#### **READ & PREPARE**

#### 1- Problem Statement

- Read Carefully Mark important details
- Input constraints / Output Format

## 2 – Sample Test Cases

-Trace, Check boundaries / Missed Cases

# 4 - Input Properties

- Over Flow (DP counting, ^\*+, exp)
- Precision
- <u>Graph</u>: complete, general, bipartite, tree, DAG, connectivity, directivity, self/multi edges
- <u>Polygon</u>: simple, convex, duplicate points, degenerate
- Constrained <u>Input Combinations</u>

# **5 - Output Properties (Boundaries)**

- Small: WA, RTE
- Large: overflow (intermediate), RTE

### **6- Constraints**

- $Small \le 42$
- -- n!, 2^n, 3^n, MeetInMiddle
- Medium
- -- BF, NlogM vs MlogN, NsqrtN
- Big
- -- Fake. Cancelled, Log, BinarySch
- -- MatrixPow, Cycle tricks
- -- Pre/After cycle, Simulate S steps
- -- Values reRank
- -- Recursion Pruning
- -- Functions: linear/quad, fake/exp

#### **INVESTIGATE**

- Solution Space Analysis: Problem type? bounds? Equ representation
- Domains? Graphical? Geometrical?
- Similar Problem? (mis) Lead?
- Abstraction(s) for Problem
- <u>Search Space</u>: Size? BF? BF State?
- <u>Draw</u>: elements, properties, relations, reformulate equations
- Reversed / Simplified Problem

#### **THINK**

- Think: On paper NOT on PC
- Think: Concretely & Symbolically
- Think: Divide & Conquer problem
- Think: Forward & Backward
- Think: With/out known Algorithms
- Observations use PC if better
- KISS
- Solving problem OR sub-problem?
- Rank & Attack Ideas
- Guess & Check

### **SOLVE**

- <u>Found</u> solution? Any simpler?
- -Solution Verification
- -- Test cases Verification
- -- Logic, Correctness Proof/Intuitive
- -- O(time), O(memory), Rec depth
- -- Look back Verification
- Solution failure? Think-code go-back

#### **BIG Order?**

- Exact # of operations big?
- Reduced variables?
- Reference of locality
- Clever tricks
- Pre-computation
- -- Full, Partial (Range Props)
- -- Preprocessing

## **Simplifications?**

- Adhock Simplification
- N Constraints -> 1 2 ... N
- 2D ->1\*1, 1\*2, 2\*1, 1\*N
- Polygons->convex->triangle
- N players -> 1->2..N Player
- Graph->DAG->Tree->Chain
- 3D->2D->1D
- Bases ->10, prime, [1-N]
- Big rectangles->Compressed

## **Reverse?**

- Adhock Reversing
- (Value -> Idx)  $\rightarrow$  BSch(idx)
- $X \rightarrow Y$ : Y=F(X) indicative, X Searchable
- Property Reverse
- -- MinSum =Total MaxSum
- -- Subsets with X = Total Subset !X
- -- Probability(X) = 1-prop(!X)

# **Optimization**

#### Common:

- Fake/dfs
- DP/greedy/bf
- -Binary Search/TS
- -Branch & Bound
- RMQ/LCA
- Line sweep
- AlgoX

## **Minimization**

- MCMF
- Min cut / vertex
- MST / Dijkstra
- Chull / mec

### **Maximization**

- Max flow / MCMF
- Max Independent Set
- Kruskal Reverse
- LIS/GCD

# **Search Algorithms**

- BFS / DFS / ID-dfs
- Backtracking
- Binary Search/TS
- Golden Ratio
- Meet in middle
- Divide & Conquer
- Branch & Bound
- Min Enclosing Circle

### DP

#### General

- State representation(s)
- Diff sub-states calls?
- -- move to state
- Cycles?
- -- Depth?
- -- Dijkstra / Bfs
- -- Dec(rement)-inc-dec

# **Types**

- Restricted / Range
- Counting
- Tree / Partitioning
- Extending table

#### **Concerns**

- Base case order
- Search space?
- -- Constrained pars
- Redundant pars

### **States**

- Canonical states?
- Local Minima
- Small substates cnt?
- Large pars
- Reduces fast? (e.g. /)

# **Counting Problems**

- DP
- Combinations / Perms
- Inclusion-exclusion
- Graph Power

### **Data Structures**

- Set/Heap /DisjointSets
- BIT
- Segmentation Tree
- Treab, KDT
- LCA/RMQ
- Hashing
- Interval Compression
- Quad Tree

# **Graph Algorithms**

- MST: Kruskal / Prime
- Dijkstra / Topological
- Convex Hull / Floyd
- Max Flow/Min Cut
- Max Matching
- Max Indep Set
- Min path/vertex cover
- Bellman / DConsts
- Euler/Postman

## **String Algorithms**

- Trie
- Permutation Cycles
- LIS / LCS
- Polynomial Hashing
- KMP / Aho Corasick
- Suffix tree/array

### **Mathematics**

- GCD/LCM/Phi/Mob
- NIM/Grundy/Chinese
- Seive/Factorization
- System of Linear Eqs
- Determinant
- Simplex/ Pick's Theo
- Numerical Integration
- Matrix Power
- Closed Form
- Pigeon Hole
- Triangle inequality
- Voronoi diagram

## **Adhock Algorithms**

- Greedy
- Line Sweep
- Sliding Window
- Canonical Form
- Grid Compression
- Constructive algos
- Test cases driven
- Randomization
- Time cut-off
- Stress Test & Observe

## **Decision Algorithms**

- 2SAT
- Difference constraints
- Grundy
- Bipartite?