An Experiential-Based Computer Technology Curriculum

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Introduction

- Program History
- Problems with a “Traditional” Model
- Program Revision Goals
- Features of a Polytechnic Education
- Program Revision Calendar
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Program History

- K-State Polytechnic has had an A.S. degree in Computer Science since 1967.
- An A.S. in Web Development Technology and a B.S. in Computer Systems Technology were added later.
- All use “hands-on” learning, in keeping with the philosophy of our technology college.
- All follow a “traditional” curriculum model of courses organized around discrete content areas.
- Sophomore and senior capstone courses are meant to tie everything together.

Problems with a “Traditional” Model

- Content separated into discrete “content” courses.
  - Course focuses on proficiency in that one topic.
  - Students don’t adequately connect the topics in different classes.
  - Students aren’t adequately exposed to the full spectrum of working in the field.
- Students don’t retain information for subsequent classes.
  - Especially problematic in the final capstone course.

Program Revision Goals

- Address the problems identified above.
- Increase the rigor of the programs.
- Retain desirable features of the current programs:
  - Good alignment with 2-year computing degrees at Kansas community colleges.
  - Around 97% job placement rate.
- Adopt a “polytechnic” approach in keeping with college and department strategic goals.
- Facilitate academic assessment activities.

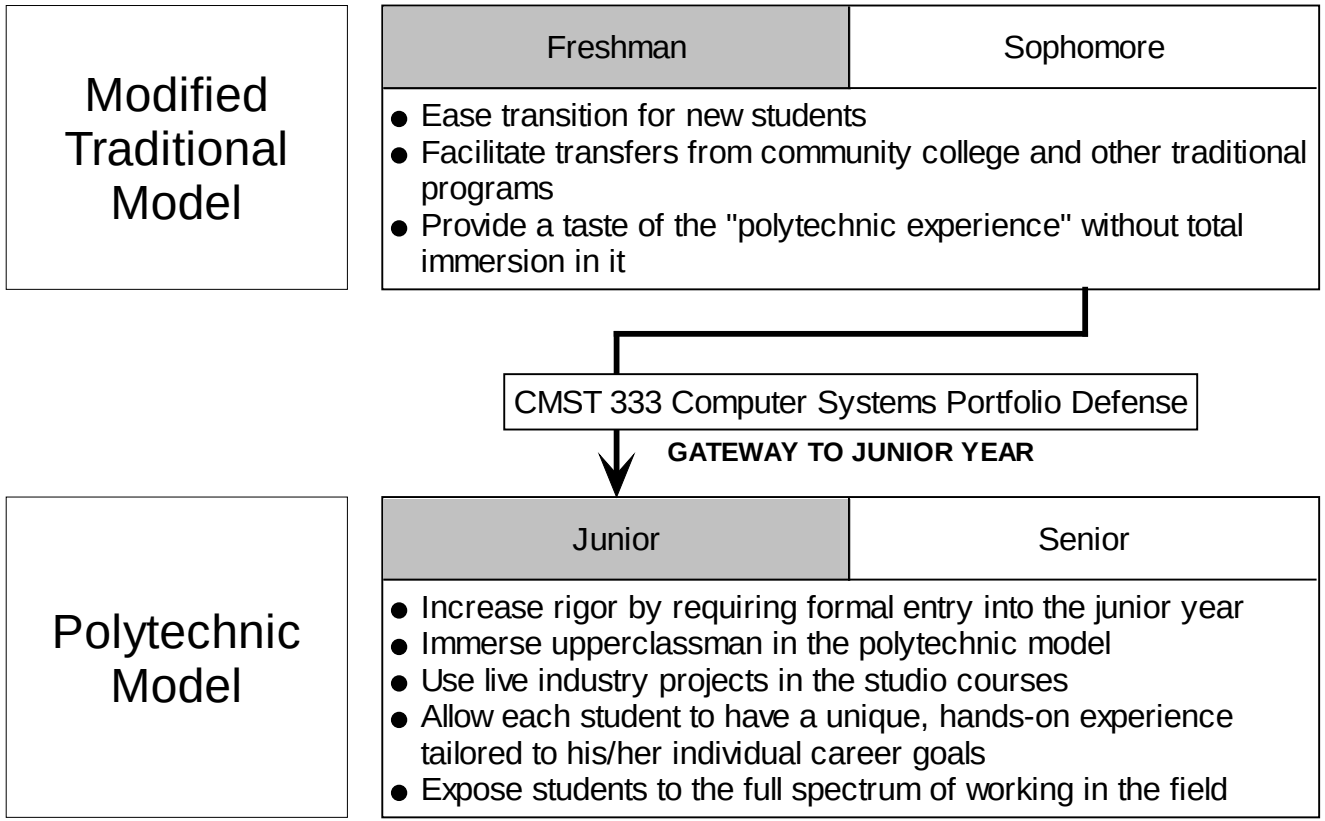
Features of a Polytechnic Education

- Emphasizes practice-based learning.
- Incorporates projects with industry partners into the curriculum.
- Promotes attainment of important career skills including written/oral communication, problem solving, teamwork, life-long learning and ethical behavior.
- Encourages creativity.
- Allows for successful learning through failure.

Program Revision Calendar

- A revised curriculum became effective Fall, 2016.
  - Revisions were developed with the advice of our industry advisory committee.
  - The committee proposing revision included non-computer faculty in addition to the computer faculty.
- Spring, 2017, completes its freshman year.
  - The committee overseeing the program includes business, communications and math faculty in addition to the computer faculty.

The Revised Program



The Underclass Program (freshman & sophomore years)

Modified Traditional Model

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Underclass SLOs and Skills

Freshman		Sophomore	
Graduates will be able to set up a web server, create a web-site on the server that supports modern e-commerce and act as both developer and administrator of the site.			
FALL	SPRING	FALL	SPRING
Client-side web page construction	Networks and Client-side web page programming	Database and Server-side web page programming	System/network administration and capstone project

Modified Traditional Features

- Kept the traditional model of courses organized around a single content area.
- Added a 1-credit studio course to each of the first three semesters.
- Added a requirement that the students build a portfolio.

Underclass Courses

Freshman Fall	Sophomore Fall
CMST 103 Computing Principles **CMST 135 Web Fundamentals** **CMST 183 Computer Systems Studio I** **MATH 100 College Algebra** **EDCEP 111 University Experience** **ENGL 100 Expository Writing**	**DIGME 137 Fundamentals of Visual Literacy** **CMST 180 Introduction to Database Systems** **CMST 283 Computer Systems Studio III** **CMST 335 Programming II** **COMM 106 Public Speaking I** **Humanities/social science elective**
Freshman Spring	**Sophomore Spring**
CMST 185 Computer Systems Studio II **CMST 247 Programming I** **CMST 250 Hardware & Network Fundamentals** **MATH 150 Plane Trigonometry** **PHILO 105 Introduction to Critical Thinking** **Business elective**	**CMST 252 System & Software Fundamentals** **CMST 315 Introduction to System Admin** **CMST 332 Web Development Project** **CMST 333 Computer Systems Portfolio Defense** **ENGL 302 Technical Writing** **Science elective**

Content course
1-Credit Studio course
3-Credit Capstone course
General Ed course

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1-Credit Studio Course

- Primary student learning objective is for the students to apply what they are learning in the content courses to the completion of a project.
- Helps students to “connect the dots” – i.e. see how the topics in the content courses relate.
- Requires students to revisit topics learned in previous semesters.
- Allows instructors to work with students having individual needs.

CMST 103
Computing Principles

SLO
Use an event-driven construct to interact with a user

CMST 135
Web Fundamentals

SLO
Create and format a web page using HTML and CSS

ENGL 100
Expository Writing I

SLO
Produce focused papers that have a consistent purpose and significance

CMST 103 Computing Principles
CMST 135 Web Fundamentals
CMST 183 Computer Systems Studio I
MATH 100 College Algebra
EDCEP 111 University Experience
ENGL 100 Expository Writing

CMST 183
Freshman Studio I

- Build a web site about the game pong
- Use HTML5, CSS3 and responsive design
- Articles must describe the history and workings of the game
- Include the ability for the user to play pong

Example use of a studio to integrate content within the modified traditional model

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Underclass Portfolios

- Contains a student's projects and his/her reflections on what was learned in completing them.
- Student reflection enhances learning.
- Students begin building their portfolios in their first semester.
- Portfolios are used for longitudinal program assessment.

Underclass Portfolio Defense

- 0-credit class that students must pass to move on to the junior year.
- Provides the opportunity for faculty to assess the readiness of students to be successful in the class polytechnic curriculum.

Upperclass Program (junior & senior years)

Polytechnic Model

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Upperclass SLOs and Skills

Junior		Senior	
Graduates will be able to design, develop and administrate a commercial-quality software system that includes database interaction, cyber security and a multi-user interface.			
FALL	SPRING	FALL	SPRING
Data structures and advanced programming	Systems and database administration	Emerging technologies	Project management

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Polytechnic Program Features

- Most content courses replaced by 6-credit studio courses.
- Each studio includes content taught to all students.
- Each studio course allows students to pursue additional content of individual interest.
- All content is taught in the context of completing a project.

Upperclass Courses

Junior Fall	Senior Fall
CMST 383 Prgrmng and Data Struct Studio MATH 205 General Calculus and Linear Algebra ENGL 200 Expository Writing II Humanities/social science elective	**CMST 460 Software Engineering** **CMST 483 Emerging Technologies Studio** PHILO 390 Business Ethics Unrestricted elective
Junior Spring	**Senior Spring**
CMST 385 Systems and Database Admin Studio STAT 325 Introduction to Statistics Business elective Unrestricted elective	**CMST 485 Comp Sys Senior Capstone Project** Humanities/social science/business elective Science elective

Content course
6-Credit Studio course
6-credit Capstone course
General Ed course

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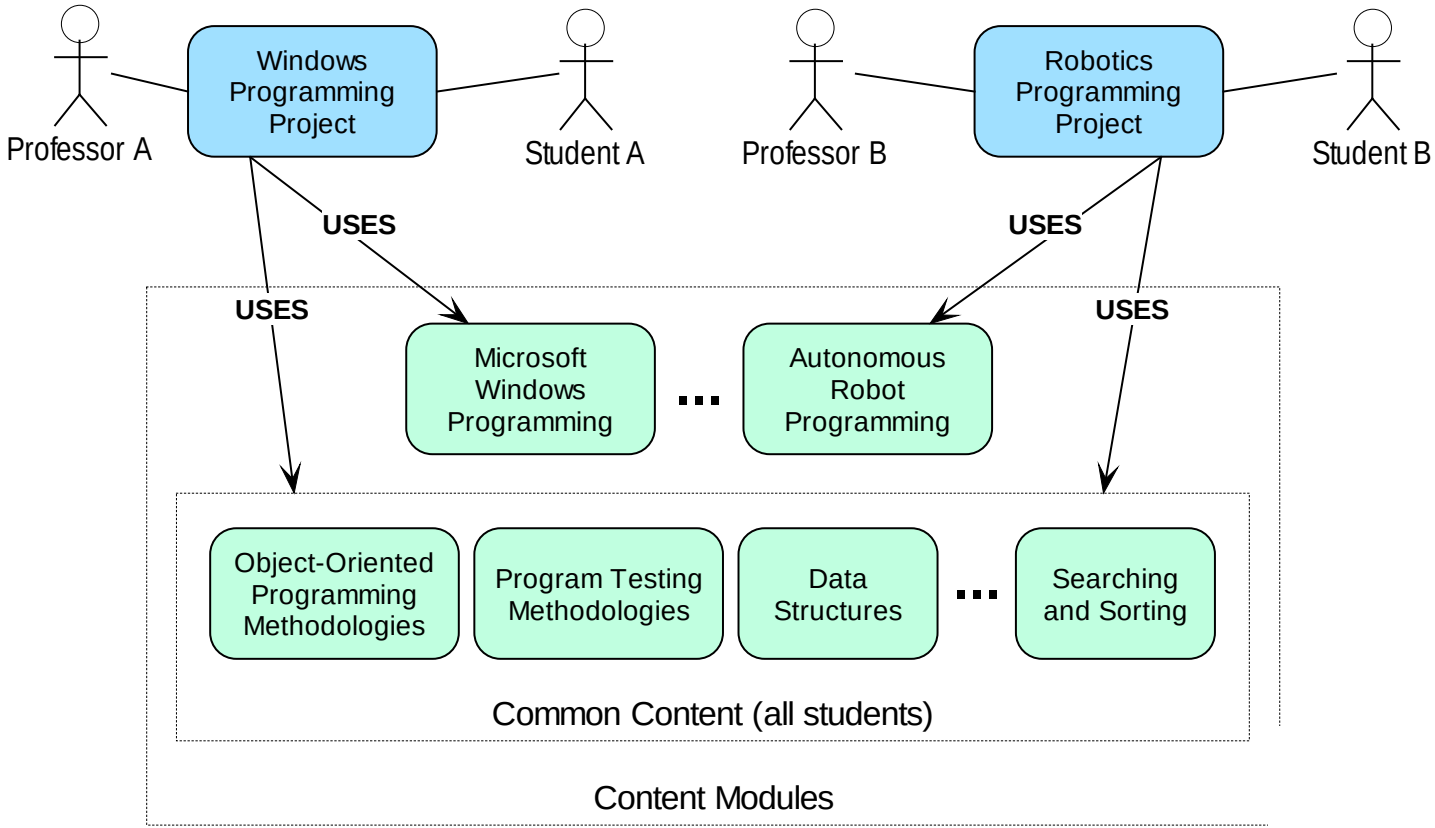
Example use of a studio to integrate content within the polytechnic model



6-Credit Studio Advantages

- Team teaching increases content flexibility and allows instructors to model teamwork.
- Allows students to pursue individual interests.
- Allow team members with different interests to work on different aspects of the same project.
- Allow students to focus on current, relevant and/or emerging technologies.
- Reinforces the concept of life-long learning.

Upperclass Portfolios

- Students can use their portfolios to demonstrate their skills to potential employers.
- Portfolios are used for final academic outcomes program assessment.

Observations of the First Year

First Freshman Cohort Complete

- First Semester Studio Project
  - **Build a responsive design web site;** combined content from:
    - Web Fundamentals: HTML, CSS, design elements
    - Computing Principles: Programming dynamic content
    - Expository Writing I: Written content
  - **Written reflection** about the project and process
  - **An oral presentation of the project**

- Second Semester Studio Project
  - **Web-based project using web sockets to create a network game**; combined content from:
    - Programming I: JavaScript programming
    - Network Fundamentals: network communications

Unforeseen Assessment Benefits

- Student weaknesses discovered during assessment of the fall semester projects were able to be addressed during the spring semester studio course.
- The current cohort of students can make up important concepts needed in later courses.
- Program improvement isn’t held up – only benefiting future cohorts.

Other Unforeseen Benefits

- Freshman studios allowed the development of a student cohort.
- Exposed students to project management from the first semester.
- Students exposed to teamwork from the second semester.
- Provided a “gentle introduction” to the polytechnic method.

Student Comments

in the studio class we pulled ideas from all three of the CMST courses that each of us were in

in the studio, we were able to go into more depth on how to make a website accessible to those with disabilities, and generally easier to use for everyone

what I liked best about the studio is when we were actually doing things

Challenges of Studio Courses

- Satisfying administration's idea of standard faculty work loads in the context of **team taught** 1-credit and 6-credit courses.
- Tracking and delivery of content modules within the 6-credit studio courses.
- Assigning grades in a studio course that is such an amalgam of common and individual work.
- Requiring faculty members to work effectively as a team and demonstrate such to the students.

Questions? Comments?

Two Processes of Curriculum Development

- Business Process = how do you develop a curriculum that will attain your business goals?
- Academic Process = how do you develop a curriculum that will attain your academic goals?

The Business Process

1. State the problem clearly.
2. Determine the mission and vision:

Mission = who are we?

Vision = who will we be in the future?

3. Research solutions.
4. Identify ***our*** solution.
5. Create a plan to achieve the vision using our solution.
6. Implement the plan.

The Business Process, cont.

7. Assess the success of the plan:
   a. During step 5 (create the plan) identify your:
      - Key Performance Indicators
      - Critical Success Factors
   b. After step 6 (implement the plan) measure them evaluate your success.

The Problem

- Students don’t see the “big picture.”
- Students don’t adequately connect the topics in different classes.
- Students don’t retain information for subsequent classes.

Mission

- We educate students from Kansas and the Midwest, transforming them into capable, ethical members of the computing profession.
- We provide Kansas and Midwestern industries with employees that are ready to take responsibility and meet the needs of industry now and in the future.

Vision

- The program will be the preferred choice of students in Kansas and the Midwest and it will attract superior students because of its unique focus on entrepreneurial and project-based experiences tailored to the specific needs of students and industry.

Our Solution

- The junior/senior curriculum must be a unique, hands-on, polytechnic experience available only here.
- There must be a formal entry into the junior year to increase rigor and develop student cohorts.
- The freshman/sophomore curriculum must be preparation for the rigor of the polytechnic program.
- The freshman/sophomore curriculum must facilitate transfers from community colleges and those frustrated with traditional programs.

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Our Key Performance Indicators

- Student population by gender and underrepresented groups
- Graduate placement rate and salary data
- Student retention and graduation rates by gender and underrepresented groups
- Percentage of alumni participation and number of industry partnerships
- Equipment inventory
- Number of student projects published or presented at conferences

Our Critical Success Factors

- The program attracts a diverse student population.
- Graduates are ready for employment.
- Capable students are retained in the program through graduation.
- Graduates obtain employment and salaries commensurate with their education.
- The program develops ongoing relationships with alumni and industrial partners.
- The program maintains state-of-the-art equipment and software.
- The program successfully disseminates the results of undergraduate research projects.

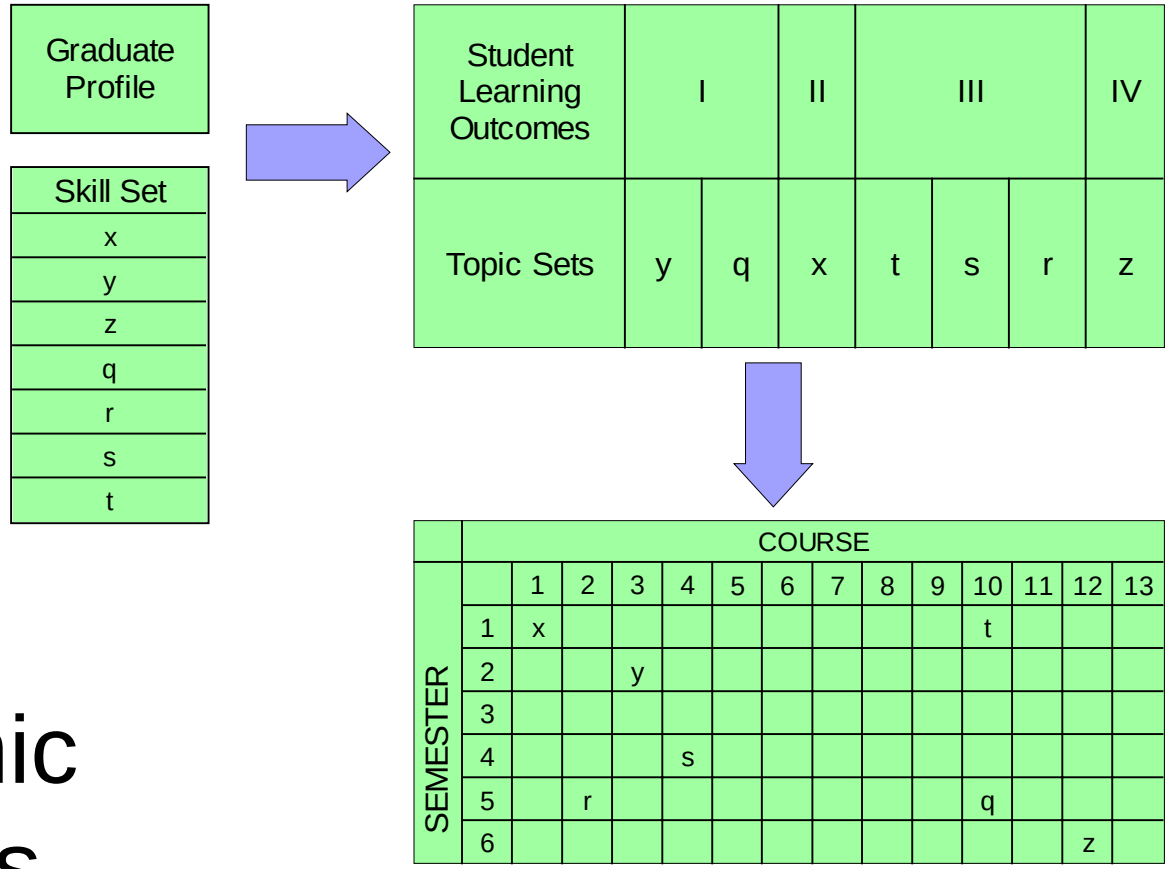
The Academic Process

1. Develop the profile of a graduate.

Profile = graduates of this program will be able to…

2. Elaborate a skill set for a graduate.
3. Develop high-level student learning outcomes.
4. Map each skill to its appropriate learning outcome.
5. Map each learning outcome and skill to a course.

The Academic Process



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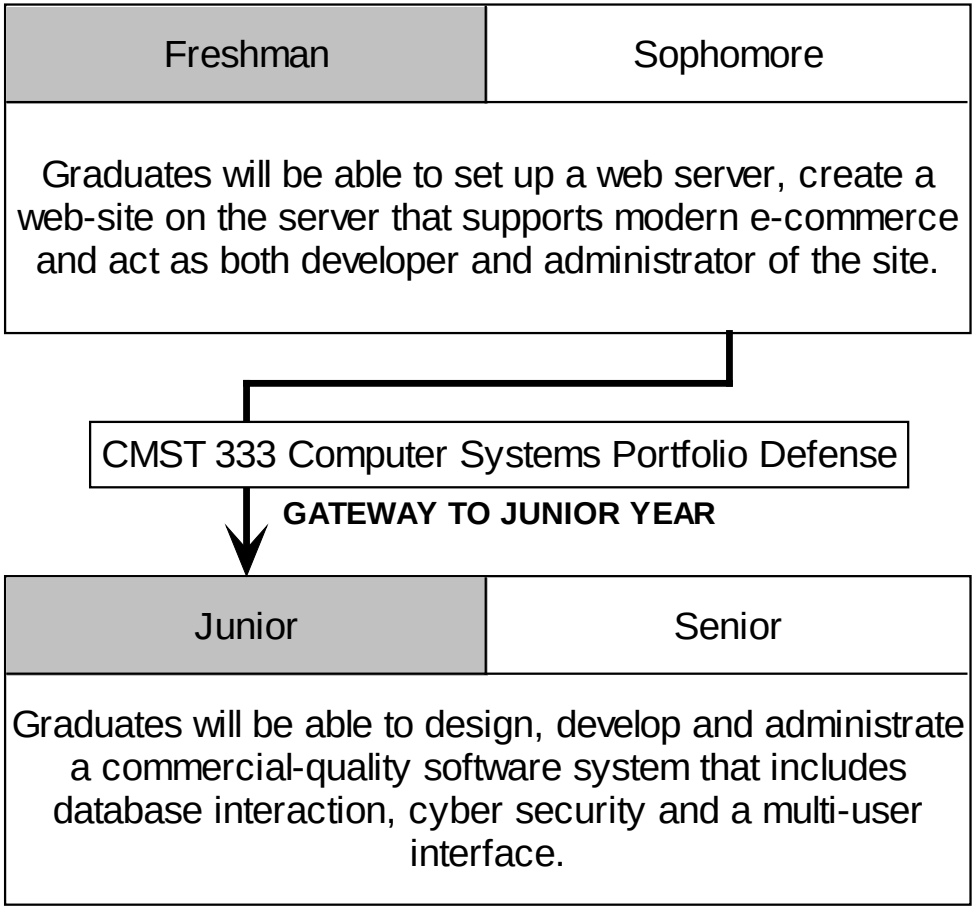
Graduate Profiles



Samples from Skill Set

- Create and format web pages using HTML and CSS.
- Create dynamic web page content using JavaScript.
- Place a relational database table into normal form.
- Use SQL to create and populate database tables.
- Describe the OSI model.
- Describe network topologies.
- Explain and use procedural flow-of-control constructs (e.g. evaluation of expressions, assignment, sequential execution, if, looping)

Student Learning Outcomes

1 **Technical ability**

Graduates will demonstrate an ability to identify and apply current technical concepts and practices in the core computer systems technologies of database management, web technology, computer programming, digital media, and network/system administration.

2 **Application ability**

Graduates will demonstrate an ability to analyze, design, implement, test, and maintain complex computer systems that meet stakeholder requirements.

3 **Communication skills**

Graduates will demonstrate an ability to communicate effectively with a range of audiences.

4 **Professional and ethical knowledge**

Graduates will demonstrate an ability to recognize professional, ethical, legal, security and social issues and responsibilities to make informed judgments, while considering the impact of computing solutions.

5 **Lifelong learning**

Graduates will demonstrate an ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.

6 **Teamwork and project management skills**

Graduates will demonstrate an ability to function effectively on teams that establish goals.

Academic Assessment

- The studio courses become the focus of assessment activities.
- The structure allows longitudinal assessment.
- The structure allows immediate “closing the loop” of assessment findings.