1. Suppose there is a penalty for 1 for each gap and a penalty of 2 for matching two different symbols in a column. What is the NW score of the strings AGTACG and ACATAG?

1. 3
2. 4
3. 5
4. 6

$$A-GTCG$$
$$ACATA-G$$

(2) is the correct answer. We have an upperbound of 8 if we compute the NW score of the original strings. The strings are of the same length so they must have an even NW score because inserting a gap in one of the strings will require we insert a gap in the other. We will have at least one mismatch will we give us a lowerbound of 4.

2. Let $X = x_1, x_2, \ldots, x_m$ and $Y = y_1, y_2, \ldots, y_n$ be two input strings, with each symbol x_i or y_j in $\{A, C, G, T\}$. How many relevant possibilities are there for the contents of the final column of an optimal alignment?

1. 2
2. 3
3. 4
4. $m \cdot n$

(2) is the correct answer. We choose for the x_m character to be a gap or the x_m charater. We again can choose for the y_n character to be a gap or the y_n character. Making both x_m and y_n gaps would be redundant and we could have a better solution by having either x_m or y_n as a gap. Thus we have three options. x_m and y_m staying the same. x_m staying the same and matched with a gap. y_n staying the same and matched with a gap.

3. Suppose one of the two input strings is empty. What is the NW score of X and Y?

1. 0
2. $\alpha_{gap} \cdot (length\, of\, X)$

3. $+\infty$
4. undefined

(2) is the correct answer. We make Y the "gap" string. which would result in a penalty of the length of X.

4. Consider the following two search trees that store objects with key $1, 2$ and 3: and the search frequency 1:.8, 2:.1, 3:.1. What are the average search times in the two trees, respectively?

1. 1.9 and 1.2
2. 1.9 and 1.3
3. 2 and 1
4. 2 and 3

The average search time for the first tree is $\sum_{n \in N} p(n) \cdot [depth\, of\, n\, in\, tree + 1] = .8 * 2 + .1 * 1 + .1 * 2 = 1.9$. The average search time for the second tree is $\sum_{n \in N} p(n) \cdot [depth\, of\, n\, in\, tree + 1] = .8 * 1 + .1 * 2 + .1 * 2 = 1.2$.