CS 3100 / In-class Activity 4, Greedy Algorithms

Name	Computing ID
Your Name:	

In class: You must work in teams of 2, 3 or 4. Each person writes answers and turns in the sheet at end of class. **Missed class?** Work alone and answer to the best of your ability. Submit to GradeScope by 9am on the 2nd day after in-class activity.

1. With your group, think about how you would move the two slowest people across the bridge if there are only four people (n=4). We'd like you to work on this first without looking at or thinking about any solutions in the slides or given in class (or later in this handout). Draw the moves as shown in class or in the slides.

2. The slides describe a strategy for this that works as follows:
Fastest escorts the two slowest, as follows::

Move the fastest and the slowest across, then
Move the fastest back, then
Move the fastest and the second slowest across, then
Move the fastest back.

Draw the moves for this and calculate the total costs of this for these two inputs:

(1, 2, 4, 5) and (1, 3, 4, 5)

3. The slides describe another strategy that is:
The two slowest together move together, as follows:

Move the two fastest remaining people across, then
Move the fastest of these back, then
Move the slowest and the second slowest back, then
Move the second fastest back.

Draw the moves for this and calculate the total costs of this for these two inputs:

(1, 2, 4, 5) and (1, 3, 4, 5)

4. Which strategy works better for input (1, 2, 4, 5)?

5. Which strategy works better for input (1, 3, 4, 5)?

6. For the bridge crossing problem presented in class and in the slides, let's try to argue that the optimal substructure property applies to the problem. Let's use the notation $M(P1,\ P2)$ to signify the problem of moving everyone in the subset $P1$ to the right side when $P2$ is the set of people on the left side. The entire problem we want to solve is thus $M(P,\ P)$ where P is the set of all the people.

So the solution for the entire problem can be thought of as the problem of being made up of the solution for moving one person p_i across the bridge combined with the solution for moving everyone else across. Thus the following subproblems must be solved:

$M(\{p_i\},\ P)$ and $M(P - p_i, P - p_i)$

The first subproblem is of size 1 and the second is of size $n - 1$. If the optimal substructure property holds, then the optimal solution for the entire problem $M(P,\ P)$ must include optimal solutions to the two subproblems, i.e. the optimal way to move one person and also the optimal way to move the others. Use contradiction to argue that this must be true.