Newton's Divided Difference Polynomial Method of Interpolation

Major: All Engineering Majors

Authors: Autar Kaw, Jai Paul
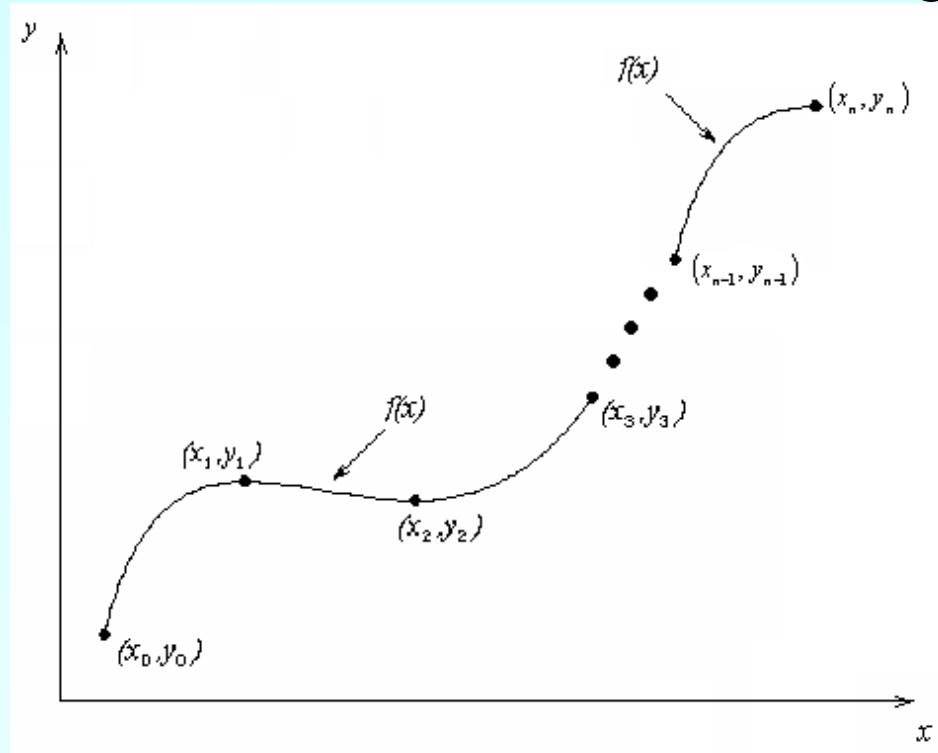
http://numericalmethods.eng.usf.edu
Transforming Numerical Methods Education for STEM Undergraduates

Newton's Divided Difference Method of Interpolation

http://numericalmethods.eng.usf.edu

What is Interpolation ?

Given (x_0,y_0), (x_1,y_1), …… (x_n,y_n), find the value of 'y' at a value of 'x' that is not given.

Interpolants

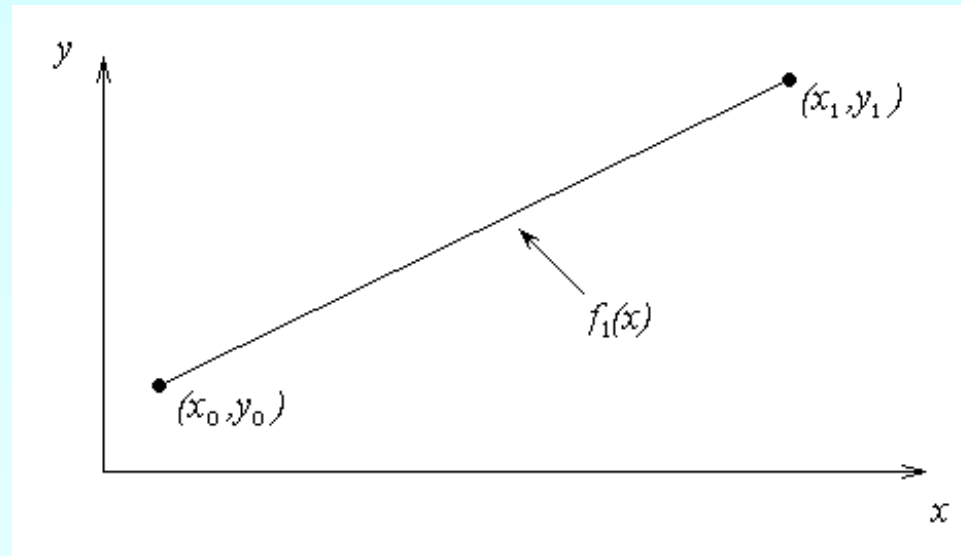Polynomials are the most common choice of interpolants because they are easy to:

- Evaluate
- Differentiate, and
- Integrate.

Newton's Divided Difference Method

Linear interpolation: Given   pass a linear interpolant through the data

where

Example

The upward velocity of a rocket is given as a function of time in Table 1. Find the velocity at t=16 seconds using the Newton Divided Difference method for linear interpolation.

Table. Velocity as a function of time

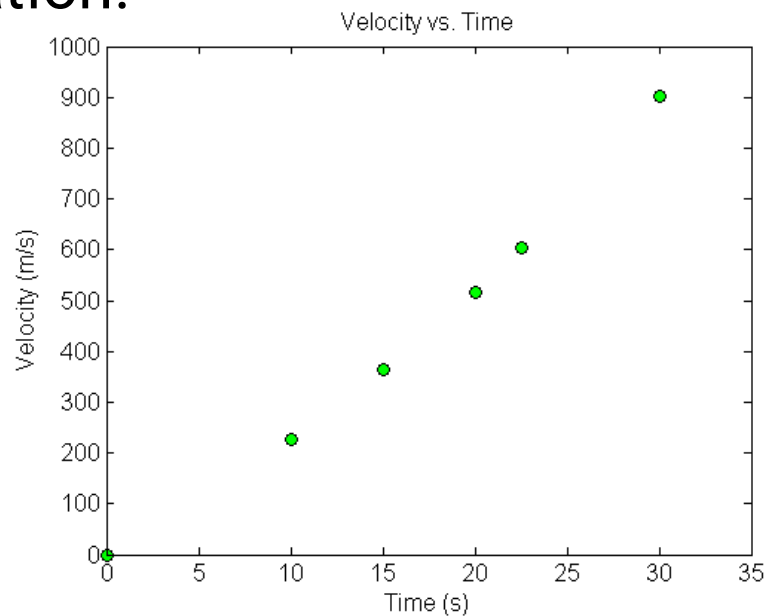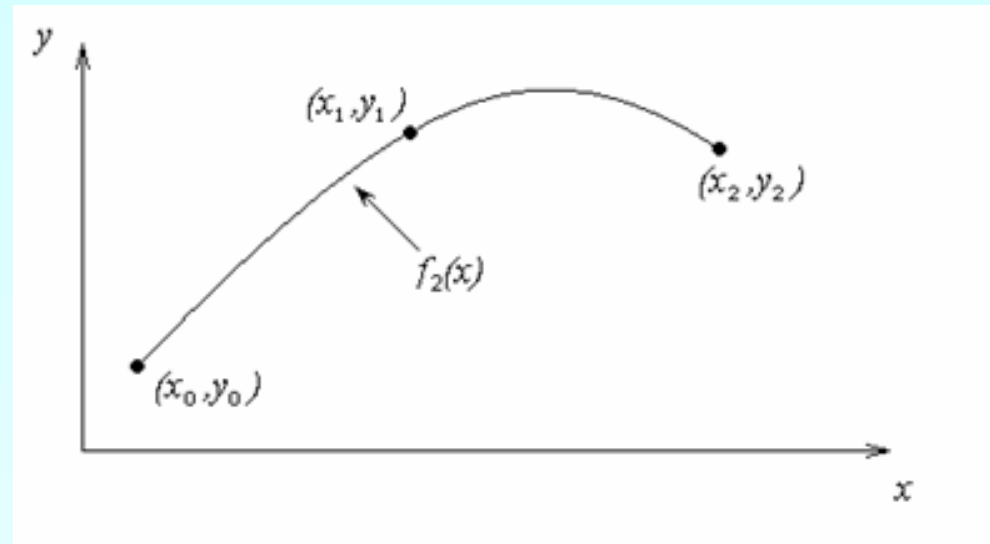|	
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

Figure. Velocity vs. time data for the rocket example

Linear Interpolation

Linear Interpolation (contd)

Quadratic Interpolation

Example

The upward velocity of a rocket is given as a function of time in Table 1. Find the velocity at t=16 seconds using the Newton Divided Difference method for quadratic interpolation

Table. Velocity as a function of time

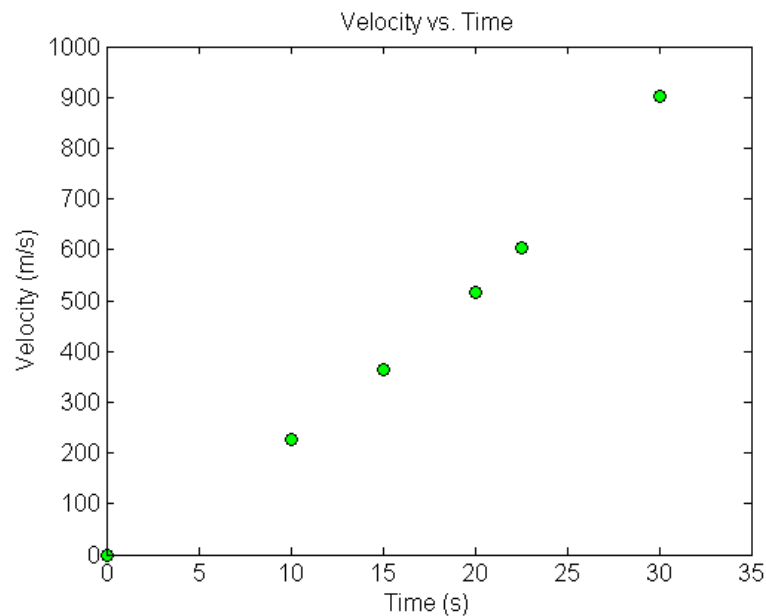|	
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

Figure. Velocity vs. time data for the rocket example

Quadratic Interpolation (contd)

Quadratic Interpolation (contd)

Quadratic Interpolation (contd)

General Form

where

Rewriting

General Form

General form

Example

The upward velocity of a rocket is given as a function of time in Table 1. Find the velocity at t=16 seconds using the Newton Divided Difference method for cubic interpolation.

Table. Velocity as a function of time

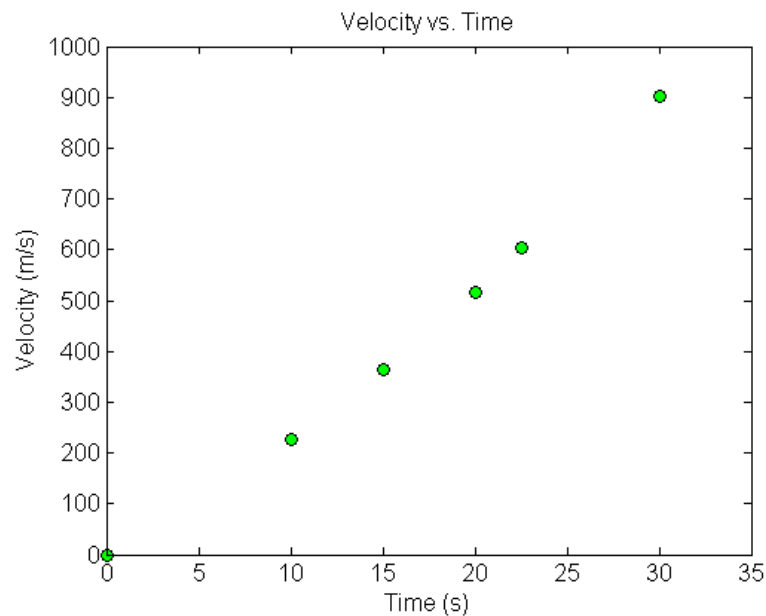|	
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

Figure. Velocity vs. time data for the rocket example

Example

The velocity profile is chosen as

we need to choose four data points that are closest to

Example

Example

Comparison Table

Distance from Velocity Profile

Find the distance covered by the rocket from t=11s to t=16s ?

Acceleration from Velocity Profile

Find the acceleration of the rocket at t=16s given that

Additional Resources

For all resources on this topic such as digital audiovisual lectures, primers, textbook chapters, multiple- choice tests, worksheets in MATLAB, MATHEMATICA, MathCad and MAPLE, blogs, related physical problems, please visit

http://numericalmethods.eng.usf.edu/topics/newton_divided_difference_method.html

THE END