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Class: Web Programming Fundamentals

Assignment: Problem Solving

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

1. The problem is that the man needs to get the cat, parrot and the bag of seed across to the other side of the river on his boat; however, his boat will only allow him to take one at a time. He’s afraid that if he leaves the cat with the parrot, the cat will eat the parrot, and if he leaves the parrot with the bag of seeds, the parrot will eat the bag of seeds. He also has to avoid this problem at the other side of the river when he transports them over. The goal is to transport all of them over without losing any of them.
2. The constraints are only one item can be taken on the boat at a time, the parrot cannot be left with the bag of seeds, and the cat cannot be left with the parrot. The sub-goals are to take the cat to the other side of the river, to take the parrot to the other side of the river without eating the bag of seeds or being eaten by the cat, and to take the bag of seeds across without being eaten by the parrot.
3. The possible solutions for the sub goals are to take the parrot, leaving the cat with the bag of seeds. Take the cat leaving the bag of seeds, bring the parrot back and take the bag of seeds, leaving the cat with the bag of seeds again. Go back and get the parrot. Another solution would be the same exact scenario but taking the bag of seeds instead of the cat, and then get bring back the parrot, leave it and bring back the cat, then go back for the parrot.
4. These solutions all meet the goals, and work in all cases.
5. The solution is for the man to take the parrot across the river on the boat first. This will keep the bird safe from the cat, and the bag of seeds safe from the bird. He will need to go back to the other side and get the cat, bring it across the river. To keep the parrot safe from the cat, he will need to bring the parrot back to the other side of the river, leave it there, and get the bag of seeds and bring it across the river. This will leave the cat with the bag of seeds. Then he can go back and get the parrot across the river again, and he will have all three across the river safe and sound.

**Problem 2: Socks in the Dark**

1. The problem is that you have to get a matching pair of socks in the dark from a drawer with 10 socks that are black, 6 socks that are brown and 4 socks that are white.
2. The constraint is that it is dark, and you can only see if you have a matching pair after you make a selection. You have to pull out a matching pair, and then a matching pair of every color.
3. To get a matching pair, you need to select at least 4 socks from the drawer. To get a matching pair of each color, you need to select at least 18 socks.
4. These solutions meet the goals.
5. To get a matching pair, we look at the different colors available. There are 3 different colors, so if you select just 3, you might get a pair, but you might also get one of each color, so you need to select at least 4 socks, even if you get one of each color, the 4th would have to pair up with one of the colors.  
     
   To get a matching pair of each color, we look at the number of socks that are in the drawer for each color. If you select 10 socks, they may all be black socks, if you select 12 socks you might get 5 pairs or black socks and 1 pair of white, if you select 16, you may get 5 pairs of black socks and 2 pairs of brown socks. The only way to get a pair of each color, is to select at least 18 socks, you may get the maximum of 5 pairs of black socks, and 3 pairs of brown socks, the other pair will have to be white, and that is the only way to guarantee a matching pair of each color.

**Problem 3: Predicting Fingers**

1. The problem is trying to figure out what finger the girl will stop at if she continues counting in the manner she was counting.

The girl counts from her thumb to the little finger and continues to count back to her thumb back and forth.

1. Numbers for the thumb are 1, 9, 17, 25, 33 etc. incrementing by 8 every time. The goals are to figure out what fingers she would land on if she counted from 1 to 10, and from 1 to 100, and from 1 to 1000.
2. To get to potential solutions, I had to look at what the information was telling me. First solution is to come up with a formula that takes into account that between the first number at the thumb and coming back to the thumb, the number increments by eight, it works the same way for the little finger, and the index finger is always a multiple of 8.  
     
   The solution is to divide the number by 8. If the number is a multiple of 8 then it’s going to be the index finger.  
   If the number is not a multiple, then multiply the result (without the remainder) by 8. This gives you the closest multiple. Take the original number and subtract the actual multiple, this will give you a remainder which coincides with one of the fingers.

|  |  |  |
| --- | --- | --- |
| Thumb | 1 | 9 |
| Index Finger | 2 | 8 |
| Middle Finger | 3 | 7 |
| Ring Finger | 4 | 6 |
| Little Finger | 5 | 13 |

1. This solution meets the goals and works in all cases.
2. I tried a variety of different calculations to get to this formula, and mostly worked it out on paper. I tested with smaller numbers and manually counted out which finger the numbers would land on until a pattern emerged.  
     
   The best way to explain the solution is to use a formula; this is a 3-step calculation.  
   * + 1. **Step 1:** Divide number by 8 to get a result.   
          n / 8 = R1
       2. **Step 2:** Check if R1 is a multiple, if there is no remainder, then it’s a multiple in which case you already know it’s the index finger.
       3. **Step 3:** If it’s not the index finger, take just the whole number of R1 and multiply that by 8.

R1 \* 8 = R2

* + - 1. **Step 4:** Take R1 and subtract R2 to get the actual remainder, which will coincide, with one of the fingers based on the table above.

R1 – R2 = R

**An example counting to 57**

* + - 1. Divide number by 8 57/8 = 7.125
      2. 7.125 is not a multiple of 8 so it is not the index finger.
      3. Multiply result by 8 to get actual multiple 7\*8= 56
      4. Subtract original number from actual multiple 57-56 =1
      5. She lands on the thumb.

**An example counting to 27 and manual verification**

27/8 = 3.375

8 \* 3 = 24

27 -24 = 3  
Number lands on the middle finger.

**Manual counting verification completed, number 27 indeed falls on the middle finger.**

**Solutions**

a) 1-10 She will stop on her index finger.   
10/8 = 1.25

8 \* 1 = 8  
10 – 8 = 2

2 is the index finger.

b) 1-100 She will stop on her ring finger.

100/8 = 12.5

8 \* 12 = 96

100 – 96 = 4  
 4 is the ring finger.

c) 1-1000 She will stop on her first finger.   
 1000/8 = 125.   
 That’s a multiple of 8  
 8 is the index finger.