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CS 180

Assignment 1

2.1 *Write the 3x3 transformation matrix for 120 CW rotation*

We have the Transformation matrix formula = {{cos, sin, 0}, {-sin, cos, 0}, {0, 0, 1}} which rotates CCW.
In order to get the CW rotation we can use: {{cos,- sin, 0}, {sin, cos, 0}, {0, 0, 1}}
Substituting 120 for theta we get

{{- (½), - (sqrt(3)/2), 0}, {(sqrt(3)/2), - (½), 0}, {0, 0, 1}}

2.2 *Write the 4x4 transformation matrix to move a 3D point by (11, 5, -4)*

We have the Translation formula: $T(t_x, t_y, t_z)$ = {{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {t_x, t_y, t_z, 1}}
Substituting our values for translation (11, 5, -4) gives the translation matrix:
{{1, 0, 0, 0}, {0, 1, 0, 0}, {0, 0, 1, 0}, {11, 5, -4, 1}}

2.3 *a) Move the point (1, 6) to the origin*

Again we use the translation formula (this time for a 2D point). To move the point to the origin we need to subtract (1, 6), so we have the translation values t_x = -1, t_y = -6
Giving the translation matrix: {{1, 0, 0}, {0, 1, 0}, {-1, -6, 1}}

b) Scale the rectangle so that it's width is 4 and height is 1

Our original rectangle has a width of 3 and a height of 2
This makes our scaling factors S_x = (4/3) and S_y = (1/2)
We substitute the values into our scaling formula to get the scaling matrix:
{{(4/3), 0, 0}, {0, (1/2), 0}, {0, 0, 1}}

c) Rotate the rectangle 90 degrees CCW

Using our previous rotation formula we substitute 90 for theta:
{{cos(90), sin(90), 0}, {-sin(90), cos(90), 0}, {0, 0, 1}}
And get the rotation matrix: {{0, 1, 0}, {-1, 0, 0}, {0, 0, 1}}

Combining: We have matrices Move(M), Scale(S), Rotate(R) applied in that order
C = R x S x M

Multiplying left to right we have first: (S x M), and then (R x SM) giving the final combined matrix:
{{0, (4/3, 0}, {-(1/2), 0, 0}, {3, -(4/3), 1}}