PROGRAM CONCENTRATION: Business & Computer Science
CAREER PATHWAY: Computing
COURSE TITLE: Intermediate Programming

The goal of this course is to deepen students understanding of computing. Students will learn key concepts of software engineering, graphical user interface, and user interface design. Students will gain a deeper understanding of basic data structures and use them to solve more complex problems in a collaborative manner.

HARDWARE AND SOFTWARE COMPONENTS

Students will apply knowledge of hardware and software components. Students will apply knowledge of high-level program execution.

BCS-IP-1. Students will apply knowledge of hardware and software components.

a. Explain how Boolean logic is related to computer hardware.
b. Explain how a computer monitor displays text and images.
c. Explain how a graphical button is displayed and how it knows when it has been pushed.

Academic Standards:
ELA12W2 The student demonstrates competence in a variety of genres.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

BCS-IP-2. Students will apply knowledge of high-level program execution.

a. Build an interpreter that executes a simple language.
b. Build a compiler that translates one simple language to another.

Academic Standard:
ELA12W2 The student demonstrates competence in a variety of genres.

Sample Tasks:

- Read about Boolean logic at http://computer.howstuffworks.com/boolean.htm. Simulate a logic gate.
- Write a program that interprets simple graphic commands: draw a line, draw an ellipse, draw a rectangle, and draw the resulting picture.
- Write a compiler which creates a class that draws a picture based on a set of simple graphic commands.

SOFTWARE ENGINEERING

Students will demonstrate knowledge of key concepts in software engineering.

BCS-IP-3. Students will demonstrate knowledge of key concepts in software engineering.

a. Define software engineering.
b. Compare and contrast software engineering and programming.
c. List the phases in the software life cycle.
d. Perform software requirements analysis.
e. Discuss Extreme Programming and pair programming.
f. Discuss societal and ethical issues in software engineering.

Academic Standards:
ELA12W3 The student uses research and technology to support writing.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

USER INTERFACE DESIGN

Students will demonstrate knowledge of the important principles in user interface design.

BCS-IP-4. Students will demonstrate knowledge of the important principles in user interface design.

a. List the criteria used to determine the effectiveness of an interface.
b. Apply user interface design criteria to critique common user interfaces (car door handle, steering wheels, light switches, cell phones, and VCRs).
c. Perform a user-centered task analysis. Identify sub-groups of users and their characteristics.
d. List examples of good and bad user interface designs. Discuss the impact of bad user interface designs.

Academic Standards:
ELA12W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA12W2 The student demonstrates competence in a variety of genres.

ELA12W3 The student uses research and technology to support writing.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

Sample Tasks:

- Compare cell phone user interfaces for various tasks such as changing a ring tone, adding a new contact, or creating a memo.
- Evaluate web sites based on user interface criteria.
- Compile a list of accidents due to poor user interface design.
- Interview people of different ages and occupations about their cell phone use and what problems they experience. Identify some cell phone user groups.

PROBLEM SOLVING

Students will apply problem-solving strategies to more advanced problems.

BCS-IP-5. The student will collaboratively develop solutions for specific problems.

a. Collaboratively determine a course of action for problem resolution.
b. Design algorithms for problem resolution.
c. Break a task into subtasks required for problem resolution.
d. Select appropriate tools and technology resources to accomplish a variety of tasks.
e. Collaboratively design, combine, test, analyze, and adjust coding solutions based on problem-solving algorithms.
f. Review and discuss coding solutions for elements of thoroughness and correctness.

Academic Standards:
SCSh3 Students will identify and investigate problems scientifically.

ELA12W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA12W2 The student demonstrates competence in a variety of genres.

ELA12W3 The student uses research and technology to support writing.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

PROGRAMMING

Students will use basic and advanced programming techniques to design, implement, and solve complex problems using an object-oriented programming language.

BCS-IP-6. Students will design solutions for complex programs using advanced programming techniques and constructs.

a. Implement techniques such as conditional statements, iterative statements, and variables to solve complex problems.
b. Utilize basic and advanced mathematical expressions to solve complex problems.
c. Create appropriate arrays and lists.
d. Utilize various testing and debugging techniques to test classes.
e. Design classes that can be used in other programs.
f. Analyze and explain simple programs involving advanced programming constructs.

Academic Standards:
ELA12W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA12W2 The student demonstrates competence in a variety of genres.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

BCS-IP-7. Students will use and develop algorithms to solve complex problems.

a. Develop algorithms to solve complex problems using pseudocode.
b. Interpret algorithms written in pseudocode to code solutions to complex problems.
c. Identify properties of well-written algorithms in solving complex problems.
d. Use an Action, Components, and Events (ACE) chart to design your GUI components.

Academic Standards:
ELA12W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

BCS-IP-8. Students will demonstrate knowledge of advanced object-oriented concepts.

a. Define polymorphism, interface, inheritance, encapsulation, and abstract class.
b. Develop programs that use inheritance and interfaces in the development of GUI applications.

Academic Standards:
ELA12W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA12W2 The student demonstrates competence in a variety of genres.

ELA12W3 The student uses research and technology to support writing.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

DATA STRUCTURES

Students will apply their knowledge of arrays and lists. Students will demonstrate an understanding of stacks and queues.

BCS-IP-9. Students will apply their knowledge of arrays and lists.

a. Choose between an array and a list for representing data in a variety of contexts.
b. Create one- and two-dimensional arrays of the correct size for a variety of problems.
c. Describe how elements are removed and added to a list.
d. Implement common searching and sorting algorithms for arrays.

Academic Standards:
ELA12W1 The student produces writing that establishes an appropriate organizational structure, sets a context and engages the reader, maintains a coherent focus throughout, and signals a satisfying closure.

ELA12W2 The student demonstrates competence in a variety of genres.

ELA12W3 The student uses research and technology to support writing.

BCS-IP-10. Students will demonstrate an understanding of stacks and queues.

a. Use stacks and queues to solve a variety of problems.
b. List common uses of stacks and queues.
c. Explain the function of an event queue.

Academic Standards:
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ELA12W2 The student demonstrates competence in a variety of genres.

ELA12W3 The student uses research and technology to support writing.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

Sample Tasks:
- Use a 2D array to hold disks in the game Connect Four.
- Use a 2D array to represent a checkerboard.
- Use a list to hold slides for a slide show.
- Use a stack to solve simple postfix equations such as 3 4 + 2 * 5 -.
- Use a queue to create a simulation of a printer queue.
- Search a list of students for a specific name.
- Sort a list of students based on the student name.

LIMITS OF COMPUTING

Students will investigate the various limits to computing, identify key limiting factors and how they affect computing, and discuss possible technological advances to overcome some of these limits in the future.

BCS-IP-11. Students will identify the physical constraints on computing.

a. Investigate miniaturization and its relationship to sub-atomic concerns.
b. Identify the thermodynamic limits on energy dissipation.
c. Identify the speed-of-light limitations on computing and discuss its implications.
d. Explain and give examples of parallel processing.

Academic Standards:
ELA12W3 The student uses research and technology to support writing.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

BCS-IP-12. Students will examine the limits to computing based on complexity and computability.

a. Define complexity theory.
b. Compare polynomial time versus exponential time.
c. Define non-deterministic and intractable.
d. Discuss the importance of computational time in relationship to solvable problems.
e. Explain the Turing Machine and its relationship to the halting problem.

Academic Standard:
ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.