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

**Define the problem:**

A man needs to move his cat, parrot, and seed across a river in his boat. The river has only room for him self and one additional item. He cannot leave the cat and bird together or the bird and seed. The overall goal is to safely get all three to the other side.

**Break the problem apart:**

Limitations in this problem include the mode of transportation and the allowed combinations of items. The sub goals of this problem are successfully transporting each item safely and making it across the river: Get the cat across without leaving it with the bird, get the bird across without leaving it with the seed. The bird is the key to this problem as it has the most limitations: no cat, no seed. Solve the bird’s movements and the problem is solved.

**Potential solutions:**

The problem does not say you can’t bring an animal back across the river once on the other side. If you can transport one more item in the boat, assuming you can move things back to the original side you have five options for movement.

Solution 1: Movement Sequence (Side A is original side B is far side):

Bird A>>B Leave at B

Cat A>>B Remove Bird from B

Bird B>>A Leave at A

Seed A>>B Take to B

Bird A>>B

This solution moves each item across without leaving the cat and bird together alone or the bird and seed together alone.

**Evaluate:**

This is the only solution I can see with the given materials, constraints, and items. It meets all of the problems goals: get all three across, do not leave the bird and seed together, and do not leave the cat and bird together.

**Solution:**

In my solution the man first moves the bird to the far side (B side). He then returns to the original side (A Side). From there he moves the cat from A to B and returns to the A side with the bird. The man doesn’t leave the two alone, so the cat doesn’t eat the bird. The man then leaves the bird at A and moves the seed to B. Again, the bird and seed are not alone so the bird cannot eat the seed and the cat will not eat the seed. Next the man returns to A with no other items on his boat. He then brings the bird to B, he remains with the items and the movement is complete.

To test this I created 3 squares in Google Draw and labeled them bird, cat, and seed. I drew a line down the middle and started moving the squares from one side to the other, paying attention to the combinations left alone and checking against the rules. The solution meets the set rules and successfully transports all items.

**Socks in the dark:**

**Define the problem:**

There are 20 socks in a drawer that you cannot see into. There are 5 pair black, 3 pair brown, and 2 pair white. Selecting the fewest socks, how can you guarantee one matching pair and a matching pair of each.

**Break the problem apart:**

I see this as one smaller problem, how many socks (n) needed to guarantee one pair? Three pairs should then be 3(n).

**Potential solution:**

For one matching pair: 4 socks

By >=4 socks you should have one pair.

If finding one pair takes 4 socks finding 3 should be 3(4), 12 socks

**Evaluate:**

One pair:

To guarantee one pair you must grab four socks:

Two socks could be a pair but could also be black/white or black/brown or brown/white: 25% chance of pair

Three socks could be one of each or a pair: 50% chance of pair

Four socks guarantee a pair.

To guarantee one pair of each you should grab 12 socks. If four socks produce one pair then 12 socks should produce 3 pairs. To test this I created a spreadsheet that calculated the chance of picking that sock from the drawer. The answer I got, following highest percent or picking white socks last in case of a tie, shows 3n could be wrong and cannot guarantee one pair of each, but if you select a white sock in the case of a tie before other socks 3n is correct. Being in a dark room you couldn’t control the first pick in a tie, so the worst case scenario would guarantee one pair of each, 14 socks, and change the formula to 3n + a. “a” would be additional pairs from the initial one pair. To test this I tried to see if 2 pairs would evaluate to 2(4)+1 = 9. This formula came out true in the case of 2 pairs.

**Solution:**

I based my solution on worst-case scenario. To ensure you grab one matching pair you should grab at least four socks. This guarantees that you will have at least one pair within the four if you grab one of each sock within the first three socks, or number of sock colors + 1 = n. To calculate a guaranteed 3 pairs you need to grab 14 socks. This formula is 3(4) + 2. The +2 represents the additional pairs from the initial first pair. While testing this formula, in the case of a probability tie between white socks and brown or black socks I did not select the white sock first, which resulted in 14 socks being needed. If the tie goes to the white socks then the equation would be 3(4). Since the instructions explain to find the fewest number of socks to ensure one pair of each is grabbed 14 is the answer, because in the dark you cannot control which is picked first in a tie.

**Predicting fingers:**

**Define the problem**

A girl is counting on her fingers on one hand. She starts on her thumb and counts to her little finger, then reverses the count starting with her index finger. When she reaches her thumb she starts back the other way with her index finger. If she continues this count what finger will she stop on at counts 10, 100, and 1000?

**Break the problem apart**

To solve this problem you need to figure out a pattern within how the numbers fall on the fingers. Figuring out a pattern to where the numbers fall should give the answer for 10, 100 and 1000.

**Potential solution:**

Numbers fall on the thumb in sets of 8: 1, 9, 17, etc. Because of this constant you would divide by 8 to see how many times the thumb lands within that number. The remainder is then related to the other fingers. The solution to this problem would be n % 8 = x. Assigning numbers to the fingers starting with 0 progressing from index finger as 0, thumb 1, index 2, etc. until 9 we mark the fingers to the options for x.

10 % 8 = 2

2 = index

From this example you can see that ten would fall on the index finger.

**Evaluate:**

Finger assignments:

0 Index

1 Thumb

2 Index

3 Middle

4 Ring

5 Little

6 Ring

7 Middle

8 Index

9 Thumb

10 % 8 = 2 Index

100 % 8 = 4 Ring

1000 % 8 = 0 Index

Using this formula you could evaluate any number to find what finger it would land on. Further testing shows the following:

11 % 8 = 3 Middle

12 % 8 = 4 Ring

24 % 8 = 0 Index

30 % 8 = 6 Ring

This are all outcomes I verified within a spreadsheet with numbers counted out to 30 based on the counting scheme given.

**Solution:**

The solution to this problem is found within the way the numbers fall on the hand. The thumb (since the count starts here) holds the important pattern of numbers falling in sets of 8. The thumb is number 1, 9, 17, 25, etc. From this point you count out from 0 – 9 in the pattern of Index, Thumb, Index, Middle etc. This assigns the fingers a remainder value for the solution. To find the remainder you use the mod function or divide to the nearest whole number. This formula (Number % 8 = Remainder) then gives the finger any number will land on based on how many times that number can be divided by 8. Examples:

8 % 8 = 0

The formula returns 0 because 8 divides by 8 with no remaining value. Using the number 0 we see that 8 falls on the index finger.

Doing a quick count following the given problem verifies the finger.

17 % 8 = 1 (or 17/8= 2R1)

17 lands on the thumb, which is verified by counting the numbers out.

1000 % 8 = 0 Index finger

1000 divided by 8 equals 125 with no remainder, so again this

Number is 0, which falls on the Index finger.