CPSC 314, Written Homework 1: Transformations

Out: Wed 20 Jan 2016
Due: Wed 27 Jan 2016 2pm (hand in at start of lecture)
Value: 4% of final grade
Total Points: 100

Name: _____

Student Number: _____

$Q1$	$/15$
$Q2$	$/3$
$Q3$	$/4$
$Q4$	$/16$
$Q5$	$/8$
$Q6$	$/54$
$Total$	$/100$

Please check one of the following:

☐ I did not collaborate with anyone in the completion of this homework.
☐ I collaborated with people named below in the completion of this problem set:

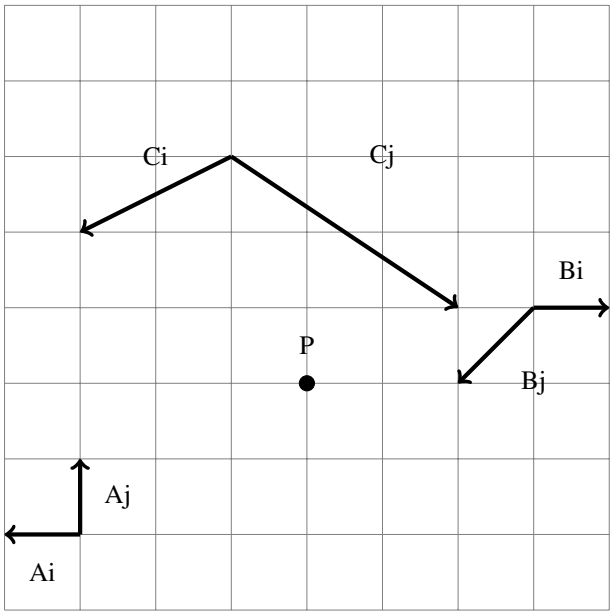
Name: _____ Student Number: _____

Name: _____ Student Number: _____

Name: _____ Student Number: _____

1. (15 pts) The point coordinate P can be expressed as (4,3): that is, P = 4*i + 3*j, where i and j are basis vectors of unit length along the x and y axes, respectively, with an origin at the lower left of the grid. Describe the point P in terms of the three other coordinate systems given below (A, B, C).

   Update Jan 22: origin of C coordinate frame moved.



2. (3 pts) Write down the 4x4 matrix for scale an object by 1 in y, 3 in x, and 2 in z.

   [ ]

3. (4 pts) Homogenize the point (6,3,0,3).

   ( )

4. (16 pts) Give the 4x4 modelview matrix at the four lines A, B, C, and D in the pseudocode below. Assume the matrix stack has been initialized with LoadIdentity(). The transformation direction goes left to right.

```
LoadIdentity();
translation(1,0,0);
A
rotation(90,0,0,1);
B
scale(2,1,3);
C
translation(0,1,2);
D
```

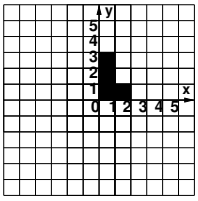
5. (8 pts) Give the pseudocode required to encode M with left-to-right direction. You may assume the matrix stack has been initialized with `LoadIdentity()`.

$$\mathbf{M} = \begin{bmatrix} 2 & 0 & 0 & 3 \\ 0 & 2 & 0 & 1 \\ 0 & 0 & 1 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

6. (54 pts) For each equation below, sketch the new location L' of the L shape on the grid and provide the pseudocode sequence needed to carry out those operations. You may assume the matrix mode is `mvMatrix` and that the stack has been initialized with `LoadIdentity()`.

   For reference, the pseudocode transformation is `scale(x,y,z)`,`rotation(theta,x,y,z)`,`translation(x,y,z)`. Show your partial work, with the position that the L would be drawn after each transformation.

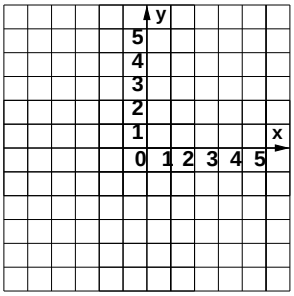
   Do these computations in both directions: from left to right (moving coordinate frame), and also from right to left (moving object). You will get different intermediate answers, but the final position of the L should be the same each way; it's a good way to cross-check your work! You don't need to rewrite the pseudocode from right to left, once is enough.

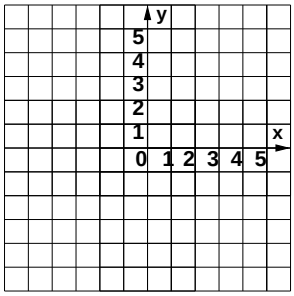


$$\mathbf{A} = \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{C} = \begin{bmatrix} 1 & 0 & 0 & -1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \mathbf{D} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

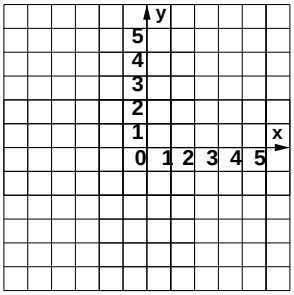
   a) L' = BC L

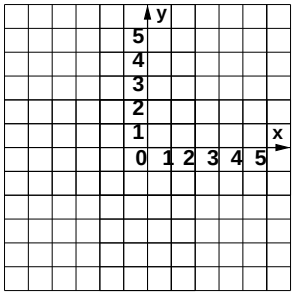
   Left to Right:





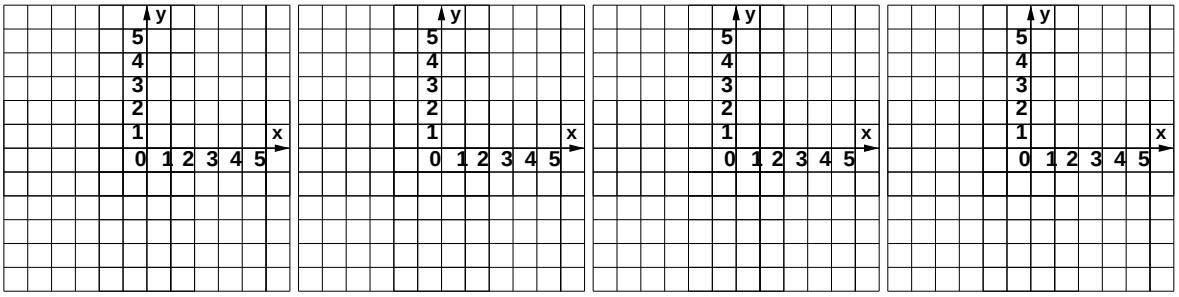
   Right to Left:





b) L' = CDAC L

Left to Right:



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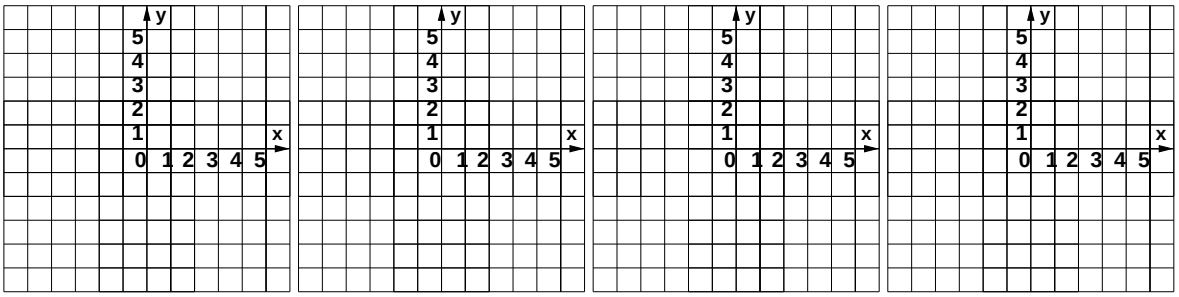
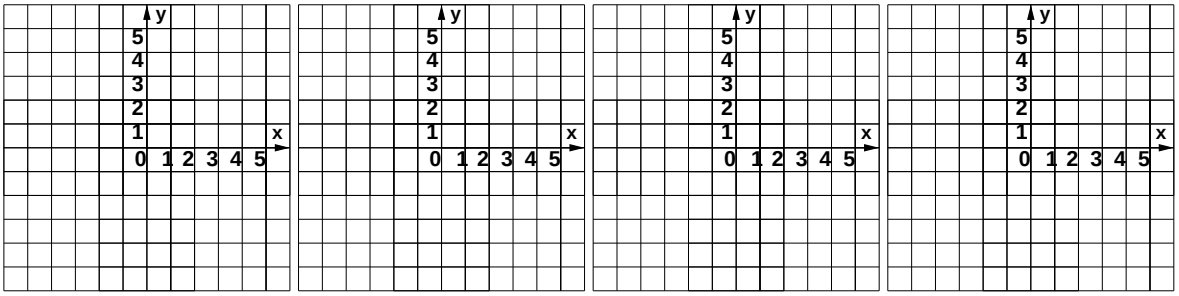


c) L' = ADCC L

Left to Right:



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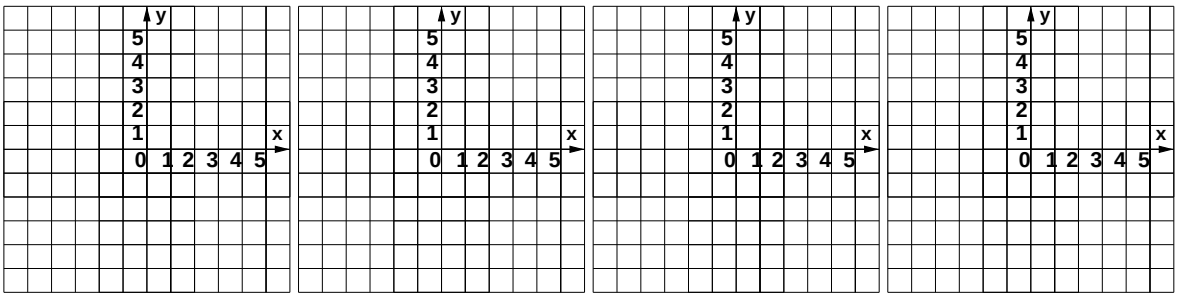
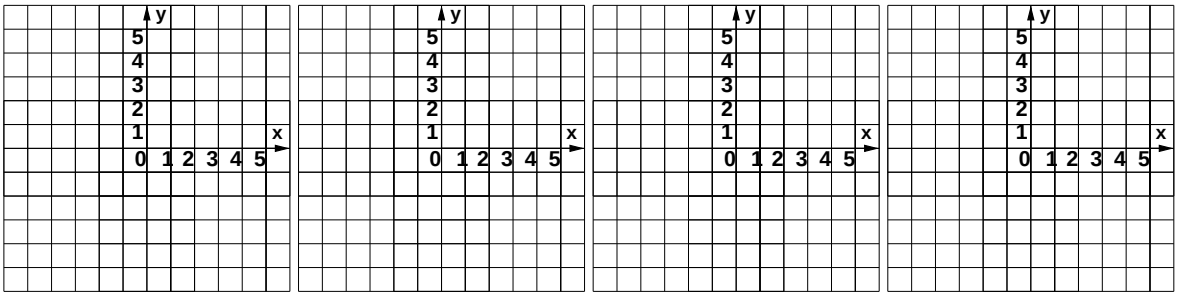


d) L' = ACBD L

Left to Right:



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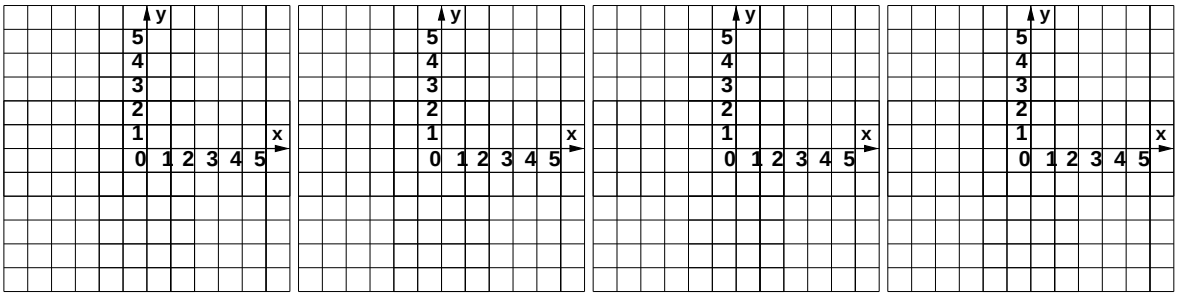
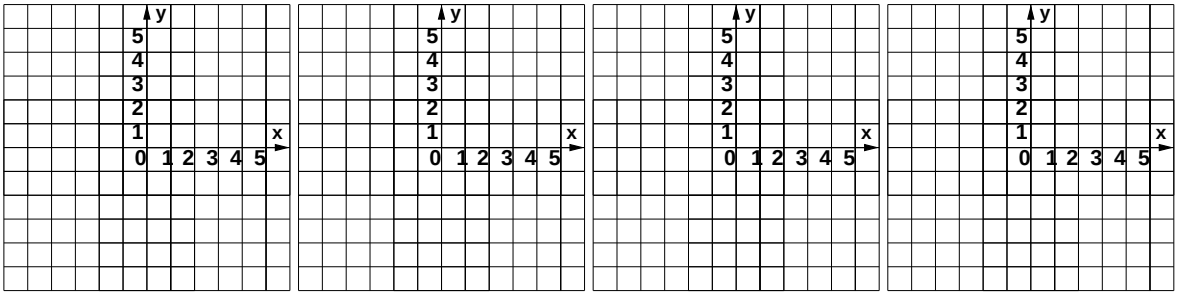


e) L' = ACDB L

Left to Right:



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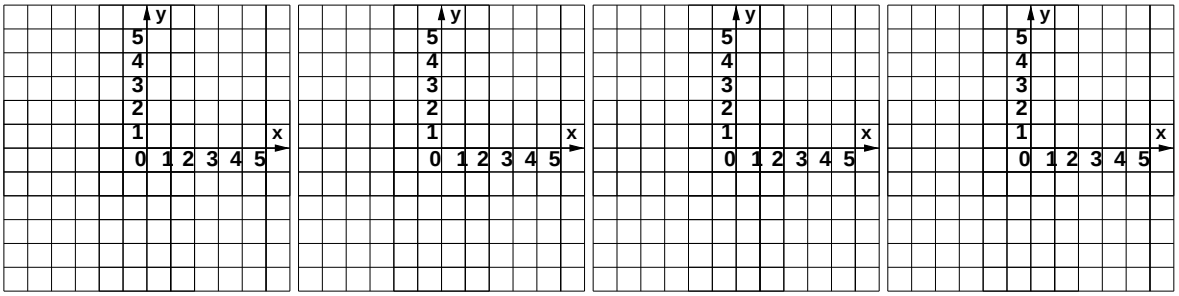
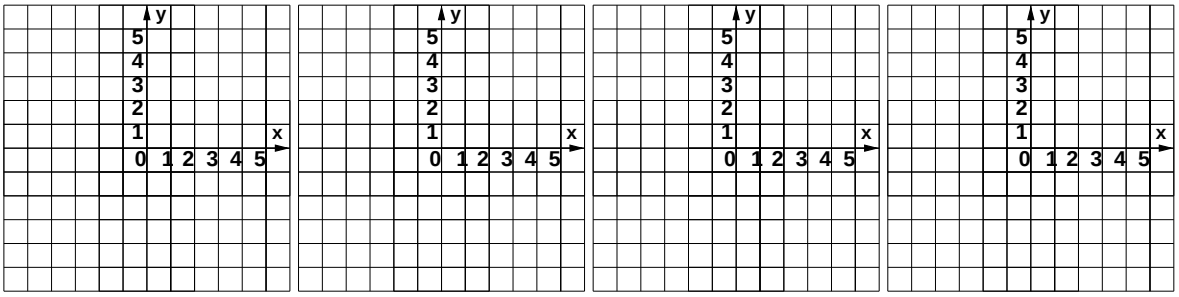


f) L' = CCBC L

Left to Right:



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