Lagrangian Interpolation

Major: All Engineering Majors

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Lagrange Method of Interpolation

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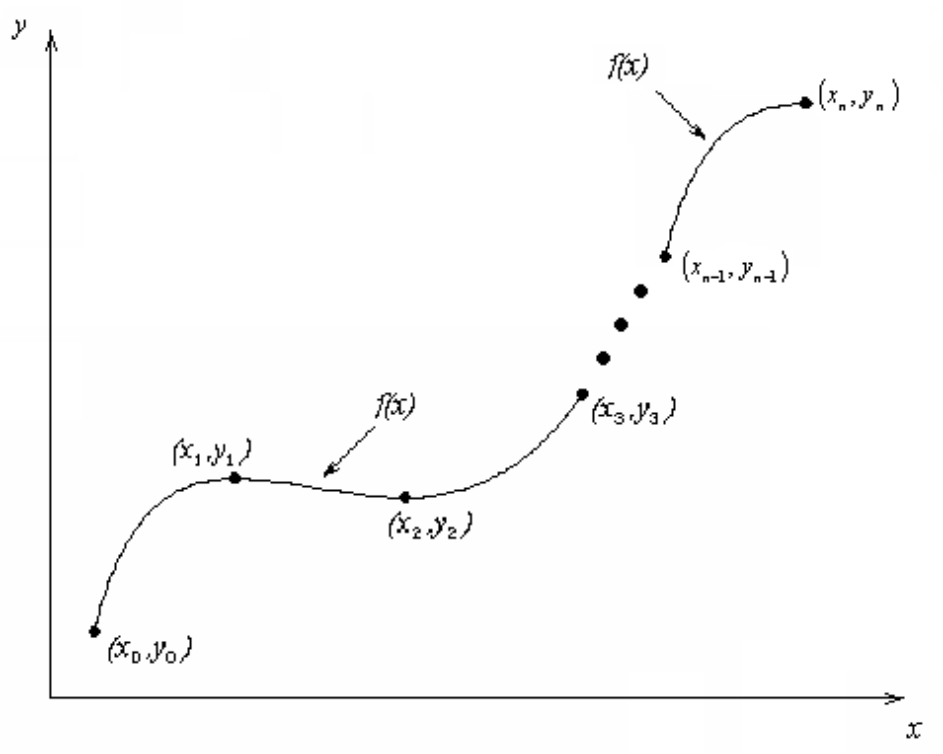
What is Interpolation ?

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.

Lagrangian 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 Lagrangian method for linear interpolation.

Table Velocity as a function of time

(s)	(m/s)
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

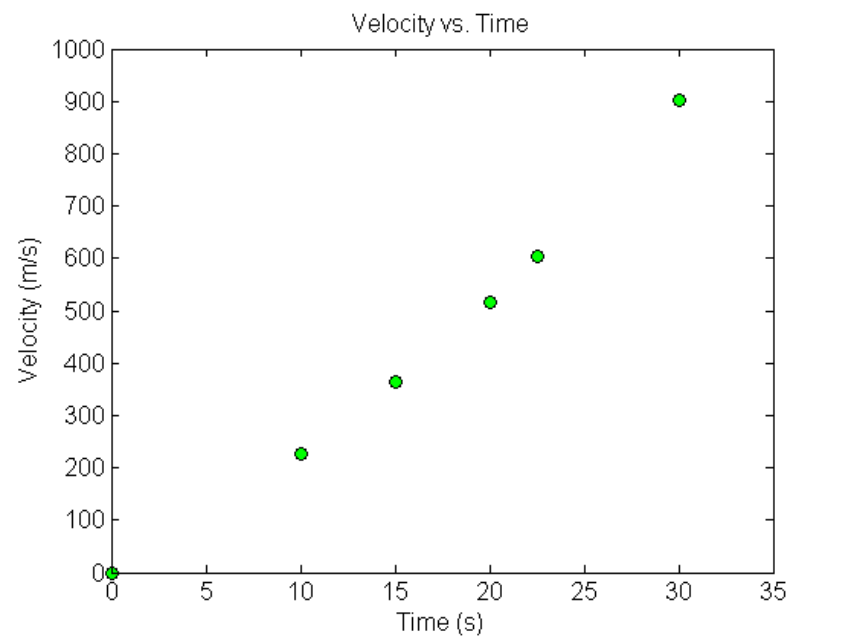
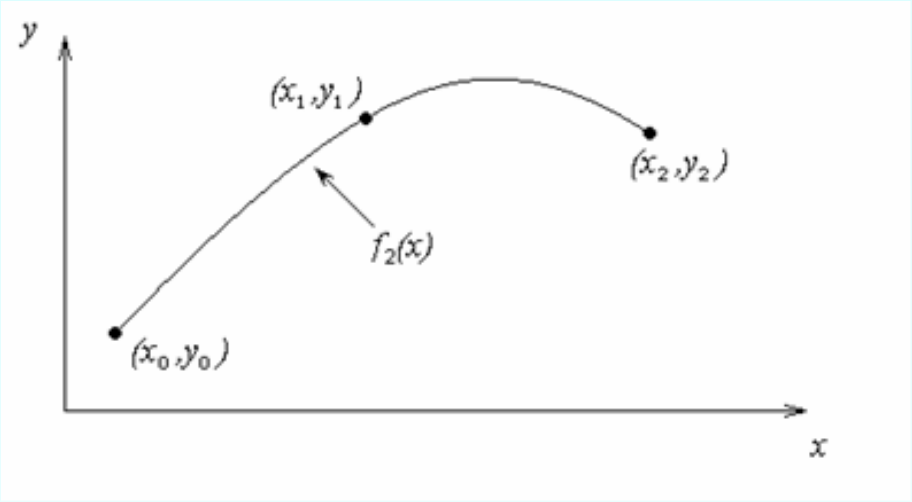


Figure. Velocity vs. time data for the rocket example

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 Lagrangian method for quadratic interpolation.

Table Velocity as a function of time

(s)	(m/s)
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

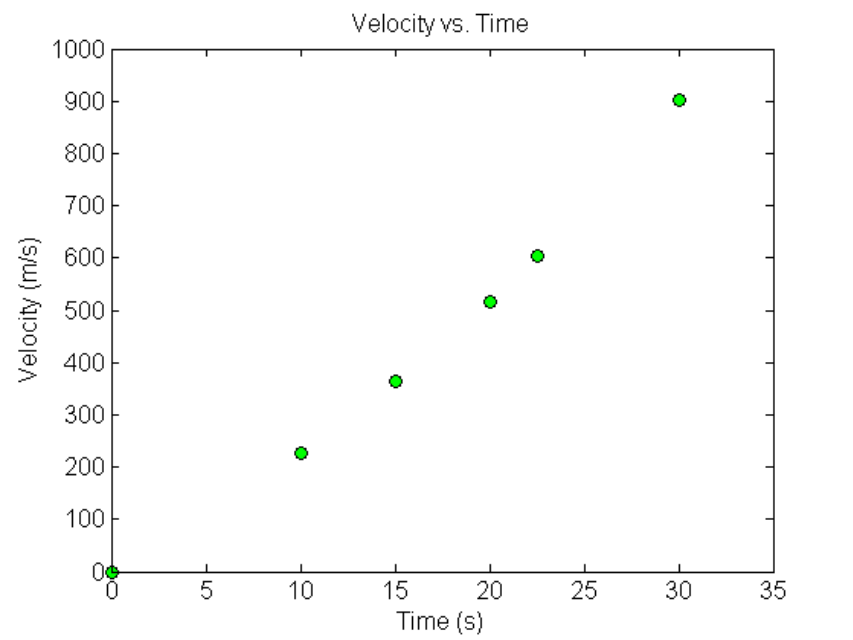


Figure. Velocity vs. time data for the rocket example

Quadratic Interpolation (contd)

Quadratic Interpolation (contd)

The absolute relative approximate error obtained between the results from the first and second order polynomial is

Cubic 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 Lagrangian method for cubic interpolation.

Table Velocity as a function of time

(s)	(m/s)
0	0
10	227.04
15	362.78
20	517.35
22.5	602.97
30	901.67

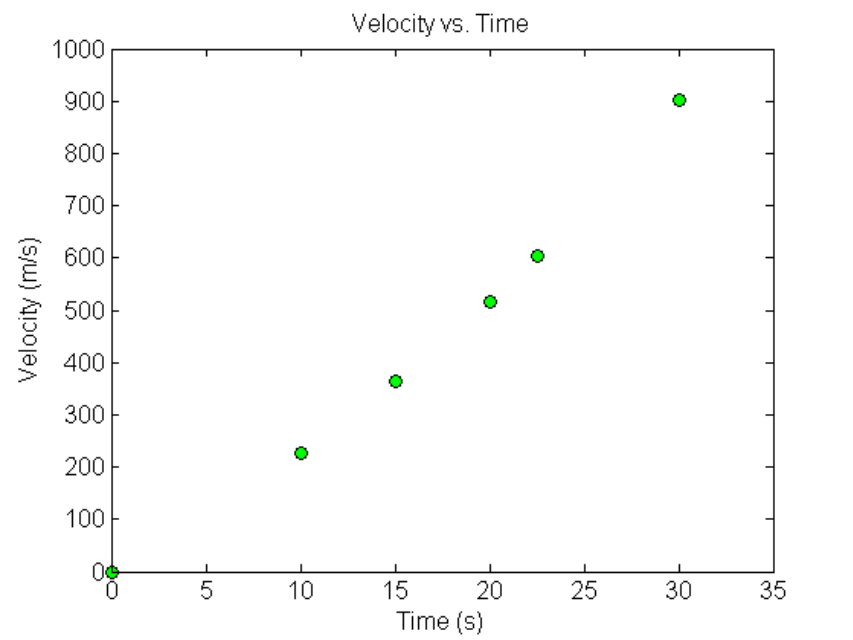


Figure. Velocity vs. time data for the rocket example

Cubic Interpolation (contd)

Cubic Interpolation (contd)

The absolute relative approximate error obtained between the results from the first and second order polynomial is

Comparison Table

Order of Polynomial	1	2	3
v(t=16) m/s	393.69	392.19	392.06
Absolute Relative Approximate Error	- - - - - - - -	0.38410%	0.033269%

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/lagrange_method.html

THE END

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