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Time: Mondays and Wednesdays, 3:00 PM – 4:20 PM
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ECE 217: Data Structure and Algorithm
Fall 2022

Course Description:
This course involves an in-depth programming-based study of data structures, algorithms, and cooperating programming techniques used in real-time and embedded systems. Topics include static and dynamic structures, hashing, searching, signals, distributive and concurrent inter-process communication. Discussions will also cover compiler-linker, multi-core, and trade-offs that impact real-time systems performance.

Credit Hours: 3
Pre-requisites: ECE 111 (Introduction to C and C++ Programming) or Approval of the ECE Chair.

Course Outcomes:
1) Comprehend principles of data structures and algorithms.
2) Understand concepts and usages of objects, structures, and classes.
3) Comprehend essential aspects of vector class, linked list, binary search tree, AVL tree, and cryptographic algorithms.
4) Gain knowledge of finite-state machine and inter-process communication (IPC).

Course Outline:

Item	Topic	Duration
1	Why use Data Structures and Algorithms Classes and Data Abstraction • Review C/CPP Structures and IDE • Introduction to Object oriented Classes • Class Implementation • Understand the differences <struct> and <class>	3 weeks
2	Application of searching and sorting of Record Structures • Vector Class: understand C static and CPP dynamic data types	3 weeks
3	Algorithms: Understanding Linked Lists • Ordered/Sorted and Unordered/Unsorted Lists: • BST and AVL	3 weeks
4	Dynamic Algorithms Introduction • Introduction to State Machines and Implementation • Introduction to Cryptographic Algorithms • Recursion • Hashing Algorithms	3 weeks
5	Introduction to IPC, applied task communication • Signals (Synchronization) • Shared Memory (Distributed)	3 weeks

Course Assessment Methods:

Assessment Methods	Outcome 1	Outcome 2	Outcome 3	Outcome 4
Assignments	X	X	X	
Examinations	X	X	X	X

Course Assessment Method Details:
1. Assignments: Assignment problems shall be designed to test knowledge and comprehension of data structures and algorithms. The expected experiments are according to the following:
- Theoretical Assignment 1: Basic Theories of Data Structures and Algorithms.
- Laboratory Assignment 1: Practical Applications of Structures, Classes, Vector Classes, and Linked Lists.
- Assignment 2: BST and AVL Tree.
- Assignment 3: Cryptographic Algorithms.

2. Examinations: The exam shall contain problems designed to test knowledge and comprehension of data structures and algorithms.

Course Textbooks:
1. C++ Programming, From Problem Analysis to Program Design; D.S. Malik, Eighth Edition; Course Tech, ISBN: 978-1-337-10208-7.
2. Beginning Linux Programming, 4th Edition, by Neil Matthew and Richard Stones, Wiley Publishing, Indianapolis, IN, 2004, ISBN 0-7645-4497-7.

Course Policies:
- Integrity: Cheating in any form will not be tolerated. Willfully misrepresenting your work in this class may result in an "F" grade for the course. Please refer to the *Gannon University Code of Academic Integrity*.
- Testing: The test procedure will be announced prior to the examinations. Anyone violating the testing procedure will be dropped from class.
- Submission: Homework assignments are due before the class time of the due date. **Late homework assignments are penalized 20% plus 5% for each day late.**
- Attendance:
- Two unexcused absences or late homework assignments will invoke the Early Alert and Referral System (EARS)
- Two more unexcused absences from class, after an EARS will result in a grade of **F.**
- Participation: Active participation in course meetings is expected of all students. With each submitted assignment, students should be prepared to explain their solutions to the class.
- Individual Assignments: Students are encouraged to discuss course topics and homework assignments with each other. However, duplicate assignments are not allowed. **All submissions must represent your own work.**

Grading Policy:
Course Outcomes Assessment Criteria: The course outcomes and the corresponding student outcomes are assessed by the construction of the **EAMU** vectors - Excellent (**E**), Adequate (**A**), Minimal (**M**), and Unsatisfactory (**U**). The construction of the EAMU vectors used for course assessment applies the following scoring in all cases and based on the **Accreditation Board for Engineering and Technology, Inc.** (**ABET**) criteria for accrediting engineering programs [Ref. 1]: **Excellent** (E) is scoring 90 or better of the total points possible, **Adequate** (A) is 75 or better, **Minimal** (M) is 60 or better, and **Unsatisfactory** (U) is anything below 60. The **PI** is an abbreviation for Performance Indicator and **SO** is an abbreviation for **Student Outcomes** in the following:

1. Comprehend principles of data structures and algorithms.

CYENG_ABET_SO_2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

- **CYENG_ABET_PI_2_3:** Analyze and evaluate components and systems with respect to security and to maintaining operations in the presence of risks and threats.

***Key Assignment*:** Assignment 3.
Justification: Assignment 3 includes: (1) helping them to well understand computations and applications of cryptographic algorithms; (2) improving their practical and programming skills for these subject through implementation of an exclusive-OR cryptographic algorithm; and (3) comprehending usages of the algorithm for security and safety applications. All of these items together satisfy the requirements of **CYENG_ABET_SO_2**.

2. Understand concepts and usages of objects, structures, and classes.

CYENG_ABET_SO_1: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science and mathematics.

- **CYENG_ABET_PI_1_1:** Apply probability and statistics to problem solving in Cyber Engineering.

***Key Assignment*:** Laboratory Assignment 1.
Justification: Laboratory Assignment 1 includes applying their theoretical knowledge of Structures, Classes, Vector Classes, and Linked Lists into practice and improving their practical and programming skills for these subjects through implementation of the mentioned items. The students should utilize certain methods from statistics and data analysis in their implementations and for their results to achieve conclusive remarks. All of these items together satisfy the requirements of **CYENG_ABET_SO_1**.

3. Comprehend essential aspects of vector class, linked list, binary search tree, AVL tree, and cryptographic algorithms.

CYENG_ABET_SO_2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

- **CYENG_ABET_PI_2_3:** Analyze and evaluate components and systems with respect to security and to maintaining operations in the presence of risks and threats.

***Key Assignment*:** Assignment 2.
Justification: Assignment 2 includes: (1) helping the students to well understand computations and applications of binary search tree and AVL tree; (2) improving their practical and programming skills for these subjects through implementation of the mentioned items; and (3) analyzing and evaluating the implementation systems of these trees along with their components with considering their important applications, including security and object recognition. All of these items together satisfy the requirements of **CYENG_ ABET_SO_2**.

4. Gain knowledge of finite-state machine and inter-process communication (IPC).

CYENG_ABET_SO_2: An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

- **CYENG_ABET_PI_2_3:** Analyze and evaluate components and systems with respect to security and to maintaining operations in the presence of risks and threats.

***Key Assignment*:** Final Exam – Question 9.
Justification: Final Exam – Question 9 includes evaluating the theoretical and the analytical understanding of the Hierarchical Finite-State Machines, with considering their acceptable and non-risky transitions. The item satisfies the requirements of **CYENG_ ABET_SO_2**.

Grading:

The following is the overall grading for the class.

- Exams: 55%
- Assignments: 45%

Letter Grade	Percentage
A+	100-97
A	96-90
A-	89-88
B+	87-85
B	84-80
B-	79-78
C+	77-75
C	74-70
C-	69-67
D	66-60
F	59 or Below

Relationship of Objective Evidence to CYENG Performance Indicator, Student Outcome, and Course Outcome:

Performance Indicator Met (Student Outcome)	Course Outcome	Objective Evidence
CYENG_ ABET_PI_1_1: Apply probability and statistics to problem solving in Cyber Engineering (**CYENG_ ABET_SO_1**).	2	Lab. Assignment 1
CYENG_ABET_PI_2_3: Analyze and evaluate components and systems with respect to security and to maintaining operations in the presence of risks and threats (**CYENG_ ABET_SO_2**).	1, 3, 4	Assignment 2, Assignment 3, Final Exam – Q. 9

Contribution to Professional Component:

Distributed cooperating tasks are some of the most complex software designs and challenging to implement for embedded systems. By introducing the student to these basic data structures, algorithms, and communication techniques, while focusing on deterministic time domain constraints. Prepares the student for more complex embedded system designs, embedded kernel, and real-time control applications.

Accessibility Support Services:

The University will make reasonable accommodations for students with disabilities in compliance with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. The purpose of accommodations is to provide equal access to educational opportunities for eligible students with academic and/or physical disabilities. Gannon students who require accommodations due to a documented diagnosed physical, emotional or learning disability should contact Gannon's Office of Disability Services at extension 5522 or find more information at: https://mygannon.edu/studentresources/studentsuccesscenter/disabilitysupportservices/Page/default.aspx

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