



# Crafting a Foundation for Computing Majors

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- Introduction
- Motivation
- Course Design
- Benchmarking
- Course Execution
- Results
- Challenges with Languages
- Conclusion & Future Research



- The United States Military Academy (USMA) graduates students in 4 years
- Curriculum changed in 2016-17 to allow greater disciplinary depth
- Students now select major in Spring of freshman year (previously Fall of sophomore year)



- Novice Computer Science (CS) and Information Technology (IT) students often did not understand the difference between programs
- Computing (CS and IT) students take introductory programming course (CY300) and survey course of CS and IT (CY355)
- Allows movement of students between programs
- CY355 also introduces upper-level topics to foster interest in future electives



Topic	Number of Lessons
Intellectual Property	1
Digitization	6
Exponential Growth	1
Relational Database	5
NoSQL Database	2
Introduction to Machine Learning	1
Human-Computer Interaction	1
Web Site Development	6
Web Application Development	5
Networking Basics	4
Cyber Security	3
Introduction to Encryption	1
Ethical & Legal Considerations	1



## CS Core Tier 1 & Tier 2 Topics Covered

Graphics and Visualization/Fundamental Concepts

Human-Computer Interactions/Foundations

Information Assurance and Security/Foundational Concepts

Information Assurance and Security/Threats & Attacks

Information Assurance and Security/Cryptography

Information Management/Database Systems

Networking and Communication/Introduction

Networking and Communication/Networked Applications

Social Issues and Professional Practice/Intellectual Property

Social Issues and Professional Practice/Civil Liberties



## IT Essential Domains Covered Covered

Cybersecurity Principles/Cryptography Overview

Information Management/Database Query Languages

Networking/Foundations of Networking

User Experience Design/Perspectives and Impact

Global Professional Practice/Ethical, Legal, and Privacy Issues

Global Professional Practice/Intellectual Property

Web and Mobile Systems/Technology



- Technologies Taught/Introduced:
  - SQL (MySQL)
  - No-SQL (MongoDB)
  - HTML/CSS
  - JavaScript
  - Meteor (JavaScript Framework)





- 28 institutions (including USMA) offer both CS and IT ABET accredited Bachelors Degrees
- 15 of those institutions offer common courses:
  - Programming (7)
  - Data Structures (4)
  - Intro to Computer Science (4)
- Breadth of topics in CY355 is novel



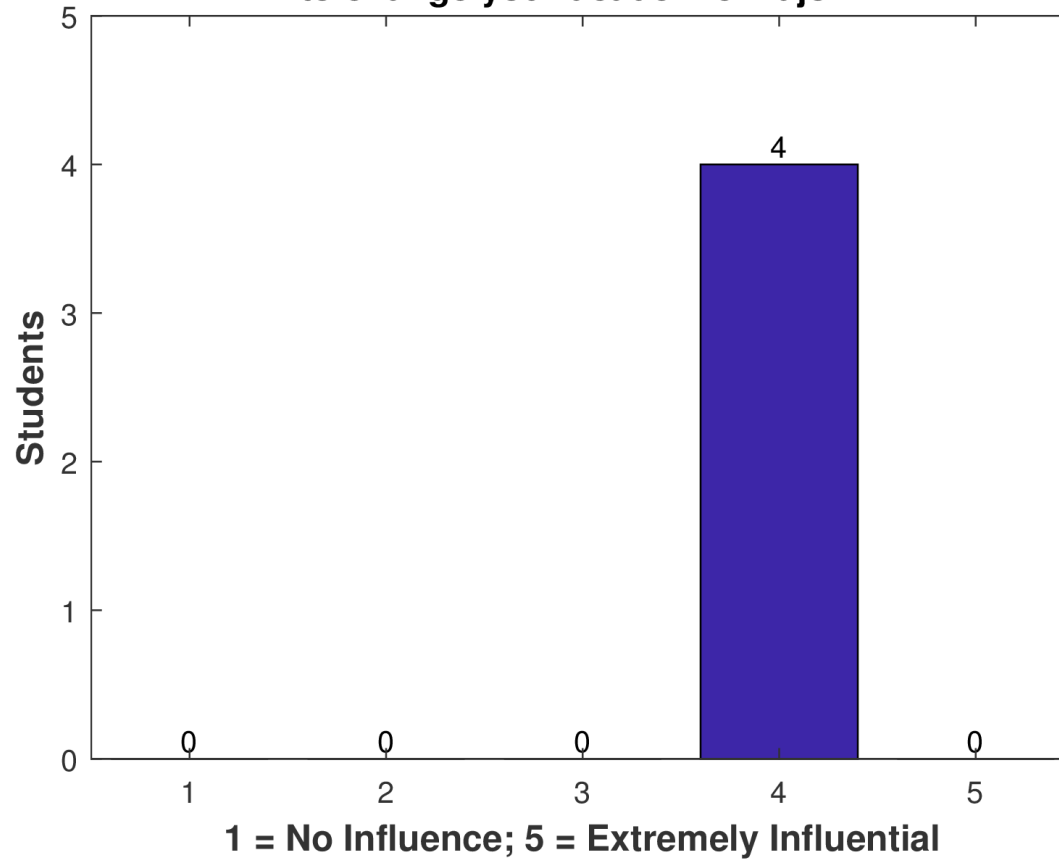
- Inaugural Course offered in Fall 2016
  - 70 students (67 CS or IT majors taking CY300 concurrently)
- Assessments:
  - Database Project (MySQL)
  - Web Application Project (MongoDB, HTML, CSS, JavaScript, Meteor)
  - In Class Examinations (All)



- After Course Survey:
  - 29/67 students (43.2%) responded
  - 28 respondents started as CS majors; 1 respondent started as an IT major
  - 4 respondents changed their major during the course
  - 5 respondents changed one or more computing electives during the course (4 indicated that CY355 was influential on decision; 1 indicated minimal influence)

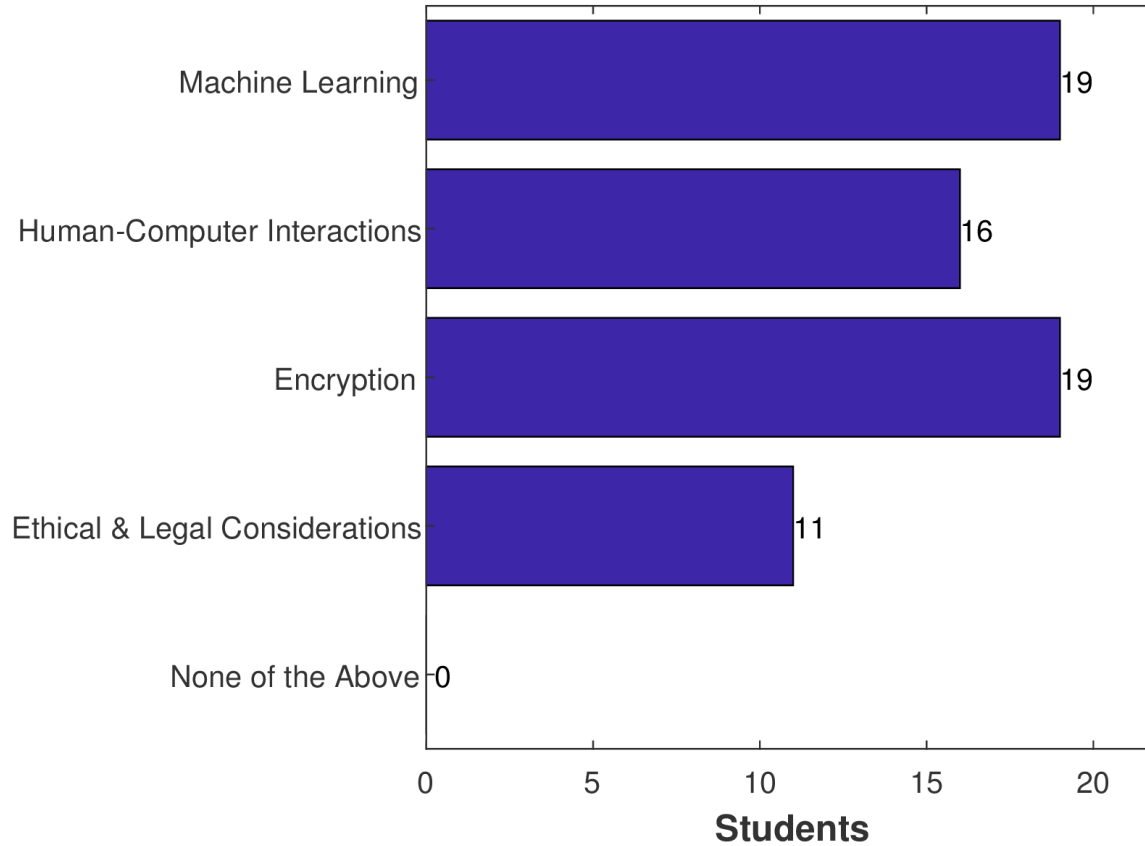


**What influence did CY355 have on your decision to change your academic major?**



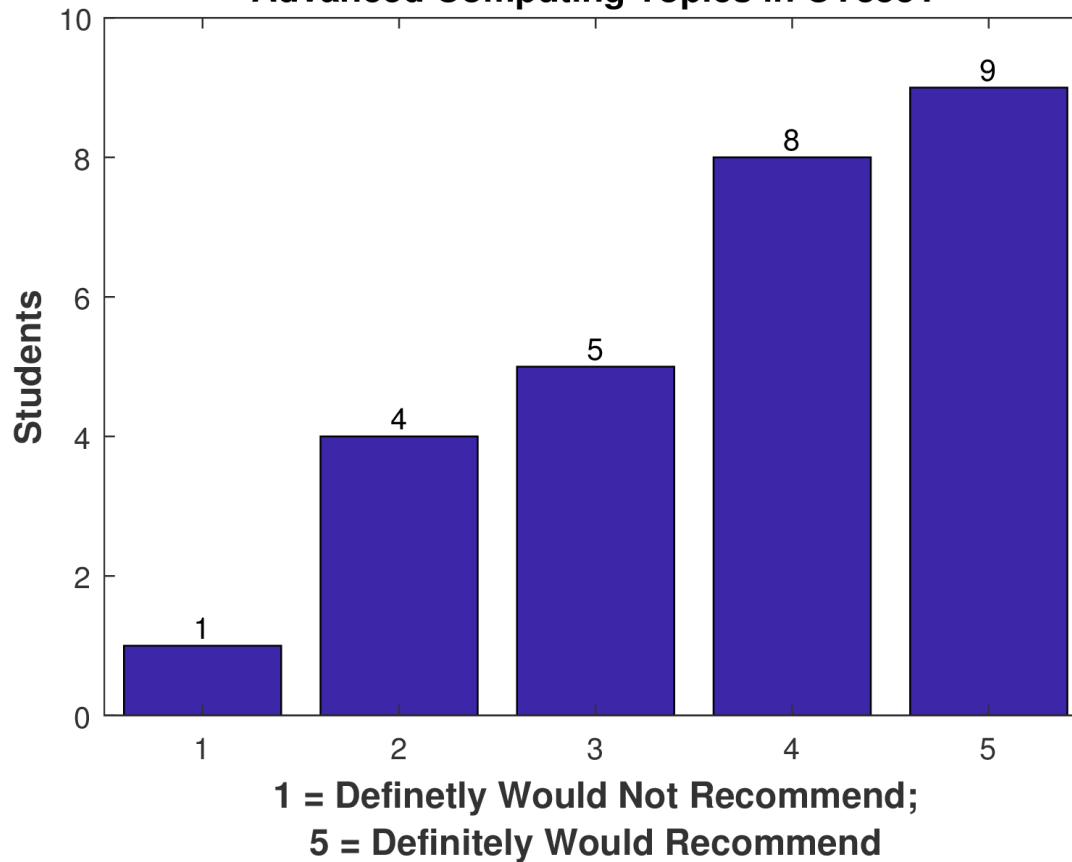


### Which advanced computing topic(s) did you find interesting?





## How Much Would You Recommend Introducing Advanced Computing Topics in CY355?

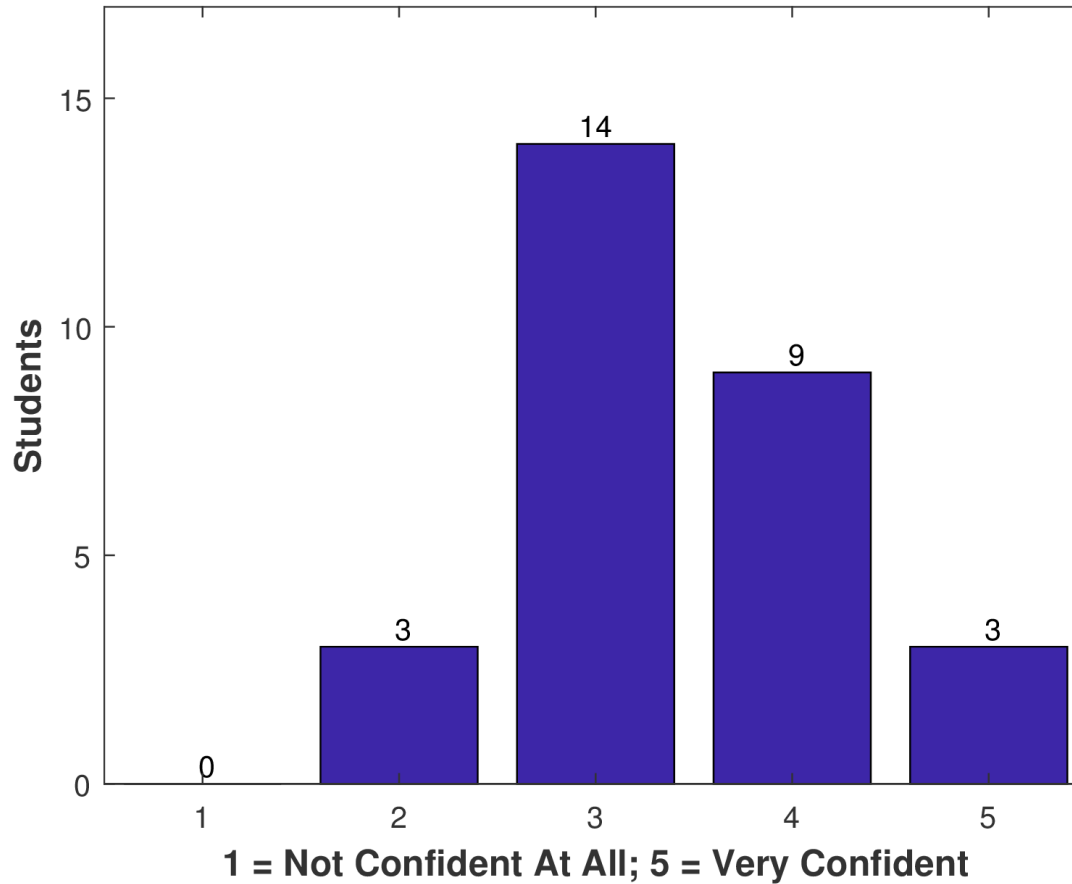




- Breadth of technologies/languages introduced was difficult
- Students Felt Confident with:
  - SQL
  - HTML & CSS
- Students Felt Less Confident with:
  - MongoDB
  - JavaScript & Meteor



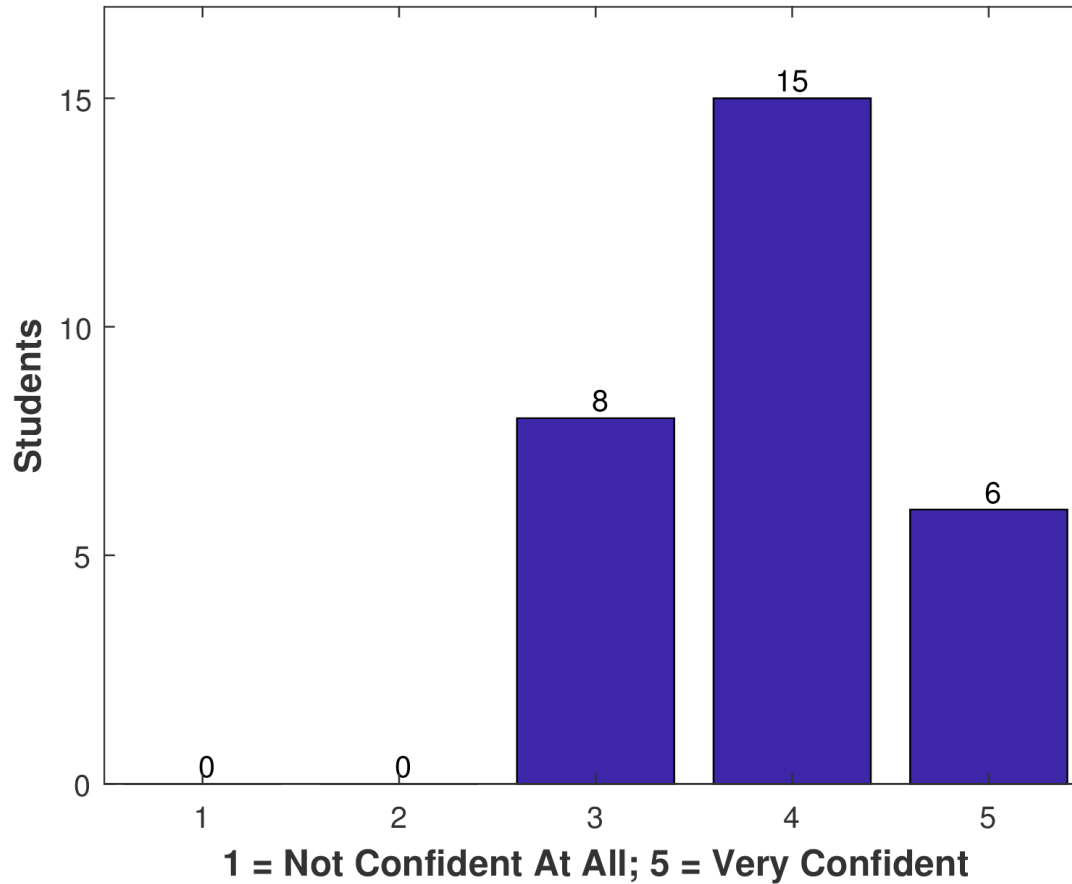
**How confident are you in your ability to write SQL?**





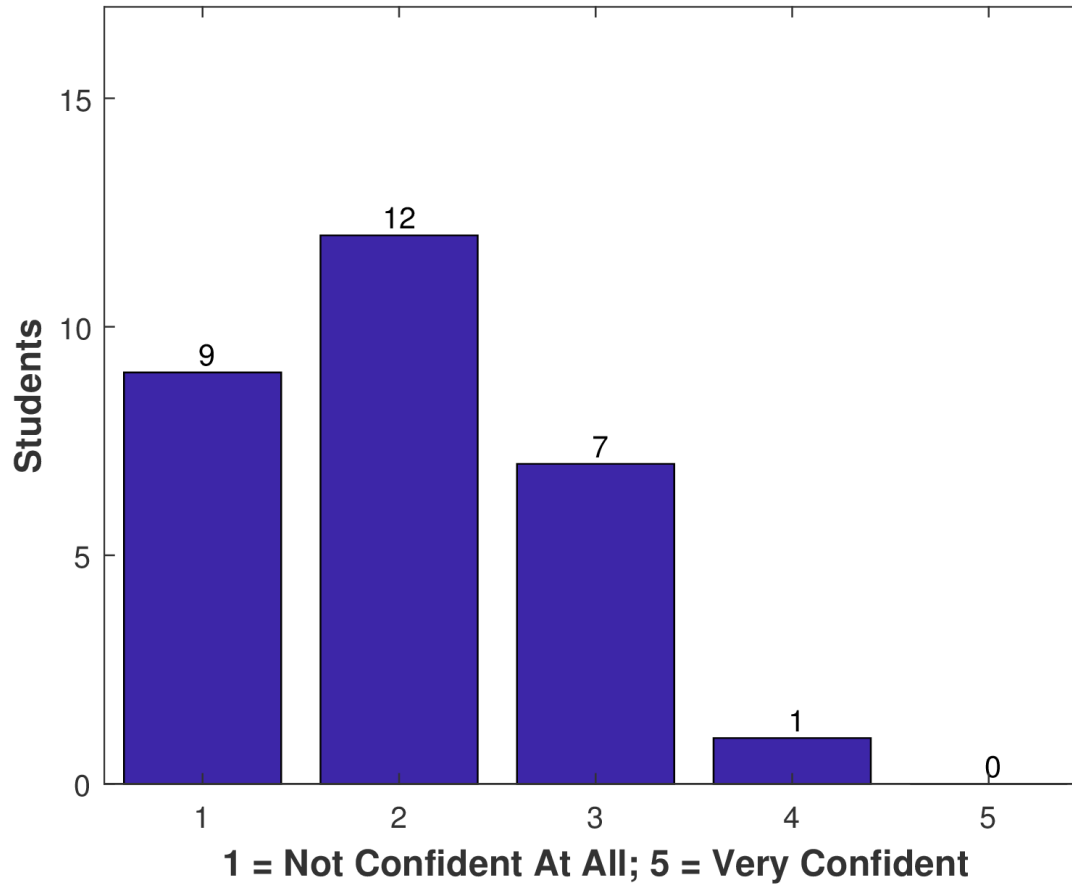


**How confident are you in your ability to write HTML/CSS?**





**How confident are you in your ability to write Meteor code?**





- **Positive Feedback:**
  - CY355, in conjunction with CY300, confirmed students choice of computing decision or informed their decision to change major
  - Introduced advanced topics that students may want to later pursue



- **Future Improvements:**
  - Training for most difficult component, Meteor
  - Smoother transition from static HTML/CSS pages to dynamic JavaScript pages
  - Use of Virtual Machines to eliminate student requirement to install various programming tools, environments, and libraries on personal computers



# Questions?