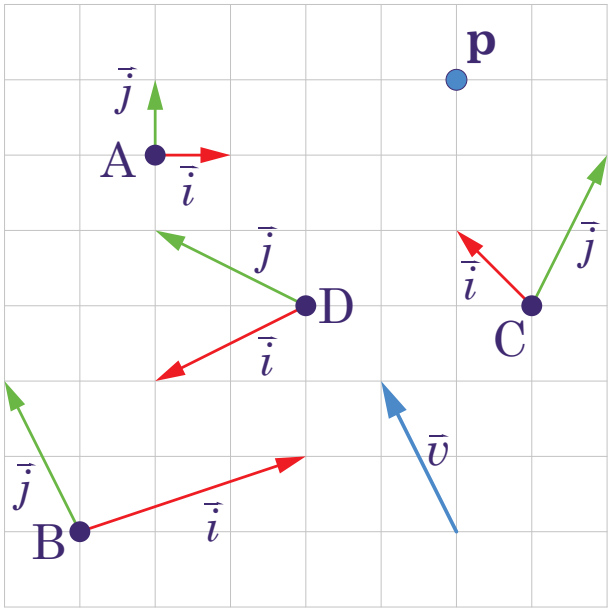
CPSC 314
Theory Assignment 2

Due Friday, Oct 09 at 23:59

Submit your answers on the corresponding assignment on canvas

1 - Coordinate Frames



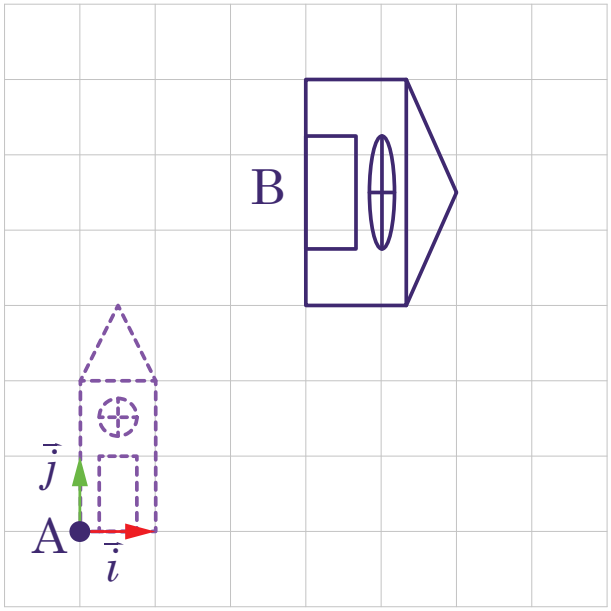
a) (6 points) Express the coordinates of point p with respect to coordinate frames **A, B, C**, and **D**.

b) (6 points) Express the coordinates of vector v with respect to coordinate frames **A, B, C**, and **D.**

c) (8 points) Compute the 2D transformation matrix that takes any point from frame **C** to frame **A**.

d) (8 points) Compute the 2D transformation matrix that takes any point from frame **A** to frame **B**.

e) (12 points) Compute the 2D transformation matrix that takes any point from frame **C** to frame **B**.



2 - Composing Transformations

a) (8 points) What sequence of affine transformations should you do to get the house back from state B to state A?

b) (8 points) Compute the resulting 4 X 4 transformation matrix. Assume that the transformation leaves z to be unaltered.

c) (16 points) What values would need to be assigned to theta, a, b, c, i, j, k, x, y, z in order for the following transformations to yield an identical final transformation? Note, THREE.Matrix4() constructs an identity matrix. Also note that here we pretend that * does matrix multiplication. In actual JS code, you'd use multiplyMatrices() function instead.

```
var m = new THREE.Matrix4();
var m1 = new THREE.Matrix4();
var m2 = new THREE.Matrix4();
var m3 = new THREE.Matrix4();
m1.makeRotationAxis(new THREE.Vector3(i,j,k), theta);
m2.makeScale(a,b,c);
m3.makeTranslation(x,y,z);
m = m3*m2*m1;
house.geometry.applyMatrix(m);
```

3 - Decomposing Transformations

Decompose the following complex transformations in homogeneous coordinates into a product of simple transformations (scaling, rotation, translation, shear). Pay attention to the order of transformations.

a) (6 point)

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 \\ -2 & 0 & -1 & 0 \\ 0 & 1 & 0 & -8 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

b) (6 point)

$$H = \begin{bmatrix} 1.5 & 0 & 0 & -9 \\ 0 & 2 & 0 & 2 \\ 0 & 0 & 1.5 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

c) (8 points) Compute the inverses of the matrices G and H. Hint, remember that the inverse of a transformation matrix is like playing back the same transformation.

d) (8 points) Give the sequence of THREE.js transformations that would produce the same transformation matrix as in part (b) of this question.