Errata for first printing of *Essential Mathematics for Games and Interactive Applications*

November 5, 2005

Page xxiii, bottom should read: "[...] at their respective jobs, Red Storm Entertainment and Numerical Design Limited, [...]"

Page 14, in Figure 1.4, $\mathbf{w}$ is shown as double-headed arrow. It should be a single-headed arrow pointing downwards from the arrowhead of $\mathbf{v}$ to the arrowhead of $\mathbf{u} + \mathbf{v} + \mathbf{w}$.

Page 26, in Figure 1.9, the label on the hypotenuse should be $\sqrt{x^2 + y^2}$.

Page 39, in Figure 1.21, the caption should read: "Scalar triple product indicates left turn." Scalar is misspelled.

Page 54, second paragraph: The phrase "[...] which holds if only t lies in the interval [...]" should be "[...] which holds only if t lies in the interval [...]".

Page 84, end of section 2.3.8: The end of the last sentence should read "[...] assume it is the correct size in order to allow an operation to proceed."

Page 84, the fourth equation should read:

$$(\mathbf{u} \bullet \mathbf{v})\mathbf{w} = (\mathbf{w} \otimes \mathbf{v})\mathbf{u}$$

Page 84, the fifth equation should read:

$$(\mathbf{u} \bullet \hat{\mathbf{v}})\hat{\mathbf{v}} = (\hat{\mathbf{v}} \otimes \hat{\mathbf{v}})\mathbf{u}$$

Page 96, middle: Sentence should read "Therefore, if we could find the inverse of $\mathbf{A}$, we could use it to solve for $\mathbf{x}$."

Page 100: Last sentence of the first paragraph of section 2.6.2 should read "A standard recursive definition, choosing any row i, is". The next sentence should read "Alternatively, we can expand by column j instead:".

Page 101, fourth paragraph. Should be: "Let's compute an example determinant, expanding by row 0:"

Page 102, first full paragraph. The second sentence should begin, "First of all, as we have mentioned,[...]".

Page 105, last paragraph of Section 2.6.3. First sentence should read "So all we need to do is multiply our running product by each pivot element and negate for each row swap."

[*reported by Tim Lowery*] Page 117: the two figures do not match their captions. The figures should be swapped.

Page 132, first equation should read:

$$\mathbf{H}_{\hat{\mathbf{n}},\mathbf{s}} = \begin{bmatrix} \mathbf{I} + \mathbf{s} \otimes \hat{\mathbf{n}} & \mathbf{0} \\ \mathbf{0}^T & 1 \end{bmatrix}$$

Page 132, second equation should read:

$$\mathbf{H}^{-1}_{\hat{\mathbf{n}},\mathbf{s}} = \begin{bmatrix} \mathbf{I} - \mathbf{s} \otimes \hat{\mathbf{n}} & \mathbf{0} \\ \mathbf{0}^T & 1 \end{bmatrix}$$

Page 215, third paragraph, fifth sentence should be "Alternatively, we can set the distance to the view plane to a fixed value and use the field of view to determine the size of our view window.".

Page 435, first paragraph, should be:

For this discussion, we have assumed uniform time values (this is also known as a *normalized cubic spline*). However, as mentioned under linear interpolation, our time values may vary from t_i to t_{i+1} across each spline segment. One solution is to do the same thing we did for linear interpolation: if we know that a given value t lies between t_i and t_{i+1}, we can use equation 9.1 to normalize our time value to the range $0 \leq u \leq 1$, and use that as our parameter to curve segment Q_i. While not strictly correct, this provides a reasonable approximation. For those who require it, a full derivation for non-normalized splines can be found in [95].

Page 450, first full paragraph, third sentence, should be: "As an example, we can construct a quarter-circle [...]"

Page 451, change "It is faster and can actually improve our floating point [...]" to "In addition, it can actually improve our floating point [...]".

Page 456, in the pseudocode in the middle of the page, the formatting on the sixth line has a space in the wrong place. It should read

```
L2 = (L1 + H)*0.5f;
```

Pages 461-462: the technique fails if you end up dividing by zero. See http://www.essentialmath.com/blog/ or the patched code for more information.

Page 499, Equation 10.11 should read:

$$(2w^2 - 1)\mathbf{p} + 2(\mathbf{v} \bullet \mathbf{p})\mathbf{v} + 2w(\mathbf{v} \times \mathbf{p})$$

The immediately following equation should read:

$$\begin{aligned} R_{\mathbf{q}}(\mathbf{p}) &= \left(2\cos^2\left(\frac{\theta}{2}\right) - 1\right)\mathbf{p} + 2\left(\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right) \bullet \mathbf{p}\right)\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right) \\ &\quad +2\cos\left(\frac{\theta}{2}\right)\left(\hat{\mathbf{r}}\sin\left(\frac{\theta}{2}\right) \times \mathbf{p}\right) \end{aligned}$$

Page 500: the first three lines should be rewritten as:

```
float vMult = 2.0f*(x*vector.x + y*vector.y + z*vector.z);
float crossMult = 2.0f*w;
float pMult = crossMult*w - 1.0f;
```

Page 517, first equation should be

$$\text{proj}_{\mathbf{v}}\mathbf{w} = \frac{\mathbf{w} \bullet \mathbf{v}}{\|\mathbf{v}\|^2}\mathbf{v}$$

Page 587, last paragraph. `CurrentForce()` should be `ComputeForces()`.

Page 606: Equation 12.13 should be

$$\omega_{i+1} = \mathbf{\Omega}_{i+1}\mathbf{J}^{-1}\mathbf{\Omega}_{i+1}^T\mathbf{L}_{i+1}$$

[*reported by k.avery*] Page 623: The final line should be

$$= \cos\theta/\sin\theta = \csc\theta/\sec\theta$$