C2-001_Practice 05

Date	@2022년 8월 29일 오전 9:30
Lecture Note	C2-001_Lecture_05_affine transform.pdf
Practice (pdf)	
Solution (pdf)	
Topics	Lecture 05: Affine Transformation
Week	5

1. Mario in Super Mario game can be represented by a set of points $\mathbf{P} = \{(-1,0,0,1),(1,0,0,1),(0,0,2,1),(0,0,-2,1)\}$ in $\mathbb{R}^3$. Mario is now at $(0,0,0)$. There are the scaling item (×2) at $(5,2,0)$ and the x-axis reflection item at $(5,2,3)$. At first, Mario got the scaling item by moving to $(5,2,0)$. His size doubled. And then, he moved to $(5,2,3)$ to avoid enemies and inevitably got the x-axis reflection item. So, his x-axis movement was reversed. Note that Mario can only move in the direction of x-, y-, and z-axis. It means that he cannot move diagonally at once.
   a. Show all affine transformation matrices applied to Mario in the above mentioned scenario.

   b. Calculate the finally transformed Mario's points $\mathbf{P'} = \mathbf{TP}$, ($\mathbf{T}$ indicates the composition of all affine transformations)

2. There are bases of enemies which are $\mathbf{A}$ at $(4,9,0)$ and $\mathbf{B}$ at $(8,5,2)$ [unit: km]. The enemy, $\mathbf{E}$, at a speed of $2km/h$ patrols between $\mathbf{A}$ and $\mathbf{B}$. To attack the enemy, we built the missile turret, $\mathbf{M}$, at $(2,5,0)$, which is the shortest distance between the trajectory of the enemy $\mathbf{E}$ and our missile turret $\mathbf{M}$. The shortest distance is our maximum missile range, $||\mathbf{d}||$. Please refer to the approximation of square root for the simplification of your calculation in Table 1. Fig. 1 shows overall scenario of this problem.

   Table 1. Approximation of square root of each positive integer, 100 - 196.

$\sqrt{100} \sim \sqrt{110}$	10	$\sqrt{145} \sim \sqrt{156}$	12
$\sqrt{111} \sim \sqrt{121}$	11	$\sqrt{157} \sim \sqrt{169}$	13
$\sqrt{122} \sim \sqrt{132}$	11	$\sqrt{170} \sim \sqrt{182}$	13
$\sqrt{133} \sim \sqrt{144}$	12	$\sqrt{183} \sim \sqrt{196}$	14

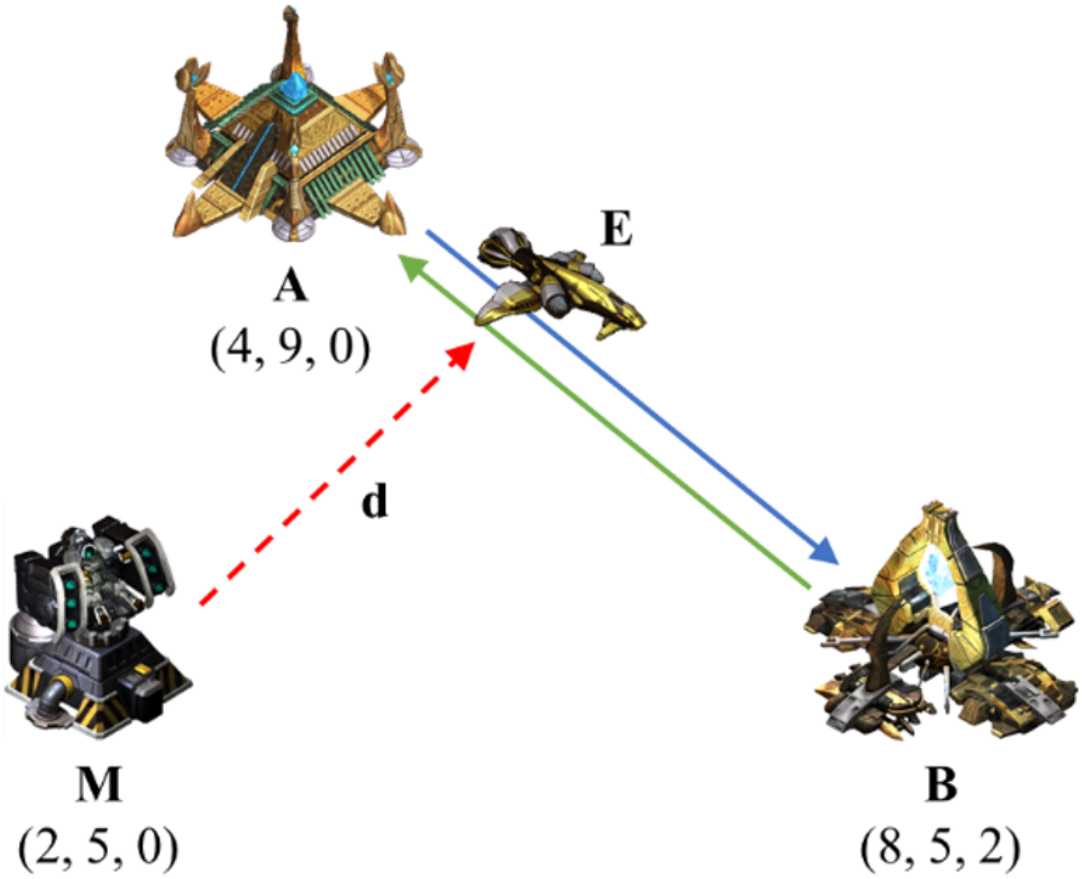

Fig. 1. Overall scenario of Problem 2.

a. Calculate the maximum missile range, $||\mathbf{d}||$ (i.e., the shortest distance between $\mathbf{E}$ and $\mathbf{M}$.

b. Calculate the position of the enemy, $\mathbf{E}$, at time t where $0 \leq t < 3$ hours.

c. After the enemy leaves the base $\mathbf{A}$ at $t = 0$, when does it get the first attack by the missile?