Invention Studio
A Student Organization at Georgia Tech®

Prospective PI Checklist
Version 8.1 (Spring 2024)

Instructions:

Name: _____

Train
- Grab a copy of the Prospective PI Checklist or save a digital version. Make sure to write your name!
- Ask any Invention Studio Prototyping Instructor (called a PI) to train you on a category of equipment and sign off on your checklist. Taking notes is highly recommended!
- The Safety training and Introductory training **must be completed first**, but the rest can be done in any order.

Test
- Wait at least 1 day after getting trained on a section. You can still do other trainings in the meantime!
- Ask a full PI (green armband) to test you on the section. The same PI who trained you on a section cannot administer that section's test.
- Certain tests **must be completed sequentially**:
    - Wood Room Processing -> Laser -> Wood Room Finishing
    - Waterjet -> Metal Room
- For every test, **you should know the tools well enough to give a training yourself** - take time to practice! You can't use notes on your test.
- If you fail a test, don't worry – it's perfectly normal! The PI will provide retraining, and you can attempt the test again the next day. There's no limit on the maximum number of attempts.

Interview
- After completing all tests, scan/photograph your checklist and submit it to the form at the front desk. Follow the instructions posted there to schedule a Prospective PI Interview!
- If you are hired as a PI, you will receive further information about beginning the provisional period and the steps to becoming a Full PI.
- If you are not hired as a PI, you may reattempt the checklist and interview the following semester.

General Notes:
- Because this checklist changes frequently, trainings/tests will expire after 2 semesters after completed.
- PIs are expected to uphold the highest standards of professional conduct when interacting with anyone on campus, in addition to the Institute's Code of Conduct. Prospective PIs are being qualitatively evaluated during their interactions throughout their progress on the checklist.
- **DO NOT LEAVE A MESS.** You must take your parts home with you and clean up.
- For further information visit www.inventionstudio.gatech.edu/become-a-pi or email ops@inventionstudio.gatech.edu.

Disclaimer: **The completion of this checklist does not guarantee that you will be hired as an Invention Studio Prototyping Instructor.**

Name: _____ **GTID:** _____ **GT Email:** _____

Reason for Completing Checklist (circle): Become a PI | Limited SCC Access *SCC Team:* _____

Section		PI Name (Print)	Date	Notes
Safety (COMPLETE TRAINING FIRST)	Trained			
	Retrained			
	Completed			
Introductory (COMPLETE TRAINING SECOND)	Trained			
Wood Room Processing	Trained			
	Retrained			
	Completed			
Laser	Trained			
	Retrained			
	Completed			
Wood Room Assembly	Trained			
	Retrained			
	Completed			
Electronics	Trained			
	Retrained			
	Completed			
Waterjet	Trained			
	Retrained			
	Completed			
Metal Room	Trained			
	Retrained			
	Completed			
3D Printing	Trained			
	Retrained			
	Completed			
Craftland – Vinyl Cutter	Trained			
	Retrained			
	Completed			
Craftland - Sewing	Trained			
	Retrained			
	Completed			

Safety

Note: This section's training must be completed first!

1. In the Hub, Metal Room, and Wood Room, locate the following:
    a. First aid kits
    b. Fire extinguishers
    c. Emergency exits
    d. SUMS terminals
    e. Eyewash/shower (in Hub and Metal Room)
2. Describe how to handle major and minor injuries.
3. Describe how and when to use the incident reporting form. Explain who should be contacted following an emergency incident.
    a. What classifies as an "incident"?
4. Identify the four Tool Safety Categories and give examples of 2 tools from each.
5. Explain Stop Work Authority and how it applies to users and PIs.
6. Explain the steps to extinguish a laser cutter fire.
7. Explain the steps to extinguish an electrical fire.
8. Explain what to do if the fire alarm goes off.
9. Explain what to do during a tornado warning.
10. Describe how to determine what materials are acceptable to use with a certain set of tools, e.g. laser cutters or wood room tools.
11. Describe what PPE or clothing is required for different areas/tools.
12. Identify which materials in the Studio are hazardous and what precautions should be taken when handling/disposing of them.
13. What is the difference between trash cans with a bag and without?
    a. Where do you dispose of blades/pins/needles?
14. What should be done with excess project material (ex: a piece of wood that has been laser cut that is no longer needed)

Introductory

Note: Complete this training after safety. No test required. This is so you know what you're signing up for!

1. Identify each of the Invention Studio's tool groups, their locations, and how to tell which group a particular tool belongs to.
2. Walk to the paint booth. Explain:
    a. Properly closing the door.
    b. Turning on lights/ventilation.
3. What do the armband colors mean?
4. How many hours per week do PIs staff?
5. Explain the responsibilities of a PI on shift and their general order of importance.
6. Explain masters' role in the space and how they can be contacted.
7. Explain the role of the Exec Board and how they can be contacted.
8. Explain what SUMS is, how it is used, and when it should be used.
9. Locate the Montgomery Machining Mall (MMM) and explain its role and relationship to the Invention Studio.
10. Explain how to submit feedback regarding PIs or the Invention Studio.
    a. Where do you submit safety incidents?

Wood Room - Processing

1. Sign into SUMS.
2. From the checklist materials drawer retrieve a 13" long 2x4 board and a 14" x 14" plywood sheet. Note these are rough dimensions and subject to error.
3. Explain to a PI the process of milling wood to be "Four-Square".
4. Show how to turn the ventilation on (including vents for each machine).
5. Using the jointer, joint a face and an edge of the 2x4 board so that you end up with the two surfaces flat and perpendicular to each other.
6. Explain to a PI the correct direction to send wood through the planer to minimize tear-out.
7. Use the planer to plane down the opposite face of the 2x4 board to 1¼" thickness. Now you should have two faces flat and parallel to each other, and a finalized thickness.
8. Explain what causes kickback on the table saw and how to avoid it. Also explain where it is safest to stand.
9. Using the table saw, perform a rip cut so that you end up with a 3" wide board. You should now have a four-square board with the dimensions 1¼" x 3" x 13".
10. Using the miter saw, cut an 8" long piece from your board. Make sure to square both ends.
11. Using the table saw again, cut a 10" x 7" piece of plywood from your 14"x14" plywood sheet stock.
12. Use the bandsaw to cut a 5" x 3 ¼" plate from an offcut of the previous step.
13. Show how to turn the ventilation off.
14. Vacuum and clean the area you worked in and sign out of SUMS.
15. Show a PI the following parts to be signed off:
    a. 10"x 7" plywood sheet
    b. 3 ¼ " x 5" plate with holes and sanded
    c. 1 ¼ " x 3" x 8" planed and sanded board (Faces will be checked for squareness)
    d. A clean workspace.

Laser

Note: Before you start the Laser test you must complete the Wood Room Processing test.

Part 1: Inkscape Setup

Item #1: GT

1. Using Inkscape, import the file IS_laserchecklist_GT.png.
2. Trace the image and remove everything except the outline of a single GT (hint, the node tool is your friend).
3. Resize the GT so that its overall dimensions are 9" x 5.75".
4. Move the GT so the bottom left corner is at the origin.
5. Remove the fill and set a red stroke.
6. Place 0.15" diameter circles at (5",1.5") and (5",3") to be cut out.

Item #2: Guide

1. Open a new document and import the file Guide.dxf. Show the PI on duty the correct manual scale factor and remove all the SolidWorks text.
2. Select the 4 lines and combine the nodes to form a single rectangle.
3. Convert the rectangle to a path to be engraved (there should be no stroke).
4. Insert your Name, Major, Class of 20xx inside the guide. Make sure that the font is small enough to fit all the necessary text and ensure it is properly centered within the rectangle.
5. Convert all text to path to ensure proper upload to Ruby.
6. Show the PI the Inkscape files before moving on to Part 2. If approved, save the Inkscape files to the computer.

Part 2: Laser Operation

1. Demonstrate signing into SUMS and explain how the laser cutter queue works.
2. Show how to turn on and off the laser and how to focus the lens with both auto focus and the focus tool.
3. Demonstrate uploading Inkscape files to Ruby.
4. Explain how to navigate Ruby & what is done in each menu from upload to laser operation.
5. Demonstrate turning on ventilation and opening relevant machine vents.
6. Using the 10"x7" plywood sheet from the Wood Room test, cut out the GT with holes:
    a. Demonstrate selecting material settings and explain what steps should be taken to ensure the settings are correct.
    b. Explain the importance of test cuts and when they should be used.
    c. Perform a test cut on an appropriate part of your material.
    d. Position the job on your material.
    e. Show how to start a job on the laser cutter (and run the cut).
    f. Explain when it is necessary to abort a cut and how to do so.
7. Engrave both the text AND rectangular guide on the 2x4 from the Wood Room test.
    a. Show to select the correct material and edit the engrave power/speed settings.
    b. Show how to change which color is performing an engrave or cut.
    c. Position the job on your material. Ensure the GT cutout will not cover the engraving when assembled.
    d. Perform a test cut on an appropriate part of your material.
8. Show the following parts to a PI to be signed off:
    a. GT cutout
    b. Engraved 2 x 4
9. Sign out of SUMS.

Wood Room – Finishing/Assembly

Note: Before you start the Finishing/Assembly test you must complete the Laser test.

1. Sign into SUMS and turn on ventilation.
2. Use the drill press and a 3/32" drill bit to drill two holes in the 5" x 3 ¼" plate at the coordinates (1 ¾",1 ⅝") and (3 ¼",1 ⅝").
3. Use one of the mounted sanders to round the corners of the plate.
4. Use the orbital sander, working your way up from 120 grit to 320 grit, to smooth your 8" board.
5. Use the air hose to clean off dust from parts.
6. Explain the different applications of the impact driver, hand drill, and drill press.
7. Countersink the holes in the GT and base plate.
8. Use powered hand tools to attach the GT to 2x4 using #6 x1" wood screws.
9. Explain what pilot holes are & why they are used. Use them to aid in your trophy construction.
10. The top left corner of the T should be flush with the top left corner of the 2x4.
11. Use powered hand tools to attach the base plate to the 2x4.
12. There should be a 1" border around the base of the 2x4.
13. Vacuum and clean the area you worked in.
14. Show the assembled trophy to a PI to be signed off.
15. Turn off ventilation and sign out of SUMS.

Waterjet

1. Sign into SUMS and demonstrate MAXIEM startup.
2. Explain the process of diagnosing and clearing a pump fault error.
3. Open the IS_waterjetchecklist.dxf on the waterjet computer and identify which units the software is operating in.
4. Prepare the file for cutting. Use tabs for both parts. Make sure the parts are positioned to minimize waste area.
5. Export to OMAX Make and set proper material settings. Explain what type of materials can be cut on the waterjet and explain why that is the case.
6. Explain the process of diagnosing and clearing a movement fault error.
7. Demonstrate usage of ballast tanks and explain how to rectify the situation when water level cannot be lowered sufficiently.
8. Secure the material in the waterjet using an appropriate method for the sheet you are cutting. **Note: The material you are cutting is thin, so be careful on how you clamp so it doesn't bow or shift during cutting. If this happens, your cut was not successful.**
9. Demonstrate how to home the machine.
10. Explain why it is important to set the z-axis zero correctly.
11. Set path start and zero the x-axis, y-axis, and z-axis appropriately, keeping in mind the following:
    a. The z-axis zero point should be the highest spot on the cut area.
    b. Make sure that your cut doesn't go off the edge or collide with any weights or clamps.
    c. Reduce the amount of material wasted by locating your piece near previous cuts.
12. Demonstrate how to go to a point along the cutting path.
13. Explain why it is important to home the machine before cutting.
14. Cut out the part. Remove it and any remaining material from the waterjet.
15. Close OMAX Make and Layout, making sure not to save any changes made to the file.
16. Turn off the machine and explain why it is important to do so.
17. Keep both parts. They will be used to complete the metal room checklist.
18. Show the finished parts to a PI to be signed off.

Metal Room

Note: Before you start the Metal Room test you must complete the Waterjet test.

Part 1: Preparation

1. Sign into SUMS.

GT Logo Piece

2. Use tabletop shears to remove all tabs from the Waterjet part.
3. Demonstrate changing bits and replacing sanding drums on a rotary tool (Dremel).
4. With a sanding bit installed, sand down the tab on the inside of the waterjet part.

Aluminum Standoff

5. Using the big vertical bandsaw, cut a 1" long piece from the 1-1/2" x 3/8" aluminum stock.

Triangle Base

6. Using an angle grinder*,
    a. Explain safety considerations and proper cutting technique.

    **If the user has severe anxiety when using an angle grinder, an alternative tool may be used*
7. Cut a 3.5"x3.5" right triangle from the steel (NOT ALUMINUM) stock. Explain why cutting aluminum with an angle grinder is not recommended.
    a. Identify three alternative tools to the angle grinder to cut out the steel piece.
8. Explain why it's important to deburr, then deburr the edges of the plate on the belt sander.
    a. Identify three alternative tools to the belt sander to deburr.

Part 2: Making Holes

9. Transfer the holes from the waterjet part onto the steel plate and punch them on the anvil.
10. Explain when it's appropriate to use a hand drill vs the drill press.
11. Using the hand drill, drill two holes of a diameter between 0.145" to 0.150" on the marked spots in the steel plate.
    a. Switch the bit to a countersink and deburr the holes.
12. Transfer the holes from the steel plate onto the aluminum part and punch them on the anvil.
13. Using the drill press, drill two holes of the same size in the aluminum standoff.
    a. Switch the bit to a countersink and chamfer both holes.

Part 3: Assembly

14. Using two flathead 1" #6-32 screws and nuts, assemble the trophy using an appropriate handheld tool with a hex bit.
15. Demonstrate to a PI returning all the tools used and sign out of SUMS.

Electronics

Part 1: Breadboard Circuit

1. Find and set aside an LED, 330-ohm resistor, 2 different color spools of wire, a few jumper cables, a spool of solder, a breadboard, and a protoboard.
2. Explain the differences between solid and stranded wire and when to use them.
3. Set up the circuit on the breadboard; use two male-to-male jumper cables, one for the positive side and the other for the negative side, to serve as attachment points to test the circuit.
4. Configure the power supply to 3 volts and connect it to your circuit so the LED turns on.

Part 2: Protoboard Circuit

5. Cut a two-inch length of wire from each spool to use as power connection leads to the protoboard circuit. Strip both wires at both ends.
6. Transfer the components to the protoboard (replacing the jumper cables with the prepared wires), lining them up in the manner you want to solder them in place. Pay attention to the polarity of the LED!
7. Explain why the soldering iron tip oxidizes, how to tin the tip, and when to do so.
8. Explain the difference between leaded and unleaded solder.
9. Put on safety glasses and explain their purpose while soldering.
10. Turn on one of the three ventilation systems and explain the purpose of ventilation.
11. Turn on the soldering iron and set the iron to the correct temperature for the solder in use.
12. Solder the components to the board, tinning the iron when needed. If the iron's tip is clean but the solder isn't flowing well, apply flux to the board to improve solder flow.
13. Explain the bridging technique and use it to complete the circuit.
14. Tin the iron and turn it off.
15. Using the same power supply configuration as before, power your board.
16. Explain the use cases of both methods of desoldering (solder sucker and wick).
17. Turn the soldering iron back on and desolder all parts from your board using your preferred method; clear any solder-filled holes with the solder sucker.
18. Tin the iron, turn it off, return the breadboard and protoboard, and return any cords and jumper cables; the LED, resistor, and power wires can be discarded.
19. Explain a few of the most common ways users damage soldering iron tips.
20. Explain why one should always wash their hands after soldering, then wash your hands!

3D Printing

General Information

1. Locate each type of 3D printer (Bambu Lab X1E, Ultimaker S3/ S5, Form 3/3L, Markforged Mark Two, Fuse 1+) and briefly describe the use cases of each.
2. Explain the differences between FDM, SLA, and SLS printing.
3. Explain what parts cannot be printed at the Invention Studio. When should you reject someone's print? What should be done if someone refuses to let their print be rejected?

Hardware

4. Describe the differences between the Bambu X1-series and Ultimaker S-series.
5. Identify the AMS, briefly explain how it works, and describe the materials that cannot be used with it.
6. Demonstrate changing filament in the AMS.
7. Explain the auto-refill system on the AMS, and what it means for partially used spools.
8. Show where partially used spools are stored. When can you remove spools from the AMS?
9. Identify the build plate(s) used with Bambu Lab printers. Explain which ones glue is used with, why it is used, and how to clean excess glue from the plate.
10. Explain how and when to mark a printer down.

Slicer

11. Launch Bambu Studio. Explain what file type(s) are used as inputs and outputs.
12. Show where to set build plate type and choose the correct one.
13. Demonstrate setting the correct filament type and AMS slot.
14. Identify which system preset is used for most prints.
15. Open Puzzle.stl and Skull.stl on the same build plate. Explain which parts require supports, how to switch between tree and normal supports, and how to manually add supports.
16. Remove all files from the build area. Open IS_kiwi.stl and scale the model to 17%.
17. Identify the following settings, their purpose, and their recommended ranges:
    a. Layer Height
    b. Wall Thickness
    c. Infill Density
18. Explain what a brim is and what types of parts it should be used for.
19. Select the invention studio profile. Set wall thickness to 0.8mm and infill density to 10% gyroid. Enable normal supports with a 7mm brim.
20. Slice the plate and export the resulting gcode.

3DPrinterOS

21. Log into 3DPrinterOS using your GT account. Upload your file and add it to the print queue.
22. Using the PI's account, demonstrate starting a print.
23. Demonstrate how to abort a print and explain why you should not abort a print on the printer itself.
24. Explain when to use the in-person queue and how to start a print from it.
25. Show how to quickly look at a preview of a part and that part's history.

Post-Processing

26. Safely remove your print and its brim and supports. Explain what to do with finished and failed prints.
27. Explain the completed print bucket policy.
28. Show the printed kiwi to a PI to be signed off.

Craftland – Vinyl Cutter

1. Locate both the vinyl scrap drawer and the vinyl sheet stock drawer. From the scrap drawer, or the sheet stock if no scraps are available, retrieve two colors of vinyl.
2. Take out the cutting mat and tools.
3. Open Leonardo Design Studio and go to the design tab. Open or import the checklist image.
4. Within the import options screen, describe the difference between importing using print and cut or with background image selected. Select the appropriate option.
5. In the following screen, describe what mask tolerance does as well as what the advanced masking tools do including color tolerance. Utilize these tools to remove the white background from the image.
6. Go to the Traced Contours screen. In here, describe how you know what the machine is going to cut. Also describe the functions of smoothing, minimum contour area, and include holes settings. Change these settings to ensure all parts of the checklist image are included and of adequate detail.
7. Go to the cutting contours screen. Describe what offsets and insets are, how to make them, and why you would use them. Set these settings appropriately and click finished.
8. Resize the image to 4" wide. If you would like to place your sticker on a single circular background, instead resize the image to 3.5" width and create a circle of 4" diameter.
9. Disable the print and cut option to remove the registration marks and describe why we are doing this.
10. Ungroup the paths and separate the interior features of the bird as well as the ISGT text from the outline of the bird and the gear. Describe the different applications of ungroup paths vs break paths.
11. Regroup your different path subgroups based on what needs to be cut together out of the same color of vinyl, and position them in software appropriately.
12. Cut out sheets of vinyl to match your software specification and stick these onto the mat. if the mat is not sticky enough, you may use a small amount of glue.
13. Show how to set fill and stroke for specific cut lines. Change the stroke color of one of your subgroups. This step is not necessary to make this design work, but is important to learning how the machine works.
14. Click send design. Describe what the options in the send menu do, and make sure to use the appropriate ones for how we set up our vinyl.

15. Locate the use cutters settings button, ensure it is selected, and describe its function.
16. Turn on the machine or point out the on button if it is already on.
17. Demonstrate how you change cut settings by loading presets and making temporary modifications.
18. Run a test cut. If the test cut fails, modify your settings and run test cuts until your settings are good.
19. Send your design to cut out the sticker components.
20. Remove your vinyl pieces from the mat and weed them.
21. Use transfer tape to assemble your sticker.
22. Describe in what situations you would trim the transfer tape as opposed to peeling it up immediately. Do whichever you want and show your PI your completed sticker.

Craftland - Sewing

1. Locate a fat quarter of solid-colored fabric, a fat quarter of patterned fabric, and the box of Poly-fill.
2. Iron the fat quarters to remove any wrinkles in the fabric.
3. Using tailor's chalk and a ruler, mark off a 6"x6" (15.25 cm x15.25 cm) square of each of your two fabrics.
4. Identify fabric scissors from general purpose scissors. Use the pinking shears to cut the two 6" x 6" (15.25 cm x 15.25 cm) squares out.
5. Pin the squares together with the "right sides" of the fabric facing each other.
6. Mark a ¼" (.6 cm) seam allowance around the edges of the fabric.
7. Explain the purpose of the different threads and which to use for sewing.
8. Demonstrate the proper way to wind a bobbin to a PI. (If there are no empty bobbins available, explain the process.)
9. Demonstrate the proper way to thread the sewing machine to a PI.
10. Check sewing settings (tension, length, width, etc.)
11. Use a straight stitch to hem the pillow along the seam allowance, leaving about a 2" gap at the end. (Remember to start and stop with a reverse/locking stitch. You must pivot at the corners. Once finished, turn the dial until the thread take-up lever is fully raised before removing fabric.)
12. Trim the corners using fabric scissors.
13. Flip the pillow inside out through the gap.
14. Stuff the pillow with Poly-fill.
15. Use a ladder stitch to close the 2" gap.
16. Show your pillow to a PI to be signed off.