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1 October 2014

Web Programming Fundamentals

Problem Solving

**A Cat, A Parrot, and a Bag of Seed:**

**1) Define the problem.**

**a) Do this in your own words.**

A man needs to bring a cat, a bag of seed, and a parrot across a river, but he can only bring one at a time. If he leaves the parrot and the seed together, the bird will eat the seed. If he leaves the cat and the parrot together, the cat will eat the parrot. He needs to make it across the river with all three items alive and intact.

**b) What insight can you offer into the problem that is not immediately visible from the word problem alone?**

One should think about what the man is leaving on the other side of the river while he goes back to get something else. The cat and parrot (or parrot and seed) should not be left together on either side. Another important idea to note is that, once an item is on the other side of the river, it can still be returned to the original side.

**c) What is the overall goal?**

The overall goal is to get all three items on the other side of the river without the cat eating the parrot, and without the parrot eating the seed.

**2) Break the problem apart.**

**a) What are the constraints?**

The cat cannot be left alone with the parrot, and the parrot cannot be left alone with the seed.

**b) What are the sub-goals?**

The man will need to bring one item across the river, leaving two that can be left together. Then he will need to come back to fetch the rest of the items while considering the same issue on the other side.

**3) Identify possible solutions.**

**a) For each of the sub-problems you’ve discussed in #2, what is a possible solution?**

The man could bring the bird first, leaving the cat and seed. He could then go back and get the seed. Then he could leave the seed on the new side of the river, and take the parrot back to the original side. He could then trade the parrot for the cat, leaving the parrot alone. Once he’s on the second side of the river again, he can leave the cat with the birdseed and go back for the parrot.

**4) Evaluate each potential solution.**

**a) Does each solution meet the goals?**

Yes, the solution meets the goals.

**b) Will each solution work for all cases?**

Yes, the solution will work for all cases.

**5) Choose a solution and develop a plan to implement it.**

**a) Explain the solution in full.**

On trip one, take the parrot, leaving the cat and birdseed together. On trip two, bring the birdseed, leaving the cat alone. On the way back from trip two, bring the parrot back to the original side, leaving the birdseed. Before leaving for trip three, trade the parrot for the cat and leave the cat on the second side with the birdseed. Go back for the parrot, and make one more trip across.

**b) Describe some test cases you tried out to make sure it works.**

I drew a river on a piece of paper, and then used smaller pieces of paper to represent the cat, the parrot, and the birdseed. I then moved the representative pieces across the river as the man would, while continuously ensuring that the cat and parrot were not left alone, and neither were the parrot and birdseed.

**Socks in the Dark:**

**1) Define the problem.**

**a) Do this in your own words.**

You have five pairs of black socks, three pairs of brown socks, and two pairs of white socks. You need to grab at least one matching pair, and at least one matching pair of each color. If it is dark in the room and you can’t see, how many socks will you have to grab in order to fulfill that goal?

**b) What insight can you offer into the problem that is not immediately visible from the word problem alone?**

The word problem lists the number of socks in pairs, so remember to double those numbers in order to figure out how many individual socks there are.

**c) What is the overall goal?**

The overall goal is to figure out how many socks need to be gathered in order to guarantee the existence of one matching pair of socks, and one matching pair of each color.

**2) Break the problem apart.**

**a) What are the constraints?**

The biggest constraint is that you cannot see in the dark.

**b) What are the sub-goals?**

1) Grab enough socks to have at least one matching pair.

2) Grab enough socks to have one matching pair in each color.

**3) Identify potential solutions.**

**a) For each of the sub-problems you’ve discussed in #2, what is a possible solution?**

1) If you grab four socks, you will grab at least two of one color, since there are only three colors.

2) If you grab 18 socks, you will have at least one pair of each color even if you get all ten black socks and all six brown socks.

**4) Evaluate each potential solution.**

**a) Does each solution meet the goals?**

Yes, each solution meets each sub-goal.

**b) Will each solution work for all cases?**

Each solution will work for all of the cases presented in this word problem.

**5) Choose a solution and develop a plan to implement it.**

**a) Explain the solution in full.**

Grab four socks in order to guarantee that at least one pair will match. Grab 18 socks in order to guarantee at least one matching pair in each color.

**b) Describe some test cases you tried out to make sure it works.**

I drew diagrams for each sub-problem in order to show each possible result.

**Predicting Fingers:**

**1) Define the problem.**

**a) Do this in your own words.**

A girl is counting to various numbers using only the fingers (and thumb) of her left hand. She starts on her thumb and counts to five, at which point she is on her pinky finger. She then reverses direction, starting her ring finger on “six”. She continues this pattern until she reaches 10, and then 100, and finally 1,000. Which finger does she end on when she reaches each of those numbers?

**b) What insight can you offer into the problem that is not immediately visible from the word problem alone?**

This is a pattern that must correspond with some kind of mathematical algorithm.

**c) What is the overall goal?**

The overall goal is to figure out which finger the girl will end on when she reaches 10, then 100, then 1,000.

**2) Break the problem apart.**

**a) What are the constraints?**

The only constraint is the fact that one must figure out an algorithm or mathematical equation to solve this problem.

**b) What are the sub-goals?**

1) Figure out what finger the girl will end on when she reaches 10.

2) Figure out what finger the girl will end on when she reaches 100.

3) Figure out what finger the girl will end on when she reaches 1,000.

**3) Identify potential solutions.**

**a) For each of the sub-problems you’ve discussed in #2, what is a possible solution?**

1) Count on your own hand. She will end on her first finger.

2) Figure out a pattern. The 10s will always land on the first or ring finger.

10 is on the first finger, 20 and 30 are on the ring finger, then it continues by twos. 100 will land on her ring finger.

3) Continue the pattern. When counting by 100s, switch off between the

first and ring fingers. 1,000 will end on her first finger.

**4) Evaluate each potential solution.**

**a) Does each solution meet the goals?**

Yes, each solution meets the goals.

**b) Will each solution work for all cases?**

Yes, each solution will work for all cases.

**5) Choose a solution and develop a plan to implement it.**

**a) Explain the solution in full.**

There is a pattern present in this problem. When counting by tens, the ending fingers will switch between the first and ring fingers every two numbers (zero being a number). Therefore, 10 will end on the first finger. In order to figure out what finger 100 will end on, continue that pattern. 100 will end on the ring finger. In order to find the finger that 1,000 will end on, count by one hundreds and switch back and forth between the first and ring fingers. 1,000 will end on the first finger.