

# Assignment 1—Hello 2D World & Arbitrary Rotations

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Due: Sunday September 9 at noon

1. Implement a 3-D vector class that stores 3 floats and has the following functionality:
  - a. Constructor from 3 floats
  - b. Read/write access through square brackets operator “[]”
  - c. Addition of two vectors
  - d. Subtraction of two vectors
  - e. Dot product
  - f. ~~Cross product~~
  - g. ~~Multiplication by scalar~~
  - h. ~~Division by scalar~~
  - i. ~~Normalization~~
  - j. ~~Length computation~~
  - k. Rotation of “this” point about arbitrary axis
  - l. Rotation of “this” vector about arbitrary direction
  - m. ~~Output to ostream, input from istream~~
2. Implement a 3x3 matrix class that stores 3 3-D vectors as rows and has the following functionality:
  - a. Constructor from 3 3-D vectors
  - b. Read/write access to rows through square brackets operator “[]”
  - c. Function to get column
  - d. Function to set column
  - e. Multiplication with 3-D vector
  - f. ~~Multiplication with another matrix~~
  - g. ~~Inversion~~
  - h. ~~Transposition~~
  - i. Function to set matrix as rotation about principal axis by theta degrees
  - j. ~~Output to ostream, input from istream~~
3. Implement a frame buffer class that stores unsigned int pixels and the resolution of the frame buffer and that has the following functionality:
  - a. Constructor from input resolution
  - b. ~~Set all pixels to given color~~
  - c. ~~Set one pixel to given color~~
  - d. ~~Drawing of axis aligned rectangle~~
  - e. Drawing of 2D triangle
  - f. ~~Drawing of circle~~
  - g. Load / save from tiff file

4. Demonstrate your code.
  - a. Choose a point and an arbitrary axis and rotate the point full circle by 1 degree increments (i.e. 360 steps). Show the point with coordinates  $(x, y, z)$  in the framebuffer at location  $(u, v)$ , where  $u = x$ , and  $v = y$ . Draw the point as a circle with a radius of 5 pixels. Choose the point and the axis such that the point stays on screen at all times, and such that the trajectory of the point is an ellipse (and not a segment or a circle).
  - b. Render a 12s 30Hz 720p video sequence illustrating your rotating point. The video will have one frame for each position, i.e.  $12 \times 30 = 360$  frames in total. The video file should be in a popular format. Use the video making software of your choice.
5. Turn in via blackboard one zip archive that contains
  - a. Source code
  - b. Executable
  - c. Video file