



Lesson Information			
Semester	Course Unit Code	ECTS	Course Name
Bahar	CE100	5.00	Algorithms and Programming II

Lesson Information	
<b>Department / Program</b>	FACULTY OF ENGINEERING AND ARCHITECTURE - Computer Engineering
<b>Type of Course Unit</b>	
<b>Prerequisites and co-Requisites</b>	Algorithms and Programming I
<b>Objectives of the Course</b>	This course is a continuation of the Algorithms and Programming I course. In this course learned programming skills in Algorithms and Programming I course met with common problems and their solution algorithms. This lecture is about analyzing and understanding how algorithms work for common issues. The class will be based on expertise sharing and guiding students to find learning methods and practice for algorithm and programming topics. By making programming applications and projects in the courses, the learning process will be strengthened by practicing rather than theory.
<b>Course Content</b>	? Algorithms Basics, Pseudocode ? Algorithms Analysis for Time Complexity and Asymptotic Notation ? Sorting Problems (Insertion and Merge Sorts) ? Recursive Algorithms ? Divide-and-Conquer Analysis (Merge Sort, Binary Search) ? Matrix Multiplication Problem ? Quicksort Analysis ? Heaps, Heap Sort and Priority Queues ? Linked Lists, Radix Sort and Counting Sort ? Convex Hull ? Dynamic Programming ? Greedy Algorithms ? Graphs and Graphs Search Algorithms o Breadth-First Search o Depth-First Search and Topological Sort ? Graph Structure Algorithms o Strongly Connected Components o Minimum Spanning Tree ? Disjoint Set Operations ? Single-Source Shortest Path Algorithm ? Q-Learning Shortest Path Implementation ? Network Flow and Applications ? Hashing and Encryption
<b>Recommended Optional Programme Components</b>	During this course, you should have a laptop for programming practices. You will have your development environment, and you will use this for examination and assignments also classroom practices.
<b>Recommended or Required Reading</b>	? Paul Deitel and Harvey Deitel. 2012. C How to Program (7th. ed.). Prentice Hall Press, USA. ? Intro to Java Programming, Comprehensive Version (10th Edition) 10th Edition by Y. Daniel Liang ? Introduction to Algorithms, Third Edition By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein ? Problem Solving and Program Design in C, J.R. Hanly, and E.B. Koffman, 6th Edition. ? Robert Sedgewick and Kevin Wayne. 2011. Algorithms (4th. ed.). Addison-Wesley Professional. ? Harvey M. Deitel and Paul J. Deitel. 2001. Java How to Program (4th. ed.). Prentice-Hall PTR, USA. ? Paul Deitel and Harvey Deitel. 2016. Visual C# How to Program (6th. ed.). Pearson.
<b>Internship Status</b>	Not Exist
<b>Name of Lecturers</b>	Asst. Prof. Dr. Uğur CORUH

Learning Outcomes	
<b>1</b>	Interpret a computational problem specification and algorithmic solution and implement a C/C++, Java or C# application to solve that problem.
<b>2</b>	Argue the correctness of algorithms using inductive proofs and invariants.
<b>3</b>	Understand algorithm design steps
<b>4</b>	Argue algorithm cost calculation for time complexity and asymptotic notation
<b>5</b>	Analyze recursive algorithms complexity
<b>6</b>	Understand divide-and-conquer, dynamic programming and greedy approaches.
<b>7</b>	Understand graphs and graph related algorithms.
<b>8</b>	Understand hashing and encryption operations input and outputs.

Weekly Course Contents			
Week	Subjects		
	Theoretical	Practice	Laboratory
1	Course Plan and Communication Grading System, Assignments and Exams. Algorithms Basics, Pseudocode, iv. RAM (Random Access Machine Model), Algorithm Cost Calculation for Time Complexity. Worst, Average and Best Case Summary Sorting Problem (Insertion and Merge Sort Analysis), 4. Asymptotic Notation (Big O, Big Teta, Big Omega, Small o, Small omega Notations)	N/A	Programming Workshop
2	Solving Recurrences (Recursion Tree, Master Method and Back-Substitution) Divide-and-Conquer Analysis (Merge Sort, Binary Search) Recurrence Solution	N/A	Programming Workshop
3	Matrix Multiplication (Traditional, Recursive, Strassen), Quicksort (Hoare and Lomuto Partitioning, Recursive Sorting), Quicksort Analysis, Randomized Quicksort, Randomized Selection (Recursive, Medians) Heaps (Max / Min Heap, Heap Data Structure, Iterative and Recursive Heapify, Extract-Max, Build Heap) Heap Sort, Priority Queues, Linked Lists, Radix Sort, Counting Sort, Midterm Homework-1 Will Be Sent	N/A	Programming Workshop
4	Midterm Homework-1 Controls and Review with Summary	N/A	Midterm Homework-1 Controls and Review with Summary
5	Convex Hull (Divide & Conquer) Dynamic Programming (Fibonacci Numbers) Divide-and-Conquer (DAC) vs Dynamic Programming (DP) Development of a DP Algorithms Matrix-Chain Multiplication and Analysis	N/A	Programming Workshop
6	Elements of Dynamic Programming Recursive Matrix Chain Order Memoization (Top-Down Approach, RMC, Memoized Matrix Chain, LookupC) Dynamic Programming vs. Memoization Longest Common Subsequence (LCS) Most Common Dynamic Programming Interview Questions, Greedy Algorithms and Dynamic Programming Differences Greedy Algorithms (Activity Selection Problem, Knapsack Problems) Midterm Homework-2 Will Be Sent	N/A	Programming Workshop
7	Midterm Homework-2 Controls and Review with Summary	N/A	Midterm Homework-2 Controls and Review with Summary
8	Midterm	N/A	Midterm
9	Heap Data Structure Heap Sort Huffman Coding	N/A	Programming Workshop
10	Introduction to Graphs, Graphs and Representation, BFS (Breath-First Search), DFS (Depth-First Search), Topological Order, SCC (Strongly Connected Components), MST, Prim, Kruskal Disjoint Sets and Kruskal Relationships, Single-Source Shortest Path, (Bellman-Ford, Dijkstra),	N/A	Programming Workshop
11	Q-Learning Shortest Path, Max-Flow Min-Cut (Ford-Fulkerson, Edmond's Karp, Dinic) Crypto++ Library Usage, Hashing and Integrity Control, Cryptographic Hash Functions (SHA-1, SHA-256, SHA-512, HMAC), Checksums (MD5, CRC32) Final Homework-1 Will Be Sent	N/A	Programming Workshop
12	Final Homework-1 Controls and Review with Summary	N/A	Final Homework-1 Controls and Review with Summary
13	Symmetric Encryption Algorithms (AES, DES, TDES), Symmetric Encryption Modes (ECB, CBC), Asymmetric Encryption, Key Pairs (Public-Private Key Pairs), Signature Generation and Validation	N/A	Programming Workshop
14	OTP Calculation (Time-based, Counter-based), File Encryption and Decryption and Integrity Control Operations Final Homework-2 Will Be Sent	N/A	Programming Workshop
15	Final Homework-2 Controls and Review with Summary	N/A	Final Homework-2 Controls and Review with Summary
16	Final	N/A	Final

#### Course Assessment

Yarıyıl (Yıl) İçi Etkinlikleri	Number	Percentage of Contribution
Project Preparation	2	100
Sum		<b>100</b>

Yarıyıl (Yıl) Sonu Etkinlikleri	Number	Percentage of Contribution
Project Preparation	2	100
Sum		<b>100</b>

<b>Contribution of the in-term activities and final exam grade to the final success grade</b>	<b>Percentage of Contribution</b>
End of Semester(Year) Learning Activities	60
Semester(Year) Learning Activities	40
<b>Sum</b>	<b>100</b>

<b>Activities</b>	<b>Number</b>	<b>Hour</b>	<b>Total Work Load (Hours)</b>
Project Preparation	6	9	54
Attending Lectures	14	5	70
<b>Total Work Load (Hours)</b>			<b>124</b>