Solution Logic

ICPC 2010 Asia-Amritapuri Site
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Problem A – Playing Field

- Type: Precomputation, coordinate geometry
- Cannot find the area on the fly for all Q
- Precompute the area of all polygons with a segment joining 0 and x as end points.
- We can do this by using area of [0,x-1] and area of triangle [0,x-1,x]
- To find area of given polygon we need to add/ subtract the precomputed areas and 1 triangle (how?)

Problem B – Regular Expression Edit Distance

- Type: Graph theory & Finite Automata
- Create 2 NFA from the given Regex-s.
- With state as [NFA1-state, NFA2-state] -> Length of string search for the end state [NFA1-sink, NFA2-sink]
- There is an edge from state 1 to 2 if there is an edge between NFA1-state1 to NFA1-state2 or/and NFA2-state1 to NFA2-state2.

Problem C – Square-Free Numbers

- Type: Number theory
- Find prime factors of the given number.
- The answer is the maximum power of the prime factors.
- eg: 20 = 2*2*5
  since the maximum power is 2, the answer is 2

Problem D – Soccer Teams

- Type: Number theory
- As per the test of divisibility of 11, the sum of alternate digits should differ by a multiple of 11.
- Since we can only add 0 digit we have to split the digits into 2 sets such that their sum differs by multiple of 11.
- If d[1] + d[2] + .. = X (number of non-zero digits), then we need to minimize the |size of 1 set - X|
- How do we do this? Knapsack (DP)

Problem E – Sales Prediction

- Type: Matrix Exponentiation
- You have to find Summation of Matrix exponentiation.
- Create a matrix that finds f(x+k) from f(x) when multiplied.
- We have to find Summation of these matrices.
- If X is the matrix then we have to find (1+X+X^2+X^3..) and multiply it with the basic matrix.
- We can exponentiate it using (1+X^k/2)(1+X^k/4)...
- Alternate strategy
  - The function we need to find is,
    g(n) = f(n) + g(n-k)
  - We can represent the recurrence for f(n) and g(n) in a single matrix of size (R+K) and exponentiate the matrix.

Problem F – Cookie Piles

- Type: Math
- Use the mathematical formula to find the summation of arithmetic progression. N*A + N(N-1)*D/2

Problem G – Christmas Play

- Type: Sorting
- Sort the students by height, and iterate over it to find minimum a[x+k-1]-a[x]

Problem H – Shopping Rush

- Type: Greedy
- The highest probability will be the center floor (greedy)
- Arrange the items as per this logic:
  - Sort the elements by probability in descending order
  - Take the even index (including index 0 the highest probability) elements and reverse then and place them in the starting floors.
  - Then place the odd index elements in descending order of probability.
  - Use the formula to find expected time adding every pair probability * time

Note: Constraints also allowed for an O(2^n * n) DP solution to clear.

Problem I – Dividing Stones

- Type: Brute force
- Take all prime numbers below N, and find prime partitions made using these numbers such that the sum of the a1*k1 + a2*k2... (a1, a2, etc. are primes and each of them occurs k1, k2, etc. times in the partition) is at most N
- Since number of such partitions are not many under these constraints a simple brute force will work.

Problem J - Chemicals

- Type: Graph Coloring
- The graph is a special type of graph where each connected component contains exactly 1 cycle.
- First consider only the cycle in each component and find the coloring for it independently.
- This can be done using DP:
  f(L) = K (if L=1); f(L) = K*(K-1) (if L=2); f(L) = K*(K-1)*(K-2)
  f(L) = (K-1) * f(L-2) + (K-2) * f(L-1)
- Then consider the cycle as a single node colored with 1 color. The graph will be a simple tree rooted at this colored node.
- Now the find the ways of coloring of the remaining Y nodes (which do not belong to the cycle) as (K-1)^Y. Multiply these together for all components.

Trivia :)

Team XYZ: Just verifying that Sample output 1 for Problem H is correct (to satisfy a skeptical teammate). It is correct, right?
Judge: Yes. Its correct. Hope your team mate is satisfied now :-)

Trivia :)

First time we have seen a `Program Size Exceeded` error (on Problem D).

Trivia :)

Closest Judge prediction of Accepteds (by Prunthaban)

A : 20 (actual 23 Accepted)
B : 1 (actual 0)
C : 45 (actual 53)
D : 9 (actual 9)
E : 5 (actual 3)
F : 90+ (actual 124)
G : 70+ (actual 84)
H : 5 (actual 2)
I : 1 (actual 4)
J : 0 (actual 1)