Ex2: Modeling

This exercise should be submitted individually and not pairs. Due date: 29/3/2015

Question 1

Given are the following vectors:

$$u = (2 \quad 3 \quad 2)^T \quad v = (-1 \quad 0 \quad 3)^T \quad w = (4 \quad 2 \quad 0)^T$$

Find the following values, either geometrically or algebraically:

1. $|\sin\measuredangle(u, w)|$
2. $\|w \times v\|$
3. $(u \times w) \cdot u$
4. $w \times u$
5. $\cos\measuredangle(u, v)$
6. $\left(\|v\|^2 - \left(\frac{u}{\|u\|} \cdot v\right)^2\right)\|u\|^2 - \|u \times v\|^2$

Question 2

Two lines are given in space by the following equations:

i. $\frac{2x}{3} = y - 2 = 2z$

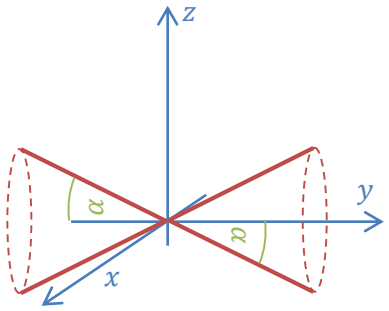
ii. $l_2(t) = \begin{pmatrix} a \\ 1 \\ 1 \end{pmatrix} + t\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$

1. Find the equation of the plane containing the first line and parallel to the second line.
2. Find a for which the lines intersect.

Question 3

Find explicit, implicit and parametric representations (cylindrical) of a 3d cone with the following attributes:

i. Its tip is located at the origin.
ii. It opens in the directions of the y axis.
iii. The opening angle is α, counting from the y axis.



Question 4

Let $\underline{b}$, $\underline{a}$ be 2 points on the axis of a cylinder, and $\underline{p}$ a point on the cylinder. Find the shortest vector that starts at $\underline{p}$ and ends on the axis.

Question 5

You should implement a Vector class in Java. The idea is to create a useful class for the next programming exercises including ray tracing in exercise 3.

We provided a file called Vec.java that defines the class and where you have to add the relevant code that implements various operations. You should test your class using JUnit, with the provided VecTest.java class, as was explained in the recitation.

The partial code is in the moodle

Note that you would need other classes for geometric processing such as Point class or Ray class. You can start thinking how to implement those (or even start implementing them) but do not submit them!

Submission Guidelines

Upload to the moodle site the pdf of the answers and **only** the java source file Vec.Java (part 5) by zipping it as usual to a zip.

file:

<Ex##> <FirstName> <FamilyName> <ID>
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