Lecture 22 Practice - Interpolation and Curve Fitting

(a) Make a linear interpolant and a cubic spline to the (x, y) data.
Plot both of them on the same axes.

$$x := [0\ \ 1.5\ \ 3\ \ 4.5\ \ 6\ \ 7.5\ \ 9\ \ 10.5\ \ 12\ \ 13.5\ \ 15]^{T}$$

$$y := [1.988\ \ 2.692\ \ 0.857\ \ 0.012\ \ 0.758\ \ 1.157\ \ 0.454\ \ -0.767\ \ -1.667\ \ -2.345\ \ -2.712]^{T}$$

The x points to make the plot:

$$i := 0..100 \qquad x_{plt_i} := 15 \cdot \frac{i}{100}$$

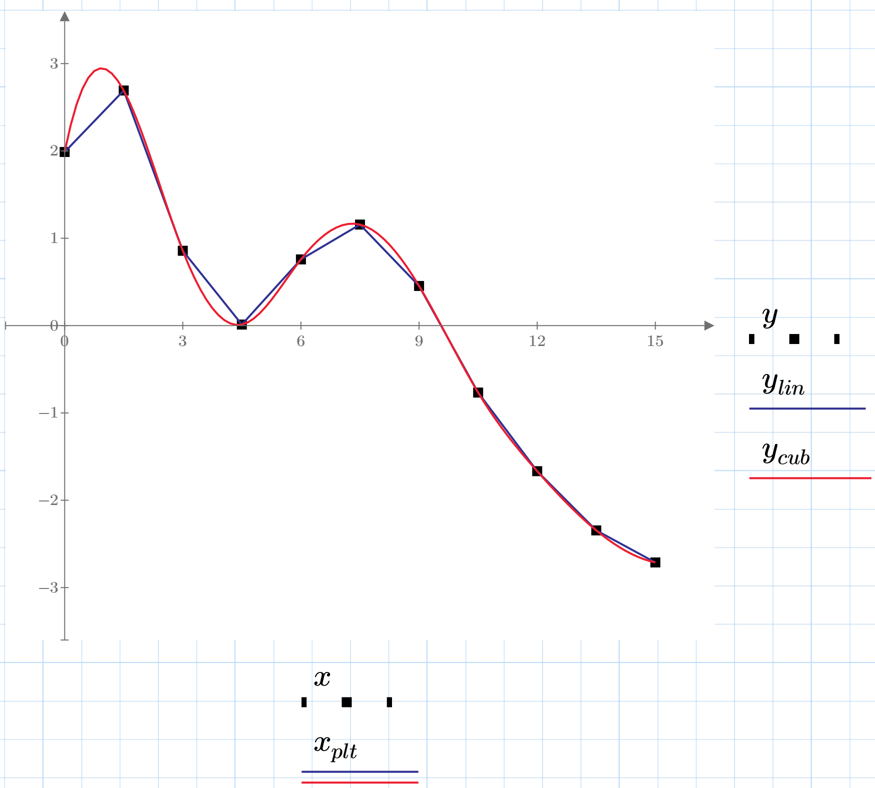
Linear interpolation:

$$y_{lin} := \mathrm{linterp}(x, y, x_{plt})$$

Cubic spline:

$$f_{cub} := \mathrm{cspline}(x, y)$$

$$y_{cub} := \mathrm{interp}(f_{cub}, x, y, x_{plt})$$



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(b) Find the coefficients that best fit the heat capacity data with the polynomial:

$$\frac{Cp(T)}{R} = a_0 + a_1 \cdot \frac{T}{K} + a_2 \cdot \left(\frac{T}{K}\right)^2 + a_3 \cdot \left(\frac{T}{K}\right)^3 + a_4 \cdot \left(\frac{T}{K}\right)^4$$

$$T := \begin{bmatrix} 298 & 303 & 308 & 313 & 318 & 323 & 328 & 333 & 338 & 343 & 348 \end{bmatrix}^T \cdot K$$

$$Cp := \begin{bmatrix} 4.474 & 4.498 & 4.524 & 4.55 & 4.577 & 4.602 & 4.629 & 4.652 & 4.677 & 4.705 & 4.727 \end{bmatrix}^T \cdot R$$

$$coeffs := \text{polyfitc}\left(\frac{T}{K}, \frac{Cp}{R}, 4\right)^{\langle 1 \rangle} = \begin{bmatrix} \text{"Coefficient"} \\ 88.192 \\ -1.04 \\ 0.005 \\ -9.78 \cdot 10^{-6} \\ 7.459 \cdot 10^{-9} \end{bmatrix}$$

(c) Use the Haaland equation

$$\frac{1}{\sqrt{f}} = -3.6 \cdot log\left(\left(\frac{1}{3.7} \frac{\varepsilon}{D}\right)^{1.11} + \frac{6.9}{Re}\right)$$

and the friction factor versus Reynolds number data in Lec_22-Practice_PartC.dat to find the roughness, epsilon, when $D = 1 \cdot in$

$$data := \text{READPRN}(\text{"Lec\_22-Practice\_PartC.dat"})$$

$$Re_{dat} := data^{\langle 0 \rangle} \qquad f_{dat} := data^{\langle 1 \rangle} \qquad D := 1\ in$$

$$f(Re, \varepsilon) := \left(-3.6 \cdot \log\left(\left(\frac{1}{3.7} \frac{\varepsilon}{D}\right)^{1.11} + \frac{6.9}{Re}\right)\right)^{-2}$$

$$\varepsilon_{guess} := 0.1\ mm$$

$$\text{genfit}\left(Re_{dat}, f_{dat}, \varepsilon_{guess}, f\right) = \left(5.778 \cdot 10^{-5}\right)\ m$$

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