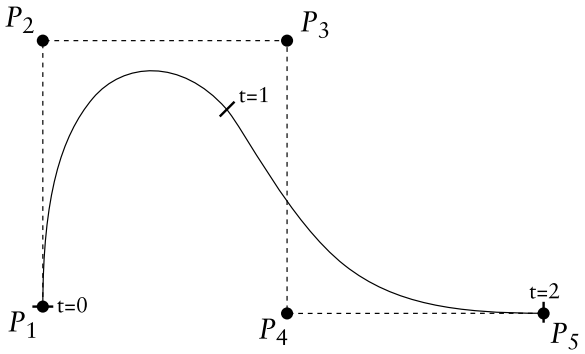
2003 Paper 9 Question 6

Advanced Graphics

(*a*) (*i*) Derive the quadratic uniform B-spline basis function, $N_{1,3}(t)$, for the knot vector $[1, 2, 3, 4, 5, 6, 7, 8]$. [6 marks]

(*ii*) Explain how $N_{i,3}(t)$ is related to $N_{1,3}(t)$, $i \in \{2, 3, 4, 5\}$. [2 marks]

(*b*) The following picture shows a set of five control points and the B-spline curve generated by the control points and the knot vector $[0, 0, 0, 0, 1, 2, 2, 2, 2]$ with $k = 4$ (a cubic B-spline).

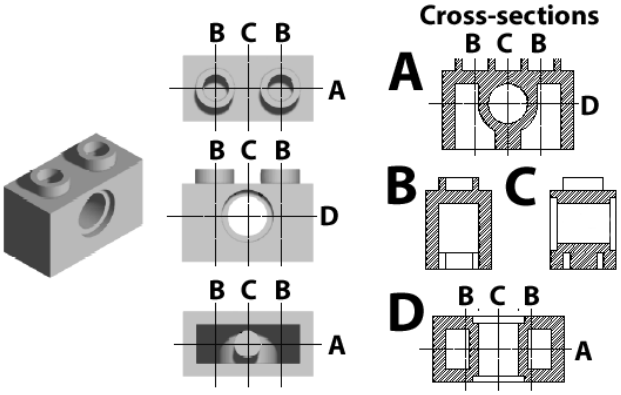


(*i*) Draw a similar diagram, using the same five control points, for the knot vector from part (*a*), $[1, 2, 3, 4, 5, 6, 7, 8]$, defining a quadratic B-spline ($k = 3$). [3 marks]

(*ii*) Draw another diagram, with the same control points, for the knot vector $[1, 2, 3, 4, 4, 5, 6, 7]$, defining a quadratic B-spline ($k = 3$). [3 marks]

(*iii*) What is the continuity of the curve at $t = 4$ in each of the cases in parts (*b*)(*i*) and (*b*)(*ii*)? [2 marks]

(*c*) Show how the following object can be constructed using Constructive Solid Geometry (CSG). You may assume the following primitives: sphere, cylinder, cone, torus, box. [You are expected to describe which primitives are needed and how they are combined but you are not expected to specify accurately all of the parameters of the primitives.]



[4 marks]