon the playing board. This game is dissimilar enough from chess to be an interesting conversion, yet all of the objects in ChessNet will be reused. In addition to object-oriented resuse, this paper will also address reuse related to Macintosh operating system routines.

II. Object-Oriented Approach Vs. Procedure Oriented Approach

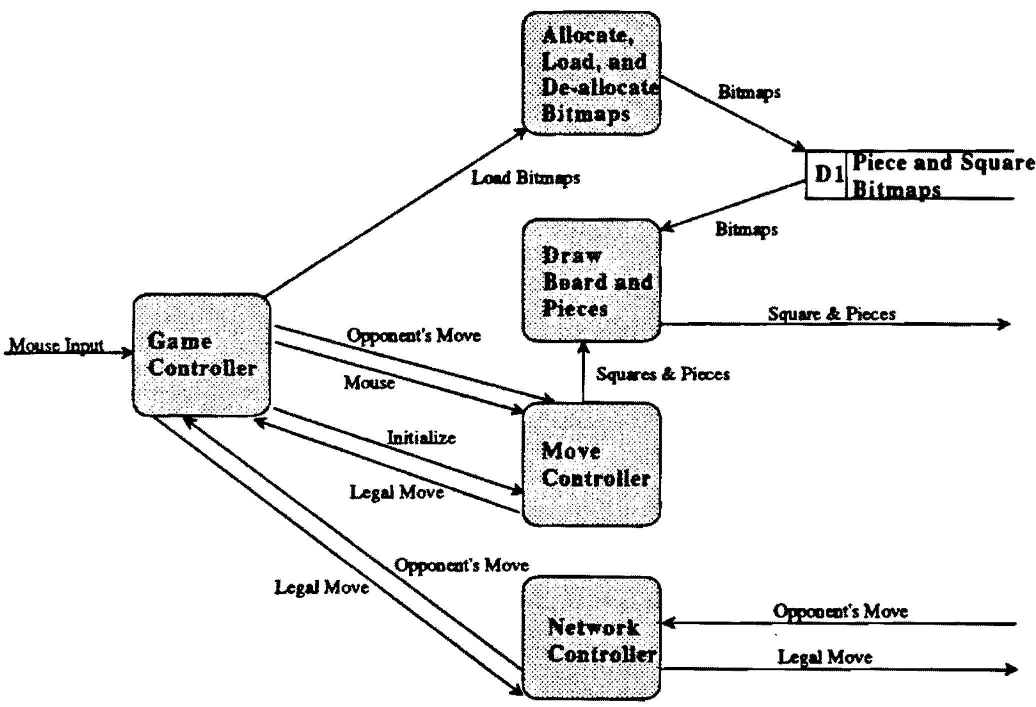
In order to show the nature of object-oriented design, it can be helpful to first look at an alternate type of design, an approach used by Booch [2]. Figures 1 - 3 show a simple design for a chess game, using the data flow notation of Gane and Sarson [3].



Alternate DataflowDesign
Figure 1

With this approach, the design is first functionally decomposed into separate processes, which do some work on data moving in and out of the processes. Thus data flow diagrams show the movement of data through a program, represented here by rounded rectangular boxes for processes, lines with arrows which show the movement of

data, and open-ended rectangles which serve as data stores. The rectangle boxes in figure 1 represent devices external to the system. The data stores show a grouping of data, such as an array or a file located on disk, which exists for some meaningful duration during the execution of the program. This excludes passed parameters and local variables which exist only during the execution of a particular procedure. The arrows show movement of data usually passed as parameters when a procedure is called or when a procedure manipulates the contents of a data store directly.

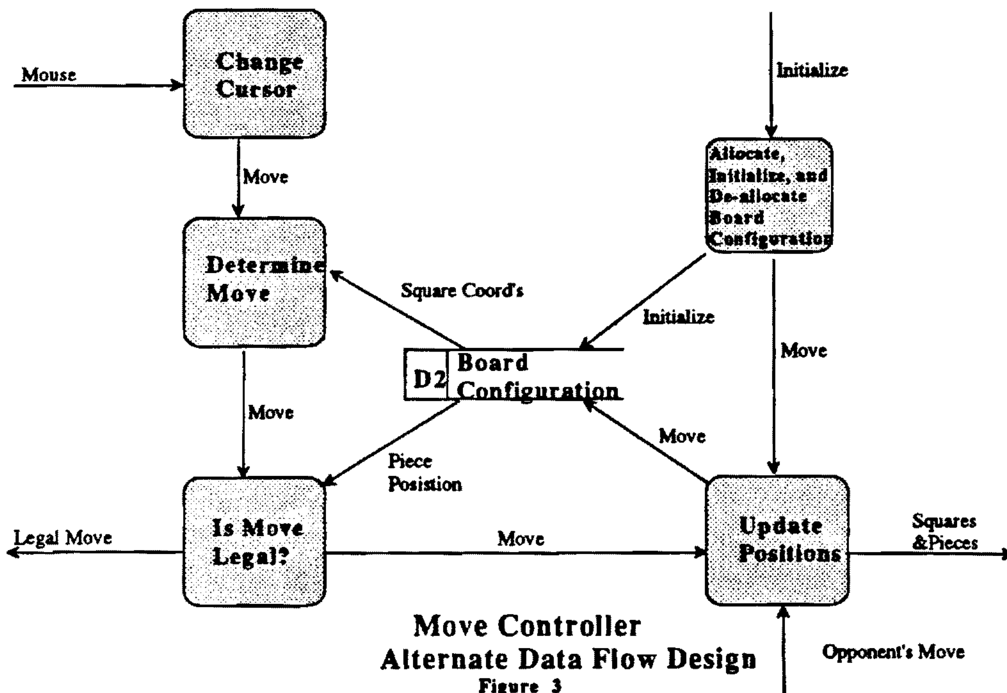


Alternate Data Flow Design

Figure 2

This design begins with the "Game Controller" allocating and loading piece and square bitmaps into data store D1, so they will be available for drawing on the screen through the life of the program. Similarly the board configuration information in data store D2, inside the "Move Controller" process (figure 3) is allocated and initialized. The D2 data includes coordinates used for drawing the square on the screen and locating

mouse clicks, as well as the chess pieces stored in each square. The "Allocate & Initialize" process within the "Move Controller" sets the initial piece positions by calling the "Update Positions" process repeatedly. "Update Positions" stores the beginning move pieces in D2, and calls "Draw Board and Pieces" (back on Figure 2) to display the squares & pieces on the screen, using the D1 data store.



Move Controller
Alternate Data Flow Design
Figure 3

A move is initiated by the user clicking on a chess piece and dragging the cursor across the screen to another square. This mouse input is passed by the "Game Controller" process to the "Move Controller". Inside this process, "Change Cursor" alters the cursor to indicate that a piece is being moved. When the mouse button is released "Determine Move" calculates the "to" and "from" squares using the mouse input and the square coordinates in the D2 data store. "Is Move Legal" decides if the move is legal, using the piece positions also from D2. If the move is not legal nothing remains to be done (since the piece has not itself moved, just the cursor, nothing has to be un-done) If the move is legal then it is sent in two directions: the first to "Update Positions" which updates the D2 data store with the move and calls "Draw Board and Pieces" to update the screen; the

second back to the "Game Controller" and through the "Network Controller" which sends the move across the network to the opponent's copy of the game. Lastly, a move coming in from the opponent is passed by the "Network Controller", through the "Game Controller" to the "Move Controller", where "Update Positions" again updates D2 and calls "Draw Board and Pieces" to update the screen.

The object-oriented design (OOD) for a chess game is introduced in the diagram of figure 4. Here the design is decomposed into objects, as opposed to processes. The objects contain methods, which are just processes in their own right, but more importantly, the objects also contain data structures. In figure 4, the top half of each object lists attributes or data stored in that object. The bottom half lists the methods related to that object. Relationships of one to one, one to many, or inheritance, are shown between the objects. A detailed description of this object oriented diagramming notation from Coad and Yourdon [4] is contained in appendix A. The piece and square bitmaps from the D1 data store in figure 2 are distributed between the "KindsOfSquares" and the "KindsOfPieces" objects. From the D2 data store in figure 3, coordinates placing a square in its window on the screen are moved to the "Squares" objects. Information relating which chess pieces are on which squares, again from the D2 data store, is also placed in the "Squares" object in the form of a "pointer" (currentPiecePtr) to a PiecesInUse object. If the pointer is null, then that square is empty. So in a sense, the data stores from figures 2 and 3 have been split apart and the processes have been wrapped around them to form the objects. Meyer states this in another way: "this law of inversion is the key to turning a functional decomposition into an object-oriented design: Reverse the viewpoint and attach the routines to the data structures. To programmers trained in functional approaches, this is as revolutionary as making the Sun orbit Earth."[5]

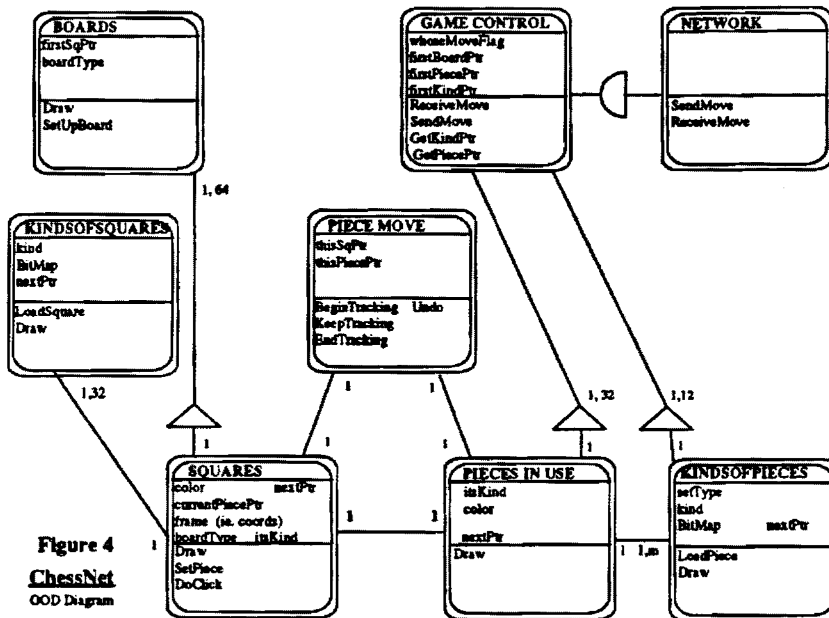


Figure 4
ChessNet
OOD Diagram

As a consequence of this re-orientation, there is more cohesion between procedures and data in the object-oriented design when compared with the data flow design. In ChessNet the data and the code that uses the data are associated explicitly in the object diagram as the attribute and methods of that object. In figures 2 and 3, the data stores exist as separate elements on the same level as the processes. Although the dataflow diagrams indicate now which processes access which data stores, it will be less obvious as the program is changed in a later maintenance stage, where within the code itself, it is less obvious what code goes with what data. Even without the OOD diagram, the code for ChessNet explicitly states the relationship between the attributes and methods of an object in a "header" file, where the object and its data are declared.

There is a benefit to having cohesion between procedures and data as Booch notes: "One side-effect of the functional decomposition is that all interesting data end up being global to the entire system, so that any change in representation tends to effect all subordinate modules. Alternately, in the object-oriented approach the effect of changing the representation of an object tends to be much more localized."[6] A change to data in an object will be more localized because it is only necessary to change the methods of that object's class. Client code should only access that data through one of the methods of

that class, not directly. In the dataflow design, the procedures which we must modify due to changes in data representation may be more generally spread throughout the program. For example a change in the D2 data store may require changes in the following procedures in figure 3: "Determine Move", "Allocate Board Configuration", "Update Positions", and "IsMoveLegal". A change to the attributes in the Squares class in figure 4 would require changes only to the methods for that class. It is true that the number of methods requiring changes could equal the number of procedures, but at least the methods would all be confined to one place in the program.

There is a second benefit to grouping data with procedures: for the object-oriented approach it is more obvious where the data are allocated, initialized, and de-allocated than in the data flow design. Though the first design has specific processes to perform these functions , when other data stores are added later they may be allocated and initialized elsewhere, as is left to the whims of the programmer. Object-oriented design imposes some organization by standardizing initialization. Each object should include an initializing method, which as standard practice would be called just after the object is created. Later users and maintainers of the program can count on the object-oriented program being organized in such a manner, and therefore can become familiar with the workings of the program more readily.

III. Code Reuse

While there is always a need for new applications to be created, whether driven by business needs or changing technology, the costs of developing new applications increases. This stems primarily from the personnel costs needed to design, code, test, and maintain new software. The reuse of existing designs and code is one way to reduce the expense of developing new applications.

Object-oriented programming offers advantages when reusing code developed by others. The first advantage involves the cohesion between code and data discussed in the previous section. It may be difficult to reuse code stored in libraries, in a non-object form, if this reuse requires major data structures to persist for significant periods of time through the execution of a program. The library would have to supply "create data" and "dispose of data" routines which put a burden upon the user to implement correctly. Alternately, "static" variables (available in languages such as C) could be used to save

the persistent data between calls to a function.[7] While use of static variables encapsulates data within a routine, they do not provide the flexibility of object-oriented techniques. Only one copy of a particular function and its static variables can be used (without duplicating the function and renaming the duplicate), whereas multiple instances of an object and its data can be easily created. Also data and code itself cannot be protected from being utilized by parts of the program which should not have access to it. With object-oriented programming, methods not meant to be used outside of an object can be kept "private", and thus protected from use in other parts of a program. Object-oriented classes also include initialize and dispose methods encapsulated along with the data, which are always called at the beginning and end of an object's existence. Thus there is no confusion as to when to initialize or dispose of data. A second advantage of object-oriented programming arises in the need to modify some of the reused code. "Inheritance" lets us replace portions of the provided code and data, while still reusing the bulk of it. Inheritance will be covered in more detail when discussing the code created for ChessNet.

Code Reuse For A Graphical User Interface

Another view of the difference between object-oriented development and functional decomposition, discussed earlier, focuses on the idea of 'state'. Booch says: "Because of the existence of state, objects are not input/output mappings as are procedures or functions. For this reason, we distinguish objects from mere processes which are input/output mappings."[8] The object does not just accept data as input, process it , and then output it, but holds onto it for some meaningful duration. Booch defines an object as "something that exists in time & space and may be affected by the activity of other objects. The state of an object denotes its value plus the objects denoted by this value. For example, thinking back to the multiple window system we discussed in the first section,[2] the state of a window might include its size as well as the image displayed in the window (which is also an object)."

This idea of state relates to a graphical user interface (GUI). The types of capabilities provided by a GUI typically require state information to be saved for each instance of a certain part of the interface. For example, if a new window is added to our application we might need to save, in addition to information concerning the window's

[2] i.e. in Booch's paper.

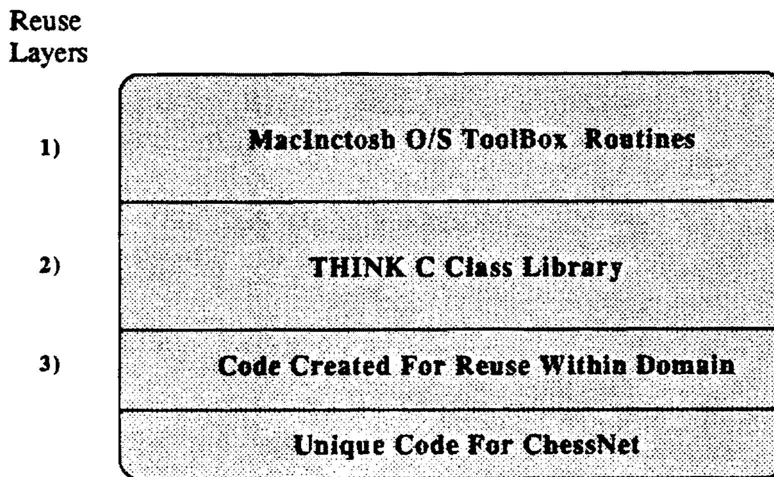
size and content, the kind of window (what it looks like and whether scrollable or not) and its current location on the screen. Its capturing of state information (and Booch's example of a window system) suggests that the object-oriented approach would be especially useful in providing a means of reusing code for a GUI. This type of interface is a good candidate for reuse because, by its very nature, its use implies a standard way of doing things and standard methods should not have to be recreated. Use of a GUI suggests that certain portions of the application; using window frames to surround portions of the screen, presenting commands to the user in the form of pull-down items on a menu bar; or running a program by clicking on an icon, will all be done in standard ways. Since these identical functions are performed repeatedly by applications using the GUI, there is no reason to create new code to perform these functions when existing code can be reused.

Object-oriented technology has a special advantage when trying to reuse code to enable a developer to put features of a complex GUI interface into his application. Such interfaces require many data structures along with code which communicates between these structures. It would be difficult to supply these built in features to a developer without using object-oriented techniques, due to the large amount of entwined data and code associated with a GUI. If you want to add a new window using an class library, you need only create a new instance of a class, i.e. an object, and initialize it. Without a class library, you would have to call procedures to create data structures for the window, and then call other procedures to control the window. However, when using a class library where there is much interaction between objects, as with the THINK C class library, it can be difficult understanding how things actually work. The developer needs to determine to which objects some called methods belong, which can be difficult, especially with some classes inheriting methods four to five levels deep. (Also on the Macintosh, a called routine may not even be a method, but instead come from the Toolbox). These problems can be remedied with good documentation, which is always important , and tools to allow users to browse objects graphically.

Code Reuse Within the ChessNet Computer Game

We can separate the reuse of code within the ChessNet computer game into three distinct layers, and discuss each in turn. These layers of reuse, shown in figure 5, are as

follows: 1) system routines provided as part of the Macintosh operating system and described herein as the Toolbox; 2) pre-coded classes provided for the use of application programmers in the form of the THINK C Class Library; and 3) separate classes created as part of this project to provide reuse of specific functions between the ChessNet computer game and the Battleship computer game. A fourth type, the use of code resources, will be mentioned as an alternate form of reuse, related to number 1) above.



ChessNet Code Layers

Figure 5

The first form of reuse in the ChessNet game is composed of routines which perform functions needed in the Macintosh environment. Known collectively as the Toolbox, portions of these are included in the read-only memory (ROM) of Macintosh computers. Though in ROM, a means is provided to update this code through subsequent releases of the Macintosh operating system. The Toolbox is a more conventional form of reuse in that it consists of a library of routines which require specific parameters, and return some value or perform some action, either internally or drawing to the screen. The subset of routines that draw to the screen is called QuickDraw. Many of these routines are called from within the methods in the THINK Class Library, but programmers may also use these routines directly as they see fit. However, it is sometimes difficult to determine the specific routine and its required parameters to use, for Apple documents them in a bulky series of manual that are extended (new volumes created instead of updating the old), as changes are made to the existing routines, or new ones added. Some form of on-line documentation, such as on CD-ROM, would definitely make using the Toolbox routines easier.

A related, but more minor, form of reuse in the Macintosh programming environment is the use of resources. These involve placing values into standard structures defined outside of the normal compilation process. The programmer uses a utility, such as ResEdit, to pull up a list of resources known to the Macintosh environment. He then defines a new instance of a needed structure, filling in specific values as required. The resource is added to the executable code. Within the program source code, the programmer calls other provided routines to load these structures, previously defined, into memory where they are actively used. For example, the programmer may define the structure for a window in ResEdit, filling in needed values such as window ID, type of window, initial size of the window, and initial location of the window on the screen. Within the program code, a Toolbox routine would be called to load this pre-defined window into memory, and cause it to appear on the screen at the designated location. These Resources provide a means of more easily reusing structures, such as menu items, windows, icons, and bitmaps, which are frequently needed when programming for a GUI environment. The reuse of these structures goes hand in hand with the reuse of code provided in the Macintosh Toolbox.

THINK C is a C language compiler for the Macintosh computer, which provides object extensions to the C language. These extensions make THINK C very similar to the C++ object-oriented language, although some differences remain between the two (see Appendix E). Basically, these extensions permit the following: the declaration of classes which contain attributes (data) and methods (functions); the linking of these into inheritance chains where a class will inherit the attributes and methods of those classes above it; the ability to create at run time instances of declared classes, or objects, whose attributes and methods may be accessed by other parts of a program through the use of pointers to those created objects. Along with the compiler, THINK C provides a class library which can be used at the programmers discretion. The THINK Class Library provides source code for a variety of classes which provide attributes, methods, and inheritance chains which users may link with their own code to build applications. Basically this library consists of objects which provide much of the functionality of the Macintosh interface. Figure 6 shows the THINK Class Library classes available for a programmers' use (not all of these classes were used in ChessNet).[8] The classes are shown in an hierarchical fashion (to show which classes are sub-classes of others) but the specific attributes and methods for each class are omitted. Typically, a majority of

these classes, not just one or two, would be used in an application, in order to provide the functionality of the Macintosh Interface.

Some examples of this functionality are: 1) the class "Switchboard" provides methods which comprise the event loop at the heart of every program operating within the Macintosh interface. This event loop chooses actions for each event received; whether originating from within the application or from outside such as those coming from another program or the user's mouse or keyboard input. 2) The combination of "Collaborator", "Bureaucrat", "View", and "Window" together provide the functionality for a window, while "Collaborator", "Bureaucrat", "View", and "Pane" together describe an area on the computer screen within that window. All of the classes have "Object" as a base class. As discussed earlier, the THINK Class library provides a good means of reusing code to provide the functions of a GUI such as the Macintosh interface. However, to accomplish this end, a majority of the classes must be used, not just a select few, because the classes have many interrelationships, and the inheritance extends up to nine levels deep. Most of the objects created from these classes send messages (i.e. call functions) to other objects from the THINK Class Library which are assumed to be present. This interaction between objects can at times become complex and its purpose is not always obvious. Therefore the use of a class library such as THINK C's does not come without a price. While it does give us a means of reusing code to perform the difficult yet standardized functions for an interface, time and study is required to understand the operation of the class library, especially where the library code interacts with new code written for an application.

Reusable Code Created For This Project

There are two types of code reuse provided for the Macintosh environment: the classes of the THINK Class Library used to perform the functions of a particular GUI; and the internal Toolbox routines called either directly, or indirectly through the code provided by the Class Library An application programmer can use object-oriented code to add his own layer of reuse on top of these two layers. By planning carefully, new classes may be added which fulfill particular functions required in similar applications and thus may be reused across multiple applications. The area of functionality intended for reuse can be described as a "domain". These new classes may interact with the existing classes of the THINK Class Library or call Toolbox routines.

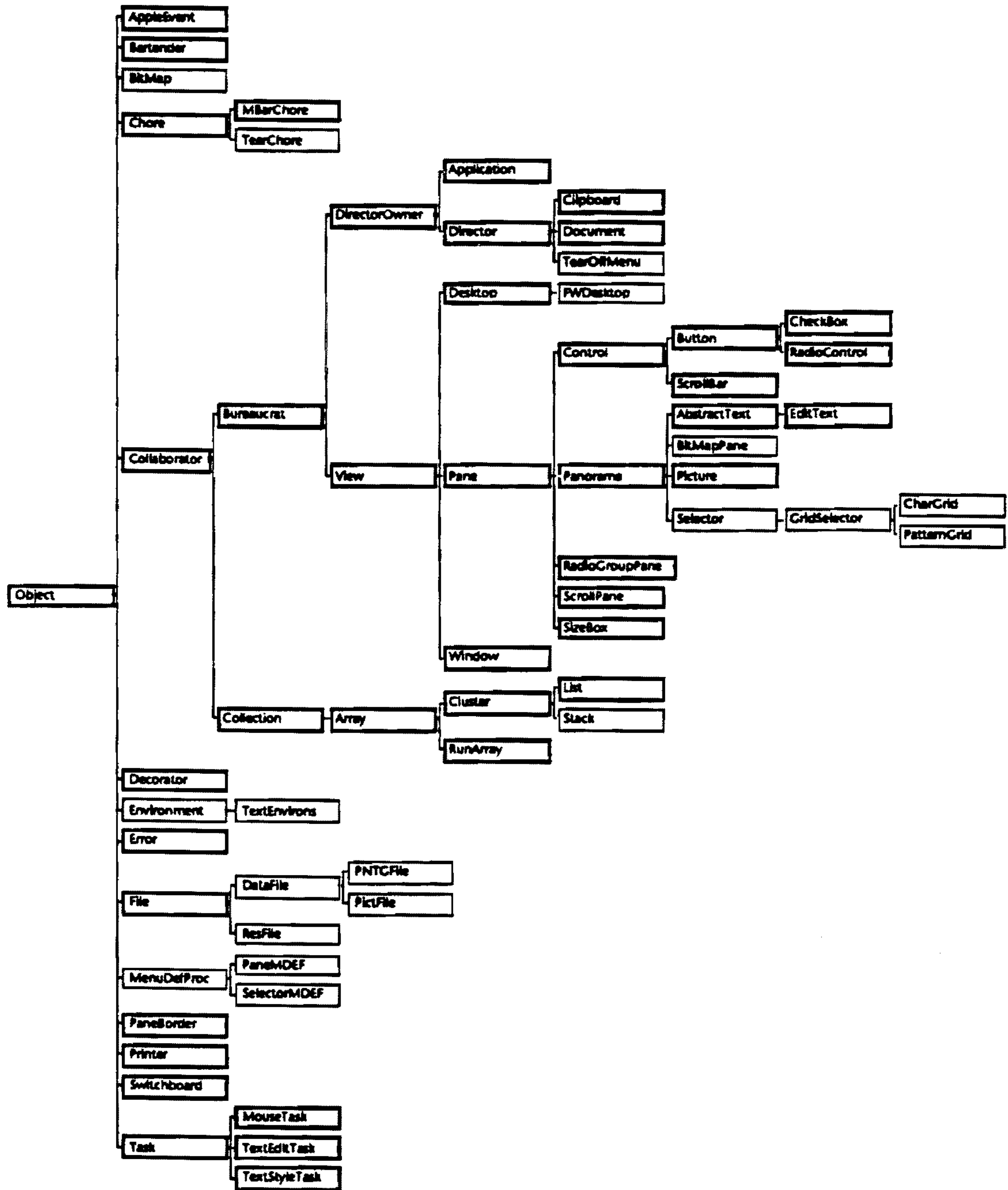


Figure 6 The THINK Class Library's class hierarchy

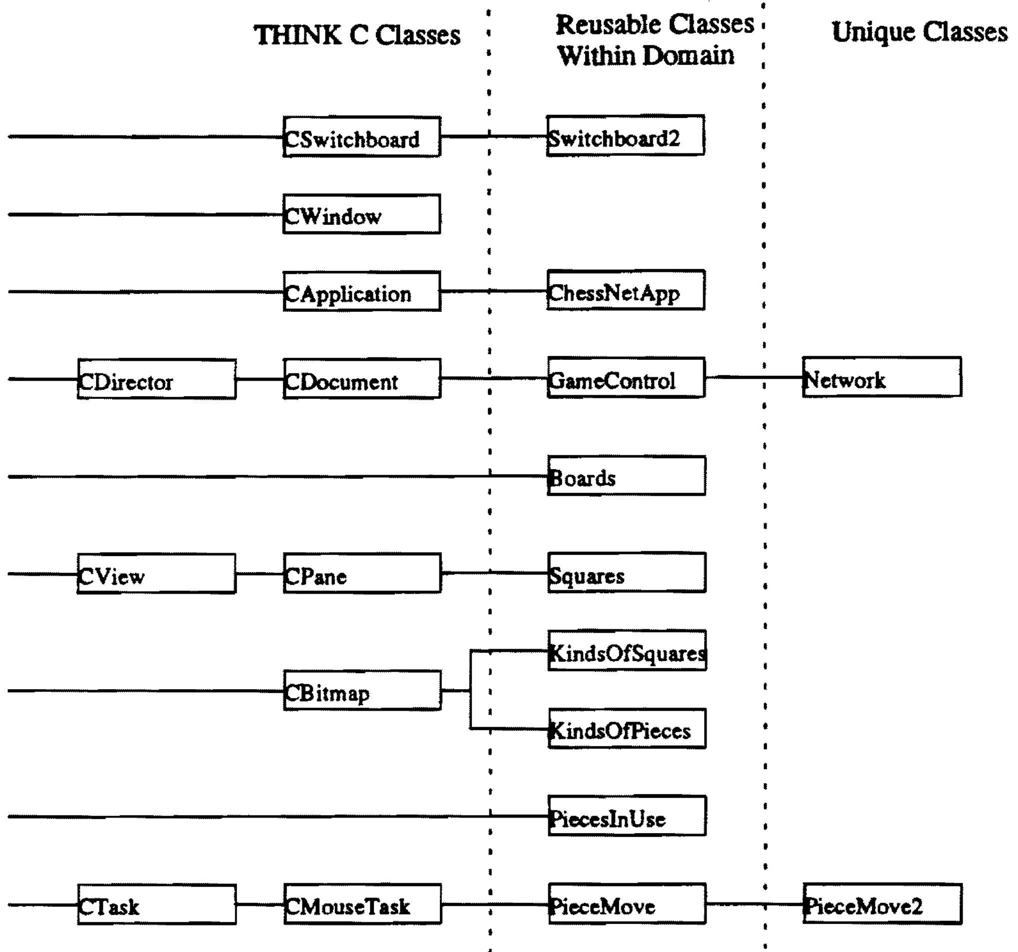
The ChessNet computer chess game can be broken down into three functional areas: 1) displaying a bitmapped graphic to some portion of the screen; 2) creating bitmapped screen objects which can be moved within a window with the mouse; and 3) sending move information across a network to the opponent's copy of the computer game. These three functions, along with code specific to the chess game (such as that needed to determine legal piece moves), and the reused Toolbox and THINK Class Library code, is all that is needed for the ChessNet application. Code for the three functions above will be reused in the Battleship game. The description of this second game, along with an explanation of how these three functions are reused, while adding code unique to the Battleship game, will be described later. Figure 7 shows the classes used in ChessNet, and indicates which are from the class library (some are omitted), which were created for ChessNet but will be reused in Battleship, and which are unique to ChessNet. These differ slightly from the classes in figure 4, because classes were added to separate the reusable from the singular code. The ChessNet program is described further in appendix B.

The first functional area involves a class used to define an area on the screen, named "Square", which contains a pointer to the class used to store the bitmap for that square, "KindsOfSquares". To fulfill this function we only need code to create and initialize objects with the desired bitmaps and then draw the bitmaps to the desired location on the screen. The bitmaps must first be created in a drawing program and stored as resources, or data structures, which can be loaded into program memory during execution. As described earlier, the use of a resource editor to create data outside of the program compilation process, facilitates the reuse of these predefined structures. It is easier to deal with structures such as bitmaps in this manner rather than putting them into the program code directly. Code in the "Boards" class will create and initialize the desired number of "Squares" and "KindsOfSquares" objects, and will load the bitmaps into the "KindsOfSqures" objects. When a "Squares" object receives a draw command, it relays this message to its accompanying "KindsOfSquares" object, which actually draws the bitmap on the screen using a QuickDraw graphics routine.

The second functional area permits the user to click on and move a game piece around the window or game board. This also requires the loading of bitmaps as for the first function. Each piece must be created in a drawing program and stored as a resource which can be loaded into program memory during execution. Code in the "GameControl"

class will create and initialize the desired number of "PiecesInUse" and "KindsOfPieces" objects, and load the bitmaps into the "KindsOfPieces" objects where they are stored. The game pieces are set in their initial positions on the board by setting a pointer in the "Squares" objects to the appropriate "PiecesInUse" objects. When the user selects and moves a chess piece with the mouse, both new code and reused code from the THINK Class Library are combined to actually move the piece. The Class Library determines where the user has "clicked" on the screen, and which "Square" object needs to receive this notification. This "Square" creates a new object of the class "PieceMove", which controls the actual move, while receiving continual updates from the Class Library concerning the position of the mouse as it moves across the screen. The PieceMove object draws the game piece as it moves across the screen, while erasing the previous piece images and cleaning up the underlying squares to give the illusion of continuous movement.

The third functional area consists of simple network routines used to communicate between the two copies of the game on different computers. These routines access the Macintosh Toolbox, reusing several layers of code to actually send data across the network. Methods provided by the "GameControl" class perform two main steps. The first provides the ability to find and select the opponent's copy of the game and then link to it. The second step sends messages to the opponent's copy. These messages are composed in the form of "events", which are recognized as originating from the opponent's copy of the game. Attached to each event is a data structure, usually containing information about a move , which can be filled and processed as needed depending upon the implementation, i.e. whether used in the ChessNet or Battleship games.



ChessNet Class Hierarchy

Figure 7

The functions described above make up the portion of the code created for this project which is reusable within the chosen domain of "board games". Now the unique code must be added to the chess game to describe its particular set of rules. The inheritance feature of object-oriented programming can be used in this situation, to add unique code, while at the same time reusing code developed earlier. A sub-class can be added to an existing class such that the former inherits the methods and attributes of the

latter. To intercept method calls from elsewhere in the program, the sub-class can override methods in a super-class, by providing methods with duplicate names. Figure 8 shows an example where code is needed to support Networks A, B, and C for some hypothetical program.[10] With object-oriented programming, sub-classes for each new network can be added to provide code unique to one particular network, while the code common to all can be left in the super-class Network. Networks A and B may be able to use methods SendMove() and ReceiveMove(), and attribute moveData as they exist in the superclass Network. When we add Network C, which requires modified versions of these methods and the data structure, we can supply them in the sub-class Network C, where they will override the definitions in Network. When the user selects a network, an instance of the chosen network can be created, NetworkA, NetworkB, or NetworkC, which inherits methods and data from the superclass Network.

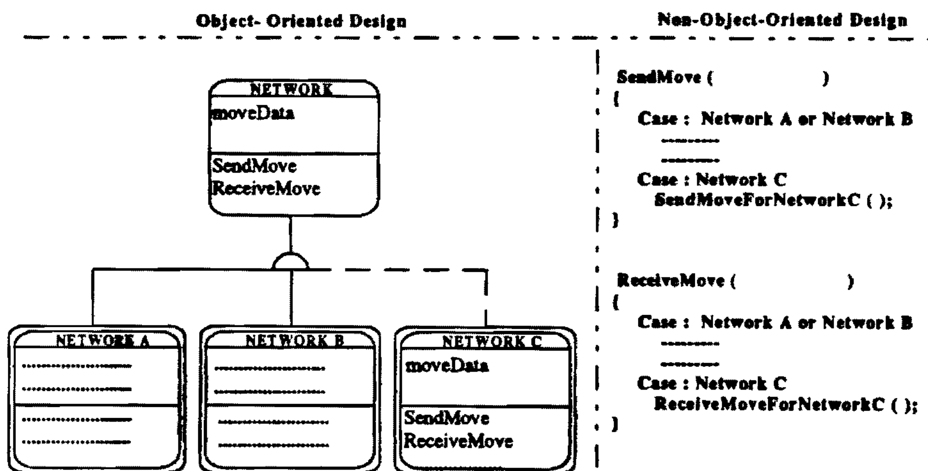


Figure 8

In a non-object-oriented program, some selection criteria is needed in each procedure that will have different code for various networks. Thus, both the SendMove() and ReceiveMove() procedures would need a case statement to switch between specialized code for Network C, and the general code for the other networks. The coding for "differences" ends up in separate places (each procedure) and is more difficult to keep track of. With inheritance, all the non-common code can be kept in one place: in overriding methods of the sub-class for the specific network; while the common code will be stored in the methods of the superclass. Another difference lies in that, in the

non-object-oriented program, the selecting between general and specific code may require the creation of additional similarly named procedures which perform the same function, but for a specific network. A case statement may call ReceiveMoveNetA(), ReceiveMoveNetB(), etc. This leads to a proliferation of procedure names. Within the object-oriented program names for methods which provide the same functionality may be reused. The method name ReceiveMove() can appear in the subclass Network C, where it overrides the inherited ReceiveMove() in the super-class Network. This is called 'overloading', and helps to reduce the proliferation of procedure names.

By using inheritance in the manner just described, the singular code required by the chess game can be added on top of the layers formed by the THINK Class Library and the reusable code developed for the domain of a "board game". Thus the "PieceMove2" in figure 7 is attached as a sub-class to the "PieceMove" class. Methods in "PieceMove2" override those in PieceMove, but instead of moving the piece these methods actually add the "rules" needed to determine legal moves in the game of chess. "PieceMove2" calls the methods within it's super-class, "PieceMove", to move the chess pieces. Likewise, "Network" is attached as a sub-class to the "GameControl" class. "Network" contains code that builds the data structure which is sent across the network. The specifics of this data structure will change from application to application. The parent "GameControl" class contains the generic method which actually sends the data across the network, but which does not need to change with different applications.

Code Reuse And Domain Analysis

The use of objects as "parts" for multiple applications in similar functional areas, such as in ChessNet, is an emerging concept for object-oriented development.[11] More emphasis will be put on developing each object to be flexible within its range of intended function. With this comes a de-emphasis on the development of the application as a whole. By concentrating on constructing a good set of re-usable, adaptable parts to be used by many applications, the development of the overall program may be simplified. The process is then reduced to picking out the proper objects for the job and putting them together. Software construction is envisioned as changing, along these lines, into an industrial enterprise, with applications being built in an assembly line mode where parts are put together. These ideas suggest that the important work will lie in

producing these parts, not in developing entire applications from scratch. Meyer puts this in the context of "top down" vs. "bottom up" approaches [12]:

> Object-oriented design may be defined as a technique that, unlike classical (functional) design, bases the modular decomposition of a software system on the classes of objects the system manipulates, not on the functions the system performs. Classical approaches like functional top-down design (even, to a large extent, data flow analysis methods) require designers to first ask what the system does. Object-oriented design avoids such questions as long as possible, in fact until the system actually is run......
>
> More importantly, top-down design goes against the key factor of software reusability because it promotes one-of-a-kind developments, rather than general-purpose, combinable software elements....
>
> The bottom-up method promoted here does not mean that system design should start at the lowest possible level. What it implies is construction of systems by reusing and combining existing software.

Since the bottom-up approach de-emphasizes the overall system, more consideration must be given to its parts. A study of the intended domain of the objects to be reused will contribute to the effectiveness of each class as it is reused in some new application. If the planned reuse of each new class is not taken into account, it then increases the likelihood that the class is missing some needed attribute or method when used in another application. Kang comments: "The productivity and quality improvement from reusing components built for the purpose of reuse is much greater than that from components developed without reuse in mind. However, in order to build reusable components, the context in which the reusable components will be used must be understood and the reusable components must be designed to accommodate the contextual differences." [13] This study of planned reuse is called a domain analysis, which Prieto-Diaz defines as "a process by which information used in developing software systems is identified, captured, and organized with the purpose of making it reusable when creating new systems"[14] According to Kang, the outputs from a Domain Analysis do the following [15]:

- facilitate reuse of domain knowledge in systems development,
- define a context in which reusable components can be developed and the reusability of candidate components can be ascertained,
- provide a model for classifying, storing, and retrieving software components,

- provide a framework for tooling and systems synthesis from the reusable components,
- allow large-grain reuse across products, and
- can be used to identify software assets.

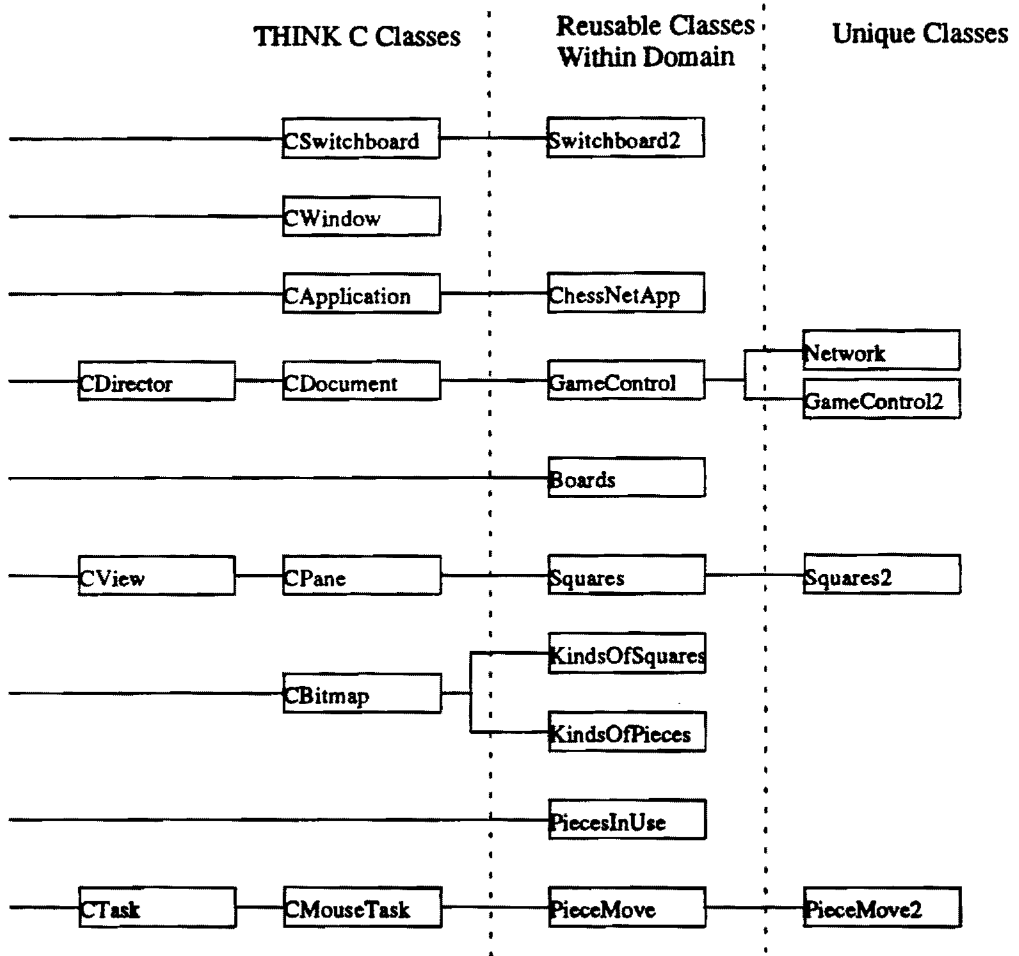
No domain analysis has been attempted for this project, other than informally considering ways to reuse a few functional requirements from one application to another. However, the scope of this project is quite small with only three functional areas reused between two applications. Where more code is reused between a greater number of applications, a serious domain analysis effort would undoubtedly increase the likelihood of successful reuse.

Code Reuse For The Battleship Game

The game of Battleship starts with each player placing four ships on his own board. Neither player can see the other's ships. This is the preparation phase of the game, and will for the most part function the same way as the chess game: the user moves the pieces around the board with the mouse. After each player places his ships, they remain locked in their positions on the board. The second phase of the game then commences. Each captain takes turns indicating coordinates on the opponent's grid (actually one square on a board of 100 squares). If a ship occupies those coordinates it is identified as a "hit", otherwise it is a "miss". Each ship can accept from 2 to 4 "hits" (and thus overlays 2 to 4 squares) depending on the size of the vessel. A player loses and the game is over when all his ships are filled with "hits".

The domain classes from ChessNet can be reused for Battleship. The mechanism for moving the ships into position works the same as when the chess pieces are moved. One hundred squares must be allocated for the game of battleship whereas sixty-four were needed for the chess board. These squares will be initialized with a different size. Next different bitmaps for the squares and the ships will be required. These changes can be made by passing different parameters to the initializing methods. The complicated rules governing chess moves in "PieceMove2" can be replaced with simpler ones which

just restrict the ships to non-overlapping positions on the board. New code in "GameControl2" enables the player to signal to his opponent that his ships are in position and so is ready to start the second phase of the game.



Battleship Class Hierarchy

. Figure 9

In the second phase, the game requires two views of the board. The first shows the player's own ships, and records any hits on them by his opponent. When it is his turn to fire, the player must flip to the other view of the board, where his hits and misses against his opponents vessels are recorded, but without showing the positions of the

vessels (their positions can be deduced as more hits are recorded which is the key for success in the game). The two views of the board may be accomplished reusing the ChessNet code by adding a new sub-class, "Squares2". "Squares" will store the first board view while "Squares2" holds the second. Instead of just two instances of "Kinds Of Squares", one black square and one white square, there will be three: an empty square, a "hit" square, and a "miss" square. In this second phase of the game, the opponent's shot, passed across the network, is actually just a square designator, and is recorded on the first board view as a miss in an empty square, or a hit on one of the ships. A shot is fired back by switching to the second board view, reviewing previous hits and misses against the opponent, and "clicking" on an empty square to return fire. The act of "clicking" on a target square and sending the "shot" across the network is handled by code in the "PieceMove2", "Network", and "GameControl" objects. An additional requirement of Battleship is that after a shot is fired, verification is needed to determine whether a hit was scored. This will be accomplished by storing the location of the enemies ships after the setup phase, using a "Squares2" attribute. These enemy ships would not be displayed to the user: their positions would be used internally to determine a hit or a miss.

IV. Conclusions

Functionality can be shared across applications using object-oriented methods in the following manner: place common code in reusable classes, while unique code for each application is placed in sub-classes. In ChessNet and Battleship, a layer of common classes representing functions needed by both are built upon two existing layers of code reuse. The first is a class library performing the functions of a graphical user interface. Secondly routines are provided for reuse as part of the operating system. On top of this three layer foundation is added the singular code which represents the "rules" of each game and make each game distinct from the other. The "rules" are attached in the form of sub-classes linked through inheritance to the classes composing the common elements of the two games. When some method in the reused classes is called, an overriding method of the same name may be called instead. This inherited method will perform some action according to the "rules" of the game and then call the overridden method to provide the common functionality as needed.

Some forethought is needed to replicate functionality across multiple applications. A study, called a Domain Analysis, is useful in this situation to ensure that code intended to be shared will prove useful when it is actually reused. This study determines not only what the code needs for reuse, but also where it will be reused, i.e. its domain. This needs to be defined in order for reuse to be consistently successful. The common code for ChessNet and Battleship could prove to be inadequate if used outside its intended domain: that of "board games". For example, the common code created for this case study would not prove sufficient for another more complex type of game such as a flight simulator.

When constructing a program which uses a graphical user interface, object oriented programming gives an advantage in productivity, especially for a developer unfamiliar with the interface. By creating objects using a class library designed for that interface, he immediately gains the methods and the data which provide its functionality. However, the interrelationships between objects from such a library can be complex. They may require some study, especially to understand the interactions between the class library and the application code. The developer will experience more independence in defining his own classes and objects the less frequently they communicate with those of the class library.

While there is no count for the code reused from the Toolbox operating system routines, the following is a breakdown of the approximate object sizes produced from source code for the other two layers of reuse, and the unique code for ChessNet:

Game	Type of Code	Object size (bytes)
ChessNet\ Battleship	THINK Class Library for GUI	89,738
ChessNet\ Battleship	Reused code for common purposes	6948
ChessNet	Unique code for game "rules"	4778

These numbers show that an overwhelming majority of the code for these two applications has been reused in some form, or is available for reuse in another application. The object files from the THINK Class Library are very large because all the

methods for a class are linked in, even though many of the methods are not used. Thus use of the THINK Class Library will result in a program size of, at a minimum, approximately 90,000 bytes. Other factors affecting memory use are: 1) the hierarchical nature of classes results in deeply nested program calls which requires memory use in the form of calls and parameters being added to the "stack"; 2) multiple object instances (64 objects for the squares alone in ChessNet) may use more dynamic "heap" memory than procedure oriented programs which gather the data together in global data stores.

Despite these demands on memory usage, object-oriented techniques will grow in popularity as a means of reusing code in general, and for user interfaces in particular, especially as the cost of memory for small computers decreases. It use will also increase as more developers gain a working knowledge of these techniques. Though successful reuse of designs and code with object-oriented techniques requires much up front in terms of thought and planning, it should pay off in the long run with reduced development times and costs for successive applications.

References

[1] Meyer, Bertrand. "Reusability: the case for object-oriented programming", IEEE Software, 4(2), March 1987, p. 2.

[2] Booch, Grady. "Object-Oriented Development", IEEE Transactions On Software Engineering, Vol. SE-12, No.2 February 1986, pp. 211-220.

[3] Gane, C. and T. Sarson. Structured Systems Analysis: Tools and Techniques. New Jersey: Prentice-Hall, 1979.

[4] Coad, Peter, and Eduard Yourdon. Object - Oriented Design. New Jersey: Yourdon Press, 1991.

[5] Meyer, p.18.

[6] Booch, p. 213.

[7] Smith, Jerry. Reusability & Software Construction: C and C++. New York: John Wiley & Sons, 1990.

[8] Booch, p. 215.

[9] Borenstein, Philip, and Jeff Mattson. THINK C Object-Oriented Programming Manual. California: Symantec Corporation, 1989, p. 94.

[10] Thomas, Dave. "What's in an Object?", Byte, March 1989, pp. 231-240.

[11] Taylor, David. Object - Oriented Technology. California: Servio Corporation, 1990.

[12] Meyer, p. 8 and p. 26.

[13] Hooper, J. and R. Chester. Software Reuse Guidelines & Methods. New York: Plenum Press, 1991. p 54.

[14] Hooper, p. 52.

[15] Levy, David. The Joy of Computer Chess. New Jersey: Prentice-Hall, 1984

Appendices

Appendix A - Object-Oriented Design Notation

The design of ChessNet was accomplished by loosely following a methodology set forth in the books: Object-Oriented Design, written by Peter Coad and Edward Yourdon. This design method uses the set of notation shown in Figure 10. Classes of objects are presented as rounded rectangular boxes divided three ways to show the class name on top, the attributes (or instance variables) in the middle section, and services on the bottom. (called methods by some - these are basically code procedures for the class) A box within a box represents a class and actual instances of that class, called Class-&-Object. A single box would represent just the class itself. This distinction is made because some classes, called "abstract", do not have instances of objects. Instead they occur in a hierarchy where the abstract class has sub-classes which inherit services and attributes. The sub-classes of abstract classes have object instances, but the abstract class, without any object instances of its own, exists only to provide services. The opposite, an object existing without a class, is meaningless and so not allowed.

The notation summary in Figure 10 shows several structures and connections. The Gen-Spec Structure is a relationship between generalized classes and more specialized, yet related classes. This Gen-Spec structure really represents an inheritance between classes, so the connecting line are drawn touching the inner-most box (if Class&Object), i.e. the class box. The Whole-Part structure is a relationship between objects, so the lines are drawn touching the outer- most, or object boxes. This structure shows that an object instance representing some "whole" is related to many other object instances of an entirely different class which represents some part of that whole. An instance connection is similar to the Whole-Part Structure in that it shows some relationship, perhaps one to many, between objects of different classes, yet the relationship has some meaning other than "part of some larger whole". A Message Connection is shown drawn between objects signifying that one object sends a message triggering a service in another object. Lastly, the large rectangle drawn around the entire page, with the numeral 1 in the corners indicates a "subject" area. Subject areas would be used to divide large, unwieldy projects into smaller more manageable partitions.

OOA/OOD Notation Summary

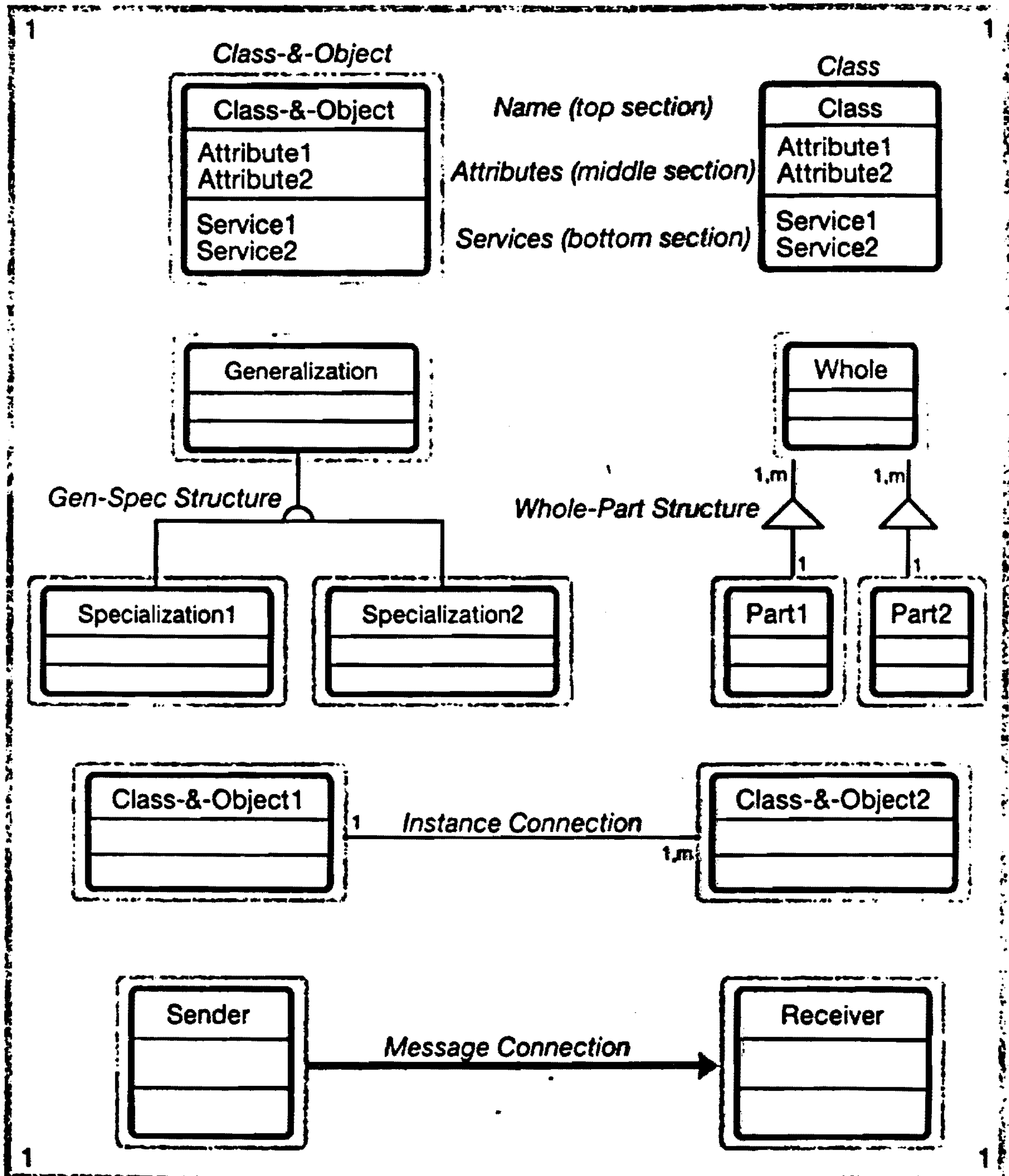


Figure 10 OOA/OOD notations

Reprinted from P. Coad and E. Yourdon, *Object-Oriented Analysis*, pp. 195-205, © 1991 Object International Inc., by permission of Prentice Hall, Inc., Englewood Cliffs, NJ.

Appendix B - Further Description Of The ChessNet program.

Creating The Chess Pieces

Multiple steps are required in order to create and display the chess pieces on the screen in the ChessNet program. First, each piece was drawn using the MacPaint drawing program. Within this application each piece is not so much drawn as "marked". With MacPaint set at its maximum resolution the image is created by turning each pixel on or off. This allows the most control in creating the piece as it will appear as a bit map within ChessNet. As the magnification is lowered it appears as a smooth object, instead of a jagged construction of black and white blocks.

Next the image is copied and pasted into the "scrapbook", part of the operating system which facilitates moving data between applications. From there it is copied into yet another application, ResEdit, a resource editor for the MacIntosh, where the image is stored as a structure called a PICT. Resources are pre-defined structures for holding common elements of MacIntosh programs such as windows, menus, icons, and, in this case pictures. These are common throughout programs and using resources saves the developer from having to define the structures that will store each of these data items. Since they are pre-defined, he only needs to specify the contents.

Once compiled with the program code, the resources are available to be accessed by the code itself. In this case, the program uses a QuickDraw command to "draw" the image stored as a PICT into a simpler QuickDraw data structure called a BitMap. (These two structures are used because there is no BitMap resource to store the image when the program is not running) The image, now stored as a BitMap instance variable for an object, is available to be-drawn and re-drawn on the screen while the program is executing. The actual process of drawing a BitMap onto the screen involves using a third type of QuickDraw data structure - the GrafPort. This structure is associated with a window on the screen and itself contains a BitMap along with other variables describing the drawing environment. To draw the chess piece within the window, the stored BitMap is copied to the BitMap contained within the GrafPort of that window, using a QuickDraw routine called CopyBits.

Coordinate Systems - Global, Window, & Local

In order to place the new chess pieces somewhere on the screen, we have to become acquainted with the coordinate systems used by the MacIntosh Toolbox routines: global coordinates, window coordinates, and local coordinates. All three of these systems have vertical and horizontal axis, but unlike the common "x,y" geometric coordinates, these numbers run positively *down* the vertical axis away from the origin, as the horizontal axis runs positively to the right. The origin is usually placed in the upper left hand corner of the enclosure, whether that is the screen, a window, or some smaller part of the window. We do not deal with the global coordinates directly within ChessNet, which take in the entire area of the screen - or all of the "desktop". This is because after we create the window with a new instance of the "Window" class, initializing it with the window's starting position on the screen, the objects of the THINK C class library take care of updating the global coordinates to move the window around the screen. These objects also translate window and local coordinates into global coordinates.

The window coordinates measure the entire window, while the local coordinates measure panes, areas within the window, created using the THINK C class "Pane". Drawing the chess piece at a specific location within the window is not straightforward. Since the pieces are always drawn within the board squares, (moving pieces are described later) the pieces are placed on the screen using the coordinates of the squares. The "Squares" objects' window coordinates (its sub-class is "Pane") are set when the object is created and initialized, and saved as instance variables. Instead of passing window coordinates directly, another QuickDraw routine, SetOrigin, must be called just before CopyBits. We pass SetOrigin the Square's window coordinates, which it uses to convert the coordinates of the GrafPort from window to local coordinates (the window itself does not move). For example, if the square was set at (8, 8) within the window, the call to SetOrigin would change the GrafPort from window to local coordinates by setting the origin of the window within the GrafPort to (-8, -8). Subsequent calls to CopyBits, which always places the image at (0,0) within the window, are now inset to the proper location within the window because its origin has been changed. This procedure seems backwards from the more obvious method of just passing the window coordinates for where you want to draw to the drawing routine.

Initializing Objects

In order to use the objects at runtime within ChessNet they must be allocated, just like other data structures that are created dynamically. With THINK C, space for an object is created with the "new" function, similar to malloc. First a pointer to the object is declared, then "new" allocates space in memory for the object and returns a pointer to that object. Actually these pointers to objects are pointers to pointers and are called handles, but they will be referred to here as pointers. Handles are used so that the objects may be moved around in memory as needed by the operating system, without disturbing access to the object. Next, the initialization method must be called to fill the instance variables with starting values, most of which are passed as parameters to the method. If all objects are going to be created by other objects, obviously some set order must be devised, otherwise the objects could all be created from a procedure such as main. In ChessNet, main creates an instance of the THINK C "Application" class. This in turn creates the object "GameControl", which has as a superclass the THINK C "Document" class. "GameControl" is the central organizing object within ChessNet. It creates the main window (also an object), and sets the menu items. Next "GameControl" creates the main operational objects within ChessNet.. The multiple "KindsOfPieces" and "PiecesIn Use" are created and the initialize messages are sent to each new object. Then a "Boards" object is created. This object in turn creates and initializes the "KindsOfSquares" objects. Next "Boards" creates and initializes the "Squares" objects themselves, which require both the "KindsOfSquares" and the "PiecesInUse" objects to exist, so their pointers can be passed to the "Squares" where they are stored as attributes.

Creating Board , Initial Piece Setup, And Main Messages

After the main objects have been created and initialized, the square and the chess pieces in their beginning positions are displayed. First the chess board must display the starting chess pieces on their initial squares. The "Boards" object loops through the linked list of "Squares" objects, starting with the "Square" referenced by firstSqPtr. After creating and initializing the "Squares", "Boards" needs to assign the proper pieces to the proper squares. First the pointers to the "PiecesInUse" objects must be retrieved. "Boards" does this by repeatedly sending the GetPiecePtr message to "GameControl". This method retrieves the pointers of the "PiecesInUse" objects based upon an arranged numerical order. Next "Boards" assigns starting pieces to some of the "Squares" by sending them the SetPiece message. The Squares' SetPiece method places the "PiecesInUse" pointer into

the currentPiecePtr instance variable: if currentPiecePtr contains an address, then that square contains a chess piece; if currentPiecePtr is null then that square contains no chess piece.

Now the squares and pieces must be drawn. The "Boards" object again loops through the linked list of "Squares" objects, sending the Draw method to all of its by now properly initialized "Squares". Each "Square" object will in turn, in its Draw method, send Draw messages to its appropriate "KindsOfSquares" and "PiecesInUse" objects, if currentPiecePtr is not null. In turn, "PiecesInUse" passes the Draw message on to the proper "KindsOfPieces" object, depending upon what kind of chess piece it is. The actual drawing of the squares and the chess pieces on the screen is accomplished using the QuickDraw CopyBits routine, as described in the "Creating the Chess Pieces" section.

How Pieces Are Moved

The user moves a chess piece in ChessNet by moving the cursor with the Mouse to the piece being moved, pressing down and holding the Mouse button, moving the piece on the screen to the desired square, and then releasing the Mouse button. This simple action sets in motion a whole sequence of events within the ChessNet code. The squares and pieces involved in the move must be identified, the legality of the move within the rules of chess must be determined, the move must be stored or, if illegal, undone, and finally a successful move must be communicated to the opponent's copy of ChessNet.

The "Squares" objects have as a superclass the THINK C "Pane" class. This class describes an area within a window that can accept a mouse click, so by using "Pane" we can identify exactly where on the screen the mouse was clicked and then perform some action. The following describes the general mechanism by which the location of the mouse click is determined, and involves other classes provided by THINK C which communicate with one another. First of all the "Switchboard" class includes code which performs a typical "event loop" - constantly receiving events from the system, interpreting them and deciding where to pass them. Some of these events are ignored, while others are passed on to the specific code intended to handle that event. The "handler" would be included in other objects. For a mouse down event, the DoMouseDown method of "Switchboard" sends a DispatchClick message to the "Desktop" object, which determines which window the click was in and sends this same

message to the appropriate "Window" object. In turn "Window" has a list of all sub-views contained within the window. These sub-views are of the class "View" and have the sub-class "Pane", which in turn, for ChessNet, has the sub-class "Squares". So eventually the "Window" method DispatchClick finds the appropriate "Squares" object which will handle the mouse click, and sends it the DoClick message.

So when we click on a chess piece within a square, the DoClick message sent to a "Pane" object triggers the ChessNet code (as distinguished from the reused code provided by the THINK C class library) that actually moves the chess piece. We override the DoClick method provided in "Pane", by creating the "Squares" class, with its own DoClick method, as a sub-class of "Pane". This code creates and initializes a new object called "PieceMove", which is a sub-class of the THINK C class "MouseTask". We create this object to exist only for the life of the move, because a piece's movement is rather involved and we may wish to undo the move, so we need some place to store all the information that makes up the move. See Figure 11 for a description of the objects and messages involved in moving a piece.

After the "Squares" object (within its DoClick method) has created the "PieceMove" object, it sends the message TrackMouse to its enclosure. In this case the "Squares" enclosure is a window, so the message goes to the "Window" object. The TrackMouse method that is called is inherited from the "View" class, which "Window" is a sub-class of. As long as the user drags the chess piece across the screen, "View" will send a series of "tracking" messages to our "PieceMove" object. As parameters for these "tracking" messages, "View" sends the current point, the previous point, and the starting point at which the mouse was clicked. "View" knows which object to send the messages to because a pointer to "PieceMove" was included as a parameter in the call of TrackMouse. The tracking messages are BeginTracking, KeepTracking, and EndTracking. At the start of the mouse movement, "View" sends the BeginTracking message once to Piece Move. This method clears the currentPiecePtr of the square the piece is being moved from and updates the array of positions which is used to determined if the move was legal (this will be covered later). Next "View" sends the KeepTracking message to "PieceMove", and repeatedly sends this message as long as the mouse button is held down. This provides the mechanism by which the chess piece can be displayed as if it were a single object, constantly in motion across the screen. For each

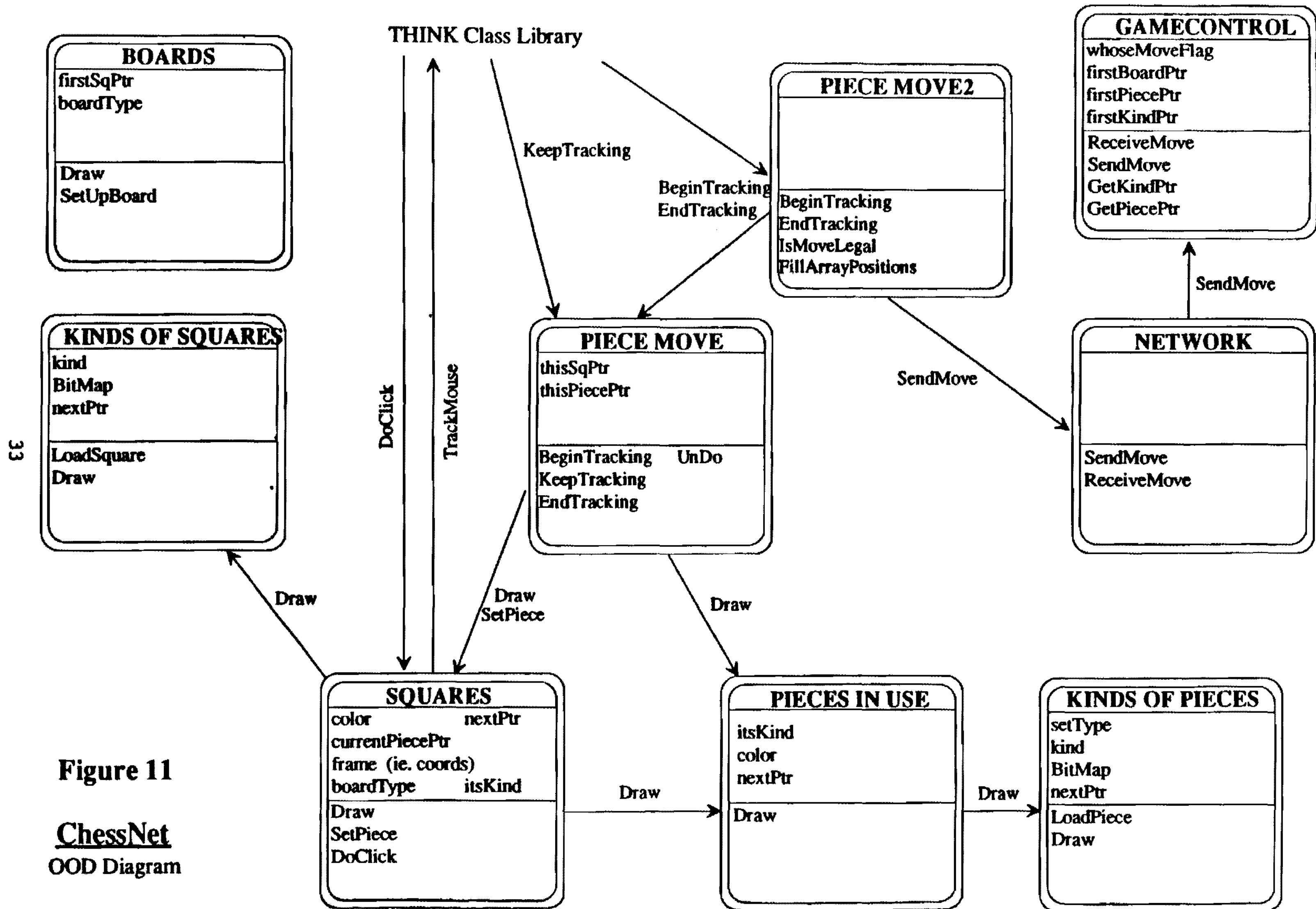


Figure 11

ChessNet
OOD Diagram

KeepTracking message sent, this method draws the chess piece once on the screen, using the current point parameter to know where the cursor is on the screen and hence where to draw the piece. Drawing takes place by doing a QuickDraw SetOrigin call using the current point (which sets where the piece will be drawn) and sending the Draw message to the "PiecesInUse" object. In order to make the chess piece appear to move fluidly across the screen, the picture of the chess piece drawn in each *previous* call to KeepTracking must first be cleaned up. KeepTracking determines which squares the previous picture overlaid using the previous point parameter. KeepTracking sends the Draw message to these "Squares" objects, re-drawing the square and its contents, if any, which wipes clean the previous picture of the chess piece being moved - revealing the squares underneath.

When the user releases the mouse button as he drags the chess piece across the board, "View" sends the EndTracking message to "PieceMove". This method determines the "to square" which the piece is being moved to, again using the current point parameter. If the "to square" is a legitimate "Square" object, then its currentPiecePtr is set to the moved "PiecesInUse" object. If the "to square" is not legitimate, i.e. the mouse button is released with the mouse position off the board or outside the window, then the UnDo method is called. UnDo rolls back any effect of the move on the board state. Now the short life of the Piece Move object is almost at an end. It has one last job to do, before it is disposed of entirely.. It must determine if the move just made was a legal move according to the rules of chess. If not, then UnDo is called, restoring the previous board state. If the move was legal, then nothing else is done. Either way, "PieceMove's" function is fulfilled, and this object is disposed of. When the next move is made, a new instance of "PieceMove" will be created and initialized.

Figure 12 - Numbering system for square & pieces used to determine legal moves.

These following numbers represent the squares stored in an array. They are offset by +10 when referenced so they will fit into an array starting at 0. The middle numbers represent the actual squares on the board. The outer numbers represent border squares, which always contain -9 in the array item. When a move generates the -9 values, then the move is known to be off the board and is discarded.

-01	09	19	29	39	49	59	69	79	89	99	109
-02	08	18	28	38	48	58	68	78	88	98	108
-03	07	17	27	37	47	57	67	77	87	97	107
-04	06	16	26	36	46	56	66	76	86	96	106
-05	05	15	25	35	45	55	65	75	85	95	105
-06	04	14	24	34	44	54	64	74	84	94	104
-07	03	13	23	33	43	53	63	73	83	93	103
-08	02	12	22	32	42	52	62	72	82	92	102
-09	01	11	21	31	41	51	61	71	81	91	101
-10	00	10	20	30	40	50	60	70	80	90	100

The following numbers are stored in the array items referenced by the above values, and indicate the positions of the chess pieces on the board. White pieces are positive, black pieces are negative.

Empty Square	0
Pawn	1
Knight	2
Bishop	3
Rook, never moved	4
Rook , has moved	5
Queen	6
King, never moved	7
King, has moved	8
Border square	-9

In ChessNet the current state of the chess board, i.e. where the pieces currently appear on the board, is stored in the currentPiecePtr for each "Squares" object. This pointer is either empty or points to the specific piece object that occupies that square. This scheme might be used in some manner to check for legal moves. However, the process of checking for legal moves can become quite complicated, what with the need to check not only the piece being moved but whether the king is left in check, a standard method used by existing chess games to generate legal moves has been used.[15] Under this scenario, an array is used with each array item representing a square numbered sequentially. Contained within each array item is a number representing a chess piece or an empty square. Using this method, chess moves can be generated simply by adding a value, or offset, to the array item number. For example 8 offset values can be added to the array item (i.e. "from" square) would give all the possible moves for a knight are: 8; -8; 12; -12; 19; -19; 21; and -21. These generated moves are called "pseudo moves", since they are not the finished list of legal moves for the knight. Some of the moves must be eliminated if they involve moving to a position occupied by your own piece, leaving your king in check, or moving off the board. Moving off the board is detected simply by using border squares which always contain the value -9. If a generated move results in a "move to" array item which contains the value -9, that move is immediately discarded. Figure 12 shows a complete listing of the values used to represent the pieces, and the board squares including the border (off the board) squares. Note that the values -10 through 109 are used so that the sequences 11.. 18; 21..28; 31.. 38; etc. will match up with the files on the chess board. These values must be offset by -10 to get the actual array items, which must start at 0.

All of the code checking for legal moves is unique to the chess game, so is stored in a sub-class of "PieceMove": "PieceMove2". The checking for legal moves starts after a "PieceMove" object has been created as described in the prior section. When the BeginTracking message is sent to "PieceMove" (actually "PieceMove2"), the array "arrayOfPositions", is filled with pieces information using the scheme just described. The program loops through the "Squares" object, checking the contents of each, and updating the arrayOfPositions accordingly. This array could be updated as each move is made, thus saving the time required to re-fill it as each move is made. However, the method used is simpler because the array can be stored in the "PieceMove2" object, which is created and destroyed with each move. The extra time required to re-fill the array each time does not add any noticeable delay while moving a piece.

Appendix C - Glossary

Class - A template for defining the methods and variables for a particular type of object. Methods, also called services, are procedures or functions associated with a class. Attributes are the data associated with a class, also called instance variables.

Class hierarchy - A tree structure representing the relationships among a set of classes. Lower classes in the hierarchy may inherit the methods and attributes of the classes above them.

Inheritence - A mechanism whereby classes can make use of the methods and variables defined in all classes above them on their branch of the class hierarchy.

Object - A run time instance of a class.

Overloading - The assignment of multiple meanings to the same method name, allowing a single message to perform different functions depending on which object receives.

QuickDraw - The subset of the Toolbox routines which implements drawing to the screen.

THINK C - A commercial programming environment for the Macintosh computer which supports the C language and object-oriented extensions to C.

THINK Class Library - A library of classes in the form of source code which may be compiled and linked into a program to provide support of the Macintosh user interface.

Toolbox - The software in the Macintosh ROM that implements the Operating System and the User Interface Toolbox. The User Interface Toolbox helps you implement the standard Macintosh user interface in your applications.

Appendix D- Differences Between THINK C And C++

The following is taken from the THINK C user's manual :

The syntax that THINK C uses for object is a subet of C++ as descibed in *the Annotated C++ Rerference Manual* by Margaret A. Ellis and Bjarne Stroustrup (Addison-wesley). THINK C implements simple objects without multiple inheritance. THINK C does not implement any non-object extensions from C++ such as operator or function overloading.

General Differences

The main diffence between THINK C and C++ is that, at its core, THINK C is an ANSI C compiler, and there are significant yet subtle differences between ANSI C and C++ besides the obvious ones. Keep in mind that C and C++ are completely different languages.

There are a few anomalous cases where something that works in THINK C might not work in C++, even if you've taken care not to use any of the THINK C extensions. Or there might be cases where a C++ program that restricts itself to the implementation of objects in THINK C will behave differently in THINK C. For guidance in these anomalous cases, look at section 18.2 "C++ and ANSI C" of *The Annotated C++ Reference Manual.* The scope rules of ANSI C and C++ are significantly different. Refer to section 3.1.2.1 "Scopes of Identifiers" of the ANSI C Standard (*American National Standard for Information Systems--Programming Language*--C ANS X3.159-1989).

Appendix E - Source Code

```
/****
 * Boards••.h
 *
 *        Board ••class for different types ( probably views) of boards
 *
 ****/

#pragma once                    /* Include this file only once */
#include        <CObject.h>
#include        "Squares.h"
#include        <CView.h>
#include        "ChessNetDef.h"

class Boards : public CObject {

public:

        struct   Boards          *nextBoardPtr;                  /* linked list of
boards */

        Squares                  *arrayOfSqPtr[NUM_SQUARES-1];/* array of
pointers to all squares */

        struct KindsOfSquares    *firstKindSqPtr;

                                                                /**
Construction/Destruction **/

        void            IBoards(CView *anEnclosure, CBureaucrat *aSupervisor,

                Boards *nextPtrParm);


        void            Dispose( void );


        void            Rotate( void );

        void            Draw( void );    /* re-draw all squares of board */
```

```
                                                                /**
Filing **/

};

/****
 * Boards.c
 *
 *        Board ••class for different types ( probably views) of boards
 *
 ****/
#include                "Boards.h"
#include                <oops.h>
#include                <stdlib.h>
#include                <LongCoordinates.h>
#include                "CChessNetDoc.h"

extern   Network                 *gAGame;        /* global ptr to A Game docum
*/


/***
 * Boards
 *
 *        This is your document's initialization method.
 *        If your document has its own instance variables, initialize
 *        them here.
 *        The least you need to do is invoke the default method.
 *
 ***/

/* anEnclosure ( usually window ) gets passed as enclosure for Squares */

void     Boards::IBoards( CView  *anEnclosure, CBureaucrat *aSupervisor,
                                                                        Boa
*nextPtrParm )

{
        Rect      unusedArea;                                   /* needed to
match Draw() prototype - not used */
        LongRect        myLongRect;                             /* long rect
needed for getframe call

        to CView */
```

```
	Rect	myRect;						/* rect used to
draw squares */

	KindsOfSquares *arrayOfKindPtr[2];	/* pointers to KindsOfSquares */

	struct	squareData	{
		short		squareNumber;
		short		aHEncl;
		short		aVEncl;
		short		color;
	}	arrayOfSqData [] =	{
			11, 0, 315,	BLACK,
			12, 0, 270,	WHITE,
			13, 0, 225,		BLACK,
			14, 0, 180,		WHITE,
			15, 0, 135,		BLACK,
			16, 0, 90,	WHITE,
			17, 0, 45,		BLACK,
			18, 0, 0,	WHITE,
			21, 45, 315,	WHITE,
			22, 45, 270,	BLACK,
			23, 45, 225,	WHITE,
			24, 45, 180,	BLACK,
			25, 45, 135,	WHITE,
			26, 45, 90,	BLACK,
			27, 45, 45,		WHITE,
			28, 45, 0,		BLACK,
			31, 90, 315,	BLACK,
			32, 90, 270,	WHITE,
			33, 90, 225,	BLACK,
			34, 90, 180,	WHITE,
			35, 90, 135,	BLACK,
			36, 90, 90,	WHITE,
			37, 90, 45,		BLACK,
			38, 90, 0,		WHITE,
			41, 135, 315,	WHITE,
			42, 135, 270,	BLACK,
			43, 135, 225,	WHITE,
			44, 135, 180,	BLACK,
			45, 135, 135,	WHITE,
			46, 135, 90,	BLACK,
			47, 135, 45,	WHITE,
			48, 135, 0,		BLACK,
			51, 180, 315,	BLACK,
			52, 180, 270,	WHITE,
			53, 180, 225,	BLACK,
			54, 180, 180,	WHITE,
			55, 180, 135,	BLACK,
			56, 180, 90,	WHITE,
			57, 180, 45,	BLACK,
			58, 180, 0,		WHITE,
			61, 225, 315,	WHITE,
			62, 225, 270,	BLACK,
			63, 225, 225,	WHITE,
			64, 225, 180,	BLACK,
			65, 225, 135,	WHITE,
			66, 225, 90,	BLACK,
			67, 225, 45,	WHITE,
			68, 225, 0,		BLACK,
			71, 270, 315,	BLACK,
			72, 270, 270,	WHITE,
			73, 270, 225,	BLACK,
			74, 270, 180,	WHITE,
			75, 270, 135,	BLACK,
			76, 270, 90,	WHITE,
			77, 270, 45,	BLACK,
			78, 270, 0,		WHITE,
			81, 315, 315,	WHITE,
			82, 315, 270,	BLACK,
			83, 315, 225,	WHITE,
			84, 315, 180,	BLACK,
			85, 315, 135,	WHITE,
			86, 315, 90,	BLACK,
			87, 315, 45,	WHITE,
			88, 315, 0,		BLACK
};

/* counters for array indexes */
short i;
short j = 1;


/* store next board ptr */
this->nextBoardPtr = nextPtrParm;

/* create KindOfSquare (bitmaps) for black & white squares */

arrayOfKindPtr[1] = new( KindsOfSquares );
arrayOfKindPtr[1]->IKindsOfSquares(
```

```
                                                45,
            /* Width of BitMap in pixels        */
                                                45,
            /* Height of BitMap in pixels       */
                                                TRUE,
        /* Create offscreen port?           */
                                                "Black",
/* kind of square */

(KindsOfSquares *) NULL);

/* ptr to next kind in linked list */

arrayOfKindPtr[0] = new( KindsOfSquares );
arrayOfKindPtr[0]->IKindsOfSquares(
                                                45,
            /* Width of BitMap in pixels        */
                                                45,
            /* Height of BitMap in pixels       */
                                                TRUE,
        /* Create offscreen port?           */
                                                "White",
/* kind of square */

arrayOfKindPtr[1]);

/* ptr to next kind in linked list */

firstKindSqPtr = arrayOfKindPtr[0];     /* set first pointer for linked list
*/


/* draw bit maps for squares */

SetRect( &myRect, 0, 0, 45, 45 );
arrayOfKindPtr[0]->BeginDrawing();              /* white square */
        FillRect( &myRect, white );
arrayOfKindPtr[0]->EndDrawing();

arrayOfKindPtr[1]->BeginDrawing();              /* black square */
        FillRect( &myRect, gray );
        FrameRect( &myRect );
arrayOfKindPtr[1]->EndDrawing();
```



```
/* create and init 64 squares for this board */

for (i = 0; i < NUM_SQUARES ; i++)      {

        arrayOfSqPtr[i] = new( Squares );

        (arrayOfSqPtr[i])->ISquares(    anEnclosure,/* for••• IPane
                                */

aSupervisor,    /* CBureaucrat * - for IPane    */
                                                        45,
                /* Width of square      - IPane         */
                                                        45,
                /* Height of square     - IPane         */

(arrayOfSqData[i]).aHEncl,

                /*      horz. pos.in enclosure IPane*/

(arrayOfSqData[i]).aVEncl,

                /*      vert. pos.in enclosure IPane*/


sizFIXEDSTICKY,         /* sizing option  IPane         */

sizFIXEDSTICKY,         /* sizing option  IPane         */

(arrayOfSqData[i]).squareNumber,

                /* for ISquares                         */

(arrayOfSqData[i]).color,

                /* BLACK/WHITE - for ISquares */

(arrayOfSqData[i].color == WHITE) ? arrayOfKindPtr[0]

: arrayOfKindPtr[1],

                /* pointer to proper b/w Bit Map */
                                                        "TO:

/* board name  - for ISquares      */
}
```

```
	/* set pieces on starting squares
		pieces are numbered in order as they appear in PiecesInUse linked
list
		white main pieces left to right, then black, then white pawns, then
black,
		pass order  to GetPiece() to get pointer */

	/* start with whites main pieces */
	for( i = 0; i < NUM_SQUARES; i += 8)	{
		arrayOfSqPtr[i]->SetPiece( gAGame->GetPiece( j++ ) );
	}
	/* Do black•••• main pieces */
	for( i = 7; i < NUM_SQUARES; i += 8)	{
		arrayOfSqPtr[i]->SetPiece( gAGame->GetPiece( j++ ) );
	}
	/* Do white pawns */
	for( i = 1; i < NUM_SQUARES; i += 8)	{
		arrayOfSqPtr[i]->SetPiece( gAGame->GetPiece( j++ ) );
	}
	/* Do black pawns */
	for( i = 6; i < NUM_SQUARES; i += 8)	{
		arrayOfSqPtr[i]->SetPiece( gAGame->GetPiece( j++ ) );
	}



	/* allow clicks in each square	*/
	/* draw each new square		*/
	for( i = 0; i < NUM_SQUARES; i++)	{

			(arrayOfSqPtr[i])->SetWantsClicks( TRUE );
			(arrayOfSqPtr[i])->Show();
/*********** NOT USING LONG COORDS - DEFAULT */
/*			(arrayOfSqPtr[i])->UseLongCoordinates( TRUE );	*/
/*******************************************/
			(arrayOfSqPtr[i])->GetFrame( &myLongRect );
			(void) LongToQDRect(&myLongRect, &myRect);
			(arrayOfSqPtr[i])->Prepare(); /* just added this */
			(arrayOfSqPtr[i])->Draw( &myRect );
	}


}
```



```
/***
 * Dispose
 *
 *	This is your document's destruction method.
 *	If you allocated memory in your initialization method
 *	or opened temporary files, this is the place to release them.
 *
 *	Be sure to call the default method!
 *
 ***/

void Boards::Dispose()

{	short i;

	/* deallocate squares created in init */
	for (i = 0; i < NUM_SQUARES ; i++)	{
		arrayOfSqPtr[i]->Dispose();
	}


	/* then delete the board */
	delete( this );

}



/***
 * Rotate
 *
 * rotate board one quarter turn
 *
 ***/

void Boards::Rotate( void )

{	short i;
	short h, v;
	Rect	myRect;

	/* reset coords	*/
	for( i = 0; i < NUM_SQUARES; i++)	{
```

```
				h = abs((arrayOfSqPtr[i])->hEncl - 315);
				v = abs((arrayOfSqPtr[i])->vEncl - 315);


				(arrayOfSqPtr[i])->Place( h, v, FALSE );

	}

	/* then re-draw each square */
	for( i = 0; i < NUM_SQUARES; i++)		{


		(arrayOfSqPtr[i])->Prepare();
		(void) LongToQDRect(&(arrayOfSqPtr[i]->frame), &myRect);
		(arrayOfSqPtr[i])->Draw( &myRect );

	}

}

/***
 * Draw
 *
 * draw all squares in board
 *
 ***/

void Boards::Draw( void )

{	short i;
	Rect	myRect;

	/* re-draw each square making up board */
	for( i = 0; i < NUM_SQUARES; i++)		{
				(void) LongToQDRect(&(arrayOfSqPtr[i]->frame),
&myRect);
				(arrayOfSqPtr[i])->Prepare();
				(arrayOfSqPtr[i])->Draw( &myRect );
	}

}
/*****
 * CChessNetApp.h
 *
```



```
 *	Application class for a typical application.
 *
 *****/

#pragma once				/* Include this file only once */
#include <CApplication.h>
#include "Switchboard2.h"

struct CChessNetApp : CApplication {

public:

	/* instance variables */

	Switchboard2		*itsSwitchboard;  /* override */

	/* methods */

	void	IChessNetApp(void);
	void	SetUpFileParameters(void);

  void  SetUpMenus(void);
  void  UpdateMenus(void);

	void	DoCommand(long theCommand);

	void	Exit(void);

	void	CreateDocument(void);
	void	OpenDocument(SFReply *macSFReply);
	void	MakeSwitchboard( void);

};
/*****
 * CChessNetApp.c
 *
 *	Application methods for a typical application.
 *
 * Copyright © 1990 Symantec Corporation.  All rights reserved.
 *
 *****/

#include "CChessNetApp.h"
#include "CChessNetDoc.h"
#include "ChessNetDef.h"
```

```
#include "Switchboard2.h"
#include "CChessNetDoc.h"
#include "CBartender.h"
/*#include <CChessNet.h>*/

extern    OSType gSignature;

extern    Network                    *gAGame;        /* global ptr to A Game document
*/
extern CBartender                    *gBartender;    /* Manages all menus
                */

#define          kExtraMasters           4
/*
#define          kRainyDayFund           20480
#define          kCriticalBalance20480
#define          kToolboxBalance         20480
*/
#define          kRainyDayFund           50480
#define          kCriticalBalance20480
#define          kToolboxBalance         20480

/***
 * IChessNetApp
 *
 *        Initialize the application. Your initialization method should
 *        at least call the inherited method. If your application class
 *        defines its own instance variables or global variables, this
 *        is a good place to initialize them.
 *
 ***/

void CChessNetApp::IChessNetApp(void)

{
          CApplication::IApplication( kExtraMasters, kRainyDayFund,
                                                      kCriticalBalance,
kToolboxBalance);

/* The parameters to IApplication are the number of times to call
   MoreMasters, the total number of bytes of heap space to reserve for
   monitoring low memory situations, and the portion of the memory
   reserve to set aside for critical operations and toolbox calls.

   Four (4) is a reasonable number of MoreMasters calls,
   but you should determine a good number for your application
   by observing the heap using Lightsbug,
   TMON, or Macsbug. Set this parameter to zero, give your
   program a rigorous work-out, then look at the heap and count
   how many master pointer blocks have been allocated. Master
   pointer blocks are nonrelocatable and have a size of $100
   (hex). You should call MoreMasters at least this many
   times -- add a few extra just to be safe. The purpose of all
   this preflighting is to prevent heap fragmentation. You
   don't want the Memory Manager to call MoreMasters and
   create a nonrelocatable block in the middle of your heap. By
   calling MoreMasters at the very beginning of the program,
   you ensure that these blocks are allocated in a group at the
   bottom of the heap.

   The memory reserve is a safeguard for handling low memory
   conditions and is used by the GrowMemory method in
   CApplication (check there for more comments). In general,
   your program should never request a memory block greater
   than this reserve size without explicitly checking in
   advance whether there is enough free memory to satisfy the
   the request.

 */

}



/***
 * SetUpFileParameters
 *
 *        In this routine, you specify the kinds of files your
 *        application opens.
 *
 *
 ***/

void CChessNetApp::SetUpFileParameters(void)

{
          inherited::SetUpFileParameters();          /* Be sure to call the default
method */
```

```
		/**
		**	sfNumTypes is the number of file types
		**	your application knows about.
		**	sfFileTypes[] is an array of file types.
		**	You can define up to 4 file types in
		**	sfFileTypes[].
		**
		**/

	sfNumTypes = 1;
	sfFileTypes[0] = 'TEXT';

		/**
		**	Although it's not an instance variable,
		**	this method is a good place to set the
		**	gSignature global variable. Set this global
		**	to your application's signature. You'll use it
		**	to create a file (see CFile::CreateNew()).
		**
		**/

	gSignature = '????';
}
```



```
/***
 * SetUpMenus
 *
 * Set up menus which must be created at run time, such as a
 * Font menu. You can eliminate this method if your application
 * does not have any such menus.
 *
 ***/

void CChessNetApp::SetUpMenus()
{

 inherited::SetUpMenus(); /*  Superclass takes care of adding
			menus specified in a MBAR id = 1
			resource
		*/

	/* Add your code for creating run-time menus here */
}
```

```
/***
 * DoCommand
 *
 *	Your application will probably handle its own commands.
 *	Remember, the command numbers from 1-1023 are reserved.
 * The file Commands.h contains all the predefined TCL
 * commands.
 *
 *	Be sure to call the default method, so you can get
 *	the default behvior for standard commands.
 *
 ***/
void CChessNetApp::DoCommand(long theCommand)

{
	switch (theCommand) {

		/* Your commands go here */

				/* rotate the board */
		case 1025:	gAGame->firstBoardPtr->Rotate();
					break;

		case 1026:	gAGame->ChooseColor();

		case 1027:	gAGame->GetOpponent();

		default: inherited::DoCommand(theCommand);
					break;
	}
}


/***
 *
 * UpdateMenus
 *
 *  Perform menu management tasks
 *
 ***/

void CChessNetApp::UpdateMenus()
{
```

```
	inherited::UpdateMenus();	/* Enable standard commands */

	/* Enable the commands handled by your Application class */
		gBartender->EnableCmd( 1025 );		/* Rotate board */
		gBartender->EnableCmd( 1026 );		/* Choose color */
		gBartender->EnableCmd( 1027 );		/* Link With Opponent */
}


/***
 * Exit
 *
 *	Chances are you won't need this method.
 *	This is the last chance your application gets to clean up
 * things like temporary files before terminating.
 *
 ***/

void CChessNetApp::Exit()

{
	/* your exit handler here */
}


/***
 * CreateDocument
 *
 *	The user chose New from the File menu.
 *	In this method, you need to create a document and send it
 *	a NewFile() message.
 *
 ***/

void CChessNetApp::CreateDocument()

{

	/*CChessNetDoc *theDocument = NULL; */
	 Network		*theDocument = NULL;		/* Network is
subclass of CChessNetDoc*/

	TRY
	{
		theDocument = new(Network);
		gAGame = theDocument;

			/**
			 **	Send your document an initialization
			 **	message. The first argument is the
			 **	supervisor (the application). The second
			 **	argument is TRUE if the document is printabl
			 **
			 **/

		theDocument->IChessNetDoc(this, TRUE);

			/**
			 **	Send the document a NewFile() message.
			 **	The document will open a window, and
			 **	set up the heart of the application.
			 **
			 **/
		theDocument->NewFile();
	}

	CATCH
	{
		/*
		 * This exception handler gets executed if a failure occurred
		 * anywhere within the scope of the TRY block above. Since
		 * this indicates that a new doc could not be created, we
		 * check if an object had been allocated and if it has, send
		 * it a Dispose message. The exception will propagate up to
		 * CSwitchboard's exception handler, which handles displaying
		 * an error alert.
		 */

		if (theDocument) theDocument->Dispose();

	}
	ENDTRY;
}

/***
 * OpenDocument
 *
 *	The user chose Open... from the File menu.
 *	In this method you need to create a document
```

```
*       and send it an OpenFile() message.
*
*       The macSFReply is a good SFReply record that contains
*       the name and vRefNum of the file the user chose to
*       open.
*
***/

void CChessNetApp::OpenDocument(SFReply *macSFReply)

{
        CChessNetDoc    *theDocument = NULL;

        TRY
        {

                theDocument = new(CChessNetDoc);

                        /**
                         **     Send your document an initialization
                         **     message. The first argument is the
                         **     supervisor (the application). The second
                         **     argument is TRUE if the document is printable.
                         **
                         **/

                theDocument->IChessNetDoc(this, TRUE);

                        /**
                         **     Send the document an OpenFile() message.
                         **     The document will open a window, open
                         **     the file specified in the macSFReply record,
                         **     and display it in its window.
                         **
                         **/
                theDocument->OpenFile(macSFReply);
        }

        CATCH
        {
                /*
                 * This exception handler gets executed if a failure occurred
                 * anywhere within the scope of the TRY block above. Since
                 * this indicates that the document could not be opened, we
                 * send it a Dispose message. The exception will propagate up to
                 * CSwitchboard's exception handler, which handles displaying
                 * an error alert.
                 */

                if (theDocument) theDocument->Dispose();
        }
        ENDTRY;
}

/***************************************************************************
 MakeSwitchboard  Overridden in CApplication so can add Switchboard2

        Create application's switchboard. Override if a different switchboard
        is desired.
***************************************************************************

void CChessNetApp::MakeSwitchboard( void)
{
        itsSwitchboard = new(Switchboard2); /* for ChessNetApp */
        itsSwitchboard->ISwitchboard2();

         CApplication::itsSwitchboard = itsSwitchboard;

}
/****
 * CChessNetDoc.h
 *
 *      Document class for a typical application.
 *
 ****/

#pragma once                    /* Include this file only once */
#include <CDocument.h>
#include <CApplication.h>   /* Altered by TCL Demo Weaver 1.0 (2/21/90) */
#include "Boards.h"
#include "KindsOfPieces.h"
#include "PiecesInUse.h"

#include        <PPCToolBox.h>
#include        <AppleEvents.h>
#include        <events.h>
#include        <oops.h>
#include        <stdlib.h>
#include        <types.h>
```

```
/* includes for Network */
#include        "ChessNetDef.h"
#include        <CObject.h>
#include        <PPCToolBox.h>
#include        <AppleEvents.h>
#include        <EPPC.h>

typedef short  NetworkData [NUM_SQUARES-1];

class CChessNetDoc : public CDocument {

public:

        /* pointers* to first objects in in linked lists */
        PiecesInUse             *firstPiecePtr;
        KindsOfPieces   *firstKindPtr;
        Boards                  *firstBoardPtr;

        /* color of chess pieces for this player */
        short                   color;

        /* Is it this player's turn to move? */
        Boolean                 myTurn;


        /* pointer to  pawn piece which just made double square move - eligible for
                en passant capture */
        PiecesInUse             *enPassantPtr;

        /* used to link with opponent */
        TargetID                toTargetID;
        PortInfoRec             myPortInfo;
        AEDesc                  *targetAddress;

                                                                        /**
Construction/Destruction **/

  /* Altered by TCL Demo Weaver 1.0 (2/21/90) */

  void      IChessNetDoc(CApplication *aSupervisor, Boolean printable);
  void      Dispose(void);

        void                    DoCommand(long theCommand);

  void      UpdateMenus(void); /* Altered by TCL Demo Weaver 1.0 (2/21/90) */
```



```
        void                    NewFile(void);
        void                    BuildWindow(Handle theData);

                                                                        /**
Filing **/

        PiecesInUse             *GetPiece( short pieceNumParm );

        short GetPieceOrder( PiecesInUse *piecePtr );

        KindsOfPieces *GetKindsOfPieces( short  kindNumParm );

        void                    LoadPieces( void );

        void                    ChooseColor( void );

        void                    GetOpponent( void );

        void                    SendMoveToOpponent( NetworkData pieceNumbersPa
);

};

class Network : public CChessNetDoc {

public:



                                                                        /**
Construction/Destruction **/

        virtual void                    INetwork( void );


        virtual void                    Dispose( void );


                                                                        /**
Filing **/

        virtual void                    ReceiveMove( NetworkData *pieceNumbers );
```

```
	virtual void			SendMove ( void );

};


/* used by CChessNetDoc methods */
void		CenterPict( PicHandle thePicture, Rect *myRectPtr );
void		GetNSetDialogItems( short turnOnItem, short loopVar );

/****
 * CChessNetDoc.c
 *
 *	Document methods for a typical application.
 *
 * Copyright © 1990 Symantec Corporation.  All rights reserved.
 *
 ****/

#include "CChessNetDoc.h"
#include <Global.h>
#include <Commands.h>
#include <CApplication.h>
#include <CBartender.h>
#include <CDataFile.h>
#include <CDecorator.h>
#include <CDesktop.h>
#include <CError.h>
#include <CPanorama.h>
#include <CScrollPane.h>

/* I added this */
#include <TBUtilities.h>
#include <CBitMap.h>
#include "ChessNetDef.h"
#include <CWindow.h>

#include <LongCoordinates.h>
#include <string.h>

#define WINDChessNet		500		/* Resource ID for WIND
template */

extern	DialogPtr			gDialogPtr; /* global dialog ptr */
extern	Network			*gAGame;	/* global ptr to A Game document
*/
```



```
extern	CApplication *gApplication;	/* The application */
extern	CBartender	*gBartender;	/* The menu handling object */
extern	CDecorator	*gDecorator;	/* Window dressing object	*/
extern	CDesktop	*gDesktop;		/* The enclosure for all windo
*/
extern	CBureaucrat	*gGopher;		/* The current boss in the cha
of command */
extern	OSType		gSignature;		/* The application's signature
extern	CError		*gError;	/* The global error handler */

/***
 * IChessNetDoc
 *
 *	This is your document's initialization method.
 *	If your document has its own instance variables, initialize
 *	them here.
 *
 *	The least you need to do is invoke the default method.
 *
 ***/

/* Altered by TCL Demo Weaver 1.0 (2/21/90) */

void CChessNetDoc::IChessNetDoc(CApplication *aSupervisor, Boolean printabl

{
	CDocument::IDocument(aSupervisor, printable);

	color = WHITE;
	myTurn = TRUE;

}


/***
 * Dispose
 *
 *	This is your document's destruction method.
 *	If you allocated memory in your initialization method
 *	or opened temporary files, this is the place to release them.
 *
 *	Be sure to call the default method!
 ***/
```

```
void CChessNetDoc::Dispose()

{
	Boards			*loopBPtr,	*storeBPtr;
	KindsOfPieces	*loopKPtr,	*storeKPtr;
	PiecesInUse		*loopPPtr,	*storePPtr;


	/* dispose of any objects for Boards, KindsOfPieces, & PiecesInUse */
	loopBPtr = firstBoardPtr;
	while( loopBPtr != NULL )	{
		storeBPtr = loopBPtr->nextBoardPtr;
		loopBPtr->Dispose();
		loopBPtr = storeBPtr;
	}

	loopKPtr = firstKindPtr;
	while( loopKPtr != NULL )	{
		storeKPtr = loopKPtr->nextKindPtr;
		loopKPtr->Dispose();
		loopKPtr = storeKPtr;
	}

	loopPPtr = firstPiecePtr;
	while( loopPPtr != NULL )	{
		storePPtr = loopPPtr->nextPiecePtr;
		loopPPtr->Dispose();
		loopPPtr = storePPtr;
	}

	inherited::Dispose();
}


/***
 * DoCommand
 *
 *	This is the heart of your document.
 *	In this method, you handle all the commands your document
 *	deals with.
 *
 *	Be sure to call the default method to handle the standard
 *	document commands: cmdClose, cmdSave, cmdSaveAs, cmdRevert,
 *	cmdPageSetup, cmdPrint, and cmdUndo. To change the way these
 *	commands are handled, override the appropriate methods instead
 *	of handling them here.
 *
 ***/

void CChessNetDoc::DoCommand(long theCommand)

{
	switch (theCommand) {

		/* your document commands here */

		default: inherited::DoCommand(theCommand);
				break;
	}
}


/* Altered by TCL Demo Weaver 1.0 (2/21/90) */

/***
 * UpdateMenus
 *
 * In this method you can enable menu commands that apply when
 * your document is active.
 *
 * Be sure to call the inherited method to get the default behavior.
 * The inherited method enables these commands: cmdClose, cmdSaveAs,
 * cmdSave, cmdRevert, cmdPageSetup, cmdPrint, cmdUndo.
 *
 ***/

 void CChessNetDoc::UpdateMenus()

 {
  inherited::UpdateMenus();

   /* Enable your menu commands here (enable each one with a call to
     gBartender->EnableCmd(command_number)).
    */

 }


/***
```

```
 * NewFile
 *
 *       When the user chooses New from the File menu, the CreateDocument()
 *       method in your Application class will send a newly created document
 *       this message. This method needs to create a new window, ready to
 *       work on a new document.
 *
 *       Since this method and the OpenFile() method share the code for creating
 *       the window, you should use an auxiliary window-building method.
 *
 ***/
void CChessNetDoc::NewFile(void)

{
  /* Altered by TCL Demo Weaver 1.0 (2/21/90) */

  Str255  wTitle = " ChessNet";    /* Window title string.       */

              /**
               **       BuildWindow() is the method that
               **       does the work of creating a window.
    ** Its parameter should be the data that
               **       you want to display in the window.
               **       Since this is a new window, there's nothing
               **       to display.
               **
               **/

        BuildWindow(NULL);


  itsWindow->SetTitle( wTitle );

              /**
               **       Send the window a Select() message to make
               **       it the active window.
               **/

        itsWindow->Select();
}
```



```
/***
 * BuildWindow
 *
 *       This is the auxiliary window-building method that the
 *       NewFile() and OpenFile() methods use to create a window.
 *
 *       In this implementation, the argument is the data to display.
 *
 ***/

void CChessNetDoc::BuildWindow (Handle theData)

{

        Boards                  *boardPtr;
        /* used to create Boards object */

        Rect                    setSize;
        short i;

              /**
               **       First create the window and initialize
               **       it. The first argument is the resource ID
               **       of the window. The second argument specifies
               **       whether the window is a floating window.
               **       The third argument is the window's enclosure; it
               **       should always be gDesktop. The last argument is
               **       the window's supervisor in the Chain of Command;
               **       it should always be the Document object.
               **
               **/

        itsWindow = new(CWindow);
        itsWindow->IWindow(WINDChessNet, FALSE, gDesktop, this);

              /**
               **       After you create the window, you can use the
               **       SetSizeRect() message to set the window's maximum
               **       and minimum size. Be sure to set the max & min
               **       BEFORE you send a PlaceNewWindow() message to th
               **       decorator.
               **
               ** The default minimum is 100 by 100 pixels. The
               **       default maximum is the bounds of GrayRgn() (The
               **       entire display area on all screens.)
```

```
		**
	** We'll use the defaults.
	**
		**/


	setSize.top    = 360;
	setSize.left   = 360;
	setSize.bottom = 360;
	setSize.right  = 360;
	itsWindow->SetSizeRect( &setSize );

	/* create & load KindsOfPieces & PiecesInUse */
	LoadPieces();


	/* create board & squares */
	boardPtr = new( Boards );

	firstBoardPtr = boardPtr;			/* set pointer to first object in
linked list */

	boardPtr->IBoards( itsWindow, this, (Boards *) NULL );


		/**
		**	The Decorator is a global object that takes care
		**	of placing and sizing windows on the screen.
		**	You don't have to use it.
		**
		**/


	gDecorator->PlaceNewWindow(itsWindow);

}


/***
 * GetPiece
 *
 *	searches link list of PiecesInUse to get piece which matches piece number
 *
 ***/
```



```
PiecesInUse *CChessNetDoc::GetPiece( short	pieceNumParm )

{	PiecesInUse		*thisPiecePtr = this->firstPiecePtr;
	short			i;

	for( i = 1; i != pieceNumParm && thisPiecePtr != NULL; i++ )	{
		thisPiecePtr = thisPiecePtr->nextPiecePtr;
	}

	return( thisPiecePtr );
}

/***
 * GetPieceOrder
 *
 *	searches link list of PiecesInUse to get piece order in linked list
 *
 ***/

short CChessNetDoc::GetPieceOrder( PiecesInUse *piecePtr )

{	PiecesInUse		*thisPiecePtr = this->firstPiecePtr;
	short			i;

	for( i = 1; thisPiecePtr != piecePtr && thisPiecePtr != NULL; i++ )	{
		thisPiecePtr = thisPiecePtr->nextPiecePtr;
	}

	return( i );
}

/***
 * GetKindsOfPieces
 *
 *	searches link list of KindsOfPieces to get object for desired chess piece
 *
 ***/

KindsOfPieces *CChessNetDoc::GetKindsOfPieces( short	kindNumParm )
{	KindsOfPieces		*thisKindPtr = this->firstKindPtr;

	for( ; thisKindPtr->pieceNumber != kindNumParm && thisKindPtr !=
NULL; ){
		thisKindPtr = thisKindPtr->nextKindPtr;
	}
```

```
	return( thisKindPtr );
}



void CChessNetDoc::LoadPieces( void )
{

	Rect				drawRect;
	LongRect			longDrawRect;

	short				i, j;
	PiecesInUse			*piecePtr, *storePiecePtr;
	PiecesInUse			*arrayOfPiecePtr[32];
	KindsOfPieces		*arrayOfKindPtr[12];
	KindsOfPieces		*aKindPtr;
	PicHandle			arrayOfPicHandles[12];

	char				*arrayOfPieceNames[] = {
							"WhitePawn\0",
							"BlackPawn\0",
							"WhiteKing\0",
							"BlackKing\0",
							"WhiteHorse\0",
							"BlackHorse\0",
							"WhiteBishop\0",
							"BlackBishop\0",
							"WhiteCastle\0",
							"BlackCastle\0",
							"WhiteQueen\0",
							"BlackQueen\0"
							};

	short				arrayOfPieceNum[] = {
							1,
		/* WhitePawn  */
							-1,
		/* BlackPawn  */
							7,
		/* WhiteKing  */
							-7,
		/* BlackKing  */
							2,
		/* WhiteHorse */
							-2,
		/* BlackHorse */
							3,
		/* WhiteBishop*/
							-3,
		/* BlackBishop*/
							4,
		/* WhiteCastle*/
							-4,
/* BlackCastle*/
							6,
		/* WhiteQueen */
							-6
		/* BlackQueen */
							};


/********************** create KindOfPieces *****************/

/* create last KindOfPieces, then loop through others, from last to first *

arrayOfKindPtr[0] = new( KindsOfPieces );


arrayOfKindPtr[0]->IKindsOfPieces(	45,
/* Width of BitMap in pixels		*/

45,						/* Height of BitMap in pixels
*/

TRUE,					/* Create offscreen port?
*/

arrayOfPieceNames[0],	/* kind of piece */

(KindsOfPieces *) NULL,

						/* ptr to next kind in linked li
*/

arrayOfPieceNum[0] );	/* kind of piece by number */

for( i = 1; i < 12; i++ )	{

	arrayOfKindPtr[i] = new( KindsOfPieces );
```

```
		arrayOfKindPtr[i]->IKindsOfPieces(
									45,
					/* Width of BitMap in pixels
*/
									45,
					/* Height of BitMap in pixels
*/
									TRUE,
				/* Create offscreen port?			*/

	arrayOfPieceNames[i],	/* kind of piece */

	arrayOfKindPtr[i-1],

					/* ptr to next kind in linked list */

	arrayOfPieceNum[i] );	/* kind of piece by number */
	}

	firstKindPtr = arrayOfKindPtr[11];		/* set first pointer for linked list
*/

	for( i = 0, j = 400; i < 12; i++, j++) {
		/* load Pic for KindOfPiece */
		arrayOfPicHandles[i] = GetPicture( j );

		/* get original rect using GetBounds then center the picture -
		   this changes drawRect to centered coords */

		arrayOfKindPtr[i]->GetBounds( &longDrawRect);
		(void) LongToQDRect( &longDrawRect, &drawRect);

		CenterPict( arrayOfPicHandles[i], &drawRect );

		/* create mask region for KindOfPiece */
		arrayOfKindPtr[i]->maskRegion = NewRgn();
		OpenRgn();
			FrameRect( &drawRect);
		CloseRgn(arrayOfKindPtr[i]->maskRegion);


		/* load KindOfPiece with drawing of piece
			also include frame around piece drawing */
		arrayOfKindPtr[i]->BeginDrawing();
			DrawPicture ( arrayOfPicHandles[i], &drawRect );
			FrameRgn( arrayOfKindPtr[i]->maskRegion );
		arrayOfKindPtr[i]->EndDrawing();

	}


	/********************** create PiecesInUse *****************/

	/* create 32 PiecesInUse - linked list - start at end work backwards */
	/* NOTE: loading black pawns and white pawns as PiecesInUse are crea
			load other pieces individually below
				*/

	storePiecePtr = NULL;
	for( i = 0; i < 32; i++)	{


		piecePtr = new( PiecesInUse );
		piecePtr->IPiecesInUse( 45,
	/* height			*/
								45,
				/* width		*/
								0,
				/*	aHEncl		*/
								0,
				/*	aVEncl		*/
	((i < 8) ? arrayOfKindPtr[1]:arrayOfKindPtr[0]),	/* KindsOfPieces
*itsKindPtr*/
						((i < 8) ? BLACK:WHITE),
	/* short colorParm		*/
								storePiecePt
		/* PiecesInUse	*nextPtrParm */
								);


		storePiecePtr		= piecePtr;
		arrayOfPiecePtr[i]	= piecePtr;

	}
	/* set ptr to beginning of linked list */
	firstPiecePtr = piecePtr;

	/*********************************************************/
	/* now load other PiecesInUse with non-pawn KindsOfPieces */
```

```
/*.......... black pieces .........*/
/* black castles */
arrayOfPiecePtr[16]->itsKindPtr =  arrayOfKindPtr[9];
arrayOfPiecePtr[23]->itsKindPtr =  arrayOfKindPtr[9];

/* black horses */
arrayOfPiecePtr[17]->itsKindPtr = arrayOfKindPtr[5];
arrayOfPiecePtr[22]->itsKindPtr = arrayOfKindPtr[5];

/* black bishops */
arrayOfPiecePtr[18]->itsKindPtr =  arrayOfKindPtr[7];
arrayOfPiecePtr[21]->itsKindPtr =  arrayOfKindPtr[7];

/* black queen */
arrayOfPiecePtr[20]->itsKindPtr = arrayOfKindPtr[11];

/* black king  */
arrayOfPiecePtr[19]->itsKindPtr = arrayOfKindPtr[3];


/*......... white pieces..........*/
/* white castles */
arrayOfPiecePtr[24]->itsKindPtr =  arrayOfKindPtr[8];
arrayOfPiecePtr[31]->itsKindPtr =  arrayOfKindPtr[8];

/* white horses */
arrayOfPiecePtr[25]->itsKindPtr = arrayOfKindPtr[4];
arrayOfPiecePtr[30]->itsKindPtr = arrayOfKindPtr[4];

/* white bishops */
arrayOfPiecePtr[26]->itsKindPtr = arrayOfKindPtr[6];
arrayOfPiecePtr[29]->itsKindPtr = arrayOfKindPtr[6];

/* white queen */
arrayOfPiecePtr[28]->itsKindPtr = arrayOfKindPtr[10];

/* white king  */
arrayOfPiecePtr[27]->itsKindPtr = arrayOfKindPtr[2];

/* now walk through all pieces again - setting the PiecesInUse pieceNumber
        to the appropriate KindsOfPieces pieceNumber */
for( i = 0; i < 32; i++)        {

        aKindPtr = arrayOfPiecePtr[i]->itsKindPtr;
        arrayOfPiecePtr[i]->pieceNumber = aKindPtr->pieceNumber;
        }
}

/***
 * ChooseColor
 *
 *        set color for this player's pieces
 *
 *  & set myTurn flag - WHITE starts out with TRUE, BLACK gets FALSE
 *
 ***/

void CChessNetDoc::ChooseColor( void )
{

        int                 dialogDone = FALSE;
        int                         itemHit = 1;
        int                         colorSelection;


        /* init dialog manager */
        InitDialogs ( NIL_POINTER );

        /* initialize dialog */
        gDialogPtr = GetNewDialog( 401, NIL_POINTER, gAGame->itsWindow
        /*GetNewDialog(short dialogID,void *dStorage,WindowPtr behind)*/

        /* default selected item to queen */
        GetNSetDialogItems( 1, 3 );


        /* show dialog */
        ShowWindow( gDialogPtr );

        while ( dialogDone == FALSE )    {

                /* save previouse selection 'cuz at end will always point to save
button */
                colorSelection = itemHit;

                ModalDialog( NIL_POINTER, &itemHit );

                switch ( itemHit )          {

                        case 1:
```

```
                                        GetNSetDialogItems( 1, 3 );
        /* white */
                                        break;

                                case 2:
                                        GetNSetDialogItems( 2, 3 );
        /* black */
                                        break;

                                case 3:
                                        HideWindow( gDialogPtr );
        /* save button */
                                        dialogDone = TRUE;
                                        break;

                        }

        }

        switch (colorSelection )        {
                case 1:  color = WHITE;
                                        myTurn = TRUE;
                                        break;
                case 2:  color = BLACK;
                                        myTurn = FALSE;
                                        break;
        }

        DisposDialog( gDialogPtr );

}

/***
 * GetOpponent
 *
 * Get info of opponents copy of game in order to make connection
 *
 ***/

void CChessNetDoc::GetOpponent( void )

{       OSErr           myErr;
        Handle                  targetHandle;
```



```
        targetHandle = NewHandle( sizeof( TargetID ) );

        myErr = PPCBrowser( "\pLink with opponent's copy of game",
                                                "\pChessNet",
                                                FALSE,
                                                &(toTargetID.location),
                                                &myPortInfo,
                                                NULL,
                                                "\p ");


        if ( myErr == noErr )       {
                toTargetID.name = myPortInfo.name;
                myErr = AECreateDesc( typeTargetID,
                                                        ((Ptr) &targetHandl
                                                        sizeof(  toTargetID )
                                                        targetAddress );
        }

        if( myErr != noErr ) {



        }

}

/***
 * SendMoves
 *
 *      send piecNumbers for squares across network to opponent
 *
 ***/

void CChessNetDoc::SendMoveToOpponent( NetworkData pieceNumbersParm )

{       OSErr myErr;
        unsigned long   dataLength = sizeof( NetworkData );
        Handle                  dataHandle;

        EventRecord      myEvent;
        char *number ="0xGAME";
        char *extra;
        long result;
```

```
        myEvent.what = kHighLevelEvent;
        myEvent.message = strtol( number, &extra, 0);
/*      myEvent.where =  UNUSED                 */

        dataHandle = NewHandle( sizeof( NetworkData) );
        (void *) memcpy( *dataHandle, pieceNumbersParm, sizeof( NetworkData )
);

        /*
        myErr = PostHighLevelEvent( &myEvent,

        toTargetID.sessionID,
                                                                1,

                                                                ( (Ptr)
&dataHandle ),
                                                                dataLength,

        receiverIDisTargetID );
        */
        myErr = PostHighLevelEvent( &myEvent,

        toTargetID.sessionID,
                                                                1,
                        /* unused */
                                                                ( (Ptr)
pieceNumbersParm ),
                                                                dataLength,

        receiverIDisTargetID );
        DisposeHandle( dataHandle );

}

/********************** non-Method functions ********************************/

void    CenterPict( PicHandle thePicture, Rect *myRectPtr )
{
        /* windRect not for a window in this case !*/

        Rect            windRect, pictureRect;
```

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```
        windRect = *myRectPtr;
        pictureRect = (**( thePicture )).picFrame;
        myRectPtr->top = (windRect.bottom - windRect.top -
                        (pictureRect.bottom - pictureRect.top))/ 2  +
                        windRect.top;
        myRectPtr->bottom = myRectPtr->top +
                        (pictureRect.bottom - pictureRect.top);
        myRectPtr->left = (windRect.right - windRect.left -
                        (pictureRect.right - pictureRect.left))/ 2
                        + windRect.left;
        myRectPtr->right = myRectPtr->left + (pictureRect.right -
                        pictureRect.left);
}

void    GetNSetDialogItems( short turnOnItem, short loopVar )
{       int                     i;
        int                     itemType;
        Rect            itemRect;
        Handle          itemHandle;


        /* set in order of defines, such as: QUEEN_RADIO, ROOK_RADIO,
BISHOP_RADIO,
                KNIGHT_RADIO */

        for( i = 1; i < loopVar ; i++)          {
                GetDItem( gDialogPtr, i, &itemType, &itemHandle, &itemRect);
                SetCtlValue( itemHandle, ( i == turnOnItem) ? ON : OFF );
        }

}
/*****************************************************************************
 CKindsOfPieces.h

                Interface for the KindsOfPieces Class


*****************************************************************************

#pragma once                    /* Include this file only once */

#include <CBitMap.h>                                    /* Interface for its
superclass              */
#include "ChessNetDef.h"
```

```
class KindsOfPieces : public CBitMap {                    /* Class
Declaration                    */

public:

                                                          /** Instance
Variables **/
        char                                kind[10];
        RgnHandle                           maskRegion;
        struct KindsOfPieces      *nextKindPtr;

        short                               pieceNumber;
        /* number representation of kind of piece

                        1 - pawm

                        2 - horse

                        3 - bishop

                        4 - rook that has not moved

                        5 - rook that has moved

                        6 - queen

                        7 - king that has not moved

                        8 - king that has moved


                              Negatives indicate black pieces

                        */

                                                          /** Instance
Methods **/
                                                                /**
Contruction/Destruction **/
        void            IKindsOfPieces(short width, short height, Boolean
makePort, char *piece,
                                                          KindsOfPieces
        *nextPtrParm,   short    pieceNumParm);
        void            Dispose(void);
```



```
        void            Draw( Rect      *area );

        void            Erase( void );

                                                                      /**
Accessing **/

        void            SetRegion( Rect  *area);

};

/******************************************************************************
 KindsOfPieces.c

                                                          The KindsOfPieces C

        SUPERCLASS = CBitMap

*******************************************************************************

#include "KindsOfPieces.h"
#include "Global.h"
#include <string.h>
#include <Quickdraw.h>
#include <LongCoordinates.h>
/**** C O N S T R U C T I O N / D E S T R U C T I O N   M E T H O D S ****/


/******************************************************************************
 IKindsOfPieces

                Initialize a KindsOfPieces object

*******************************************************************************

void    KindsOfPieces::IKindsOfPieces(
        short                   width,                             /* W
of BitMap in pixels                     */
        short                   height,                            /*
Height of BitMap in pixels                   */
        Boolean                 makePort,                          /*
Create offscreen port?                       */
```

```
	char			*pieceParm,			/* kind of piece
	*/
	KindsOfPieces	*nextPtrParm,			/* next kind in linked list
			*/
	short			pieceNumParm )			/* number
representation of kind of piece*/
{
	IBitMap( width, height, makePort);
	nextKindPtr = nextPtrParm;
	strcpy( kind, pieceParm );
	pieceNumber = pieceNumParm;
}


/******************************************************************************
 Dispose {OVERRIDE}

		Dispose of a KindsOfPieces

******************************************************************************/

void	KindsOfPieces::Dispose()
{


	inherited::Dispose();					/* Pass message on to
superclass	*/
}

/******************************************************************************
 Draw
		Draw a BitMap

******************************************************************************/

void	KindsOfPieces::Draw( Rect	*area)			/* parm now
unused!! */
{	LongRect longRectArea;

	SectRect(area, &macBitMap->bounds, area);

	(void) QDToLongRect( area, &longRectArea);

	inherited::CopyFrom(&longRectArea, &longRectArea, maskRegion);
}
/******************************************************************************
 Erase
		Erase region ( to erase previously drawn BitMap )

******************************************************************************

void	KindsOfPieces::Erase( void)
{
	EraseRgn( maskRegion );

}

/****A C C E S S I N G   M E T H O D S****/

/******************************************************************************
 SetRegion
		set rect for region

******************************************************************************

void	KindsOfPieces::SetRegion( Rect	*area)
{

	(**maskRegion).rgnBBox = *area;
}

/******************************************************************************
 CKindsOfSquares.h

		Interface for the KindsOfSquares Class


******************************************************************************

#pragma once			/* Include this file only once */

#include <CBitMap.h>					/* Interface for its
superclass	*/
#include "ChessNetDef.h"

class KindsOfSquares : public CBitMap {				/* Class
Declaration				*/

public:
```

```
                                                        /** Instance
Variables **/
        char                                    kind[10];
        RgnHandle                               maskRegion;
        struct KindsOfSquares   *nextKindPtr;

                                                        /** Instance
Methods **/
                                                              /**
Contruction/Destruction **/
        void            IKindsOfSquares(short width, short height, Boolean
makePort, char *square,
                                                        KindsOfSquares
        *nextPtrParm);
        void            Dispose(void);

        void            Draw( Rect *area );

        void            Erase( void );

                                                              /**
Accessing **/

        void            SetRegion( Rect *area);

};
/******************************************************************************
 KindsOfSquares.c

                                                The KindsOfSquares
Class

        SUPERCLASS = CBitMap

******************************************************************************/

#include "KindsOfSquares.h"
#include "Global.h"
#include <string.h>
#include <Quickdraw.h>
#include <LongCoordinates.h>
/**** C O N S T R U C T I O N / D E S T R U C T I O N   M E T H O D S ****/
```

```
/******************************************************************************
 IKindsOfSquares

                Initialize a KindsOfSquares object

******************************************************************************

void    KindsOfSquares::IKindsOfSquares(
        short                   width,                          /* W
of BitMap in pixels             */
        short                   height,                         /*
Height of BitMap in pixels              */
        Boolean                 makePort,                       /*
Create offscreen port?                  */
        char                    *squareParm,                    /* kind of squ
*/
        KindsOfSquares *nextPtrParm)                    /* next kind in linked
*/
{
        IBitMap( width, height, makePort);
        nextKindPtr = nextPtrParm;
        strcpy( kind, squareParm );
}

/******************************************************************************
 Dispose {OVERRIDE}

                Dispose of a KindsOfSquares

******************************************************************************

void    KindsOfSquares::Dispose()
{


        inherited::Dispose();                           /* Pass message on to
superclass      */
}

/******************************************************************************
 Draw
                Draw a BitMap
```

```
*****************************************************************************/

void    KindsOfSquares::Draw( Rect *area)
{       LongRect longRectArea;

        SectRect( area, &macBitMap->bounds, area);

        (void) QDToLongRect( area, &longRectArea);

        inherited::CopyFrom(&longRectArea, &longRectArea, maskRegion);

}
/*****************************************************************************
 Erase
                Erase region ( to erase previously drawn BitMap )

*****************************************************************************/

void    KindsOfSquares::Erase( void)
{
        EraseRgn( maskRegion );

}

/**** A C C E S S I N G   M E T H O D S ****/

/*****************************************************************************
 SetRegion
                set rect for region

*****************************************************************************/

void    KindsOfSquares::SetRegion( Rect *area)
{

        (**maskRegion).rgnBBox = *area;
}

/****
 * Network**.h
 *
 *      Functions needed to communicate with other copy of game
 *
 ****/
```

```
#pragma once                    /* Include this file only once */
#include        "CChessNetDoc.h"
#include        "ChessNetDef.h"
#include        <CObject.h>
#include        <PPCToolBox.h>
#include        <AppleEvents.h>
#include        <EPPC.h>


typedef short  NetworkData [NUM_SQUARES-1];

class Network : public CChessNetDoc {

public:



                                                                /**
Construction/Destruction **/

        virtual void            INetwork( void );


        virtual void            Dispose( void );


                                                                /**
Filing **/

        virtual void            ReceiveMove( NetworkData *pieceNumbers );

        virtual void            SendMove ( void );

};

/****
 * Network.c
 *
 *      Functions needed to communicate with other copy of game
 *
 ****/
#include                "CChessNetDoc.h"
#include                <PPCToolBox.h>
```

```
#include                <AppleEvents.h>
#include                <oops.h>
#include                <stdlib.h>
#include                <types.h>


void    Network::INetwork( void )

{
}

/***
 * Dispose
 *
 ***/

void Network::Dispose( void )

{

}
```



```
void Network::ReceiveMove( NetworkData *pieceNumbers )

{       short i;

        /* reset all pieces to squares as recieved from opponent */
        for( i = 0; i < NUM_SQUARES; i++)       {
                firstBoardPtr->arrayOfSqPtr[i]->SetPiece( GetPiece(
*pieceNumbers[i] ) );
        }

        /* redraw each square by drawing board   */
        firstBoardPtr->Draw();

}



void Network::SendMove( void )

{       short i, order;
        NetworkData     pieceNumbers;

        /* get & save all piece order numbers so as to send to opponent */
        for( i = 0; i < NUM_SQUARES; i++)       {

                order = GetPieceOrder( firstBoardPtr->arrayOfSqPtr[i]-
>currentPiecePtr );
                pieceNumbers[i] = order;
        }

        /* collected piece order numbers - now send over network */
        CChessNetDoc::SendMoveToOpponent( pieceNumbers );

}

/**************************************************************************
 CPieceMove.h

                Interface for the PieceMove Class



***************************************************************************

#pragma once                    /* Include this file only once */

#include <CMouseTask.h>                         /* interface for
superclass */
#include "Squares.h"
#include "PiecesInUse.h"
#include "ChessNetDef.h"

class PieceMove : public CMouseTask {           /* Class Declaration
                */

public:

                                                        /** Instance
Variables **/

        struct Squares
        *arrayOrigSqPtr[NUM_SQUARES_PER_MOVE];

                        /* store squares to undo move */
        struct PiecesInUse
        *arrayOrigPiecePtr[NUM_SQUARES_PER_MOVE];
```

```
                    /* store pieces to undo move */
        short
        arrayOrigPieceNum[NUM_SQUARES_PER_MOVE];

                    /* store piece numbers to undo num */


        short                                   origSqArrayIndex;
        /* store which piece or square you're

                      pointing at */

        short                                   arrayOfPositions[120];    /* stores
positions of pieces on board,

                              10 x 12 grid - w/ border spaces to

                              detect out of bounds moves */


        struct KindsOfPieces ,     *thisKindPtr; /* KindsOfPieces ptr for piece being
moved */
        struct PiecesInUse              *thisPiecePtr; /* PiecesInUse ptr for piece
being moved  */
        struct Squares                  *thisSqPtr;         /* Squares prt for
square moving from      */

        Point                                   offsetPoint;  /* original click
point within pane - stored

                distance from origin in pane coords */

        short                                   firstKeepTracking;        /* first
call of KeepTracking */

        Boolean                                 hasMoved;                 /*
passed to piece hasMoved if not undone */

        struct PiecesInUse              *enPassantPtr; /* save gAGame-
>enPassantPtr for Undo  */

        Boolean                                 goodMove;
                                                                        /** Instance
Methods **/

                                                                               /**
Contruction/Destruction **/

        void        IPieceMove( short aNameIndex,
                                                  Squares
*arraySqPtrParm[NUM_SQUARES_PER_MOVE],
                                                  PiecesInUse
*arrayPiecePtrParm[NUM_SQUARES_PER_MOVE],
                                                  short           indexParm,
                                                  Point offsetPointParm );

        void        Dispose(void);

                                                                               /**
Accessing **/

        void        BeginTracking( LongPt *startPt );

        void        KeepTracking( LongPt *currPt, LongPt *prevPt, LongPt *startP

        void        EndTracking( LongPt *currPt, LongPt *prevPt, LongPt *startPt

        void        Undo();


};

/* used by PieceMove methods */

void    CleanupSquares(Point offsetPoint, Point *prevPt, Rect pieceRect );

/**************************************************************************
 PieceMove.c

                                                           The PieceMove Class

        SUPERCLASS = CMouseTask


**************************************************************************
```

```
#include "PieceMove.h"
#include <CMouseTask.h>
#include "KindsOfPieces.h"
#include "Boards.h"
#include "PiecesInUse.h"
#include "KindsOfPieces.h"
#include "Squares.h"
#include "ChessNetDef.h"
#include <stdlib.h>
#include <LongCoordinates.h>

#include "CChessNetDoc.h"        /* need for def. of GetNSetDialogItems - not a
member */

extern  Network                  *gAGame;        /* global ptr to A Game document
*/
extern  DialogPtr                         gDialogPtr; /* global dialog ptr */extern
        DialogPtr                         gDialogPtr; /* global dialog ptr */

/**** CONSTRUCTION/DESTRUCTION METHODS ****/
```



```
/******************************************************************************
 IPieceMove

                Initialize a PieceMove object

******************************************************************************/

void    PieceMove::IPieceMove(  short aNameIndex,
                                                        Squares
*arraySqPtrParm[],
                                                        PiecesInUse
*arrayPiecePtrParm[],
                                                        short
        indexParm,
                                                        Point
        offsetPointParm )
{       short i;

        IMouseTask(  aNameIndex );

        for( i = 0; i < indexParm && i < NUM_SQUARES_PER_MOVE; i++)
        {
                arrayOrigSqPtr[i]               = arraySqPtrParm[i];
                arrayOrigPiecePtr[i]    = arrayPiecePtrParm[i];
                arrayOrigPieceNum[i]    = arrayPiecePtrParm[i]->pieceNumbe
        }

        /* save index - will start at this value & decrement if you have to Undo
move */
        origSqArrayIndex = i -1;



        /* offsetPoint used so that piece starts off from starting place
                no matter where first clicked within piece */

        offsetPoint = offsetPointParm;

        /* save Kind ptr for first piece ptr and square ptr in array
                                this is always the piece & square being moved!
        thisKindPtr  = arrayOrigPiecePtr[0]->itsKindPtr;
        thisPiecePtr = arrayOrigPiecePtr[0];
        thisSqPtr    = arrayOrigSqPtr[0];

        firstKeepTracking = TRUE;

}


/******************************************************************************
 Dispose {OVERRIDE}

                Dispose of a PieceMove

******************************************************************************

void    PieceMove::Dispose()
{

        inherited::Dispose();
}


/**** ACCESSING METHODS ****/
```

```
/*****************************************************************************
 BeginTracking (OVERRIDE if needed )

                BeginTracking a PieceMove ( dont need to override if you dont
change startPt)

*****************************************************************************/
void    PieceMove::BeginTracking( LongPt *unusedPt )
{       Rect area;


        /* erase piece being moved from starting square */
        thisSqPtr->currentPiecePtr = (PiecesInUse *) NULL;
        thisSqPtr->Prepare();

        (void) LongToQDRect( &(thisSqPtr->frame), &area);
        thisSqPtr->Draw( &area );
}


/*****************************************************************************
 KeepTracking (OVERRIDE)

                KeepTracking a PieceMove

*****************************************************************************/
void    PieceMove::KeepTracking( LongPt *currLongPt, LongPt *prevLongPt,
                                                                LongPt
*startLongPt )
{       long            hLocation;
        long            vLocation;
        short           i, j;
        short           vOffset, hOffset, hEncl, vEncl;
        long            hOriginCurr, vOriginCurr, hOriginPrev, vOriginPrev;
        Rect            pieceRect;
        Point           pt1, pt2, pt3;
        Point           *currPt= &pt1, *prevPt= &pt2, *startPt= &pt3;

        /* cPreparedView is static variable - provides pointer to a CView
                object which is cast to pointer to CPane class so can
                access FrameToWind method
        */

        thisSqPtr->FrameToWind( currLongPt, currPt);
        thisSqPtr->FrameToWind( prevLongPt, prevPt);
        thisSqPtr->FrameToWind( startLongPt, startPt);


        /*
        ((CPane*)CView::cPreparedView)->FrameToWind( currLongPt, currPt);
        ((CPane*)CView::cPreparedView)->FrameToWind( prevLongPt, prevPt);
        ((CPane*)CView::cPreparedView)->FrameToWind( startLongPt, startPt)
        */

        /* if piece has moved - then draw a new piece */
        if ( currPt->h != prevPt->h || currPt->v != prevPt->v )     {


                if( !firstKeepTracking )   {                    /* dont update prevPt
first time called*/

                        (void) LongToQDRect( &(thisSqPtr->frame), &pieceRec
                        /*thisSqPtr->GetFrame( &pieceRect );*/
                        /*thisSqPtr->FrameToWindR( &(thisSqPtr->frame),
&pieceRect);*/

                        /*  update - redraw underlying squares -
                        for previous piece position */

                        CleanupSquares(offsetPoint, prevPt, pieceRect );


                } else {
                        firstKeepTracking = FALSE;
                }       /* end - if not firstKeepTracking


                /**************draw piece in
movement****************************************/

                /*                      COMPENSATE FOR OFFSET BETWEEN
CORNER AND CLICK POINT                  */
                /* offsetPoint holds original offset between click point and corne
rect
                in pane coords.   Need to add it here so that piece starts off fron
where
                it was when you move it, not with corner of rect at click point */
```

```
			hOriginCurr = - currPt->h + offsetPoint.h;/* Origin maps between
Frame and	*/
			vOriginCurr = - currPt->v + offsetPoint.v; /*   Window coords.
Origin is the	*/

				/*  top left corner of the window  */

				/*  expressed in Frame coords		*/

			hOriginPrev = - prevPt->h + offsetPoint.h;/* Origin maps between
Frame and	*/
			vOriginPrev = - prevPt->v + offsetPoint.v; /*   Window coords.
Origin is the	*/

	/*  top left corner of the window  */

	/*  expressed in Frame coords		*/


			/* set origin to draw at */
			SetOrigin((short) hOriginCurr, (short) vOriginCurr);

			/* get piece rect from the mask region for piece */
			/* RectRgn( thisKindPtr->maskRegion, &pieceRect ); */

			(void) LongToQDRect( &(thisSqPtr->frame), &pieceRect);
			/*thisSqPtr->GetFrame( &pieceRect );*/
			/*hisSqPtr->FrameToWindR( &(thisSqPtr->frame), &pieceRect);*/

			/* draw moving piece */
			thisKindPtr->Draw(  &pieceRect );


	}		/* end - if piece point has moved - redraw it */

}

/*******************************************************************************
 EndTracking (OVERRIDE)

			EndTracking a PieceMove

*******************************************************************************/
void	PieceMove::EndTracking( LongPt *currLongPt, LongPt *prevLongPt,
									LongPt
*startLongPt )
{		short	i, j, found = FALSE;
		Boards	*boardPtr;
		Rect	pieceRect;
		short		fromSq, fromPiece, toSq;
		Point		pt1, pt2, pt3;
		Point		*currPt= &pt1, *prevPt= &pt2, *startPt= &pt3;

		/* cPreparedView is static variable - provides pointer to a CView
			object which is cast to pointer to CPane class so can
			access FrameToWind method
		*/

		/* set attribute - used in subclass code */
		goodMove = FALSE;

		thisSqPtr->FrameToWind( currLongPt, currPt);
		thisSqPtr->FrameToWind( prevLongPt, prevPt);
		thisSqPtr->FrameToWind( startLongPt, startPt);


		/*
		((CPane*)CView::cPreparedView)->FrameToWind( currLongPt, currPt);
		((CPane*)CView::cPreparedView)->FrameToWind( prevLongPt, prevPt);
		((CPane*)CView::cPreparedView)->FrameToWind( startLongPt, startPt)
		*/

		boardPtr = gAGame->firstBoardPtr;

		(void) LongToQDRect( &(thisSqPtr->frame), &pieceRect);
		/*thisSqPtr->GetFrame( &pieceRect );*/
		/*thisSqPtr->FrameToWindR( &(thisSqPtr->frame), &pieceRect);*/

		/*  update - redraw underlying squares -
				for previous piece position */

				CleanupSquares(offsetPoint, currPt, pieceRect );

		/*  determine move TO square & set current piece for that square */
		for( i = 0; i < NUM_SQUARES && found == FALSE; i++)	{
				/* check to see if square contains point */
				if( boardPtr->arrayOfSqPtr[i]->Contains( *currPt ) )
		{
```

```
					/* save To square & its prior piece in case of undo
*/

					/*  increment array index - decrement this in Undo
works backwards */
					origSqArrayIndex++;

					arrayOrigSqPtr[origSqArrayIndex] = boardPtr-
>arrayOfSqPtr[i];

				/* store square to undo move */
					arrayOrigPiecePtr[origSqArrayIndex] =

	boardPtr->arrayOfSqPtr[i]->currentPiecePtr;

				/* store piece to undo move */

					/* set current piece for MOVE TO square */
					boardPtr->arrayOfSqPtr[i]->SetPiece( thisPiecePtr
);
					(void) LongToQDRect( &(boardPtr-
>arrayOfSqPtr[i]->frame), &pieceRect);
					/*boardPtr->arrayOfSqPtr[i]->GetFrame(
&pieceRect );*/

					boardPtr->arrayOfSqPtr[i]->Prepare();
					boardPtr->arrayOfSqPtr[i]->Draw( &pieceRect );
					found = TRUE;   /* stop! */
				}
	}

	goodMove = found;

}
/*************************************************************************
 Undo (OVERRIDE - in CTask)

		Undo a previous move for this PieceMove

*************************************************************************/
void	PieceMove::Undo()
{	Rect	pieceRect;
	LongRect		longRect;

	/* restore & redraw square and pieces to state before last move */
	/* start at last value for origSqArrayIndex - then decrement */
	for( ; origSqArrayIndex >= 0; origSqArrayIndex-- ) {

		/* reset pieceNumber if needed - for just moved king and rook */
		if (arrayOrigPiecePtr[origSqArrayIndex] != (PiecesInUse *) NUl
	{
			if( arrayOrigPieceNum[origSqArrayIndex] !=
				arrayOrigPiecePtr[origSqArrayIndex]-
>pieceNumber )

				arrayOrigPiecePtr[origSqArrayIndex]-
>pieceNumber =

				arrayOrigPieceNum[origSqArrayIndex];
		}

		/* reset old piece for each square & draw it */
		arrayOrigSqPtr[origSqArrayIndex]->currentPiecePtr =

arrayOrigPiecePtr[origSqArrayIndex];
		arrayOrigSqPtr[origSqArrayIndex]->GetFrame( &longRect );
		(void) LongToQDRect(&longRect, &pieceRect);
		arrayOrigSqPtr[origSqArrayIndex]->Prepare();
		arrayOrigSqPtr[origSqArrayIndex]->Draw( &pieceRect );

	}

	/* restore state of gAGame->enPassantPtr using PieceMove enPassantP
	gAGame->enPassantPtr = this->enPassantPtr;

}

/************* non-method function ****************/

void	CleanupSquares(Point offsetPoint, Point *updatePt, Rect pieceRect )
{	Rect		updateRect, shortUpdateRect, shortFrameRect;
```

```
	Boards		*boardPtr = gAGame->firstBoardPtr;
	Squares		*updateSqPtrs[ NUM_SQUARES + 1 ];
	short i,j;
	LongRect		longFrameRect, longUpdateRect;

	updateRect.left = updatePt->h - offsetPoint.h;
	updateRect.top  = updatePt->v - offsetPoint.v;
	updateRect.right = updateRect.left + pieceRect.right; /* frame always at 0,0
! */
	updateRect.bottom = updateRect.top + pieceRect.bottom;


	/* check to see if each square contains any of 4 points of update area */
	for( i = 0, j = -1; i < NUM_SQUARES; i++) {

		boardPtr->arrayOfSqPtr[i]->GetFrame( &longFrameRect );


		/*boardPtr->arrayOfSqPtr[i]->Prepare(); */


		/* convert update rect from window to frame ( but long ) coords
		however, not actually using long coords so already map to QD */
		boardPtr->arrayOfSqPtr[i]->WindToFrameR( &updateRect,
&longUpdateRect);

		/* now convert from long to short */
		(void) LongToQDRect( &longUpdateRect, &shortUpdateRect);


		(void) LongToQDRect( &longFrameRect, &shortFrameRect);

		SectRect(  &shortFrameRect, &shortUpdateRect, &shortFrameRect
);
		if ( ! EmptyRect( &shortFrameRect ) )		{
			updateSqPtrs[++j] = boardPtr->arrayOfSqPtr[i];

		}
	}

	while( j >= 0 )	{


		/*updateSqPtrs[j]->Prepare();*/

		/* convert update rect from window to frame ( but long ) coords
		however, not actually using long coords so already map to QD */
		updateSqPtrs[j]->WindToFrameR( &updateRect,
&longUpdateRect);

		/* now convert from long to short */
		(void) LongToQDRect( &longUpdateRect, &shortUpdateRect);


		/* draw only update area - converted from window to frame (
already QD!)
			then long to short above */
		updateSqPtrs[j]->ForceNextPrepare();	/* in case my setorigi
messes up

			preparedView scheme	*/
		updateSqPtrs[j]->Prepare();
		updateSqPtrs[ j-- ]->Draw( &shortUpdateRect);
	}

}

/*****************************************************************************
 CPieceMove2.h

		Interface for the PieceMove2 Class



*****************************************************************************

#pragma once				/* Include this file only once */

#include <CMouseTask.h>				/* interface for
superclass */
#include "Squares.h"
#include "PiecesInUse.h"
#include "ChessNetDef.h"
#include  "PieceMove.h"
class PieceMove2 : public PieceMove {			/* Class Declaration
		*/

public:
```

```
                                                            /** Instance
Variables **/

                                                            /** Instance
Methods **/
                                                                      /**
Contruction/Destruction **/

        void        IPieceMove2( short aNameIndex,
                                              Squares
*arraySqPtrParm[NUM_SQUARES_PER_MOVE],
                                              PiecesInUse
*arrayPiecePtrParm[NUM_SQUARES_PER_MOVE],
                                              short           indexParm,
                                              Point offsetPointParm );

        void        Dispose(void);
                                                                      /**
Accessing **/

        void        BeginTracking( LongPt *startPt );

        void        EndTracking( LongPt *currPt, LongPt *prevPt, LongPt *startPt );

                                                  /** Methods needed to check for
legal moves **/
        Boolean IsMoveLegal( short fromSq, short fromPiece, short toSq );

        Boolean TryToCastle( short *psuedoMoves, short *counter,

        short fromSq, short fromPiece, short toSq );

        Boolean EnPassant( short fromSq, short fromPiece, short toSq );

        Boolean IsYourKingInCheck( short *psuedoMoves, short *counter,

        short fromSq, short fromPiece, short toSq );

        Boolean IsSquareUnderAttack( short *psuedoMoves, short *counter,
```



```
        short fromSq, short fromPiece);

        void        GeneratePsuedoMoves( short *psuedoMoves, short *counter,
                                                                      short fromS
short fromPiece);

        void        GenerateRankNFileMoves( short *psuedoMoves, short *counter
                                                                      short fromS
short fromPiece);

        void        GenerateDiagonalMoves( short *psuedoMoves, short *counter,
                                                                      short fromS
short fromPiece);

        void        GeneratePawnMoves( short *psuedoMoves, short *counter,

        short fromSq, short fromPiece);

        void        GenerateKnightMoves( short *psuedoMoves, short *counter,

        short fromSq, short fromPiece);

        void        GenerateKingMoves( short *psuedoMoves, short *counter,

        short fromSq, short fromPiece);

        void        CheckASquare( short i ,short *psuedoMoves, short *counter,

short fromPiece);

        void        FillArrayPositions( void );

        void        PromotePawn(    short pieceColor, Squares *toSquarePtr );

};

/*****************************************************************************
 PieceMove2.c

                                                            The PieceMove2 Clas

        SUPERCLASS = PieceMove
```

```
*****************************************************************************/

#include "PieceMove2.h"
#include <CMouseTask.h>
#include "KindsOfPieces.h"
#include "Boards.h"
#include "PiecesInUse.h"
#include "KindsOfPieces.h"
#include "Squares.h"
#include "ChessNetDef.h"
#include <stdlib.h>
#include <LongCoordinates.h>
#include "PieceMove.h"

#include "CChessNetDoc.h"        /* need for def. of GetNSetDialogItems - not a
member */

extern  Network                 *gAGame;        /* global ptr to A Game document
*/
extern  DialogPtr                       gDialogPtr; /* global dialog ptr */extern
        DialogPtr                       gDialogPtr; /* global dialog ptr */
```



```
/**** CONSTRUCTION/DESTRUCTION  METHODS ****/

/****************************************************************************
 IPieceMove

                Initialize a PieceMove object

*****************************************************************************/

void    PieceMove2::IPieceMove2(        short aNameIndex,
                                                        Squares
*arraySqPtrParm[],
                                                        PiecesInUse
*arrayPiecePtrParm[],
                                                        short
        indexParm,
                                                        Point
        offsetPointParm )
{
        IPieceMove(     aNameIndex,
                                                arraySqPtrParm,
                                                arrayPiecePtrParm,
                                                indexParm,
                                                offsetPointParm );

}


/****************************************************************************
 Dispose {OVERRIDE}

                Dispose of a PieceMove

*****************************************************************************

void    PieceMove2::Dispose()
{

        inherited::Dispose();
}


/**** ACCESSING  METHODS ****/


/****************************************************************************
 BeginTracking {OVERRIDE if needed }

                BeginTracking a PieceMove ( dont need to override if you dont
change startPt)

*****************************************************************************
void    PieceMove2::BeginTracking( LongPt *unusedPt )
{       Rect area;

        /* save piece positions in array to determine legal moves later */
        FillArrayPositions();

        PieceMove::BeginTracking( unusedPt );
}


/****************************************************************************
 EndTracking {OVERRIDE}
```

```
		EndTracking a PieceMove

*****************************************************************************/
void	PieceMove2::EndTracking( LongPt *currLongPt, LongPt *prevLongPt,
								LongPt
*startLongPt )
{	short	i, j;
	Boards	*boardPtr;
	Rect	pieceRect;
	short		fromSq, fromPiece, toSq;
	Point		pt1, pt2, pt3;
	Point		*currPt= &pt1, *prevPt= &pt2, *startPt= &pt3;

	/* cPreparedView is static variable - provides pointer to a CView
		object which is cast to pointer to CPane class so can
		access FrameToWind method
	*/


	thisSqPtr->FrameToWind( currLongPt, currPt);
	thisSqPtr->FrameToWind( prevLongPt, prevPt);
	thisSqPtr->FrameToWind( startLongPt, startPt);

	PieceMove::EndTracking( currLongPt,prevLongPt, startLongPt );


	if( !goodMove )	{					/* no ending
square was found UNDO move!!!*/
		Undo();
	} else	{						/*
ending square was found so check for legal move */

		/* arrayPositions filled in BeginTracking	*/


		if(  FALSE == IsMoveLegal( thisSqPtr->squareNumber,
	/* from square */

	thisPiecePtr->pieceNumber,

								/* from piece  */

	arrayOrigSqPtr[origSqArrayIndex]->squareNumber ) )
```

71

```
									/* to square
			Undo();							/* if
legal move undo move */

		else	{


			/* move is legal, so set hasMoved flag -
			  meaningful only for king & rook */
			if( abs(thisPiecePtr->pieceNumber) == 4 | |
abs(thisPiecePtr->pieceNumber) == 7)
				thisPiecePtr->hasMoved = TRUE;


				/* set special values for moved king or rook
		*/
				/* rook changes from 4 to 5, king changes from
8	*/


				switch ( thisPiecePtr->pieceNumber )	{
					case ( 4  ):  thisPiecePtr->pieceNumbe
5;
						break;
					case ( -4 ):  thisPiecePtr->pieceNumbe
5;
						break;
					case ( 7  ):  thisPiecePtr->pieceNumbe
8;
						break;
					case ( -7 ):  thisPiecePtr->pieceNumbe
8;
						break;
				}



			/* check for pawn double square move - if found set
enPassantPtr in
				AGame object - used to allow legal enPassant
capture */

			/* but first save current state øf enPassant in case of U
*/
```

```
			this->enPassantPtr = gAGame->enPassantPtr;


			if( abs(thisKindPtr->pieceNumber) == 1
			/* is pawn */
				&&
				( abs(arrayOrigSqPtr[origSqArrayIndex]-
>squareNumber		/* double move */

thisSqPtr->squareNumber) == 2 ) )
				gAGame->enPassantPtr = thisPiecePtr;

			/* otherwise blank out enPassantPtr - must perform en
passant capture
				immediately after double pawn move */
			else
				gAGame->enPassantPtr = (PiecesInUse *) NULL;



			/* P A W N   P R O M O T I O N */

			/* check for pawn */
			if( abs(thisPiecePtr->pieceNumber) == 1 ) {

				/* array item 1 should be second square involved -
or "to" square */
				switch ( arrayOrigSqPtr[1]->squareNumber )
	{
					case 18: case 28: case 38: case 48: case 58:
case 68: case 78:
					case 88:		/* on top squares? */
						PromotePawn( WHITE,
arrayOrigSqPtr[1] );

						break;
					case 11: case 21: case 31: case 41: case 51:
case 61: case 71:
					case 81:		/* on bottom squares? */
						PromotePawn( BLACK,
arrayOrigSqPtr[1] );

						break;
				}
			}
```



```
					/* move is legal and other work done so send across
network */
					gAGame->SendMove();


			}
		}


}

Boolean PieceMove2::IsMoveLegal( short fromSq, short fromPiece, short toSq )
{	Boolean returnValue = FALSE;
	short			psuedoMoves[NUM_POSSIBLE_MOVES];
	short			i, counter = 0;

	/* check for castle move - test for unmoved king & proper to square */
	if( abs(fromPiece) == 7 && ( toSq == fromSq + 20 || toSq == fromSq - 2
	{

		returnValue = TryToCastle( &psuedoMoves[0], &counter,

	fromSq, fromPiece, toSq );

	} else	{		/* other than castle move */

		/* generate all possible moves for from Piece at fromSq	*/
		GeneratePsuedoMoves( &psuedoMoves[0], &counter, fromSq,
fromPiece );

		/* set end of array marker to  110 - not a valid square! */
		psuedoMoves[ counter ] = 110;

		/*	check to see if toSq is in list of possible moves - if it is, i
legal move! - unless
			the move leaves your king in check
		*/
		for( i = 0; returnValue == FALSE && psuedoMoves[i] != 110 &&
NUM_POSSIBLE_MOVES; i++)	{

			if( toSq ==  psuedoMoves[i])	{
				returnValue = TRUE;
			}
		}
```

```
		/* if move above was illegal, check for possibility of pawn en
passant move
			which is not covered in GeneratePsuedoMoves. If en
passant occurs, set
			returnValue to TRUE and check for king in check as
follows */
		if ( returnValue == FALSE)
			returnValue = EnPassant( fromSq, fromPiece, toSq );


		/* if move above was legal, so far, then determine if your own king
has been
			left in check, which would then be an illegal move
		*/
		if ( returnValue == TRUE)		{
			returnValue = IsYourKingInCheck( &psuedoMoves[0],
&counter,

	fromSq, fromPiece, toSq );
		}
	} /* end other than castle move */

	return( returnValue );
}

Boolean PieceMove2::TryToCastle( short *psuedoMoves, short *counter,

	short fromSq, short fromPiece, short toSq )
{	Boolean returnValue = TRUE;
	short		i;
	short		thisPiece, thisSq, rookSq, newRookSq;
	Boards		*boardPtr = gAGame->firstBoardPtr;
	PiecesInUse	*aPiecePtr;
	Squares		*aSquarePtr1, *aSquarePtr2;
	Rect drawRect;

	/* remember! already tested for unmoved king & proper to square */
	switch (toSq)	{
		case ( 31 ): rookSq = 11; newRookSq = 41;
			break;
		case ( 38 ): rookSq = 18; newRookSq = 48;
			break;
		case ( 71 ): rookSq = 81; newRookSq = 61;
			break;
		case ( 78 ): rookSq = 88; newRookSq = 68;
```

```
			break;
	}

	/* check for rook in proper square and never moved */
	/* already tested for unmoved king so don't worry about rook color */
	/* 4 = unmoved rook */
	if( abs(arrayOfPositions[ rookSq + BOARD_OFFSET ]) != 4  )
		returnValue = FALSE;		/* if not rook in corner or alre
moved */
	else	{

		/* make sure intervening squares empty and
			not castling through check !
	*/

		if( toSq == 31 || toSq == 38 )	{			/* ca
left */



			for( i = fromSq; i > 20 && returnValue == TRUE; i -= 1
	{

				/*	check squares, starting with king squa
that you are castling through,
					up to, not including rook square, to se
empty, except for king square */
				if( arrayOfPositions[ i + BOARD_OFFSET ] ==
|| i == fromSq)


						/*	check to see if king in
check, or intervening squares in check,
							'cuz you can't castle
through check */

						returnValue =
IsSquareUnderAttack( psuedoMoves,  counter,  i, fromPiece );

				else
					returnValue  = FALSE;
			}

		} else	{
		/* castle right */
```

```
                        for( i = fromSq; i < 80 && returnValue == TRUE; i += 10 )
        {
                                /*      check squares, starting with king square,
that you are castling through,
                                        up to, not including rook square, to see if
empty, except for king square */
                                if( arrayOfPositions[ i + BOARD_OFFSET ] == 0
|| i == fromSq)
                                                /*      check to see if king in
check, or intervening squares in check,
                                                        'cuz you can't castle
through check */
                                                returnValue =
IsSquareUnderAttack( psuedoMoves, counter, i, fromPiece );

                                else
                                        returnValue = FALSE;
                        }

                }
        } /* end rook is in corner & unmoved */

        if( returnValue == TRUE )       {

                for( i = 0; i < NUM_SQUARES ; i++)      {
                        /* walk through all squares looking for rookSquare to
blank out
                          and newrooksquare to put rook in */
                        if( boardPtr->arrayOfSqPtr[i]->squareNumber == rookSq) {

                                /* save this piece ptr. so it can be re-assigned */
                                aPiecePtr = boardPtr->arrayOfSqPtr[i]-
>currentPiecePtr;

                                /* save square ptr so it can be drawn later */
                                aSquarePtr1 = boardPtr->arrayOfSqPtr[i];

                                /* save moved from rook square & piece for later
undo */
                                /*  increment array index -
                                                        decrement this in Undo  worl
backwards */
                                        origSqArrayIndex++;

                                        arrayOrigSqPtr[origSqArrayIndex] = aSquareI
                                /* store square to undo move */
                                        arrayOrigPiecePtr[origSqArrayIndex] = aPiece
                                /* store piece to undo move */
                                        arrayOrigPieceNum[origSqArrayIndex] =
aPiecePtr->pieceNumber;
                                /* store piece number for undo */

                                        /* then blank out square's current piece ptr to
empty square */
                                        boardPtr->arrayOfSqPtr[i]->currentPiecePtr =
(PiecesInUse *) NULL;


                        } else if( boardPtr->arrayOfSqPtr[i]->squareNumber ==
newRookSq)      {

                                        /* save square ptr. so can assign rook piece prt
outside of loop */
                                        aSquarePtr2 = boardPtr->arrayOfSqPtr[i];


                                        /* save moved to rook square & blank piece for
later undo */
                                        /*  increment array index -
                                                        decrement this in Undo  worl
backwards */
                                        origSqArrayIndex++;

                                        arrayOrigSqPtr[origSqArrayIndex] = aSquareI
                                /* store square to undo move */
                                        arrayOrigPiecePtr[origSqArrayIndex] =
(PiecesInUse *) NULL;

                                /* store piece to undo move */

                        }
```

```
			}

			/* now assign rook piece to new square - in effect moving it */
			aSquarePtr2->currentPiecePtr = aPiecePtr;

			/* re-draw both new & old rook squares */
			aSquarePtr1->Prepare();
		/* prepare, ie. set origin */

			(void) LongToQDRect(&aSquarePtr1->frame, &drawRect);
			aSquarePtr1->Draw( &drawRect );			/* draw old
square */

			aSquarePtr2->Prepare();
		/* prepare, ie. set origin */

			(void) LongToQDRect(&aSquarePtr2->frame, &drawRect);
			aSquarePtr2->Draw(  &drawRect );			/* draw new
square */


		}

		/* still need return value so move is not undone later */
		return( returnValue );

}

Boolean PieceMove2::EnPassant( short fromSq, short fromPiece, short toSq )
{	short				leftMove, rightMove, behindSq, oppositePiece,
returnValue = FALSE;
	short				i;
	Boards				*boardPtr = gAGame->firstBoardPtr;
	KindsOfPieces	*aKindPtr;
	PiecesInUse			*aPiecePtr, *aPiecePtr2;
	Rect	drawRect;

	/* was pawn moved?, and was there a double pawn move made last move? */
	if( abs(fromPiece) == 1 && ( gAGame->enPassantPtr != (PiecesInUse *)
NULL) )		{

		/* set values depending on black or white piece */
		if (fromPiece > 0)		{			/* white pawn */
			leftMove = -9;
			rightMove =	11;
			behindSq = -1;
			oppositePiece = -1;
		} else	{					/* black pawı
			leftMove = 9;
			rightMove =	-11;
			behindSq = 1;
			oppositePiece = 1;
		}

		/* was 1 square diagonal move made? */
		if ( toSq - fromSq == leftMove || toSq - fromSq == rightMove )
	{


			aPiecePtr = gAGame->enPassantPtr;
			aKindPtr = aPiecePtr->itsKindPtr;

			/* was the double moved pawn of opposite color? */
			if ( aKindPtr->pieceNumber = oppositePiece )	{

				/* find the piece immediately behind moved pie
*/

				for( i = 0; i < NUM_SQUARES; i++)	{

					if	( behindSq == ( boardPtr-
>arrayOfSqPtr[i]->squareNumber - toSq )

		/* is this the square behind moved pawn? */
					&&
					( boardPtr->arrayOfSqPtr[i]-
>currentPiecePtr ==
					 gAGame->enPassantPtr )

		/* does this square contain en passant ptr pawn? */
					)	{


					/* then carryout en passant
capture */

					/* save square & piece for und
					/*  increment array index -
					 decrement this in Undo worl
backwards */
					origSqArrayIndex++;
```

```
                                        aPiecePtr2 = boardPtr-
>arrayOfSqPtr[i]->currentPiecePtr;

        arrayOrigSqPtr[origSqArrayIndex] = boardPtr->arrayOfSqPtr[i];
                        /* store square to undo move */
        arrayOrigPiecePtr[origSqArrayIndex] =
        boardPtr->arrayOfSqPtr[i]->currentPiecePtr;
                        /* store piece to undo move */
        arrayOrigPieceNum[origSqArrayIndex] = aPiecePtr2->pieceNumber;
                        /* store piece number for undo */

                                        /* now blank piece ptr out - pawn
has been captured */
                                        boardPtr->arrayOfSqPtr[i]-
>currentPiecePtr =
        (PiecesInUse *) NULL;

                                        /* now draw the empty square */
                                        boardPtr->arrayOfSqPtr[i]-
>Prepare();
        /* prepare, ie. set origin */
                                        (void) LongToQDRect(&boardPtr-
>arrayOfSqPtr[i]->frame, &drawRect);
                                        boardPtr->arrayOfSqPtr[i]-
>Draw( &drawRect );
        /* draw new square */

                                        /* set return value */
                                        returnValue = TRUE;
```



```
                                }
                            }
                        }
                    }
        }
        return( returnValue );
}

Boolean PieceMove2::IsYourKingInCheck( short *psuedoMoves, short *counter,
        short fromSq, short fromPiece, short toSq )
{       Boolean returnValue = TRUE;             /* not callled unless returnVa
in IsMoveLegal = TRUE */
        short           i;
        short           thisPiece, thisSq, kingSq;
        Boards          *boardPtr = gAGame->firstBoardPtr;
        PiecesInUse     *aPiecePtr;
        KindsOfPieces *aKindPtr;

        /* save piece positions in array to determine if king in check later
          need to do this again ( done in BeginTracking) because piece(s) have
moved
         */
        FillArrayPositions();

        /* find your king square - if king is not piece being moved */

        if( abs(fromPiece) == 7 || abs( fromPiece) == 8 )
                kingSq = toSq;                                          /*
        piece being moved is your king,
                                so dont have to find
        */
```

```
	else	{
	/* not your king so have to find king */
		kingSq = 110;		/* meaning king not yet found - invalid
square */
		for( i = 0; i < NUM_SQUARES && kingSq == 110; i++)	{
			/* walk through all squares looking for your king */
			/* if square has a piece */
			if( boardPtr->arrayOfSqPtr[i]->currentPiecePtr !=
(PiecesInUse *) NULL)	{

				aPiecePtr = boardPtr->arrayOfSqPtr[i]-
>currentPiecePtr;
				aKindPtr = aPiecePtr->itsKindPtr;
				thisPiece = aKindPtr->pieceNumber;

				if ( (fromPiece < 0 && thisPiece < 0) ||	/* check
for SAME color */
					(fromPiece > 0 && thisPiece > 0)
	)	{

					/* if this is your king save the square
number for later use */
					if( abs(thisPiece) == 7 || abs(thisPiece)
== 8 )
						kingSq = boardPtr-
>arrayOfSqPtr[i]->squareNumber;
				}

			}
		}
	}		/* else have to find king */


	/* now using king square, check moves of opponent to see if king left in
check - not legal */
	returnValue = IsSquareUnderAttack( psuedoMoves, counter, kingSq,
fromPiece);

	return( returnValue );
}
```

```
Boolean PieceMove2::IsSquareUnderAttack( short *psuedoMoves, short *counter

	short fromSq, short fromPiece)
{	Boolean returnValue = TRUE;		/* not callled unless returnVa
in IsMoveLegal = TRUE */
	short		i;
	short		thisPiece, thisSq;
	Boards		*boardPtr = gAGame->firstBoardPtr;
	PiecesInUse	*aPiecePtr;
	KindsOfPieces *aKindPtr;

	/* re-use psuedoMoves array so initialize counter variable */
	*counter = 0;

	for( i = 0; i < NUM_SQUARES ; i++)	{
			/* if square has a piece */
			if( boardPtr->arrayOfSqPtr[i]->currentPiecePtr !=
(PiecesInUse *) NULL)	{

				aPiecePtr = boardPtr->arrayOfSqPtr[i]-
>currentPiecePtr;
				aKindPtr = aPiecePtr->itsKindPtr;
				thisPiece = aKindPtr->pieceNumber;


				/* generate moves only for pieces of OPPOSITE
color */
				if ( (fromPiece < 0 && thisPiece > 0) ||
					(fromPiece > 0 && thisPiece < 0)
	)	{
					thisSq = boardPtr->arrayOfSqPtr[i]-
>squareNumber;

					/* generate all possible moves for
thisPiece at thisSq	*/
					GeneratePsuedoMoves( psuedoMoves,
counter, thisSq, thisPiece );

				}

			}
	}

	/* set end of array marker to 110 - not a valid square! */
	psuedoMoves[ *counter ] = 110;
```

```
	/*	check to see if fromSq is in list of possible moves of opposing pieces
- if it is,
		then fromSq IS under attack ( if king occupies it - would be in check
	*/
	for( i = 0; returnValue == TRUE && psuedoMoves[i] != 110 && i <
NUM_POSSIBLE_MOVES; i++)  {

		if( fromSq == psuedoMoves[i])	{
			returnValue = FALSE;				/* if
square under attack return false */
		}
	}

	return( returnValue );

}

void	PieceMove2::GeneratePsuedoMoves( short *psuedoMoves, short *counter,

	short fromSq, short fromPiece )
{
	switch (fromPiece)		{

		case 1: case -1:	GeneratePawnMoves( psuedoMoves, counter,
fromSq, fromPiece );
							break;
		case 2: case -2:	GenerateKnightMoves( psuedoMoves, counter,
fromSq, fromPiece );
							break;
		case 3: case -3:	GenerateDiagonalMoves( psuedoMoves, counter,
fromSq, fromPiece );
							break;
		case 4: case -4:	GenerateRankNFileMoves( psuedoMoves, counter,
fromSq, fromPiece );
							break;
		case 5: case -5:	GenerateRankNFileMoves( psuedoMoves, counter,
fromSq, fromPiece );
							break;

		case 6: case -6:	GenerateDiagonalMoves(psuedoMoves, counter,
fromSq, fromPiece);

	GenerateRankNFileMoves( psuedoMoves, counter, fromSq, fromPiece);
							break;
```



```
		case 7: case -7:	GenerateKingMoves( psuedoMoves, counter,
fromSq, fromPiece);
							break;
		case 8: case -8:	GenerateKingMoves( psuedoMoves, counter,
fromSq, fromPiece);
							break;
	}

}

void	PieceMove2::GenerateRankNFileMoves( short *psuedoMoves, short
*counter,

	short fromSq, short fromPiece)
{	short i, j, offset;

	for( j=0; j< 4; j++)		{

		switch  ( j )	{
			case 0	: offset = 1;
				break;
			case 1	: offset = -1;
				break;
			case 2	: offset = 10;
				break;
			case 3	: offset = -10;
				break;
		}

		i = fromSq + BOARD_OFFSET;
		do {

			i += offset;
			CheckASquare( i , psuedoMoves,  counter, fromPiece);


		} while( arrayOfPositions[i] == 0 );
	}

}

void	PieceMove2::GenerateDiagonalMoves( short *psuedoMoves, short *coun

	short fromSq, short fromPiece)
{	short i, j, offset;
```

```
	for( j=0; j< 4; j++)		{

		switch	( j )	{
			case 0	: offset = 9;
				break;
			case 1	: offset = 11;
				break;
			case 2	: offset = -9;
				break;
			case 3	: offset = -11;
				break;
		}

		i = fromSq + BOARD_OFFSET;
		do {

			i += offset;
			CheckASquare( i , psuedoMoves,  counter, fromPiece);


		} while( arrayOfPositions[i] == 0 );
	}

}

void	PieceMove2::GeneratePawnMoves( short *psuedoMoves, short *counter,

	short fromSq, short fromPiece)
{	short i;
	Boolean whitePawn = TRUE, onStartSq = FALSE;

	/* set white or black pawn */
	if( fromPiece == -1 )
		whitePawn = FALSE;

	/* determine if pawn on one of starting squares */
	if( whitePawn )	{
		for( i = 12; i < 83 && onStartSq == FALSE; i += 10)		{
			if( fromSq == i )				/* check
for white pawn on start squares */
					onStartSq = TRUE;
		}
	} else	{
		for( i = 17; i < 88 && onStartSq == FALSE; i += 10)		{
			if( fromSq == i )				/* ch
for black pawn on start squares */
					onStartSq = TRUE;
			}
		}

		/* white pawn on start square */
		if( whitePawn == TRUE && onStartSq == TRUE  )		{


			/* loop twice to add 1 & 2 square pawn moves if empty */
			for( i = fromSq + BOARD_OFFSET + 1; arrayOfPositions[i] == (
&&
				i < (fromSq + BOARD_OFFSET + 3); i++) {

				psuedoMoves[(*counter)++] = i - BOARD_OFFSET;
		/* store empty square */
			}

		/* black pawn on start square */
		} else if( whitePawn == FALSE && onStartSq == TRUE )	{

			/* loop twice to add 1 & 2 square pawn moves if empty */
			for( i = fromSq + BOARD_OFFSET -1; arrayOfPositions[i] == 0
				i > (fromSq + BOARD_OFFSET - 3); i--)	{

				psuedoMoves[(*counter)++] = i - BOARD_OFFSET;
		/* store empty square */
			}

		/* white pawn - 1 square move */
		} else if( whitePawn == TRUE)	{

			if( arrayOfPositions[fromSq + BOARD_OFFSET + 1] == 0)
				psuedoMoves[(*counter)++] = fromSq + 1;		/* st
empty square */

		/* black pawn - 1 square move */
		} else {

			if( arrayOfPositions[fromSq + BOARD_OFFSET - 1] == 0)
				psuedoMoves[(*counter)++] = fromSq - 1;		/* st
empty square */
		}
```

```
	/* add diagonal attack squares */
	if( whitePawn == TRUE) {

		/* white right attack */
		if( arrayOfPositions[fromSq + BOARD_OFFSET + 11] < 0   &&

			arrayOfPositions[fromSq + BOARD_OFFSET + 11] != -9 )
	/* check for border square */
			psuedoMoves[(*counter)++] = fromSq + 11;	/* store
captured square */

		/* white left attack */
		if( arrayOfPositions[fromSq + BOARD_OFFSET - 9 ] < 0    &&

			arrayOfPositions[fromSq + BOARD_OFFSET - 9 ] != -9 )
	/* check for border square */
			psuedoMoves[(*counter)++] = fromSq - 9;  /* store captured
square */

	} else    {

		/* black right attack */
		if( arrayOfPositions[fromSq + BOARD_OFFSET - 11] > 0 )
	/* pos. so no border squares */
			psuedoMoves[(*counter)++] = fromSq  - 11;	/* store
captured square */

		/* black left attack */
		if( arrayOfPositions[fromSq + BOARD_OFFSET + 9 ] > 0 )
	/* pos. so no border squares */
			psuedoMoves[(*counter)++] = fromSq  + 9;/* store captured
square */

	}

}

void	PieceMove2::GenerateKnightMoves( short *psuedoMoves, short *counter,

	short fromSq, short fromPiece)
{	short i, j, offset;

	for( j=0; j< 8; j++)		{
```

```
		switch  ( j )	{
			case 0	: offset = 8;
				break;
			case 1	: offset = 19;
				break;
			case 2 : offset = 12;
				break;
			case 3 : offset = 21;
				break;
			case 4	: offset = -19;
				break;
			case 5 : offset = -8;
				break;
			case 6 : offset = -12;
				break;
			case 7 : offset = -21;
				break;
		}

		i = fromSq + BOARD_OFFSET + offset;
		CheckASquare( i , psuedoMoves,  counter, fromPiece);

	}

}

void	PieceMove2::GenerateKingMoves( short *psuedoMoves, short *counter,

	short fromSq, short fromPiece)
{	short i, j, offset;

	for( j=0; j< 8; j++)		{

		switch  ( j )	{
			case 0	: offset =-11;
				break;
			case 1	: offset =-10;
				break;
			case 2 : offset = -9;
				break;
			case 3 : offset = -1;
				break;
			case 4	: offset =		1;
				break;
```

```
                case 5  : offset = 9;
                          break;
                case 6  : offset = 10;
                          break;
                case 7  : offset = 11;
                          break;
            }

            i = fromSq + BOARD_OFFSET + offset;
            CheckASquare( i , psuedoMoves,  counter, fromPiece);

        }

}


void    PieceMove2::CheckASquare( short i ,short *psuedoMoves, short *counter,

short fromPiece)
{
        if( arrayOfPositions[i] == -9)

            ;
                                    /* out of bounds value - do nothing */
        else if( arrayOfPositions[i] == 0)
            psuedoMoves[(*counter)++] = i - BOARD_OFFSET;
        /* store empty square */
        else if((fromPiece > 0 && arrayOfPositions[i] < 0) | |
                    (fromPiece < 0 && arrayOfPositions[i] > 0) )
            psuedoMoves[(*counter)++] = i - BOARD_OFFSET;
        /* store square w/ captured piece

                                     otherwise square has your own piece so

                                     do nothing

                                    */


}

void    PieceMove2::FillArrayPositions( void )
{       short    i,j,k, m;
        PiecesInUse              *aPiecePtr;

        /********** first fill in arrayOfPositions *************/

        for( i = 0; i < 20; i++)        {                            /* se
left out of bounds squares */
                arrayOfPositions[ i ] = -9;
        }

        m = 0;
                /* counter for array of sq. ptrs */

        for( j= 0; j < 8; j++)          {
                arrayOfPositions[i++] = -9 ;
        /* set bottom out of bounds square */

                for( k = 0;  k < 8; k++)     {
        /* set actual squares and pieces   */

                        aPiecePtr =      gAGame->firstBoardPtr-
>arrayOfSqPtr[m++]->currentPiecePtr;

                        if( aPiecePtr == (PiecesInUse *) NULL )
                                arrayOfPositions[i++] =   0;
                        else {
                                arrayOfPositions[i++] = aPiecePtr->pieceNumt
                        }



                }

                arrayOfPositions[i++] = -9;
        /* set top out of bounds square */

        }

        for( i = 100; i < 120; i++) {                                /* se
right out of bounds squares */
                arrayOfPositions[ i ] = -9;
        }

}
```

```
void	PieceMove2::PromotePawn(	short pieceColor, Squares *toSquarePtr )
{
	int			dialogDone = FALSE;
	int				itemHit = QUEEN_RADIO;
	int				pieceSelection;
	short			kindPieceNum;
	KindsOfPieces *aKindPtr;
	PiecesInUse	*newPiecePtr, *storePiecePtr;
	Rect drawRect;

	enum piece_numbers {	WHITE_PAWN		= 1 ,
						BLACK_PAWN
	= -1,
						WHITE_KING
	= 7,
						BLACK_KING
	= -7,
						WHITE_HORSE
	= 2,
						BLACK_HORSE
	= -2,
						WHITE_BISHOP
	= 3,
						BLACK_BISHOP
	= -3,
						WHITE_CASTLE
	= 4,
						BLACK_CASTLE
	= -4,
						WHITE_QUEEN
	= 6,
						BLACK_QUEEN
	= -6	};


	/* init dialog manager */
	InitDialogs ( NIL_POINTER );

	/* initialize dialog */
	gDialogPtr = GetNewDialog( PAWN_DIALOG, NIL_POINTER, gAGame-
>itsWindow );
	/*gDialogPtr = GetNewDialog( PAWN_DIALOG, NIL_POINTER, (DialogPtr
*) NULL );*/

	/*GetNewDialog(short dialogID,void *dStorage,WindowPtr behind)*/

	/* default selected item to queen */
	GetNSetDialogItems( QUEEN_RADIO, 5 );


	/* show dialog */
	ShowWindow( gDialogPtr );

	while ( dialogDone == FALSE )	{

		/* save previouse selection 'cuz at end will always point to save
button */

		pieceSelection = itemHit;

		/*ModalDialog( NIL_POINTER, &itemHit );*/
		ModalDialog( (ModalFilterProcPtr *) NULL, &itemHit );

		switch ( itemHit )		{

			case QUEEN_RADIO:
				GetNSetDialogItems( QUEEN_RADIO, 5 );
				break;

			case ROOK_RADIO:
				GetNSetDialogItems( ROOK_RADIO, 5 );
				break;

			case BISHOP_RADIO:
				GetNSetDialogItems( BISHOP_RADIO, 5 );
				break;

			case KNIGHT_RADIO:
				GetNSetDialogItems( KNIGHT_RADIO, 5 );
				break;

			case SAVE_BUTTON:
				HideWindow( gDialogPtr );
				dialogDone = TRUE;
				break;

		}

	}
```

```
switch (pieceSelection )  {
        case QUEEN_RADIO:     if (pieceColor == WHITE)
kindPieceNum = WHITE_QUEEN;
                                                    else
                kindPieceNum = BLACK_QUEEN;
                                                    break;
        case ROOK_RADIO:      if (pieceColor == WHITE)
kindPieceNum = WHITE_CASTLE;
                                                    else
                kindPieceNum = BLACK_CASTLE;
                                                    break;
        case BISHOP_RADIO:    if (pieceColor == WHITE)
kindPieceNum = WHITE_BISHOP;
                                                    else
                kindPieceNum = BLACK_BISHOP;
                                                    break;
        case KNIGHT_RADIO:    if (pieceColor == WHITE)
kindPieceNum = WHITE_HORSE;
                                                    else
                kindPieceNum = BLACK_HORSE;
                                                    break;
}


/* done with dialog - got selection - now change pawn to new piece */

/* find correct kind ptr for kind of piece you want to add */
aKindPtr = gAGame->GetKindsOfPieces ( kindPieceNum    );


/* create a new PiecesInUse */
storePiecePtr = gAGame->firstPiecePtr;
newPiecePtr = new( PiecesInUse );
newPiecePtr->IPiecesInUse(       45,
/* height                 */
                                                          45,
                /* width          */
                                                          0,
                /*        aHEncl          */
                                                          0,
                /*        aVEncl          */
                                                 aKindPtr,
          /*  CBitMap       *aBitMap         */
                                                                pieceColor,
                              /* short  colorParm          */
                                                                      storePiecePtr
                         /* PiecesInUse    *nextPtrParm */
                                                                           );


      /* set ptr to beginning of linked list */
      gAGame->firstPiecePtr = newPiecePtr;

      /* now  place new piece in square  */
      toSquarePtr->currentPiecePtr = newPiecePtr;

      /* redraw square with new piece */
      toSquarePtr->Prepare();
      (void) LongToQDRect(&(toSquarePtr->frame), &drawRect);
      toSquarePtr->Draw( &drawRect );

      /* resume & update main window */
      /* gAGame->Activate( ); */
      /* gAGame->Activate( ); */
      /* SelectWindow( gAGame->itsWindow );
      /* gAGame->Activate( );*/
      DisposDialog( gDialogPtr );

}

/*****************************************************************************
 PieceInUse.h

                    Interface for the PieceInUse Class


*****************************************************************************

#pragma once                          /* Include this file only once */
#include <CObject.h>
#include <CBitMap.h>



class PiecesInUse : public CObject {                /* Class Declaration
                    */
```

```
public:

                                                        /** Instance
Variables **/

        char                                    kind[10];
        short                                   color;
        /* color of piece */
        struct PiecesInUse              *nextPiecePtr;  /* ptr to next
piece in linked list */
        Rect                                    frame;
        struct  KindsOfPieces       *itsKindPtr;
        Boolean                                 hasMoved;
        short                                   pieceNumber;    /*
number representation of kind of piece

                        1 - pawm

                        2 - horse

                        3 - bishop

                        4 - rook that has not moved

                        5 - rook that has moved

                        6 - queen

                        7 - king that has not moved

                        8 - king that has moved

            negatives indicate black pieces
                                        Negatives indicate black pieces

        */

                                                        /** Instance
Methods **/
                                                        /**
Contruction/Destruction **/
        void            IPiecesInUse(   short aWidth,
                                                                short aHeigh
                                                                short aHEnc
                                                                short aVEncl
                                                                struct
KindsOfPieces   *aKindPtrParm,
                                                                short
        colorParm,
                                                                PiecesInUse
        *nextPtrParm);

        void            Dispose(void);

                                                                /**
Accessing **/

        void            Draw( Rect *area );                     /* parm not u
*/


};

/*****************************************************************************
 PiecesInUse.c

                                                        The PiecesInUse Clas

        SUPERCLASS = CBitMapPane


*****************************************************************************

#include "PiecesInUse.h"
#include "KindsOfPieces.h"


/**** C O N S T R U C T I O N / D E S T R U C T I O N   M E T H O D S ****/

/*****************************************************************************
 IPiecesInUse

                Initialize a PiecesInUse object

*****************************************************************************
```

```
void	PiecesInUse::IPiecesInUse(
	short			aWidth,
	short			aHeight,
	short			aHEncl,
	short			aVEncl,
	KindsOfPieces	*aKindPtrParm,
	short			colorParm,
	PiecesInUse		*nextPtrParm)
{

	color = colorParm;
	nextPiecePtr = nextPtrParm;

	itsKindPtr = aKindPtrParm;


	this->pieceNumber = itsKindPtr->pieceNumber;


	frame.left = aHEncl;
	frame.top  = aVEncl;
	frame.right = frame.left + aWidth;
	frame.bottom = frame.top + aHeight;

	hasMoved = FALSE;

}

/******************************************************************************
 Dispose (OVERRIDE)

		Dispose of a PiecesInUse

******************************************************************************/

void	PiecesInUse::Dispose()
{

	delete( this );

}
```



```
/**** A C C E S S I N G   M E T H O D S ****/

void	PiecesInUse::Draw( Rect *area )
{
	itsKindPtr->Draw( area );

}

/****
 * Squares.h
 *
 *	Squares • •class for all squares on board
 *
 ****/

#pragma once			/* Include this file only once */
#include			<CPane.h>
#include			"PiecesInUse.h"
#include			"KindsOfSquares.h"

class Squares : public CPane {

	public:

	char			squareName[8];
	short			color;			/*
BLACK/WHITE */
	PiecesInUse		*currentPiecePtr;	/* current piece in sq
*/
	char			boardName[8];
	KindsOfSquares		*itsKindPtr;
	short			squareNumber;


									/**
Construction/Destruction **/

	void		ISquares(	CView			*anEnclosur
							CBureaucrat
	*aSupervisor,
							short
	aWidth,
							short
	aHeight,
```

```
                                        short
        aHEncl,
                                        short
        aVEncl,
                                        SizingOption
        aHSizing,
                                        SizingOption
        aVSizing,
                                        short
        squareNumParm,
                                        short
        colorParm,
                                        KindsOfSquares
*itsKindPtrParm,
                                        char
        *boardNameParm
                                        );


        void            Dispose( void );
        void            Draw(Rect *area);
        void            SetPiece( PiecesInUse  *piecePtrParm );


        void            DoClick( Point hitPt, short modifierKeys, long when);

};
/****
 * Squares.c
 *
 *      Squares • •class for squares of boards
 *
 ****/
#include            "Squares.h"
#include            "PiecesInUse.h"
#include            "KindsOfPieces.h"
#include            "PieceMove.h"
#include            <CView.h>
#include            "ChessNetDef.h"
#include            <string.h>
#include            <oops.h>
#include            <CWindow.h>
#include            "CChessNetDoc.h"
#include            "PieceMove2.h"
```



```
extern  Network                 *gAGame;        /* global ptr to A Game docum
*/


/***
 * Squares
 *
 *      This is your document's initialization method.
 *      If your document has its own instance variables, initialize
 *      them here.
 *      The least you need to do is invoke the default method.
 *
 ***/
void Squares::ISquares(  CView                  *anEnclosure,
                                                        CBureaucrat
        *aSupervisor,
                                                        short
        aWidth,
                                                        short
        aHeight,
                                                        short
        aHEncl,
                                                        short
        aVEncl,
                                                        SizingOption
        aHSizing,
                                                        SizingOption
        aVSizing,
                                                        short
        squareNumParm,
                                                        short
        colorParm,
                                                        KindsOfSquares
*itsKindPtrParm,
                                                        char
        *boardNameParm
                        )


{
                (void) CPane::IPane(    anEnclosure,
                                                                aSupervisor,
                                                                aWidth,
```

```
                                                            aHeight,
                                                            aHEncl,
                                                            aVEncl,
                                                            aHSizing,
                                                            aVSizing
        );


                this->color = colorParm;
                this->currentPiecePtr = NULL;
                (void) strcpy( this->boardName, boardNameParm);
                this->itsKindPtr = itsKindPtrParm;
                squareNumber = squareNumParm;

}


/***
 * Dispose
 *
 *      This is your  destruction method.
 *      If you allocated memory in your initialization method
 *      or opened temporary files, this is the place to release them.
 *
 *      Be sure to call the default method!
 *
 ***/

void Squares::Dispose()

{
        inherited::Dispose();
}


/***
 * Draw
 *
 *      Draw this square
 *
 ***/

void Squares::Draw(Rect *area)                              /* overridden
parm not used */
{
        /* draw square itself */
        itsKindPtr->Draw( area );

        /* draw piece if square contains a piece */
        if ( currentPiecePtr != NULL)       {
                currentPiecePtr->Draw( area );
        }

}


/***
 * SetPiece
 *
 *      set currentPiecePtr
 *
 ***/

void Squares::SetPiece( PiecesInUse *piecePtrParm )
{
        this->currentPiecePtr = piecePtrParm;

}

/***
 * DoClick
 *
 *      overrides DoClick in CView
 *
 ***/


void    Squares::DoClick( Point hitPt, short modifierKeys, long when)
{
        short                   i;
        LongRect                pInRect;
        PieceMove2              *pieceMovePtr;
        Squares                 *arraySqPtrParm[NUM_SQUARES_PER_MO
        PiecesInUse     *arrayPiecePtrParm[NUM_SQUARES_PER_MOVE];
        KindsOfPieces   *thisKindsOfPieces;
        LongPt  longHitPt;

        /* coerce itBitMap to KindsOfPieces ptr */
        if( !( currentPiecePtr == NULL ) )
```

```
		thisKindsOfPieces = currentPiecePtr->itsKindPtr;

	if( currentPiecePtr == NULL ||
		!( PtInRgn( hitPt, thisKindsOfPieces->maskRegion ) )		)
	{

		/* if square has no current piece or point is not in mask region */
		/* ---- DO NOTHING! ----- ignore mouse click */

	} else {		/**********try to move piece!**********/

		/* initialize arrays for square and pieces being moved */
		for( i = 0; i < NUM_SQUARES_PER_MOVE; i++)	{
			arraySqPtrParm[i]			= NULL;
			arrayPiecePtrParm[i]		= NULL;
		}

		/* create new PieceMove object */
		pieceMovePtr = new( PieceMove2 );

		/* pass square(s) & piece(s) being moved to new PieceMove */
		/* for MOVING FROM ONE SQUARE ONLY */
		arraySqPtrParm[0]			= this;
		arrayPiecePtrParm[0]		= currentPiecePtr;
		pieceMovePtr->IPieceMove2(	UNDO_MOVE_STR,

	arraySqPtrParm,

	arrayPiecePtrParm,
											1,
				/* array index */
											hitPt );

		/* send Track Mouse to window - it will send	BeginTracking

				KeepTracking

				EndTracking
			to PieceMove ( a CMouseTask )
		*/
```



```
			/* get interior size of window */
			(void) Prepare();				/* just added this */
			gAGame->itsWindow->GetInterior( &pInRect );
			(void) EnclToFrameR( &pInRect );
			/*gAGame->itsWindow->TrackMouse( pieceMovePtr, hitPt,
&pInRect );*/
			(void) QDToFrame( hitPt, &longHitPt);
			TrackMouse( pieceMovePtr, &longHitPt, &pInRect );


			/* tell supervisor of itsWindow that PieceMove task is complete
			gAGame->Notify( pieceMovePtr );


		} /* end if square has current piece and point is in mask region accept m
click*/

} /* end DoClick */


/*************************************************************************
 Switchboard2.h

		added to override DoHighLevelEvent

*************************************************************************

#pragma once				/* Include this file only once */
#include "CSwitchboard.h"

class Switchboard2 : public CSwitchboard {					/* Class
Declaration					*/

public:
										/** Instance
Variables **/

										/** Instance
Methods **/
		virtual void		ISwitchboard2(void);				/* Initializati
		*/
```

```
	virtual void		DoHighLevelEvent(const EventRecord* macEvent);
	/* Accept an AppleEvent */


};

/******************************************************************************
 Switchboard2.c

	used to implement recieving high level event from opponent


******************************************************************************/


#include "Switchboard2.h"
#include "Global.h"
#include "TBUtilities.h"
#include "CApplication.h"
#include "CDesktop.h"
#include "CBartender.h"
#include "CWindow.h"
#include "CSwitchboard.h"
#include "Commands.h"
#include "Constants.h"
#include "CAppleEvent.h"
#include "AppleEvents.h"
#include <stdlib.h>
#include "CChessNetDoc.h"		/* includes typedef short  NetworkData
[NUM_SQUARES-1]; */

extern	Network			*gAGame;	/* global ptr to A Game document
*/

/************************************************************************
 ISwitchboard

		Initialize a Switchboard object.

******************************************************************************/

void	Switchboard2::ISwitchboard2( void )
{

	CSwitchboard::ISwitchboard();
```



```
}

/******************************************************************************
 DoHighLevelEvent

	Handle a high level events. The TCL assumes all high level
	events are AppleEvents. If you use high level events that
	don't follow the Apple Event Interprocess Messaging Protocol you
	must override DoHighLevelEvent and handle those events yourself.
	Be sure to call inherited::DoHighLevelEvent so standard AppleEvents
	get handled.

******************************************************************************

void Switchboard2::DoHighLevelEvent ( const EventRecord *theEvent)
{
	OSErr	err;

	char *number ="0xGAME";
	char *extra;
	long result;

	TargetID *myTarget;
	unsigned long *myRefCon;
	Handle				dataHandle;
	unsigned long	dataLength = sizeof( NetworkData );

	dataHandle = NewHandle( sizeof( NetworkData) );

	/* convert string to long int - store in result - use for comparison */
	result = strtol( number, &extra, 0);


	if ( theEvent->message == result )		{

		(void) AcceptHighLevelEvent(myTarget,

	myRefCon,
											( ( P
&dataHandle ),

	&dataLength	);
		gAGame->ReceiveMove( ( NetworkData *) *dataHandle );

	} else	{
```

```
		CSwitchboard::DoHighLevelEvent(theEvent);
	}

	DisposHandle( dataHandle );

}

/*****
 * ChessNet.c
 *
 *	A ChessNet main file for writing programs with the
 *	THINK Class Library
 *
 * Copyright © 1990 Symantec Corporation.  All rights reserved.
 *
 *****/
#pragma once
#include "CChessNetApp.h"
/*#include "CChessNetDoc.h"*/
#include "ChessNetGlobalDecl.h"

extern	CApplication	*gApplication;

void main()

{
	gApplication = new(CChessNetApp);
	((CChessNetApp *)gApplication)->IChessNetApp();
	gApplication->Run();
	gApplication->Exit();
}

/*
 * Header for declarations used throughout ChessNet application
 *
 *
 ***/

#pragma once			/* Include this file only once */

#define WHITE			0
#define BLACK			1
#define NUM_SQUARES			64
```

```
#define TRUE				1
#define FALSE				0

#define UNDO_MOVE_STR			1
#define NUM_SQUARES_PER_MOVE	4

#define NUM_POSSIBLE_MOVES		100

#define BOARD_OFFSET			10

/* defines for Pawn Promotion dialog */
#define PAWN_DIALOG		400
#define NIL_POINTER		0L
#define QUEEN_RADIO		1
#define ROOK_RADIO		2
#define BISHOP_RADIO 3
#define KNIGHT_RADIO		4
#define SAVE_BUTTON		5
#define MOVE_TO_FRONT		-1L
#define ON				1
#define OFF				0


/*****
 * ChessNetGlobalDecl.h
 *
 *	Global variables Declared
 *
 *
 *****/
#pragma once			/* Include this file only once */
#include "CChessNetDoc.h"
/* CChessNetDoc			*gAGame; */	/* global ptr to A Game docum
*/

Network			*gAGame;	/* global ptr to A Game document */

DialogPtr			gDialogPtr; /* global dialog ptr */
```