

Analysis and Design of Algorithm

Unit I

Introduction: What is algorithm? Why analyze algorithm? RAM Model of Computation, Asymptotic Notations, **Solving recurrence equations:** Iterative method, substitution method, a well-used general formula (Master's theorem), proof of master's theorem, homogeneous recurrence equation, and non-homogeneous recurrence equation.

Sorting: Insertion, sort, merge sort, quick sort, selection sort, lower bound of sorting and proof.

Unit II

Divide and Conquer Strategy: Merge sort, quick sort, integer multiplication, matrix multiplication (Strassen's Algorithm), exponentiation problem, convex hull problem, closest pair of points in 2 dimensional space.

Unit III

Graph Algorithm: Topological sort, queue based topological sort, algorithm, shortest path on un-weighted graph, Dijkstra's algorithm for weighted graph, DFS algorithm and finding articulation points in bi-connected graph, finding strongly connected components, articulation points detection. **Greedy Algorithm:** Minimum spanning tree problem, disjoint set data structure, prims and kruskal algorithm, Huffman coding, rational knapsack problem, bin-packing problem. **Backtracking:** The general method, the 8-queen problem, sum of subsets, graph coloring, Hamilton cycle.

Unit IV

Dynamic Programming: Introduction with Fibonacci series calculation, 0-1 knapsack problem, matrix chain multiplication, LCS, optimal binary tree search, Floyd- Warshal's algorithm.

Unit V

String Search Problem: Naïve algorithm, rabin-karp algorithm, FSA based algorithm, knuth-morris-pratt algorithm. **Complexity theory:** Decidability of problems: Halting problem, NP-class of problem, P class of problem, NP=P question, Polynomial reduction problem, Cook's theorem, NP hardness and NP completeness.

Books:

- T H Cormen, C E Leiserson, and R L Rivest, Introduction to Algorithm, PHI
- Richard E Neapolitan and Kumarss Naimipour, Foundation of Algorithms
- A V Aho, J E Hopcroft and J D Ullman, The Design and analysis of computer algorithms, Pearson Education
- E Horwitz, and S Sahni, Fundamentals of Computer Algorithm, PHI

Automata Theory

Unit 1: INTRODUCTION TO FINITE AUTOMATA

Strings, Alphabets and Languages, Graphs & Trees, Sequential machine, State tables & diagram, Mealy & Moore machines, State and Machine equivalence.

Unit 2: REGULAR EXPRESSIONS

Deterministic and Non-deterministic Finite Automata, Regular Expressions, Regular grammar, Minimization of DFA, Pumping Lemma for Regular sets, Properties of Context Free Languages.

Unit 3: CONTEXT FREE GRAMMAR & LANGUAGES

Context free Grammar, Chomsky Normal form and Greibach Normal form, Pushdown Automata, Context Free languages, Chomsky Classification of languages, Simplification of CFG, Pumping Lemma for context free languages, properties of context free languages, Push down automaton (PDA), conversion from PDA to CFG and vice versa.

Unit 4: TURING MACHINES

Turing Machines, Computing with Turing Machines, Non-deterministic Turing Machines, unrestricted grammars, context sensitive languages, Church's Thesis, Universal Turing Machines.

Unit 5: UNCOMPUTABILITY & COMPUTATIONAL COMPLEXITY

Halting Problems, Unsolvable Problems about Turing Machines, Time bounded Turing Machines, The Class P and NP Languages, NP Completeness, Some NP Complete Problems

Books:

- J.E. Hopcroft & J.D. Ullmann, "Introduction to Automata Theory, Language and Computation", Narosa Publications.
- H.R. Lewis & C.H. Papadimitrou, "Elements of the Theory of Computation", PHI
- John C. Martin, "Introduction to Languages and the Theory of Computation", McGraw-Hill International
- D.A. Cohen, "Introduction to Computer Theory", John Wiley
- Zvi Kohavi, "Switching and Finite Automata Theory" , Tata McGraw-Hill

Microprocessor

Unit I: Introduction & Organization

Review, Organization and architecture of 8085 Microprocessor, Instruction of 8085 & Programming techniques, Machine Language Vs Assembly Language, Basic Concepts of timing & control unit, Timing Diagrams for 8085.

Unit II: Interfacing Memory & I/O Devices

Minimal System, Necessity for Interfacing, Address space partitioning, Memory mapped I/O & I/O mapped I/O, Advantages and Disadvantages, Types of Interfacing Devices, I/O ports, programmable peripheral Interfaces 8255,8259,8251,8153,8279

Unit III: Data Transfer Schemes

Hardware schemes for data Transfer, Programmed data transfer, Interrupt Data Transfer, Various Interrupt schemes, multiple interrupt, Enabling, Disabling and Masking of Interrupts particularly in 8085, DMA & DMA Controller.

Unit IV : Architecture and Programming of Advanced Microprocessors.

Study of Important 8-bit Microprocessors & their comparison, introduction to 16-bit Processors-8086, 8088 and 68000, Coprocessors and comparison, Introduction to 32-bit Microprocessors.

Unit V: Microprocessor Applications

Microprocessor based System Design, Introduction and Basic Concepts, Introduction to MDS, System Design Kits, Introduction to Micro controller, Some Practical applications.

Books:

- A.P. Mathur, “An Introduction to Microprocessors” Tata McGraw Hill, 1995.
- K.L. Short, “Microprocessor & Programmed Logic”, 2nd Ed., PHI, 1994
- R.G. Gaonkar, “Microprocessor Architecture programming and application”, Wiley Eastern Ltd., 1994.

Software Engineering

Unit1: Introduction

Definition, Program Vs Software, Software processes, Software life cycle models: Build and Fix, Waterfall, Prototype, Iterative Enhancement Model, Evolutionary and Spiral model, RAD Model. *Software Metric*: Size Metrics like LOC, Token Count, Function Count, Design Metrics and Data Structures Metrics Information Flow Metrics.

Unit2: Software Project Planning

Cost estimation, static, Single and multivariate models, COCOMO model, Putnam Resources Allocation Model, Risk management.

Unit3: Software Requirement Analysis and Specifications

Problem Analysis, Data Flow Diagram, Data Dictionaries, Entity-Relationship diagrams, Software Requirement and Specifications, Behavioral and non-behavioral requirement, Software Prototyping.

Unit4: Software Design and Software Reliability

Cohesion & Coupling, Classification of Cohesiveness & Coupling, Function Oriented Design, Object Oriented Design, User Interface Design, Software Reliability: Failure and Faults, Reliability Models: Basic Model, Logarithmic Poisson Model, Calendar time Component, Overview of Quality standards like ISO 9001, SEI-CMM

Unit5: Software Testing and Maintenance

Software process, Functional testing: Boundary value analysis, Equivalence class testing, Decision table testing, Cause effect graphing, Structural testing: path testing Data flow and mutation testing, unit testing, integration and system testing, Debugging, Testing Tools, & Standards. Software Maintenance: Management of maintenance, Maintenance Process, Maintenance Models: Quick fix, Iterative Enhancement, Reuse oriented etc. Reverse Engineering, Software Re-engineering, Configuration Management, Documentation

BOOK

- Prof: KK Aggarwal & Yogesh Singh: SOFTWARE ENGG:
- Pankaj Jalote, "An Integrated Approach to Software Engg" Narosa Publishing House, New Delhi.
- Pressman "Principles of Software Engg" TMC, 5th Ed. 2005

Computer Networks

UNIT – I

Introduction: Review of Physical & Data link layer, ISDN, X.25 Frame Relay, ATM, IP Addresses: Classful, Classless Addressing, CIDR Notation, Special Addresses, Private Addresses, Subnetting and Supernetting.

The Transport Layer: The Transport Service, Elements of Transport Protocols, A Simple Transport Protocol, The Internet Transport Protocols; UDP, TCP, Flow control, Silly window syndrome, TCP timers, Performance Issues

UNIT- II

The Data Link Layer: Data Link Layer Design Issues, Error Detection and Correction, Flow Control Protocols, Stop-and-wait Flow Control, Sliding – Window Flow Control, Error Control, Stop-and-wait ARQ, Go-back-N, Selective-repeat, Example of Data Link Protocols- HDLC , The Medium Access Control Sub Layer: The Channel Allocation Problem, ALOHA, Multiple Access Protocols, Collision Free Protocols, IEEE Standards for LANs and MANs, Bridges, wireless LANs, IEEE 802.11, Blue Tooth, High Speed LANs.

UNIT – III

Network Security: Traditional Cryptography, Cryptographic Principles, Secret Key Algorithm: Substitution cipher, Transposition cipher, DES, Public Key Algorithm: RSA, Diffie-Helman , MD5, Authentication protocol, Digital Signature, Security in the Internet, Firewalls.

UNIT – IV

Internet Protocol: Datagram, Fragmentation, Delivery , Forwarding, Routing of IP Packets, ARP and RARP, ICMP, IGMP. IPV4 Protocols , IPV6 (over view), Security in the Internet: IPsec, PGP, VPN.

UNIT – V

Application Layer: Domain Name System , Remote Login , Simple Network Management Protocol, File Transfer Protocol, Electronic Mail: Simple Mail Transfer Protocol, Post Office Protocol, Internet Mail Access Protocol, WWW, HTTP.

TEXT BOOKS:

- B. A. Forouzan, “TCP/IP Protocol Suite”, TMH, 3rd Edition., 2006.
- Andrew S. Tanenbaum “ Computer Networks” by Pearson Education ,fourth edition.

Computer Architecture

Introduction , Architectural classification scheme:-Flynn's, Shore's, Feng's, Handler; Technology Trend, Cost Price and their trend, measuring and reporting performance, Power consumption and efficiency as the metric ,Micron technology, Moor's law, Rock's law,

Design of Arithmetic circuit, Logical circuits, ALU, Modify AC to act as ALU, CPA, CLA, CSA, Speed Calculation of N-bit Parallel Adder, Comparison of Various parallel adders, Array Multiplication, sequential multiplier, Booth recording , Booth Multiplier, signed multiplication, unsigned multiplication, designing fast and efficient algorithm for multiplication and Division , Restoring division, Non Restoring Division, integer representation, floating point representation. Range of representation, Floating point operation, Normalization, IEEE754 floating point standard for both single precision and double precision, rounding, guard bit, sticky bit, demoralized value, NaN.

Register Transfer and Micro operation: Register transfer language, register transfer, bus and memory transfer, arithmetic micro operations, logic micro operations, shift micro operations, using RTL to specify digital system, more complex digital system and RTL, Introduction to VHDL

Hard wired Control unit Design: Basic concepts and its application to implement hardware loops, Hard wired circuit to compute factorial , sum of series ,Booth multiplication etc. Specifying a CPU, Design and implementation of a very simple CPU, a relatively simple CPU-Specification, fetching, decoding, executing, establishing required data paths, design of ALU, Designing control unit using hardwired control, design verification; real world example, short comings of simple CPUs,

Micro programmed Control unit design-Basic concepts, application to implement hardware loops, Hard wired circuit to compute factorial, sum of series ,Booth multiplication etc. Basic Micro sequencer design, design and implementation of a very simple micro sequencer: basic layout, generating the correct sequence and designing the mapping logic, generating the micro operations using horizontal microcode, generating the micro operations using vertical microcode, nano instruction, generating control signal from microcode, design and implementation of a simple micro sequencer:-Modifying the state diagram, designing the sequencing hardware and microcode, completing the design using horizontal microcode, reducing the number of microinstructions ,size of control memory,

Micro programmed control versus Hardwired Control: Complexity of instruction set, ease of modification, Clock speed; Real world example of Micro coded CPU:-Pentium processor

Introduction to Parallel Processing, Parallelism in uni processor system, Introduction to data flow computing, wave front array, Systolic Array

Pipelining:-introduction, design of arithmetic pipeline, instruction pipeline, calculating its throughput, efficiency, speed up, frequency., no of stages, PCR, Pipeline Hazards:-

structural, data ,control, branch; hazards solutions-h/w and s/w solutions. Calculating various attributes of pipeline considering branch instructions, Numericals.

Introduction to superscalar processor, Instruction-level Parallelism: Concepts and challenges, basic concept of Dynamic scheduling , Score boarding Tomasulo's algorithm, overcoming data hazards with dynamic scheduling , reducing branch cost with dynamic hardware prediction, High performance instruction delivery, Taking advantages of more ILP with multiple issues, Hardware based speculation, the P6 micro architecture, Basic compiler techniques for exposing ILP, static branch prediction, static multiple issues: the VLIW approach, advanced compiler support for exposing and exploiting ILP,H/W support for exposing more parallelism at compile time, H/W versus S/W speculation mechanism, Intel IA-64 architecture
Case studies of recent processors (Pentium 4 , Power PC etc)

BOOKS:

- John L. Hennessy & David A. Patterson, “Computer Architecture, A Quantitative Approach”, Morgan Kaufmann, 3rd edition, 2003.
- John D. Carpinelli, “Computer System Organization & architecture”, Pearson Education
- Rafiqzamman and Chandra, “Modern Computer Architecture”. Galgotia Publication.
- Sima, Fountain & Kacsuk, “Advanced Computer architectures a design space approach”, Pearson education
- Kai Hwang, “Advanced Computer architectures, Parallelism, Scalability & Programmability”, McGraw Hill,
- J. P. Hayes, “Computer Architecture and Organization”, McGraw Hill, 1998.
- W. Stallings, “Computer Organization & Architecture”, PHI, 2001.
- Dandamudi, “Fundamental of Computer Organization & Design”, Wiley Dreamtech,