OBJECTIVE: The objective of this competition is to put the whole ArmLab together into a complete system, requiring components from parts 1 through 3. The most successful teams will build upon this minimal system. Teams will be tasked with finding objects and placing them in a bucket. Evaluation metric will be based on the number of objects collected and the time taken.

BASELINE: Teams are expected, at a minimum, to autonomously collect 1 ball from an unknown location and place it in the bucket. Another way to say this is that teams need a non-zero score.

DELIVERABLES: No write-up is required for this part of the lab, but a simple GUI must be running during the competition showing 1) the arm configuration, 2) the time elapsed, 3) # of objects collected, and 4) points accrued thus far. A screenshot of your GUI is required in the ArmLab writeup.
**Competition Day Logistics**

At 10:10 am a random drawing will determine the contest ordering. To prevent any unfair advantage, all teams must vacate their workspace upon contest commencement and may not return until their allotted timeslot.

**Competition Overview**

Each team compete for points by collecting objects from somewhere on the 24” x 24” board and placing them in a bucket. Points are based on both the number of objects collected and the time taken. However, teams must weigh the trade-off between time and # of objects collected. Teams must also present a GUI showing the following:

- Elapsed time (in seconds)
- Arm configuration (forward kinematics model)
- Number of objects collected (suggest breaking it down by type)
- Current point value (equation given below)
- (subjective) What is going on with your system. For example, put a box around the current goal object and maybe draw the expected path to the object.

**Note**: Time does not 'stop' if a team collects all the objects; the code, not the team members, decides when to stop time (up to maximum time).

*Illustration 1*: Possible snapshot during competition. At this point the bucket contains 1 of each object type.
Competition

**Winner:** The team with the most points wins

**Interaction:** At no time once the run begins are teams allowed to interact with their system, except for viewing the GUI. You will be given a few minutes to setup after the previous team completes their run.

**Baseline:** As part of ArmLab, all teams are expected to find and collect at least 1 ball. The rest is for fun!

**Number of objects:** On the order of 10 (but likely not exactly 10)

**Types of objects:** The objects will consist of some combination of yellow balls and the two types of wood blocks.

**Location of collection bucket:** The bucket will be placed directly behind the arm (on the pointed side of the triangle, see Illustration 1). There are both green and blue buckets in the lab, you are welcome to use either color.

**Size of playable area (where objects could be placed):** Anywhere on the 24” x 24” board.

**Time:** Elapsed time once your team is setup

- **Absolute Time Limit:** 240 seconds
- **Time (w.r.t. points):** Whenever your system decides to stop the contest the time will stop and your points will be evaluated with the present time (in seconds). The possible times are 0- 240s and the code decides when to stop (not the teammates).

**Points:** Points are awarding with the following formula; the intention is to reward both:

- $c = \#$ of objects collected into bucket
- $t = \text{time of completion}$

$$points(c, t) = \frac{c^2}{t + 1}$$

**Additional Items:** You are allowed to add 1 item (within reason) to the playing field if you think it would improve your collection abilities. (Hint: A major step in human evolution occurred when we learned to use tools, the same applies to robots)

Illustration 2: Example GUI Screenshot. Showing arm, points accrued, time elapsed, objects found, and current goal object.

**Competition Specifics**