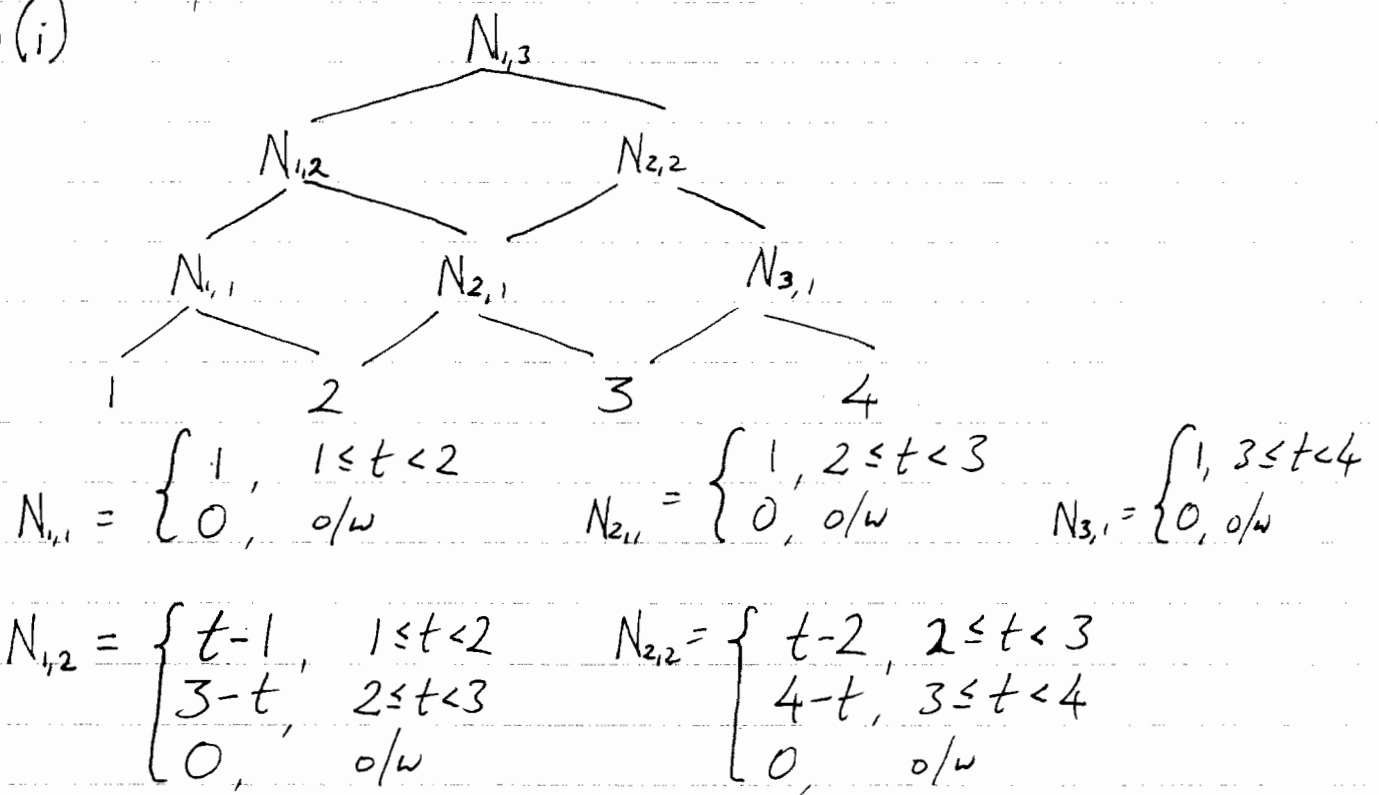


# ADVANCED GRAPHICS paper 9, 2003 q. 6

(a)(i)



$$N_{1,3} = \frac{t-1}{2} N_{1,2} + \frac{4-t}{2} N_{2,2}$$

$$= \begin{cases} \frac{1}{2}(t-1)^2, & 1 \leq t < 2 \\ \frac{1}{2}(3-t)(t-1) + \frac{1}{2}(4-t)(t-2), & 2 \leq t < 3 \\ \frac{1}{2}(4-t)^2, & 3 \leq t < 4 \\ 0, & \text{o/w} \end{cases}$$

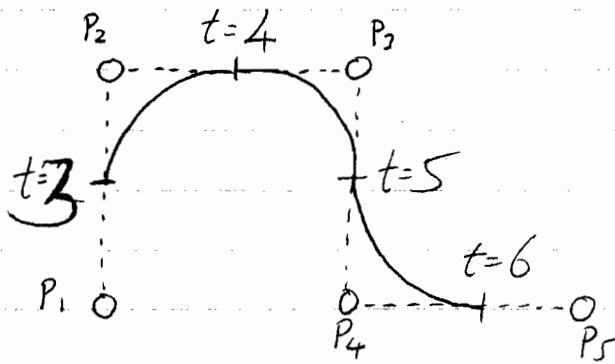
It is not necessary to "simplify" the  $2 \leq t < 3$  equation, but if you do, it is:

$$\begin{aligned}
 & \frac{1}{2}(3t+t-t^2-3+4t+2t-t^2-4) \\
 &= \frac{1}{2}(-2t^2+10t-7) \\
 &= -t^2+5t-\frac{7}{2}
 \end{aligned}$$

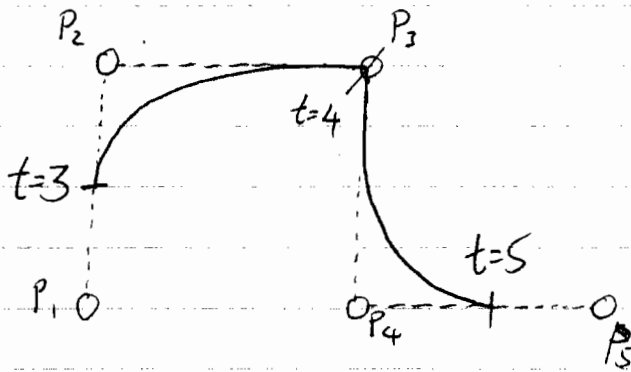
$$(ii) \quad N_{i,3}(t) = N_{1,3}(t-i+1) \quad i \in \{2, 3, 4, 5\}$$

# ADVANCED GRAPHICS, paper 9, 2003, page 2 of 3

(b)(i)

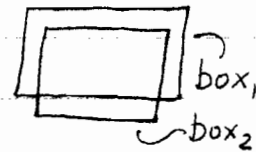


(ii)

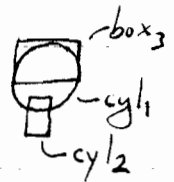


(iii) in case (i), at  $t=4$ , continuity is  $C1$   
 " " (ii), " " " " "  $C0$

(c) the basic box is  $\text{box}_1 - \text{box}_2$



the central pillar is union of a box and cylinder with a cylinder stuck (unioned) on the bottom:  $\text{cyl}_1 \cup \text{box}_3 \cup \text{cyl}_2$



the knobs on top are  $\text{cyl}_3 - \text{cyl}_4$



the hole is the union of three cylinders,  $\text{cyl}_5 \cup \text{cyl}_6 \cup \text{cyl}_7$



Overall:  $[(\text{box}_1 - \text{box}_2) \cup (\text{cyl}_1 \cup \text{box}_3 \cup \text{cyl}_2) \cup (\text{cyl}_3 - \text{cyl}_4) \cup (\text{cyl}_3' - \text{cyl}_4')] - [\text{cyl}_5 \cup \text{cyl}_6 \cup \text{cyl}_7]$

# ADVANCED GRAPHICS, paper 9, 2003, page 3 of 3

This questions tests the B-Spline/NURBS and "Other 3D modelling mechanisms" parts of the course, covering three of the eight lectures

## MARKING SCHEME

(a)(i) correct method correct lines in the final equation	2 4 <hr/> 6
(ii)	2 <hr/> 2
(b)(i) correct curve shapes correct knot locations correct knot values	1 1 1 <hr/> 3
(ii) curve goes through $P_3$ & has $C1$ -discontinuity correct knot locations correct knot values	1 1 1 <hr/> 3
(iii) (i) is $C1$ (ii) is $C0$	1 1 <hr/> 2
(c) central pillar main box + top knobs central hole overall structure	1 1 1 1 <hr/> 4 <hr/> 20