

## Interpolation

You are given the following data:

$x$	$y$
0	1.0
1	2.0
2	1.0
3	0.5
4	4.0
5	8.0

► Use `scipy.interpolate.InterpolateUnivariateSpline` to fit a linear spline to these data. Now fit a quadratic spline. Next fit a cubic spline.

► Use Lagrange’s method (`scipy.interpolate.lagrange`) to find the unique fifth-order polynomial that passes through the above six points.

(Submit a plot that shows the above four curves passing through the six given points.)

## Nonlinear equations

► Solve the equation

$$\sin(\cos(\exp(x))) = 0$$

using the bisection method (`scipy.optimize.bisect`) using  $(-1, 1)$  as your starting bracket. Report the result. Also report the value of  $\sin(\cos(\exp(x)))$  at the root that you just obtained. Is it zero? If not, why not?

► Calculate the derivative of  $\sin(\cos(\exp(x)))$  using Wolfram Alpha. Then use the Newton-Raphson method (`scipy.optimize.newton`) with  $-1$  as your initial guess to solve the above equation. Report the result. Next, repeat the procedure with  $-0.1$  as your initial guess. Does the answer change? Why?

► If you do not specify the derivative, `scipy.optimize.newton` finds the root using the Secant method. Use it with  $-0.1$  as your initial guess to solve the above equation.

## Integration

► Compute

$$\int_0^1 \exp(x) dx$$

using

- the Trapezoidal rule (`numpy.trapz`)
- Simpson's rule (`scipy.integrate.simps`)
- Romberg method (`scipy.integrate.romberg`)
- 5-th order Gaussian quadrature (`scipy.integrate.fixed_quad`)

(Hint: the documentation for each of the above functions has examples.)