BIL105E - Introduction to Scientific and Engineering Computing

Midterm Exam

03.04.2008

- Notes and books are closed.
- Exam duration is 1.5 hours.

Question 1) [50 points] Draw a **flowchart** (25 points) and write a **program** (25 points) to calculate air pollution statistics.

- First, the program should get several air pollution (P) values from the user, until user enters -1 to terminate data entry.
- Then, the program should display the averages for each pollution level.
- If there is no P value entered for a level, program should display "No data" message.

Input (P)	Pollution Level
$0 \leq P < 5$	Low
$5 \leq P < 20$	Medium
$P \geq 20$	High

Sample run:

```
Enter P (-1 to stop) : 3
Enter P (-1 to stop) : 4
Enter P (-1 to stop) : 2
Enter P (-1 to stop) : 4
Enter P (-1 to stop) : 50
Enter P (-1 to stop) : 65
Enter P (-1 to stop) : -1

Avg. of Low Levels    = 3.25
Avg. of Medium Levels = No data
Avg. of High Levels   = 57.5
```

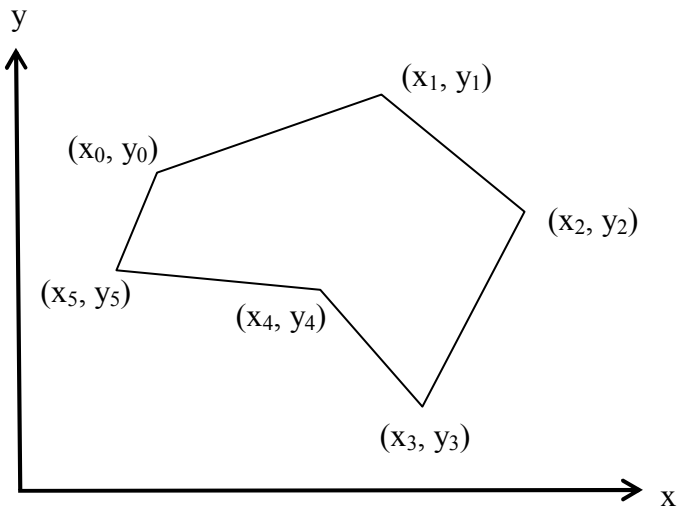
Question 2) [50 points] Write a **program** to calculate and display the followings:

- Area of the polygon (A).
- Centroid coordinates (C_x and C_y) of the polygon.

The program should get from user the followings:

- Number of edges of the polygon (**N).**
- All of the polygon coordinates (**x** and **y**) into **two arrays.**

The following example shows a polygon with N=6 edges in the coordinate system.



The area of the polygon is given by:

$$A = \frac{1}{2}\sum_{i=0}^{N-1}(x_i.y_{i+1} - x_{i+1}.y_i)$$

The centroid coordinates $\mathbf{C_x}$ and $\mathbf{C_y}$ (also known as the "centre of gravity") of the polygon is given by:

$$C_x = \frac{1}{6A}\sum_{i=0}^{N-1}(x_i + x_{i+1}).(x_i.y_{i+1} - x_{i+1}.y_i)$$

$$C_y = \frac{1}{6A}\sum_{i=0}^{N-1}(y_i + y_{i+1}).(x_i.y_{i+1} - x_{i+1}.y_i)$$

IMPORTANT:

- When ***i*** is at the ***(N-1)th*** element, then ***i+1*** must be set to the ***0th*** element.
- For example, after X_5 the next is X_0 , not X_6 .
- Similarly after Y_5 the next is Y_0 , not Y_6 .