C for Science - 2011 - Practical Exercise #3

1. Write three C functions with the following prototypes:

```
double v3dot (double *, double *);
void v3cross (double *, double *, double * );
void v3crosscross (double *, double *, double *, double *);
```

   where,

   (a) `v3dot(a,b)` calculates the scalar product of the two vectors **a** and **b**:

$$\texttt{v3dot(a,b)} = \mathbf{a} \bullet \mathbf{b} = \texttt{a[0]b[0] + a[1]b[1] + a[2]b[2]}$$

   (b) `v3cross(a, b, r)` computes the vector product of **a** and **b** and stores the result in **r**:

$$\mathbf{r} = \mathbf{a} \times \mathbf{b} = \begin{pmatrix} \texttt{a[1]b[2]} - \texttt{a[2]b[1]} \\ \texttt{a[2]b[0]} - \texttt{a[0]b[2]} \\ \texttt{a[0]b[1]} - \texttt{a[1]b[0]} \end{pmatrix}$$

   (c) `vecrosscross(a, b, c, r)` computes the triple vector cross product of **a**, **b** and **c** storing the result in **r**.

$$\mathbf{r} = \mathbf{a} \times (\mathbf{b} \times \mathbf{c}) = (\mathbf{a} \bullet \mathbf{c})\mathbf{b} - (\mathbf{a} \bullet \mathbf{b})\mathbf{c}$$

2. Write a `main` function that:

   (a) prompts for:

      i. the 3 components of vector **a**,

      ii. the 3 components of vector **b**, and

      iii. the 3 components of vector **c**.

   (b) Computes the triple vector cross product $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$, printing out all three components.

3. Test the code on the two data sets:

   (a) $\mathbf{a} = (1, 1, 0)^{\mathrm{T}}, \quad \mathbf{b} = (0, 1, 1)^{\mathrm{T}}, \quad \mathbf{c} = (1, 0, 1)^{\mathrm{T}}$, and

   (b) $\mathbf{a} = (1, -1, 2)^{\mathrm{T}}, \quad \mathbf{b} = (2, 1, 1)^{\mathrm{T}}, \quad \mathbf{c} = (1, 2, 11)^{\mathrm{T}}$

4. Amend your program to call `v3cross` twice to compute the triple vector cross product (rather than use `v3crosscross(a,b,c,r)`). Verify this on the above data set.

5. Print out $\mathbf{a} \times (\mathbf{b} \times \mathbf{c})$ and $(\mathbf{a} \times \mathbf{b}) \times \mathbf{c}$ for the above data set. Are they the same?