**List of Mathematics Topics for programming Competitions -**

1. **Basic Geometry/Euclidean Geometry/Coordinate Geometry/ [3-D variants of everything].**
2. ***Computational Geometry.***
   1. **Graham Scan algorithm for Convex Hull O(n \* log(n)).**
   2. **Online construction of 3-D convex hull in O(n^2).**
   3. **Bentley Ottmann algorithm to list all intersection points of n line segments in O((n + I) \* logn).**
      * Suggested Reading -
        1. [http://softsurfer.com/Archive/algorithm\_0108/algorithm\_0108.htm](http://www.google.com/url?q=http%3A%2F%2Fsoftsurfer.com%2FArchive%2Falgorithm_0108%2Falgorithm_0108.htm&sa=D&sntz=1&usg=AFQjCNGHQhcxX4Fmwl4SNxT_aka8mbXabQ)
   4. **Rotating Calipers Technique.**
      * Suggested Reading - [http://cgm.cs.mcgill.ca/~orm/rotcal.html](http://www.google.com/url?q=http%3A%2F%2Fcgm.cs.mcgill.ca%2F~orm%2Frotcal.html&sa=D&sntz=1&usg=AFQjCNEpr1ZpsZJ56mVXjfaYMG2f2sCbCA)
      * Problems - Refer the article for a list of problems which can be solved using Rotating Calipers technique.
   5. **Line Sweep/Plane Sweep algorithms -**
      * Area/Perimeter of Union of Rectangles.
      * Closest pair of points.
      * Suggested Reading -
        1. [http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=lineSweep](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Ftc%3Fmodule%3DStatic%26d1%3Dtutorials%26d2%3DlineSweep&sa=D&sntz=1&usg=AFQjCNHfGJkCXE6CJ6cW8GrhVB1sRa18nA)
      * Problems - Follow the tutorial for list of problems.
   6. **Area of Union of Circles.**
   7. **Delayunay Triangulation of n points in O(n \* logn).**
   8. **Voronoi Diagrams of n points in O(n \* logn) using Fortunes algorithm.**
   9. **Point in a polygon problem -**
      * O(n) solution without preprocessing.
      * O(logn) algorithm with O(n \* logn) preprocessing for convex polygons.
   10. **Problems on computational geometry -**
       * [BSHEEP](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FBSHEEP&sa=D&sntz=1&usg=AFQjCNHrQnQIXAHii4tur4t2muJJ7pzzIQ), [BULK](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FBULK&sa=D&sntz=1&usg=AFQjCNGkGqPc5jyvbR7umTXGAzOkyrV04Q), [SEGVIS](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FSEGVIS&sa=D&sntz=1&usg=AFQjCNHDL6-G9gyo1nQq4r_XBmOx3BdDWw), [CONDUIT](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCONDUIT&sa=D&sntz=1&usg=AFQjCNE_T_3ZvKY12Cj_wWBMJHES59QvxQ), [RUNAWAY](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FRUNAWAY&sa=D&sntz=1&usg=AFQjCNGUJdoxwo00a81YJmgEQv2c9tKAmA), [DIRVS](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FDIRVS&sa=D&sntz=1&usg=AFQjCNGLi0ndUIgEia_o767dVma82r3FCg), [RAIN1](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FRAIN1&sa=D&sntz=1&usg=AFQjCNHlj9N3r6qaVHAQn7yd9C_MSYsDzQ), [SHAMAN](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FSHAMAN&sa=D&sntz=1&usg=AFQjCNFfHJa2psJr09sW-TsMvHnV8NoJyg), [TCUTTER](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FTCUTTER&sa=D&sntz=1&usg=AFQjCNGkc7R1QswuEHQDfSbgm1CN_EuouA), [LITEPIPE](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FLITEPIPE&sa=D&sntz=1&usg=AFQjCNG5Gr3w6r78MNgTq7C3Z8-Q7A1Vag), [RHOMBS](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FRHOMBS&sa=D&sntz=1&usg=AFQjCNHFV81La4xqxYB8xtqDZro8GPc7yg), [FSHEEP](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FFSHEEP&sa=D&sntz=1&usg=AFQjCNGGKcTJ2DoyhrRJoHP9H2fgwgJ2ow), [FLBRKLIN](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FFLBRKLIN&sa=D&sntz=1&usg=AFQjCNGt2YjKpjnfXjs2zuocFIi9GsayBg), [CERC07P](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCERC07P&sa=D&sntz=1&usg=AFQjCNFPzmHxOyMDyEA8usNeWT8NDgGWpQ), [BAC](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FBAC&sa=D&sntz=1&usg=AFQjCNF3Q6F6POk-t7n4MqmfIGAZqOwkNA), [ALTARS](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FALTARS&sa=D&sntz=1&usg=AFQjCNH_qtGg91a3u6FSVb4uY1zD7UXFKA), [CERC07C](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCERC07C&sa=D&sntz=1&usg=AFQjCNFKDRB_j5Tn4EbPpy4z9rhTROKe8w), [NECKLACE](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FNECKLACE&sa=D&sntz=1&usg=AFQjCNFtVet7fKaSrNYEB40ZwPcZ2jtZ3w), [CH3D](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCH3D&sa=D&sntz=1&usg=AFQjCNFxd1wPbbMpMCY1ufqoBATQ3mcwDA), [RECTANGL](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FRECTANGL&sa=D&sntz=1&usg=AFQjCNHOvAwG0bLHV39ptONdr9jjsG4xlQ), [POLYSSQ](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FPOLYSSQ&sa=D&sntz=1&usg=AFQjCNHCsZRqf52QIsalJ6JnyBiEnvnFWA), [FOREST2](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FFOREST2&sa=D&sntz=1&usg=AFQjCNEyyyTMF69-Fc_HSEMoc3xTku42gA), [KPPOLY](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FKPPOLY&sa=D&sntz=1&usg=AFQjCNHvsQMxoQ1UKJEUIwZ453CWCe6u-A), [RAIN2](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FRAIN2&sa=D&sntz=1&usg=AFQjCNGmC6HqrcPL9yywlwZjWCQ-a2A-KA), [SEGMENTS](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FSEGMENTS&sa=D&sntz=1&usg=AFQjCNHilM8lQ6O66NjaVUHiKzzX8d4Lqw), [ARCHPLG](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FARCHPLG&sa=D&sntz=1&usg=AFQjCNHxZxWl6kTRlLwSm5f-hRVhBaoXUw), [BALLOON](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FBALLOON&sa=D&sntz=1&usg=AFQjCNFJ2JC9vsd6-cgcKyvkSAIyTnAHyg), [CIRCLES](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCIRCLES&sa=D&sntz=1&usg=AFQjCNFBjOye5vwvHjFQZcU6pgm1CB4_4Q), [COMPASS](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCOMPASS&sa=D&sntz=1&usg=AFQjCNHxm9AZPj8aQYHlsQmoumsQmQeBZA), [EOWAMRT](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FEOWAMRT&sa=D&sntz=1&usg=AFQjCNH4RUwwKEfP3vpekPDoq20y2476SA), [ICERINK](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FICERINK&sa=D&sntz=1&usg=AFQjCNFF6PcrYWaK17Tt82GYwmPbqm1wCQ) on SPOJ.
       * [CultureGrowth](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D3996&sa=D&sntz=1&usg=AFQjCNH8N6avfA-fum614aB6dS5nlKuSMA), [PolygonCover](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D8540&sa=D&sntz=1&usg=AFQjCNF7chzZhWrZMOyIjnfQTRX6vYE_yw) on Topcoder.
   11. **Suggested Reading -** 
       * Computational Geometry: Algorithms and applications. Mark De Burg.
3. ***Number Theory.***
   1. **Modulus arithmetic - basic postulates [Including modular linear equations , Continued fraction and Pell's equation]**
      * Suggested Reading -
        1. Chapter 1 from Number Theory for Computing by SY Yan [ Recommended ]
        2. 31.1, 31.3 and 31.4 from Cormen
        3. [www.topcoder.com/tc?module=Static&d1=tutorials&d2=primeNumbers](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Ftc%3Fmodule%3DStatic%26d1%3Dtutorials%26d2%3DprimeNumbers&sa=D&sntz=1&usg=AFQjCNEKO-9OH1cY7-GbcfcNiR8oliKDAw)
      * Problems
        1. [http://projecteuler.net/index.php?section=problems&id=64](http://www.google.com/url?q=http%3A%2F%2Fprojecteuler.net%2Findex.php%3Fsection%3Dproblems%26id%3D64&sa=D&sntz=1&usg=AFQjCNGll3P-CKppQF_DQ6Yr9T4x7dZC8w)
        2. [http://projecteuler.net/index.php?section=problems&id=65](http://www.google.com/url?q=http%3A%2F%2Fprojecteuler.net%2Findex.php%3Fsection%3Dproblems%26id%3D65&sa=D&sntz=1&usg=AFQjCNGRZ70ap9kDbPXryA6cMFViXowVCA)
        3. [http://projecteuler.net/index.php?section=problems&id=66](http://www.google.com/url?q=http%3A%2F%2Fprojecteuler.net%2Findex.php%3Fsection%3Dproblems%26id%3D66&sa=D&sntz=1&usg=AFQjCNHvCY0cBg2UWT-wxVxnGkO1kG5o2w)
        4. [http://www.topcoder.com/stat?c=problem\_statement&pm=6408&rd=9826](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D6408%26rd%3D9826&sa=D&sntz=1&usg=AFQjCNEaPQEfpWWOP6othlFGpzb9vf9D6g)
        5. [http://www.topcoder.com/stat?c=problem\_statement&pm=2342](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D2342&sa=D&sntz=1&usg=AFQjCNHa_Cy1GHASfzpAKSx8X_TAVSnHNQ)
   2. **Fermat's theorem, Euler Totient theorem ( totient function, order , primitive roots )**
      * Suggested Reading
        1. 1.6, 2.2 from Number Theory by SY Yan
        2. 31.6 , 31.7 from Cormen
      * Problems
        1. [http://projecteuler.net/index.php?section=problems&id=70](http://www.google.com/url?q=http%3A%2F%2Fprojecteuler.net%2Findex.php%3Fsection%3Dproblems%26id%3D70&sa=D&sntz=1&usg=AFQjCNHP2ypWWT0KRj6wJ-43wcZV3SfDnQ)
        2. [http://www.spoj.pl/problems/NDIVPHI/](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FNDIVPHI%2F&sa=D&sntz=1&usg=AFQjCNHhJ8fV9Sqpt2WM30pD1nlrjbv7aA)
   3. **Chinese remainder theorem**
      * Suggested Reading
        1. 31.5 from Cormen
        2. 1.6 from Number Theory by SY Yan
      * Problems
        1. Project Euler 271
        2. [http://www.topcoder.com/stat?c=problem\_statement&pm=10551&rd=13903](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D10551%26rd%3D13903&sa=D&sntz=1&usg=AFQjCNHkwpzK0Y7bpA1ZxggqA_wJ2bFGJQ)
   4. **Primality tests -**
      * Deterministic O(sqrt(n) ) approach
      * Probabilistic primality tests - Fermat primality test, Miller-Rabin Primality test
        1. Suggested Reading -
           1. [*http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=primalityTesting*](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Ftc%3Fmodule%3DStatic%26d1%3Dtutorials%26d2%3DprimalityTesting&sa=D&sntz=1&usg=AFQjCNGESIkX7rmPFjJ_yx8IKxuZRsNA4A)
           2. Cormen 31.8
           3. 2.2 from Number Theory by SY Yan
        2. Problems -
           1. PON, PRIC, SOLSTRAS on SPOJ
           2. [http://www.topcoder.com/stat?c=problem\_statement&pm=4515](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D4515&sa=D&sntz=1&usg=AFQjCNEv8xM30xjlA71lK3bgsX6u5vrt6A)
   5. **Prime generation techniques - Sieve of Erastothenes**
      * Suggested Problems - PRIME1 on SPOJ
   6. **GCD using euclidean method**
      * Suggested Reading
        1. 31.2 Cormen
      * Problems -
        1. GCD on SPOJ
        2. [http://uva.onlinejudge.org/external/114/11424.html](http://www.google.com/url?q=http%3A%2F%2Fuva.onlinejudge.org%2Fexternal%2F114%2F11424.html&sa=D&sntz=1&usg=AFQjCNFocMHM1lWNT9MtA3A1yRHROmaMKg)
   7. **Logarithmic Exponentiation**
      * Suggested Reading -
        1. [http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=primalityTesting](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Ftc%3Fmodule%3DStatic%26d1%3Dtutorials%26d2%3DprimalityTesting&sa=D&sntz=1&usg=AFQjCNGESIkX7rmPFjJ_yx8IKxuZRsNA4A)
   8. **Integer Factorization**
      * Naive O(sqrt(n)) method
      * Pollard Rho factorization
      * Suggested Reading
        1. 2.3 from Number Theory SY Yan 2. 31.9 Cormen
      * Problems -
        1. [http://www.topcoder.com/stat?c=problem\_statement&pm=2986&rd=5862](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D2986%26rd%3D5862&sa=D&sntz=1&usg=AFQjCNGQkQftHtaGV4CVVUt4H0UXslmofg)
        2. [http://www.spoj.pl/problems/DIVSUM2/](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FDIVSUM2%2F&sa=D&sntz=1&usg=AFQjCNGsmpSq4SsVqrMMRVVt8XYE7TKANA)
        3. [http://www.topcoder.com/stat?c=problem\_statement&pm=4481&rd=6538](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D4481%26rd%3D6538&sa=D&sntz=1&usg=AFQjCNH1lO1gpDJ99YMALj5A4EtciLlThw)
   9. **Stirling numbers**
   10. **Wilson theorem**
       * nCr % p in O(p) preprocess and O(log n ) query
   11. **Lucas Theorem**
   12. **Suggested Reading for Number Theory -**
       * Number theory for computing by Song Y Yan [ Simple book describing concepts in details ]
       * Concepts are also superficially covered in Chapter 31 of Introduction to Algorithms by Cormen
       * [http://www.codechef.com/wiki/tutorial-number-theory](http://www.google.com/url?q=http%3A%2F%2Fwww.codechef.com%2Fwiki%2Ftutorial-number-theory&sa=D&sntz=1&usg=AFQjCNHPFa-C7y2hFvP0lqY1SkoC4C9zxQ)
       * [http://www.algorithmist.com/index.php/Category:Number\_Theory](http://www.google.com/url?q=http%3A%2F%2Fwww.algorithmist.com%2Findex.php%2FCategory%3ANumber_Theory&sa=D&sntz=1&usg=AFQjCNH0jypXH-endzREh_SEoxeQ9QAXhQ)
   13. **Problems on Number Theory -** 
       * [http://www.algorithmist.com/index.php/Category:Number\_Theory](http://www.google.com/url?q=http%3A%2F%2Fwww.algorithmist.com%2Findex.php%2FCategory%3ANumber_Theory&sa=D&sntz=1&usg=AFQjCNH0jypXH-endzREh_SEoxeQ9QAXhQ)
       * <http://problemclassifier.appspot.com/index.jsp?search=number&usr=>
4. **Math (Probability, Counting, Game Theory, Group Theory, Generating functions, Permutation Cycles, Linear Algebra)**
   1. **Probability.**

*Syllabus*

* + - **Basic probability and Conditional probability**
      1. Suggested problems
         1. [http://www.spoj.pl/problems/CT16E/](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCT16E%2F&sa=D&sntz=1&usg=AFQjCNG6_fDMZSsBGjcjtCWCtENiLOOkRg)
         2. [http://www.spoj.pl/problems/CHICAGO/](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FCHICAGO%2F&sa=D&sntz=1&usg=AFQjCNFYu0---9CwCb7xC3uaBGyM2-Tl4A)
    - **Random variables, probability generating functions**
    - **Mathematical expectation + Linearity of expectation**
      1. Suggested problems
         1. [http://www.spoj.pl/problems/FAVDICE/](http://www.google.com/url?q=http%3A%2F%2Fwww.spoj.pl%2Fproblems%2FFAVDICE%2F&sa=D&sntz=1&usg=AFQjCNGV35ZgvRCvmAlQKSNX-N6RGBDRig)
         2. [http://www.topcoder.com/stat?c=problem\_statement&pm=10744](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Fstat%3Fc%3Dproblem_statement%26pm%3D10744&sa=D&sntz=1&usg=AFQjCNFOwPTb_3uuVf15P_SQ3lE0ICTq4w)
    - **Special discrete and continuous probability distributions**
      1. Bernoulli, Binomial, Poisson, normal distribution
      2. Suggested Problem
         1. [http://acm.sgu.ru/problem.php?contest=0&problem=498](http://www.google.com/url?q=http%3A%2F%2Facm.sgu.ru%2Fproblem.php%3Fcontest%3D0%26problem%3D498&sa=D&sntz=1&usg=AFQjCNE-qseN_HAzaurfwTjN5zt07D5jTg)
    - **Suggested Readings**
      1. Cormen appendix C (very basic)
      2. Topcoder probabilty tutorial [http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=probabilities](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Ftc%3Fmodule%3DStatic%26d1%3Dtutorials%26d2%3Dprobabilities&sa=D&sntz=1&usg=AFQjCNHov438KhnvQhbabtoM8UCrZFZV0g)
      3. [http://en.wikipedia.org/wiki/Random\_variable](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FRandom_variable&sa=D&sntz=1&usg=AFQjCNEkvOf1b56_vUlvlokh_0DAPF4erg)
      4. [http://en.wikipedia.org/wiki/Expected\_value](http://www.google.com/url?q=http%3A%2F%2Fen.wikipedia.org%2Fwiki%2FExpected_value&sa=D&sntz=1&usg=AFQjCNG9JtXu_jF4NOyIEA_JqbZxSVtR7w)
      5. William Feller, An introduction to probability theory and its applications
  1. **Counting**

*Syllabus*

* + - **Basic principles - Pigeon hole principle, addition, multiplication rules**
      1. Suggested problems
         1. http://acm.timus.ru/problem.aspx?space=1&num=1690
         2. http://www.topcoder.com/stat?c=problem\_statement&pm=10805
      2. Suggested readings
         1. http://en.wikipedia.org/wiki/Combinatorial\_principles
         2. http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=combinatorics
         3. http://www.maa.org/editorial/knot/pigeonhole.html
    - **Inclusion-exclusion**
      1. Suggested readings
         1. http://en.wikipedia.org/wiki/Inclusion–exclusion\_principle
      2. Suggested problems
         1. http://www.topcoder.com/stat?c=problem\_statement&pm=4463&rd=6536
         2. http://www.topcoder.com/stat?c=problem\_statement&pm=10238
    - **Special numbers** 
      1. Suggested reading - Stirling, eurlerian, harmonic, bernoulli, fibonnacci numbers
         1. http://en.wikipedia.org/wiki/Stirling\_number
         2. http://en.wikipedia.org/wiki/Eulerian\_numbers
         3. http://en.wikipedia.org/wiki/Harmonic\_series\_(mathematics)
         4. http://en.wikipedia.org/wiki/Bernoulli\_number
         5. http://en.wikipedia.org/wiki/Fibonnaci\_numbers
         6. Concrete mathematics by Knuth
      2. Suggested problems
         1. http://www.topcoder.com/stat?c=problem\_statement&pm=1643
         2. http://www.topcoder.com/stat?c=problem\_statement&pm=8202&rd=11125
         3. http://www.topcoder.com/stat?c=problem\_statement&pm=8725
         4. http://www.topcoder.com/stat?c=problem\_statement&pm=2292&rd=10709
    - **Advanced counting techniques - Polya counting, burnsides lemma**
      1. Suggested reading
         1. http://en.wikipedia.org/wiki/Burnside's\_lemma
         2. http://petr-mitrichev.blogspot.com/2008/11/burnsides-lemma.html
      2. Suggested Problems
         1. http://www.topcoder.com/stat?c=problem\_statement&pm=9975
         2. http://www.spoj.pl/problems/TRANSP/

**c. Game theory**

*Syllabus*

* + - **Basic principles and Nim game**
      1. **Sprague grundy theorem, grundy numbers**
      2. Suggested readings
         1. http://en.wikipedia.org/wiki/Sprague%E2%80%93Grundy\_theorem
         2. http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=algorithmGames
         3. http://www.ams.org/samplings/feature-column/fcarc-games1
         4. http://www.codechef.com/wiki/tutorial-game-theory
      3. Suggested problems
         1. http://www.topcoder.com/stat?c=problem\_statement&pm=3491&rd=6517
         2. http://www.topcoder.com/stat?c=problem\_statement&pm=3491&rd=6517
    - **Hackenbush**
      1. Suggested readings
         1. http://en.wikipedia.org/wiki/Hackenbush
         2. http://www.ams.org/samplings/feature-column/fcarc-partizan1
      2. Suggested problems
         1. http://www.cs.caltech.edu/ipsc/problems/g.html
         2. http://www.spoj.pl/problems/PT07A/

**d. Linear Algebra**

*Syllabus*

* + - **Matrix Operations**
      1. **Addition and subtraction of matrices**
         1. Suggested Reading

Cormen 28.1

* + - 1. **Multiplication ( Strassen's algorithm ), logarithmic exponentiation**
         1. Suggested reading

Cormen 28.2

Linear Algebra by Kenneth Hoffman Section 1.6

* + - * 1. Problems

http://uva.onlinejudge.org/external/111/11149.html

* + - 1. **Matrix transformations [ Transpose, Rotation of Matrix, Representing Linear transformations using matrix ]**
         1. Suggested Reading

Linear Algebra By Kenneth Hoffman Section 3.1,3.2,3.4,3.7

* + - * 1. Problems

http://www.topcoder.com/stat?c=problem\_statement&pm=6877

JPIX on Spoj

* + - 1. **Determinant , Rank and Inverse of Matrix [ Gaussean Elimination , Gauss Jordan Elimination]**
         1. Suggested Reading

28.4 Cormen

Linear Algebra by Kenneth Chapter 1

* + - * 1. Problems

http://www.topcoder.com/stat?c=problem\_statement&pm=8174

http://www.topcoder.com/stat?c=problem\_statement&pm=6407&rd=9986

http://www.topcoder.com/stat?c=problem\_statement&pm=8587

HIGH on Spoj

* + - 1. **Solving system of linear equations**
         1. Suggested Reading

28.3 Cormen

Linear Algebra by Kenneth Chapter 1

* + - * 1. Problems -

http://www.topcoder.com/stat?c=problem\_statement&pm=3942&rd=6520

* + - 1. **Using matrix exponentiation to solve recurrences**
         1. Suggested Reading

[http://www.topcoder.com/tc?module=Static&d1=features&d2=010408](http://www.google.com/url?q=http%3A%2F%2Fwww.topcoder.com%2Ftc%3Fmodule%3DStatic%26d1%3Dfeatures%26d2%3D010408&sa=D&sntz=1&usg=AFQjCNHpIKTDyWZYmQ5DT1nW2aAGMR9SuA)

* + - * 1. Problems

REC, RABBIT1 , PLHOP on spoj

http://www.topcoder.com/stat?c=problem\_statement&pm=6386 , http://www.topcoder.com/stat?c=problem\_statement&pm=7262, http://www.topcoder.com/stat?c=problem\_statement&pm=6877

* + - 1. **Eigen values and Eigen vectors**
         1. Problems

http://www.topcoder.com/stat?c=problem\_statement&pm=2423&rd=4780

* + - **Polynomials**
      1. **Roots of a polynomial [ Prime factorization of a polynomial, Integer roots of a polynomial,**

**All real roots of a polynomial ]**

* + - * 1. Problems

http://www.topcoder.com/stat?c=problem\_statement&pm=8273&rd=10798

POLYEQ , ROOTCIPH on Spoj

* + - 1. **Lagrange Interpolation**
         1. Problems

http://www.topcoder.com/stat?c=problem\_statement&pm=10239

http://www.topcoder.com/stat?c=problem\_statement&pm=8725

**e. Permutation cycles**

* + - Suggested Reading
      1. Art of Computer Programming by Knuth Vol. 3
    - Problems
      1. ShuffleMethod, Permutation and WordGame on topcoder.

**f. Group Theory**

* + - **Bernside Lemma, Polias theorem**
      1. Suggested Reading
         1. Hernstein's topics in algebra
         2. <http://petr-mitrichev.blogspot.com/2008/11/burnsides-lemma.html>
      2. Problems
         1. TRANSP on spoj
         2. http://www.topcoder.com/stat?c=problem\_statement&pm=9975
  1. **Generating functions**
     + Suggested Reading
       1. Herbert Wilf's generating functionology
       2. Robert Sedgewick and Flajoulet's Combinatorial analysis

Resource <https://docs.google.com/document/d/1_dc3Ifg7Gg1LxhiqMMmE9UbTsXpdRiYh4pKILYG2eA4/edit>