Errata for

Geometric Modeling with Splines: An Introduction

by

Cohen, Riesenfeld, and Elber

1 Chapter 1

1. page 15, just below Definition 1.26. The text discusses that matrix multiplication is not commutative. Matrix B is incorrect and should be

$$B = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$$

2 Chapter 3

1. p. 106, section 3.8 shows parametric definitions for the equations defining the m pieces. The one for $\gamma_m(t)$ should be

$$\gamma_m(t) = \frac{(m-t)^2 P_m + 2\left(\sqrt{K_m}\right)^{-1}(t-(m-1))(m-t)T_m + (t-(m-1))^2 P_{m+1}}{(m-t)^2 + 2\left(\sqrt{K_m}\right)^{-1}(t-(m-1))(m-t) + (t-(m-1))^2}$$

2. p. 108, Algorithm 3.21 the last line on the page

   currently:

   such that $K = 4\lambda(1-\lambda)$, can be ...

   SHOULD BE: such that $K = 4\lambda/(1-\lambda)$, can be ...

3 Chapter 4

1. page 121, section 4.4, the second line of the last paragraph on the page refers to (B, B'). It is the inner product and should be written $\langle B, B' \rangle$.

2. page 136, problem 5, SHOULD READ

   Given a regular curve $\alpha(t)$, the evolute of α is defined as

$$\alpha^*(t) = \alpha(t) + \frac{1}{\kappa(t)} N(t)$$

   What is the geometrical meaning of α^*? For points (x, y) in the plane, define $A(x, y) = (-y, x)$. If α is a planar curve, show

$$\alpha^* = \alpha + \frac{(\alpha', \alpha')}{\langle \alpha'', A(\alpha') \rangle} A(\alpha').$$

   If $\alpha(t) = (a \cos t/c, a \sin t/c, bt/c)$, where $c^2 = a^2 + b^2$, what is the evolute of α? What is the evolute of its evolute?

4 Chapter 5

1. p. 166 Section 5.6, third line from bottom of first paragraph mentions Example 5.2.4. It should refer to Section 5.2.4.

5 Chapter 6

1. p. 183 Section 6.2, the displayed equations should read

$$\begin{aligned} \gamma(t) &= \sum_i P_i \mathcal{B}_{i,\kappa}(t) \\ &= \sum_i P_i^{[j]} \mathcal{B}_{i,\kappa-j}(t) \qquad\qquad j = 0, \ldots,\ \kappa. \end{aligned}$$

2. page 184, the lines below the top equations SHOULD READ

   But since we would like $\gamma(t) = \sum_i P_i^{[j-1]} B_{i,k-(j-1)}(t)$, a function ...

3. p 184, definition 6.7 SHOULD READ:

   Let $t_0 \leq t_1 \leq \cdots \leq t_N$ be a sequence of real numbers. For $\kappa = 0$, $\ldots$, $N-1$, and $i = 0$, $\ldots$, $N - \kappa - 1$, define the i^{th} (normalized) B-spline of degree κ and order $k = (\kappa + 1)$ as

$$\mathcal{B}_{i,0}(t) = \begin{cases} 1 & \textit{for } t_i \leq t < t_{i+1} \\ 0 & \textit{otherwise} \end{cases}$$

and for $\kappa > 0$,

$$\mathcal{B}_{i,\kappa}(t) = \begin{cases} \frac{(t-t_i)}{t_{i+\kappa}-t_i}\mathcal{B}_{i,\kappa-1}(t) + \frac{(t_{i+1+\kappa}-t)}{t_{i+1+\kappa}-t_{i+1}}\mathcal{B}_{i+1,\kappa-1}(t), & t_i < t_{i+1+\kappa}, \\ 0 & \textit{otherwise.} \end{cases}$$

Although the concept of polynomial degree...

4. p. 194 Corollary 6.19 SHOULD READ

   Suppose the conditions of Theorem 6.18 apply. Then for $t_J \leq t < t_{J+1}$,$i = J - (\kappa - 1) + p, \ldots, J$, and $p = 1, \ldots, \kappa - 1$,

$$Q_{1,i}^{[p]} = \kappa \frac{P_i^{[p]} - P_{i-1}^{[p]}}{t_{i+\kappa-p} - t_i}$$

5. p. 194 Corollary 6.20 SHOULD READ

   It is possible to evaluate both position and derivative with a single application of Algorithm 6.4, since

$$Q_{1,J}^{[\kappa-1]} = \kappa \frac{P_J^{[\kappa-1]} - P_{J-1}^{[\kappa-1]}}{t_{i+1} - t_i}$$

6. p. 194 Corollary 6.21 needs a modification on the ranges of the values of t and SHOULD READ If $\boldsymbol{\tau}$ is a knot vector of length $n + \kappa + 2$, $n + 1 \geq \kappa \geq 0$ and $\boldsymbol{t}$ is defined with length $n + \kappa + 4$, $t_{-1} < \tau_0$, $\tau_n < t_{n+1}$, $\tau_{n+\kappa+1} < t_{n+\kappa+2}$, and $t_i = \tau_i, i = 0, \ldots, n + \kappa + 1$. Then, $\mathcal{B}_{i,\kappa} \in \mathcal{S}_{\kappa,\boldsymbol{\tau}}$ has an indefinite integral given by

$$\int_{-\infty}^{t} \mathcal{B}_{i,\kappa}(u)du = \begin{cases} 0, & t < t_i \\ \frac{t_{i+1+\kappa}-t_i}{\kappa+1} \sum_{j=i}^{n} \mathcal{B}_{j,\kappa+1,\boldsymbol{t}}(t) & t_i \leq t < t_{n+1} \\ \frac{t_{i+1+\kappa}-t_i}{\kappa+1} & t \geq t_{n+1} \end{cases}$$

7. page 201 midway down the page, the paragraph between equations should start out reading

   Since $\mathcal{B}_{i+\kappa+1-p,p-1}$ has support in $[t_{i+\kappa-p+1}, t_{i+\kappa+1}]$, if $i = p$, $supp(\mathcal{B}_{\kappa+1,p-1}) = [t_{\kappa+1}, t_{\kappa+1+p}] = [b, b]$.

6 Chapter 9

1. p. 264, the matrix at the top of the page: the $0p$ occurring in the second row should simply be 0. The correct matrix is shown below:

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & \dots & 0 & 0 & 0 & 0 & 0 \\ -a & a & 0 & 0 & 0 & \dots & 0 & 0 & 0 & 0 & 0 \\ 0 & 1/4 & 7/12 & c & 0 & \dots & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & c & d & c & \dots & 0 & 0 & 0 & 0 & 0 \\ & & & & \ddots & \ddots & \ddots & & & & \\ 0 & 0 & 0 & 0 & 0 & \dots & c & d & c & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \dots & 0 & c & 7/12 & 1/4 & 0 \\ 0 & 0 & 0 & 0 & 0 & \dots & 0 & 0 & 0 & -a & a \\ 0 & 0 & 0 & 0 & 0 & \dots & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$