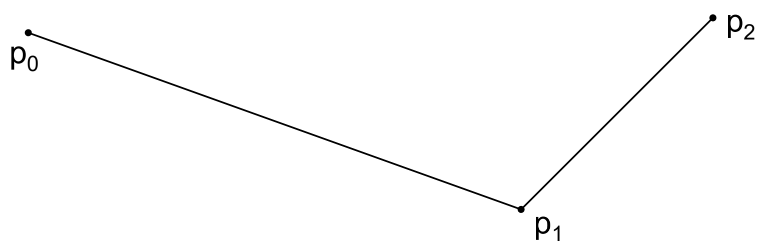
1. **2nd order (quadratic) Bézier curve:** Draw the Bézier curve with control points $\vec{p}_0, \vec{p}_1, \vec{p}_2$ using guiding points with t = 0.25, 0.5, 0.75.



2. Here is the parametric equation of a quadratic Bézier curve

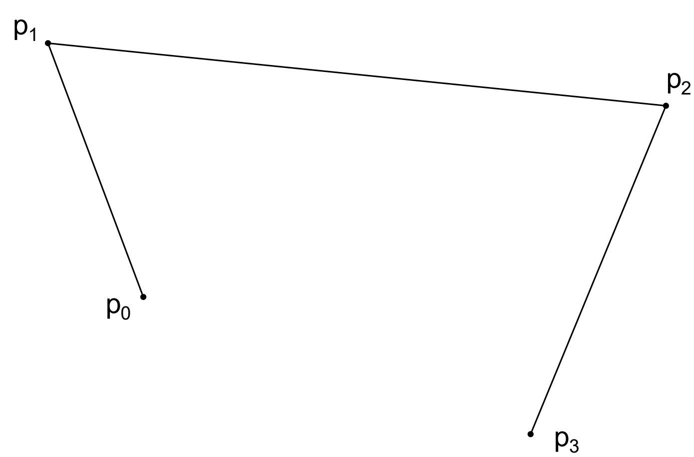
$$Q(t) = (1-t)^2\vec{p}_0 + 2(1-t)t\vec{p}_1 + t^2\vec{p}_2$$

Rearrange this function to make it look more like a quadratic in t (i.e., $Q(t) = at^2 + bt + c$).

(a) Take the derivative of this rearranged function with respect to t.

(b) What is the derivative at $t = 0$? $t = 1$? What can we say about the tangents at p_0 and p_2?

3. **3rd order (cubic) Bézier curve:** Draw the Bézier curve with control points $\vec{p}_0, \vec{p}_1, \vec{p}_2, \vec{p}_3$ using guiding points with t = 0.25, 0.5, 0.75.



4. Cubic splines: We wish to find a cubic spline passing through the four control points (2,-1), (3,3), (0,1), and (-1,5). We will parameterize the curve as t=-1 for the first point, t=0 for the second, t=1 for the third, and t=2 for the fourth. Recall that we must solve the system of equations below:

$$\begin{bmatrix} t_1^3 & t_1^2 & t_1 & 1 \\ t_2^3 & t_2^2 & t_2 & 1 \\ t_3^3 & t_3^2 & t_3 & 1 \\ t_4^3 & t_4^2 & t_4 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$

(a) Given the t values specified above, fill in the numeric values for the 4x4 matrix.

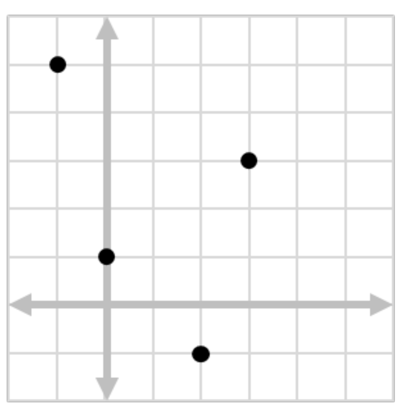
(b) Using the x values of the points above and the definition of matrix multiplication, write the system of four equations that is represented by the matrix equation above.

(c) Solve for the unknowns a, b, c, and d.

(d) Use the formula $x = at^3 + bt^2 + ct + d$ to compute x values at $t = 0.25$, $t = 0.5$, $t = 0.75$.

(e) Carry out the same procedure to find a, b, c, and d parameters for computing the y component, and compute y values at $t = 0.25$, $t = 0.5$, $t = 0.75$.

(f) Plot the curve between (3,3) and (0,1) using the computed coordinates.



In a cubic spline, filling in the remaining sections would require additional control points and calculation of new values of a, b, c, and d.