University of Colombo School of Computing

Internal Undergraduate Degrees

Course Detail Document

Course Outline									
Course Code :	SCS 1020								
Course Name :	Foundations of Algorithm								
(Bold and underline the appropriate)	**Year :**	**1**	2	3	4		**Semester :**	1	**2**
Number of Credits	04 (3L + 1P)								
Core/Optional	Core								
Evaluation Criteria	**Assignments :**	30%							
	Final Exam :	70%							
Requisites for following the Course	-								

Method of Delivery		Per Week	Total
	Lectures	3 Hours	45 Hours
	Tutorials	1 Hour	10-15 Hours
	Lab Work	2 Hours	30 Hours
	Group Work/e-leaning		

Course Definition	
Introduction	This course examines the essential algorithm design and analysis concepts and techniques. Students will be introduced to the idea of efficiency in computer programs and how to analyze computer programs using standard analysis methods considering the searching and sorting problems as case studies. The applications of analysis methods would enable the classification of algorithms into various complexity classes. Furthermore, the course introduces tree data structures and their variations, where each structure is presented with the underlying requirement and consideration for efficiency.

Course Aim/Intended Learning Outcomes	Upon completion of this course, students will be able to do the following: LO1 : Understand algorithm efficiency: Students will be able to define and explain the concept of efficiency in computer programs and its importance in algorithm design. LO2 : Analyze algorithms: Students will demonstrate the ability to apply standard analysis methods (e.g., time and space complexity) to evaluate and compare the performance of algorithms, particularly focusing on searching and sorting problems. LO3 : Classify algorithms by complexity: Students will categorize algorithms into various complexity classes (e.g., constant, logarithmic, linear, quadratic) based on their performance analysis. LO4 : Learn and apply tree data structures: Students will explore different tree data structures (e.g., binary search trees, AVL trees, heaps) and describe their design, operations, and use cases for efficient data organization and retrieval. LO5 :Evaluate efficiency in tree structures: Students will analyze the efficiency of tree data structures and variations, considering the underlying requirements for time and space efficiency in specific applications.
Assessment Plan	• In class Assignment • Programming In-class Assignment • Weekly Pop-up Quizzes • Programming Take-Home Assignments **Teaching, learning and evaluation methodology**: blended learning approach (F2F, e-leaning), incorporate pedagogical techniques (e.g. Bloom's Taxonomy, Kolb's experiential leaning circle, constructive alignment, knowledge exchange activities (through individual, group activities etc.)
References/Reading Materials	• Cormen, T.H., Leiserson, C.E., Rivest, R.L. and Stein, C., 2022. Introduction to algorithms. MIT Press. • Neapolitan, R. and Naimipour, K., 2015. Foundations of Algorithms. 5th Edition, Jones & Bartlett Publishers. • Karumanchi, N., 2017, Data Structures and Algorithms Made Easy

Course Content

Topic 1: Recursion

- Time Complexity Analysis and Growth Functions
- Proving Correctness
- Recurrences
- Solving recurrences
    - Recursion Tree
    - Iteration method
    - Substitution method
    - Masters Theorem

Duration : 3 Weeks

Topic 2 : Computational complexity and intractability

- Three general problems of intractability
- The theory of P and NP
- Handling NP hard problems

Duration : 2 week

Topic 3: Searching and Sorting Problems

- Basic sorts – Shell sort
- Efficient sorting – Radix sort
- Searching Algorithms
    - Linear search
    - Binary search
    - Jump search
    - Interpolation search
- Hashing
    - Open addressing, Chaining
    - Perfect hashing

Duration : 3 Weeks

Topic 4: Non-Linear Data structures

- Introduction to trees(general trees, Binary trees, BST trees)
- Basic operations of trees
- Tree traversal techniques
- Tree balancing
    - Requirement for balancing trees
    - Global balancing of Trees (Day-Stout-Warren Algorithm)
    - Self-Balancing Trees (AVL Trees, Red black trees)
- B-Trees
    - Basic operations and variants of B-trees

Duration : 7 Weeks

Course Administration Details

Lecturer in-charge	Dr. Dinuni K. Fernando		
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