BIM A+

European Master in
Building Information Modelling
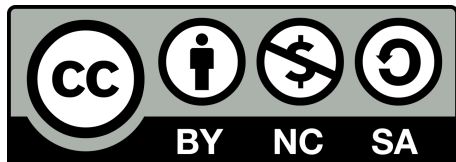
Programming assignments - 03

Topic 2: Fundamentals of programming

BIM A+3: Parametric Modelling in BIM

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Create a simple application

- Develop a simple application for calculating different geometrical characteristics of a polygon shape using Python programming language.

- Basic requirements:

  - The end-user must be able to calculate polygon shapes of different sizes - the number of polygon points must not be limited.

  - The program should display end-user entered data (x and y coordinates of polygon points) in a "table" format.

  - The calculated results must be displayed with two decimal numbers.

- Work submission:

  - Deadline: 29. 11. 2020

  - Upload your solution to your GitHub repository and share the repository link
  (https://docs.google.com/spreadsheets/d/1hH-0Dsa9buz2bGSMVgMQcfZF_sWg3dcOWialk5apCkQ/edit?usp=sharing)

- *Instructions:*

  - *Start with VERY basic solution and work from there :-)*

  - *The formulas are on the next slide.*

  - *The points must be ordered counter clockwise.*

Površina prečnega prereza:

$$A_x = \frac{1}{2}\sum_{i=1}^{n}\left(x_{i+1}+x_i\right)\left(y_{i+1}-y_i\right)$$

Statična momenta prečnega prereza:

$$S_x = -\frac{1}{6}\sum_{i=1}^{n}\left(x_{i+1}-x_i\right)\left(y_{i+1}^2+y_i y_{i+1}+y_i^2\right)$$

$$S_y = \frac{1}{6}\sum_{i=1}^{n}\left(y_{i+1}-y_i\right)\left(x_{i+1}^2+x_i x_{i+1}+x_i^2\right)$$

Osni vztrajnostni momenti prečnega prereza:

$$I_x = -\frac{1}{12}\sum_{i=1}^{n}\left(x_{i+1}-x_i\right)\left(y_{i+1}^3+y_{i+1}^2 y_i+y_{i+1}y_i^2+y_i^3\right)$$

$$I_y = \frac{1}{12}\sum_{i=1}^{n}\left(y_{i+1}-y_i\right)\left(x_{i+1}^3+x_{i+1}^2 x_i+x_{i+1}x_i^2+x_i^3\right)$$

$$I_{xy} = -\frac{1}{24}\sum_{i=1}^{n}\left(y_{i+1}-y_i\right)\left[y_{i+1}\left(3x_{i+1}^2+2x_{i+1}xi+x_i^2\right)+y_i\left(3x_i^2+2x_{i+1}x_i+x_{i+1}^2\right)\right]$$

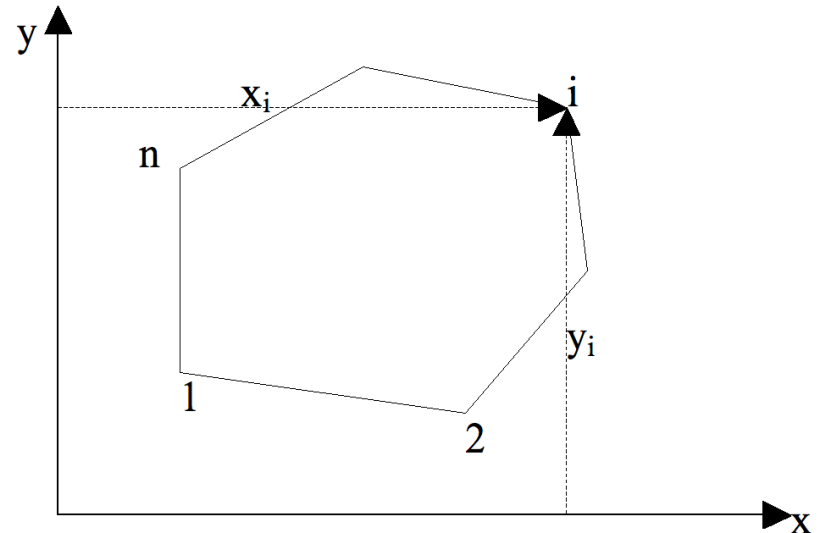Koordinati težišča prečnega prereza:

$$x_T = \frac{S_y}{A_x}$$

$$y_T = \frac{S_x}{A_x}$$

Vztrajnostni momenti glede na vzporedno premaknjeni osi skozi težišče prečnega prereza:

$$I_x^T = I_x - y_T^2 A_x$$

$$I_y^T = I_y - x_T^2 A_x$$

$$I_{xy}^T = I_{xy} + x_T y_T A_x$$

Formulas

```
[mbp15-2016:bimaplus mdolenc$ python3 geocaracteristics.py
Enter the number of polygon points: 4

Enter x and y coordinates for polygon points ...
Point 1: 0 0
Point 2: 1 0
Point 3: 1 1
Point 4: 0 1

Point       x          y
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1          0.00       0.00
2          1.00       0.00
3          1.00       1.00
4          0.00       1.00

Geometric characteristics:
Ax:     1.00
Sx:     0.50
Sy:     0.50
Ix:     0.33
Iy:     0.33
Ixy:   -0.25
xt:     0.50
yt:     0.50
Ixt:    0.08
Iyt:    0.08
Ixyt:   0.00
mbp15-2016:bimaplus mdolenc$
```