



**DIGITAL LIBRARIES**  
Curriculum Development

# **Digital Library Curriculum Development**

JCDL 2006, University of North Carolina at Chapel Hill, NC

# Curriculum Development Project

- Collaborative Research launched by:
  - Department of Computer Science, Virginia Tech
  - School of Information and Library Science, University of North Carolina, Chapel Hill
- Three year (2006 - 2008) funded project

# Project Teams/NSF Grant

- Project Team at VT (IIS-0535057):
  - PI: Dr. Edward A. Fox (fox@vt.edu)
  - GRA: Seungwon Yang (seungwon@vt.edu)
- Project Team at UNC-CH (IIS-0535060):
  - Co-PI: Dr. Barbara Wildemuth (wildem@ils.unc.edu)
  - Co-PI: Dr. Jeffrey Pomerantz (pomerantz@unc.edu)
  - GRA: Sanghee Oh (shoh@email.unc.edu)

# Project links

- Homepage

<http://curric.dlib.vt.edu/DLcurric.html>

- Overview, proposal, progress diary, news & interviews, contact information

- Wiki

<http://curric.dlib.vt.edu/wiki>

- Resources will be added here

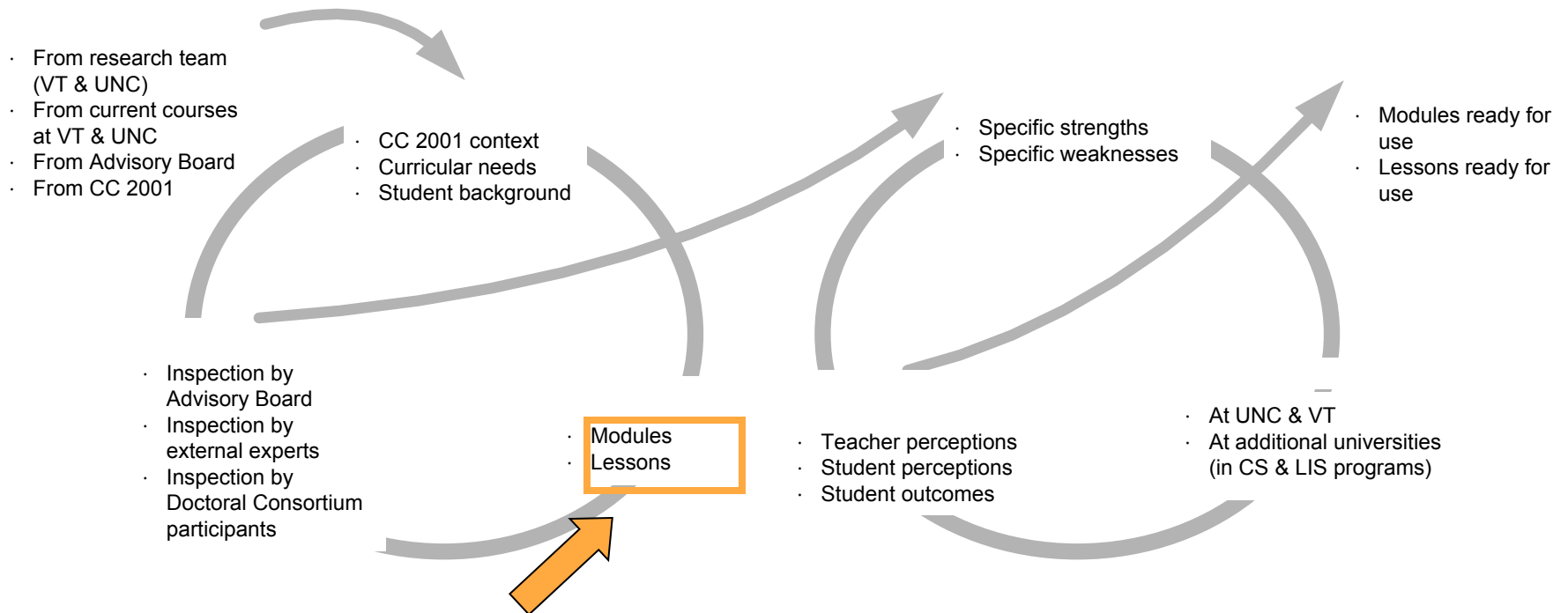
- Coming soon 😊

# News and Interviews

- WVTF Public Radio: Morning Edition,  
"Interview with Dr.Fox" [January 30, 2006]
- VT Collegiate Times article [January 26, 2006]
- UNC Gazette article [January 25, 2006]
- Virginia Tech Computer Science Department News  
article [January 23, 2006]
- Virginia Tech News article [January 20, 2006]

# Development / Evaluation Plan

## January 2006 – December 2008





# What we do:

- Identify, develop and test educational DL modules, guided by
  - **Experts** and **international collaborators**
  - Computing Curriculum 2001 [6, 7]
  - 5S framework [1,2,3,4]
    - (Ex) Module revision in 3/27/06
  - **Analysis of DL course syllabi**
    - (Ex) UNC-CH is collecting DL syllabi
      - VT collected syllabi from DELOS member institutions in Europe
  - **Development of module template**

# Experts / Advisory board members

**Table 3. Experts (all have agree to assist)**

Advisory Board	VT	UNC
<p>Dan Atkins, U. Michigan            Christine Borgman, UCLA            Lillian Cassel, Villanova            Michael Christel, CMU            Raya Fidel, U. Washington            Richard Furuta, Texas              A&amp;M University            Elizabeth Liddy, Syracuse              University            Clifford Lynch, CNI            Kurt Maly, ODU            Javed Mostafa, Indiana            Tefko Saracevic, Rutgers            Linda Smith, UIUC</p>	<p>Steven Edwards, CS            Roger Ehrich, CS            Weiguo Fan, ACIS            Steve Harrison, CS            Gail McMillan, Library            Chris North, CS            Manuel Pérez-Quiñónez,              CS            Naren Ramakrishnan, CS            Deborah Tatar, CS            Layne Watson, CS</p>	<p>Catherine Blake, SILS            Laura Gasaway, Law School            Jane Greenberg, SILS            Stephanie Haas, SILS            Brad Hemminger, SILS            Thomas James, Dean, School of              Education            Paul Jones, Director, ibiblio; SILS &amp;              School of Journalism &amp; Mass              Communication            Diane Kelly, SILS            Gary Marchionini, SILS            Montek Singh, CS            Natasha Smith, Library            Helen Tibbo, SILS            Steve Weiss, CS</p>

# Selected International Collaborators

- **India**

Dr. Arun Kumar Chakraborty

– Bose Institute, Kolkata, India

- **Brazil**

Dr. Ricardo da Silva Torres

– State University of Campinas (UNICAMP), SP, Brazil

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## CC2001 Information Management Areas

IM1. Information models and systems*	IM8. Distributed DBs
IM2. Database systems*	IM9. Physical DB design
IM3. Data modeling*	IM10. Data mining
IM4. Relational DBs	IM11. Information storage and retrieval
IM5. Database query languages	IM12. Hypertext and hypermedia
IM6. Relational DB design	IM13. Multimedia information & systems
IM7. Transaction processing	IM14. <b>Digital libraries</b>

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# 5S Framework

- Developed by Digital Library Research Laboratory (DLRL) at Virginia Tech
- Strong foundation for DL module development
- Captures entities and medium involved in DLs.
- The five S's
  - streams, structures, spaces, scenarios, societies

# 5S Framework

- “Streams”
  - All types of contents  
(as well as communications and flows over networks, or into sensors, or sense perceptions)
- “Structures”
  - Organizational schemes  
(including data structures, databases, and knowledge representations)

# 5S Framework

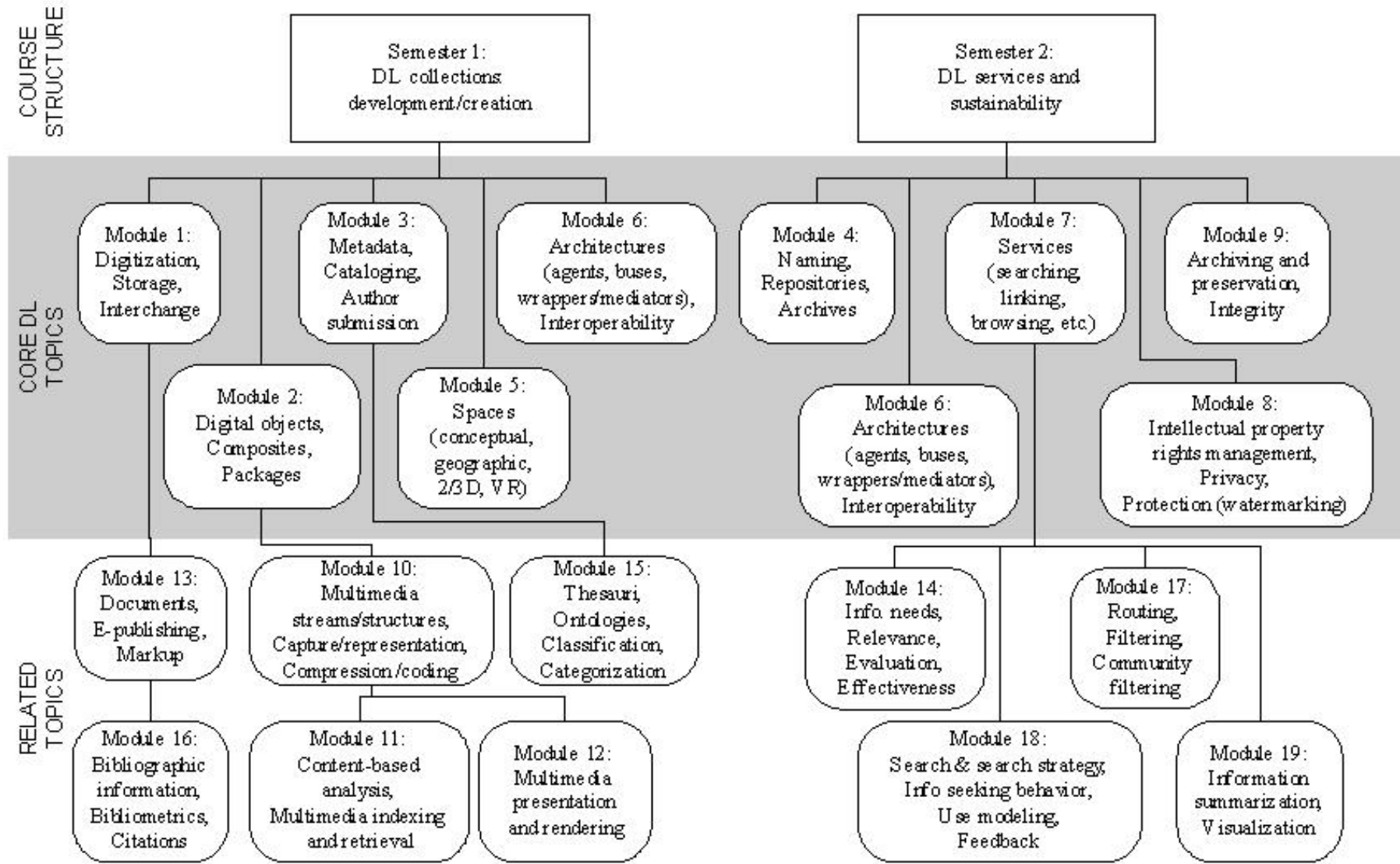


- “Spaces”
  - 2D and 3D interfaces, GIS data, representations of documents and queries.
- “Scenarios”
  - System states and events, but also can represent situations of use by human users (or machine processes, yielding services or transformations of data).
- “Societies”
  - Both software “service managers” and fairly generic “actors” who could be (collaborating) human (users).

# 5S Examples

<b>Table 7. The 5 Ss</b>		
<b>Ss</b>	<b>Examples</b>	<b>Formalization</b>
Streams	Text; video; audio; image	Sequence (list)
Structures	Collection; catalog; hypertext; document; metadata	Graph, Function, Relation
Spaces	Used in indexing, browsing, and searching services – as well as interfaces	Set (vector, topological, measurable, measure, probability spaces)
Scenarios	Searching, browsing, recommending	States, events, sequences (lists)
Societies	Service managers (software), Actors (learners, teachers, etc.)	Tuple (relating events and actions)

# DL Topics in 19 Modules (original)



# Module Revision in 3/27/06

Organized using 5S framework

## **STREAM**

### 1. Collection Development

- Digitization
- Document and E-publishing Markup
- Harvesting

### 2. Digital objects/Composites/Packages

- Text Resources
- Multimedia streams/structures, Captures/representation, Compression/coding
  - Content-based analysis, Multimedia indexing
  - Multimedia presentation rendering

## **STRUCTURE**

### 3. Metadata, Cataloging, Author submission

- Thesauri, Ontologies, Classification, Categorization
- Bibliographic information, Bibliometrics, Citations

### 4. Architecture (agents, buses, wrappers/mediators), Interoperability

# Module Revision 06/01/06

## **SPACE**

### 5. Spaces (conceptual, geographic, 2/3D, VR)

- Storage
- Repositories, Archives

## **SENARIOS**

### 6. Services (searching, linking, browsing, etc.)

- Info needs, Relevance, Evaluation, Effectiveness
- Search & search strategy, Info seeking behavior, User modeling, Feedback
- Routing, Filtering, Community filtering
- Sharing, Networking, Interchange\_
- Info summarization, Visualization

### 7. Archiving and preservation integrity (ILS)

## **SOCIETIES**

### 8. Intellectual property rights management, Privacy, Protection (watermarking) (ILS)

### 9. Social issues / Future DLs

# What we will do:

- Course Development (summer 2006)
  - 1-semester and 2-semester courses will be based on the developed modules
- Courses and modules will be...
  - Evaluated by experts
  - Pilot-tested in CS and LIS courses by the U.S. institutions and our international collaborators in India (Dr. Arun Kumar Chakraborty) and Brazil (Dr. Ricardo da Silva Torres).

# Dissemination Efforts

Conference	Type	Status
JCDL 06	Curriculum Development for Digital Libraries (paper)	Accepted
ETD Symposium 06	Digital Library Curriculum Development: Enhancing Education and Comprehension of NDLTD (paper)	Accepted
ICADL 06	Collaborative Research: Community-Oriented Curriculum Development for Digital Library Education (paper)	Planned

# Ascertaining Priority Topics

- We've manually classified and analyzed publications using 9-Modules(revised):

	Source	Count
Proceedings	JCDL '01 – '05	354
Proceedings	ACM DL '96 – '00	189
Magazine articles	D-Lib '95 – '06	521
Session titles	JCDL, ACM DL, ECDL	264

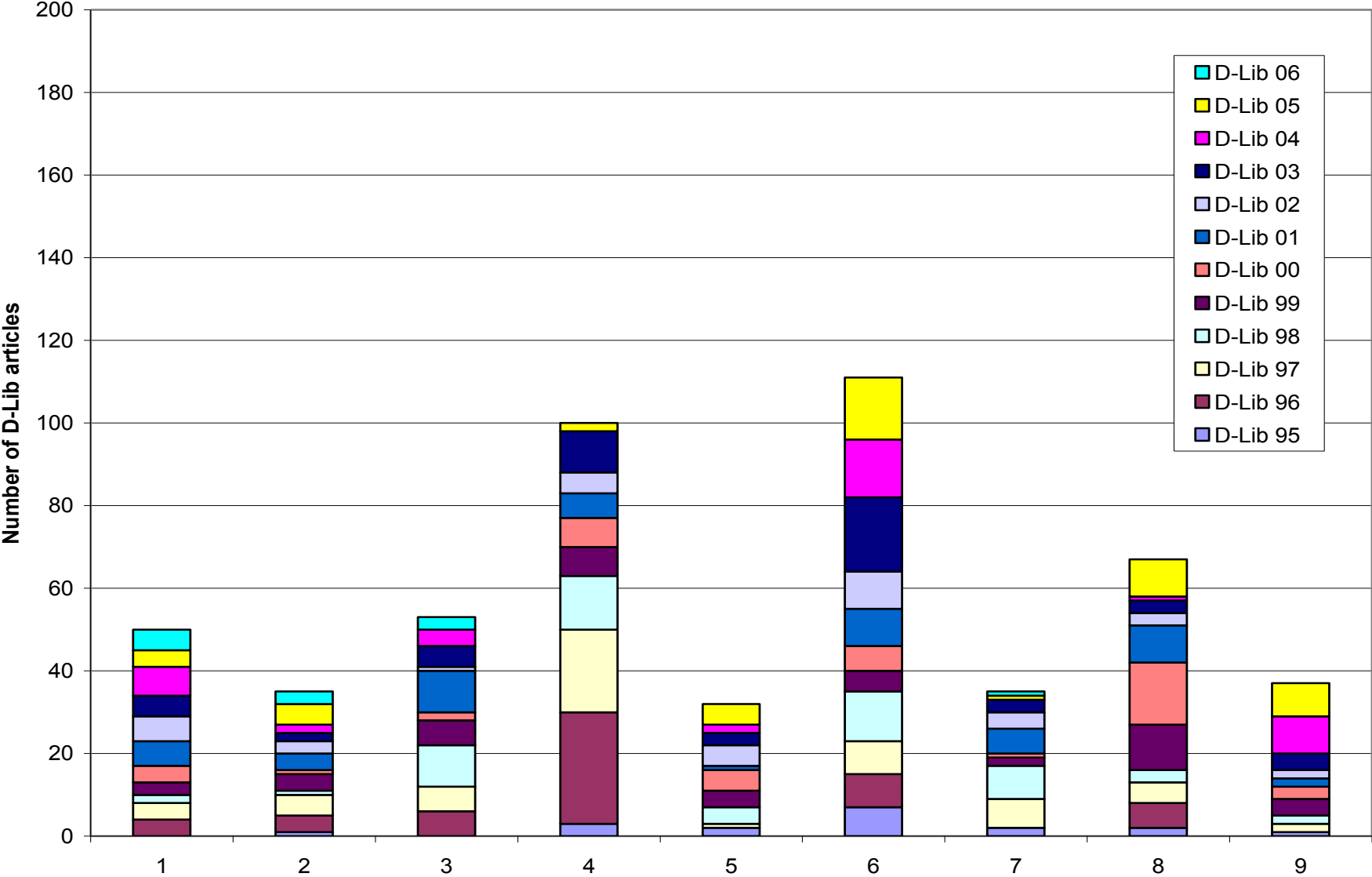


- Analysis Results:
  - Total of 543 proceedings:  
Most popular topics were  
architecture (module 4) and services (module 6)



# Distribution of D-Lib Magazine Articles

## across Module Topics



- Analysis Results:

- Total of 521 articles:

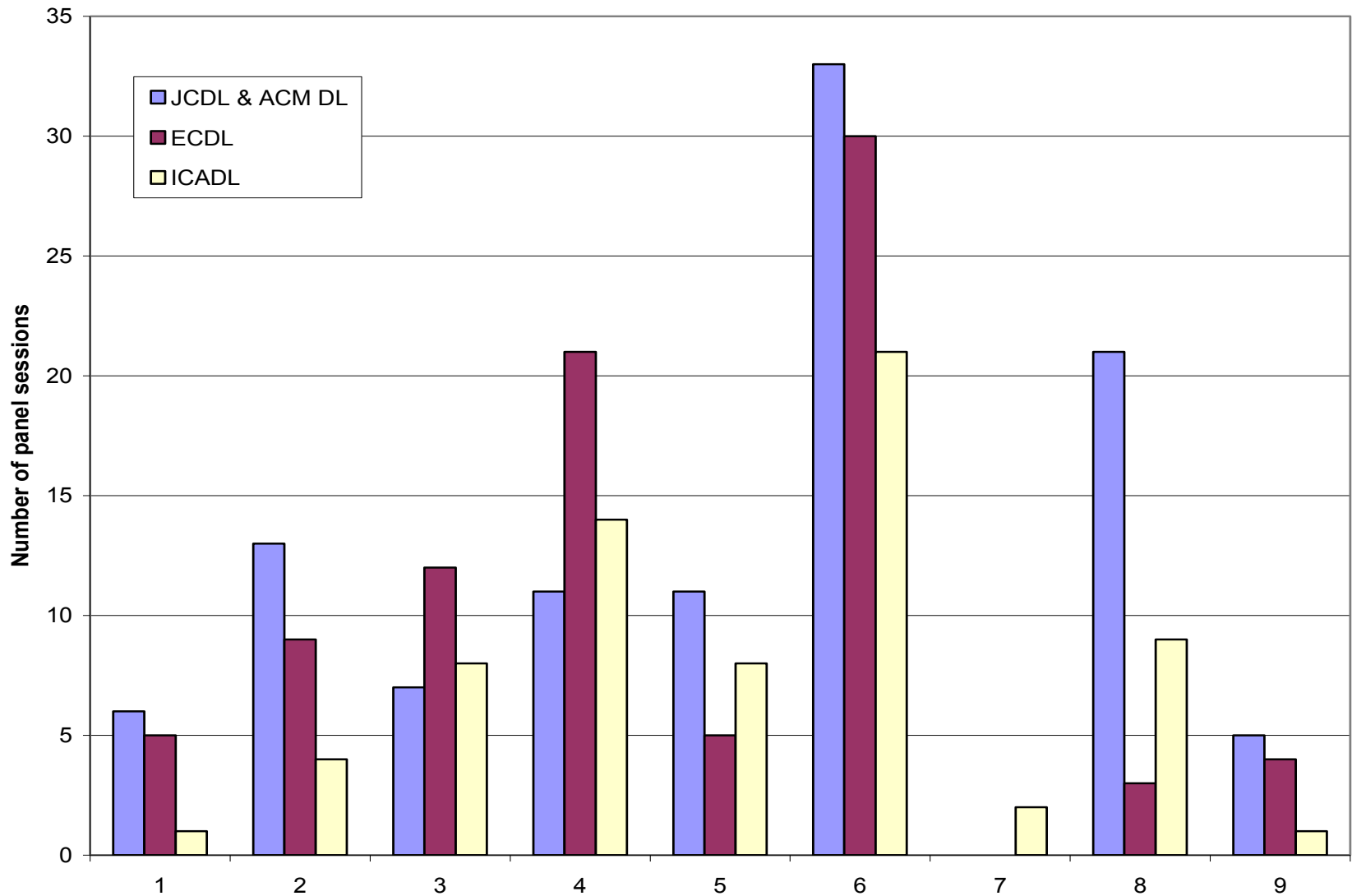
Most popular topics were

architecture (module 4), services (module 6)

and social issues (module 9)



# Distribution of **Session Titles** across Module Topics



- Analysis Results:

- Total of 264 session titles (JCDDL, ECDL, ICADL):

Most popular topic was **services** (module 6)  
followed by **architecture** (module 4)



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# Resource Analysis

- European DL course syllabi -

- DL-related course syllabi were collected from
  - DELOS member institutions in Austria, Czech Republic, United Kingdom, Switzerland, Norway, and Germany
- English resources (reference papers, textbooks, online demo) were retrieved from the syllabi and organized into tables.
- We will expand this effort to include courses in the U.S., Asia, and Oceania.

# Links to Resources

Excel files can be downloaded from the links below.

- Corpus Table Download Link

<http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCourseCorpusTable-v1.xls>

- Textbook Analysis Table Download Link

<http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCourseBookAnalysisTable-v1.xls>

- Reference Paper Analysis Table Download Link

<http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCoursePaperAnalysisTable-v1.xls>

- Online Documents and Tutorials Analysis Table Download Link

<http://curric.dlib.vt.edu/DLcurric/syllabiCollection/European/v1/EuropeanDLCourseOnlineDocTutorialsAnalysisTable-v1.xls>

# Selected Corpus Table

Country	University / Institution	Course Title	Books	Papers	Online
Austria	Institute for Information Systems and Computer Media - IICM	Multimedia Information Systems 2	0	0	59
		Information Visualisation	22	4	4
	Vienna University of Technology	Informationsvisualisierung	7	0	0
Czech Republic	Masaryk University of Brno	Informatics Colloquium	1	0	0
		Multimedia data indexing	1	0	0
Germany	Max-Planck-Institut für Informatik	Information Retrieval and Data Mining WS 2005/06	18	0	0
		Information Retrieval and Data Mining WS 2002/2003	6	0	0
	Universität Duisburg-Essen	Information Regrieval	3	0	1

# Selected Textbooks

<b>Count</b>	<b>Topic</b>	<b>Title</b>	<b>Author</b>
11	Information Retrieval	Modern Information Retrieval	Ricardo Baeza-Yates, Berthier Ribeiro-Neto
5	Information Retrieval	Information Retrieval	van Rijsbergen C.J.
5	Searching/cognition.	Finding Out About: Search Engine Technology from a cognitive Perspective	Richard, K. Belew
3	Information Retrieval	HySpirit - Integrating Information Retrieval and Database Technologies	Roelleke T., Lalmas M. and Luebeck R.
3	Information Retrieval	Introduction to modern information retrieval.	Chowdhury, G. G.
2	Classification	Pattern Classification	Richard O. Duda, Peter E. Hart, David G.Stork
2	Language Processing	Foundations of Statistical Natural Language Processing	Christopher D. Manning, Hinrich Schütze

# Selected Reference Papers

<b>Topic</b>	<b>Title</b>	<b>Author</b>
Database	Maintenance of Materialized Views: Problems, Techniques, and Applications	Ashish Gupta et al.
Digital Library	A Spectrum of Interoperability. The Site for Science Prototype for the NSDL.	William Y. Arms et al.
Digital Library	Automated Digital Libraries. How Effectively can Computers be used for the Skilled Tasks of Professional Librarianship?	William Y. Arms
Digital Library	Digital Libraries, value, and productivity.	Wiederhold, G.
Digital Library	Going Digital: A Look at Assumptions Underlying Digital Libraries	David M. Levy et al.
Digital Library	Harvard's Library Digital Initiative. Building a first Generation Digital Library Infrastructure.	Dale Flecker
Digital Library	The Next Stage: Moving from Isolated Digital Collections to Interoperable Digital Libraries.	Besser, Howard.

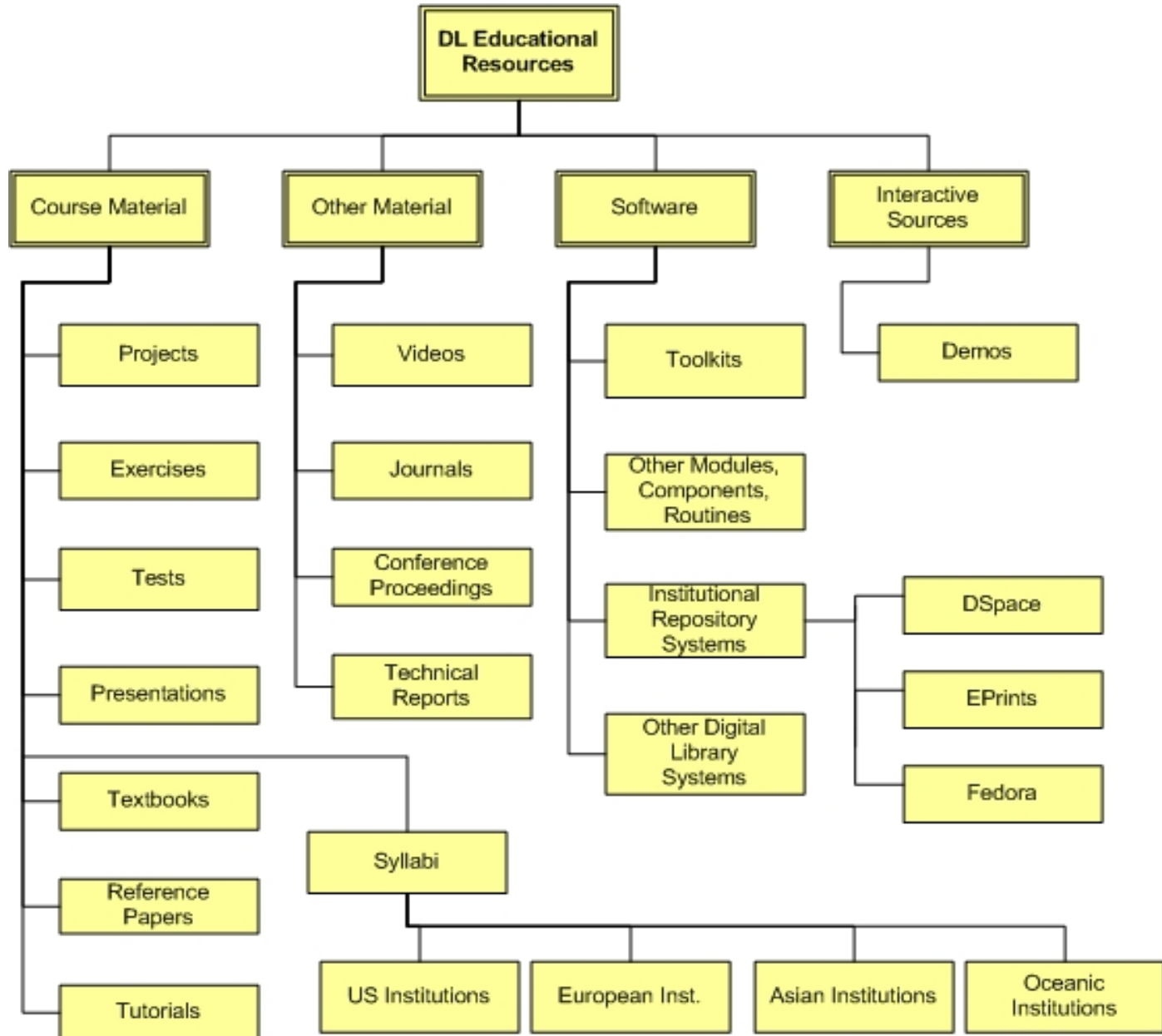
# Online Software, Demos, Tutorials

Topic	Title	URL
Application program	HyperCard	<a href="http://en.wikipedia.org/wiki/HyperCard">http://en.wikipedia.org/wiki/HyperCard</a>
	Visual knowledge builder	<a href="http://www.cdltamu.edu/VKB/vkb_download.html">http://www.cdltamu.edu/VKB/vkb_download.html</a>
Data access object	J2EE Patterns: Data Access Object	<a href="http://java.sun.com/blueprints/corej2eepatterns/Patterns/DataAccessObject.html">http://java.sun.com/blueprints/corej2eepatterns/Patterns/DataAccessObject.html</a>
Database	Agile Database Techniques	<a href="http://www.ambyssoft.com/agileDatabaseTechniques.html">http://www.ambyssoft.com/agileDatabaseTechniques.html</a>
	Datenbanken Artikel	<a href="http://onjava.com/topics/java/jdbc_sqlj">http://onjava.com/topics/java/jdbc_sqlj</a>
Hibernate	Get started with Hibernate	<a href="http://www.javaworld.com/javaworld/jw-10-2004/jw-1018-hibernate.html">http://www.javaworld.com/javaworld/jw-10-2004/jw-1018-hibernate.html</a>
	Hibernate Reference Manual	<a href="http://www.hibernate.org/hib_docs/v3/reference/en/html/">http://www.hibernate.org/hib_docs/v3/reference/en/html/</a>
	Hibernate Your Data	<a href="http://www.onjava.com/pub/a/onjava/2004/01/14/hibernate.html">http://www.onjava.com/pub/a/onjava/2004/01/14/hibernate.html</a>
	Struts Recipes: Hibernate and Struts	<a href="http://www.javaworld.com/javaworld/jw-01-2005/jw-0124-strutshibernate.html">http://www.javaworld.com/javaworld/jw-01-2005/jw-0124-strutshibernate.html</a>
html	A List Apart	<a href="http://www.alistapart.com/">http://www.alistapart.com/</a>

- Taxonomy Development:
  - By examining the syllabi and current DL courses, we developed a Taxonomy of DL Educational Resources



# Taxonomy of DL Educational Resources



# Textbook on DLs

- PI Fox, along with co-author Gonçalves, is preparing a textbook on DLs based on 5S
- This work will rely on the 5S framework to ensure that it provides integrated coverage of the many concepts related to DLs
- Fox and Gonçalves are focused on a book for teaching as well as reference

# Textbook Outline

- Ch. 1. Introduction (Motivation, Synopsis)
- Part 1 – The “Ss”
  - Ch. 2: Streams
  - Ch. 3: Structures
  - Ch. 4: Spaces
  - Ch. 5: Scenarios
  - Ch. 6: Societies

# Textbook Outline

- Part 2 – Higher DL Constructs
  - Ch. 7: Collections
  - Ch. 8: Catalogs
  - Ch. 9: Repositories and Archives
  - Ch. 10: Services
  - Ch. 11: Systems
  - Ch. 12: Case Studies

# Textbook Outline

- Part 3 – Advanced Topics
  - Ch. 13: Quality
  - Ch. 14: Integration
  - Ch. 15: How to build a digital library
  - Ch. 16: Research Challenges, Future Perspectives
- Appendix
  - A: Mathematical preliminaries
  - B: Formal Definitions: Ss
  - C: Formal Definitions: DL terms, Minimal DL
  - D: Formal Definitions: Archeological DL
  - E: Glossary of terms, mappings

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# Module Template

- Module Design is based on the resources below and the UNC's module template
1. Yue-Ling Wong, Jennifer Burg, and Leah McCoy, "Integrated Digital Media Curriculum Development Project" Supported by the National Science Foundation under Grant No. DUE-0340969, from Jan 2004 - Dec 2006. The project homepage URL is <http://digitalmedia.wfu.edu/project/digital-media-curriculum-development/textbased-index.html>
  2. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia" at <http://www.cs.sfu.ca/mmbook/>
  3. Multimedia Systems course website, Department of computer science at University of Victoria, British Columbia, Canada. URL: <http://www.csc.uvic.ca/courses/spring2004/csc/461-561.html>

# Module Template

- VT Template + UNC Template - June 2, 2006 (draft)
  1. Module name
  2. Learning objectives
  3. Level of effort required (in-class and out-of-class time required for students)
  4. Prerequisite knowledge required (completion optional)

# Module Template

5. Relationships with other modules

6. 5S characteristics of the module

7. Introductory remedial instruction

(completion optional: intended to address the prerequisite knowledge/skills required)

8. **Resources** (textbooks, required and optional readings for instructors and students)

→ **plan A**: all resources of the module are here

# Module Template

## 9. Body of knowledge (Theory + Practice)

Topics might be skipped or studied in different orders

### Topic 1

- Theories and background knowledge of the topic
- Learning activities
  - Chapters in the textbook / presentation slides
  - Interactive demo
- Resources → **plan B**: each topic has its resources
  - Reference papers (relevant parts might be marked with SI tool)
  - Advanced reading
  - Worksheets

### Topic 2

....

### Topic 3

....

# Module Template

10. Concept map (created by students)
11. Exercises / Learning activities
12. Evaluation of learning outcomes
13. Glossary
14. Useful links

# Digital Media Material

-From Wake Forest Univ.-

- Homepage:

<http://digitalmedia.wfu.edu/project/digital-media-curriculum-development/textbased-index.html>

## **Call for Applications for Pilot-testing Site**

If the digital media curriculum material at this site meets your needs and you would like to use it in your courses, please consider participating in pilot-testing. Click [here](#) to find out more about pilot-testing the material and apply online.

**Primer:** [expand all](#) | [collapse all](#)

- ◆ Chapter 1. Background
- ◆ Chapter 2. Fundamentals of Digital Imaging
- ◆ Chapter 3. Capturing and Editing Digital Images
- ◆ Chapter 4. Fundamentals of Digital Audio
- ◆ Chapter 5. Capturing and Editing Digital Audio
- ◆ Chapter 6. Fundamentals of Digital Video
- ◆ Chapter 7. Digital Video Production and Post-Production
- ◆ Chapter 8. Interactive Multimedia Authoring

**CS Module:** [expand all](#) | [collapse all](#)

- ◆ Chapter 1. Digital Data Representation and Communication
- ◆ Chapter 2. Digital Image Representation
- ◆ Chapter 3. Digital Image Processing
- ◆ Chapter 4. Digital Audio Representation
- ◆ Chapter 5. Digital Audio Processing
- ◆ Chapter 6. Digital Video Representation
- ◆ Chapter 7. Digital Video Processing
- ◆ Chapter 8. Multimedia Programming

# Topic Expanded

Digital Media Curriculum Materials - Listed by Modules and Chapters - Mozilla Firefox

파일 (F) 편집 (E) 보기 (V) 바로 가기 (G) 북마크 (B) 도구 (T) 도움말 (H)

← → ↺ × 🏠  열기

🔴 파이어폭스 시작하기 📰 최신 모질라 뉴스

**CS Module:** [expand all](#) | [collapse all](#)

- ◆ Chapter 1. Digital Data Representation and Communication
- ◆ Chapter 2. Digital Image Representation
- ◆ Chapter 3. Digital Image Processing
- ◆ Chapter 4. Digital Audio Representation
- ◆ Chapter 5. Digital Audio Processing
  - ◇  **Chapter 5 Digital Audio Processing** (text) posted 08-16-2005
  - ◇  **File Size and Data Transfer Rate** (worksheet) posted 02-20-2005
  - ◇ Audio Dithering
    - **Interactive** posted 02-20-2005
    - **Mathematical Modeling** (worksheet) posted 02-20-2005
  - ◇ Noise Shaping
    - **Mathematical Modeling** (worksheet) posted 08-16-2005
  - ◇ Non-Linear Companding and mu-Law Encoding
    - **Interactive** posted 02-20-2005
    - **Mathematical Modeling** (worksheet) posted 02-20-2005
    - **Implementing mu-Law Encoding** (programming worksheet) (worksheet) posted 11-04-2005
  - ◇  **Audio Processing: Adobe Audition** (worksheet) posted 02-20-2005
- ◆ Chapter 6. Digital Video Representation
- ◆ Chapter 7. Digital Video Processing
- ◆ Chapter 8. Multimedia Programming

# Summary

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# Discussion

## 1. Are identified modules reasonable?

(e.g., creation of a module for DL evaluation, case studies, and other DL application)

## 2. Is the draft module template too complicated?

## 3. How to prepare resources?

- Use of publicly-available materials (e.g., Digital Media materials from Wake Forest University)

## 4. How to make the flow between modules natural in a course?

# References

- [1] M. Gonçalves, E. Fox, L. Watson, and N. Kipp, “Streams, Structures, Spaces, Scenarios, Societies (5S): A Formal Model for Digital Libraries,” *ACM Transactions on Information Systems*, vol. 22, pp. 270-312, 2004.
- [2] M. A. Gonçalves, “Streams, Structures, Spaces, Scenarios, and Societies (5S): A Formal Digital Library Framework and Its Applications,” *Computer Science Doctoral Dissertation*. Blacksburg, VA: Virginia Tech, 2004, 161 pages. <http://scholar.lib.vt.edu/theses/available/etd-12052004-135923/unrestricted/MarcosDissertation.pdf>
- [3] M. A. Gonçalves and E. A. Fox, “5SL - A Language for Declarative Specification and Generation of Digital Libraries,” in *Proc. JCDL'2002, Second ACM / IEEE-CS Joint Conference on Digital Libraries*, July 14-18, G. Marchionini, Ed. Portland, Oregon, USA: ACM, 2002, pp. 263-272.

# References

- [4] Q. Zhu, “5SGraph: A Modeling Tool for Digital Libraries,” Department of Computer Science MS thesis. Blacksburg: Virginia Tech, 2002. <http://scholar.lib.vt.edu/theses/available/etd-11272002-21053>
- [5] NDLTD, Networked Digital Library of Theses and Dissertations. available at <http://www.ndltd.org>, 2006
- [6] CC2001, “Computing Curricula 2001: Computer Science (IEEE Computer Society and Association for Computing Machinery Joint Task Force on Computing Curricula),” Journal on Educational Resources in Computing (JERIC), vol. 1, 2001. <http://doi.acm.org/10.1145/384274.384275>
- [7] CC2001, “Computing Curricula 2001 (Web Site),” vol. 2004: ACM and IEEE-CS, 2001. <http://www.computer.org/education/cc2001>

**Thank you!**

# Extras