CS241 Homework 3

In this problem, you will build a rotation matrix to implement and arbitrary viewing orientation. The rotation matrix will be built from some simple vector operations and an application of the **rigid rotations** of a previous homework problem.

Start with

- the eye at the origin,
- a viewing direction V, and
- a so called **up vector**, U,

and produce a matrix M that

- produces a view along V
- with the vector U projecting vertically up on the screen. (This is equivalent to saying the horizon must be level in the final image, but using an **up vector** makes it easy to state mathematically.)

Proceed in two steps.

1. Compute, from U and V, three orthonormal vectors $\hat{U}$, $\hat{V}$, $\hat{W}$, which define a, so called, **coordinate frame** around the viewing direction, and ***Hint:*** *Replace U with $U+tV$ where t is chosen so that the replacement is perpendicular to V. (Remember a zero **dot product** means perpendicular.) Form a third vector W which is perpendicular to both. (Think **cross product**). Make all three unit length and show that they form a orthonormal set.*
2. Compute a matrix M which maps the coordinate frame $\hat{U}$, $\hat{V}$, $\hat{W}$, to the usual X, Y, and Z axes, as necessary for the graphics pipeline. ***Hint:*** *Refer to a previous homework about forming rotations (i.e., **rigid rotations**) from three orthonormal vectors.*