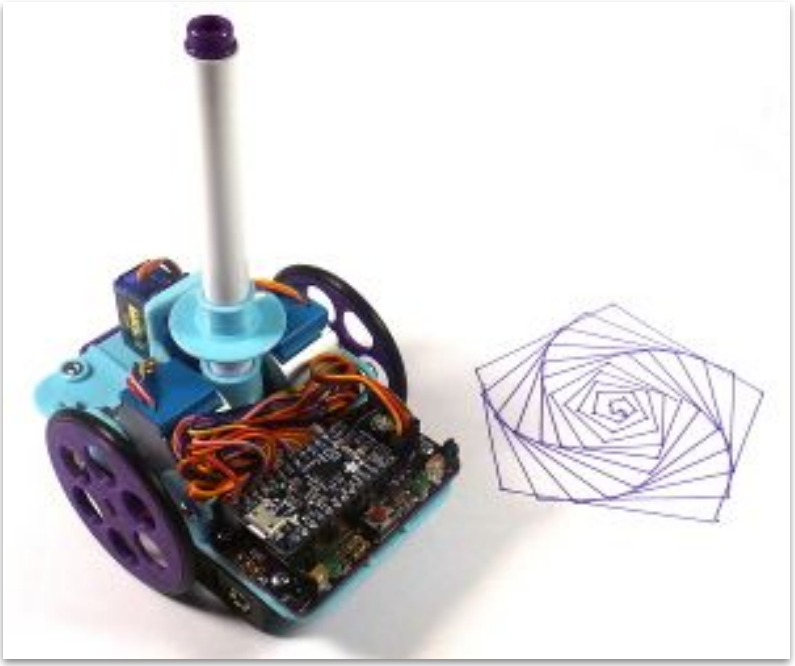
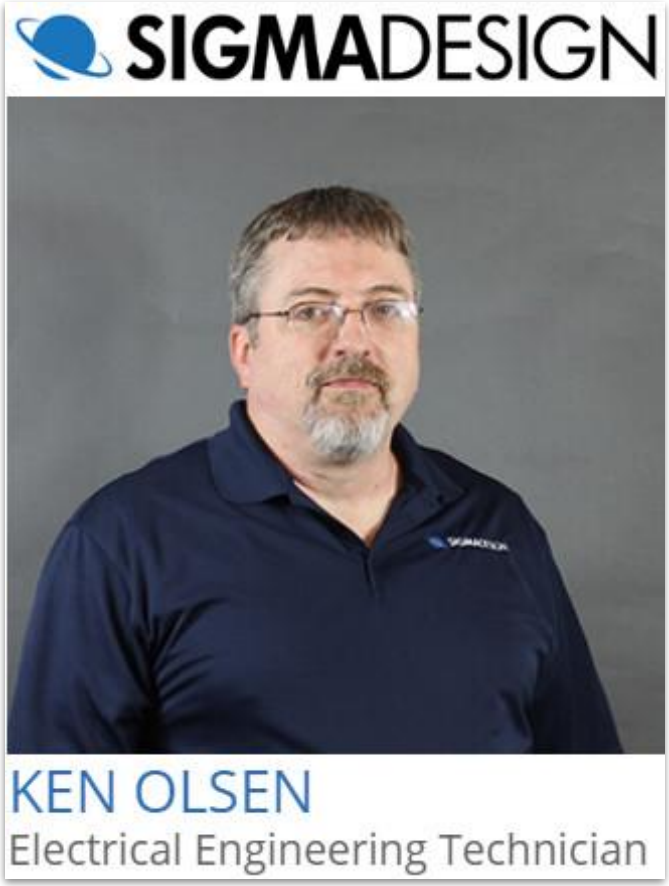
Turtle Robots:
Gateway to Engineering



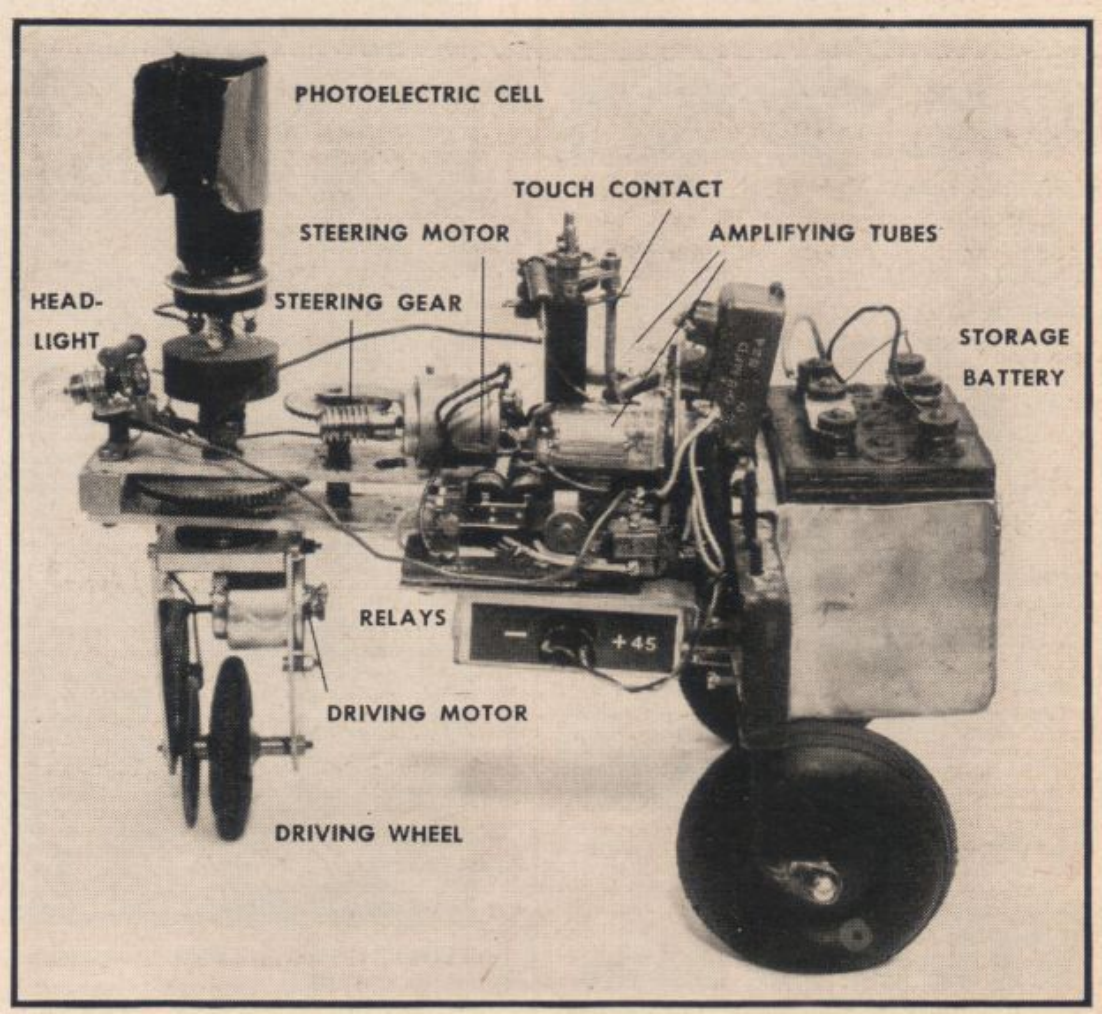


Who Am I?

By day: Mild Mannered Technican

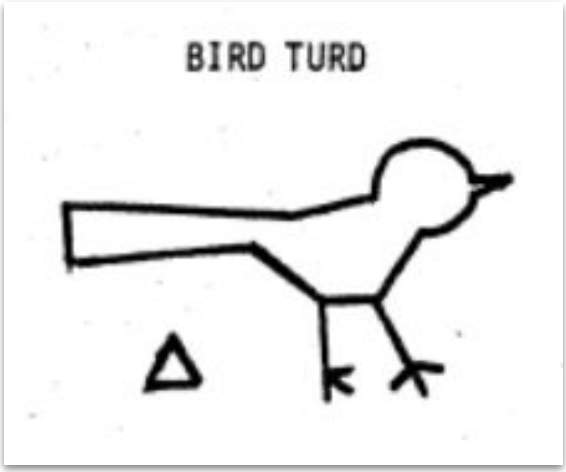
By night and weekends: Mild Mannered Maker

What is a Turtle Robot?



Grey Walter Tortise circa 1948

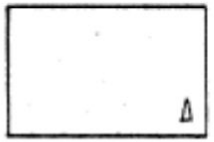
MIT Turtle circa 1970



5th Graders Contribution to MIT's Research

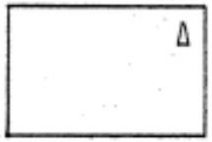
TURTLE LANGUAGE

At any time the turtle is at a particular place and facing in a particular direction. The place and direction together are the turtle's geometric state. The picture shows the turtle in a field, used here only to give the reader a frame of reference:

(1) 

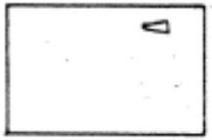
The triangular picture shows the direction.

FORWARD 50

(2) 

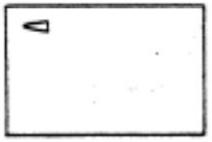
The turtle advanced 50 units in the direction it was facing.

LEFT 90

(3) 

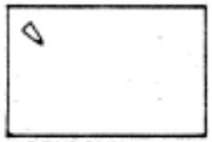
The turtle's position remained fixed. It rotated 90° to the left. So its direction changed.

FORWARD 150

(4) 

The turtle advanced 150 units in its new direction.

LEFT 135

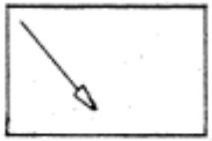
(5) 

The turtle rotated left 135°.

PENDOWN

(Produces no visible effect. But the next FORWARD instruction will leave a trace.)

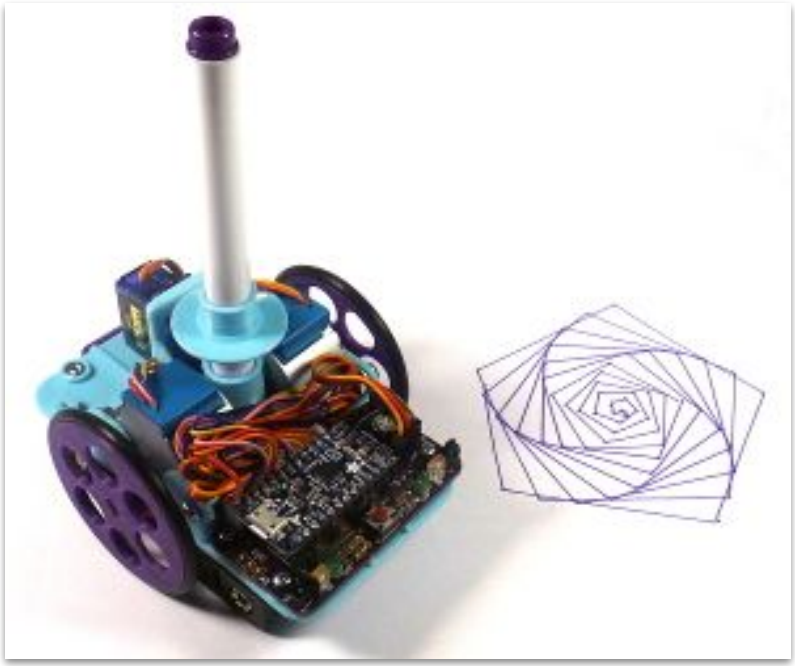
FORWARD 70

(6) 

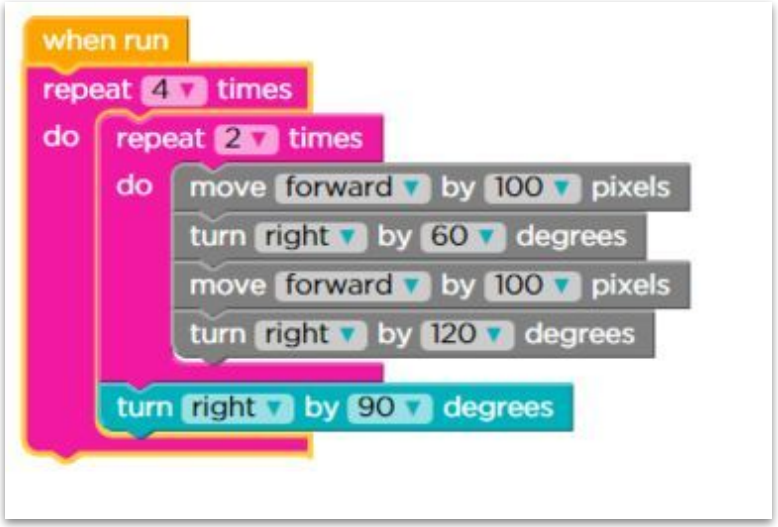
The effect of PENDOWN is to put the turtle in a state to leave a trace: the pen draws on the ground.

Turtle Commands and Program Circa 1971

```
TO VEE :SIZE
1  LEFT 50
2  DRAW :SIZE
3  RIGHT 100
4  DRAW :SIZE
5  LEFT 50
END
```



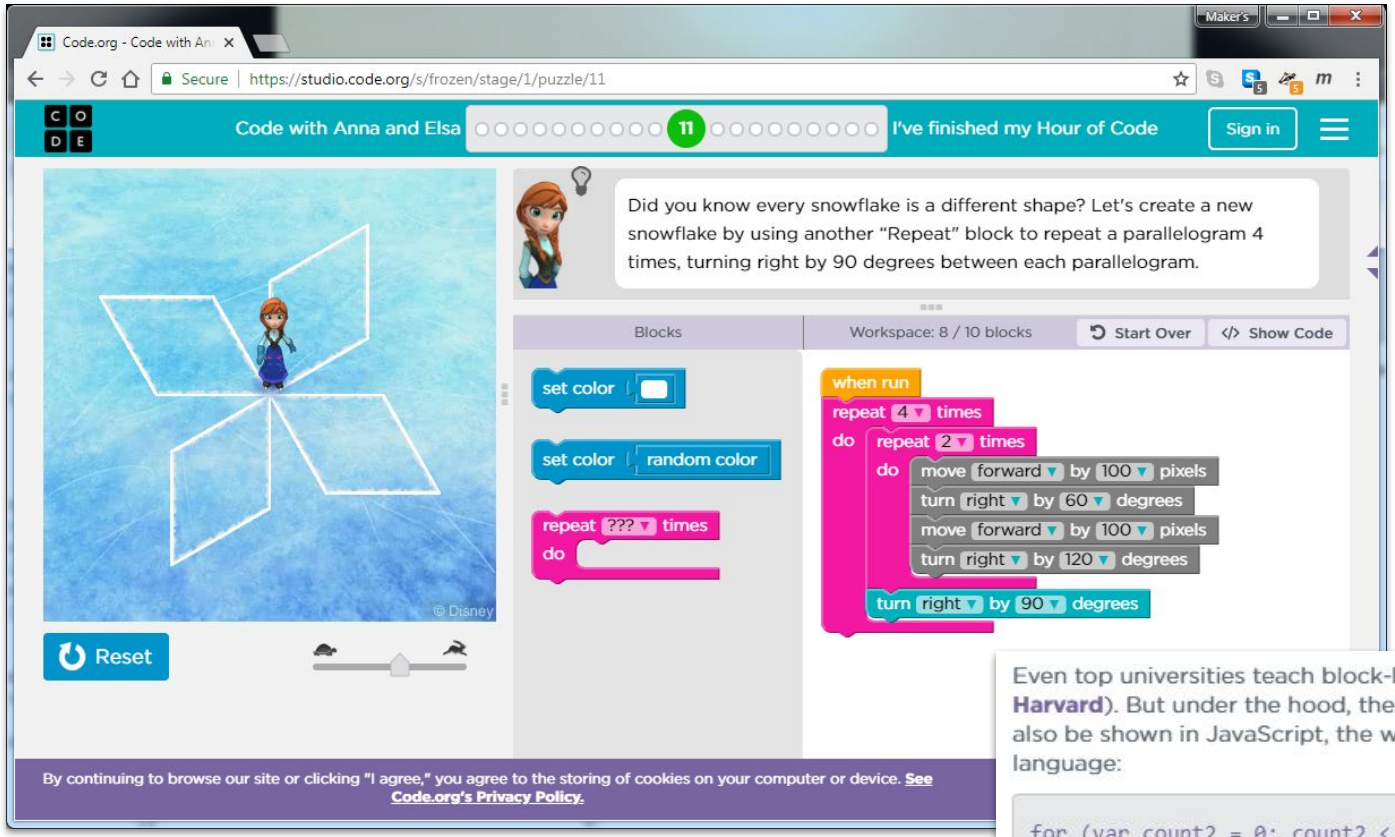
Open Source Turtle Robot circa 2018



"Block" programming example from Code.org

Golden Age of the Turtle?

- Learning **programing** has never been easier.
- **DIY electronics** have never been easier.
- **3D printing** has never been easier.



Even top universities teach block-based coding (e.g., **Berkeley**, **Harvard**). But under the hood, the blocks you have assembled can also be shown in JavaScript, the world's most widely used coding language:

```
for (var count2 = 0; count2 < 4; count2++) {
  for (var count = 0; count < 2; count++) {
    executionInfo.checkTimeout(); if (executionInfo.isTerm
inated()){return;}
    moveForward(100);
    turnRight(60);
    moveForward(100);
    turnRight(120);
  }
  turnRight(90);
}
```

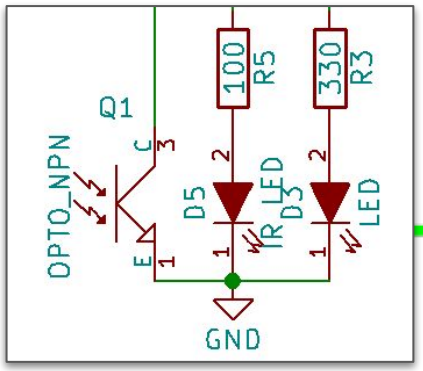
https://studio.code.org/s/frozen/stage/1/puzzle/11

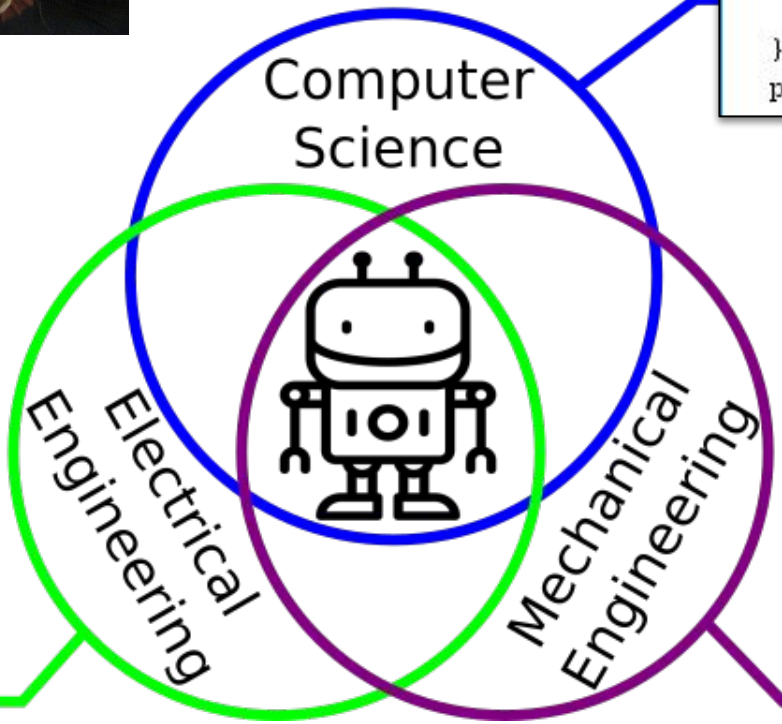
ChickTECH

```
void loop(){ // draw a box
  pendown();
  for(int x=0; x<16; x++){
    forward(100);
    right(90);
  }
  penup();
```

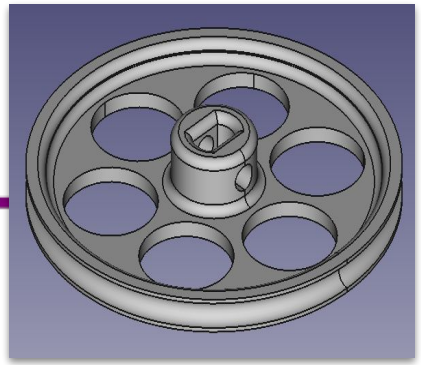
ARDUINO

KiCad

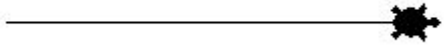




FreeCAD



What now?:



- Play with Turtle graphics online at :
  - *https://blockly-games.appspot.com/* (block programming)
  - *http://bit.ly/ttturtle* (JavaScript)
- Do an “Hour of Code” activity at *https://hourofcode.com/us/learn*
- Do a 3D design tutorial at *https://www.tinkercad.com*
- Find out if your library or local makers space will print your design
- Build and program a Turtle Robot of your own: *http://bit.ly/OSTurtle*
- **Make it better and share your results!**

648.ken@gmail.com
@TheMakersBox *#TurtleRobot*

Slide Deck @ http://bit.ly/OMSIturtle