Vectors Notes

Vectors

Adding 2 vectors

- Adding 2 vectors, means we add one vector to the tip of the initial vector
- $\overline{Vec1}$ = (2,3); $\overline{Vec2}$ = (1,0); $\overline{Vres}$ = (2+1, 3+0) = (3,3)

Subtracting 2 vectors

- Subtracting 2 vectors, means we add one vector to the tip of the initial vector but instead of adding them we subtracting them.
- $\overline{Vec1}$ = (2,3); $\overline{Vec2}$ = (1,0); $\overline{Vres}$ = (2-1, 3-0) = (1,3)
- Resulting vector goes from origin of the first to the tip of second.

Vector multiplication with a float

- Multiplying a vector with a float means we multiply each component of the vector with that particular float
- $\overline{Vec1}$ = (2,3); f = 2; $\overline{Vres}$ = (2*2, 3*2) = (4,6)

Vector division with a float

- Dividing a vector with a float means we divide each component of the vector with that particular float
- $\overline{Vec1}$ = (2,3); f = 2; $\overline{Vres}$ = (2/2, 3/2) = (1,1.5)

Vector magnitude

- Use Pythagorean theorem; $c^2 = a^2 + b^2$; $c = \sqrt{(a^2 + b^2)}$; For our vector $c = \sqrt{(x^2 + y^2)}$;
- Magnitude of a vector - $||\overline{Vec1}|| = \sqrt{(\overline{Vec1}.x * \overline{Vec1}.x, + \overline{Vec1}.y * \overline{Vec1}.y)}$
- $\overline{Vec1}$ = (2,3); $||\overline{Vec1}|| = \sqrt{(\overline{Vec1}.x * \overline{Vec1}.x, + \overline{Vec1}.y * \overline{Vec1}.y)} = \sqrt{(2*2 + 3*3)} = \sqrt{(4 + 9)} = \sqrt{13} = 3.6$

Normalising a Vector

- Normalising a vector, means making something “standard”, creating a unit vector -> length = 1
- Describes the direction of something, very useful.
- $||\overline{Vec1}||$ - magnitude; $\overline{Vec1}$ - vector; $\hat{v} = \overline{Vec1} / ||\overline{Vec1}||$;
- $\overline{Vec1}$ = (2,3); $||\overline{Vec1}||$ = 3.6; $\hat{v}$ = ((2,3) / 3.6) = (2/3.6, 3/3.6) = (0.55, 0.83);

Dot Product between 2 vectors

- Returns a value between -1 and 1 depending on the angle between 2 vectors
- If vectors face the same way you will get 1.
- If vectors face opposite directions you will get -1.
- If vectors at 90 degrees you will get 0.
- Speed_forward = DotProduct(velocity, forward vector);
- WARNING: The vectors need to be normalised in order to get the values between -1 and 1

Cross product

- It is used for vectors with 3 dimensions
- It takes 2 vectors as input and returns another vector as a result. The resulting vector is perpendicular to the two input vectors
- If you look down on the surface you should choose the vectors clockwise and you will get a positive vector(going up - left hand rule)
- If you go anticlockwise you will get a negative vector(pointing down)
- Another useful element is the Area of the surface between the 2 vectors is equal to resulting vector length divided by two $Area_{triangle} = perp_{magnitude} / 2;$

Links:

- General description of a vector from mathisfun.com: https://www.mathsisfun.com/algebra/vectors.html
- General description of the vectors - video: https://unity3d.com/learn/tutorials/topics/scripting/vector-maths
- Vector2 - 2D vector in unity: https://docs.unity3d.com/ScriptReference/Vector2.html?_ga=1.11694652.987314104.1459417513
- Vector3 - 3D vector in unity: https://docs.unity3d.com/ScriptReference/Vector3.html?_ga=1.25319989.987314104.1459417513
- Vector Arithmetic: https://docs.unity3d.com/Manual/UnderstandingVectorArithmetic.html
- Direction and distance from one vector to another: https://docs.unity3d.com/Manual/DirectionDistanceFromOneObjectToAnother.html
- Computing a normal/perpendicular vector: https://docs.unity3d.com/Manual/ComputingNormalPerpendicularVector.html
- The amount of one vector's magnitude that lies in another vector's direction: https://docs.unity3d.com/Manual/AmountVectorMagnitudeInAnotherDirection.html