

Question 1 (25 Pts, SO-2)

You have a card on which the letter **J** is written on one side and **K** on the other. You want to see all of the possible ways the card will land if you drop it **n** times. Write a recursive method that prints each session of dropping the cards with J's and K's. For example if you drop it 4 times in a given session, all possible ways to drop it are as follows (in exactly the specified order):

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J J J J
J J J K
J J K J
J J K K
J K J J
J K J K
J K K J
J K K K
K J J J
K J J K
K J K J
K J K K
K K J J
K K J K
K K K J
K K K K
```

Question 2 (15 Pts, SO-2)

Compare and contrast between iterative and recursive solutions. When would you prefer iteration over recursion and vice-versa? Justify your answer by giving different examples than the ones which are provided in the lecture slides.

Question 3 (60 Pts, SO-2)

Jeddah Municipality has decided to build a network of national hospitals to treat infectious diseases. A special task force is constituted which is tasked to investigate possible locations for these new hospitals. The task force has done its job and come back with a list of potential sites. Each of these hospitals has an associated cost and will provide coverage to some number of nearby districts within Jeddah. We can represent each potential hospital site as having: a name (string), cost to build the hospital (int) and a set of districts to be covered (Set of strings).

Jeddah Municipality is interested in providing health care to all, but they do not have funds to build an unlimited number of hospitals. The goal is to provide coverage to as many districts as possible using the available funds. For example, suppose Jeddah Municipality has the following districts:

Al-Aziziya, Ar-Rihab, Mosharafa, Al-Faysaliya, Bani Malik, An-Naseem, Al-Balad, Al-Salam, Al-Makarona, As-Salmiya, Al-Gozain, Al-Hamdaniya

Suppose that these are the possible hospital sites:

Site 1: Covers Al-Aziziya, Ar-Rihab, Mosharafa, Al-Faysaliya. Cost: SARs 20,000,000.

Site 2: Covers Ar-Rihab, Bani Malik, An-Naseem, Al-Balad. Cost: SARs 50,000,000.

Site 3: Covers Al-Balad, Al-Salam, Al-Makarona, As-Salmiya, Al-Gozain. Cost: SARs 40,000,000.

Site 4: Covers As-Salmiya, Al-Gozain, Al-Hamdaniya. Cost: SARs 10,000,000.

Site 5: Covers Mosharafa, Al-Faysaliya, An-Naseem, Al-Balad. Cost: SARs 30,000,000.

Site 6: Covers Al-Balad, Al-Salam, Al-Hamdaniya. Cost: SARs 10,000,000.

Site 7: Covers Al-Balad, Mosharafa, Al-Salam, Al-Makarona, As-Salmiya. Cost: SARs 60,000,000.

Site 8: Covers Ar-Rihab, Bani Malik, Al-Makarona, As-Salmiya, Al-Balad. Cost: SARs 50,000,000.

If you build Site 1 and Site 2, you have provided coverage to Al-Aziziya, Ar-Rihab, Mosharafa, Al-Faysaliya, Bani Malik, An-Naseem, and Al-Balad a total of seven districts, at a cost of SARs 70,000,000. (Notice that both Site 1 and Site 2 provide coverage to Ar-Rihab, so even though Site 1 and Site 2 cover four districts each, only seven total districts end up covered). Adding in Site 5 would add in a cost of SARs 50,000,000 without actually providing any new coverage, since all four of the cities it services are already covered.

Your task is to write a recursive function that takes as input a list of possible hospital sites and an amount of funds available, and then returns a list of hospitals that should be built to provide coverage to the maximum number of cities.

It is important to note that multiple hospitals could provide coverage to the same district. However, when you count up the total number of districts covered, you do not double-count a district.

A sample run:

Suppose total available funds (budget) are: SARs 80,000,000. The optimal coverage is [Site 1, Site 4, Site 5, Site 6] covers 11 districts.