[https://www.codechef.com/certification/data-structures-and-algorithms/prepare#advanced](https://www.codechef.com/certification/data-structures-and-algorithms/prepare" \l "advanced)

**Learning Resources:**

* **Heaps (priority queue)**
  + Resources
    - [cs.cmu.edu](https://www.cs.cmu.edu/~wlovas/15122-r11/lectures/15-priorqs.pdf)
    - [eecs.wsu.edu](http://www.eecs.wsu.edu/~ananth/CptS223/Lectures/heaps.pdf)
    - [geeksforgeeks.org](http://www.geeksforgeeks.org/binary-heap/)
    - [visualgo.net](https://visualgo.net/en/heap)
    - [iarcs.org.in](https://www.iarcs.org.in/inoi/online-study-material/topics/heaps.php)
  + Practice Problems
    - codechef.com - [IPCTRAIN](https://www.codechef.com/JULY17/problems/IPCTRAIN), [editorial](https://discuss.codechef.com/questions/105180/ipctrain-editorial)
    - codechef.com - [ANUMLA](https://www.codechef.com/problems/ANUMLA), [editorial](https://discuss.codechef.com/questions/53529/anumla-editorial)
    - codechef.com - [KSUBSUM](https://www.codechef.com/problems/KSUBSUM), [editorial](https://discuss.codechef.com/questions/4018/ksubsum-editorial)
    - codechef.com - [RRATING](https://www.codechef.com/problems/RRATING), [editorial](https://discuss.codechef.com/questions/1585/rrating-editorial)
    - codechef.com - [TSECJ05](https://www.codechef.com/problems/TSECJ05), [editorial](https://discuss.codechef.com/questions/103875/chef-and-his-software-tsecj05-editorial)
    - codechef.com - [LOWSUM](https://www.codechef.com/problems/LOWSUM), [editorial](https://discuss.codechef.com/questions/29659/lowsum-editorial)
    - spoj.com - [WEIRDFN](http://www.spoj.com/problems/WEIRDFN/)
    - codechef.com - [CAPIMOVE](https://www.codechef.com/problems/CAPIMOVE), [editorial](https://discuss.codechef.com/questions/90266/capimove-editorial)
    - spoj.com - [RMID2](http://www.spoj.com/problems/RMID2/)
    - spoj.com - [LAZYPROG](http://www.spoj.com/problems/LAZYPROG/)
    - spoj.com - [EXPEDI](http://www.spoj.com/problems/EXPEDI/)
    - [acm.timus.ru](http://acm.timus.ru/problem.aspx?space=1&num=1306)
    - baylor.edu - [Maze Checking and Visualization](https://icpcarchive.ecs.baylor.edu/index.php?option=onlinejudge&page=show_problem&problem=122)
    - codechef.com - [MOSTDIST](https://www.codechef.com/problems/MOSTDIST), [editorial](https://discuss.codechef.com/questions/56239/mostdist-editorial)
* **Disjoint Set Union**
  + Resources
    - [topcoder.com](https://www.topcoder.com/community/data-science/data-science-tutorials/disjoint-set-data-structures/)
    - [harvard.edu](http://people.cs.georgetown.edu/jthaler/ANLY550/lec6.pdf)
    - [ucdavis.edu](http://web.cs.ucdavis.edu/~amenta/w10/trevisanNotes.pdf)
    - [visualgo.net](https://visualgo.net/en/ufds)
  + Practice Problems
    - codechef.com - [GALACTIK](https://www.codechef.com/problems/GALACTIK), [editorial](https://discuss.codechef.com/questions/18004/galactik-editorial)
    - codechef.com - [DISHOWN](https://www.codechef.com/problems/DISHOWN), [editorial](https://discuss.codechef.com/questions/47241/dishown-editorial)
    - codechef.com - [JABO](https://www.codechef.com/problems/JABO), [editorial](https://discuss.codechef.com/questions/3710/jabo-editorial)
    - codechef.com - [PARITREE](https://www.codechef.com/problems/PARITREE), [editorial](https://discuss.codechef.com/questions/79920/paritree-editorial)
    - codechef.com - [FILLMTR](https://www.codechef.com/problems/FILLMTR), [editorial](https://discuss.codechef.com/questions/109357/fillmtr-editorial)
    - [B. Mike and Feet](http://codeforces.com/problemset/problem/547/B)
    - [D. Quantity of Strings](http://codeforces.com/contest/151/problem/D)
    - codechef.com - [SETELE](https://www.codechef.com/problems/SETELE), [editorial](https://discuss.codechef.com/questions/87909/setele-editorial)
    - codechef.com - [MAZE](https://www.codechef.com/problems/MAZE), [editorial](https://discuss.codechef.com/questions/81591/maze-editorial)
    - codechef.com - [MAGICSTR](https://www.codechef.com/problems/MAGICSTR), [editorial](https://discuss.codechef.com/questions/77347/magical-strings-editorial)
    - codechef.com - [MTRWY](https://www.codechef.com/problems/MTRWY), [editorial](https://discuss.codechef.com/questions/66031/mtrwy-editorial)
    - codechef.com - [BIGOF01](https://www.codechef.com/problems/BIGOF01), [editorial](https://discuss.codechef.com/questions/68454/bigof01-editorial)
    - codechef.com - [FIRESC](https://www.codechef.com/problems/FIRESC), [editorial](https://discuss.codechef.com/questions/7269/firesc-editorial)
* **Segment Trees**
  + Resources
    - [wcipeg.com](http://wcipeg.com/wiki/Segment_tree)
    - [topcoder.com](https://www.topcoder.com/community/data-science/data-science-tutorials/range-minimum-query-and-lowest-common-ancestor/#Segment_Trees)
    - [kartikkukreja.wordpress.com](https://kartikkukreja.wordpress.com/2014/11/09/a-simple-approach-to-segment-trees/)
    - [visualgo.net](https://visualgo.net/en/segmenttree)
    - [iarcs.org.in](https://www.iarcs.org.in/inoi/online-study-material/topics/segment-tree.php)
  + Practice Problems
    - spoj.com - [GSS1](http://www.spoj.com/problems/GSS1/)
    - spoj.com - [GSS2](http://www.spoj.com/problems/GSS2/)
    - codeforces.com - [Classic Segment Tree](http://codeforces.com/blog/entry/15890) (Expert Level)
    - spoj.com - [IOPC1207](http://www.spoj.com/problems/IOPC1207/)
    - spoj.com - [ORDERSET](http://www.spoj.com/problems/ORDERSET/)
    - spoj.com - [HELPR2D2](http://www.spoj.com/problems/HELPR2D2/)
    - spoj.com - [ANDROUND](http://www.spoj.com/problems/ANDROUND/)
    - spoj.com - [HEAPULM](http://www.spoj.com/problems/HEAPULM/)
    - spoj.com - [NICEDAY](http://www.spoj.com/problems/NICEDAY/)
    - spoj.com - [YODANESS](http://www.spoj.com/problems/YODANESS/)
    - spoj.com - [DQUERY](http://www.spoj.com/problems/DQUERY/)
    - spoj.com - [KQUERY](http://www.spoj.com/problems/KQUERY/)
    - spoj.com - [FREQUENT](http://www.spoj.com/problems/FREQUENT/)
    - spoj.com - [GSS3](http://www.spoj.com/problems/GSS3/)
    - spoj.com - [GSS4](http://www.spoj.com/problems/GSS4)
    - spoj.com - [GSS5](http://www.spoj.com/problems/GSS5/)
    - spoj.com - [KGSS](http://www.spoj.com/problems/KGSS/)
    - spoj.com - [HELPR2D2](http://www.spoj.com/problems/HELPR2D2/)
    - spoj.com - [BRCKTS](http://www.spoj.com/problems/BRCKTS/)
    - spoj.com - [CTRICK](http://www.spoj.com/problems/CTRICK/)
    - spoj.com - [MATSUM](http://www.spoj.com/problems/MATSUM/)
    - spoj.com - [RATING](http://www.spoj.com/problems/RATING/)
    - spoj.com - [RRSCHED](http://www.spoj.com/problems/RRSCHED/)
    - spoj.com - [SUPPER](http://www.spoj.com/problems/SUPPER/)
    - spoj.com - [ORDERS](http://www.spoj.com/problems/ORDERS/)
    - codechef.com - [LEBOBBLE](https://www.codechef.com/problems/LEBOBBLE)
    - codechef.com - [QUERY](https://www.codechef.com/problems/QUERY)
    - spoj.com - [TEMPLEQ](http://www.spoj.com/problems/TEMPLEQ)
    - spoj.com - [DISUBSTR](http://www.spoj.com/problems/DISUBSTR/)
    - spoj.com - [QTREE](http://www.spoj.com/problems/QTREE/)
    - spoj.com - [QTREE2](http://www.spoj.com/problems/QTREE2/)
    - spoj.com - [QTREE3](http://www.spoj.com/problems/QTREE3/)
    - spoj.com - [QTREE4](http://www.spoj.com/problems/QTREE4/)
    - spoj.com - [QTREE5](http://www.spoj.com/problems/QTREE5/)
  + Problems on segment tree with lazy propagation
    - spoj.com - [HORRIBLE](http://www.spoj.com/problems/HORRIBLE) (must do basic lazy propagation problem)
    - spoj.com - [LITE](http://www.spoj.com/problems/LITE) (a nice lazy propagation problem)
    - spoj.com - [MULTQ3](http://www.spoj.com/problems/MULTQ3/) (another nice lazy propagation problem)
    - codechef.com - [CHEFD](https://www.codechef.com/problems/CHEFD)
    - codechef.com - [FUNAGP](https://www.codechef.com/problems/FUNAGP) (a difficult lazy propagation problem.)
    - [RPAR](http://www.spoj.com/problems/RPAR/) (a difficult and nice lazy propagation)
    - codechef.com - [ADDMUL](https://www.codechef.com/problems/ADDMUL)
    - spoj.com - [SEGSQRSS](http://www.spoj.com/problems/SEGSQRSS/) (a difficult lazy propagation problem)
    - spoj.com - [KGSS](http://www.spoj.com/problems/KGSS/)
    - codeforces.com - [C. Circular RMQ](http://codeforces.com/contest/52/problem/C)
    - codeforces.com - [E. Lucky Queries](http://codeforces.com/contest/145/problem/E) (must do hard problem on lazy propagation)
    - codeforces.com - [E. A Simple Task](http://codeforces.com/contest/558/problem/E)
    - codeforces.com - [C. DZY Loves Fibonacci Numbers](http://codeforces.com/contest/446/problem/C) (important problem to do, introduces some nice properties over lazy propagation)
    - codeforces.com - [D. The Child and Sequence](http://codeforces.com/contest/438/problem/D)
    - codeforces.com - [E. Lucky Array](http://codeforces.com/contest/121/problem/E)
* **Binary Index Tree (Fenwick tree)**
  + Resources
    - [topcoder.com](https://www.topcoder.com/community/data-science/data-science-tutorials/binary-indexed-trees/)
    - [iarcs.org.in](https://www.iarcs.org.in/inoi/online-study-material/topics/binary-index-tree.php)
    - [visualgo.net](https://visualgo.net/en/fenwicktree)
  + Practice Problems:  
    Please solve the problems mentioned in the above segment tree practice problems section. Note that usually, it's difficult to do range updates in binary indexed trees. Mostly, it is used for for range query and point update. However, you can check the following article for checking how some simple specific kind of range updates can be peformed on binary indexed tree (http://petr-mitrichev.blogspot.in/2013/05/fenwick-tree-range-updates.html). Note that range updates on BIT is not a part of the syllabus.
    - spoj.com - [INVCNT](http://www.spoj.com/problems/INVCNT/)
    - spoj.com - [TRIPINV](http://www.spoj.com/problems/TRIPINV/)
* **Trees (traversals)**
  + Resources
    - [slideshare.net](https://www.slideshare.net/ecomputernotes/traversal-of-a-binary-tree-10682319)
    - [iarcs.org.in](https://www.iarcs.org.in/inoi/online-study-material/topics/dp-trees.php)
    - [berkeley.edu](https://people.eecs.berkeley.edu/~vazirani/s99cs170/notes/dynamic2.pdf)
  + Practice Problems
    - spoj.com - [TREEORD](http://www.spoj.com/problems/TREEORD/)
* **Finding Lowest Common Ancestors (O(log N) solution where N is number of nodes)**
  + Resources
    - [topcoder.com](https://www.topcoder.com/community/data-science/data-science-tutorials/range-minimum-query-and-lowest-common-ancestor/)
* **Depth First Search, Breadth First Search (Finding connected components and transitive closures)**
  + Resources
    - geeksforgeeks.org - [Connected Components in an undirected graph](http://www.geeksforgeeks.org/connected-components-in-an-undirected-graph/)
    - geeksforgeeks.org - [Transitive closure of a graph](http://www.geeksforgeeks.org/transitive-closure-of-a-graph/)
    - geeksforgeeks.org - [Depth First Traversal or DFS for a Graph](http://www.geeksforgeeks.org/depth-first-traversal-for-a-graph/)
    - iarcs.org.in - [Basic Graph Algorithms](https://www.iarcs.org.in/inoi/online-study-material/topics/graphs.php)
    - visualgo.net - [Graph Traversal](https://visualgo.net/en/dfsbfs)
    - harvard.edu - [Breadth-First Search](http://people.cs.georgetown.edu/jthaler/ANLY550/lec4.pdf)
  + Practice Problems
    - codechef.com - [FIRESC](https://www.codechef.com/problems/FIRESC), [editorial](https://discuss.codechef.com/questions/7269/firesc-editorial)
    - spoj.com - [BUGLIFE](http://www.spoj.com/problems/BUGLIFE/)
    - spoj.com - [CAM5](http://www.spoj.com/problems/CAM5/)
    - spoj.com - [GCPC11J](http://www.spoj.com/problems/GCPC11J/)
    - spoj.com - [KFSTB](http://www.spoj.com/problems/KFSTB/)
    - spoj.com - [PT07Y](http://www.spoj.com/problems/PT07Y/)
    - spoj.com - [PT07Z](http://www.spoj.com/problems/PT07Z/)
    - spoj.com - [LABYR1](http://www.spoj.com/problems/LABYR1/)
    - spoj.com - [PARADOX](http://www.spoj.com/problems/PARADOX/)
    - spoj.com - [PPATH](http://www.spoj.com/problems/PPATH/) ;(must do bfs problem)
    - spoj.com - [ELEVTRBL](http://www.spoj.com/problems/ELEVTRBL/) (bfs)
    - spoj.com - [QUEEN](http://www.spoj.com/problems/QUEEN/) (bfs)
    - spoj.com - [SSORT](http://www.spoj.com/problems/SSORT/) ;(cycles in a graph)
    - spoj.com - [ROBOTGRI](http://www.spoj.com/problems/ROBOTGRI/) ;(bfs)
* **Shortest-path algorithms (Dijkstra, Bellman-Ford, Floyd-Warshall)**
  + Resources
    - geeksforgeeks.org - [Dijkstra’s shortest path algorithm](http://www.geeksforgeeks.org/greedy-algorithms-set-6-dijkstras-shortest-path-algorithm/)
    - Iarcs.org.in - [Shortest paths](https://www.iarcs.org.in/inoi/online-study-material/topics/shortest-paths.php)
    - Visualgo.net - [Single-Source Shortest Paths (SSSP)](https://visualgo.net/en/sssp)
  + Practice Problems
    - codechef.com - [DIGJUMP](https://www.codechef.com/problems/DIGJUMP), [editorial](https://discuss.codechef.com/questions/44800/digjump-editorial)
    - codechef.com - [AMR14B](https://www.codechef.com/AMR14ROS/problems/AMR14B), [editorial](https://discuss.codechef.com/questions/61701/amr14b-editorial)
    - codechef.com - [INSQ15\_F](https://www.codechef.com/problems/INSQ15_F), [editorial](https://discuss.codechef.com/questions/74790/insq15_f-editorial)
    - codechef.com - [SPSHORT](https://www.codechef.com/problems/SPSHORT), [editorial](https://discuss.codechef.com/questions/64224/spshort-editorial) (slightly difficult dijkstra's problem.)
    - codechef.com - [RIVPILE](https://www.codechef.com/problems/RIVPILE), [editorial](https://discuss.codechef.com/questions/18188/rivpile-editorial)
    - spoj.com - [SHPATH](http://www.spoj.com/problems/SHPATH/)
    - spoj.com - [TRAFFICN](http://www.spoj.com/problems/TRAFFICN/)
    - spoj.com - [SAMER08A](http://www.spoj.com/problems/SAMER08A/)
    - spoj.com - [MICEMAZE](http://www.spoj.com/problems/MICEMAZE/)
    - spoj.com - [TRVCOST](http://www.spoj.com/problems/TRVCOST/)
    - codechef.com - [PAIRCLST](https://www.codechef.com/problems/PAIRCLST), [editorial](https://discuss.codechef.com/questions/79923/pairclst-editorial)
* **Bellman Ford Algorithm**
  + Resources
    - geeksforgeeks.org - [Dynamic Programming - Bellman–Ford Algorithm](http://www.geeksforgeeks.org/dynamic-programming-set-23-bellman-ford-algorithm/)
    - compprog.wordpress.com - ;[One Source Shortest Path - Bellman-Ford Algorithm](https://compprog.wordpress.com/2007/11/29/one-source-shortest-path-the-bellman-ford-algorithm/" \t "_blank)
  + Practice Problem
    - community.topcoder.com - [PeopleYouMayKnow](https://community.topcoder.com/stat?c=problem_statement&pm=10580" \t "_blank)
    - codeforces.com - [D. Robot Control](http://codeforces.com/problemset/problem/346/D)
    - spoj.com - [ARBITRAG - Arbitrage](http://www.spoj.com/problems/ARBITRAG/) ;(Floyd Warshall)
    - community.topcoder.com - [NetworkSecurity](http://community.topcoder.com/stat?c=problem_statement&pm=10736" \t "_blank) ;(Floyd Warshall)
* **Minimum spanning tree (Prim and Kruskal algorithms)**
  + Resources
    - algs4.cs.princeton.edu - [Minimum Spanning Trees](http://algs4.cs.princeton.edu/lectures/43MinimumSpanningTrees.pdf)
    - iarcs.org.in - [Spanning trees](https://www.iarcs.org.in/inoi/online-study-material/topics/spanning-trees.php)
    - visualgo.net - [Spanning Tree](https://visualgo.net/en/mst)
  + Practice Problem
    - spoj.com - [MST](http://www.spoj.com/problems/MST/)
    - spoj.com - [NITTROAD](http://www.spoj.com/problems/NITTROAD/)
    - spoj.com - [BLINNET](http://www.spoj.com/problems/BLINNET/)
    - spoj.com - [CSTREET](http://www.spoj.com/problems/CSTREET/)
    - spoj.com - [HIGHWAYS](http://www.spoj.com/problems/HIGHWAYS/)
    - spoj.com - [IITWPC4I](http://www.spoj.com/problems/IITWPC4I/)
    - codechef.com - [MSTQS](https://www.codechef.com/problems/MSTQS), [editorial](https://discuss.codechef.com/questions/89653/mstqs-editorial)
    - codechef.com - [CHEFGAME](https://www.codechef.com/problems/CHEFGAME), [editorial](https://discuss.codechef.com/questions/8119/chefgame-editorial)
    - codechef.com - [GALACTIK](https://www.codechef.com/problems/GALACTIK), [editorial](https://discuss.codechef.com/questions/18004/galactik-editorial)
    - codechef.com - [GOOGOL03](https://www.codechef.com/problems/GOOGOL03), [editorial](https://discuss.codechef.com/questions/70187/googol03-editorial)
    - spoj.com - [KOICOST](http://www.spoj.com/problems/KOICOST/)
* **Biconnectivity in undirected graphs (bridges, articulation points)**
  + Resources
    - e-maxx-eng.appspot.com - [Finding Bridges in a Graph](https://e-maxx-eng.appspot.com/graph/bridge-searching.html)
    - iarcs.org.in - [Articulation Points](https://www.iarcs.org.in/inoi/online-study-material/topics/articulation-points.php)
    - pisces.ck.tp.edu.tw - [Articulation Points](http://pisces.ck.tp.edu.tw/~peng/index.php?action=showfile&file=fb1f19a9be617037cb419c5d454b184bead47e243)
  + Practice Problem
    - uva.onlinejudge.org - [Network](https://uva.onlinejudge.org/index.php?option=onlinejudge&page=show_problem&problem=251)
    - icpcarchive.ecs.baylor.edu - [Building Bridges](https://icpcarchive.ecs.baylor.edu/index.php?option=onlinejudge&page=show_problem&problem=722)
    - uva.onlinejudge.org - [Tourist Guide](https://uva.onlinejudge.org/index.php?option=onlinejudge&page=show_problem&problem=1140)
    - acm.tju.edu.cn - [Network](http://acm.tju.edu.cn/toj/showp1026.html)
    - spoj.com - [EC\_P - Critical Edges](http://www.spoj.com/problems/EC_P/)
    - spoj.com - [SUBMERGE - Submerging Islands](http://www.spoj.com/problems/SUBMERGE/)
    - spoj.com - [POLQUERY - Police Query](http://www.spoj.com/problems/POLQUERY/)
    - codeforces.com - [A. Cutting Figure](http://codeforces.com/problemset/problem/193/A)
* **Strongly connected components in directed graphs**
  + Resources
    - iarcs.org.in - [Strongly connected components](https://www.iarcs.org.in/inoi/online-study-material/topics/scc.php)
    - theory.stanford.edu - [Strongly Connected Components](http://theory.stanford.edu/~tim/w11/l/scc.pdf)
  + Practice Problem
    - spoj.com - [ANTTT](http://www.spoj.com/problems/ANTTT/)
    - spoj.com - [CAPCITY](http://www.spoj.com/problems/CAPCITY/)
    - spoj.com - [SUBMERGE](http://www.spoj.com/problems/SUBMERGE/)
    - codechef.com - [MCO16405](https://www.codechef.com/problems/MCO16405), [editorial](https://discuss.codechef.com/questions/91585/mco16405-editorial)
    - spoj.com - [BOTTOM](http://www.spoj.com/problems/BOTTOM/)
    - spoj.com - [BREAK](http://www.spoj.com/problems/BREAK/)
    - community.topcoder.com - [Marble Collection Game](https://community.topcoder.com/stat?c=problem_statement&pm=8488&rd=11125)
* **Topological Sorting**
  + Resources
    - geeksforgeeks.org - [Topological Sorting](http://www.geeksforgeeks.org/topological-sorting/)
  + Practice Problem
    - spoj.com - [TOPOSORT](http://www.spoj.com/problems/TOPOSORT/) ;
    - codeforces.com - [C. Fox And Names](http://codeforces.com/contest/510/problem/C) ;
    - codechef.com - [RRDAG](https://www.codechef.com/problems/RRDAG), [editorial](https://discuss.codechef.com/questions/47983/rrdag-editorial)
    - spoj.com - [RPLA](http://www.spoj.com/problems/RPLA/)
    - codechef.com - [CL16BF](https://www.codechef.com/problems/CL16BF) (topological sort with dp), [editorial](https://discuss.codechef.com/questions/85994/cl16bf-editorial)
    - spoj.com - [MAKETREE](http://www.spoj.com/problems/MAKETREE/)
* **Euler path, tour/cycle.**
  + Resources
    - math.ku.edu - [Euler Paths and Euler Circuits](http://jlmartin.faculty.ku.edu/~jlmartin/courses/math105-F11/Lectures/chapter5-part2.pdf)
  + Practice Problem
    - spoj.com - [WORDS1](http://www.spoj.com/problems/WORDS1/)
    - codechef.com - [CHEFPASS](https://www.codechef.com/problems/CHEFPASS), [editorial](https://discuss.codechef.com/questions/2096/chefpass-editorial)
    - codechef.com - [TOURISTS](https://www.codechef.com/problems/TOURISTS), [editorial](https://discuss.codechef.com/questions/90320/tourists-editorial)
    - codeforces.com - [D. New Year Santa Network](http://codeforces.com/contest/500/problem/D)
    - [B. Strongly Connected City](http://codeforces.com/contest/475/problem/B)
    - codechef.com - [PEOPLOVE](https://www.codechef.com/problems/PEOPLOVE)
    - codeforces.com - [D. Tanya and Password](http://codeforces.com/contest/508/problem/D)
    - codeforces.com - [E. One-Way Reform](http://codeforces.com/contest/723/problem/E)
    - spoj.com - [GCPC11C](http://www.spoj.com/problems/GCPC11C/)
    - spoj.com - [MAKETREE](http://www.spoj.com/problems/MAKETREE/)
* **Modular arithmetic including division, inverse**
  + Resources
    - codechef.com - [Fast Modulo Multiplication (Exponential Squaring)](https://discuss.codechef.com/questions/20451/a-tutorial-on-fast-modulo-multiplication-exponential-squaring)
    - codechef.com - [Best known algos for calculating nCr % M](https://discuss.codechef.com/questions/3869/best-known-algos-for-calculating-ncr-m) ;(only for expert level)
* **Amortized Analysis**
  + Resources
    - ocw.mit.edu - [Amortized Analysis](https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2012/lecture-notes/MIT6_046JS12_lec11.pdf)
    - wikipedia.org - [Amortized Analysis](https://en.wikipedia.org/wiki/Amortized_analysis)
    - iiitdm.ac.in - [Amortized Analysis](http://www.iiitdm.ac.in/old/Faculty_Teaching/Sadagopan/pdf/ADSA/amortized-analysis.pdf)
* **Divide and Conquer**
  + Resources
    - cs.cmu.edu - [Divide-and-Conquer and Recurrences](http://www.cs.cmu.edu/afs/cs/academic/class/15210-s12/www/lectures/lecture02.pdf)
    - geeksforgeeks.org - [Divide-and-Conquer](http://www.geeksforgeeks.org/category/divide-and-conquer/)
  + Practice Problem
    - codechef.com - [MRGSRT](https://www.codechef.com/problems/MRGSRT), [editorial](https://discuss.codechef.com/questions/70773/mrgsrt-editorial)
    - spoj.com - [HISTOGRA](http://www.spoj.com/problems/HISTOGRA/)
    - codechef.com - [TASTYD](https://www.codechef.com/problems/TASTYD), [editorial](https://discuss.codechef.com/questions/15957/tastyd-editorial)
    - codechef.com - [RESTPERM](https://www.codechef.com/problems/RESTPERM), [editorial](https://discuss.codechef.com/questions/86763/restperm-editorial)
    - codechef.com - [ACM14KP1](https://www.codechef.com/problems/ACM14KP1), [editorial](https://discuss.codechef.com/questions/56980/acm14kp1-editorial)
* **Advanced Dynamic Programming** problems (excluding the dp optimizations which are added in expert level, Please go through the basic DP resources and problems mentioned in foundation level resource.)
  + Resources
  + [Dynamic Programming: From Novice to Advanced (topcoder.com)](https://www.topcoder.com/thrive/articles/Dynamic%20Programming:%20From%20Novice%20to%20Advanced)
    - apps.topcoder.com - [Commonly used DP state domains](http://apps.topcoder.com/forums/?module=Thread&threadID=697369&start=0)
    - apps.topcoder.com - [Introducing Dynamic Programming](http://apps.topcoder.com/forums/?module=Thread&threadID=700080&start=0)
    - apps.topcoder.com - [Optimizing DP solution](http://apps.topcoder.com/forums/?module=Thread&threadID=697925&start=0)
    - codeforces.com - [DP over Subsets and Paths](http://codeforces.com/blog/entry/337)
  + Problems for Advanced DP
    - spoj.com - [HIST2](http://www.spoj.com/problems/HIST2/) ;(dp bitmask)
    - spoj.com - [LAZYCOWS](http://www.spoj.com/problems/LAZYCOWS/) ;(dp bitmask)
    - spoj.com - [TRSTAGE](http://www.spoj.com/problems/TRSTAGE/) ;(dp bitmask)
    - spoj.com - [MARTIAN](http://www.spoj.com/problems/MARTIAN/)
    - spoj.com - [SQRBR](http://www.spoj.com/problems/SQRBR/)
    - spoj.com - [ACMAKER](http://www.spoj.com/problems/ACMAKER/)
    - spoj.com - [AEROLITE](http://www.spoj.com/problems/AEROLITE/)
    - spoj.com - [BACKPACK](https://www.spoj.com/problems/BACKPACK/)
    - spoj.com - [COURIER](http://www.spoj.com/problems/COURIER/)
    - spoj.com - [DP](http://www.spoj.com/problems/DP/)
    - spoj.com - [EDIST](http://www.spoj.com/problems/EDIST/)
    - spoj.com - [KRECT](http://www.spoj.com/problems/KRECT/)
    - spoj.com - [GNY07H](http://www.spoj.com/problems/GNY07H/)
    - spoj.com - [LISA](http://www.spoj.com/problems/LISA/)
    - spoj.com - [MINUS](http://www.spoj.com/problems/MINUS/)
    - spoj.com - [NAJKRACI](http://www.spoj.com/problems/NAJKRACI/)
    - spoj.com - [PHIDIAS](http://www.spoj.com/problems/PHIDIAS/)
    - spoj.com - [PIGBANK](http://www.spoj.com/problems/PIGBANK/)
    - spoj.com - [PT07X](http://www.spoj.com/problems/PT07X/)
    - spoj.com - [VOCV](http://www.spoj.com/problems/VOCV/)
    - spoj.com - [TOURIST](http://www.spoj.com/problems/TOURIST/)
    - spoj.com - [MKBUDGET](http://www.spoj.com/problems/MKBUDGET)
    - spoj.com - [MMAXPER](http://www.spoj.com/problems/MMAXPER)
    - spoj.com - [ANARC07G](http://www.spoj.com/problems/ANARC07G)
    - spoj.com - [MENU](http://www.spoj.com/problems/MENU)
    - spoj.com - [RENT](http://www.spoj.com/problems/RENT/) ;(dp with segment tree/BIT)
    - spoj.com - [INCSEQ](http://www.spoj.com/problems/INCSEQ/) ;(dp with segment tree/BIT)
    - spoj.com - [INCDSEQ](http://www.spoj.com/problems/INCDSEQ/) ;(dp with segment tree/BIT)
    - You can solve some advanced problems from
    - codeforces.com - [Dynamic Programming Type](http://codeforces.com/blog/entry/325)
* **Sieve of Eratosthenes**
  + Resources:
    - codechef.com - [Sieve Methods](https://discuss.codechef.com/questions/54846/please-proofread-the-atricle-for-tutorial-section-on-sieve-methods)
  + Practice Problems
    - spoj.com - [TDKPRIME](http://www.spoj.com/problems/TDKPRIME/)
    - spoj.com - [TDPRIMES](http://www.spoj.com/problems/TDPRIMES/)
    - spoj.com - [ODDDIV](http://www.spoj.com/problems/ODDDIV/) ;(sieve + binary search)
    - spoj.com - [NDIVPHI](http://www.spoj.com/problems/NDIVPHI/) ;O(N) prime testing algorithm)
    - spoj.com - [DIV](http://www.spoj.com/problems/DIV/) ;(divisor sieve)
    - codechef.com - [LEVY](https://www.codechef.com/problems/LEVY), [editorial](https://discuss.codechef.com/questions/8115/levy-editorial)
    - codechef.com - [PRETNUM](https://www.codechef.com/problems/PRETNUM), [editorial](https://discuss.codechef.com/questions/28909/pretnum-editorial)
    - codechef.com - [KPRIME](https://www.codechef.com/problems/KPRIME), [editorial](https://discuss.codechef.com/questions/17915/kprime-editorial)
    - codechef.com - [DIVMAC](https://www.codechef.com/problems/DIVMAC), [editorial](https://discuss.codechef.com/questions/84917/divmac-editorial-unofficial) (segment tree with sieve)
    - codechef.com - [PPERM](https://www.codechef.com/problems/PPERM), [editorial](https://discuss.codechef.com/questions/2555/pperm-editorial) ;(a bit advanced sieve application)
* **General**
  + [Stanford Algoriths 1](https://www.youtube.com/playlist?list=PLXFMmlk03Dt7Q0xr1PIAriY5623cKiH7V)
  + [Stanford Algoriths 2](https://www.youtube.com/playlist?list=PLXFMmlk03Dt5EMI2s2WQBsLsZl7A5HEK6)