CS3334: DATA STRUCTURES

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Data Structures

Subject Code
CS - Computer Science

Course Number
3334

Academic Unit
Computer Science (CS)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
CS2310 Computer Programming or CS2311 Computer Programming or CS2312 Problem Solving and Programming or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
CS2334 Data Structures for Data Science
Part II Course Details

Abstract
This course aims to provide students an appreciation to the fundamentals of computer science. Models and applications of data structures including heaps, search trees, hash tables and disjoint sets are introduced and evaluated. Mathematical tools for analysis of algorithms and data structures are discussed and applied. Students are given the opportunity to develop and implement applications of the data structures and their derivatives.

Course Intended Learning Outcomes (CILOs)

<table>
<thead>
<tr>
<th>CILOs</th>
<th>Weighting (if app.)</th>
<th>DEC-A1</th>
<th>DEC-A2</th>
<th>DEC-A3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Implement common data structures and algorithms.</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Analyse efficiency and correctness of algorithms using mathematical techniques.</td>
<td></td>
<td>x</td>
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<tr>
<td>3</td>
<td>Evaluate and compare similar data structures and algorithms.</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td>4</td>
<td>Design and apply appropriate data structures to solve problems.</td>
<td>x</td>
<td>x</td>
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A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

<table>
<thead>
<tr>
<th>TLAs</th>
<th>Brief Description</th>
<th>CILO No.</th>
<th>Hours/week (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lecture</td>
<td>1, 2, 3, 4</td>
<td>3 hours/week</td>
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<tr>
<td></td>
<td>Explain key concepts about algorithms and data structures for searching, indexing, sorting, manipulating data.</td>
<td></td>
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<tr>
<td>2</td>
<td>Tutorial</td>
<td>1, 2, 3, 4</td>
<td>8 hours/semester</td>
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<tr>
<td></td>
<td>Work on hands-on exercises and labs related to the key concepts taught in lectures.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Assignments</td>
<td>1, 2, 3, 4</td>
<td>After Class</td>
</tr>
<tr>
<td></td>
<td>Require students to do programming and analysis tasks.</td>
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</tbody>
</table>
Assessment Tasks / Activities (ATs)

<table>
<thead>
<tr>
<th>ATs</th>
<th>CILO No.</th>
<th>Weighting (%)</th>
<th>Remarks (e.g. Parameter for GenAI use)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Assignments 1, 2, 3, 4</td>
<td>25</td>
<td>Students are required to work on assignments at least once every four weeks</td>
</tr>
<tr>
<td>2</td>
<td>Quiz 1, 2, 3, 4</td>
<td>15</td>
<td></td>
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</table>

Continuous Assessment (%)
40

Examination (%)
60

Examination Duration (Hours)
2

Additional Information for ATs
For a student to pass the course, at least 40% of the maximum mark for the continuous assessment and 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)

Assessment Task
Assignments

Criterion
CAPACITY for DIRECTED LEARNING to understand the concepts and implementation of key data structures and algorithms

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Mid-term and Final exams

Criterion
ABILITY to apply the knowledge about the data structures and algorithms taught in the lectures and tutorials

Excellent (A+, A, A-)
High
Part III Other Information

Keyword Syllabus

Syllabus:
- Program correctness and complexities
  Techniques for proving program correctness, e.g., loop invariant and induction. Asymptotic notations for program complexities. Summation and recurrence formulas. Complexities of common programming constructs, e.g., loops and recursive programs. Average and worst case analysis.
- Sorting algorithms
  Selected sorting algorithms, such as merge sort, heap sort, quicksort, bucket sort, radix sort, as examples to illustrate the previous concepts and analysis techniques. Algorithms for order statistics.
- Review of abstract data types
  Principles of abstract data types. Examples: stacks, queues, heaps.
- Search trees
- Game trees
- Hash tables
  Hash functions. Collision resolution. Rehashing
- Disjoint Set
  Disjoint set operations. Path compression. Ackermann’s function.
- Graphs
  Adjacency Matrix, Depth First Search, Breadth First Search
- Selected advanced topics in Data Structures

Reading List

Compulsory Readings

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<th>Title</th>
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### Additional Readings

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