Assignment 2

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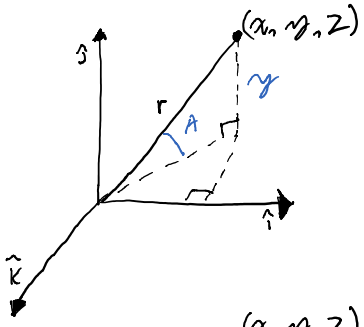
Non-Programming Assignment [2 points]

(You can do it by hand with readable hand writing, and scan it with your assignment, or you can do it with a Word processor and submit it in PDF or DOCX format).

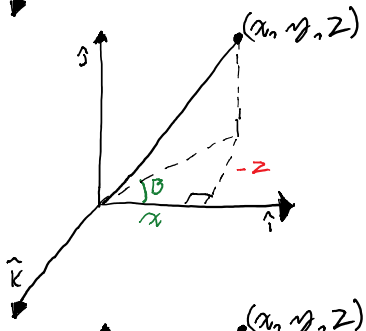
- From first principles, derive the conversion from Cartesian Coordinates to Spherical Coordinates and from Spherical Coordinates to Cartesian Coordinates. Your solution must include a clear picture of the triangles showing the mapping between the 2 coordinates system. **[1.5 point]**

Conversion from Cartesian to spherical Coordinates Given (x, y, z)

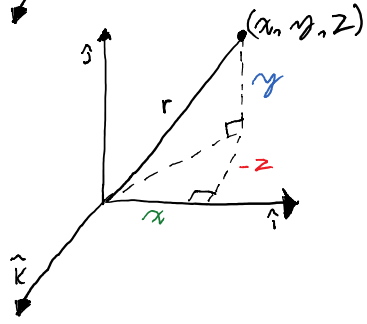
SOH CAH TOA



$\sin(A) = \frac{y}{r} \rightarrow A = \sin^{-1}\left(\frac{y}{r}\right)$



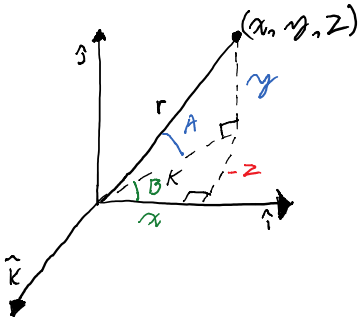
$\tan(B) = \frac{-z}{x} \rightarrow B = \tan^{-1}\left(\frac{-z}{x}\right)$



$r = \sqrt{x^2 + y^2 + z^2}$

Conversion between Spherical to Cartesian given (r, A, B)

SOH CAH TOA



$\sin(A) = \frac{y}{r} \rightarrow y = r\sin(A)$

$\cos(A) = \frac{k}{r} \rightarrow k = r\cos(A)$

$\cos(B) = \frac{x}{k} \rightarrow x = \cos(B)k \rightarrow x = \cos(B)\cos(A)r$

$\sin(B) = \frac{-z}{k} \rightarrow -z = \sin(B)k \rightarrow z = -r\sin(B)\cos(A)$

- There are Z-Fighting artifacts when 2 polygons render at the same depth as seen with 2 overlapping cubes in the Framework (lower screenshot). Explain what causes Z-Fighting, and why pushing the view frustum near plane usually reduces the artifact. **[0.5 point]**

Z-Fighting is caused when applying a projection view transform. When the frustum is transformed into a cube in NDC space the transform causes elements in the distance to have z index values very close to each other. At this point they can start jumping back and forth between which should be displayed on top. By pushing the frustum forward it decreases the amount of units the z axis must be map to the NDC cube. Because there is now more room the coordinates are less likely to be in proximity to fight.