f) What is dot product and cross product? Explain use cases of where dot product is used and cross product is used in graphics environment. Add links to places where you studied this information and get back with the understanding.

The dot product and cross product are mathematical operations used in vector algebra.

1. Dot Product: The binary operation known as the dot product, often referred to as the scalar product, accepts two vectors and returns a scalar result. It is calculated by multiplying and adding the respective vector components.

The dot product has several use cases in graphics:

- **Projection:** One vector can be projected onto another using the dot product, which identifies the component of one vector that points in the direction of another.
- **Angle between two vectors:** The formula cos(theta) = (A B) / (|A| * |B|), where A and B are vectors and |A|, |B| are their magnitudes, can be used to determine the angle between two vectors.
- **Illumination Calculation:** Lighting models, like the Phong reflection model, employ the dot product to calculate the quantity of light reflected from a surface based on the angle between the direction of the light source and the surface normal.
- **Collison Detection:** Based on the relative velocity vectors, collision detection algorithms can utilize the dot product to identify whether two objects are travelling towards or away from one another.

Referred links:

https://www.youtube.com/watch?v=YyNnK0T0w9o

https://www.haroldserrano.com/blog/vectors-in-computer-graphics

https://www.geeksforgeeks.org/dot-and-cross-products-on-vectors/

2.Cross Product: The cross product, also known as the vector product, is a binary operation that accepts two vectors and yields a vector that is perpendicular to both of the input vectors.

The cross product has several use cases in graphics:

- **Normal vector computation:** The cross product is frequently employed to determine a surface's normal vector. A vector perpendicular to the surface is produced by taking the cross product of two vectors that are lying on the surface.
- **Determining orientation:** By computing the normal vector and verifying its direction, the cross product can be used to ascertain the orientation of a triangle or polygon.
- **Generating coordinate systems:** In computer graphics, building a camera coordinate system is one application where the cross product is utilized to generate orthogonal coordinate systems.

Referred links:

https://www.geeksforgeeks.org/dot-and-cross-products-on-vectors/

https://www.youtube.com/watch?v=M5U4_l0Aoxc

Bonus - How do you calculate the intersection between a ray and a plane/sphere/triangle?

You may use the parametric form of a ray and the equation of a plane to determine where a ray and a plane intersect. The intersection point may be found by performing the following steps given a ray with an origin point O and a direction vector D, and a plane with a normal vector N and a point on the plane P:

Use the formula t = dot(P - O, N) / dot(D, N) to determine the ray's parameter t.

The intersection point is determined by I = O + t * D if t falls within an acceptable range, such as t >= 0.

Referred link:

https://en.wikipedia.org/wiki/Line%E2%80%93plane_intersection