Section, Name and ID#: [redacted]

AMERICAN UNIVERSITY OF ARMENIA
College of Science and Engineering
CS 120 Introduction to Object-Oriented Programming

MIDTERM EXAM

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:

$$\pi = 2\sum_{k=0}^{n} \frac{(2k-1)!!}{(2k)!!(2k+1)} = \frac{2}{1*1} + \frac{1}{2}*\frac{2}{3} + \frac{1*3}{2*4}*\frac{2}{5} + \frac{1*3*5}{2*4*6}*\frac{2}{7} + \cdots$$

Recall that **n!!** is the product of odd numbers from *1* to ***n***, if ***n*** is odd; and is the product of even numbers from *2* to ***n***, if ***n*** is even. The double factorial of non-positive numbers equals to *1* by definition.

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

~~float p(n|n)~~ {

~~float recall 0,~~

~~for i=0, <= n, k++)~~ {

~~recall + =~~

float p (int n) { double a=0 double b=0
double c=0;

for(int i=0 i≤n; i++){

for (int i=1, i≤n, i++) if i%2!=0){b=b*i;}

for (int i=2; i≤n; i++) if i%2==0{c=c*i;}

a = kacen (a+ c/(b·(2i+1)),0);

Use the backside, if needed

Problem 1 of 4

return (float)(2·a);

0

Jea RS

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Section, Name and ID#:______________________

Problem 2: Write a Java method ***public static double[] lin(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 slope of the linear regression and the second element being the intercept. The linear regression approximates the data points by the linear formula

$$y = k\,x + b,$$

where the slope k and the intercept b are computed as

$$k = \frac{\overline{xy} - \bar{x}\,\bar{y}}{\overline{x^2} - \bar{x}^2}, b = \bar{y} - k\,\bar{x}$$

Here $\bar{x}$ is the mean of the x coordinates, $\bar{y}$ is the mean of the 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 y coordinates. Use the element indices of the array ***double[] data*** as x coordinates and the element values as y coordinates. You may assume and use the method double ***mean(double[] a)***.

```
public static doublelin[ ]data) {
double[] anr= new arr [2 ]
double [] vy =mean double [ data, ~~[illegible]~~line]
for ( Wmo() <  double  int( ++) {
double []~~[illegible]~~ X = new double (1) [illegible]

new double
mean( double[] a) x [illegible] return.
```

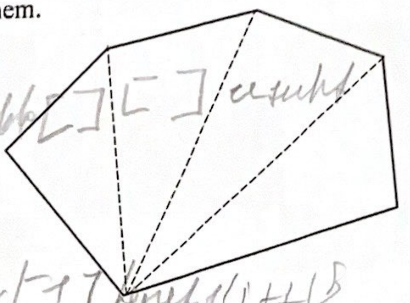
1

Section, Name and ID#:__ T/

Problem 3: Write a Java function ***public static double area(double[][] vertex)*** 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. It returns polygon's area as follows:

1. Divides the polygon into triangles by connecting the ***first*** vertex with the n^{th} and $(n+1)^{st}$ vertices;
2. Adds the areas of the constructed triangles using the formula $area = \sqrt{p(p-a)(p-b)(p-c)}$, where a, b and c are the sides and $p = (a + b + c) / 2$.

You may assume and use a method ***double dist(double x1, double y1, double x2, double y2)*** that takes as its arguments coordinates of two points and returns the distance between them.



```
public   static   double area[double[ ][ ] result
  double result =0
    for int i =1;  i < venter[1] length(i++){
    double a = dist  mate [0][0]ouble [1][0]
                                  vrten[a][0]
                                     vrtr[1]
    dube b < dist  | vrten [1]
    double c = dist[a][0]
   doubleaslire = dist [a][0]  lengt  ar be =flat
```

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Section, Name and ID#:

Problem 4: Write a Java method ***public static void magic4N(int[][] square)*** that creates a magic square of a *4N-by-4N* size using the following algorithm:

1. Creates an array of the same size as ***int[][] square*** and fills it forward with successive integers assigning ***1*** to the top-left element;
2. Creates anther array of the same size as ***int[][] square*** and fills it backward with successive integers assigning ***1*** to the bottom-right element;
3. Divides the original ***int[][] square*** into 16 blocks of the same size – 4 blocks per row and column. In the on-diagonal (shaded) blocks copies the elements from the first array, and in the off-diagonal blocks copies the elements from second array.

1	2					7	8
9	10					15	16
		19	20	21	22		
		27	28	29	30		
		35	36	37	38		
		43	44	45	46		
49	50					55	56
57	58					63	64

		62	61	60	59		
		54	53	52	51		
48	47					42	41
40	39					34	33
32	31					26	25
24	23					18	17
		14	13	12	11		
		6	5	4	3		

Rewrite

1	0	0	1
0	1	1	0
0	1	1	0
1	0	0	1

nowky and forward new int new int [4n][4n]

(row=0, row ≤ row<colomn length row++)

for(int colum=0 col< forward[row]length column++)

int forward [row] [col]=can-forward[row]length- ~~int col~~

+ cd ~~int~~ width

print forward

int backward = new int [4n] [4n]

for (int row=0; row < backward length row++)

for (int col=0; col < backward[row length col++)

backward [row] [col] = backward[row].length

(backward length -row)

int [][] = new int [4] [4]

for int (row=0 | magic square length)

printf col=0 col < square length

notsure → { print forward

or else print backward

Use the backside, if needed

2