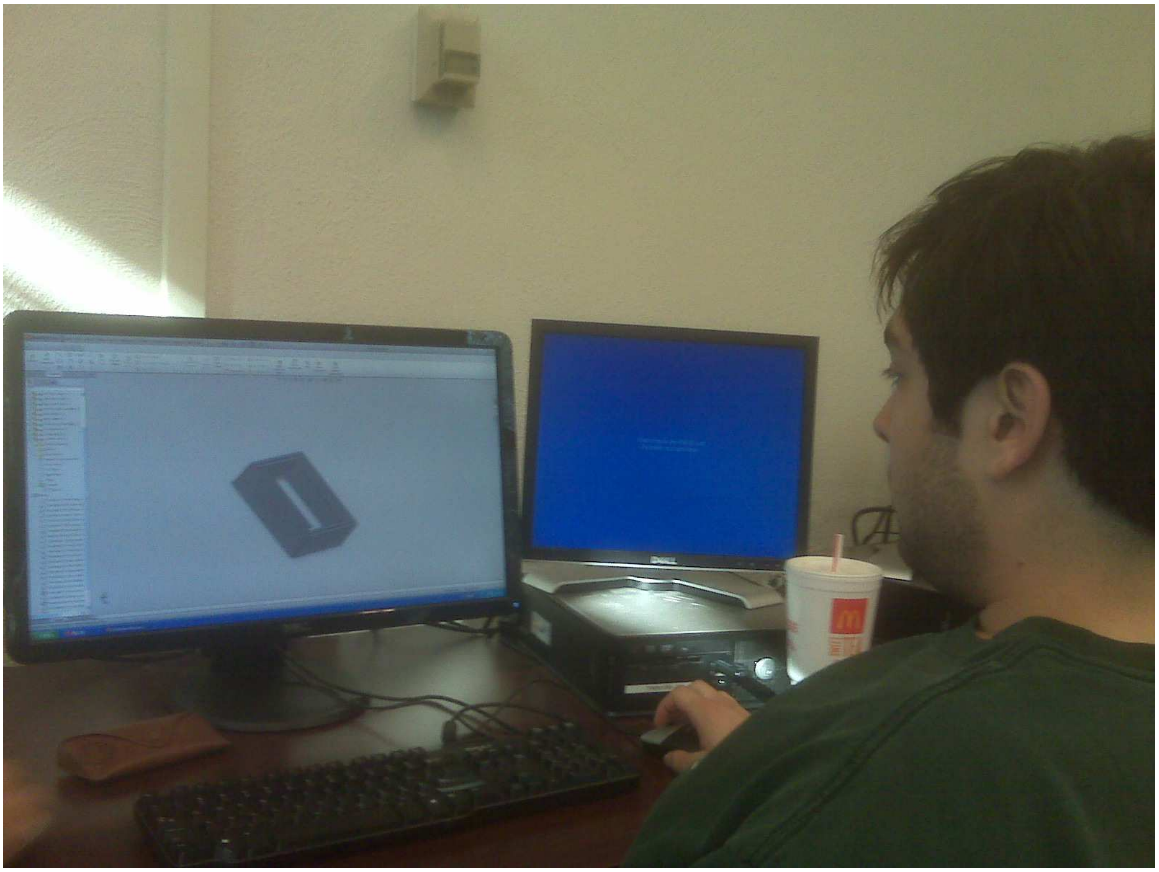
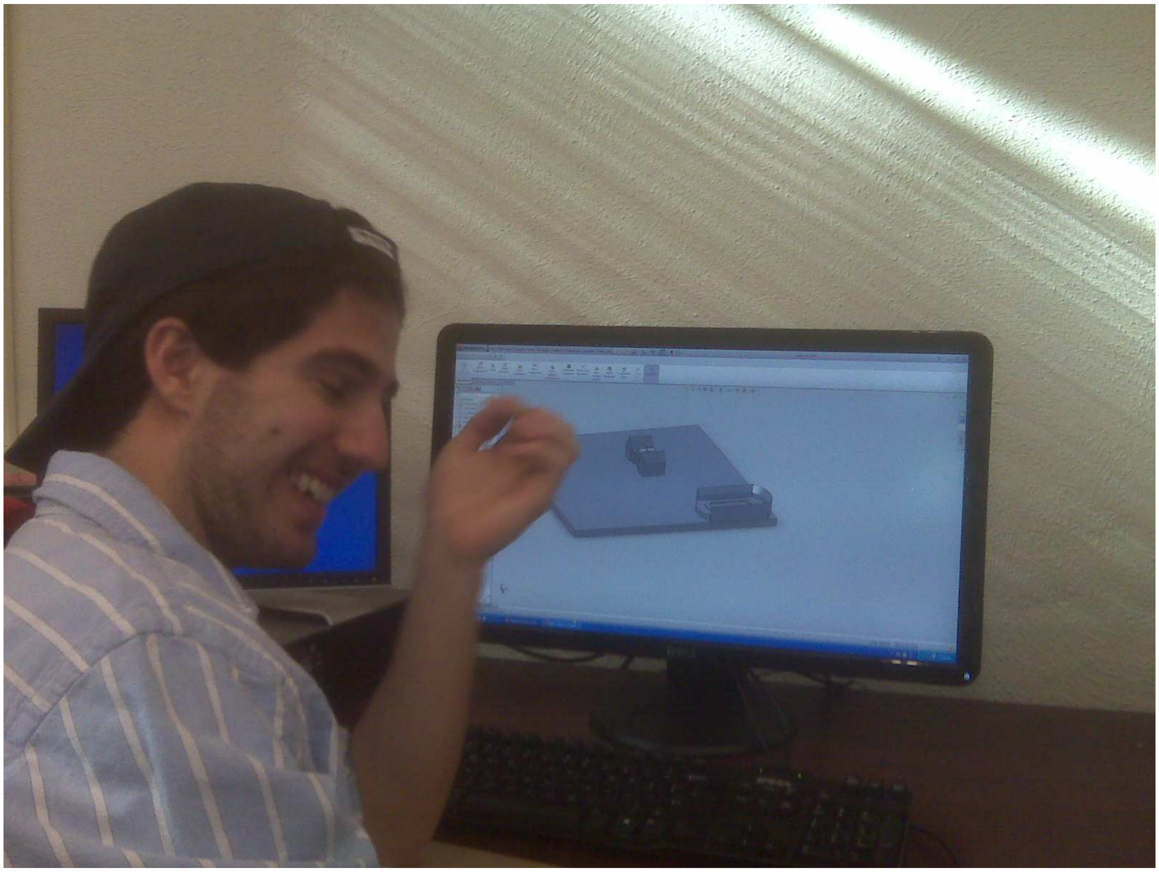
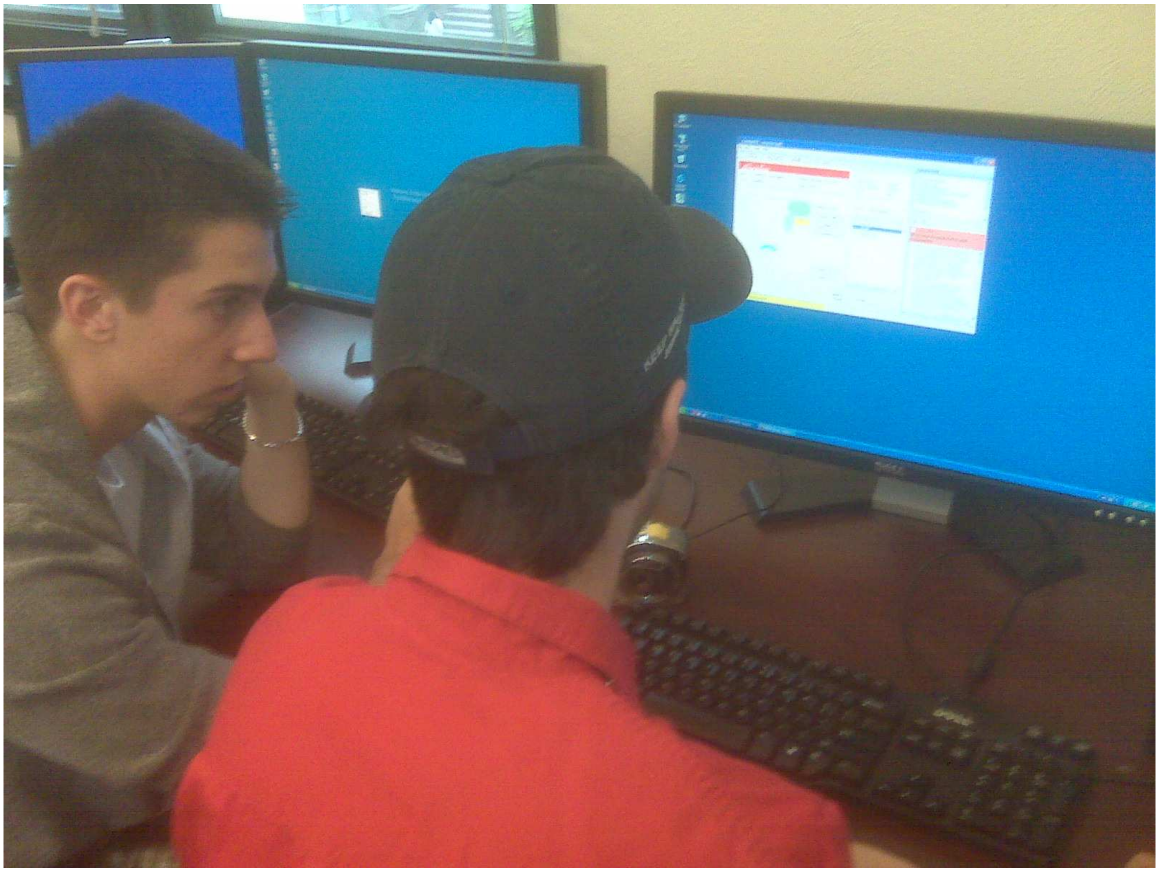
Our project goal was to build a labyrinth marble maze out of Acrylic, MDF, 3D Printed ABS Plastic, and machined Aluminum and Steel.



We started off by designing the entire game in Solidworks. We designed each separate part before creating an assembly file containing the final design. We designed the outer and inner walls to press fit together and designed the playing board to have indents in it to fit the game walls and buildings. Our plan was to model the board to look like UPenn's campus. We realized this would be very difficult considering the space we had available to fit within the dimensions, so we modeled a few of the popular buildings on campus including Houston Hall, Franklin Field, Van Pelt Library, and the Commons bridge.

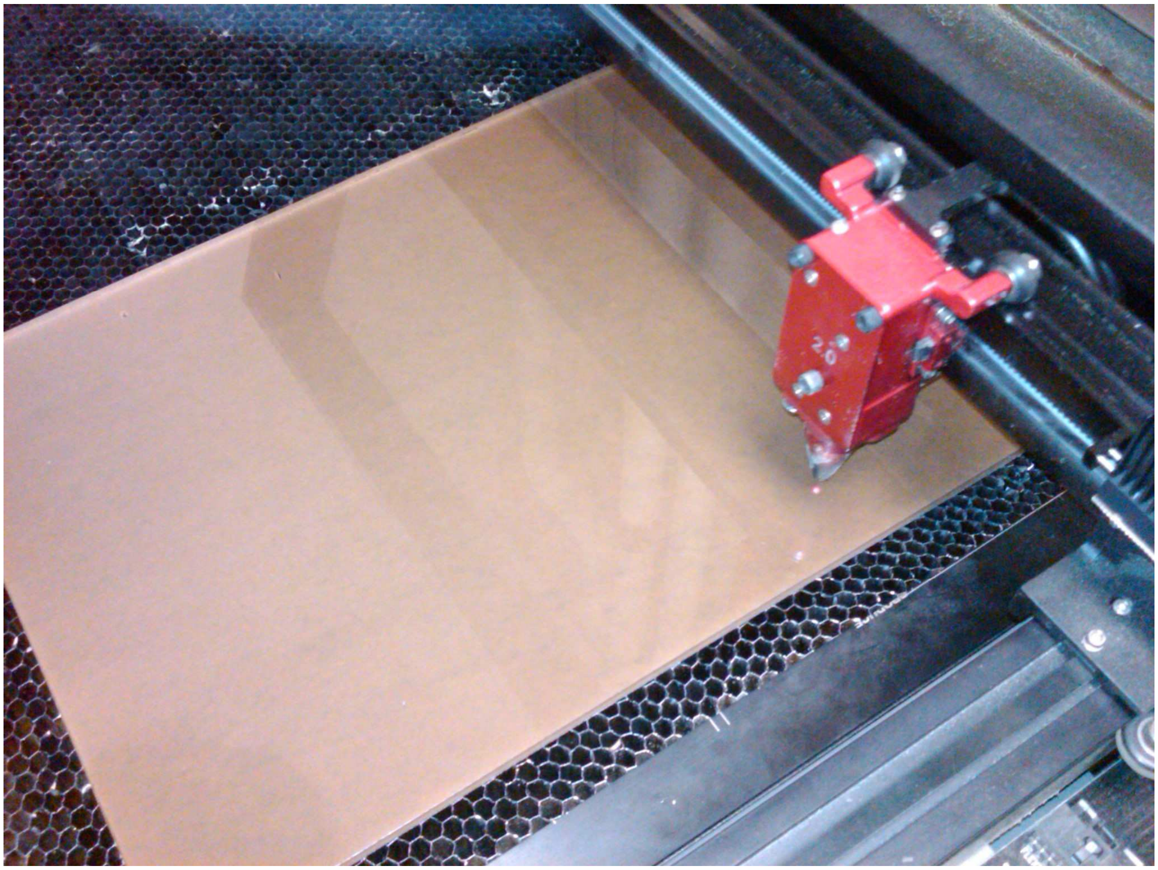


Once we finished drawing each of the individual solid works parts we put them together into one assembly. The assembly included all the parts that fit together to form our game, including all of the laser cut parts, 3D printed parts, and machined parts. The assembly was one of the most challenging parts because we had to figure out how to space everything so it would fit and make the game moderately difficult to win. We had to plan where all the holes would be that the ball must avoid, we had to decide where to place walls on the board to help the player, and how the game should start and end. We decided after much deliberation that the game should start with the ball crossing the Commons bridge and end with the ball inside Franklin Field, with holes, walls, and the other buildings as obstacle along the way.

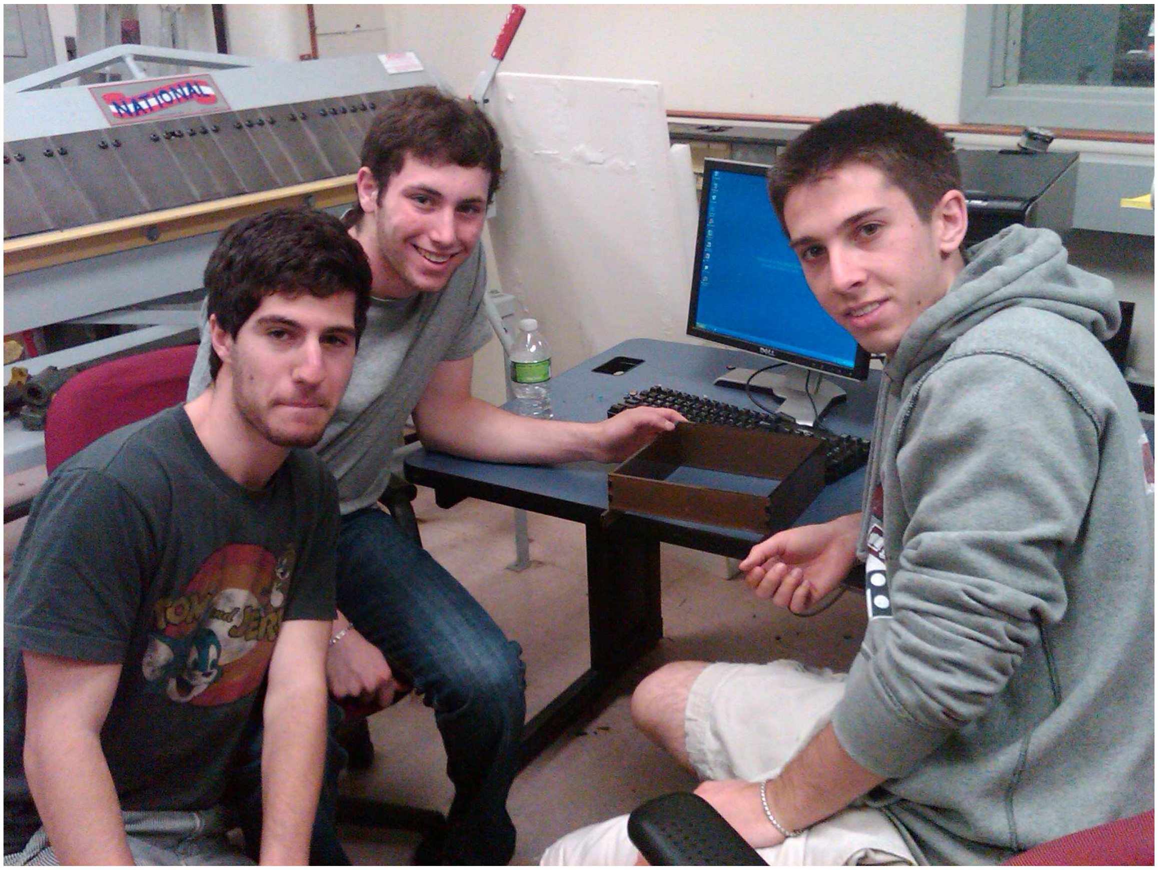


After we finished the assembly we took the parts that had to be 3D printed and converted them into cmb files through the Catalyst program. The parts that we decided should be 3D printed were the four UPenn buildings.

This is a picture of our final rendering of our game. The bridge was originally suppose to be as displayed at the starting point but we realized during the building process that if the bridge was placed there, game play would be nearly impossible so we ended up moving the bridge into the middle of the board where it because an easier obstacle to over come and the holes that were cut to hold the bridge were converted into bumps to maintain the starting point as an obstacle.

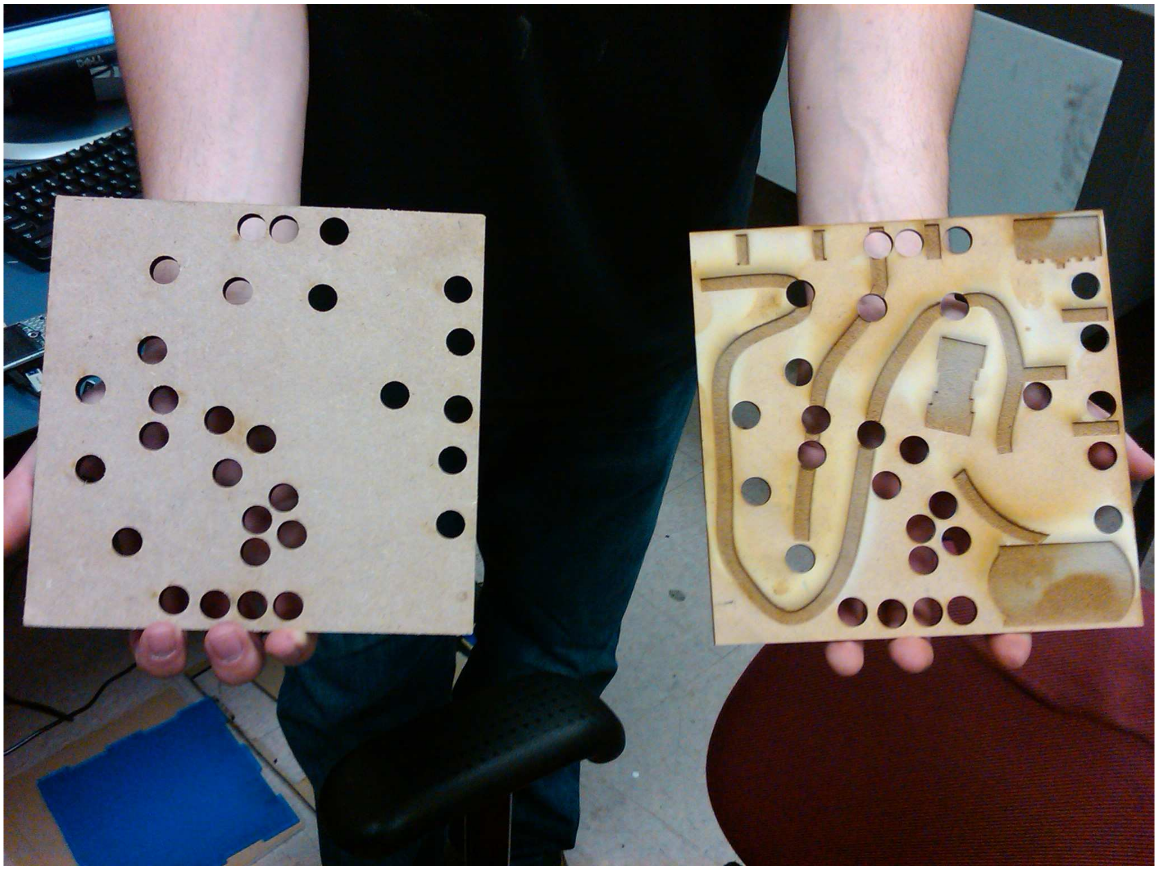


After we converted all the parts that we wanted to laser cut into dwg files, we took them down to the laser cutting lab. At the lab we uploaded our drawings into SolidWorks DWGEditor where we were able to organize our parts so they would fit on the material that we were cutting and sent those parts to the laser cutter. Once we had our parts sent to the machine, we adjusted the “z” height of the laser and made sure the drawings were lined up with the material. From there we let the machine do its work and cut our parts for us.

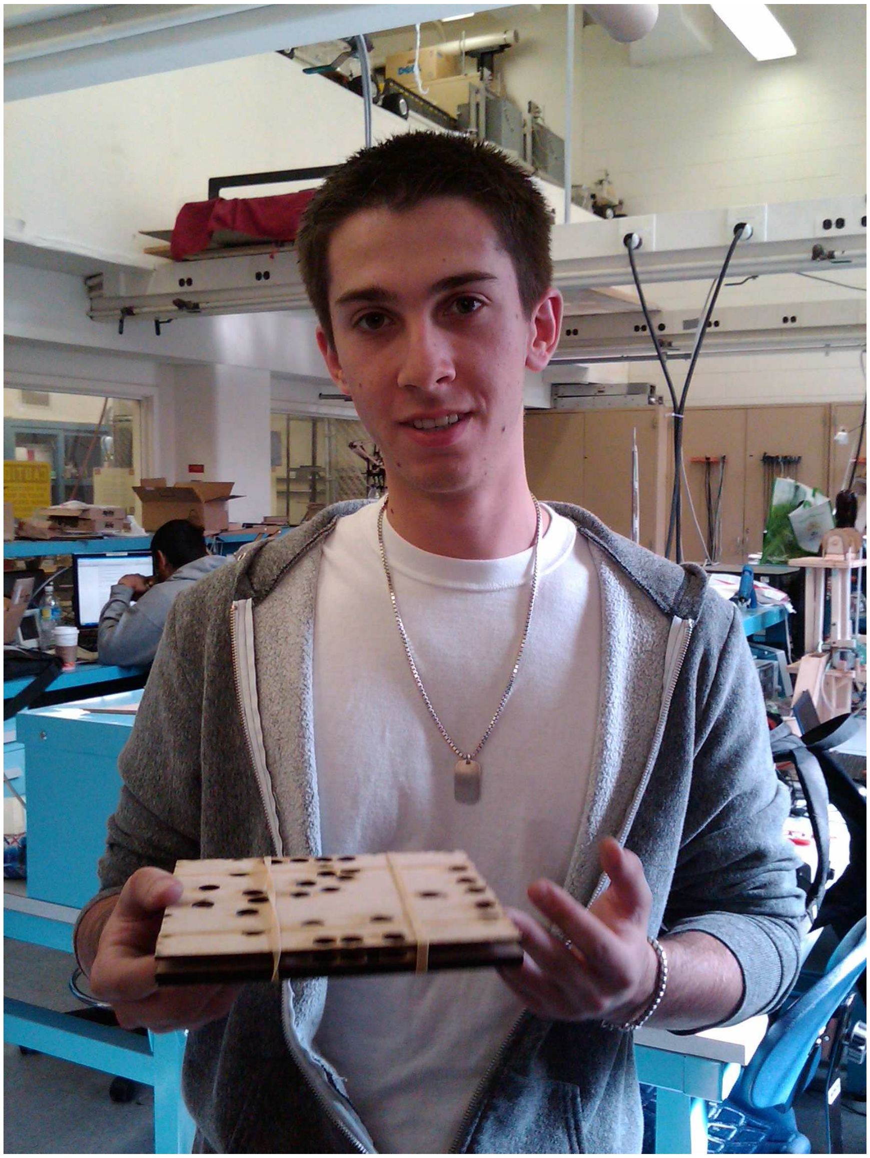


After the laser cut parts were finished being cut we assembled them together to make sure that our press fits worked perfectly. We laser cut the outer walls of the game, the two sets of inner walls that spin, and the game board with the walls that serve as obstacles/guides.

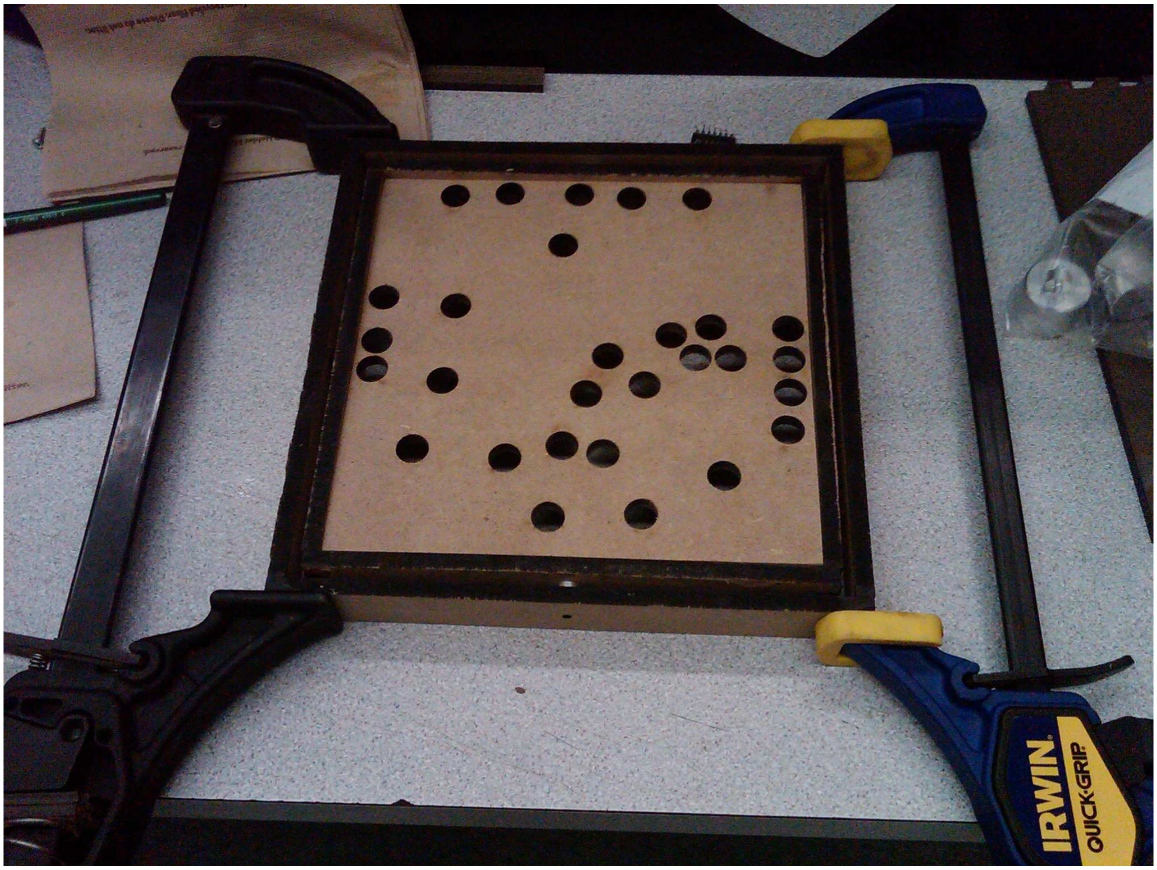
Once we had all of our parts laser cut, 3D printed, and machined by Sydney, assembling began. We met in the GM lab and added some glue to our press fits to make sure that they stayed together, drilled holes for the rods in the acrylic that we used for the outermost wall of the game board, did a lot of sanding since for some reason our 3D printed parts came out bigger that we expected, and then assembled the spring mechanism that allows the ball to move throughout the field.



This is a picture of the board before and after we used the laser cutter to perfect the game board. We rastered the slots for the walls and buildings using a high power and high speed raster on the laser cutter raster setting to ensure that the game board would not get burned, yet still give us a deep enough cut to place the pieces in.

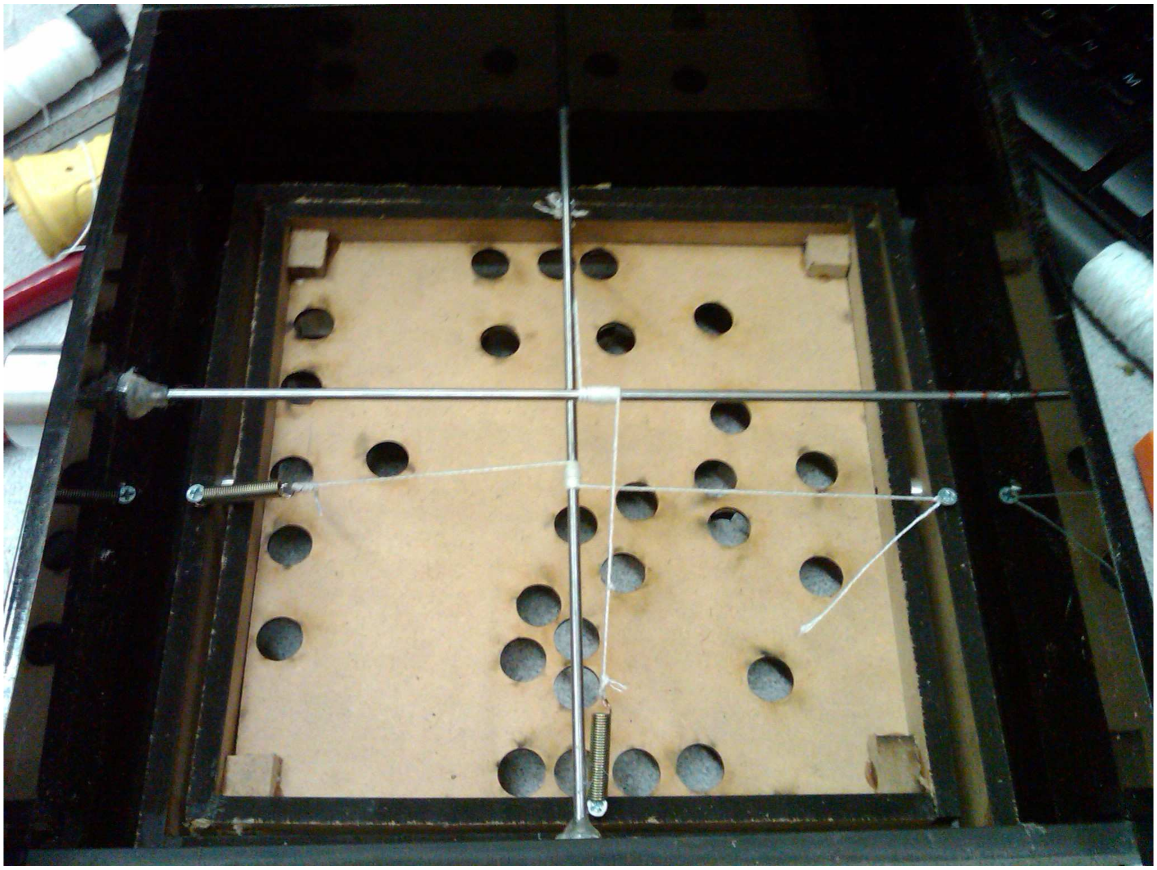


After we glued the walls onto the board in the slots we rastered, we had a brilliant idea to rubber band another board on top of it so that the walls would stay in place as the glue dried since some of the walls were very small and fragile.



This is a picture of our assembly process mid-assembly. This is a picture of the game board glued inside the innermost wall with the middle wall being assembled/glued around it. We had Sydney machine us aluminum spacers to put in between the two sets of walls to allow for rotation of the game board so that the ball could move through the playing field. We put one set of spacer between the inner walls and the middle walls and another between the middle walls and the outermost wall. This allowed for movement in four directions.

This is a picture of Sam drilling holes for the screws that we used to assemble the spring mechanism that provided the movement of our game.



This is a picture of our completed spring mechanism. We drilled screws into the bottom of the walls to attach the strings and attached a spring to the end of each string. We placed both rods into the appropriate holes that we drilled and hot glued a stopper on to each rod to prevent it from coming out of place during game play. Finally the knobs were super glued onto the end of the rods and the strings were wrapped around the rods. The spring mechanism works because the springs are tension springs so when the player turns the knob he in turn turns the string due to the friction, thus turning the board.

Final tweaks were made to the design.

The game was ready to be played. The Labyrinth was completed.

Final product with all of the parts assembled and functioning.

Victory cigar (unfortunately Todd does not smoke cigars so he took the photo).

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