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SDI Scalable Data Infrastructures Section: 01
Problem Solving

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 on 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) ***Define the Problem:***
   a) **Do this in your own words.**
      The man needs to cross the river using a boat that only hold himself and one other item. He has three items he needs to take to the other side of the river. His items are a cat, a parrot and a bag of seed. He must decide the order of the items to take because if taken in the wrong order, he risks losing one of the items.

   b) **What insight can you offer into the problem that is not immediately visible from the word problem alone?**
      While the parrot could possibly fly, but this depends on whether his wings are clipped and if he would fly to the other side of the bank. Also, cats don't eat seed.

   c) ***What is the overall goal?***
      The overall goal is to get all three items safely across the river without incident.

2) ***Break the problem apart***
   a) ***What are the constraints?***
      The constraints are that:
      - the cat could eat the parrot while the man crosses the river with the seed.
      - the boat will only hold one other item besides the man
      - the parrot will eat the seed if the man transports the cat first.

   b) ***What are the sub-goals?***
      The sub-goals are to not leave the cat alone with the parrot or the parrot alone with the seed.

3) ***Identify potential solutions***
   a) ***For each of the sub-problems you've discussed in #2, what is a possible solution?***
      - Take the parrot first
      - Take the cat first
      - Take the seed first
      - Take all three items at one time

4) ***Evaluate each potential solution***
   a) ***Does each solution meet the goals?***
      Not every solution will meet the goals.

   b) ***Will each solution work for ALL cases?***
      No, only one will.

5) ***Choose a solution and develop a plan to implement it.***
   a) ***Explain the solution in full.***
      By taking the parrot first, you will still have to transport either the cat or the seed next which results in the problem in the first place. I would suggest one trip by placing the parrot on top of the seed bag and putting the cat in my lap or between my legs on the floor of the boat.

   b) ***Describe some test cases you tried out to make sure it works.***
      The best test case is for the man to load the seed, and then place the parrot on top of it. Next, he would carry the cat to the boat and place it on his lap or on the floor of the boat between his legs.

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:

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

1) ***Define the Problem:***
   a) **Do this in your own words.**
      You need to know the smallest number of socks you can select in the dark that will result in at least one matching pair and one matching pair of the same color.

   b) **What insight can you offer into the problem that is not immediately visible from the word problem alone?**
      The chances of picking the minimum amount of socks are slim that meet the above criteria.

   c) ***What is the overall goal?***
      The overall goal is to pick a pair of matching socks in the least amount of tries and to pick at least one matching pair of each color in the minimum amount of tries.

2) ***Break the problem apart***
    a) ***What are the constraints?***
    You are constrained because you must pick the socks in the dark and the socks are not already paired up.

    b) ***What are the sub-goals?***
    The sub-goal is to get the minimum amount of socks that will result in one matching pair of the same color and one matching pair of each color.

3) ***Identify potential solutions***
    a) ***For each of the sub-problems you've discussed in #2, what is a possible solution?***
        - Use a light source, such as a flashlight, candle, or a lighter.
        - Match up your socks prior to putting them away and organize them in the drawer.

4) ***Evaluate each potential solution***
    a) ***Does each solution meet the goals?***
    Yes.

    b) ***Will each solution work for ALL cases?***
    Yes.

5) ***Choose a solution and develop a plan to implement it.***
    a) ***Explain the solution in full.***
    The easiest way to do this is to organize the sock drawer so that are socks are paired and laid out in the drawer based on color.

    b) ***Describe some test cases you tried out to make sure it works.***
        - First match all the socks together by color. Then, organize the sock drawer with so that certain colors are kept in a different area of the drawer.
        - Using the same number and color of socks, test the method yourself to determine the smallest number of socks that will achieve the overall goal.

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 finger 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?

a) 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

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1) ***Define the Problem:***
    a) **Do this in your own words.**
    The little girl has created a method for counting to ten on her fingers. She would to know which finger she would stop on if she counts to 10, 100, and 1000.

    b) **What insight can you offer into the problem that is not immediately visible from the word problem alone?**
    Her method of counting is different from the ways that most people would count to 10 on their fingers.

    c) ***What is the overall goal?***
    The overall goal is to determine which finger she would stop on when counting to 10, 100, and 1000.

2) ***Break the problem apart***
    a) ***What are the constraints?***
    We are constrained by the fact that her system of counting is unique and time consuming when counting to 100 and 1000.

    b) ***What are the sub-goals?***
    Using the girls finger counting method to determine the finger that will be the last one when counting to 10, 100, and 1000.

3) ***Identify potential solutions***
    a) ***For each of the sub-problems you've discussed in #2, what is a possible solution?***
        - Have the girl adjust her way of counting to make it easier.
        - We count using the girls method has done to determine the ending finger.
        - Since the problem deals with multiples of 10's determine which finger would you would end on and apply that to all of them.

4) ***Evaluate each potential solution***
    a) ***Does each solution meet the goals?***
    Yes.

    b) ***Will each solution work for ALL cases?***
    Yes

5) ***Choose a solution and develop a plan to implement it.***
    a) ***Explain the solution in full.***
    Both solutions are possible and realistic.

    b) ***Describe some test cases you tried out to make sure it works.***
        - Adjusting the girls counting method and counting ourselves.
        - Using the girls' current method, we count them.

- Since the problem includes multiples of ten, counting to ten would result in the pinky finger would be the one she stopped on for all scenarios.