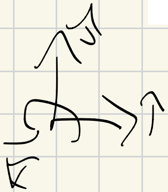
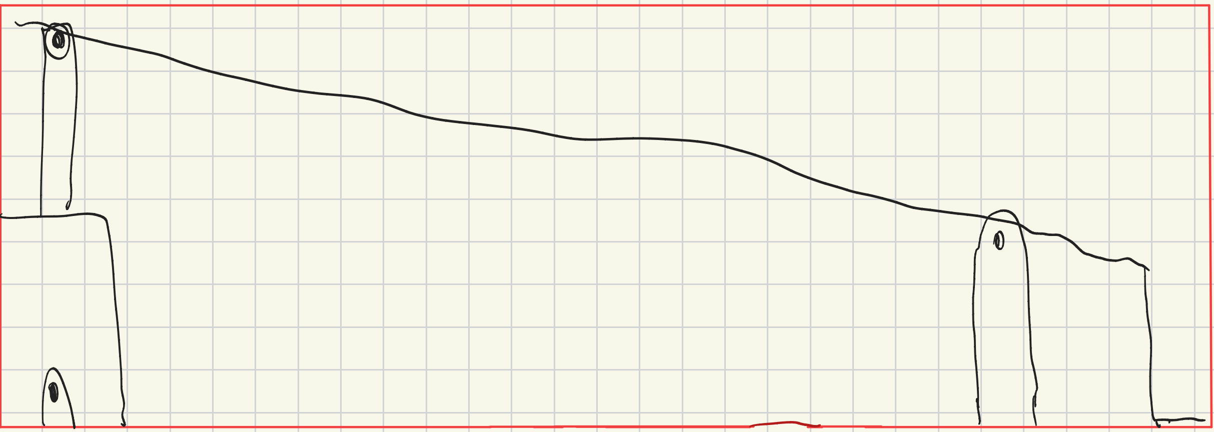
Portfolio

Note: This is not a usual homework problem.
This is intended to be part of your "portfolio". More information on portfolios and instructions related to submission can be found at this [link](). There is also a [video]() that you can watch to learn about "portfolios" and relevant instructions.

Given a 2D design space of 150cm long and 50cm tall, a rigid bar of a fixed length (your choice), 3 pin supports of which two need to be mounted on the ground and a linear actuator (pick from this [online catalog](), use max force values only), design a frame/mechanism to lift the maximum possible weight to the highest possible height. Assume all the supports and bar/actuator are rigid.

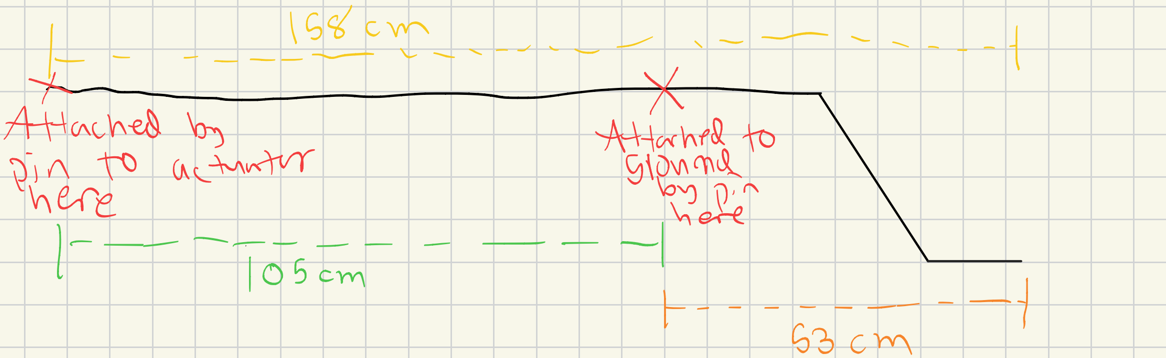


Rough Draft of Design

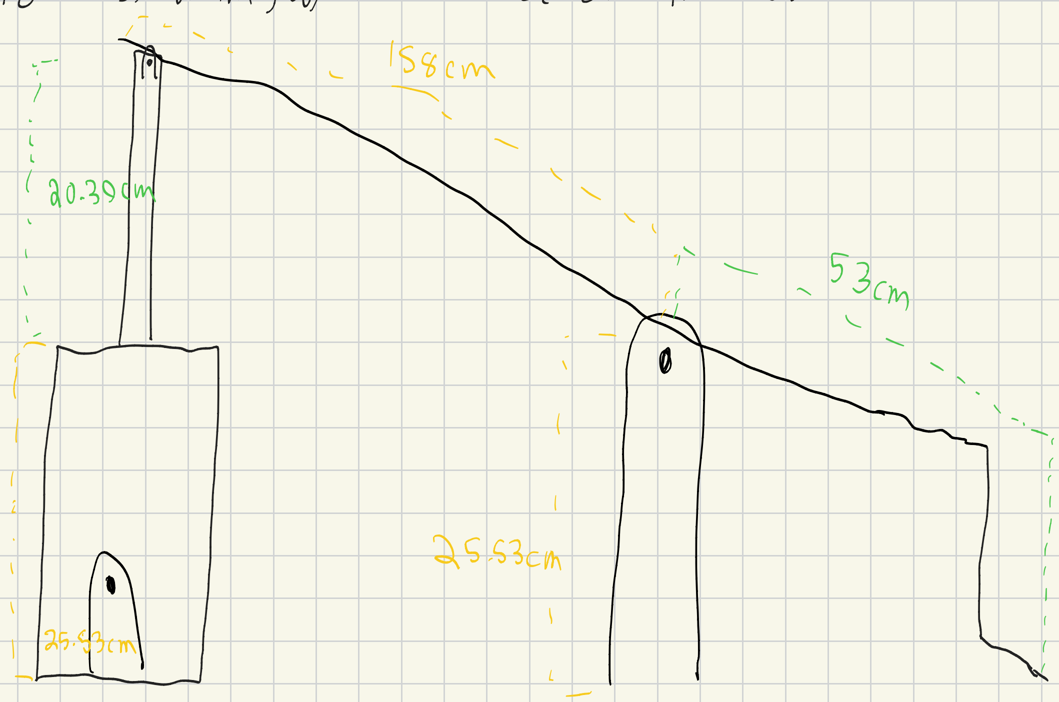


The main design constraint is that the actuater body itself is big, which limits the distance it can lift a weight. In my design, I will prioritize lifting a heavier weight over the displacement. I assumed that the weight must be lifted off the ground since a mechanism that can only lift something when it has a weight placed somewhere above the ground is less useful because you need another mechanism to get it there. Displacement is limited by the mechanical advantage, but I will prioritize a mechanical advantage of 2. That means the input arm has to be twice as long as the output arm to get this advantage. Having these constraints in mind, it is time to chose a lenght and geometry of bar.

I will choose a bar of the following geometry, with full horizontal lenghth of 158 cm.

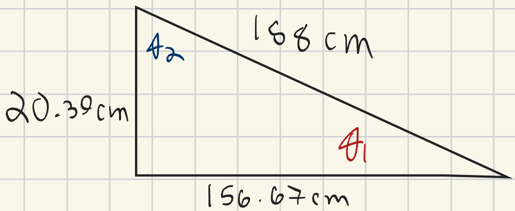


Since I am constricted to a 50cm height, I chose the IMA33 with an actuator body size of 172.5 mm + 80.8 mm resolver w/ break, which is useful for pull down movements. Body size = 253.3 mm, Body w/ stroke up to 457.2 mm, w/ max force of 11.1 kN.

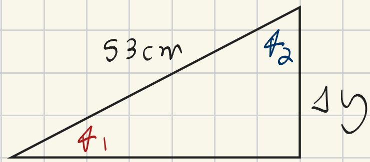


Since the max force that the actuator can apply is 11.1KN, and the max mechanical advantage when a weight is hooked to the very end of the output lever, this can lift 22.2KN of weight. Now I can calculate the displacement. This system can be modeled as a straight bar and similar triangles. When weight is at bottom-most position, the input side forms a triangle. When the left side is at its bottom-most side, the right forms a similar triangle to the one on the left

Triangle 1:



Triangle 2:



$$\sin(\theta_1) = \frac{20.39}{158\text{cm}} = \frac{\Delta y}{53}$$

$$\Delta y = \frac{53\text{ cm} \cdot 20.39\text{cm}}{158\text{ cm}} = \boxed{6.84\text{ cm}}$$

So this design can carry double the max weight of the actuator but only for 6.84 cm.