Assignment #5
Numerical Computing (COMP 350)

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1.
- Vandermonde form (using `vander_coef.m`):

$$p(x) = 2 - x + 2x^2 - x^3$$

- Lagrange form (by hand):

$$\begin{aligned}
p(x) &= (x-1)(x-2)(x-3)(x-4)\left(\frac{\frac{2}{(1-2)(1-3)(1-4)}}{(x-1)} + \frac{\frac{0}{(2-1)(2-3)(2-4)}}{(x-2)} + \frac{\frac{-10}{(3-1)(3-2)(3-4)}}{(x-3)} + \frac{\frac{-34}{(4-1)(4-2)(4-3)}}{(x-4)}\right) \\
&= (x-1)(x-2)(x-3)(x-4)\left(\frac{\frac{2}{(-1)(-2)(-3)}}{(x-1)} + \frac{\frac{-10}{(2)(1)(-1)}}{(x-3)} + \frac{\frac{-34}{(3)(2)(1)}}{(x-4)}\right) \\
&= (x-1)(x-2)(x-3)(x-4)\left(\frac{2/-6}{(x-1)} + \frac{-10/-2}{(x-3)} + \frac{-34/6}{(x-4)}\right) \\
&= \frac{-1}{3}\cdot(x-2)(x-3)(x-4) + 5\cdot(x-1)(x-2)(x-4) + \frac{-17}{3}\cdot(x-1)(x-2)(x-3) \\
&= \frac{-1}{3}\cdot(x^3 - 9x^2 + 26x - 24) + 5\cdot(x^3 - 7x^2 + 14x - 8) + \frac{-17}{3}\cdot(x^3 - 6x^2 + 11x - 6) \\
p(x) &= -x^3 + 2x^2 - x + 2
\end{aligned}$$

- Newton form (by hand):

$$\begin{aligned}
p_0(x) &= 2 \\
p_1(x) &= 2 - 2(x-1) \\
p_2(x) &= 2 - 2(x-1) - 4(x-1)(x-2) \\
p_n(x) = p_3(x) &= 2 - 2(x-1) - 4(x-1)(x-2) - (x-1)(x-2)(x-3)
\end{aligned}$$