Computer Science 102
Lab 6

In this lab you will augment your vector library with some additional functions. A sample *main.c* and sample output file are provided for you. These are not guaranteed to represent a complete test of the components. You must use the following matrix structure:

```
typedef struct matrix_type
{
   vec_t row[3];
}  mat_t;
```

Functions that you must provide are:

```
/**/
/* Compute the outer product of two input vectors */

static inline void vec_cross(
vec_t *v1,         /* Left input vector  */
vec_t *v2,         /* Right input vector */
vec_t *v3);        /* Output vector      */
```

$$V \times W = (v_y w_z - v_z w_y, \quad v_z w_x - v_x w_z, \quad v_x w_y - v_y w_x)$$

```
/**/
/* project a vector onto a plane */

static inline void vec_project(
vec_t *n,        /* plane normal     */
vec_t *v,        /* input vector     */
vec_t *p);       /* projected vector */
```

The projection of a vector *V* onto a plane with normal *N* is given by:

$$P = V - (N \cdot V) N$$

```
/**/
/* reflect a vector from a surface plane */

static inline void vec_reflect(
vec_t *n,        /* surface normal               */
vec_t *w,        /* incoming ray vector          */
vec_t *v);       /* reflected vector             */
```

If U is a unit vector in the reverse direction of the incoming ray and N is the surface normal, then the direction of the reflected ray V is

$$V = 2 N (U \cdot N) - U$$

You must reverse the input vector W to create the necessary vector U

```
/* Apply transform matrix to vector */

static inline void vec_xform(
mat_t *m,
vec_t *v1,
vec_t *v2);
```

For *i = 0, 1, 2,* the *ith* element of v2 is the dot product of the *ith* row of m with v1.

```
/* Compute the transpose of a matrix */

static inline void mat_transpose(
mat_t *m1,
mat_t *m2);
```

The transpose of a three by three matrix is also three by the matrix. Its elements are given by a simple rule:

transpose[i][j] = original[j][i]

$$\begin{bmatrix} 1.0 & 3.0 & 2.0 \\ 1.0 & 2.0 & -2.0 \\ -2.0 & 0.0 & 1.0 \end{bmatrix}^{T} = \begin{bmatrix} 1.0 & 1.0 & -2.0 \\ 3.0 & 2.0 & 0.0 \\ 2.0 & -2.0 & 1.0 \end{bmatrix}$$

In this lab you will submit a single file, vector.h that includes both your original vector functions and the new ones constructed as part of this lab.

sendlab.102.labsection# lab# vector.h