

# CPSC 424 Assignment 5

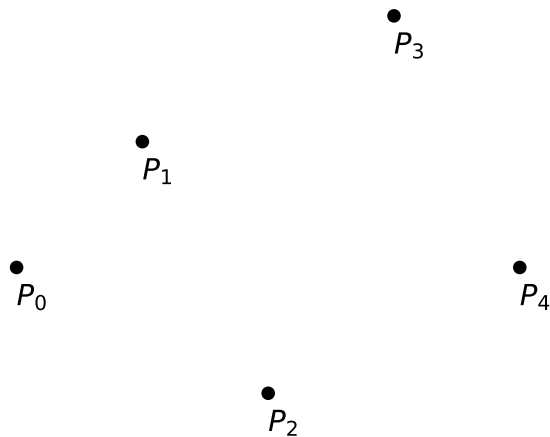
Term: September 2022, Instructor: Alla Sheffer, sheffa@cs.ubc.ca  
<https://www.students.cs.ubc.ca/cs-424>

**Due: November 14, 2022 in class**

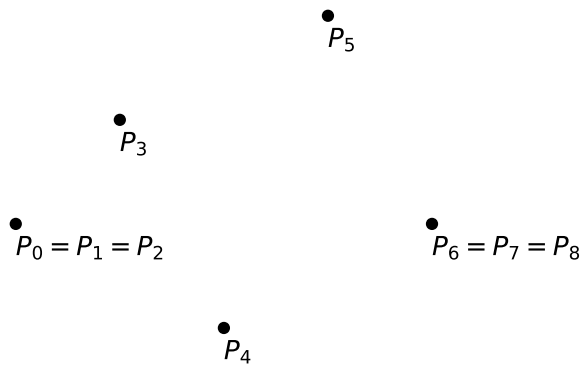
## Assignment 5.1: B-Splines (10 Points)

Draw/sketch a cubic B-spline curve (with uniformly distributed knots) defined by the points on the picture (you can draw freehand or use software),

a) assuming no points are replicated.



b) assuming the first and the last points are replicated 3 times, and all the others are not replicated.



## Assignment 5.2: Curve equivalence (10 Points)

Given the following 3 curves  $F_i(t)$ , **sketch each curve**, and for each  $F_i(t)$  write down the equations for an equivalent curve  $G_i(t)$  (check course notes for the definition of equivalence). For each one of the equivalent curves, include the corresponding parameter domain.

a) (2D)  $F_0(t) = \begin{pmatrix} t \\ t-1 \end{pmatrix}, t \in [0, 1]$

b) (2D)  $F_2(t) = \begin{pmatrix} t+1 \\ t^2 \end{pmatrix}, t \in [0, 2]$

c) (3D)  $F_1(t) = \begin{pmatrix} t \\ \sin(t) \\ \cos(t) \end{pmatrix}, t \in [0, \pi]$

## Assignment 5.3: Surface types (10 Points)

For each of the following, describe/sketch/provide an image of an everyday object defined by this type of surface. **Explain your choice.**

a) Extrusion surface

b) Surface of revolution

c) Ruled surface

d) Describe/sketch/provide a photo of an everyday surface that can't be described via the definitions above **but** can be described using Coons or Bezier patches.

## Assignment 5.4: [BONUS] Differential geometry (8 Points)

Find the equation of a 2D curve  $F(t)$ ,  $t \in [0, 1]$  with the following unit tangent vector:

a)  $\tau = \begin{pmatrix} \frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} \end{pmatrix}, t \in [0; 1]$

b)  $\tau = \begin{pmatrix} -\cos(t) \\ \sin(t) \end{pmatrix}, t \in [0; 1]$