Practice Problems - 03

Practice problems are supposed to help you digest the content of the lecture. It is important that you manage to solve them on your own. Before you write your solutions, you may of course ask questions, and discuss things. In order to prepare for the exam, already now, try to explicitly write down your solutions – clearly and easy to read. Apply definitions properly, and give explanations for what you are doing. That will help you to understand them later when you prepare for the final exam.

I. Linear Algebra

Consider a parallelogram with total area equal to 40, built by vectors v_1 and v_2. Considering that the magnitude of v_1 is equal to 10, and the angle between the two is equal to $\pi/6$:

1) Calculate the length of v_2

2) Calculate the dot product between the two vectors. Is the answer unique?

3) Calculate the cross-product between the two vectors … well, its magnitude.

4) Show graphically the sum and the difference of the two vectors. Any alternative results?

II. Robot Motion – Homogeneous Coordinates

1) Consider a mobile robot that moves in the 2D space. It starts at (0,0). It will move along the y-axis for 6 units (like meters). Then it will rotate about the origin of the coordinate system by 45 degrees. Then it will move by a vector $(3\sqrt{2}, -3\sqrt{2})^T$.
The robot is an extended physical object – not just a point. So, calculate the final transformation matrix as a combination of the three individual transformations, and show the robot path in a graph.

2) Consider a mobile robot that moves in the 2D space. It starts at (0,0). It will move along the y-axis for (– 6) units (like meters). Then it will rotate about the origin of the coordinate system by 45 degrees. Then it will move by a vector $(-3\sqrt{2}, -3\sqrt{2})^T$.
Calculate the final transformation matrix as a combination of the three individual transformations, and show the robot path in a graph.

3) Consider a mobile robot that moves in the 2D space. It starts at (0,0). It will move along the y-axis for 8 units (like meters). Then it will rotate about the origin of the coordinate system by 45 degrees. Then it will move by a vector $(4\sqrt{2}, -4\sqrt{2})^T$.
Calculate the final transformation matrix as a combination of the three individual transformations, and show the robot path in a graph.