Section, Name and ID#: _____

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AMERICAN UNIVERSITY OF ARMENIA

College of Science and Engineering

CS 120 Introduction to Object-Oriented Programming

MIDTERM EXAM

2 replaced by extra quiz

Date / Time: Friday, March 17 2017 at 17:30

Duration: 2 hours

Attention: **ANY TYPE OF COMMUNICATION IS STRICTLY PROHIBITED**

Write down your section, name and ID# at the top of all used pages

Participation:

Problem 1: Consider below a C++ function ***float kahan(float num1, float num2, float& compensation)*** that implements the ***Kahan Summation Algorithm*** for high-precision compensated summation of two float arguments ***float num1*** and ***float num2***:

```
float kahan(float num1, float num2, float &compensation)
{
    float result;
    num2 -= compensation;
    result = num1 + num2;
    compensation = (result - num1) - num2;
    return result;
}
```

Using this function, write a C++ function ***float pi(int n)*** that computes the value π by the following formula:

$$\pi = 16\sum_{k=0}^{n}\frac{(-1)^k}{(2k+1)5^{2k+1}} - 4\sum_{k=0}^{n}\frac{(-1)^k}{(2k+1)239^{2k+1}} = \left(\frac{16}{1*5} - \frac{4}{1*239}\right) - \left(\frac{16}{3*5^3} - \frac{4}{3*239^3}\right) + \left(\frac{16}{5*5^5} - \frac{4}{5*239^5}\right) - \cdots$$

The initial value of ***float compensation*** is ***0.0***.

```
double Sum (int [], int Size) {
    double array_Sum =0
for (int i=0, i < Size ,i++) {
    array_Sum + = a[i];
    }
    return array_Sum;
}
    int main(),
{ for (int  i=0,
        int  a[20],
    for (int i=0, i<20, i++);
        cin >> a[i];
        cout << Sum (a[20], 20)
    return
}
```

```
float pi(int n) {
```

1

Use the backside, if needed

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Problem 2: Write a Java method ***public static double[] expReg(double[] data)*** that takes as its argument an array of data points ***double[] data***, and returns a two-element array – the first element being the exponent of an exponential regression and the second element being the amplitude. The exponential regression approximates the data points by a formula

$$y = a\, e^{mx},$$

where the exponent ***m*** and the amplitude ***a*** are computed as

$$m = \frac{\overline{xy} - \bar{x}\,\bar{y}}{\overline{x^2} - \bar{x}^2}, a = \bar{y} - m\,\bar{x}$$

Here $\bar{x}$ is the mean of the x coordinates, $\bar{y}$ is the mean of the natural logarithm of y coordinates, $\overline{x^2}$ is the mean of the squares of the x coordinates, and $\overline{xy}$ is the mean of the products of the x and natural logarithm of y coordinates. Use the element indices of the array ***double[] data*** as x coordinates and the element values as y coordinates. For natural logarithm, use the method ***double Math.log()***.

Both result elements are zeros, if at least one data element is non-positive.

```
public static double [] expReg(double[] data){
    double result = new double [] 10,0};
    double xy_=0, x=0, y=0, x²=0;
~~for (x=0 y=0~~ for(int i=0; i<array.length; ++i){
    if (data[i]=0)
    return new double [] {0,0; 0,0};
    x +=1;
    y +=Math.log(data[i]);
    xy +=i * Math.log(data[i]);
    x² = i*i;

    y x =/= data.length;
    y =/= data.length;
    xy =/= data.length;
    x² =/= data.length;
    result[0]=(xy - x*y)/(x² - Math.pow(x,2))
~~result[1]=y - m x~~ result[1]=y - result[0]*x;
    return result;
}
```

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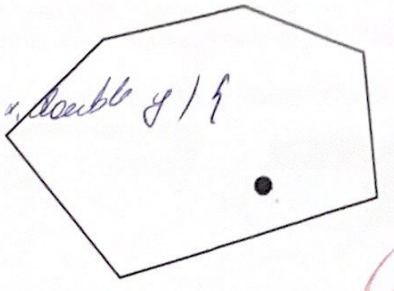
Problem 3: Write a Java function ***public static boolean isInside(double[][] vertex, double x, double y)*** that takes as its argument a ***2-by-n*** array of a convex polygon's vertex coordinates ***double[][] vertex*** – the ***x*** coordinates in the first row and ***y*** coordinates in the second row, and ***double x*** and ***double y*** coordinates of a point. It checks, if the point is inside the polygon.

Assume and use a method ***boolean toLeft(double x1, double y1, double x2, double y2, double x0, double y0)*** that takes as its arguments coordinates of three points and returns ***true***, if the third point ***(x0, y0)*** is in the left-hand side, when moving from the first point ***(x1, y1)*** to the second one ***(x2, y2)***; and ***false***, if it is in the right-hand side.



```
public boolean isInside[][] vertex, double x, double y) {
                int
for (int i=0, i< vertex length, i++) {
    for (int a=0, a< vertex length, a++) {
        for (int b=0, b< vertex length, b++) {
            for (int n=0, n< vertex length, n++) {
                if (length (i, m, n, l) {
                    if (g, l)
                        return true
                    else ~~g=~~ else
                    ~~return false~~ return false
}}}}}
```

if one point is in left side of line or right then it is inside else it is outside the polygon.

Use the backside, if needed

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Problem 4: Write a Java method ***public static void magicOdd(int[][] square)*** that creates a magic square of an *odd* size using the following algorithm:

1. The number *1* goes in the middle of the top row;
2. All numbers are then placed one ***column to the right*** and ***one row up*** from the previous number;
3. Whenever the next number placement is above the top row, stay in the same column and place the number in the bottom row (note the place of *2* instead of the shaded location);
4. Whenever the next number placement is outside of the rightmost column, stay in the same row and place the number in the leftmost column (note the place of *3* instead of the shaded location);
5. When encountering an already filled-in square, place the next number directly below the previous number;
6. When the next number position is outside both a row and a column, place the number directly beneath the previous number (note the place of *7* instead of the shaded location).

	9	2	7
8	1	6	8
3	5	7	3
4	9	2	

public static void magicOdd(int[][] square)

1

i take the place for 1 and then continue to fill our magic square. we write function which will start from initial point then go column to the right and one row up (col++, row--) then repeat the same step for next number. but if our step is outside of the rightmost column then fill leftmost column being in the same row. and with a for loop repeat this situation until fill all empty spaces

Use the backside, if needed

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