

Computational Mechanics by Isogeometric Analysis

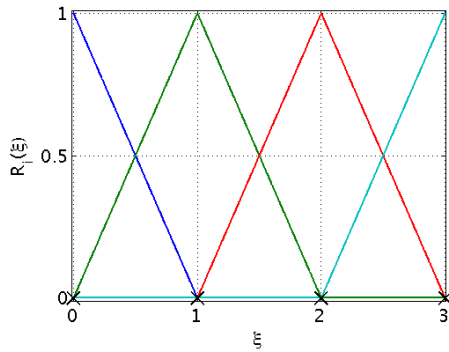
Dr. L. Dedè. A.Y. 2013/14

Exercises 27 February, 2014: Solutions

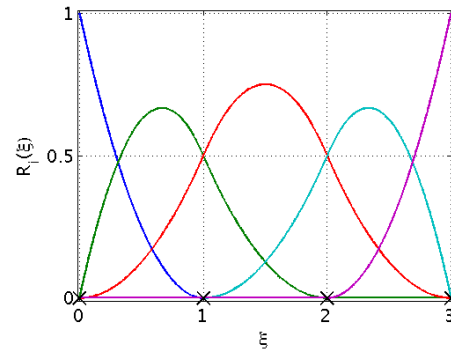
B-splines and NURBS: basis functions and curves

1. a) $p = 1$ and $n = 4$. The basis functions are globally C^0 -continuous, except at the end knots where they are C^{-1} -continuous; they are C^∞ -continuous in the knot spans and C^0 -continuous across the internal knots.
- b) $p = 2$ and $n = 5$. The basis functions are globally C^1 -continuous, except at the end knots where they are C^{-1} -continuous; they are C^∞ -continuous in the knot spans and C^1 -continuous across the internal knots.
- c) $p = 2$ and $n = 7$. The basis functions are globally C^1 -continuous across the internal knots except for the repeated knot of value $\bar{\xi} = 3$ with multiplicity $m = 2$.
- d) $p = 3$ and $n = 14$. The basis functions are C^2 -continuous across the internal knots of values 1, 2, 4, 6, 7 since they have multiplicity $m = 1$, C^1 -continuous across the internal knot of value 3 having multiplicity $m = 2$, and only C^0 -continuous across the internal knot of value 5 possessing multiplicity $m = 3$.

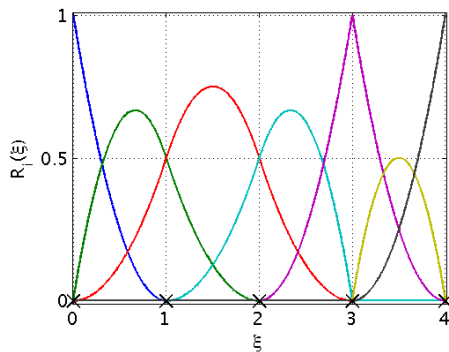
2.



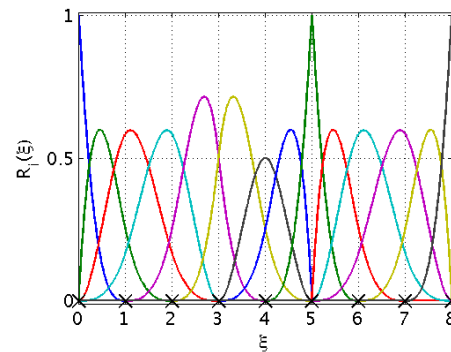
a)



b)



c)

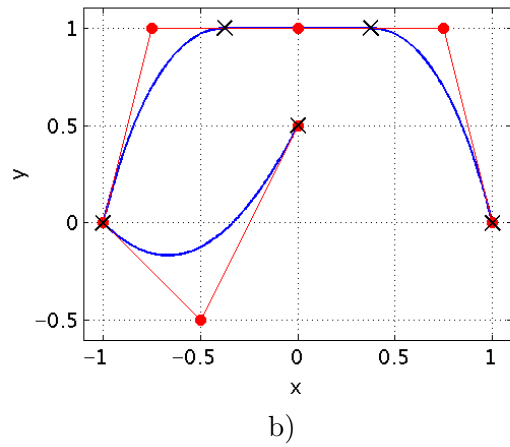
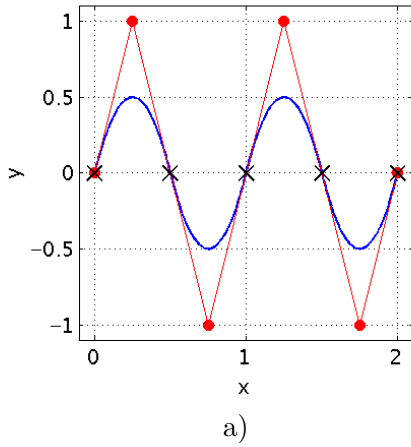


d)

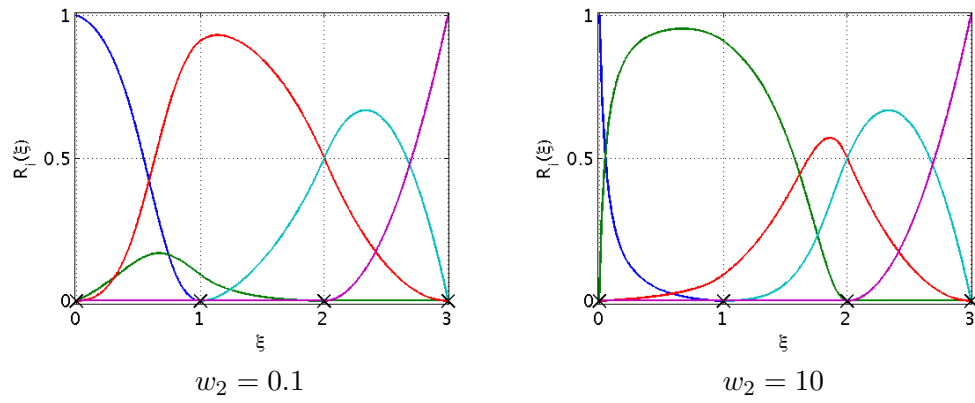
3.

$$\begin{aligned}
 \text{a) } N_{1,1}(\xi) &= \begin{cases} 1 - \xi, & 0 \leq \xi < 1, \\ 0, & \text{elsewhere;} \end{cases} & N_{2,1}(\xi) &= \begin{cases} \xi, & 0 \leq \xi < 1, \\ 2 - \xi, & 1 \leq \xi < 2, \\ 0, & \text{elsewhere;} \end{cases} \\
 N_{3,1}(\xi) &= \begin{cases} \xi - 1, & 1 \leq \xi < 2, \\ 3 - \xi, & 2 \leq \xi < 3, \\ 0, & \text{elsewhere;} \end{cases} & N_{4,1}(\xi) &= \begin{cases} \xi - 2, & 2 \leq \xi < 3, \\ 0, & \text{elsewhere.} \end{cases} \\
 \text{b) } N_{1,2}(\xi) &= \begin{cases} (1 - \xi)^2, & 0 \leq \xi < 1, \\ 0, & \text{elsewhere;} \end{cases} & N_{2,2}(\xi) &= \begin{cases} \frac{1}{2}\xi(4 - 3\xi), & 0 \leq \xi < 1, \\ \frac{1}{2}(2 - \xi)^2, & 1 \leq \xi < 2, \\ 0, & \text{elsewhere;} \end{cases} \\
 N_{3,2}(\xi) &= \begin{cases} \frac{1}{2}\xi^2, & 0 \leq \xi < 1, \\ \frac{1}{2}[\xi(2 - \xi) + (3 - \xi)(\xi - 1)], & 1 \leq \xi < 2, \\ \frac{1}{2}(3 - \xi)^2, & 2 \leq \xi < 3, \\ 0, & \text{elsewhere;} \end{cases} \\
 N_{4,2}(\xi) &= \begin{cases} \frac{1}{2}(\xi - 1)^2, & 1 \leq \xi < 2, \\ \frac{1}{2}(3 - \xi)(3\xi - 5), & 2 \leq \xi < 3, \\ 0, & \text{elsewhere;} \end{cases} & N_{5,2}(\xi) &= \begin{cases} (\xi - 2)^2, & 2 \leq \xi < 3, \\ 0, & \text{elsewhere.} \end{cases}
 \end{aligned}$$

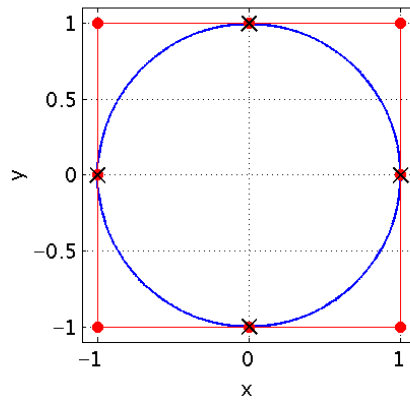
4. Refer to the files `ex2.4.a.m` and `ex2.4.b.m`.



5.



6. Refer to the file `ex2_6.m`.



7. Refer to the file `ex2_7.m`.

