Form 5 ICT Elective Module D: Programming and Software Development

Revision Assignment (1)

There are two questions in this assignment. Answer ALL questions.

1. The following algorithm is designed for checking the validity of a `password`. The function `length()` is used to find the number of characters in a string.

```
CheckPW(password) {
    Valid ← True
    If length(password) < 6 Then
        Valid ← False
    Else {
        Valid ← False
        For x ← 1 to 3 {
        If x^th character of password is a letter Then Valid ← True
    }
        If Valid = True Then {
            x ← 4
            Repeat
                If x^th character of password is a digit Then
                    Valid ← True
                Else
                    Valid ← False
                x ← x + 1
            Until x > length(password)
        }
    }
    If Valid = True Then
        Output "Valid"
    Else
        Output "Invalid"
}
```

Program Segment A →

Program Segment B →

(a) What is the output of the above algorithm for the following value of **`password`**?

Value of `password`	Output of algorithm
`ABC45`	
`AB1234`	
`ABCDEF9`	
`ABCD9EF`	

(4 marks)

(b) A password is valid if it satisfies the following three conditions:

- The password consists of at least 6 characters.
- The first 3 characters of the password are letters.
- For the remaining characters, at least one digit should be included.

For example, "HKTAYY2SS" is a valid password because

- the password consists of 9 characters,
- the first 3 characters "H", "K", "T" are letters and
- the 7th character is a digit.

There are two logical errors in the above algorithm.

Correct program segment A.

```
Valid ← _______________

For x ← 1 to 3 {

If ____________________________________________ Then

    Valid ← _______________

}
```

(2 marks)

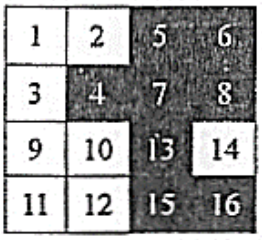
Correct program segment B.

```
Repeat









    x ← x + 1
Until x > length(password)
```

(2 marks)

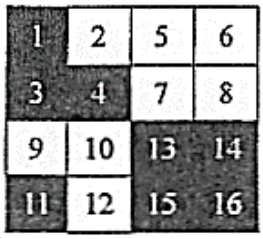
2. John develops a colouring method to blacken an image with 4×4 pixels. All pixels of the image are labelled with a number from 1 to 16. Four additional numbers, 17, 18, 19 and 20, are used to represent groups of pixels, pixels 1 to 4, pixels 5 to 8, pixels 9 to 12 and pixels 13 to 16 respectively. For a given image, John will use the shortest sequence of numbers in ascending order to record the pixels to be blackened.

For example, the image below is blackened by '4, 13, 15, 16, 18':



(a) John's colouring method is applied.

(i) What is the sequence for blackening the following image?



(ii) Blacken the following image using '1, 5, 6, 19':

1	2	5	6
3	4	7	8
9	10	13	14
11	12	15	16

(iii) Blacken the following image using the longest possible sequence:

1	2	5	6
3	4	7	8
9	10	13	14
11	12	15	16

(4 marks)

John plans to write a subprogram with the following variables to restore the image from a sequence.

Variable	Description
A	an integer array for storing the sequence
N	an integer variable for storing the length of the sequence
P	a character array with indexes from 1 to 16 for storing the colours of the pixels ('B' and 'W' represent black and white respectively.)

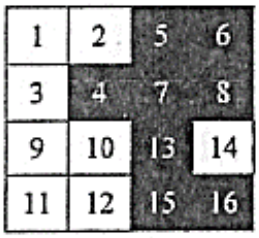
An example is shown below:

The contents of A and N for the image are

i	1	2	3	4	5
the i-th entry of A	4	13	15	16	18

N = 5

The subprogram decodes the data and stores the result in P to represent the image, as shown below:



i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
the i-th entry of P	W	W	W	B	B	B	B	B	W	W	W	W	B	W	B	B

(b) Assume that the initial content of P is empty. Write the pseudocode for the subprogram.

(5 marks)

John improves his colouring method by determining the number of times the pixels are referred to by the sequence of numbers. If a pixel is referred to by the sequence once only, it is black; otherwise, the pixel is white. For example, the following image is blackened by '4, 14, 20'. The pixels labelled with the numbers 4, 13, 15 and 16 are referred to once and so they are black. The pixel labelled with the number 14 is referred to twice, by 14 and 20, and so it is white.

1	2	5	6
3	4	7	8
9	10	13	14
11	12	15	16

(c) John's improved method is applied.

(i) What is the sequence for blackening the following image?

1	2	5	6
3	4	7	8
9	10	13	14
11	12	15	16

(ii) Blacken the following image using '2, 5, 17, 19':

1	2	5	6
3	4	7	8
9	10	13	14
11	12	15	16

(3 marks)

(d) Compare John's original method and improved method.

(i) Give an image with 7 black pixels so that the lengths of the sequences produced by the two methods are the same.

1	2	5	6
3	4	7	8
9	10	13	14
11	12	15	16

(ii) Give an image in which the difference between the lengths of the sequences produced by the two methods is the largest.

1	2	5	6
3	4	7	8
9	10	13	14
11	12	15	16

(3 marks)