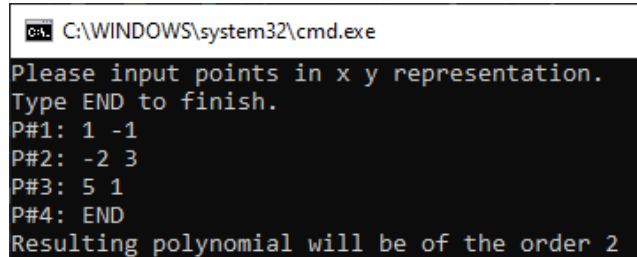# Project 03: Polynomial functions
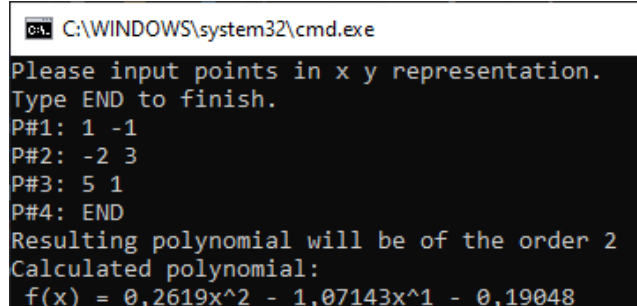
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Your task is to write a program, that for a given set of points will find an interpolation polynomial, calculate its derivative and will try to find at least one root of it. On pictures you have my take on this tasks, but if you have your own (probably better) idea, go with it!

1. (4 points) Let the user input a set of points in the `x, y` format. After the user is done inputing them, display the order of the interpolation polynomial (refer the first sentence of "Polynomial interpolation - Vandermonde matrix" section in the lecture on how to calculate the order).

```
C:\WINDOWS\system32\cmd.exe
Please input points in x y representation.
Type END to finish.
P#1: 1 -1
P#2: -2 3
P#3: 5 1
P#4: END
Resulting polynomial will be of the order 2
```

2. (4 points) Based on the provided points calculate the interpolation polynomial according to the algorithm given in the section "Polynomial interpolation - Vandermonde matrix". Hint: a big part of this process is solving system of linear equations, that you should have done in the previous assignment - just copy the code! Display obtained polynomial to the user.

```
C:\WINDOWS\system32\cmd.exe
Please input points in x y representation.
Type END to finish.
P#1: 1 -1
P#2: -2 3
P#3: 5 1
P#4: END
Resulting polynomial will be of the order 2
Calculated polynomial:
 f(x) = 0,2619x^2 - 1,07143x^1 - 0,19048
```

3. (4 points) Display to the user the value of the polynomial for at least three values: $-1, 0, 1$.

```
C:\WINDOWS\system32\cmd.exe

Please input points in x y representation.
Type END to finish.
P#1: 1 -1
P#2: -2 3
P#3: 5 1
P#4: END
Resulting polynomial will be of the order 2
Calculated polynomial:
 f(x) = 0,2619x^2 - 1,07143x^1 - 0,19048
f(-1) = 1,14286
f(0) = -0,19048
f(1) = -1
```

4. (4 points) Calculate the derivative of the interpolation polynomial using the algorithm from section "Derivative of polynomial". Display it to the user.

```
C:\WINDOWS\system32\cmd.exe

Please input points in x y representation.
Type END to finish.
P#1: 1 -1
P#2: -2 3
P#3: 5 1
P#4: END
Resulting polynomial will be of the order 2
Calculated polynomial:
 f(x) = 0,2619x^2 - 1,07143x^1 - 0,19048
f(-1) = 1,14286
f(0) = -0,19048
f(1) = -1
Derivative:
 f'(x) = 0,52381x^1 - 1,07143
```

5. (4 points) Using your computed polynomial and derivative try to calculate one root of the polynomial using Newton's method (equation 8 in the notes). Since it requires an initial guess, either let the user input the number or choose a random one. As the stop criteria preferably use equation 9 and the three options given in the notes.

```
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Please input points in x y representation.
Type END to finish.
P#1: 1 -1
P#2: -2 3
P#3: 5 1
P#4: END
Resulting polynomial will be of the order 2
Calculated polynomial:
 f(x) = 0,2619x^2 - 1,07143x^1 - 0,19048
f(-1) = 1,14286
f(0) = -0,19048
f(1) = -1
Derivative:
 f'(x) = 0,52381x^1 - 1,07143
Looking for a root with initial guess 2
Root found for x = -0,17066
Press any key to continue . . . _
```