

Core Programming

Core Programming: Reference-1

	Programming in C – A Complete Introduction to the C Programming Language
	Introduction and Some Fundamentals
01	Programming
02	Higher-Level Languages
03	Integrated Development Environments
04	Operating System
05	Compiling Programs
06	Integrated Development Environment
07	Language Interpreters
	Compiling and Running Your First Program
08	Compiling Your Program
09	Running Your Program
10	Understanding Your First Program
11	Displaying the Values of Variables
12	Comments
	Exercises
	Variables, Data Types, and Arithmetic Expressions
13	Working with Variables
19	Understanding Data Types and Constants – Topics 6
22	Working with Arithmetic Expression – Topics 3
23	The Assignment Operators
24	Types _Complex and _Imaginary
	Program Looping
29	The (for) Statement – Topics 5
30	The (While) Statement
32	The (do) Statement – Topics 2
	Making Decisions
36	The (if) Statement – Topics 4
37	The (switch) Statement
38	Boolean Variables
39	The Conditional Operators
	Exercises
	Working with Arrays
42	Defining an Array – Topics 3
43	Initializing Arrays
45	Character Arrays – Topics 2
46	Multidimensional Arrays
47	Variable-Length Arrays
	Exercises
	Working with Functions
48	Defining a Function
50	Arguments and Local Variables – Topics 2
51	Returning Function Results
53	Functions Calling Functions Calling – Topics 2
54	Top-Down Programming
57	Functions and Arrays – Topics 3
58	Global Variables
59	Automatic and Static Variables
60	Recursive Functions

	Exercises
	Working with Structures
62	A Structure for Storing the Date – Topics 1
64	Functions and Structures – Topics 1
66	Initializing Structures – Topics 1
67	Arrays of Structures
68	Structures Containing Structures
69	Structures Containing Arrays
70	Structure Variants
	Exercises
	Character Strings
71	Arrays of Characters
76	Variable-Length Character Strings – Topics 5
77	Escape Characters
78	More on Constant Strings
80	Character Strings, Structures, and Arrays – Topics 1
81	Character Operations
	Exercises
	Pointers
82	Defining a Pointer Variable
83	Using Pointers in Expressions
85	Working with Pointers and Structures – Topics 2
86	The Keyword (Const) and Pointers
87	Pointers and Functions
92	Pointers and Arrays – Topics 5
93	Operations on Pointers
94	Pointers to Functions
95	Pointers and Memory Addresses
	Exercises
	Operations on Bits
103	Bit Operators – Topics 8
104	Bit Fields
	Exercises
	The Preprocessor
109	The (#define) Statement – Topics 5
111	The (#include) Statement – Topics 1
114	Conditional Compilation – Topics 3
	Exercises
	More on Data Types
115	Enumerated Data Types
116	The (typedef) Statement
118	Data Type Conversions – Topics 2
	Exercises
	Working with Larger Programs
120	Dividing Your Program into Multiple Files – Topics 2
123	Communication Between Modules – Topics 3
124	Other Utilities for Working with Larger
127	Programs – Topics 3
	Input and Output Operations in C
128	Character I/O: getcher and putchar
130	Formatted I/O: printf and scanf – Topics 2
132	Input and Output Operations with Files – Topics 2
141	Special Functions for Working with Files – Topics 9
	Exercises
	Miscellaneous and Advanced Features

143	Miscellaneous Language Statements – Topics 2
144	Working with Unions
145	The Comma Operator
148	Type Qualifiers – Topics 3
149	Command-Line Arguments
152	Dynamic Memory Allocation – Topics 3
	Debugging Programs
153	Debugging with the Preprocessor
160	Debugging Programs with gdb – Topics 7
	Object-Oriented Programming
161	What is an Object Anyway
162	Instances and Methods
163	Writing a C Program to Work with Fractions
164	Defining Objective-C Class to Work with Fractions
165	Defining a C++ Class to Work with Fractiosn
166	Defining a C# Class to Work with Fractions
	The Standard C Library
171	Standard Header Files – Topics 5
172	String Functions
173	Memory Functions
174	Character Functions
175	I/O Functions
176	In-Memory Format Conversion Functions
177	String-to-Number Conversion
178	Dynamic Memory Allocation Functions
180	Math Functions – Topics 1
181	General Utility Functions
	Compiling Programs with gcc
182	General Command Format
183	Command-Line Options
184	Common Programming Mistakes

Core Programming: Reference-2

	Object Oriented Programming with C++
	Principles of Object-Oriented Programming
01	Software Crisis
02	Software Evolution
03	A Look at Procedure-Oriented Program
04	Object-Oriented Programming Paradigm
05	Concepts of Object-Oriented Programming
06	Benefits of OOP
07	Object-Oriented Languages
08	Applications of OOP
	Beginning with C++
09	What is C++
10	Applications of C++
11	A Simple C++ Program
12	More C++ Statements
13	An Example with Class
14	Structure of C++ Program
15	Creating the Source File
16	Compiling and Linking
	Tokens, Expression and Control Structures
17	Introduction
18	Tokens
19	Keywords
20	Identifiers and Constants
21	Basic Data Types
22	User-Defined Data Types
23	Storage Classes
24	Derived Data Types
25	Symbolic Constants
26	Type Compatibility
27	Declaration of Variables
28	Dynamic Initialization of Variables
29	Reference Variables
30	Operators in C++
31	Scope Resolution Operator
32	Member Dereferencing Operators
33	Memory Management Operators
34	Manipulators
35	Type Cast Operator
36	Expressions and Their Types
37	Special Assignment Expressions
38	Implicit Conversions
39	Operator Overloading
40	Operator Precedence
41	Control Structures
	Functions in C++
42	Introduction
43	The Main Function
44	Function Prototyping
45	Call by Reference Return by Reference
46	Inline Functions
47	Default Arguments

48	Const Arguments
49	Recursion
50	Function Overloading
51	Friend and Virtual Functions
52	Math Library Functions
	Classes and Objects
53	Introduction
54	C Structures Revisited
55	Specifying a Class 92
54	Defining Member Functions
55	A C++ Program with Class
56	Making an Outside Function Inline
57	Nesting of Member Functions
58	Private Member Functions
59	Arrays within a Class
60	Memory Allocation for Objects
61	Static Data Members
62	Static Member Functions
63	Arrays of Objects
64	Objects as Function Arguments
65	Friendly Functions
66	Returning Objects
67	(const) Member Functions
68	Pointers to Members
69	Local Classes
	Constructors and Destructors
70	Introduction
71	Constructors
72	Parameterized Constructors
73	Multiple Constructors in a Class
74	Constructors with Default Arguments
75	Dynamic Initialization of Objects
76	Copy Constructor
77	Dynamic Constructors
78	Constructing Two-Dimensional Arrays
79	(const) Objects
80	Destructors
	Operator Overloading and Type Conversions
81	Introduction
82	Defining Operator Overloading
83	Overloading Unary Operators
84	Overloading Binary Operators
85	Overloading Binary Operators Using Friends
86	Manipulation of Strings Using Operators
87	Some Other Operator Overloading Examples
88	Rules for Overloading Operators
89	Type Conversions
	Inheritance: Extending Classes
90	Introduction
91	Defining Derived Classes
92	Single Inheritance
93	Making a Private Member Inheritable
94	Multilevel Inheritance
95	Multiple Inheritance
96	Hierarchical Inheritance

97	Hybrid Inheritance
98	Virtual Base Classes
99	Abstract Classes
100	Constructors in Derived Classes
101	Member Classes: Nesting of Classes
	Pointers, Virtual Functions and Polymorphism
102	Introduction
103	Pointers
104	Pointers to Objects
105	(this) Pointer
106	Pointers to Derived Classes
107	Virtual Functions
108	Pure Virtual Functions
109	Virtual Constructors and Destructors
	Managing Console I/O Operations
110	Introduction
111	C++ Streams
112	C++ Stream Classes
113	Unformatted I/O Operations
114	Formatted Console I/O Operations
115	Managing Output with Manipulators
	Working with Files
116	Introduction
117	Classes for File Stream Operations
118	Opening and Closing a File
119	Detecting end-of-file
120	More about Open(): File Modes
121	File Pointers and their Manipulations
122	Sequential Input and Output Operations
123	Updating a File: Random Access
124	Error Handling During File Operations
125	Command-line Arguments
	Templates
126	Introduction
127	Class Templates
128	Class Templates with Multiple Parameters
129	Function Templates
130	Function Templates with Multiple Parameters
131	Overloading of Template Functions
132	Member Function Templates
133	Nontype Template Arguments
	Exception Handling
134	Introduction
135	Basics of Exception Handling
136	Exception Handling Mechanism
137	Throwing Mechanism
138	Catching Mechanism
139	Re-throwing an Exception
140	Specifying Exceptions
141	Exceptions in Constructors and Destructors
142	Exceptions in Operator Overloaded Functions
	Introduction to the Standard Template Library
143	Introduction
144	Components of STL
145	Containers

146	Algorithms
147	Iterators
148	Applications
149	Of Container Classes
150	Function Objects
	Manipulating Strings
151	Introduction
152	Creating (string) Objects
153	Manipulating String Objects
154	Relational Operations
155	String Characteristics
156	Accessing Characters in Strings
157	Comparing and Swapping
	New Features of ANSI C++ Standard
158	Introduction
159	New Data Types
160	New Operators
161	Class Implementation
162	Namespace Scope
163	Operator Keywords
164	New Keywords
165	New Headers
	Object-Oriented Systems Development
166	Introduction
167	Procedure-Oriented Paradigm
168	Procedure-Oriented Development Tools
169	Object-Oriented Paradigm
170	Object-Oriented Notations and Graphs
171	Steps in Object-Oriented Analysis
172	Steps in Object-Oriented Design

Core Programming: Reference-3

	The Object-Oriented Through Process
	Introduction to Object-Oriented Concepts
01	Procedural Versus OO Programming
03	Moving from Procedural to Object-Oriented Development – Topics 2
05	What Exactly is an Object – Topics 2
09	What Exactly is a Class – Topics 4
10	Using UML to Model a Class Diagram
14	Encapsulation and Data Hiding – Topics 4
17	Inheritance – Topics 3
18	Polymorphism
20	Composition – Topics 2
	Conclusion
	Example Code Used in This Chapter
	How to Think in Terms of Objects
23	Knowing the Difference Between the Interface and the Implementation – Topics 3
24	Using Abstract Thinking When Designing Interfaces
29	Giving the User the Minimal Interface Possible – Topics 5
	Conclusion
	References
	Advanced Object-Oriented Concepts
35	Constructors – Topics 6
39	Error Handling – Topics 4
42	The Concept of Scope – Topics 3
43	Operator Overloading
44	Multiple Inheritance
45	Object Operations
	Conclusion
	References
	Example Code Used in This Chapter
	The Anatomy of a Class
46	The Name of the Class
47	Comments
48	Attributes
49	Constructors
50	Accessors
51	Public Interface Methods
52	Private Implementation Methods
	Conclusion
	References
	Example Code Used in This Chapter
	Class Design Guidelines
53	Modeling Real World Systems
55	Identifying the Public Interfaces – Topics 2
56	Designing Robust Constructors (and Perhaps Destructors)
57	Designing Error Handling into a Class
59	Documenting a Class and Using Comments – Topics 1
60	Designing with Reuse in Mind – Topics 1
65	Designing with Extensibility in Mind – Topics 5
67	Designing with Maintainability in Mind – Topics 2
68	Using Object Persistence – Topics 1
	Conclusion
	References

	Example Code Used in This Chapter
	Designing with Objects
76	Design Guidelines – Topics 8
83	Case Study: A Blackjack Example – Topics 7
	Conclusion
	References
	Mastering Inheritance and Composition
84	Reusing Objects
86	Inheritance – Topics 2
87	Composition – Topics 1
90	Why Encapsulation is Fundamental to OO – Topics 3
	Conclusion
	References
	Example Code Used in This Chapter
	Frameworks and Reuse: Designing with Interfaces and Abstract Classes
91	Code: To Reuse or Not to Reuse?
92	What is a Framework?
98	What is a Contract? – Topics 6
102	An E-Business Example – Topics 4
	Conclusion
	References
	Example Code Used in This Chapter
	Building Objects
103	Composition Relationships
104	Building in Phases
107	Types of Composition – Topics 3
108	Avoiding Dependencies
110	Cardinality – Topics 2
111	Tying It All Together: An Example
	Conclusion
	References
	Creating Object Models with UML
112	What is UML
113	The Structure of a Class Diagram
115	Attributes and Methods – Topics 2
116	Access Designations
117	Inheritance
118	Interfaces
120	Composition – Topics 2
121	Cardinality
	Conclusion
	References
	Objects and Portable Data: XML
122	Portable Data
123	The Extensible Markup Language (XML)
124	XML Versus HTML
125	XML and Object-Oriented Languages
126	Sharing Data Between Two Companies
127	Validating the Document with the Document Type Definition (DTD)
128	Integrating the DTD into the XML Document
129	Using Cascading Style Sheets
	Conclusion
	References
	Persistent Objects: Serialization and Relational Databases
130	Persistent Objects Basics

133	Saving the Object to a Flat File – Topics 3
134	Using XML in the Serialization Process
135	Writing to a Relational Database – Topics 1
137	Loading the Driver – Topics 2
	Conclusion
	References
	Example Code Used in This Chapter
	Objects and the Internet
138	Evolution of Distributed Computing
139	Object-Based Scripting Languages
140	A JavaScript Validation Example
145	Objects in a Web Page – Topics 5
150	Distributed Objects and the Enterprise – Topics 5
	Conclusion
	References
	Objects and Client/Server Applications
151	Client/Server Approaches
155	Proprietary Approach – Topics 4
159	Nonproprietary Approach – Topics 4
	Conclusion
	References
	Example Code Used in This Chapter
	Design Patterns
160	Why Design Patterns?
161	Smalltalk's Model/View/Controller
164	Types of Design Patterns – Topics 3
165	Anti-patterns
	Conclusion
	References
	Example Code Used in This Chapter

Discrete Mathematics

	Discrete Mathematics and Its Applications
	The Foundations: Logic and Proofs
06	Propositional Logic – Topics 6
12	Applications of Propositional Logic – Topics 6
19	Propositional Equivalences – Topics 7
32	Predicates and Quantifiers – Topics 13
39	Nested Quantifiers – Topics 7
47	Rules of Inference – Topics 8
56	Introduction to Proofs – Topics 9
66	Proof Methods and Strategy – Topics 10
	End-of-Chapter Material
	Basic Structures: Sets, Functions, Sequences, Sums
74	Sets – Topics 8
79	Set Operations – Topics 5
85	Functions – Topics 6
90	Sequences and Summations – Topics 5
93	Cardinality of Sets – Topics 3
97	Matrices – Topics 4
	End-of-Chapter Material
	Algorithms
103	Algorithms – Topics 6
108	The Growth of Functions – Topics 5
113	Complexity of Algorithms – Topics 5
	End-of-Chapter Material
	Number Theory and Cryptography
118	Divisibility and Modular Arithmetic – Topics 5
122	Integer Representations and Algorithms – Topics 4
130	Primes and Greatest Common Divisors – Topics 8
137	Solving Congruencies – Topics 7
140	Applications of Congruencies – Topics 3
149	Cryptography – Topics 9
	End-of-Chapter Material
	Induction and Recursion
157	Mathematical Induction – Topics 8
162	Strong Induction and Well-Ordering – Topics 5
167	Recursive Definitions and Structural Induction – Topics 5
171	Recursive Algorithms – Topics 4
176	Program Correctness – Topics 5
	End-of-Chapter Material
	Counting
182	The Basics of Counting – Topics 6
185	The Pigeonhole Principle – Topics 3
188	Permutations and Combinations – Topics 3
191	Binominal Coefficients and Identities – Topics 3
196	Generalized Permutations and Combinations – Topics 5
199	Generating Permutations and Combinations – Topics 3
	End-of-Chapter Material
	Discrete Probability
203	An Introduction to Discrete Probability – Topics 4
213	Probability Theory – Topics 10
216	Bayes' Theorem – Topics 3
224	Expected Value and Variance – Topics 8

	End-of-Chapter Material
	Advanced Counting Techniques
227	Applications of Recurrence Relations – Topics 3
230	Solving Linear Recurrence Relations – Topics 3
232	Divide-and-Conquer Algorithms and Recurrence Relations – Topics 2
237	Generating Functions – Topics 5
239	Inclusion-Exclusion – Topics 2
244	Applications of Inclusion-Exclusion – Topics 5
	End-of-Chapter Material
	Relations
249	Relations and Their Properties – Topics 5
255	n-ary Relations and Their Applications – Topics 6
258	Representing Relations – Topics 3
263	Closures of Relations – Topics 5
267	Equivalence Relations – Topics 4
273	Partial Orderings – Topics 6
	End-of-Chapter Material
	Graphs
274	Graphs and Graph Models – Topics 1
281	Graph Terminology and Special Types of Graphs – Topics 7
287	Representing Graphs and Graph Isomorphism – Topics 6
294	Connectivity – Topics 7
298	Euler and Hamilton Paths – Topics 4
301	Shortest-Path Problems – Topics 3
303	Planar Graphs – Topics 3
305	Graph Coloring – Topics 2
	End-of-Chapter Material
	Trees
308	Introduction to Trees – Topics 3
313	Applications of Trees – Topics 5
317	Tree Traversal – Topics 4
322	Spanning Trees – Topics 5
324	Minimum Spanning Trees – Topics 2
	End-of-Chapter Material
	Boolean Algebra
329	Boolean Functions – Topics 5
331	Representing Boolean Functions – Topics 2
335	Logic Gates – Topics 4
339	Minimization of Circuits – Topics 4
	End-of-Chapter Material
	Modeling Computation
344	Languages and Grammars – Topics 5
346	Finite-State Machines with Output – Topics 2
351	Finite-State Machines with No Output – Topics 5
356	Language Recognition – Topics 5
363	Turing Machines – Topics 7
	End-of-Chapter Material
	Appendices
	Axioms for the Real Numbers and the Positive Integers
	Exponential and Logarithmic Functions
	Pseudocode

Data Structure

Data Structure: Reference-1

	Fundamentals of Data Structures in C
	Basic Concepts
01	Overview: System Life Cycle
03	Algorithm Specification – Topics 2
04	Data Abstraction
08	Performance Analysis – Topics 4
09	Performance Measurement
	References and Selected Readings
	Arrays and Structures
10	The Array as an Abstract Data Type
14	Structures and Unions – Topics 4
17	The Polynomial Abstract Data Type – Topics 3
18	The Representation of Multidimensional Arrays
21	The String Abstract Data Type – Topics 3
22	The Representation of Multidimensional Arrays
24	The String Abstract Data Type – Topics 2
	References and Selected Readings
	Additional Exercises
	Stacks and Queues
25	The Stack Abstract Data Type
26	The Queue Abstract Data Type
27	A Mazing Problem
30	Evaluation of Expressions – Topics 3
31	Multiple Stacks and Queues
	Selected Readings and References
	Additional Exercises
	Lists
33	Pointers – Topics 2
34	Singly Linked Lists
35	Dynamically Linked Stacks and Queues
40	Polynomials – Topics 5
41	Equivalence Relations
42	Sparse Matrices
43	Doubly Linked Lists
	References and Selected Readings
	Additional Exercises
	Trees
45	Introduction – Topics 2
48	Binary Trees – Topics 3
49	Binary Tree Traversals
50	Additional Binary Tree Operations
51	Threaded Binary Trees
55	Heaps – Topics 4
60	Binary Search Trees – Topics 5
61	Selection Trees
63	Forests – Topics 2
65	Set Representation – Topics 2
69	Counting Binary Trees – Topics 4
	References and Selected Readings
	Additional Exercises

	Graphs
72	The Graph Abstract Data Type – Topics 3
77	Elementary Graph Operations – Topics 5
78	Minimum Cost Spanning Trees
81	Shortest Paths and Transitive Closure – Topics 3
83	Activity Networks – Topics 2
	References and Selected Readings
	Additional Exercises
	Sorting
87	Searching and List Verification – Topics 4
88	Definitions
89	Insertion Sort
90	Quick Sort
91	Optimal Sorting Time
94	Merge Sort – Topics 3
95	Heap Sort
96	Radix Sort
97	List and Table Sorts
98	Summary of Internal Sorting
103	External Sorting – Topics 5
	References and Selected Readings
	Additional Exercises
	Hashing
104	The Symbol Table Abstract Data Type
108	Static Hashing – Topics 4
111	Dynamic Hashing – Topics 3
	References and Selected Readings
	Heap Structures
114	Min-Max Heaps – Topics 3
117	Deaps – Topics 3
118	Leftist Trees
124	Binomial Heaps – Topics 6
130	Fibonacci Heaps – Topics 6
	References and Selected Readings
	Search Structures
131	Optimal Binary Search Trees
132	AVL Trees
136	2-3 Trees – Topics 4
139	2-3-4 Trees – Topics 3
144	Red-Black Trees – Topics 5
150	B-Trees – Topics 6
151	Splay Trees
154	Digital Search Trees – Topics 3
155	Differential Files
	References and Selected Readings

Data Structure: Reference-2

	Data Structures and Program Design in C++
	Programming Principles
01	Introduction
05	The Game of Life – Topics 4
08	Programming Style – Topics 3
16	Coding, Testing, and Further Refinement – Topics 8
19	Program Maintenance – Topics 3
23	Conclusions and Preview – Topics 4
	Pointers and Pitfalls
	Review Questions
	References for Further Study – Topics 4
	Introduction to Stacks
28	Stack Specifications – Topics 5
32	Implementation of Stacks – Topics 4
33	Application: A Desk Calculator
34	Application: Bracket Matching
37	Abstract Data Types and Their Implementations – Topics 3
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Queues
39	Definitions – Topics 2
40	Implementations of Queues
41	Circular Implementation of Queues in C++
42	Demonstration and Testing
49	Application of Queues: Simulation – Topics 7
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Linked Stacks and Queues
52	Pointers and Linked Structures – Topics 3
53	Linked Stacks
57	Linked Stacks with Safeguards – Topics 4
59	Linked Queues – Topics 2
65	Applications: Polynomial Arithmetic – Topics 6
66	Abstract Data Types and Their Implementations
	Pointers and Pitfalls
	Review Questions
	Recursion
70	Introduction to Recursion – Topics 4
75	Principles of Recursion – Topics 5
82	Backtracking: Postponing the Work – Topics 7
87	Tree-Structured Programs: Look-Ahead in Games – Topics 5
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Lists and Strings
88	List Definition – Topics 1
94	Implementation of Lists – Topics 6
97	Strings – Topics 3
99	Application: A Text Editor – Topics 2
100	Linked Lists in Arrays

101	Application: Generating Permutations
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Searching
102	Searching: Introduction and Notation
103	Sequential Search
107	Binary Search – Topics 4
111	Comparison Trees – Topics 4
112	Lower Bounds
116	Asymptotics – Topics 4
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Sorting
117	Introduction and Notation – Topics 1
121	Insertion Sort – Topics 4
125	Selection Sort – Topics 4
126	Shell Sort
127	Lower Bounds
129	Divide-and-Conquer Sorting – Topics 2
131	Merge-sort for Linked Lists – Topics 2
136	Quick-sort for Contiguous Lists – Topics 5
140	Heaps and Heapsort – Topics 4
141	Review: Comparison of Methods
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Tables and Information Retrieval
142	Introduction: Breaking the $\lg n$ Barrier
143	Rectangular Tables
146	Tables of Various Shapes – Topics 3
147	Tables: A New Abstract Data Type
150	Application: Radix Sort – Topics 3
154	Hashing – Topics 4
155	Analysis of Hashing
156	Conclusions: Comparison of Methods
160	Application: The Life Game Revisited – Topics 4
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Binary Trees
163	Binary Trees – Topics 3
168	Binary Search Trees – Topics 5
172	Height Balance: AVL Trees – Topics 4
177	Splay Trees: A Self-Adjusting Data Structure – Topics 5
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Multiway Trees
183	Orchards, Trees, and Binary Trees – Topics 6
190	Lexicographic Search Trees: Tries – Topics 7
196	External Searching: B-Trees – Topics 6
202	Red-Black Trees – Topics 6
	Pointers and pitfalls

	Review Questions
	References for Further Study
	Graphs
205	Mathematical Background – Topics 3
208	Computer Representation – Topics 3
211	Graph Traversal – Topics 3
214	Topological Sorting – Topics 3
218	A Greedy Algorithm: Shortest Paths – Topics 4
222	Minimal Spanning Trees – Topics 4
223	Graphs as Data Structures
	Pointers and Pitfalls
	Review Questions
	References for Further Study
	Case Study: The Polish Notation
224	The Problem – Topics 1
225	The Idea – Topics 2
131	Evaluation of Polish Expressions – Topics 6
132	Translation from Infix Form to Polish Form
140	An Interactive Expression Evaluator – Topics 8
	Appendix: Mathematical Methods
141	Sums of Powers of Integers
149	Logarithms – Topics 8
152	Permutations Combinations, Factorials – Topics 3
153	Fibonacci Numbers
157	Catalan Numbers – Topics 4
	References for Further Study
	Appendix: Random Numbers
158	Introduction
159	Strategy
160	Program Development
	References for Further Study
	Packages and Utility Functions
161	Packages and C++ Translation Units
162	Packages in the Text
163	The Utility Package
164	Timing Methods
	Programming Precepts, Pointer and Pitfalls
172	Choice of Data Structures and Algorithms – Topics 8
173	Recursion
174	Design of Data Structures
175	Algorithm Design and Analysis
176	Programming with Pointer Objects
177	Debugging and Testing
178	Maintenance

Algorithm

Algorithm: Reference-1

	Computer Algorithms
	Introduction
01	What is an Algorithm?
03	Algorithm Specification – Topics 2
08	Performance Analysis – Topics 5
13	Randomized Algorithms – Topics 5
	References and readings
	Elementary Data Structures
14	Stacks and Queues
16	Trees – Topics 2
18	Dictionaries – Topics 2
20	Priority Queues – Topics 2
22	Sets and Disjoint Set Union – Topics 2
25	Graphs – Topics 3
	References and Readings
	Divide-and-Conquer
26	General Method
27	Binary Search
28	Finding the Maximum and Minimum
29	Merge Sort
31	Quick Sort – Topics 2
33	Selection – Topics 2
34	Strassen's Matrix Multiplication
38	Convex Hull – Topics 4
	References and Readings
	Additional Exercises
	The Greedy Method
39	The General Method
40	Knapsack Problem
41	Tree Vertex Splitting
45	Job Sequencing with Deadlines
48	Minimum-Cost Spanning Trees – Topics 3
49	Optimal Storage on Tapes
50	Optimal Merge Patterns
51	Single-Source Shortest Paths
	References and Readings
	Additional Exercises
	Dynamic Programming
52	The General Method
53	Multistage Graphs
54	All Pairs Shortest Paths General Weights
55	Optimal Binary Search Trees
56	String Editing
57	0/1-Knapsack
58	Reliability Design
59	The Traveling Salesperson Problem
60	Flow Shop Scheduling
	References and Readings
	Additional Exercises
	Basic Traversal and Search Techniques

61	Techniques for Binary Trees
63	Techniques for Graphs – Topics 2
64	Connected Components and Spanning Trees
65	Bi-connected Components and DFS
	References and Readings
	Backtracking
66	The General Method
67	The 8-Queens Problem
68	Sum of Subsets
69	Graph Coloring
70	Hamiltonian Cycles
71	Knapsack Problem
	References and Readings
	Additional Exercises
	Branch-and-Bound
77	The Method – Topics 6
79	0/1 Knapsack Problem – Topics 2
80	Traveling Salesperson
81	Efficiency Considerations
	References and Readings
	Algebraic Problems
82	The General Method
83	Evaluation and Interpolation
85	The Fast Fourier Transform – Topics 2
86	Modular Arithmetic
87	Even Faster Evaluation and Interpolation
	References and Readings
	Lower Bound Theory
90	Comparison Trees – Topics 3
94	Oracles and Adversary Arguments – Topics 4
100	Lower Bounds Through Reductions – Topics 6
101	Techniques for Algebraic Problems
	References and Readings
	NP-Hard and NP-Complete Problems
103	Basic Concepts – Topics 2
104	Cook's Theorem
110	NP-Hard Graph Problems – Topics 6
113	NP-Hard Scheduling Problems – Topics 3
115	NP-Hard Code Generation Problems – Topics 2
116	Some Simplified NP-Hard Problems
	References and Readings
	Approximation Algorithms
117	Introduction
120	Absolute Approximations – Topics 3
123	e-Approximations – Topics 3
125	Polynomial Time Approximation Schemes – Topics 2
128	Fully Polynomial Time Approximation Schemes – Topics 3
129	Probabilistically Good Algorithms
	References and Readings
	Additional Exercises
	Pram Algorithms
130	Introduction
131	Computational Model
133	Fundamental Techniques and Algorithms – Topics 2
138	Selection – Topics 5

142	Merging – Topics 4
146	Sorting – Topics 4
148	Graph Problems – Topics 2
149	Computing the Convex Hull
151	Lower Bounds – Topics 2
	References and Readings
	Additional Exercises
	Mesh Algorithms
152	Computational Model
155	Packet Routing – Topics 3
159	Fundamental Algorithms – Topics 4
162	Selection – Topics 3
165	Merging – Topics 3
167	Sorting – Topics 2
169	Graph Problems – Topics 2
170	Computing the Convex Hull
	References and Readings
	Additional Exercises
	Hypercube Algorithms
173	Computational Model – Topics 3
175	PPR Routing – Topics 2
179	Fundamental Algorithms – Topics 4
182	Selection – Topics 3
184	Merging – Topics 2
186	Sorting – Topics 2
187	Graph Problems
188	Computing the Convex Hull
	References and Readings
	Additional Exercises

Algorithm: Reference-2

	Introduction to Algorithm
	Part-1: Foundations
02	The Role of Algorithms in Computing – Topics 2
05	Getting Started – Topics 3
07	Growth of Functions – Topics 2
13	Divide-and-Conquer – Topics 6
17	Probabilistic Analysis and Randomized Algorithms – Topics 4
	Part-2: Sorting and Order Statistic
22	Heapsort – Topics 5
26	Quicksort – Topics 4
30	Sorting in Linear Time – Topics 4
33	Medians and Order Statistics – Topics 3
	Part-3: Data Structures
37	Elementary Data Structures – Topics 4
42	Hash Tables – Topics 5
46	Binary Search Trees – Topics 4
50	Red-Black Trees – Topics 4
53	Augmenting Data Structures – Topics 3
	Part-4: Advanced Design and Analysis Techniques
58	Dynamic Programming – Topics 5
63	Greedy Algorithms – Topics 5
67	Amortized Analysis – Topics 4
	Part-5: Advanced Data Structure
70	B-Trees – Topics 3
74	Fibonacci Heaps – Topics 4
77	Van Emde Boas Trees – Topics 3
81	Data Structures for Disjoint Sets – Topics 4
	Part-6: Graph Algorithms
86	Elementary Graph Algorithms – Topics 5
88	Minimum Spanning Trees – Topics 2
93	Single-Source Shortest Paths – Topics 5
96	All-Pairs Shortest Paths – Topics 3
101	Maximum Flow – Topics 5
	Part-7: Selected Topics
104	Multithreaded Algorithm – Topics 3
107	Matrix Operations – Topics 3
112	Linear Programming – Topics 5
115	Polynomials and the FFT – Topics 3
124	Number-Theoretic Algorithms – Topics 9
128	String Matching – Topics 4
132	Computational Geometry – Topics 4
137	NP-Completeness – Topics 5
142	Approximation Algorithms – Topics 5
	Part-8: Appendix: Mathematical Background
144	Summations – Topics 2
149	Sets, Etc – Topics 5
154	Counting and Probability – Topics 5
156	Matrices – Topics 2

Algorithm: Reference-3

	The Design and Analysis of Computer Algorithms
	Models of Computation
01	Algorithms and Their Complexity
02	Random Access Machines
03	Computational Complexity of RAM Programs
04	A Stored Program Model
05	Abstractions of the RAM
06	A Primitive Model of Computation: The Turing Machine
07	Relationship Between the Turing Machine and RAM Models
08	Pidgin ALGOL – A High-Level Language
	Design of Efficient Algorithms
09	Data Structures: Lists, Queues, and Stacks
10	Set Representations
11	Graphs
12	Trees
13	Recursion
14	Divide-and-Conquer
15	Balancing
16	Dynamic Programming
17	Epilogue
	Sorting and Order Statistics
18	The Sorting Problem
19	Radix Sorting
20	Sorting by Comparisons
21	Heapsort – an $O(n \log n)$ Comparison Sort
22	Quicksort – an $O(n \log n)$ Expected Time Sort
23	Order Statistics
24	Expected Time for Order Statistics
	Data Structures for Set Manipulation Problems
25	Fundamental Operations on Sets
26	Hashing
27	Binary Search
28	Binary Search Trees
29	Optimal Binary Search Trees
30	A Simple Disjoint-Set Union Algorithm
31	Tree Structures for the UNION-FIND Problem
32	Applications and Extensions of the UNION-FIND Algorithm
33	Balanced Tree Schemes
34	Dictionaries and Priority Queues
35	Mergeable Heaps
36	Concatenable Queues
37	Partitioning
	Algorithms on Graphs
38	Minimum-Cost Spanning Trees
39	Depth-First Search
40	Bi-connectivity
41	Depth-First Search of a Directed Graph
42	Strong Connectivity
43	Path-Finding Problems
44	A Transitive Closure Algorithm
45	A Shortest-Path Algorithm
46	Path Problems and Matrix Multiplication

47	Single-Source Problems
48	Dominators in a Directed Acyclic Graph: Putting the Concepts Together
	Matrix Multiplication and Related Operations
49	Basics
50	Strassen's Matrix-Multiplication Algorithm
51	Inversion of Matrices
52	LUP Decomposition of Matrices
53	Applications of LUP Decomposition
54	Boolean Matrix Multiplication
	The Fast Fourier Transform and Its Applications
55	The Discrete Fourier Transform and Its Inverse
56	The Fast Fourier Transform Algorithm
57	The FFT Using Bit Operations
58	Products of Polynomials
59	The Schonhage-Strassen Integer-multiplication Algorithm
	Integer and Polynomial Arithmetic
60	The Similarity Between Integers and Polynomials
61	Integer Multiplication and Division
62	Polynomial Multiplication and Division
63	Modular Arithmetic
64	Modular Polynomial Arithmetic and Polynomial Evaluation
65	Chinese Remaindering
66	Chinese Remaindering and Interpolation of Polynomials
67	Greatest Common Divisors and Euclid's Algorithm
68	An Asymptotically Fast Algorithm for Polynomial GCD's
69	Integer GCD's
70	Chinese Remaindering Revisited
71	Sparse Polynomials
	Pattern-Matching Algorithms
72	Finite Automata and Regular Expressions
73	Recognition of Regular Expression Patterns
74	Recognition of Substrings
75	Tow –way Deterministic Pushdown Automata
76	Position Trees and Substring Identifiers
	NP-Complete Problems
77	Nondeterministic Turing Machines
78	The Classes P and NP
79	Languages and Problems
80	NP-Completeness of the Satisfiability Problem
81	Additional NP-Complete Problems
82	Polynomial-Space-Bounded Problems
	Some Provably Intractable Problems
83	Complexity Hierarchies
84	The Space Hierarchy for Deterministic Turing Machines
85	A Problem Requiring Exponential Time and Space
86	A Non-elementary Problem
	Lower Bounds on Numbers of Arithmetic Operations
87	Fields
88	Straight-Line Code Revisited
89	A Matrix Formulation of Problems
90	A Row-Oriented Lower Bound on Multiplications
91	A Column-Oriented Lower Bound on Multiplications
92	A Row-and-Column-Oriented Bound on Multiplications
93	Preconditioning

Database Management System

	Database System Concepts
	Introduction
01	Database-System Applications
02	Purpose of Database Systems
06	View of Data – Topics 4
11	Database Languages – Topics 5
12	Database Design
15	Database Engine – Topics 3
16	Database and Application Architecture
18	Database Users and Administrators – Topics 2
19	History of Database System
	Summary and Exercises
	Relational Languages
	Introduction to The Relational Model
20	Structure of Relational Databases
21	Database Schema
22	Keys
23	Schema Diagrams
24	Relational Query Languages
33	The Relational Algebra – Topics 9
	Summary and Exercises
	Introduction to SQL
34	Overview of the SQL Query Language
35	SQL Data Definition
36	Basic Structure of SQL Queries
41	Additional Basic Operations – Topics 5
44	Set Operations – Topics 3
45	Null Values
49	Aggregate Functions – Topics 4
57	Nested Subqueries – Topics 8
60	Modification of the Database – Topics 3
	Summary and Exercises
	Intermediate SQL
64	Join Expressions – Topics 4
68	Views – Topics 4
69	Transactions
77	Integrity Constraints – Topics 8
85	SQL Data Types and Schemas – Topics 8
86	Index Definition in SQL
93	Authorization – Topics 7
	Summary and Exercises
	Advanced SQL
97	Accessing SQL from a Programming Language – Topics 4
100	Functions and Procedures – Topics 3
103	Triggers – Topics 3
105	Recursive Queries – Topics 2
109	Advanced Aggregation Features – Topics 4
	Summary and Exercises
	Database Design
	Database Design Using the E-R Model
111	Overview of the Design Process – Topics 12
113	The Entity-Relationship Model – Topics 2

114	Complex Attributes
115	Mapping Cardinalities
118	Primary Key – Topics 3
119	Removing Redundant Attributes in Entity Sets
125	Reducing E-R Diagrams to Relational Schemas – Topics 6
127	Extended E-R Features – Topics 2
131	Entity-Relationship Design Issues – Topics 4
133	Alternative Notations for Modeling Data – Topics 2
136	Other Aspects of Database Design – Topics 3
	Summary and Exercises
	Relational Database Design
139	Features of Good Relational Designs – Topics 3
142	Decomposition Using Functional Dependencies – Topics 3
146	Normal Forms – Topics 4
150	Functional-Dependency Theory – Topics 4
153	Algorithms for Decomposition Using Functional Dependencies – Topics 3
156	Decomposition Using Multivalued Dependencies – Topics 3
157	More Normal Forms
158	Atomic Domains and First Normal Form
162	Database-Design Process – Topics 4
163	Modeling temporal Data
	Summary and Exercises
	Application Design and Development
	Complex Data Types
167	Semi-Structured Data – Topics 4
169	Object Orientation – Topics 2
173	Textual Data – Topics 4
177	Spatial Data – Topics 4
	Summary and Exercises
	Application Development
178	Application Programs and User Interfaces
181	Web Fundamentals – Topics 3
185	Servlets – Topics 4
188	Alternative Server-Side Frameworks – Topics 3
192	Client-Side Code and Web Services – Topics 4
194	Application Architectures – Topics 2
196	Application Performance – Topics 2
103	Application Security – Topics 7
105	Encryption and Its Applications – Topics 2
	Summary and Exercises
	Big Data Analytics
	Big Data
107	Motivation – Topics 2
112	Big Data Storage Systems – Topics 5
118	The MapReduce Paradigm – Topics 6
120	Beyond MapReduce: Algebraic Operations – Topics 2
123	Streaming Data – Topics 3
124	Graph Databases
	Summary, Exercises
	Data Analytics
125	Overview of Analytics
129	Data Warehousing – Topics 4
133	Online Analytical Processing – Topics 4
139	Data Mining – Topics 6
	Summary, Exercises

	Storage Management and Indexing
	Physical Storage Systems
140	Overview of Physical Storage Media
141	Storage Interfaces
143	Magnetic Disks – Topics 2
144	Flash Memory
149	RAID – Topics 5
150	Disk-Block Access
	Summary, Exercises
	Data Storage Structures
151	Database Storage Architecture
154	File Organization – Topics 3
158	Organization of Records in Files – Topics 4
159	Data-Dictionary Storage
162	Database Buffer – Topics 3
163	Column-Oriented Storage
164	Storage Organization in Main-Memory Databases
	Summary, Exercises
	Indexing
165	Basic Concepts
170	Ordered Indices – Topics 5
175	B+ Tree Index Files – Topics 5
182	B+ Tree Extensions – Topics 7
183	Hash Indices
186	Multiple-Key Access – Topics 3
187	Creation of Indices
189	Write-Optimized Index Structures – Topics 2
190	Bitmap Indices
192	Indexing of Spatial and Temporal Data – Topics 2
	Summary, Exercises
	Query Proccession and Optimization
	Query Processing
193	Overview
194	Measures of Query Cost
197	Selection Operation – Topics 3
199	Sorting – Topics 2
206	Join Operation – Topics 7
211	Other Operations – Topics 5
214	Evaluation of Expressions – Topics 3
217	Query Processing in Memory – Topics 3
	Summary, Exercises
	Query Optimization
218	Overview
222	Transformation of Relational Expressions – Topics 4
227	Estimating Statistics of Expression Results – Topics 5
231	Choice of Evaluation Plans – Topics 4
235	Materialized Views – Topics 4
241	Advanced Topics in Query Optimization – Topics 6
	Summary, Exercises
	Transaction Management
	Transactions
242	Transaction Concept
243	A Simple Transaction Model
244	Storage Structure
245	Transaction Atomicity and Durability

246	Transaction Isolation
247	Serializability
249	Transaction Isolation and Atomicity – Topics 2
250	Transaction Isolation Levels
253	Implementation of Isolation Levels – Topics 3
254	Transactions as SQL Statements
	Summary, Exercises
	Concurrency Control
259	Lock-Based Protocols – Topics 5
263	Deadlock Handling – Topics 4
264	Multiple Granularity
267	Insert Operations, Delete Operations and Predicate Reads – Topics 3
270	Timestamp-Based Protocols – Topics 3
271	Validation-Based Protocols
273	Multi-version Schemes – Topics 2
276	Snapshot Isolation – Topics 3
279	Weak Levels of Consistency in Practice – Topics 3
285	Advanced Topics in Concurrency Control – Topics 6
	Summary, Exercises
	Recovery System
286	Failure Classification
288	Storage – Topics 2
294	Recovery and Atomicity – Topics 6
297	Recovery Algorithm – Topics 3
301	Buffer Management – Topics 4
302	Failure with Loss of Non-Volatile Storage
303	High Availability Using Remote Backup Systems
307	Early Lock Release and Logical Undo Operations – Topics 4
310	ARIES – Topics 3
311	Recovery in Main-Memory Databases
	Summary, Exercises
	Parallel and Distributed Databases
	Database-System Architectures
312	Overview
313	Centralized Database Systems
316	Server System Architectures – Topics 3
324	Parallel Systems – Topics 8
325	Distributed Systems
326	Transaction Processing in Parallel and Distributed Systems
328	Cloud-Based Services – Topics 2
	Summary, Exercises
	Parallel and Distributed Storage
329	Overview
332	Data Partitioning – Topics 3
335	Dealing with Skew in Partitioning – Topics 3
337	Replication – Topics 2
341	Parallel Indexing – Topics 4
342	Distributed File Systems
347	Parallel Key-Value Stores – Topics 5
	Summary, Exercises
	Parallel and Distributed Query Processing
348	Overview
350	Parallel Sort – Topics 2
353	Parallel Join – Topics 3
355	Other Operations – Topics 2

359	Parallel Evaluation of Query Plans – Topics 4
360	Query Processing on Shared-Memory Architectures
365	Query Optimization for Parallel Execution – Topics 5
366	Parallel Processing of Streaming Data
370	Distributed Query Processing – Topics 4
	Summary, Exercises
	Parallel and Distributed Transaction Processing
372	Distributed transactions – Topics 2
375	Commit Protocols – Topics 3
382	Concurrency Control in Distributed Databases – Topics 7
386	Replication – Topics 4
389	Extended Concurrency Control Protocols – Topics 3
395	Replication with Weak Degrees of Consistency – Topics 6
397	Coordinator Selection – Topics 2
402	Consensus in Distributed Systems – Topics 5
	Summary, Exercises
	Advanced Topics
	Advanced Indexing Techniques
403	Bloom Filter
408	Log-Structured Merge Tree and Variants – Topics 5
411	Bitmap Indices – Topics 3
413	Indexing of Spatial Data – Topics 2
416	Hash Indices – Topics 3
	Summary, Exercises
	Advanced Application Development
425	Performance Tuning – Topics 9
428	Performance Benchmarks – Topics 3
430	Other Issues in Application Development – Topics 2
433	Standardization – Topics 3
436	Distributed Directory Systems – Topics 3
	Summary, Exercises
	Block-chain Databases
437	Overview
438	Block-chain Properties
441	Achieving Blockchain Properties via Cryptographic Has Function – Topics 3
444	Consensus – Topics 3
446	Data Management in a Block-chain – Topics 2
450	Smart Contracts – Topics 4
453	Performance Enhancement – Topics 3
454	Emerging Application
	Summary, Exercises
	Appendix: Detailed University Schema
	Online Chapters
	Formal Relational Query Languages
	Advanced Relational Database Design
	Object-Based Databases
	XML
	Information Retrieval
	PostgreSQL

Software Engineering

Software Engineering: Reference-1

	Fundamentals of Software Engineering
	Introduction
03	Evolution – From an Art Form to an Engineering Discipline – Topics 3
05	Software Development Projects – Topics 2
07	Exploratory Style of Software Development – Topics 2
15	Emergence of Software Engineering – Topics 8
16	Notable Changes in Software Development Practices
17	Computer Systems Engineering
	Summary and Exercises
	Software Life Cycle Models
18	A Few Basic Concepts
24	Waterfall Model and its Extensions – Topics 6
27	Rapid Application Development (RAD) – Topics 3
31	Agile Development Models – Topics 4
32	Spiral Model – Topics 1
33	A Comparison of Different Life Cycle Models – Topics 1
	Software Project Management
34	Software Project Management Complexities
36	Responsibilities of a Software Project Manager – Topics 2
28	Project Planning – Topics 2
30	Metrics for Project Size Estimation – Topics 2
33	Project Estimation Techniques – Topics 3
35	Empirical Estimation Techniques – Topics 2
38	COCOMO – A Heuristic Estimation Technique – Topics 4
43	Halstead's Software Science – An Analytical Technique – Topics 5
46	Staffing Level Estimation – Topics 3
51	Scheduling – Topics 5
53	Organization and Team Structures – Topics 2
54	Staffing
57	Risk Management – Topics 3
59	Software Configuration Management – Topics 2
60	Miscellaneous Plans
	Summary
	Requirements Analysis and Specification
62	Requirements Gathering and Analysis – Topics 2
73	Software Requirements Specification (SRS) – Topics 11
75	Formal System Specification – Topics 2
76	Axiomatic Specification
78	Algebraic Specification – Topics 2
79	Executable Specification and 4GL
	Summary and Exercises
	Software Design
82	Overview of the Design Process – Topics 3
83	How to Characterize a Good Software Design? – Topics 1
85	Cohesion and Coupling – Topics 2
86	Layered Arrangement of Modules
88	Approaches to Software Design – Topics 2
	Summary and Exercises
	Function-Oriented Software Design
89	Overview of SA/SD Methodology

90	Structured Analysis – Topics 1
94	Developing the DFD Model of a System – Topics 4
95	Structured Design – Topics 1
96	Detailed Design
97	Design Review
	Summary and Exercises
	Object Modelling Using UML
103	Basic Object-Orientation Concepts – Topics 6
105	Unified Modelling Language (UML) – Topics 2
106	UML Diagrams
112	Use Case Model – Topics 6
113	Class Diagrams
114	Interaction Diagrams
115	Activity Diagram
116	State Chart Diagram
118	Postscript – Topics 2
	Summary and Exercises
	Object-Oriented Software Development
121	Patterns – Topics 3
122	Some Common Design Patterns
130	An Object-Oriented Analysis and Design (OOAD) Methodology – Topics 8
131	Applications of the Analysis and Design Process
132	OOD Goodness Criteria
	Summary and Exercises
	User Interface Design
133	Characteristics of a Good User Interface
136	Basic Concepts – Topics 3
139	Types of User Interfaces – Topics 3
144	Fundamentals of Component-based GUI Development – Topics 5
146	A User Interface Design Methodology – Topics 2
	Summary and Exercises
	Coding and Testing
147	Coding – Topics 1
150	Code Review – Topics 3
152	Software Documentation – Topics 2
156	Testing – Topics 4
159	Black-box Testing – Topics 3
167	White-Box Testing – Topics 8
169	Debugging – Topics 2
171	Program Analysis Tools – Topics 2
172	Integration Testing – Topics 1
177	Testing Object-Oriented Programs – Topics 5
180	System Testing – Topics 3
181	Some General Issues Associated with Testing
	Summary and Exercises
	Software Reliability and Quality Management
184	Software Reliability – Topics 3
185	Statistical Testing – Topics 1
186	Software Quality
188	Software Quality Management System – Topics 2
196	ISO 9000 – Topics 8
199	SEI Capability Maturity Model – Topics 3
201	Few Other Important Quality Standards – Topics 2
202	Six Sigma
	Summary and Exercises

	Computer Aided Software Engineering
203	Case and Its Scope
204	Case Environment – Topics 1
208	CASE Support in Software Life Cycle – Topics 4
215	Other Characteristics of Case Tools – Topics 7
216	Towards Second Generation CASE Tool
217	Architecture of a Case Environment
	Summary and Exercises
	Software Maintenance
219	Characteristics of Software Maintenance – Topics 2
220	Software Reverse Engineering
221	Software Maintenance Process Models
222	Estimation of Maintenance Cost
	Summary and Exercises
	Software Reuse
223	What Can be Reused?
224	Why Almost No Reuse So Far?
225	Basic Issues in any Reuse Program
230	A Reuse Approach – Topics 5
231	Reuse at Organization Level – Topics 1
	Summary and Exercises
	Emerging Trends
232	Client-Server Software
233	Client-Server Architectures
237	CORBA – Topics 4
239	COM/DCOM – Topics 2
240	Service-Oriented Architecture (SOA) – Topics 1
241	Software as a Service (SaaS)
	Summary and Exercises

Software Engineering: Reference-2

	Software Engineering: A Practitioner's Approach
	Software and Software Engineering
03	The Nature of Software – Topics 3
04	The Unique nature of WebApps
05	Software Engineering
06	The Software Process
08	Software Engineering Practice – Topics 2
09	Software Myths
10	How It All Starts
	Summary
	Problems and Points to Ponder
	Part-1: The Software Process
	Process Models
13	A Generic Process Model – Topics 3
14	Process Assessment and Improvement
19	Prescriptive Process Models – Topics 5
22	Specialized Process Models – Topics 3
24	The Unified Process – Topics 2
26	Personal and Team Process Models – Topics 2
27	Process Technology
28	Product and Process
	Summary
	Agile Development
29	What is Agility
30	Agility and the Cost of Change
33	What Is an Agile Process – Topics 3
37	Extreme Programming (XP) – Topics 4
45	Other Agile Process Models – Topics 8
46	A Tool Set for the Agile Process
	Summary
	Part-2: Modeling
	Principles That Guide Practice
47	Software Engineering Knowledge
49	Core Principles – Topics 2
54	Principles That Guide Each Framework Activity – Topics 5
	Summary
	Understanding Requirements
55	Requirements Engineering
59	Establishing the Groundwork – Topics 4
63	Eliciting Requirements – Topics 4
64	Developing Use Cases
66	Building the Requirements Model – Topics 2
67	Negotiating Requirements
68	Validating Requirements
	Summary
	Requirements Modeling: Scenarios, Information, and Analysis Classes
72	Requirements Analysis – Topics 4
75	Scenario-Based Modeling – Topics 3
77	UML Models That Supplement the Use Case – Topics 2
80	Data Modeling Concepts – Topics 3
86	Class-Based Modeling – Topics 6
	Summary

	Requirements Modeling: Flow, Behavior, Patterns, and WebApps
87	Requirements Modeling Strategies
91	Flow-Oriented Modeling – Topics 4
93	Creating a Behavioral Model – Topics 2
95	Patterns for Requirements Modeling – Topics 2
103	Requirements Modeling for WebApps – Topics 8
	Summary
	Design Concepts
104	Design within the Context of Software Engineering
106	The Design Process – Topics 2
118	Design Concepts – Topics 12
123	The Design Model – Topics 5
	Summary
	Architectural Design
127	Software Architecture – Topics 4
128	Architectural Genres
131	Architectural Styles – Topics 3
135	Architectural Design – Topics 4
138	Assessing Alternative Architectural Designs – Topics 3
140	Architectural Mapping Using Data Flow – Topics 2
	Summary
	Component-Level Design
143	What is a Component – Topics 3
147	Designing Class-Based Components – Topics 4
148	Conducting Component-Level Design
150	Component-Level Design for WebApps – Topics 2
153	Designing Traditional components – Topics 3
157	Component-Based Development – Topics 4
	Summary
	User Interface Design
160	The Golden Rules – Topics 3
162	User Interface Analysis and Design – Topics 2
166	Interface Analysis – Topics 4
169	Interface Design Steps – Topics 3
171	WebApp Interface Design – Topics 2
172	Design Evaluation
	Summary
	Pattern-Based Design
176	Design Patterns – Topics 4
181	Pattern-Based Software Design – Topics 5
182	Architectural Patterns
183	Component-Level Design Patterns
184	User Interface Design Patterns
186	WebApp Design Patterns – Topics 2
	Summary
	WebApp Design
187	WebApp Design Quality
188	Design Goals
189	A Design Pyramid for WebApps
190	WebApp Interface Design
192	Aesthetic Design – Topics 2
194	Content Design – Topics 2
196	Architecture Design – Topics 2
198	Navigation Design – Topics 2
199	Component-Level Design

202	Object-Oriented Hypermedia Design Method (OOHDM) – Topics 3
	Summary
	Part-3: Quality Management
	Quality Concepts
203	What is Quality
208	Software Quality – Topics 5
214	The Software Quality Dilemma – Topics 6
218	Achieving Software Quality – Topics 4
	Summary
	Review Techniques
219	Cost Impact of Software Defects
220	Defect Amplification and Removal
222	Review Metrics and Their Use – Topics 2
223	Reviews: A formality Spectrum
224	Informal Reviews
228	Formal Technical Reviews – Topics 4
	Summary
	Software Quality Assurance
229	Background Issues
230	Elements of Software Quality Assurance
232	SQA Tasks, Goals, and Metrics – Topics 2
233	Formal Approaches to SQA
235	Statistical Software Quality Assurance – Topics 2
237	Software Reliability – Topics 2
238	The ISO 9000 Quality Standards
239	The SQA Plan
	Summary
	Software Testing Strategies
243	A Strategic Approach to Software Testing – Topics 4
244	Strategic Issues
246	Test Strategies for Conventional Software – Topics 2
248	Test Strategies for Object-Oriented Software – Topics 2
249	Test Strategies for WebApps
252	Validation Testing – Topics 3
257	System Testing – Topics 5
261	The Art of Debugging – Topics 4
	Summary
	Testing Conventional Application
262	Software Testing Fundamentals
263	Internal and External Views of Testing
264	White-Box Testing
268	Basis Path Testing – Topics 4
271	Control Structure Testing – Topics 3
275	Black-Box Testing – Topics 4
276	Model-Based Testing
289	Testing for Specialized Environments, Architectures, and Applications – Topics 4
290	Patterns for Software Testing
	Summary
	Testing Object-Oriented Applications
291	Broadening the View of Testing
293	Testing OOA and OOD Models – Topics 2
296	Object-Oriented Testing Strategies – Topics 3
302	Object-Oriented Testing Methods – Topics 6
304	Testing Methods Applicable at the Class Level – Topics 2
306	Interclass Test-Case Design – Topics 2

	Summary
	Testing Web Applications
310	Testing Concepts for WebApps – Topics 4
311	The Testing Process – An Overview
313	Content Testing – Topics 2
318	User Interface Testing – Topics 5
319	Component-Level Testing
321	Navigation Testing – Topics 2
323	Configuration Testing – Topics 2
324	Security Testing
327	Performance Testing – Topics 3
	Summary
	Formal Modeling and Verification
328	The Cleanroom Strategy
331	Functional Specification – Topics 3
333	Cleanroom Design – Topics 2
335	Cleanroom Testing – Topics 2
336	Formal Methods Concepts
337	Applying Mathematical Notation for Formal Specification
339	Formal Specification Languages – Topics 2
	Summary
	Software Configuration Management
343	Software Configuration Management – Topics 4
346	The SCM Repository – Topics 3
351	The SCM Process – Topics 5
357	Configuration management for WebApps – Topics 6
	Summary
	Product Metrics
362	A Framework for Product Metrics – Topics 5
364	Metrics for the Requirements Model – Topics 2
374	Metrics for the Design Model – Topics 8
375	Design Metrics for WebApps
376	Metrics for Source Code
378	Metrics for Testing – Topics 2
379	Metrics for Maintenance
	Summary
	Part-4: Managing Software Projects
	Project Management Concepts
383	The Management Spectrum – Topics 4
388	People – Topics 5
390	The Product – Topics 2
392	The Process – Topics 2
393	The Project
394	The W5HH Principle
395	Critical Practices
	Summary
	Process and Project Metrics
397	Metrics in the Process and Project Domains – Topics 2
403	Software Measurement – Topics 6
405	Metrics for Software Quality – Topics 2
408	Integrating Metrics within the Software Process – Topics 3
409	Metrics for Small Organizations
410	Establishing a Software Metrics Program
	Summary
	Estimation for Software Projects

411	Observations on Estimation
412	The Project Planning Process
413	Software Scope and Feasibility
416	Resources – Topics 3
417	Software Project Estimation
426	Decomposition Techniques – Topics 9
429	Empirical Estimation Models – Topics 3
430	Estimation for Object-Oriented Projects
432	Specialized Estimation Techniques – Topics 2
434	The Make/Buy Decision – Topics 2
	Summary
	Project Scheduling
435	Basic Concepts
438	Project Scheduling – Topics 3
440	Defining a Task Set for the Software Project – Topics 2
441	Defining a Task Network
445	Scheduling – Topics 4
446	Earned Value Analysis
	Summary
	Risk Management
447	Reactive versus Proactive Risk Strategies
448	Software Risks
450	Risk Identification – Topics 2
452	Risk Projection – Topics 2
453	Risk Refinement
454	Risk Mitigation, Monitoring, and Management
455	The RMMM Plan
	Summary
	Maintenance and Reengineering
456	Software Maintenance
457	Software Supportability
458	Reengineering
460	Business Process Reengineering – Topics 2
462	Software Reengineering – Topics 2
465	Reverse Engineering – Topics 3
467	Restructuring – Topics 2
469	Forward Engineering – Topics 2
470	The Economics of Reengineering
	Summary
	Part-5: Advanced Topics
	Software Process Improvement
473	What is SPI – Topics 3
480	The SPI Process – Topics 7
481	The CMMI
482	The People CMM
483	Other SPI Frameworks
484	SPI Return on Investment
485	SPI Trends
	Summary
	Emerging Trends in Software Engineering
486	Technology Evolution
487	Observing Software Engineering Trends
494	Identifying ‘Soft Trends’ – Topics 7
501	Technology Directions – Topics 7
503	Tools-Related Trends – Topics 2

	Summary
	Concluding Comments
503	The Importance of Software – Revisited
504	People and The Way They Build Systems
505	New Modes for Representing Information
506	The Long View
507	The Software Engineer’s Responsibility
508	A Final Comment
	Part-6: Appendix
509	An Introduction to UML
510	Object Oriented Concepts

Pure Mathematics – 1, 2, and 3

	Pure Mathematics (A-Level)
	P1: Algebra
01	Background Algebra
02	Linear Equations
03	Changing the Subject of a Formula
04	Quadratic Equations
05	Solving Quadratic Equations
06	Equations that cannot be Factorized
07	The Graphs of Quadratic Function
08	The Quadratic Formula
09	Inequalities
	P2: Algebra
10	Operations with Polynomials
11	Solution of Polynomial Equations
12	The Modulus Function
	P3: Further Algebra
13	The General Binomial Expansion
14	Review of Algebraic Functions
15	Partial Functions
16	Using Partial Functions with The Binomial Expansion
	P1: Co-Ordinate Geometry
17	Co-Ordinates
18	Plotting, Sketching and Drawing
19	The Gradient of a Line
20	The Distance Between Two Points
21	The Mid-Point of a Line Joining Two Points
22	The Equation of a Straight Line
23	Finding the Equation of a Line
24	The Intersection of Two Line
25	Drawing Curves
26	The Intersection of A Line and A Curve
	P1: Sequences and Series
27	Definitions and Notation
28	Arithmetic Progressions
29	Geometric Progressions
30	Binomial Expansions
	P1: Functions
31	The Language of Functions
32	Composite Functions
33	Inverse Functions
	P1: Differentiation
34	The gradient of a Curve
35	Finding the Gradient of a Curve
36	Finding the Gradient from First Principles
37	Differentiating by Using Standard Results
38	Using Differentiation
39	Tangents and Normals
40	Maximum and Minimum Points
41	Increasing and Decreasing Functions
42	Points of Inflection
43	The Second Derivative
44	Applications

45	The Chain Rule
	P2: Differentiation
46	The Product Rule
47	The Quotient Rule
48	Differentiating Natural Logarithms and Exponentials
49	Differentiating Trigonometrical Functions
50	Differentiating Functions Defined Implicitly
51	Parametric Equations
52	Parametric Differentiation
	P3: Differential Equations
53	Forming Differential Equations from Rates of Change
54	Solving Differential Equations
	P1: Integration
55	Reversing Differentiation
56	Finding the Area Under A Curve
57	Area as The Limit of A Sum
58	Areas Below the X Axis
59	The Area Between Two Curves
60	The Area Between A Curve and the Y Axis
61	The Reverse Chain Rule
62	Improper Integrals
63	Finding Volumes by Integration
	P2: Integration
64	Integrals Involving The Exponential Function
65	Integrals Involving The Natural Logarithm Function
66	Integrals Involving Trigonometrical Functions
67	Numerical Integration
	P3: Further Integration
68	Integration by Substitution
69	Integrals Involving Exponentials and Natural Logarithms
70	Integrals Involving Trigonometrical Function
71	The Use of Partial Fractions in Integration
72	Integration by Parts
73	General Integration
	P1: Trigonometry
74	Trigonometry Background
75	Trigonometrical Functions
76	Trigonometrical Functions for Angles of any Size
77	The sine and cosine Graphs
78	The tangent graph
79	Solving Equations using Graphs of Trigonometrical Functions
80	Circular Measure
81	The Length of An ARC of A Circle
82	The Area of A Sector of A Circle
83	Other Trigonometrical Functions
	P2: Trigonometry
84	Reciprocal Trigonometrical Functions
85	Compound-Angle Formulae
86	Double-Angle Formulae
87	The Forms $r\cos$, $r\sin$
88	The General Solutions of Trigonometrical Equations
	P1: Vectors
89	Vectors in Two Dimensions
90	Vectors in Three Dimensions
91	Vectors Calculations

92	The Angle Between Two Vectors
	P3: Vectors
93	The Vector Equation of a Line
94	The Intersection of Two Lines
95	The Angle Between Two Lines
96	The Perpendicular Distance from A Point to a Line
97	The Vector Equation of a Plane
98	The Intersection of A Line and A Plane
99	The Distance of A Point from A Plane
100	The Angle Between A Line and A Plane
101	The Intersection of Two Planes
	P2: Logarithms and Exponentials
102	Logarithms
103	Exponential Functions
104	Modelling Curves
105	The Natural Logarithm Functions
106	The Exponential Function
	P2: Numerical Solution of Equations
107	Interval Estimation – Change-of-Sign Methods
108	Fixed-Point Iteration
	P3: Complex Numbers
109	The Growth of the Number System
110	Working with Complex Numbers
111	Representing Complex Numbers Geometrically
112	Sets of Points in An Argand Diagram
113	The Modulus-Argument form of Complex Numbers
114	Sets of Points Using The Polar Form
115	Working with Complex Numbers in Polar Form
116	Complex Exponents
117	Complex Numbers and Equations