Ad Hoc!

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1 Introduction

The majority of problems in USACO Bronze and many of the problems in other divisions can be classified as "ad hoc." What does that mean? An **ad hoc** problem is one that does not fall under any other category. Essentially, so many problems can be classified as ad hoc because not enough categories have been invnted.

What does this tell us about Bronze? Silver is the "standard algorithms" division, where each problem is supposed to be solvable using fairly standard stuff. Gold is the division of very hard problems, but most very hard problems tend to fit into categories easily. But Bronze problems require special thinking because ad hoc problems by nature are creative, so in order to solve one of these problems, one must be creative.

Just because a problem cannot be classified does not mean that it is hard. It just means that you might have to put in some extra thinking.

2 Strategies

Before we go into some example problems, here are a few strategies to consider when approached with a problem you have no idea how to solve. These tips apply to every problem, actually.

- Try the naive solution (the brute force or "complete search" solution): this almost always works in Bronze.
- Make sure that your algorithm is efficient! Figure out the complexity of your algorithm, and make sure the total number of operations is proportional to a number less than $200,000,000$.
- Make observations to limit the search space.
- Sort stuff—this is not always useful, but for almost any problem, you should always consider: would this problem be any easier if I sorted the input?

2.1 How do I get better at solving ad hoc problems?

Ad hoc problems are generally the hardest problems on any contest, but they are not hard to prepare for. There are two major ways to improve your problem-solving skills (which then improves your ability to solve ad hoc problems):

1. Be a natural genius.
2. Do training problems.

Essentially, the point is that the best way to improve at problem-solving is to do more of it! Solving problems improves your intuition and the speed at which you can come up with new ideas and algorithms. I highly suggest taking some time and working through at least chapter 1 of the USACO training pages (`train.usaco.org`) because that chapter is full of good ad hoc practice.

3 Problems

This is the main focus of this lecture: the problem solving. These are sets of bronze problems from complete contests. Try working through them!

- February 2010 Bronze
  1. (Damon Doucet, 2010) Given P and Q ($1 \leq P, Q \leq 6,000$), find all coordinates (x, y) such that x is a factor of P and y is a factor of Q.
  2. (Damon Doucet, 2010) You are given a $W \times H$ grid ($1 \leq W, H \leq 750$) where each cell in the grid is either a '*' (rock) or a '.' (grass). Bessie can start in whatever grass patch she wishes, and she can move left, right, up, down, or diagonally. She is not allowed to step on any rocks. What is the maximum number of grass patches that Bessie can eat, given that she chooses the best starting location?
  3. (Damon Doucet, 2010) There are N ($1 \leq N \leq 25,000$) toys. Toy i brings Bessie J_i ($0 \leq J_i \leq 1,000,000$) bundles of joy and costs P_i ($0 < P_i \leq 100,000,000$). For each toy, the happiness metric is equal to J_i/P_i. Help Bessie choose the the three toys to buy that maximizes her total happiness metric.
- February 2009 Bronze
  1. (Traditional, 2009) Given N ($1 \leq N \leq 2,000,000,000$) and P ($1 \leq P \leq 100,000$), find N^P (yes, print out all the digits).
  2. (Traditional, 2009) You are given a polynomial with degree D ($1 \leq D \leq 11$), and D is odd. The polynomial is guaranteed to only have one zero in the range $-1,000,000 \leq X \leq 1,000,000$. Given the coefficients, find X such that the polynomial evaluates to zero.
  3. (Traditional, 2009) The cows are playing Boggle (or "Coggle," the cow version). There is a 5×5 grid of letters, and words are made by starting at some letter and traveling to its neighbors. When a word is spelled, you get points. You are given a dictionary of $25,000$ words. Find the maximum number of words that can be formed. No cell may be used more than once in the same word.
- Bonus (Brian Dean, 2012 modified): You are given N ($1 \leq N \leq 1,000,000,000,000,000$, N odd) empty stacks. There are K ($1 \leq K \leq 25,000$) instructions. Each instructions have an A and a B and adds a hay bale to each of the stacks in the range $A..B$. Find the median hay stack height.