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Scalable Data Infrastructures  
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Activity: Problem Solving

OVERVIEW:

Exercise your problem–solving skills with this collection of puzzles and word problems that are analogous to some of the problems you will have to understand and solve in programming.

OBJECTIVES:

Successful completion of this activity will show that you can: Define the goals and parameters of a problem. Break down complex problems into parts for a solution. Identify and apply methods for problem solving.

Explain how you arrived at a solution.

CRITERIA:

For each solution you will need the following:

Create a solution for each of the problems below.   
You will need to commit this file to your Git repository. A minimum of 5 meaningful commits are required, **or this assignment will receive and automatic 0.**

GETTING STARTED:

* Create a word processing document and place your name, date, class and assignment name in the document’s header.    
  Place that file in your Git repository within a folder named **ProblemSolving**.
* TURNING IT IN:   
   Archive your document as a zip file.   
  Name that .zip file with the following:  o lastName\_firstName\_ProblemSolving.zip  
   Submit it to the repo and FSO as directed by your instructor.

PROBLEMS:

For each of the problems be sure to identify each of the steps discussed in the problem-solving lesson.

* **1)  Define the problem**  a) Do this in *your own words.*b) What insight can you offer into the problem that is not immediately visible from  the word problem alone? c) What is the overall goal?
* 2)  **Break the problem apart**a) What are the constraints? b) What are the sub-goals?
* 3)  **Identify potential solutions**a) For each of the sub-problems you’ve discussed in #2, what is a possible solution?
* **4)  Evaluate each potential solution**  a) Does each solution meet the goals?  b) Will each solution work for ALL cases?
* **5)  Choose a solution and develop a plan to implement it.**  a) Explain the solution in full. b) 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).

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.

1.) The man in this problem needs to get his cat, his parrot, and a bag of seed across the river in his boat. His boat only has enough room for the man and one of these objects, but he needs to get them all safely across. If left alone, some of the objects may consume one another.

2.) The man needs to figure out a way to separately transport the cat, the parrot, and the bag of seed without leaving any conflicting variables together. The cat can not be left with the parrot alone. The parrot can not be left with the seed alone. The seed can be left with the cat.

3.) The man could bring the parrot across the river in his boat first. This would leave only the cat and the seed. The cat would generally not desire to eat the seed, and the seed would not eat the cat. Therefore, this would work.  
Alternatively, the man could put the parrot in a cage. In this scenario, the man could take any individual across that he would desire because they would not be able to reach the other objects while left on their own side.   
The man could call for back up. He could recruit a friend to stay on the other side with the excess variables so that they will not consume eachother.  
Also, the man could get his parrot to fly across the river on its own. In this scenario, that would leave only the cat and the seed to be transported and would save on gas and other transportation costs.

4.) If the man brought the parrot across first, this would not be an effective solution. Although the parrot would be separated from the seed and the cat at first, when the man returned for the third variable the parrot would have to be left with one of the other two.  
Putting the parrot into a cage would be a consistently effective solution, except during the time required to go find said cages to begin with. Unless the man brought them with him, this would leave the cat, the parrot, and the seed together unsupervised.  
Calling for a friend would still be an inconsistent solution because at some point the parrot would be left alone with one of the others while the man boated his friend across.  
Forcing the parrot to fly across would only work if timed correctly. The boat would have to be 4x as fast as the parrot in order to get each of the other variables across before the parrot would reach the shore.

5.) The best idea in order to successfully get each variable across would be to contain the parrot within a cage or some other type of container. The man could take all of the variables with him to the store in order to buy these containers, and then contain the parrot that it would be successfully contained and waiting for the man on shore, regardless of who he brings across at what point. The cat could attempt to eat the parrot, but would only be blocked by the walls of its container. The parrot could attempt to eat the seed, but would be blocked by the walls of its container.

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 b) At least one matching pair *of each color.*

1.) You need to find matching pairs of socks from the 20 in your drawer. It is dark. It is not stated if you must put unused socks back or not. You need to find a pair of socks with matching colors, and eventually a matching pair from each color.

2.) There are 10 black socks, 6 brown socks, and 4 white socks total. You must make pairs from these without any light to see what you are pulling out. You need to decide the smallest number of socks you can select to guarantee you have pairs.

3.) In order to guarantee you get at least one matching pair, you will need to pull four socks out.  
In order to guarantee you get a matching pair of each color, you must pull out 18 socks.

4.) Pulling out four socks will guarantee you at least one matching pair because, in a worst case scenario, your first three pulls will each be a different color. That being said, the fourth pull would always match at least one of the first three socks.   
Pulling out 18 socks will guarantee at least one pair of each color because the worst case scenario would be pulling out 10 black socks followed by 6 brown socks. In that case, the 17th and 18th pull would be required to be white.

5.) With pulling out one pair, you could potentially pull two of the same color out on your first two tries, or within the first three. However, in order to guarantee that you get a pair, the minimum number to pull would be four. This way, you could pull out one of each color and still get a match on the fourth pull.  
You could pull out pairs of socks at any time, but in order to guarantee a pair of each color you would have to eliminate two of the colors. So, by pulling 10 black socks (the most of one color, most likely) and 6 brown socks (the second most, second most likely) that simply leaves white, which would require you to pull 2 more for a pair.

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, middle finder 3, ring finger 4, and little finger 5. Then she reverses direction, calling the ring finger 6, middle finger 7, 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 b) What if the girl counts from 1 to 100 c) What if the girl counts from 1 to 1000

1.) The little girl in this problem has not been taught the social norm for how to count using her fingers. Because she counts in such an odd way, once the initial count to five has passed, she only adds four more to the last number on her fingers. We need to decide which finger she will land on when she hits a certain number.

2.) When the little girl counts past five, she only adds four more numbers until she reaches the end of her hand. She also reverses the counting on her hand as she reaches the end.

3.) In order to solve this problem, we could teach the girl how to count in a way that is socially acceptable. That way, we wouldn’t have to guess which finger she would land on when she got to these numbers as it would generally always be the pinky finger, since they are all multiples of five.  
As the problem states, she will be on her first finger when she reaches 10.   
Upon counting this way on my own hand, I discovered we were always at a multiple of 10 on either our first or third fingers, no matter how high we counted. Therefore, it is safe to assume that for any of these problems she will either land on the first or third finger.

However, I highly doubt that a little girl has the attention span to successfully count to 1000 and still land on the correct finger according to her pattern.

4.) By continuing to count on my own hand in the little girls pattern, I discovered that 10 was on the first finger, 20 on the third, 30 on the third, 40 on the first, 50 on the first, etc. I then realized that 200 was on the first finger and 300 was on the third. I decided to follow these patterns.

5.) a.) 10 will be on the first finger  
 b.) 100 will be on the third finger  
 c.) 1000 will be on the first finger.