Benha University
Faculty of Engineering (at Shoubra)
Electrical Engineering Department
2nd Year (Electronics and Communications Engineering**)**

Final Exam
Subject: Computer Programming (2) - ECE 214C
Date: Mon 05/01/2015
Duration: 3 hours

Attempt **5** of the following questions (**including** questions 1 and 2)

№ of Questions: 6 in 2 page(s)
Total Mark: 90

Question 1: (18 Marks)

Determine the output for each of the following code snippets (assuming successful compilation):

a) (3 Marks)

```
for (int i = 0; i < 5; i++) {
    for (int j = 0; j <= 5; j++) {
        if (j == i + 1) break;
        System.out.print(j);
    }
    System.out.println();
}
```

b) (3 Marks)

```
for (int i = 0; i < 5; i++) {
    for (int j = 0; j <= 5; j++) {
        if (j == i) continue;
        System.out.print(j);
    }
    System.out.println();
}
```

c) (3 Marks)

```
int i = 0;
do {
    System.out.println(++i);
    System.out.println(i++);
} while (i < 5);
```

d) (3 Marks)

```
for (int i = 0; i < 5; i++) {
    for (int j = 0; j < 5; j++)
        System.out.print((i+j)%2==0?"■":" ");
    System.out.println();
}
```

e) (3 Marks)

```
for (int i = 0; i < 5; i++) {
    for (int j = 0; j < 5; j++) {
        char c;
        switch (Math.abs(i - j)) {
            case 0 : c = '\\'; break;
            case 2 : c = '+' ; break;
            case 4 : c = '.' ; break;
            default: c = ' ' ; break;
        }
        System.out.print(c);
    }
    System.out.println();
}
```

f) (3 Marks)

```
{
    int f1 = 1;
    int f2 = 1;
    for (int i = 1; i <= 5; i += 1) {
        System.out.println(f1);
        f2 = f1 + f2;
        f1 = f2 - f1;
    }
}
```

Question 2: (18 Marks)

For the three questions that you will solve later:

a) **(**6 Marks**)**
avoid syntax and runtime errors,

b) **(**6 Marks**)**
validate the user input,

c) **(**6 Marks**)**
prompt the user with meaningful instructions, and

d) **(**6 Marks**)**[$]
write the code using a clean style.

Question 3: (18 Marks)

Write a full program including three methods for printing the following patterns using only one '*' and one ' ' per method.

a) (6 Marks)

```
*****
*   *
* * *
*   *
*****
```

b) (6 Marks)

```
*   *
 * *
  *
 * *
*   *
```

c) (6 Marks)

```
  *
 ***
*****
 ***
  *
```

$ Bonus

Question 4: (18 Marks)

The factorial of a nonnegative integer n is written as $n!$ (pronounced "n factorial") and is defined as follows:

$$n! = \begin{cases} n \cdot (n-1) \cdot (n-2) \cdot \ldots \cdot 1 & , n \geqslant 1 \\ 1 & , n = 0 \end{cases}$$

For example, $5! = 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1$, which is 120.

Write a full program including three methods:

a) (6 Marks)

`fact` that takes a nonnegative integer and returns its factorial,

b) (6 Marks)

`nbase` that estimates the value of the mathematical constant e by using the following formula, and

$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \ldots + \frac{1}{n!}$.

c) (6 Marks)

`nexp` that takes a real number x and computes the value of e^x by using the following formula.

$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots + \frac{x^n}{n!}$.

Question 5: (18 Marks)

In survey engineering, a *traverse* is an n-sided closed polygon. *Traverse angle balancing* is a process intended for adjusting (correcting) the measured internal angles of a given traverse according to the following equations. The target of this process is to make the actual sum of the corrected angles the same as the theoretical sum ($tsum$).

$$tsum = 180 \cdot (n-2)$$

$$asum = \left(\sum_{i=1}^{n} a_i \right)$$

$$error = asum - tsum$$

$$correction = error/n$$

$$\hat{a}_i = a_i - correction \forall i \in [1, n]$$

Create a class `Traverse` and provide:

a) (6 Marks)

a constructor that takes an array with three or more traverse angles $a_1, a_2, \ldots, a_n$,

b) (6 Marks)

a method `correct` for performing *traverse angle balancing*, and

c) (6 Marks)

a method `getAngles` that returns the traverse angles.

Example: If the measured angles are $a = \{61.5, 60.5, 59.5\}$, then the corrected angles should be $\hat{a} = \{61.0, 60.0, 59.0\}$

Question 6: (18 Marks)

An n^{th} degree polynomial is expressed as:

$$f(x) = \sum_{i=0}^{n} a_i x^i, a_n \neq 0$$

Create a class `Polynomial` and provide:

a) (6 Marks)

a constructor that takes an array to initialize the polynomial parameters.

b) (6 Marks)

a method `f` that takes a real number x and returns the value of $f(x)$.

c) (6 Marks)

a method `toString` that returns a string representing the polynomial on the form:
$f(x) = a_0 + a_1 x + \ldots + a_n x^n$

Example: Assuming that the polynomial parameters are {1, 0, -2, 3}, the method `f(1)` should return 2.0 and the method `toString()` should return:

```
f(x) = 1.00 - 2.00x^2 + 3.00x^3
```

Good Luck

Dr. Islam ElShaarawy