Section, Name

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

7 See NS

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 pi(int n) {
float pi = 0.0;
float result = 0.0;
for( int i=0; i<n; i++) {
pi = kahan(result, 2(2i - 1)!!/(2i)!!(2i+1)), ~~pi~~ + 0.0);
```

int division

3/2=1.5

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```
return pi;
}
```

Use the backside, if needed

Problem 1 of 4

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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 double[] lin(double[] data){
double[] ~~xs~~ xy = new ~~[illegible]~~ double[data.length];
double[] X2 = new double [data.length];
double [] x = new double [data.length]:
double[] result = new double[2];
 ~~result[0] =~~ double[] XC = new double[data.length];
for(int i=0;i<data.length-1;i++){
  xy[i]=i*x[i];
  X2[i]= i*i;
  XC[i]=i;
 }
result[0]=(mean(xy) - mean(XC)*mean(X))/mean(X2)-((mean(XC)*mean(XC));
result[1]= mean(X)- result[0]* mean(xc);
   return result;
};
```

3/2=1.5
see NS

One more problem, take array and fill with ones."1"

```
int[][] one = new int[5][5];
 for(int row=0;row<one.length;row++){
   for(int col=0 col<one[row].length;col++){
      one[row][col]=1
   }
 };
```

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Use the backside, if needed

Problem 2 of 4

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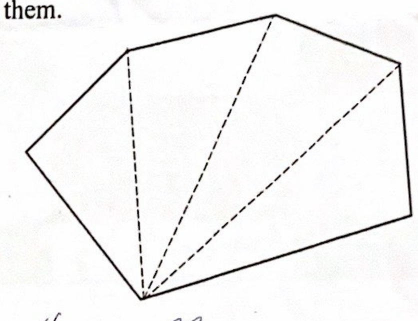
Problem 3: Write a Java function ***public static double area(double[][] vertex)*** that takes as its argument a ***2-by-n*** array of a convex polygon's vertex coordinates ***double[][] vertex*** – the ***x*** coordinates in the first row and ***y*** coordinates in the second row. It returns polygon's 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[][]vertex){
 double area;



return area;
}
```

factorial function, another problem.

```
int factorial(int n){
   if(n<=0){
      return "Error";
   }
 else{
   for (int i=n; i>1; i--){
      n=n*i

} return n;
```

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another problem

```
public static int[][]mat(int[][] arr){
for(int row=0; row<arr.length, row++){
  for (int col=0; col<arr[row].length; col++){
    }} arr[row][col] = col;
  } return arr;
};
```

takes an nxn array and fill each row from 1 to n;

eg. 4x4 array is returned in this way.

```
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4 .
```

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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	▨	▨

```
public static void magic4N(int[][] square){
  int{i,j, n,k,z=1;
 Scanner input=new scanner(System.in);
   n =input.nextInt();
   int[][] arr =new int[square.length][square-length];
    for (~~int~~i =0 i<arr-length, i++) {
     for(~~int~~j =0, j<arr[i]-length;j++ ){
         arr{i}=k;
          k++
        }
     };
 int[][]arr2 =new int{square-length][square.length];
   for (~~int~~row =0; row<arr2-length; row++ ){
      for (int col=0; col<arr2[row].length; col++){
        ~~arr2[2]~~ arr2[row]=k;
            k--
        }
    };
```

2/2=1

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array, return the biggest element,

~~public static int[] big = new~~

```
public static int big(int[] b){
    int a = b[0];
     for(let i=0; i< b.length;i++){
        if(a < b[i]){
           a = b[i]
       }
     };
    return a;
};
```

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