ME250 | Fall 2017 | University of Michigan

MS1: Individual Strategy Proposal (40 points)

This is an **individual** assignment. Your work must represent your own ideas, and you should not discuss your solutions with others before your lab section on **Monday, September 11th, 2017**.

- Due at the beginning of your lab section on **Monday, September 11th, 2017**. Bring a hardcopy of your strategy proposal to your lab section for discussion. At the beginning of lab, your GSI will grade this document based on the presence of each part (2 points per part, 10 points total). The content of this document will be graded by your GSI after you submit the document at the end of your lab section.
- Your milestone assignment will be evaluated on content and overall quality (i.e. organization, clarity and readability).

The purpose of this milestone is to brainstorm strategies to play the *Game of Zones*. The strategy is a way to play the game and win; that is, *what* the RMPs in each zone should be doing rather than *how* they should be doing it. To be creative and explore all the possible strategies, **you should avoid any specific machine design concept at this stage in the design process.** For example, instead of saying "an all-wheel-drive RMP will use an arm to lift the Cube" (*how* to do something), the strategy should just include statements like "the RMP will lift the Cube" (*what* it should be doing). As a result, your strategy won't constrain you to a design with some wheels and an arm. You want to think on a broader, higher level at this point.

The success of the game requires RMPs in each zone to pass Cubes through their own challenges, yet the whole squad works together to complete the relay. You are encouraged to generate many strategies in Parts 1 and 2 of this assignment, but the submission requirements for each part are detailed below.

1. Read the rules document (goo.gl/c93F32), and make sure you are familiar with the overall challenge of the field, the game rules, and the scoring scheme. State an overall strategy involving a total of four RMPs. Your strategies should at least include the decisions on the following items:
    - *Picking up Cubes*: The number of Cubes to pick up at a time and the priority of the Cubes (i.e. from its own zone or from the previous zone).
    - *Transporting Cubes through the challenge*: The routes that the RMP will take and the way to overcome the challenges along the routes.
    - *Delivering Cubes to different zone or to the GOAL*: The number of cubes to deliver at a time and the location of delivery, including your choice of GOAL.

2. The goal of your squad is to win the competition by scoring the highest number of points during the five-minute game time. Therefore, RMPs in your squad should be collaborating with each other to relay and score Cubes efficiently.
    a. According to your overall strategy above, identify any key principles needed in order for your squad to successfully collaborate and ideally win the game. This should also include the following items:
        - How can you take advantage of the number of Cubes in each zone?
        - How should your RMPs prioritize Cubes of different colors and GOALs of different multiplier?

- In each zone, is there any interaction required between RMPs? For example, will one RMP require the next RMP to be at a specific place in the next zone to complete the delivery?

b. Briefly explain your decision in Part A, and justify your choice with the strengths (advantages) of your squad strategy.

3. List at least three risks for the squad strategy described in Part 1 and 2 (what could go wrong), and methods of addressing each of the risks (how your squad could react).

4. Consider possible outcomes from the risks in Part 3 and list the best, the average, and the worst outcomes you would expect. Predict a score and probability for each outcome. **Write one or two sentences justifying your choice of the score and probability for each outcome.** Expected score for your strategy can be calculated using the formula below:

$$\begin{aligned} Expected\ Score &= (score\ from\ best\ outcome)\times(probability\ of\ best\ outcome) \\ &+ (score\ from\ averaage\ outcome)\times(probability\ of\ average\ outcome) \\ &+ (score\ from\ worst\ outcome)\times(probability\ of\ worst\ outcome) \\ &= s_{best}\times p_{best} + s_{average}\times p_{average} + s_{worst}\times p_{worst} \end{aligned}$$

----------**Below is an example**----------

Best outcome: Everything works well; each RMP can transport Cubes through zones…

- Drawbridge is pulled down.
- RMP passes all six yellow cubes to the high scoring goals (red basket).
- … (include details for all other RMPs)

Goal Color	Green Basket (1x)			Red Basket (3x)		
Cubes Color	Green (1x)	Yellow (2x)	Red (3x)	Green (1x)	Yellow (2x)	Red (3x)
No. of cubes	5	0	4	0	6	0
Score	5	0	12	0	36	0
Drawbridge	Yes (10 points)					

Predicted score = 63

Average outcome: Only 3 yellow Cubes are transferred to the red basket; some Cubes from the tower is not successfully transferred…

- RMP from zone 1 only passes three Cubes to the high scoring basket (red basket).
- RMP from zone 2 only manage to score 2 out of 4 red cubes to the low scoring basket.
- … (include details for all other RMPs)

Goal Color	Green Basket (1x)			Red Basket (3x)		
Cubes Color	Green (1x)	Yellow (2x)	Red (3x)	Green (1x)	Yellow (2x)	Red (3x)
No. of cubes	3	2	2	0	3	0
Score	3	4	6	0	18	0
Drawbridge	Yes (10 points)					

Predicted score = 41

Worst outcome: Most strategy does not work (**be more specific**)

- Drawbridge is not drawn
- RMP in Zone 2 cannot score any red cubes
- … (include details for all other RMPs)

Goal Color	Green Basket (1x)			Red Basket (3x)		
Cubes Color	Green (1x)	Yellow (2x)	Red (3x)	Green (1x)	Yellow (2x)	Red (3x)
No. of cubes	2	3	0	0	0	0
Score	2	6	0	0	0	0
Drawbridge	No					

Predicted score = 8

In this example, we expect the average outcome would have a 50% chance. And for the other half of the probability, the squad would have an equal chance to do very well or rather poorly. Therefore, the probability of 100% would be distributed into the three outcomes: 50% for the average, 25% for the best, and 25% for the worst. (Your probability values may be different, but they must add up to 100%.) So, the expected score can then be calculated as shown below:

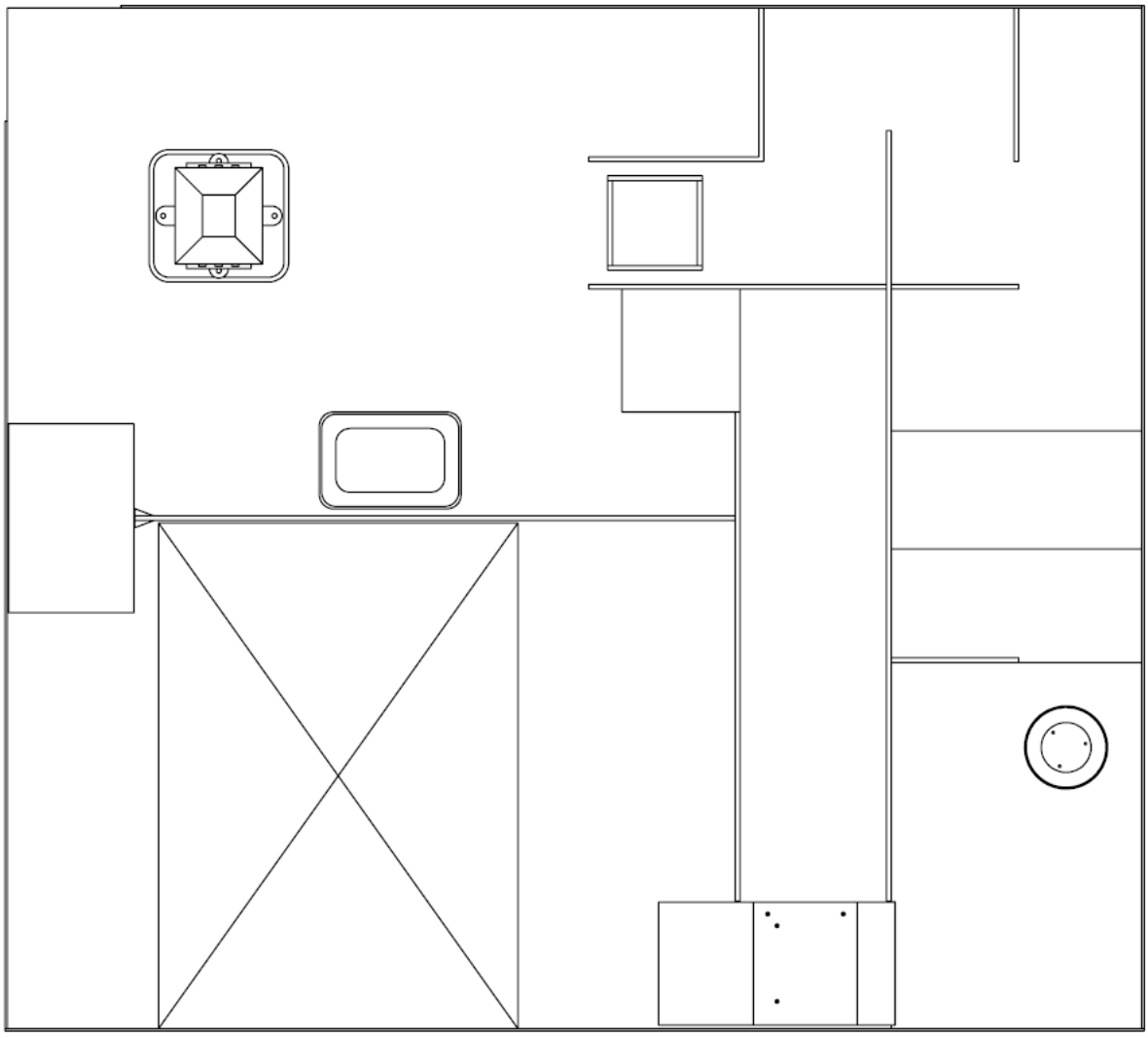
$$Expected\ Score = s_{best} \times p_{best} + s_{average} \times p_{average} + s_{worst} \times p_{worst}$$
$$= 63 \times 25\% + 41 \times 50\% + 8 \times 25\% = 38.25$$

----------**Above is an example**----------

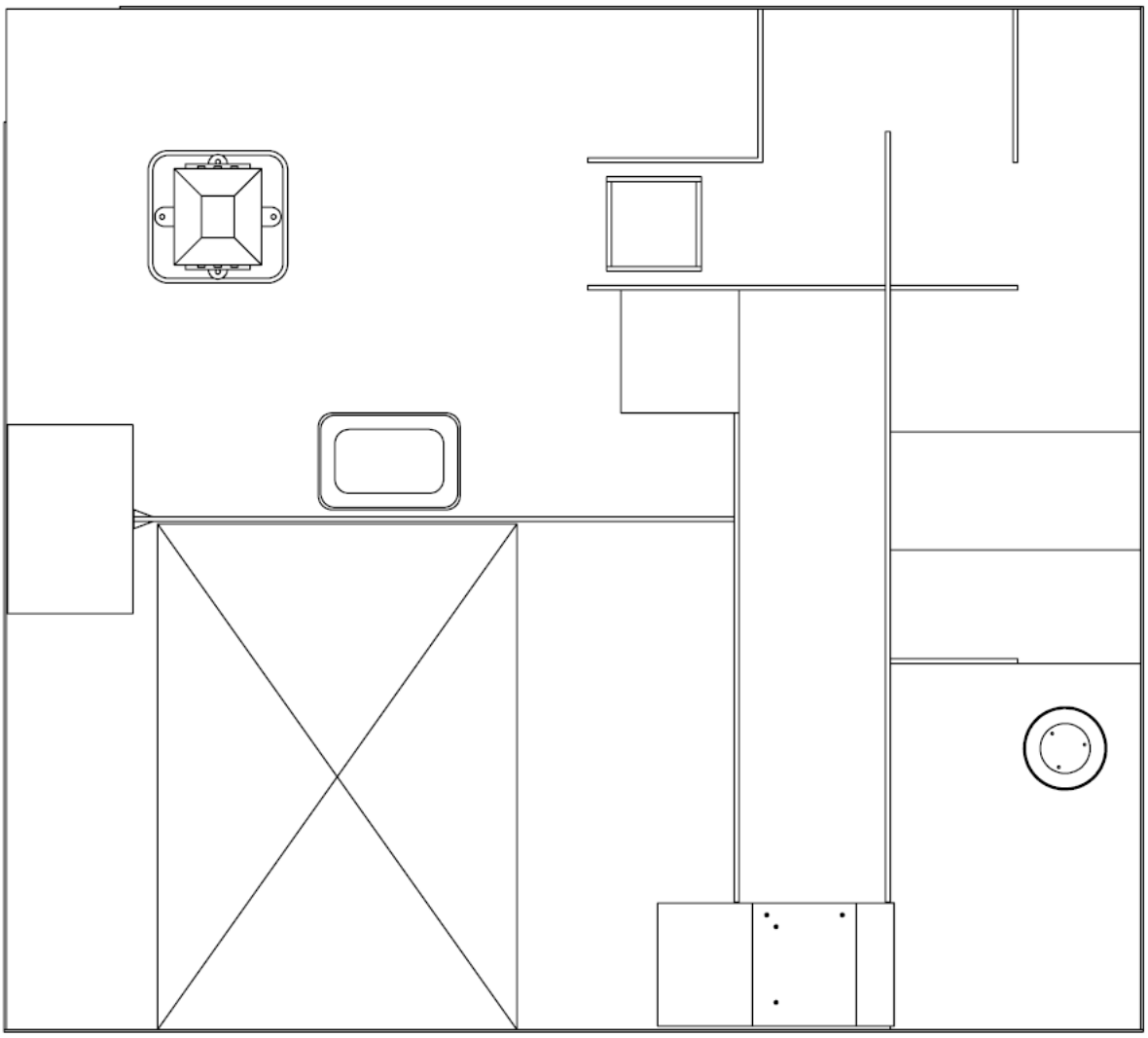
Be prepared to discuss the results of your expected score with your teammates. This expected score technique should help in deciding the strategies you and your team will move forward with throughout the course.

5. Using the worksheets on the last pages, sketch the movement of each RMP according to your strategies provided in Part 1. Choose four significant moments, and draw the snapshots of those moments to describe the motion over time. Draw RMPs as squares, and use arrows/text/etc. to indicate the motions that each RMP will take during the game.

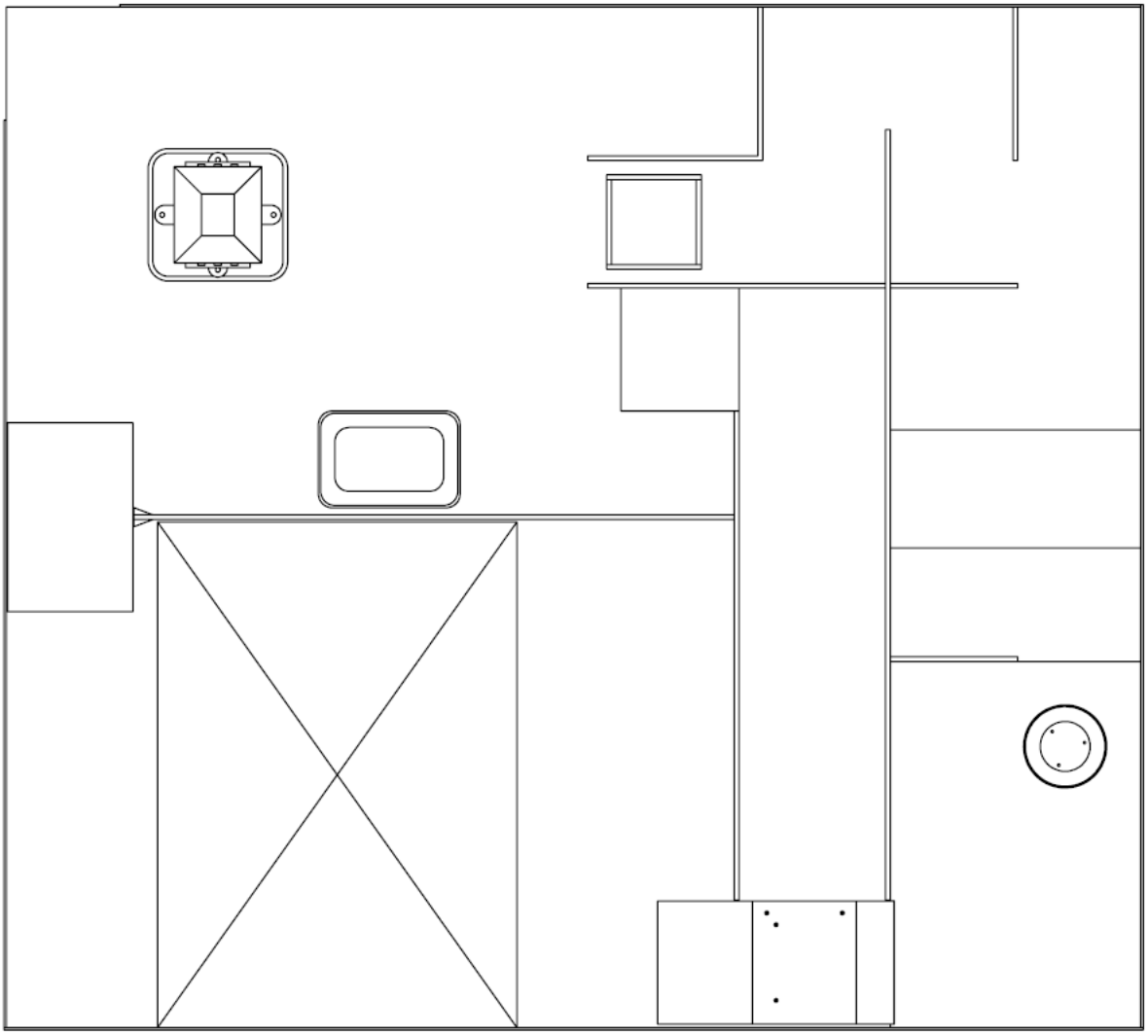
Moment 1



Moment 2



Moment 3



Moment 4