Malaysian Informatics Competition (MCC)
Sample Paper

Malaysian Informatics and Programming Society (MIPS)

July 30, 2012

This competition paper has six problems, with some problems having a few subproblems. The maximum score is 60. You have *one hour* to complete this paper.

Problems

Football (6 points total)

Three teams are in a football tournament: the Aces, the Bees, and the Cats. Each team played the other two teams once. Overall, the Aces scored 4 goals and had 3 goals scored against them. The Bees scored 2 and had 2 scored against them. The Cats scored 1 and had 2 scored against them.

1. **(2 points)** What was the score of the Aces–Bees match?
2. **(2 points)** What was the score of the Bees–Cats match?
3. **(2 points)** What was the score of the Aces–Cats match?

Rising Sequence (7 points)

A *rising sequence* is a list of numbers where each number is greater than the sum of all the numbers before it. For example, $1, 2, 5, 12, 24$ is a rising sequence because $1 < 2$, $1 + 2 < 5$, $1 + 2 + 5 < 12$, and $1 + 2 + 5 + 12 < 24$. On the other hand, $1, 2, 3, 6, 20$ is not a rising sequence because $1 + 2 + 3 \not< 6$.

You are given the following list of numbers:

$$5, 7, 9, 13, 24, 30, 40, 50, 60.$$

Your task is to form the *longest* possible rising sequence using numbers from this list.

4. **(7 points)** How many numbers are there in your rising sequence?

Spy Message (8 points total)

Spies from the Spy Academy uses the following method to send secret messages:

- Replace each `V` in the message with `XW`;
- Replace each `W` in the message with `V`;
- Replace each `X` in the message with `YZ`;
- Replace each `Y` in the message with `Z`;
- Replace each `Z` in the message with `WY`.

No letter other than `V`, `W`, `X`, `Y` or `Z` is used in the message.

Ali, Beth, Carly, David, and Edward are spies from Spy Academy. Ali starts with a message, encodes it according to the above rules, and passes it on to Beth. Beth does the similar thing (encodes the message received from Ali) and passes it on to Carly. Similarly, Carly to David, and David to Edward. Edward receives the message `VZXWWY`.

5. **(8 points)** What message did Ali start with?

Letter sort (12 points total)

A sorting program does not understand about numbers, and treats all digits as letters. Hence, the numbers $10, 12, 100, 101, 111$ would be sorted as $10, 100, 101, 111, 12$.

6. **(3 points)** If the numbers $1, 2, \ldots, 99$ are sorted, what is the 33-th number?
7. **(4 points)** If the numbers $1, 2, \ldots, 999$ are sorted, what is the 100-th number?
8. **(5 points)** If the numbers $1, 2, \ldots, 999$ are sorted, what is the 989-th number?

Adjacent Swaps (12 points total)

A bunch of letters got mixed up. Your job is to sort them in the correct order, but you can only do so by swapping letters that are adjacent to each other.

For example in the case of $CBDA$, it would take 4 swaps to get to the correct order of $ABCD$. ($CBDA \to BCDA \to BCAD \to BACD \to ABCD$).

What is the minimum number of swaps to get to the correct order for the following:

9. **(3 points)** $BEACFD$
10. **(4 points)** $CDIGABFHE$
11. **(5 points)** $HKFBDGJIALCE$

Treasure Hunter (15 points total)

You have entered a cave and found gold coins laid out nicely in sequence. Since you are a coin expert, you can identify their values. However, you cannot take them all since if you take any two adjacent coins, the cave will collapse. Hence, you wish to maximize the value of the coins you take without taking adjacent coins.

For example, if there were six coins with values $7, 2, 2, 1, 6, 9$, you would take the 1st, 3rd, and 6th coins, and get a total value of 18.

What is the maximum total value that you can get without taking adjacent coins for the following:

12. **(4 points)** $4, 3, 1, 1, 3, 7, 6, 5$.
13. **(5 points)** $5, 6, 3, 5, 1, 6, 3, 9, 8$.
14. **(6 points)** $7, 7, 4, 8, 4, 1, 8, 1, 6, 2, 1, 8, 3, 5, 8$.

Solutions

Note that most solutions are given without or with only partial explanations. Students and teachers are advised to work out the explanations themselves as preparation for the competition.

Football (6 points total)

1. **(2 points)** 2–2
2. **(2 points)** 0–0
3. **(2 points)** 2–1

Rising Sequence (7 points)

The longest rising sequence is $5, 7, 13, 30, 60$.

4. **(7 points)** 5

Spy Message (8 points total)

$$\texttt{X} \to \texttt{YZ} \to \texttt{ZWY} \to \texttt{WYVZ} \to \texttt{VZXWWY}$$

5. **(8 points)** `X`

Letter sort (12 points total)

When $1, 2, \ldots, 99$ are sorted, the order is:
$1, 10, \ldots, 19,$
$2, 20, \ldots, 29,$
$\ldots,$
$9, 90, \ldots, 99.$

6. **(3 points)** 39
7. **(4 points)** 189
8. **(5 points)** 99

Adjacent Swaps (12 points total)

9. **(3 points)** 5
10. **(4 points)** 16
11. **(5 points)** 35

Treasure Hunter (15 points total)

Selected coins are as below:

- $\textcircled{4}, 3, \textcircled{1}, 1, 3, \textcircled{7}, 6, \textcircled{5}$.
- $5, \textcircled{6}, 3, \textcircled{5}, 1, \textcircled{6}, 3, \textcircled{9}, 8$.
- $\textcircled{7}, 7, 4, \textcircled{8}, 4, 1, \textcircled{8}, 9, \textcircled{6}, 2, 1, \textcircled{8}$.

12. **(4 points)** 17
13. **(5 points)** 26
14. **(6 points)** 37