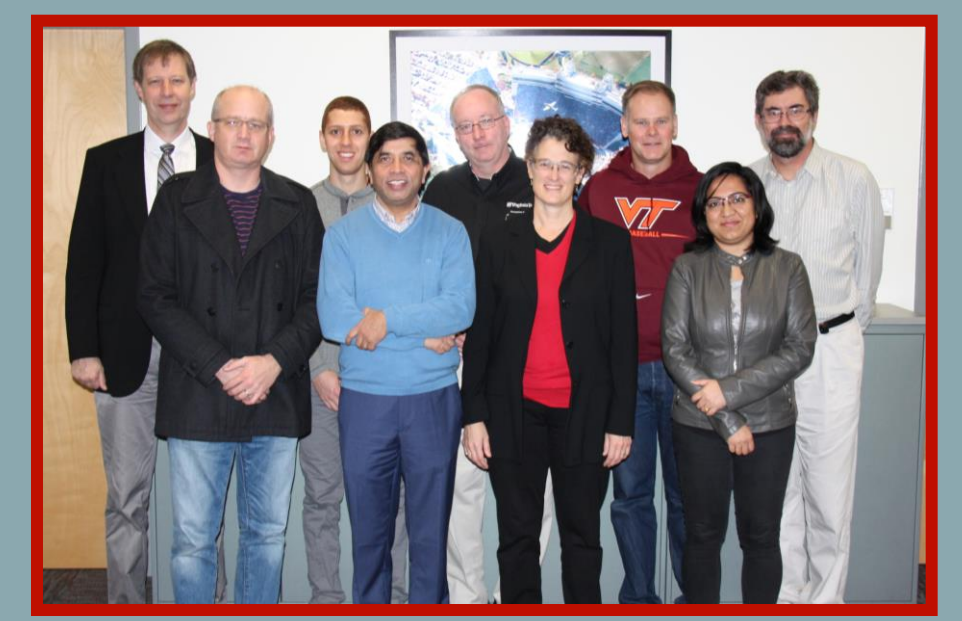


# Development and Analysis of a Spiral Theory-based Cybersecurity Curriculum

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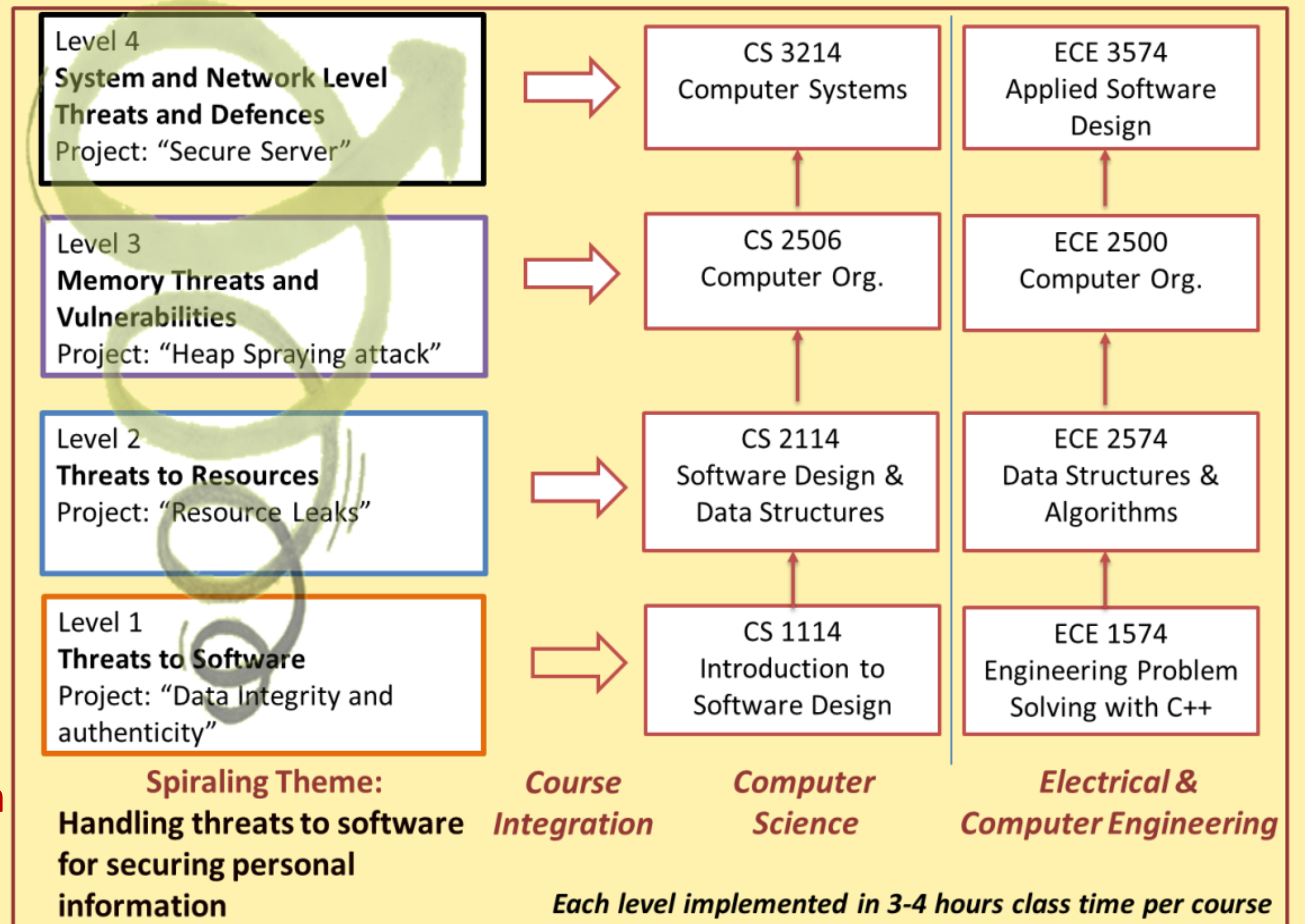
**Goal:** Enhance cybersecurity learning experiences of students at Virginia Tech's large engineering program

## Objectives:

- Development and implementation of a unique curriculum delivery model in cybersecurity into Computer Science and Computer Engineering curricula using Jerome Bruner's spiral curriculum theory
- Engineering education research to evaluate students' learning experiences

## Scientific Impact:

- Research findings regarding how students learn and get motivated about cybersecurity concepts
- Curriculum development/ implementation experiences to infuse cybersecurity into a large engineering program



## Development and pilot implementation of learning level-1 (L1) completed during Fall 2016

### Learning Objective of L1 :

- LO1:** Define cybersecurity principles: integrity and authenticity
- LO2:** Define and explain an adversary model
- LO3:** Describe potential security threats from non-validated input
- LO4:** Explain the purpose of ensuring the integrity and authenticity of data in real-world scenario
- LO5:** Apply the process of ensuring data integrity and authenticity through authentic problem solving

### Implementation in CS1114 with 423 students

#### Lecture topics:

- The Cyber security CIA/AAA goals (Confidentiality, Integrity, Availability / Authenticity, Anonymity, Assurance) was stressed
- The Adversary/Threat model assumptions and attack vectors was covered
- The Diffie-Hellman public-key cryptography algorithm was explained and demonstrated to students
- Concept of Digital Signatures was introduced
- One-way hashing, as used in digital signing, and its differences from encryption was presented
- The processes of Digital Signature generation and verification was covered

#### Authentic Activity:

Students coded a Java program to perform verification upon records in file that were Digitally Signed generating a report

Students' Perceptions on Motivational Constructs	Strongly Agree (%)	Agree (%)	Somewhat agree (%)
the cybersecurity initiative was <i>useful</i> to his/her future	20.10	39.03	25.10
the instructional method and cybersecurity initiative were <i>interesting or enjoyable</i>	15.39	36.45	26.00

## Research Questions:

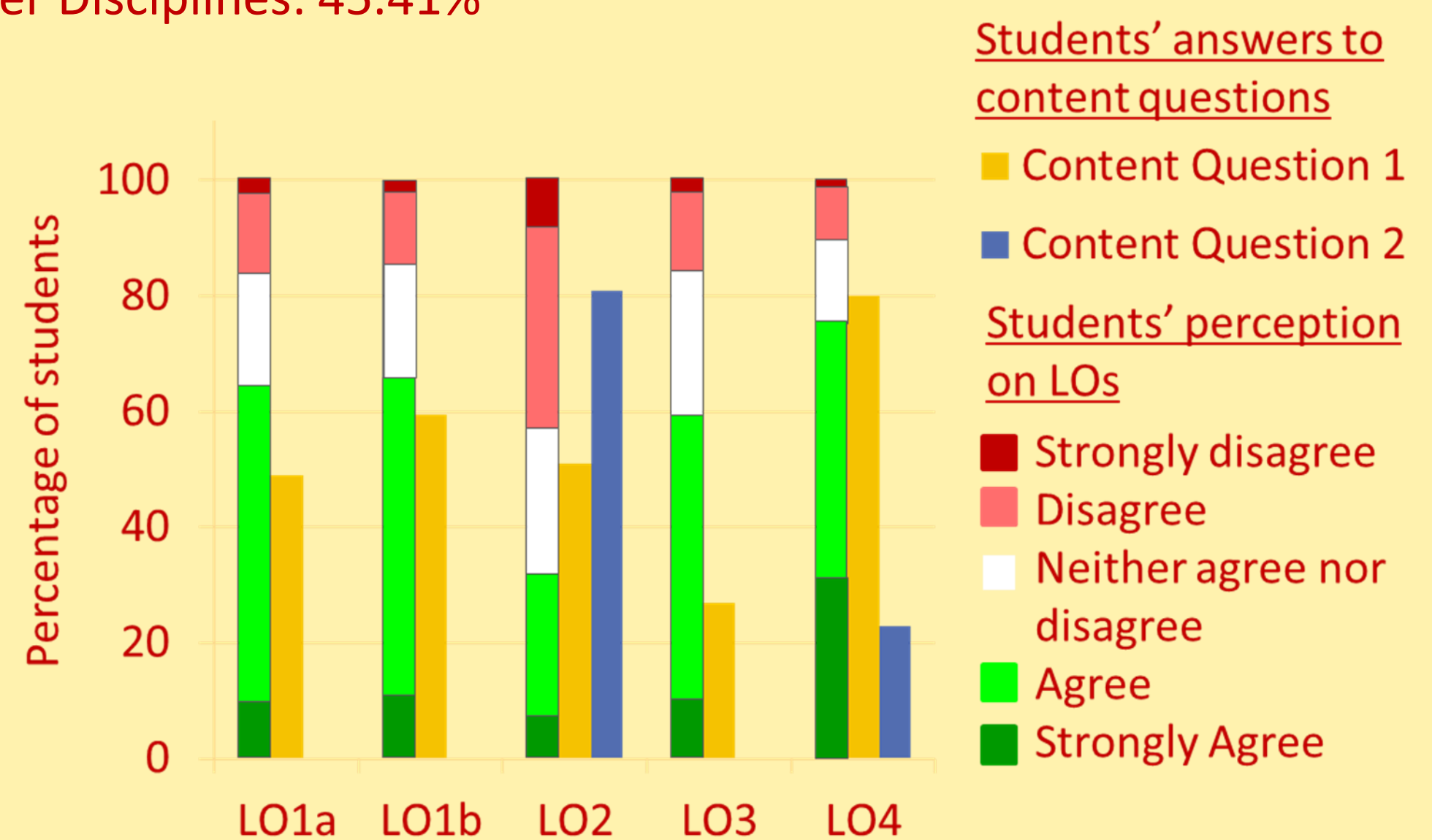
1. How effective are the spiral theory-based learning levels in enhancing students' core- knowledge and skills in cybersecurity?
2. How does students' motivation vary across gender, ethnic backgrounds, academic levels, and disciplines when participating in the cybersecurity learning levels?

## Broader Impact:

- Enhance recruitment of informed undergraduates into the CyberCorps and VT-Scholarship for Service program at VT
- Increase the number of graduates who accept employment in the cybersecurity field or pursue graduate studies in cybersecurity
- Develop an education theory based curriculum model for cybersecurity

### Post-Survey Results (n=199 out of 600+ students)

Computer Science: 25%; Computer Eng.: 11.22%; General Eng.: 18.37%; Other Disciplines: 45.41%



Interested in meeting the PIs? Attach post-it note below!

