Course number and name: **CS 04222: Data Structures and Algorithms**

Credits and contact hours: 4 credits / 5 contact hours

Course Coordinator: Gabriela Hristescu

Instructional Materials: Carrano & Prichard, Data Abstraction and Problem Solving with Java, Walls and Mirrors, 3rd Edition

Specific course information

Catalog description: This course features programs of realistic complexity. The programs utilize data structures (string, lists, graphs, stacks, trees) and algorithms (searching, sorting, etc.) for manipulating these data structures. The course emphasizes interactive design and includes the use of microcomputer systems and direct access data files.

Prerequisites: CS 04114 Object Oriented Programming and Data Abstraction
and
CS 04215 Computer Lab Techniques (may be taken concurrently)
and
(MATH 03160 Discrete Structures *or*
MATH 03150 Discrete Mathematics)

Type of Course: ☒ Required ☐ Elective ☐ Selected Elective

Educational objectives for the course

1. **big O algorithm analysis.** Students have produced an informal big O run time analysis of searching and sorting algorithms

    - ABET (1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

2. **big O data structure analysis.** Students have produced an informal big O run time analysis of various methods relating to the data structures (e.g., lists, stacks, queues, maps)

    - ABET (1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

3. **data structure selection.** Students have demonstrated the ability to make decisions on the proper use of the data structures (e.g., lists, stacks, queues, maps) for time and space criteria and discuss the advantages and disadvantages of different data structures/formats.

   - ABET (1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.

4. **primitive data structures.** Students have demonstrated the ability to construct, implement and utilize common data structures fusing three primitive structures: arrays, integers, and references and are able to list the most common structures and data formats for storing data in a computer system

   - ABET (2) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

5. **search and sort.** Students have coded and tested searching and sorting algorithms

   - ABET (2) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

Required list of topics to be covered

1. Data structures
   a. Lists (array-based, linked structure-based (simply, doubly, circular))
   b. Stacks
   c. Queues
   d. DEQs
   e. Trees (binary search trees)
   f. Heaps (e.g., priority queues)
   g. Hash tables
   h. Categories of data structures (linear v. non-linear)

2. Algorithms
   a. Sorting (selection, bubble, insertion, quick, merge, heap)
   b. Searching (sequential search, binary search, hash tables)
   c. Problem solving techniques (divide and conquer)
   d. Analysis of Algorithms
   e. Computational complexity
   f. Best/Worst/Average Case analysis
   g. Optimization

3. Recursion