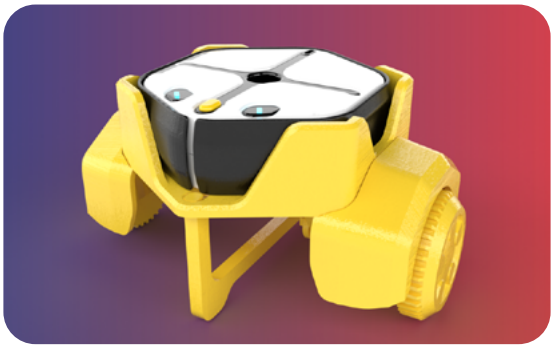
Chariot Accessory

iRobot Education

Accelerate the Root Coding Robot with the Chariot accessory!



Purpose and Application

At full speed, the Root Robot moves at 10 cm/sec. This is great for careful, accurate marker drawings. But faster might be nice for racing two robots or playing capture the flag! The chariot is designed to increase Root's speed by 5-6x.

Disclaimer

Note that Root's cliff sensor, bumpers, color sensor, whiteboard magnets, marker holder and eraser won't work in the chariot. Root won't be able to drive on vertical whiteboards, draw, see colors, detect that it's going to hit something, **or avoid driving off a table at high speed.** To avoid damaging your robot it's suggested to only use the chariot on the floor.

Keeping the chariot moving sometimes requires more torque than Root's drive motors can provide, especially on rough surfaces like carpet. In this case, Root will beep, blink red and stop. The controller device will show an "under speed stall" error. You may re-start the program, but if it keeps happening you can try driving on a smoother surface.

iRobot Corporation does not offer support for homemade or third party accessories with the Root Robot. **Damage caused while using such accessories with your robot will not be covered under warranty.**

Subject(s):

- 3D Modeling
- Mechanical Engineering

Experience Level:

Advanced

Print Time:

24 hours

Supplies:

- 3D printer with a 175 x 150mm build area (7" x 6") or larger
- 2 or 3 spools of different color filament
- Thin double-sided tape
- Two thick steel washers, approx. 25mm diameter (1 inch) and about 1.5–2mm thick (1/16"–3/32")
- Craft glue or superglue
- iRobot Coding platform

Getting Started

The Root Chariot can be 3D printed with an affordable FDM/FFF extrusion 3D printer, but it does take awhile. There are 30 parts and printing all of them will take about 24 hours, and will consume about 360 grams (13 ounces) of filament (not including any failed prints that need to be restarted!)

Printing the largest part, the "tub" that holds Root, requires a 3D printer with a minimum build area of about 7" x 6" (175mm x 150mm).

The axles have square cross-sections instead of round, to make them easy to print lying down instead of standing on end. The parts are mostly sized to press-fit together, but glue can be added where necessary.

Note that, because it has three step-up gears on each wheel, the chariot's wheels will turn the opposite direction of Root's wheels. Programs written for the chariot will need to take this into account, and instruct Root to move in reverse direction. Recommended settings for PLA material:

- 0.4mm to 0.6mm extruder
- 0.25mm layer height
- 10% infill
- 2 shells (two-layer-thick outer walls)
- 3 top & bottom layers (three-layer-thick floors & ceilings)
- 215 °C extruder temperature
- 60 °C platform temperature
- 50mm/sec printing speed, 25 mm/sec outer shell
- Rafts extending 4mm around the part (for parts that require a raft)

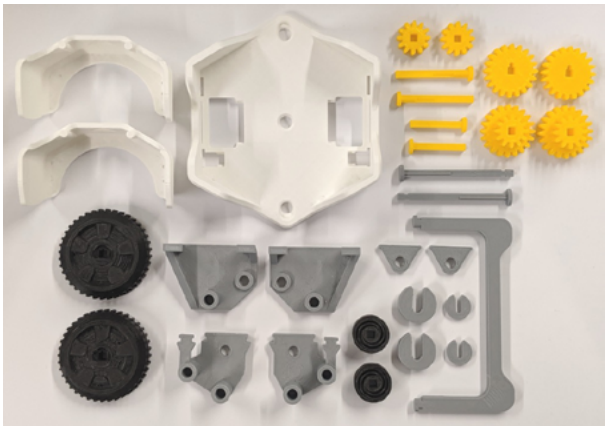
You can choose the colors of each part. Our example used yellow, white, gray and black. Printing the parts in order by color will minimize time spent switching between filaments.

When you import a part into your slicing program of choice, re-orient it so that its widest, flattest surface sits on the platform. Refer to the table below to see whether you'll need to add a raft and/or build supports to build each part successfully.

Individual Part Details

Part Name	How Many?	Print Time Each (min.)	Material Used (grams)	Raft Needed?	Supports Needed?
Outer bracket-L	1	77	16.4	Yes	Yes
Outer bracket-R	1	77	16.4	Yes	Yes
Middle bracket	2	11	2.3	Yes	
Inner bracket-L	1	63	13.8	Yes	Yes
Inner bracket-R	1	63	13.8	Yes	Yes
Primary axle	2	14	2.4	Yes	
Secondary axle	2	10	1.7	Yes	
Tertiary axle	2	17	3.4	Yes	
Tertiary axle circlip	2	7	1.5	Yes	
Primary 20 gear	2	27	5.3		
Secondary 12+20 gear	2	44	8.1		
Tertiary 12 gear	2	17	2.6		
Spiral wheel	2	45	7.1	Yes	
Big wheel	2	113	25.1	Yes	
Tub	1	464	109.4	Yes	Yes
Fender-L	1	125	24.5	Yes	
Fender-R	1	125	24.5	Yes	
Slider Support	1	69	16.6	Yes	
Slider support circlip	2			Yes	
Total Print Time (hours):		24			

Note that the largest part, the “Tub,” may come unstuck from the build platform due to plastic shrinkage, even when printed with a raft. If possible, the tub should be moved up so there’s some room between it and the platform, with intermittent walls of support material holding it up off the platform. This should let the bottom surface shrink slightly during the build, without coming unstuck.

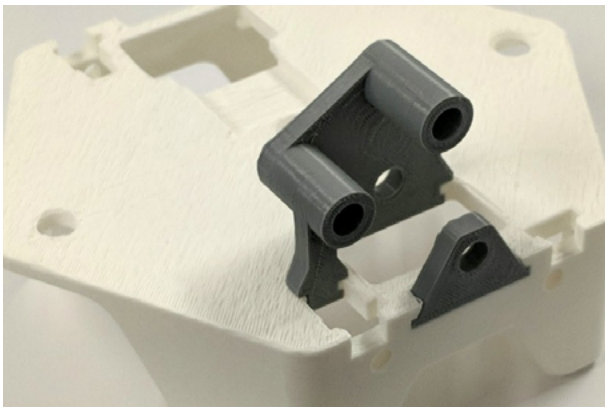


After printing all 30 of the parts listed above, then removing rafts and carefully cutting away any leftover support material from each part, you’ll be ready to start assembly!

Assembly

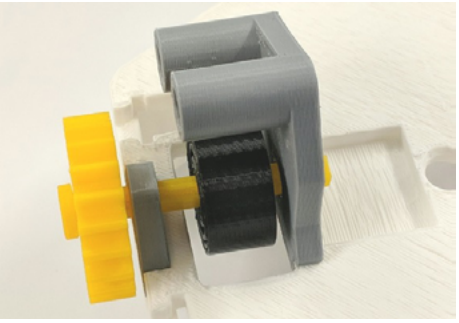
1) Wrap the two Spiral Wheels with double-sided tape. The tape will prevent Root’s drive wheels from slipping on the spiral wheels. A few times around should be enough to cover the whole surface of each wheel out to the edges.

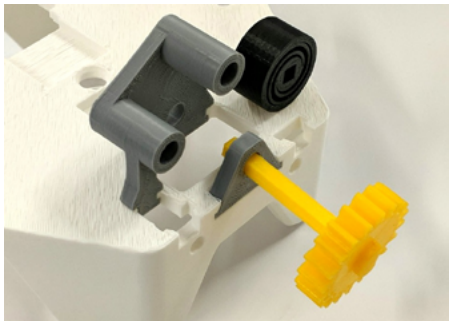
2) Let’s put together the left geartrain first. Assemble the Left Inner Bracket and Middle Bracket onto the Tub. Make sure they’re securely, fully seated. If they’re not a snug fit, remove them and add some glue.



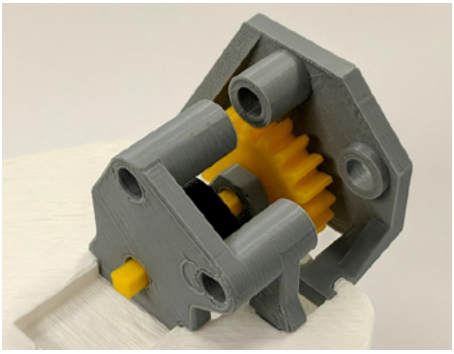
3) Slide the Primary (big single) Gear onto the Primary Axle.

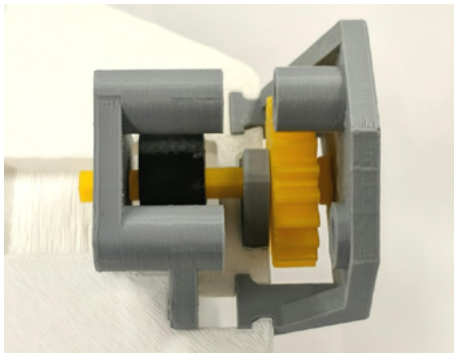
4) While holding the Spiral Wheel in place, slide the Primary Axle through the Middle Bracket, through the Spiral Wheel, and into the hole in the Left Inner Bracket.



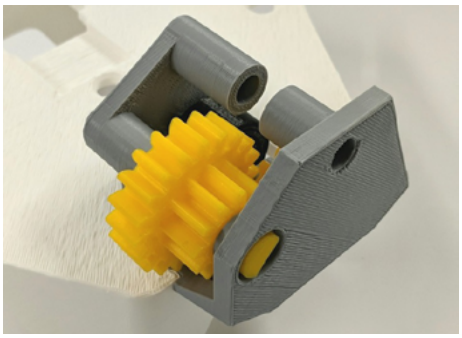


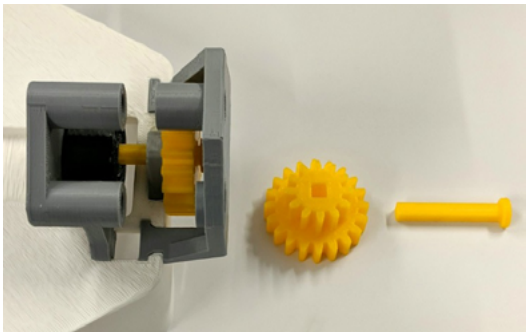
5) Assemble the Left Outer Bracket onto the Tub. Add glue if needed.



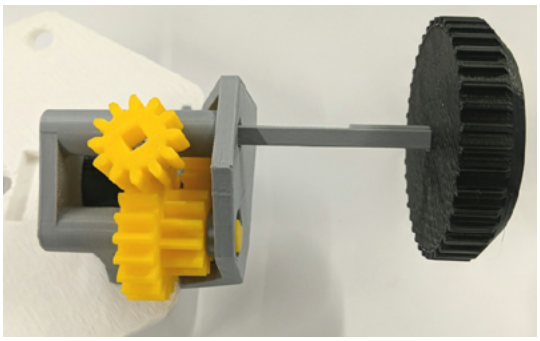


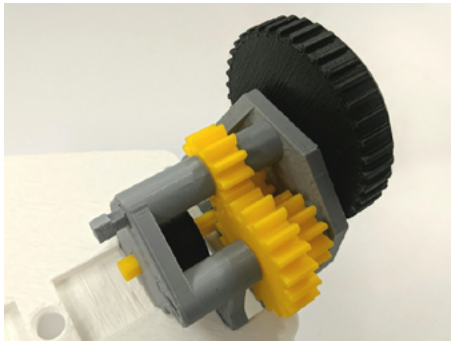
6) Hold the Secondary (double) Gear in place with the small end facing out. Slide the Secondary Axle into the Outer Bracket, through the Secondary Gear and into the tube on the Inner bracket.



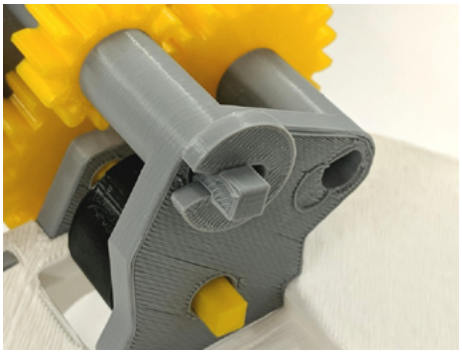


7) Slide the Tertiary Axle through the Big Wheel, so the “D” cap on the end of the axle fits in the wheel. Holding the Tertiary (small) Gear in place between the brackets, slide the Tertiary Axle with the Big Wheel through the axles and the gear.

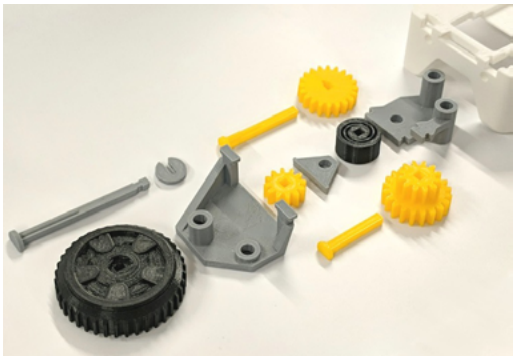




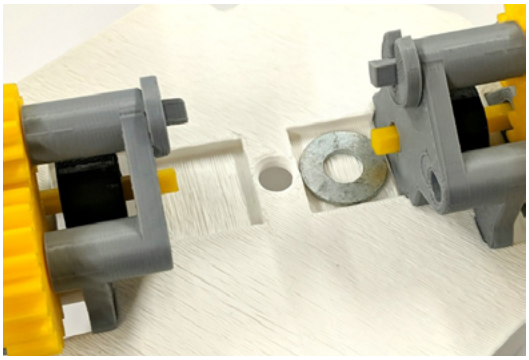
8) Snap the Tertiary Axle Circlip on the end of the axle.



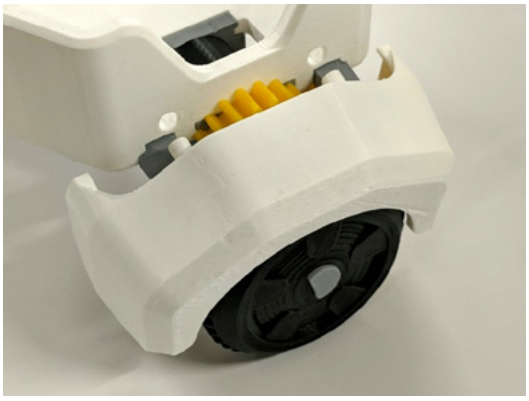
9) Now assemble the right side's geartrain following the same steps above, but mirrored.



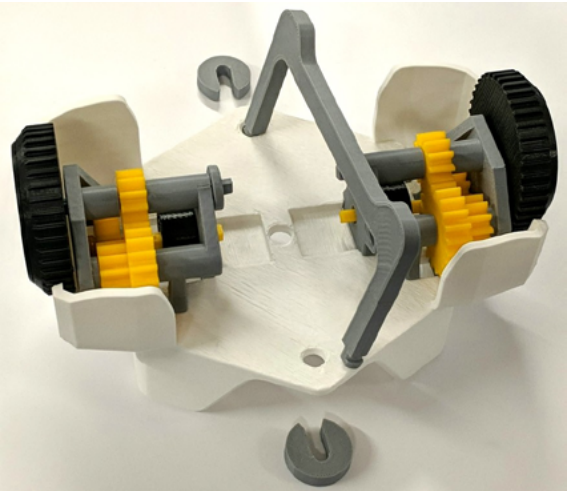
10) Glue steel washers into each of the square cutouts on the bottom of the Tub.



11) After checking that each geartrain spins smoothly and freely, assemble the Fenders onto each side of the Tub. Add glue if needed.



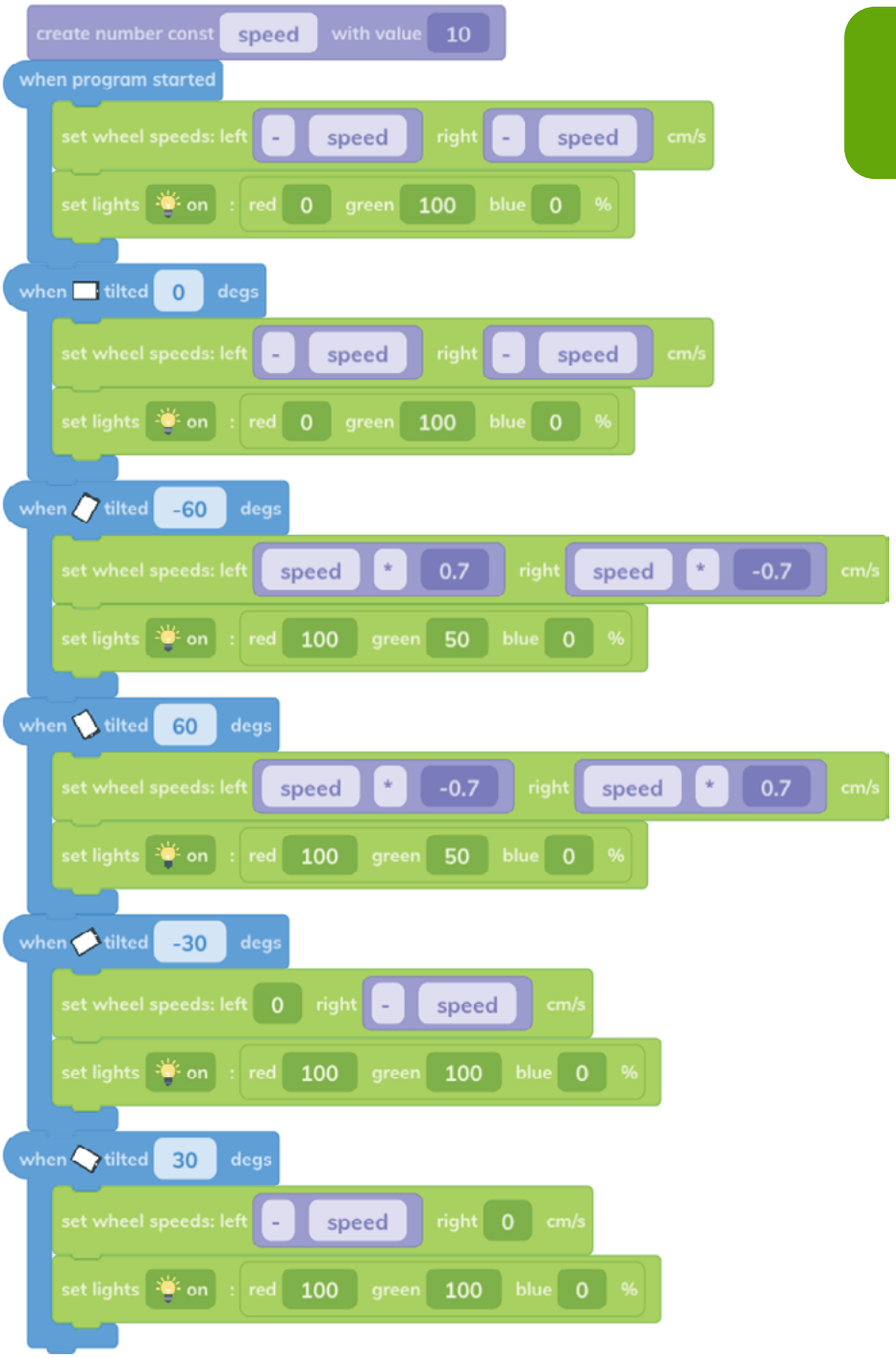
12) Hook one end of the U-shaped Slider Support into the Tub. Squeezing it slightly, push the other end of the support into the other end of the Tub.



13) Snap a Slider Support Circlip at each end of the support. While holding the support from the other side, push the support into the circlip to adjust how far the support extends from the bottom. If the support is too long, it'll hold the wheels off the table or the floor. If it's too short the chariot will rock back and forth while driving.

14) Flip the chariot over and put Root in it. **You're ready to drive!**

Here's a modified "Tilt Drive" program, which drives Root's wheels in the opposite direction as the normal Tilt Drive, so the chariot moves forward instead of backwards. If the "speed" setting of 10 (full speed) is too fast, you can change the value to be less than 10:



This program is compatible with the iOS app.