# Department of Computing

# MATH 333: Numerical Analysis

# Class: BSCS-9ABC

# Lab 7: Polynomial, Interpolation, Curve fitting (Part 2)

# Date: March 23, 2022

# Time: 10:00 pm-1:00 pm

# Lab Engineer: Anum Asif

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# Lab 7: Polynomial,Interpolation

**Introduction**

Matlab represents polynomials with a vector of coefficients. The length of the vector will always be one more than the order of the polynomial

y = x2 + 5x -3 is represented as [1 5 -3]

y = -x3/3 + x is represented as [-1/3 0 1 0]

**Objectives**

The purpose of this lab is to get familiar with Interpolation.

**Tools/Software Requirement**

Matlab R2016a

**Description**

**Interpolation**

Given a set of data points, you can use use **interp1.m** to interpolate between them at one or more x values. The method defaults to a linear interpolation.

x = [0 2 4];

y = [0 2 8];

plot(x,y,'sk-')

hold on

x2 = [1 3]

y2linear = interp1(x,y,x2)

plot(x2,y2linear,'go')

legend('Data','Linear')

**Curve Fitting with polynomials**

If you have a set of data points that you want to find a 'best fit line' for, use the **polyfit** command. This will perform a 'least squares' fit which minimizes the error (distances) between the data and the fitted curve. The experimental data will not necessarily lie on the fitted curve. The **polyval** command is used to evaluate a polynomial for a given set of x values. This is useful in interpolation and plotting.

**Find the equation of the line that best fits a set of data**

data=[0 .3

1 .9

2 2.2

3 3.1

4 4.0

5 5.4];

x=data(:,1);

y=data(:,2);

% get polynomial coefficients (pc) of bets fit line

pc = polyfit(x,y,1); % 1 means linear fit

plot(x,y,'ro');

hold on;

plot(x,polyval(pc,x),'b-');

txt = sprintf('Best fit line y=%.2fx + %.2f',pc(1),pc(2));

legend('Data points',txt);

**Lab Task**

Calculate and plot a best fit 2nd order polynomial for this data set.

t=[0:8];

y=[40.12 66.78 80.17 86.71 80.77 66.78 44.41 10.51 -32.60];

**Code:**

|  |
| --- |
| clear  clc  data=[40.12 66.78 80.17 86.71 80.77 66.78 44.41 10.51 -32.60];  x=0:8;  pc = polyfit(x,data,2);  plot(x,data,'ro');  disp("The acceleration is: " +pc(1))  disp("The velocity is: "+pc(2))  disp("The height is: "+pc(3))  t\_value = polyval(pc,2.5);  root=roots(pc);  disp("The value at time 2.5 is: "+t\_value)  disp("Y is zero at: "+root)  der = polyder(pc);  max\_height\_time = roots(der);  disp("The polynomial will give the maximum height at: "+ max\_height\_time)  max\_height=polyval(pc,max\_height\_time);  disp("The polynomial maximum height is: "+ max\_height)  hold on;  plot(x,polyval(pc,x,data),'b-');  txt = sprintf('Best fit line y=%.2fx^2 + %.2fx+%.2f',pc(1),pc(2),pc(3));  legend('Data points',txt); |

**Output:**

Graphical user interface, chart

Description automatically generated

This data represents the motion of an object shot into the air where (y=y0+v0\*t+.5\*a\*t^2).

Find:

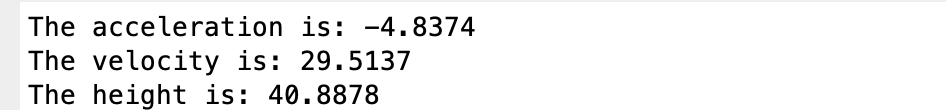
1. What is the initial height, initial velocity, and acceleration? (keep the 3rd argument of polyfit ‘2’, the result will be acceleration, velocity and height respectively)

Hint: relate to coefficients determined by polyfit

**CODE:**

|  |
| --- |
| clear  clc  data=[40.12 66.78 80.17 86.71 80.77 66.78 44.41 10.51 -32.60];  x=0:8;  pc = polyfit(x,data,2);  plot(x,data,'ro');  disp("The acceleration is: " +pc(1))  disp("The velocity is: "+pc(2))  disp("The height is: "+pc(3)) |

**OUTPUT**



1. At what positive time is y=0?s

Hint: roots

**CODE:**

|  |
| --- |
| clear  clc  data=[40.12 66.78 80.17 86.71 80.77 66.78 44.41 10.51 -32.60];  x=0:8;  pc = polyfit(x,data,2);  plot(x,data,'ro');  disp("The acceleration is: " +pc(1))  disp("The velocity is: "+pc(2))  disp("The height is: "+pc(3))  t\_value = polyval(pc,2.5);  root=roots(pc);  disp("The value at time 2.5 is: "+t\_value)  disp("Y is zero at: "+root) |

**OUTPUT**



There is no positive value at which y equals 0.It has two roots and both are negative.

1. What is the height at t=2.5?

Hint: polyval

**CODE**

|  |
| --- |
| clear  clc  data=[40.12 66.78 80.17 86.71 80.77 66.78 44.41 10.51 -32.60];  x=0:8;  pc = polyfit(x,data,2);  plot(x,data,'ro');  disp("The acceleration is: " +pc(1))  disp("The velocity is: "+pc(2))  disp("The height is: "+pc(3))  t\_value = polyval(pc,2.5);  root=roots(pc);  disp("The value at time 2.5 is: "+t\_value)  disp("Y is zero at: "+root) |

**OUTPUT**



1. What is the max height, and when does it occur?

Hint: polyder, roots, polyval (the root of the derivative determined using polyder will give the max time)

**CODE**

|  |
| --- |
| clear  clc  data=[40.12 66.78 80.17 86.71 80.77 66.78 44.41 10.51 -32.60];  x=0:8;  pc = polyfit(x,data,2);  plot(x,data,'ro');  disp("The acceleration is: " +pc(1))  disp("The velocity is: "+pc(2))  disp("The height is: "+pc(3))  t\_value = polyval(pc,2.5);  root=roots(pc);  disp("The value at time 2.5 is: "+t\_value)  disp("Y is zero at: "+root)  der = polyder(pc);  max\_height\_time = roots(der);  disp("The polynomial will give the maximum height at: "+ max\_height\_time)  max\_height=polyval(pc,max\_height\_time);  disp("The polynomial maximum height is: "+ max\_height) |

**OUTPUT**

Text, letter

Description automatically generated

**Deliverables**

Submit single word file with matlab code and screen shot of Output.