Face-to-face and Online Course Syllabus

Course Information

Course Title: DATA STRUCTURES AND ALGORITHMS
Course Number: CPS2232
Credit Hours: Four (4)
Class/Sessions: W01, W02
Course Date: See Course Announcement
Course Meeting Time: Eastern Standard Time (see Timetable)
Course Location: face-to-face and online
Instructor: Hemn Barzan Abdalla, Ph.D.

Course Catalog Official Description: The course covers the theory of Abstract Data Types (ADT's), applications and implementations of the classical ADT's including lists, sets, stacks, queues, trees and graphs, recursion and dynamic programming, and elementary algorithm analysis.

Course Prerequisite: CPS2231 and Math2110

Required Textbook Information:
Liang, Y. D., Introduction to Java Programming and Data Structures, Comprehensive Version (11th Edition), Millersburg, PA: Pearson, 2017.
ISBN: 9780134670942

- **Required Supplemental Material including OER:** A Laptop with Eclipse IDE, StarUML Software
- **Semester:** Fall 2021
- **Program/Department Name:** School of Computer Science and Technology
- **Academic Dean's Name:** Dr. Larry Brown

Course Student Learning Outcomes (CSLOs) and Topics
Through this unit, students will be able to:
1. Course Student Learning Outcome 1: Expound the theory of Abstract Data Types (ADT's)
2. Course Student Learning Outcome 2: Reasoning the selection of ADT's in the solution of a variety of programming problems
3. Course Student Learning Outcome 3: Construct recursive definitions and solutions to problems
4. Course Student Learning Outcome 4: Expound dynamic programing and its comparison to recursion
5. Course Student Learning Outcome 5: Perform elementary analysis of the complexity of various algorithms

List all of the Topics (main points and sub points) that are contained in the Course Outline. This could be listed under other titles including Course Content:
A. Foundations
    1. The Role of Algorithms in Computing
    2. Growth of Functions
    3. Asymptotic Notations and Common Functions
    4. Objects, References (Pointers) and Generics

B. Array Based List
    1. Unsorted List
    2. Sorted List

3. Searching

C. Linked List
   1. Linked List Operations
   2. Doubled Linked List

D. Stack
   1. Stack Operations
   2. Array Based Stack
   3. Linked List Stack

E. Queue
   1. Queue Operations
   2. Array Based Queue
   3. Linked List Queue

F. Recursion and dynamic programing
   1. Recursive Functions
   2. Recursive vs. Iterative using dynamic programming
   3. Advantages and disadvantages

G. Hash Table
   1. Hash Function
   2. Collision Resolution Methods

H. Sorting
   1. Selection Sort (O(n^2))
   2. Insertion Sort (O(n^2))
   3. Bubble Sort (O(n^2))
   4. Merge Sort (O(n lg n))
   5. Heap Sort (O(n lg n))
   6. Quick Sort (O(n lg n))
   7. Counting Sort (O(n))

I. Trees
   1. Binary Search Tree
   2. Representations of Trees
   3. Tree Traversal Methods (preorder, inorder, postorder)
   4. Reasons for Tree Balancing Methods

J. Graphs
   1. Undirected Graph
   2. Directed Graph
   3. Representations of Graphs
   4. Traversal Methods
   5. Topological Sort

Instructional Methods

This course is taught using in a 15-unit schedule and will use a standard of 1000 total points. Students will find common graded and non-graded learning activities present throughout the course. Each unit will include:

- Readings/Resources
- Lecture
- Discussions
- Assignments/Mid-Term Exam
- Content Assessments
- Final Exam

Textbook Information (Supplementary Textbook):

- **Textbook title-1:** Data Structures & Problem Solving Using Java 4th Edition By Mark Allen Weiss
- ISBN-10: 0-321-54140-5; 978-0-321-54140-6
- Publisher: Pearson
- Textbook online resources: http://users.cs.fiu.edu/~weiss/dsj4/code/code.html

- **Textbook title-2:** Data Structures and Algorithm Analysis in Java (3rd Edition), Mark Allen Weiss
- ISBN: ISBN-10: 0-321-54140-5, ISBN-13: 978-0-321-54140-6
- Publisher: Pearson
- Textbook online resources:
  - Source codes for the book: http://users.cis.fiu.edu/~weiss/dsaajava3/code/
- **Textbook title-3:** *Data structures and algorithms in Java* (11 ed.), Goodrich, M. T., Tamassia, R., & Goldwasser, M. H. (2014). John Wiley & Sons.

Unit Topics and Learning Activities

Unit 1	Unit 1: Recursion Lecture: Recursion, Recursion review Readings: Textbook by Daniel Y. Liang Chapter 18 Resources: Eclipse IDE DQ: Recursion Assignments: **N/A**
Unit 2	Unit 2: Objects and References Review Lecture: Objects and References Review Readings: Textbook by Daniel Y. Liang Chapter 9-11; & supplementary textbooks Resources: Eclipse IDE, StarUML Software DQ: Objects and References Assignments: **N/A**
Unit 3	Unit 3: Generics Lecture: Generics Readings: Text by Daniel Y. Liang Chapter 19; & text by Mark Allen Weiss (4th Ed.) Chapter 1(1.5) Resources: Eclipse IDE, StarUML Software DQ: Generics Assignments: **N/A**
Unit 4	Unit 4: Abstract Data Type (ADT) Concepts and Applications Lecture: Abstract Data Type Concepts and Applications Readings: Textbook by Daniel Y. Liang Chapter 20, Mark Allen Weiss (4th Ed.) Chapter 3 (3.1-2) Resources: Eclipse IDE, StarUML Software DQ: ADT Assignments: **Yes**
Unit 5	Unit 5: Stacks and Queues Lecture: Stack and Queue Readings: Text by Daniel Y. Liang Chapter 20; & supplementary textbooks Resources: Eclipse IDE DQ: Stacks and Queues Assignments: **N/A**
Unit 6	Unit 6: Set and Map Lecture: Set and Map, Hash Table Readings: Text by Daniel Y. Liang Chapter 21; & supplementary textbooks Resources: Eclipse IDE

	DQ: Set and Map Assignments: **N/A**
Unit 7	Unit 7: Abstract Data Type (List) Implementations Lecture: List Implementation Readings: Text by Daniel Y. Liang Chapter 24; & text by Mark Allen Weiss (4th Ed.) Chapter 3 (3.1-2) Resources: Eclipse IDE DQ: Array Based Stack, Linked List Stack, Array Based Queue, and Linked List Queue Assignments: **N/A**
Unit 8	Unit 8: Heap Lecture: Priority Queues Readings: Text by Daniel Y. Liang Chapter 20 & 24; & supplementary textbooks Resources: Eclipse IDE DQ: Priority Queue Operations Assignments: **YES**
Unit 9	Unit 9: Hashing Lecture: Hashing Readings: Text by Daniel Y. Liang Chapter 27; & text by Mark Allen Weiss (4th Ed.) Chapter 5 Resources: Eclipse IDE DQ: Hash Function and Collision Resolution Methods Assignments: **N/A**
Unit 10	Unit 10: Algorithm Analysis Lecture: Algorithm Analysis Readings: Text by Daniel Y. Liang Chapter 22; & supplementary textbooks Resource: Eclipse IDE DQ: Big O notation Assignments: **N/A**
Unit 11	Unit 11: Sorting Lecture: Sorting (Bubble, Insertion, Shell, Selection sort) Readings: Text by Daniel Y. Liang Chapter 23; & supplementary textbooks Resources: Eclipse IDE and StarUML DQ: Sorting Assignments: **N/A**
Unit 12	Unit 12: Dynamic programing Lecture: Recursive vs. Iterative using dynamic programming Readings: Text by Daniel Y. Liang Chapter 22-2; & Mark Allen Weiss (4th Ed.) Chapter 10(10.3) Resources: Eclipse IDE DQ: Recursive vs. Iterative using dynamic programming Assignments: **Yes**
Unit 13	Unit 13: Binary Search Tree (BST) Lecture: Binary Search Tree Readings: Text by Daniel Y. Liang Chapter 25; & supplementary textbooks Resources: Eclipse IDE DQ: BST Assignments:

Unit 14	Unit 14: AVL Tree and Red-Black Tree Lecture: AVL Trees and RB Trees Readings: Text by Daniel Y. Liang Chapter 26; & supplementary textbooks Resources: DQ: AVL Trees, RB Trees Assignments:
Unit 15	Unit 15: Graph Lecture: Graph Readings: Text by Daniel Y. Liang Chapter 28- 29 & supplementary textbooks Resources: DQ: unweighted graph, weighted graph, graph traversal Assignments:
Final Exam	Instructions: 100 questions, 1 attempt in 120 minutes' time limit. 400 points
Total points	**1000/1000**

WKU Online Undergraduate Grading Policy

The below chart outlines the point grading system used for this course.

	Letter Grade	Points	
	A	940 – 1,000	
	A-	900 – 939.9	
	B+	870 – 899.9	
	B	840 – 869.9	
	B-	800 – 839.9	
	C+	770 – 799.9	
	C	700 – 769.9	
	D	600 – 699.9	
	F	599 or below	

$$\boldsymbol{Grade}\ (\%) = \frac{\sum Earned\ points}{\sum Total\ points} * 100$$