1. **Random Numbers**

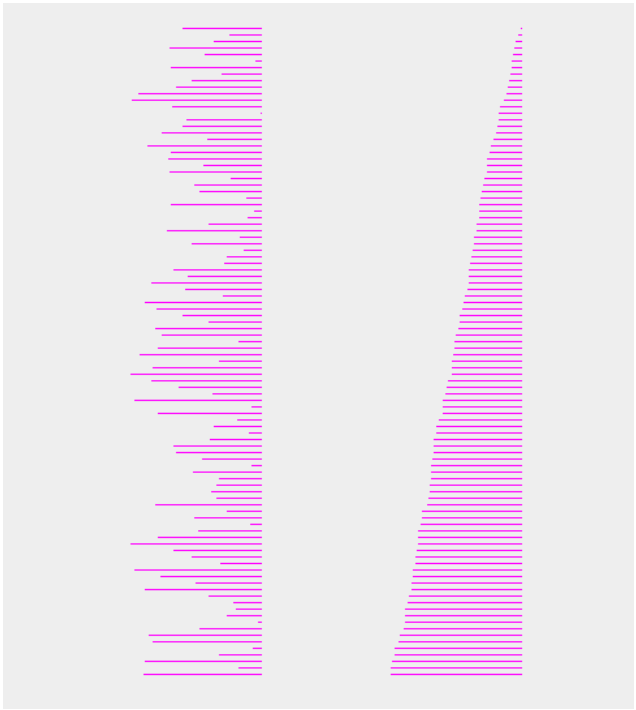
   Write a JFrame-JPanel program to generate 100 random integers between 1~100. Display the result as a bar chart. Resize the window to refresh. Please put main program and other programs in different files.

   Draw the following:

   (1) Original array.

   (2) Sorted array.

   Sample Output



2. **2D Vectors**

   Write a command line program for two-dimensional vectors. Input option and vector, and convert it between rectangular form and polar form.

   Input

   The input contains multiple test cases. Each line contains 3 integers. The first integer is option, then the vector.

   Option 1: Convert from rectangular from into polar form

   Option 2: Convert from polar form into rectangular form

   For rectangular form, the first value is X, the second value is Y.

   For polar form, the first value is R, the second value is θ.

Output

For each test case, output 2 numbers in a line. Round to 2 digits after the decimal point. ($0 \le \theta < 360$)

Sample Input

1 200 200
1 500 -300
2 10 135
2 25 330

Sample Output

282.84 45.00
583.10 329.04
-7.07 7.07
21.65 -12.50

3. Circles

Write a JFrame-JPanel program that inputs 2 integers R & N, where R is the radius of the biggest circle (also the size of JPanel), and N is the number of circles. All circles share the same center. The difference of radius between the consecutive circles is constant. The figure should scale as you resize the window so that the biggest circle always touches the edges of JPanel, and R only determines the initial size of JPanel.

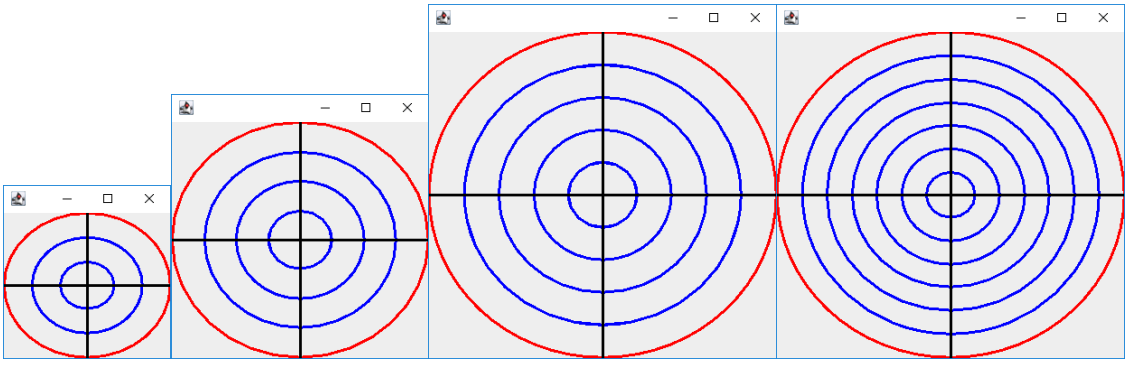
Draw the following:

(1) Biggest circle in RED.
(2) Other circles in BLUE.
(3) X-axis and Y-axis in BLACK.

Sample Input

100 3 150 4 200 5 200 7

Sample Output



Note

Draw circle, center = (x,y) and radius = r

```
g.drawOval(x-r, y-r, r*2, r*2);
```

Set line thickness

```
Graphics2D g2 = (Graphics2D) g;
g2.setStroke(new BasicStroke(3));
```

Input integer

```
Scanner scanner = new Scanner(System.in);
int a = scanner.nextInt();
```

Get dimension of JPanel

```
Dimension dim = this.getSize();
```

dim.width and dim.height are the width and height of JPanel

4. Circle & Polygon

Please modify your code in problem 3, that inputs 2 integers R & N, where R is the radius of the circle, and N is the number of edges of a regular polygon inscribed to the circle (圓內接正多邊形).

Draw the following:

(1) A circle in RED.

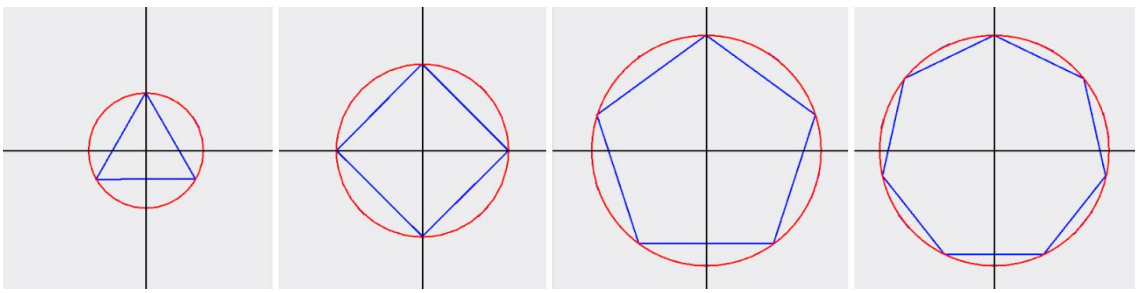
(2) A regular polygon in BLUE.

(3) X-axis and Y-axis in BLACK.

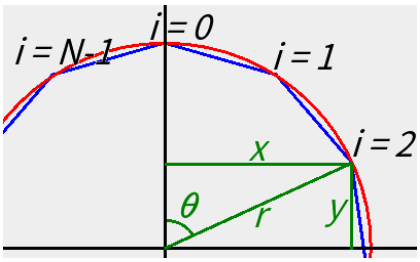
Sample Input

100 3 150 4 200 5 200 7

Sample Output



Note



θ = 360°/N*i
x = r*sin(θ)
y = r*cos(θ)