

# Solution - Exercise [2]

Introduction to Computer Graphics - B-IT Master Course

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## Exercise 1

Given are two points  $p_1, p_2$  on the unit sphere in  $\mathbb{R}^3$ . Using a quaternion the point  $p_1$  is to be rotated onto the point  $p_2$ .

- a. Give a formula to determine the angle of rotation  $\alpha$

$$\alpha = \arccos \left\{ \frac{q_1 \cdot q_2}{|q_1| \cdot |q_2|} \right\}$$

- b. Give a formula to determine the rotation axis  $v$

$$v = q_1 \cdot q_2$$

- c. Write down the quaternion  $q$  which performs the rotation with angle  $\alpha$  around  $v$

- d. Write down the relationship between  $p_1$  and  $p_2$  using quaternion multiplication

$$\begin{aligned} q_1 &= q_{10} + \mathbf{i}q_{11} + \mathbf{j}q_{12} + \mathbf{k}q_{13} \\ q_2 &= q_{20} + \mathbf{i}q_{21} + \mathbf{j}q_{22} + \mathbf{k}q_{23} \end{aligned}$$

$$\begin{aligned} q_1 \times q_2 &= (q_{10}q_{20} - q_{11}q_{21} - q_{13}q_{23} - q_{12}q_{22}) + \mathbf{i}(q_{11}q_{20} + q_{10}q_{21} + q_{13}q_{23} - q_{12}q_{22}) + \\ &\quad \mathbf{j}(q_{10}q_{22} - q_{11}q_{23} + q_{12}q_{20} + q_{13}q_{21}) + \mathbf{k}(q_{10}q_{23} + q_{11}q_{22} - q_{12}q_{21} + q_{13}q_{20}) \end{aligned}$$

## Exercise 2

And some more text ...