**Problem 1 - A Cat, a Parrot, and a Bag of Seed:**

**A man finds himself on a riverbank with a cat, a parrot and a bag of seed. He needs to transport all three to the other side of the river in his boat. However, the boat has room for only the man, himself and one other item (either the cat, parrot or seed). In his absence, the cat could eat the parrot, and the parrot would eat the bag of seed. Show how he can get all the passengers to the other side, without leaving the wrong ones alone together.**

The initial problem is that the boat is too small to get everything he needs to the other side of the river in one trip. It is obvious that he is concerned about the safety of both the cat and the parrot, and that he has taken on the roll of caring for them. The fact that he is concerned about the seeds being eaten by the parrot, implies that they are equally important to him. Because it states the words “in his absence”, I assume it means he has considered the possibility of having to more than one trip already. Ultimately the goal is to figure out how he can transport himself, the parrot, cat, and seeds safely and without having to leave any behind.

In breaking the problem apart the constraints are that the boat is too small, he is solely responsible for the welfare of the animals, the animals likely cannot be left alone for him to take more than one trip, one animal is a predator to the other, he is unable to walk, and there is no one else there to help him.

The sub goals are for the man to either get all of them across at once, or to figure out how he can leave two behind, and come back for them.

Possible solutions would be for the man to consider how he could actually fit all three into the boat, in a creative way he hasn’t thought of before. If there was only enough room for two in the boat, then I think he should put the cat in the second spot, hold the seeds in his lap, and put the parrot on his shoulder. If he were to leave any behind, he could hide the seeds, take the cat first, come back for the seeds and leave the bird behind, and then come back for the bird.

In evaluating the two solutions, I believe that both meet the goal of getting across the river, getting everything he needs there, and preventing the animals from being alone together, and protects the seeds from the parrot. Each solution works for this case.

Because the second solution to leave two behind would take longer, it seems it would be a waste of time; when the first solution will get all three across with the man at once, in a faster way, and still only takes up two spots in the boat. In choosing the first solution, the plan of action is very simple. It is for the man to set the cat inside the boat first, put the parrot on his shoulder next, and then holding the bag of seeds he can climb inside his spot in the boat and set the seeds down on his lap when he sits down.

Though it would be difficult to physically test this plan, I contemplated the different solutions. The man cannot take the bird first, because he would have to come back for either the cat or the seeds next, both of which the man does not want to leave the bird alone with. He can’t take the seeds first, because he cannot leave the cat and bird together. Taking the cat first would work, only if the man is successful in hiding the seeds from the bird, but that is risky. It makes the most sense for the man to figure out how to take all three at once.

**Problem 2: Socks in the Dark:**

**There are 20 socks in a drawer: 5 pairs of black socks, 3 pairs of brown and 2 pairs of white. You select the socks in the dark and can check them only after a selection has been made. What is the smallest number of socks you need to select to guarantee getting the following:**

1. **At least one matching pair**
2. **At least one matching pair of each color.**

The problem is that in the dark it’s difficult to know which pair of socks is being chosen, and the person is unable to view their selection until after choosing. Quite possibly they are in a location with no electricity, or a broken light, or they do not want to disturb anyone else that may be in the room, or they are in a contest where they are blindfolded. The overall goal is to choose enough to match colors, but only as little as possible.

Breaking the problem apart, I find the constraints to be the inability to see, for whatever reason. Also, the person would need to solve this problem on the spot in their mind. And the fact that they are limited on the amount they are to grab. The sub goal is to figure out a solution to find at least one matching pair, and a matching pair of each color by getting as few as possible.

Possible solutions could be: One, to just grab some and rely on luck to get matching pairs. Or two, strategize a mathematical plan to end up with enough to make matching pairs.

Randomly grabbing socks and relying on luck could work, but it’s quite a roll of the dice and will not guarantee meeting the goal of the exact amount of matching pairs asked for. So, the best solution seems to be using mathematical logic to make the matches, and as long as the calculations are correct, this solution will meet the goal for both of the required matches of socks.

a) In order to choose just 1 matching pair of socks, and grabbing the least amount possible, I feel the best mathematical method would be to grab 4 socks total. Since we know there are 3 colors of socks, it makes sense to grab at least 3. Granted there will be no guarantee that 1 of each color was chosen, but by grabbing a 4th sock, that one is guaranteed to match at least 1 of the other 3 socks chosen. All 4 socks could end up being the same color, or 2 socks and 2 socks, or 3 socks and 1 other color. No matter how you look at it, by choosing at least 4, there is guaranteed to be at least 1 matching pair. If only 3 socks were chosen, they could possibly end up being 1 of each color; therefore, not a guaranteed match. If 5 or more socks were to be chosen, it would guarantee at least 2 matching pairs; which is more than what is being asked for this scenario, and would not be the least amount possible to guarantee at least 1 match.

b) In order to choose 1 matching pair of all 3 colors, and still grabbing the least amount possible to guarantee the correct matches, I considered the possibility of using the above method for choosing just 1 sock and multiplying it by 3. That would have been a total of 12 socks chosen. However, that would only guarantee 1 matching pair still, because it’s possible that 10 of the socks chosen are black, and the other 2 are a white and a brown one. So, we need to assume, in order to guarantee 1 pair of each color, that it’s possible, not likely, but possible that 10 of the socks chosen are black. That would give us at least 1 matching pair in black, and no more black socks left to choose from. If the 2 left over were the same color, that would give us a second matching pair, at which point we would still need to get the third matching pair; but if the 2 other socks were brown, we would still have 4 brown socks, and 4 white socks left to choose from. We would need to grab at least 6 more in order to eliminate the possibility of choosing another brown pair, and giving us the guarantee of at least 1 white pair. That is a total of 18 socks chosen to guarantee 1 match of each color. If those other two socks left over after choosing our first 12 were 2 white ones, then we would only need to grab 4 more in order to guarantee a brown match. The problem with this entire scenario is that we cannot see, so we just don’t know what we are grabbing, and if we are to guarantee a match of all three colors, then we’d have to plan on eliminating the two colors with the most amount, the brown (6) and the black (10), leaving us only 2 more to have to choose to be positive that we also got at least 2 whites in there. To come to this conclusion I spent at least an hour trying to choose socks based on different options, and to do this scenario really doesn’t allow us to choose only a few to come to our goal. It’s not realistic, as there are so many variables involved. One possibility not discussed is that each color of socks could be different styles; therefore, possibly having a different feel. In lieu of eyesight, one might be able to rely on touch instead.

The same solution does not fit each of the scenarios.

**Problem 3: Predicting Fingers:**

**A little girl counts using the fingers of her left hand as follows: She starts by calling her thumb 1, the first finger 2, the middle finger 3, ring finger 4, and little finger 5. Then she reverses direction, calling the ring finger 6, middle finger 7, the first finger 8, and thumb 9, after which she calls her first finger 10 and so on. If she continues to count in this manner, on which finger will she stop?**

1. **What if the girl counts from 1 to 10**
2. **What if the girl counts from 1 to 100**
3. **What if the girl counts from 1 to 1000**

The main problem in this entire scenario is that the girl is counting irregularly on her fingers, and not in a repetitive manner going the same direction from 1-10, and then starting over going the same direction every count of 10. The girl is probably young, and does not know multiplication since she is counting on her fingers, and based on the numbers that she needs to count to, it seems she is learning to count by 10’s and 100’s. According to this scenario, the overall goal is to find out what finger she will land on if counting by 10’s, and then 100’s, using the irregular pattern of counting that she started with.

5 pinky

add 4 = 9 thumb

add 1= 10 first finger

add 3 = 13 pinky

add 4 = 17 thumb

add 3 = 20 ring

add 1 = 21 pinky

add 4 = 25 thumb

5 pinky

add 5 = 10 first 10 +20 = 30 ring +20 = 50 first +20 = 70 ring +20 = first

add 10 = 20 ring

add 10 = 30 ring

add 10 = 40 first

add 10 = 50 first

add 10 = 60 ring

add 10 = 70 ring

add 10 = 80 first

add 10 = 90 first

**add 10 = 100 ring**

110 ring

120 first

130first

140 ring

150 ring

160 first

170 first

180 ring

190 ring

**200 first**

210 first

220 ring

230 ring

240 first

250 first

260 ring

270 ring

280 first

290 first

**300 ring**

400 first

500 ring

600 first

700 ring

800 first

900 ring

1000 first

Instructions:

1. Define the problem.
   1. Do this in your own words.
   2. What insight can you offer into the problem that is not immediately visible from the word problem alone?
   3. What is the overall goal?
2. Break the problem apart.
   1. What are the constraints?
   2. What are the sub-goals?
3. Identify Potential Solutions.
   1. For each of the sub-problems you’ve discussed in #2, what is a possible solution?
4. Evaluate each potential solution.
   1. Does each solution meet the goals?
   2. Will each solution work for ALL cases?
5. Choose a solution and develop a plan to implement it.
   1. Explain the solution in full.
   2. Describe some test cases you tried out to make sure it works. (You can include drawings and diagrams as part of your explanation as long as they are clearly communicating the solution).