



Table of Contents

Introduction	1
I The Interview	6
1 Getting Ready	7
2 Strategies For A Great Interview	12
3 Conducting An Interview	19
4 Problem Solving	23
II Problems	42
5 Primitive Types	43
5.1 Computing the parity of a word	43
5.2 Swap bits	45
5.3 Reverse bits	46
5.4 Find a closest integer with the same weight	47
5.5 Compute $x \times y$ without arithmetical operators	48
5.6 Compute x/y	50
5.7 Compute x^y	51
5.8 Reverse digits	52
5.9 Check if a decimal integer is a palindrome	52
5.10 Generate uniform random numbers	54
5.11 Rectangle intersection	55
6 Arrays	57
6.1 The Dutch national flag problem	57
6.2 Increment an arbitrary-precision integer	61

6.3	Multiply two arbitrary-precision integers	62
6.4	Advancing through an array	63
6.5	Delete a key from an array	64
6.6	Delete duplicates from a sorted array	65
6.7	Buy and sell a stock once	66
6.8	Buy and sell a stock twice	67
6.9	Enumerate all primes to n	68
6.10	Permute the elements of an array	70
6.11	Compute the next permutation	73
6.12	Sample offline data	75
6.13	Sample online data	76
6.14	Compute a random permutation	77
6.15	Compute a random subset	79
6.16	Generate nonuniform random numbers	80
6.17	The Sudoku checker problem	82
6.18	Compute the spiral ordering of a 2D array	84
6.19	Rotate a 2D array	87
6.20	Compute rows in Pascal's Triangle	89
7	Strings	91
7.1	Interconvert strings and integers	91
7.2	Base conversion	93
7.3	Compute the spreadsheet column encoding	94
7.4	Replace and remove	95
7.5	Test palindromicity	96
7.6	Reverse all the words in a sentence	97
7.7	Compute all mnemonics for a phone number	98
7.8	The look-and-say problem	100
7.9	Convert from Roman to decimal	101
7.10	Compute all valid IP addresses	102
7.11	Write a string sinusoidally	103
7.12	Implement run-length encoding	104
7.13	Implement the UNIX <code>tail</code> command	105
7.14	Find the first occurrence of a substring	106
8	Linked Lists	109
8.1	Merge two sorted lists	110
8.2	Reverse a singly linked list	111
8.3	Reverse a single sublist	112
8.4	Test for cyclicity	113
8.5	Test for overlapping lists—lists are cycle-free	115
8.6	Test for overlapping lists—lists may have cycles	116
8.7	Delete a node from a singly linked list	118
8.8	Remove the k th last element from a list	118
8.9	Remove duplicates from a sorted list	119

8.10	Implement cyclic right shift for singly linked lists	120
8.11	Implement even-odd merge	121
8.12	Test whether a singly linked list is palindromic	123
8.13	Implement list pivoting	124
8.14	Add list-based integers	125
9	Stacks and Queues	127
9.1	Implement a stack with max API	127
9.2	Evaluate RPN expressions	130
9.3	Test a string over "{,},(,),[,] for well-formedness	131
9.4	Normalize pathnames	132
9.5	BST keys in sort order	134
9.6	Search a postings list	135
9.7	Compute buildings with a sunset view	136
9.8	Sort a stack	138
9.9	Compute binary tree nodes in order of increasing depth	139
9.10	Implement a circular queue	141
9.11	Implement a queue using stacks	142
9.12	Implement a queue with max API	143
10	Binary Trees	146
10.1	Test if a binary tree is balanced	148
10.2	Test if a binary tree is symmetric	150
10.3	Compute the lowest common ancestor in a binary tree	151
10.4	Compute the LCA when nodes have parent pointers	152
10.5	Sum the root-to-leaf paths in a binary tree	153
10.6	Find a root to leaf path with specified sum	154
10.7	Compute the k th node in an inorder traversal	155
10.8	Compute the successor	156
10.9	Implement an inorder traversal with $O(1)$ space	158
10.10	Reconstruct a binary tree from traversal data	159
10.11	Reconstruct a binary tree from a preorder traversal with markers	161
10.12	Form a linked list from the leaves of a binary tree	162
10.13	Compute the exterior of a binary tree	163
10.14	Compute the right sibling tree	165
10.15	Implement locking in a binary tree	166
11	Heaps	169
11.1	Merge sorted files	170
11.2	Sort an increasing-decreasing array	172
11.3	Sort an almost-sorted array	173
11.4	Compute the k closest stars	174
11.5	Compute the median of online data	176
11.6	Compute the k largest elements in a max-heap	177
11.7	Implement a stack API using a heap	178

12 Searching	180
12.1 Search a sorted array for first occurrence of k	182
12.2 Search a sorted array for the first element greater than k	183
12.3 Search a sorted array for entry equal to its index	185
12.4 Search a cyclically sorted array	185
12.5 Compute the integer square root	187
12.6 Compute the real square root	188
12.7 Search in a 2D sorted array	190
12.8 Find the min and max simultaneously	191
12.9 Find the k th largest element	193
12.10 Compute the optimum mailbox placement	195
12.11 Find the missing IP address	196
12.12 Find the duplicate and missing elements	198
 13 Hash Tables	 201
13.1 Partition into anagrams	202
13.2 Test for palindromic permutations	203
13.3 Is an anonymous letter constructible?	204
13.4 Implement an ISBN cache	206
13.5 Compute the LCA, optimizing for close ancestors	208
13.6 Compute the k most frequent queries	209
13.7 Find the nearest repeated entries in an array	209
13.8 Find the smallest subarray covering all values	210
13.9 Find smallest subarray sequentially covering all values	214
13.10 Find the longest subarray with distinct entries	216
13.11 Find the length of a longest contained interval	217
13.12 Compute the average of the top three scores	219
13.13 Compute all string decompositions	220
13.14 Find a highest affinity pair	222
13.15 Test the Collatz conjecture	223
13.16 Implement a hash function for chess	225
 14 Sorting	 227
14.1 Compute the intersection of two sorted arrays	228
14.2 Implement mergesort in-place	230
14.3 Count the frequencies of characters in a sentence	231
14.4 Remove first-name duplicates	232
14.5 Render a calendar	233
14.6 Sets of disjoint intervals	235
14.7 Compute the union of intervals	236
14.8 Partitioning and sorting an array with many repeated entries	239
14.9 Team photo day—1	241
14.10 Implement a fast sorting algorithm for lists	242
14.11 Compute a salary threshold	244

15 Binary Search Trees	246
15.1 Test if a binary tree satisfies the BST property	246
15.2 Find the first occurrence of a key in a BST	249
15.3 Find the first key larger than a given value in a BST	251
15.4 Find the k largest elements in a BST	252
15.5 Compute the LCA in a BST	253
15.6 Reconstruct a BST from traversal data	254
15.7 Find the closest entries in three sorted arrays	257
15.8 Enumerate numbers of the form $a + b\sqrt{2}$	259
15.9 The most visited pages problem	261
15.10 Build a minimum height BST from a sorted array	263
15.11 Insertion and deletion in a BST	264
15.12 Test if three BST nodes are totally ordered	266
15.13 The range lookup problem	268
15.14 Add credits	270
15.15 Count the number of entries in an interval	272
16 Recursion	274
16.1 The Tower of Hanoi problem	275
16.2 Generate all nonattacking placements of n -Queens	277
16.3 Generate permutations	279
16.4 Generate the power set	281
16.5 Generate all subsets of size k	283
16.6 Generate strings of matched parens	284
16.7 Generate palindromic decompositions	286
16.8 Generate binary trees	287
16.9 Implement a Sudoku solver	288
16.10 Compute a Gray code	290
16.11 Compute the diameter of a tree	292
17 Dynamic Programming	295
17.1 Count the number of score combinations	297
17.2 Compute the Levenshtein distance	300
17.3 Count the number of ways to traverse a 2D array	302
17.4 Plan a fishing trip	304
17.5 Search for a sequence in a 2D array	305
17.6 The knapsack problem	307
17.7 Divide the spoils fairly	308
17.8 The bedbathandbeyond.com problem	310
17.9 Find the minimum weight path in a triangle	312
17.10 Pick up coins for maximum gain	313
17.11 Count the number of moves to climb stairs	315
17.12 Compute the probability of a Republican majority	316
17.13 The pretty printing problem	317
17.14 Find the longest nondecreasing subsequence	319

18 Greedy Algorithms and Invariants	322
18.1 Implement Huffman coding	323
18.2 Compute an optimum assignment of tasks	326
18.3 Implement a schedule which minimizes waiting time	327
18.4 The interval covering problem	328
18.5 The 3-sum problem	331
18.6 Find the majority element	333
18.7 The gasup problem	334
18.8 Compute the maximum water trapped by a pair of vertical lines . .	335
18.9 Compute the largest rectangle under the skyline	337
19 Graphs	340
19.1 Identify the celebrity	342
19.2 Search a maze	343
19.3 Paint a Boolean matrix	345
19.4 Compute enclosed regions	347
19.5 Degrees of connectedness—1	349
19.6 Clone a graph	351
19.7 Making wired connections	352
19.8 Transform one string to another	353
19.9 The shortest straight-line program for x^n	355
19.10 Team photo day—2	357
19.11 Compute a shortest path with fewest edges	358
20 Parallel Computing	361
20.1 Implement caching for a multithreaded dictionary	362
20.2 Analyze two unsynchronized interleaved threads	364
20.3 Implement synchronization for two interleaving threads	365
20.4 Implement a thread pool	367
20.5 Implement asynchronous callbacks	368
20.6 Implement a Timer class	369
20.7 The readers-writers problem	370
20.8 The readers-writers problem with write preference	372
20.9 Test the Collatz conjecture in parallel	372
20.10 Design TeraSort and PetaSort	374
20.11 Implement distributed throttling	375
21 Design Problems	376
21.1 Design a spell checker	378
21.2 Design a solution to the stemming problem	378
21.3 Plagiarism detector	379
21.4 Pair users by attributes	380
21.5 Design a system for detecting copyright infringement	381
21.6 Design T _E X	382
21.7 Design a search engine	383

21.8	Implement PageRank	384
21.9	Design a scalable priority system	385
21.10	Create photomosaics	386
21.11	Implement Mileage Run	386
21.12	Implement Connexus	388
21.13	Design an online advertising system	388
21.14	Design a recommendation system	389
21.15	Design an optimized way of distributing large files	390
21.16	Design the World Wide Web	391
21.17	Estimate the hardware cost of a photo sharing app	392
22	Honors Class	393
22.1	Compute the greatest common divisor 🧐	394
22.2	Find the first missing positive entry 🧐	395
22.3	Buy and sell a stock k times 🧐	396
22.4	Compute the maximum product of all entries but one 🧐	397
22.5	Compute the longest contiguous increasing subarray 🧐	399
22.6	Rotate an array 🧐	401
22.7	Identify positions attacked by rooks 🧐	402
22.8	Justify text 🧐	404
22.9	Reverse sublists k at a time 🧐	406
22.10	Implement list zipping 🧐	407
22.11	Copy a postings list 🧐	408
22.12	Compute the median of a sorted circular linked list 🧐	409
22.13	Compute the longest substring with matching parens 🧐	410
22.14	Compute the maximum of a sliding window 🧐	412
22.15	Implement preorder and postorder traversals without recursion 🧐	413
22.16	Compute fair bonuses 🧐	416
22.17	Find k elements closest to the median 🧐	419
22.18	Search a sorted array of unknown length 🧐	420
22.19	Search in two sorted arrays 🧐	422
22.20	Find the k th largest element—large n , small k 🧐	423
22.21	Find an element that appears only once 🧐	424
22.22	Find the line through the most points 🧐	426
22.23	Find the shortest unique prefix 🧐	428
22.24	Compute the smallest nonconstructible change 🧐	430
22.25	Find the most visited pages in a window 🧐	432
22.26	Convert a sorted doubly linked list into a BST 🧐	433
22.27	Convert a BST to a sorted doubly linked list 🧐	435
22.28	Merge two BSTs 🧐	436
22.29	Test if a binary tree is an almost BST 🧐	437
22.30	The view from above 🧐	439
22.31	Searching a min-first BST 🧐	442
22.32	Implement regular expression matching 🧐	444

22.33	Synthesize an expression 🐼	447
22.34	Count inversions 🐼	449
22.35	Draw the skyline 🐼	451
22.36	Find the two closest points 🐼	455
22.37	Measure with defective jugs 🐼	457
22.38	Compute the maximum subarray sum in a circular array 🐼	459
22.39	Determine the critical height 🐼	461
22.40	Voltage selection in a logic circuit 🐼	462
22.41	Find the maximum 2D subarray 🐼	463
22.42	Trapping water 🐼	466
22.43	Load balancing 🐼	468
22.44	Search for a pair-sum in an abs-sorted array 🐼	470
22.45	The heavy hitter problem 🐼	472
22.46	Find the longest subarray whose sum $\leq k$ 🐼	474
22.47	Degrees of connectedness—2 🐼	476
22.48	Compute a minimum delay schedule, unlimited resources 🐼	477
22.49	Road network 🐼	478
22.50	Test if arbitrage is possible 🐼	480
22.51	The readers-writers problem with fairness 🐼	481
22.52	Implement a producer-consumer queue 🐼	482

III Notation, Language, and Index 483

Notation 484

C++ best practices, C++11, and C++ for Java developers 486

Index of Terms 488