Exploring with Autonomous Vehicles

October 10th - November 14th, 2020

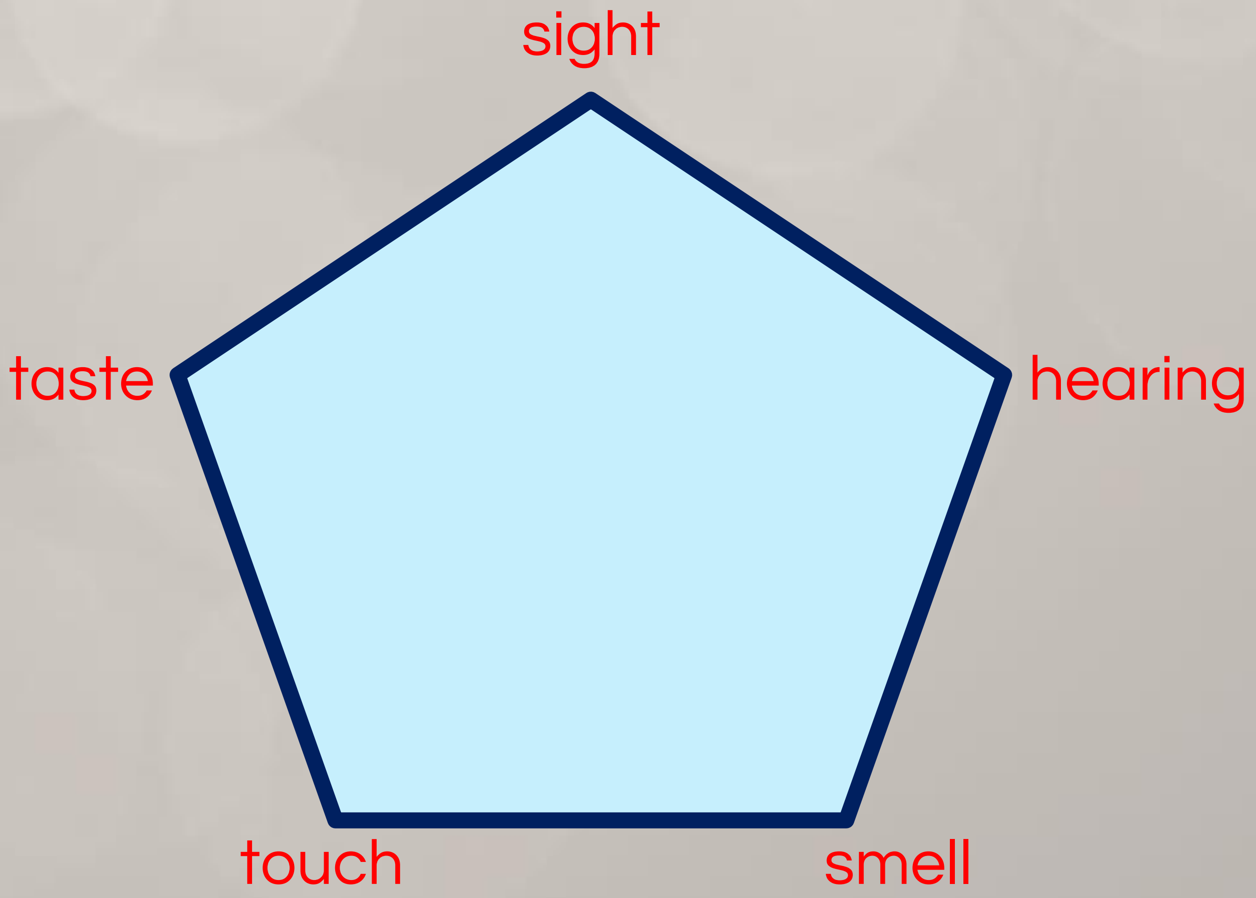
FEMMES & MEGC Workshop

University of Michigan, Ann Arbor

How do humans drive cars?

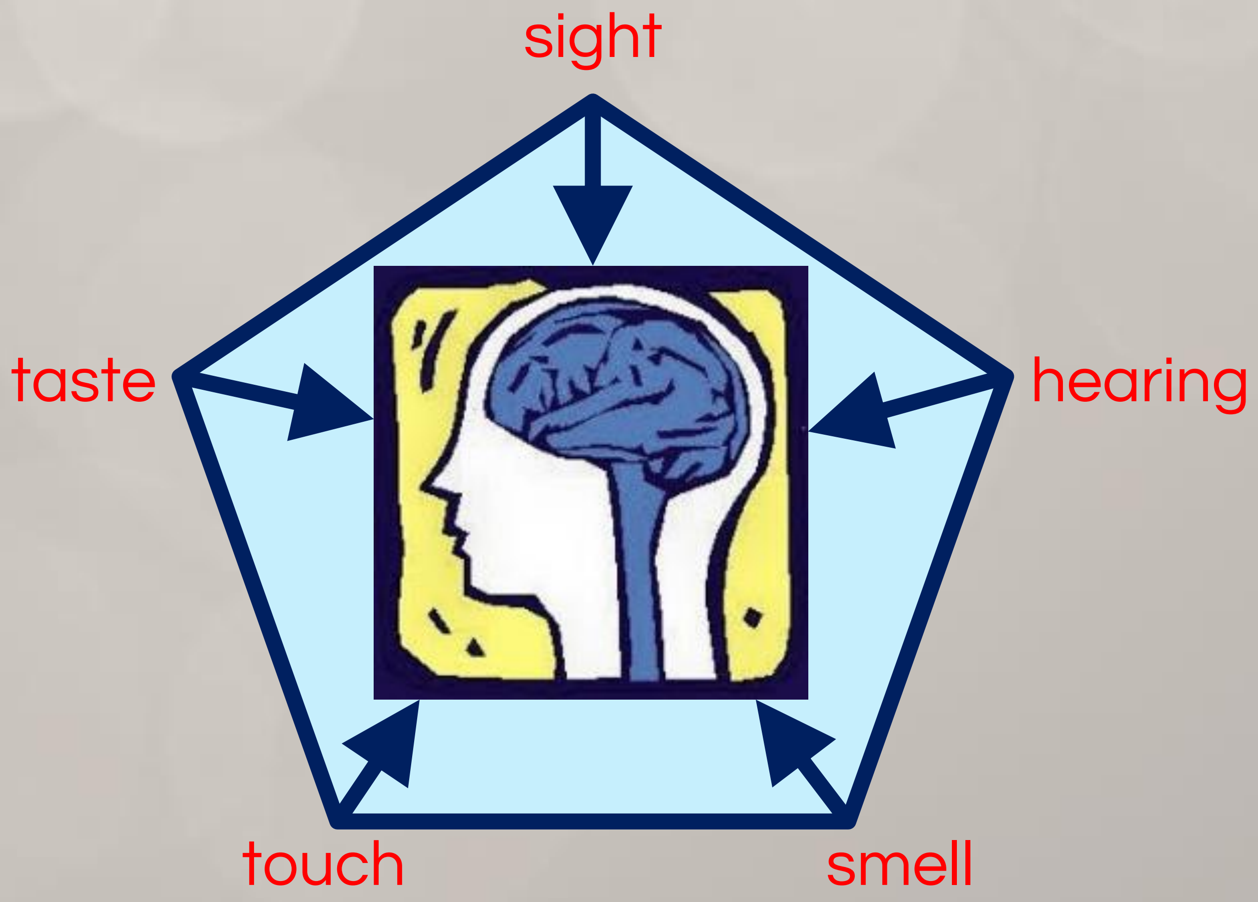
Sensing

5 senses in the human body



Sensing and perceiving

5 senses in the human body *+ one computer*



Sensing and perceiving

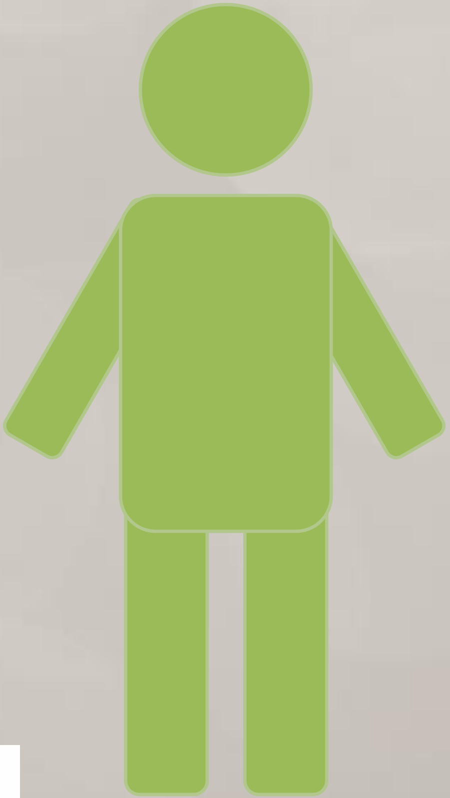
Sensing is taking in information about the world

size, shape, hue, range, texture, brightness, intensity

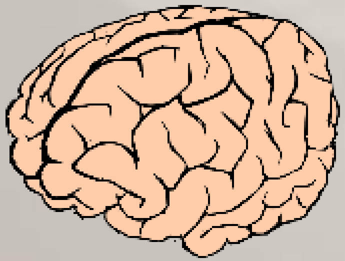
Perceiving is understanding that information

"red apple", "moving car", "fluffy dog"

How Humans Navigate

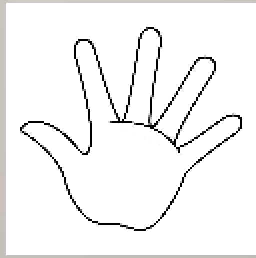


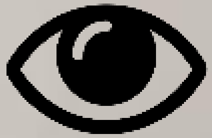
Computer

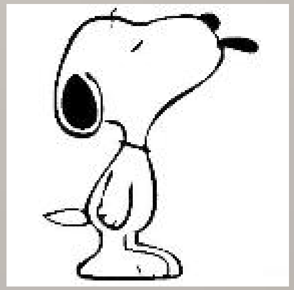


Muscles

Sensors



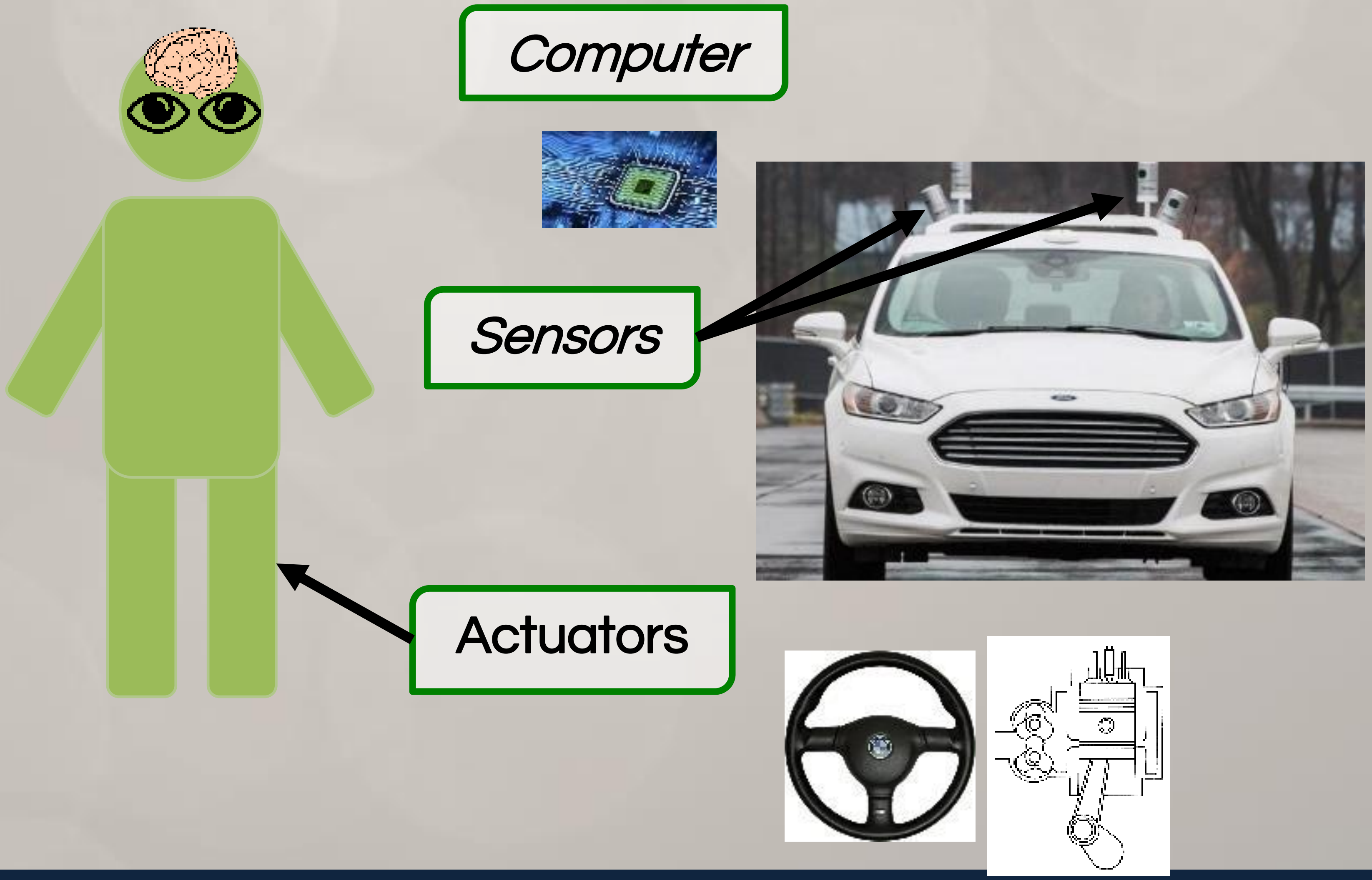




How can cars drive themselves?

To make decisions about the world, driverless cars need to know what's around them

Driverless Cars are (sort of) like you and me...



Sensing and perceiving

Driverless Cars ***sense*** with laser, radar, sonar, and cameras



They ***perceive*** thanks to complex algorithms that allow their “brains” to understand input from the sensors

[Autonomous cars in action!]()

Meet Edison

Edison has sensors to help it see and actuators to help it move

Computer
(Brain)

Wheels
(Muscles)

Line
Tracking
Sensor

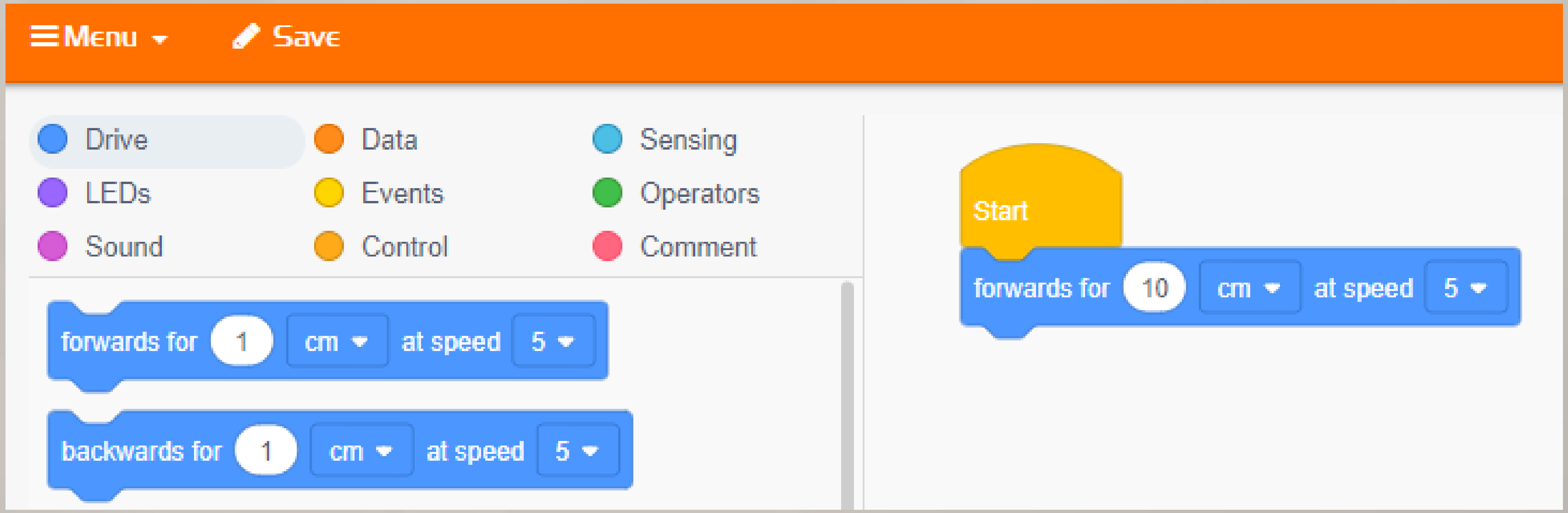
Our job is to teach the brain!

Introduction to EdScratch

Programming with EdScratch is how we tell Edison what to do
Follow along at edscratchapp.com

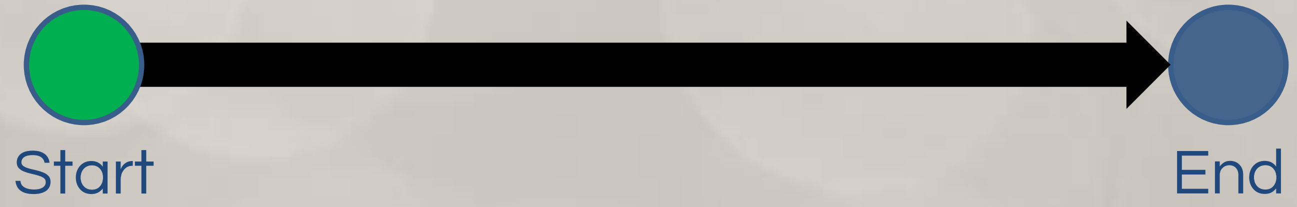
Block Categories

Program

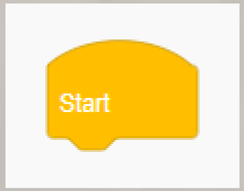


Blocks (Drag and drop)

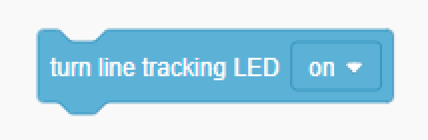
First activity: Line Following



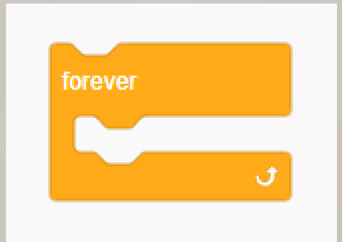
Helpful Code Blocks:



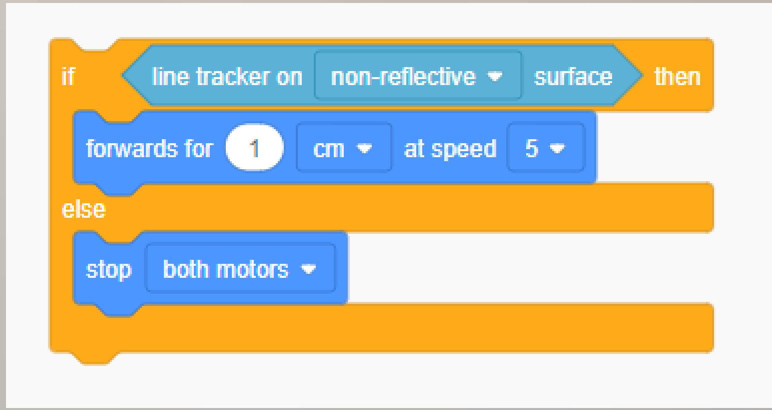
Start block



Turn on line sensor (Sensing category)

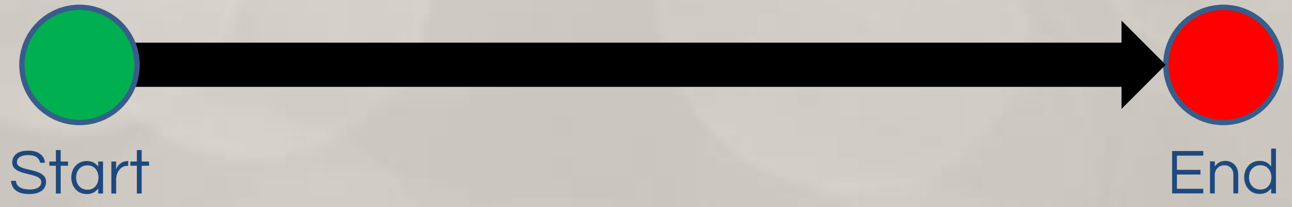


Repeat block (Control category)

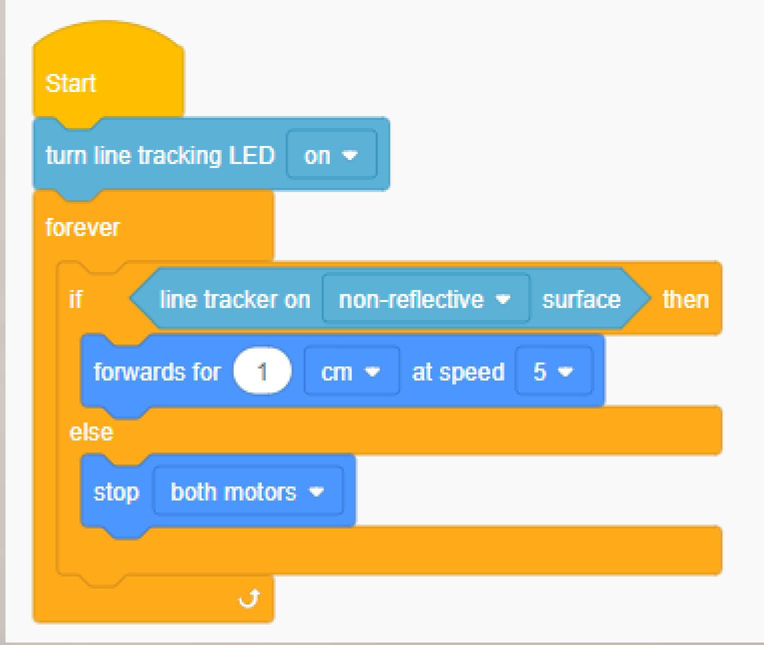


Move one step forward along line

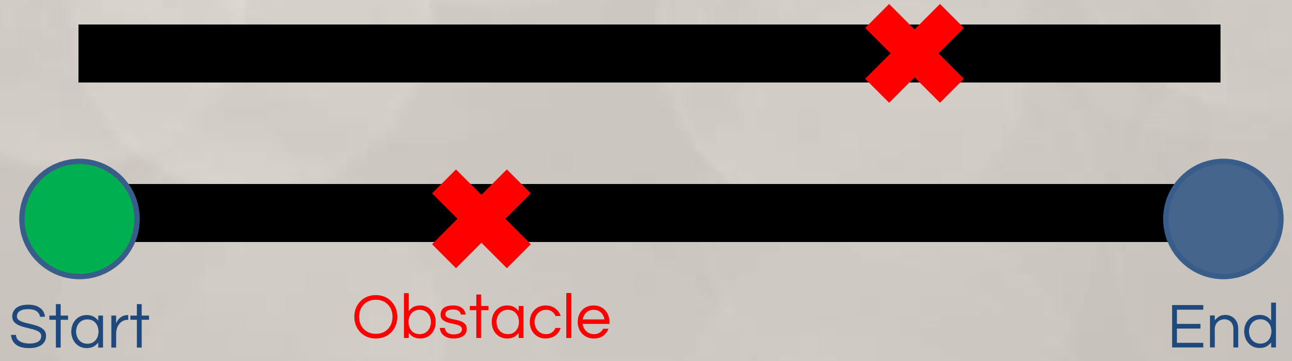
First activity: Line Following



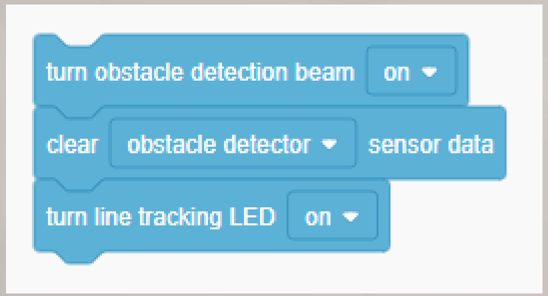
One Solution



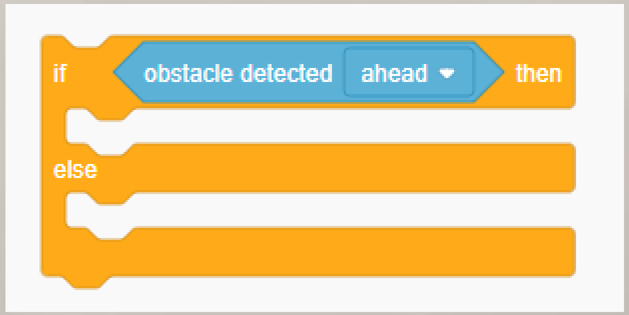
Second activity: Obstacle Avoidance



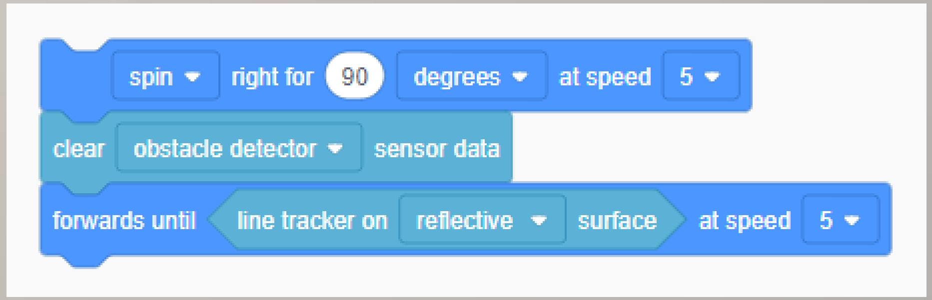
Helpful Code Blocks:



Turn on line and obstacle sensors



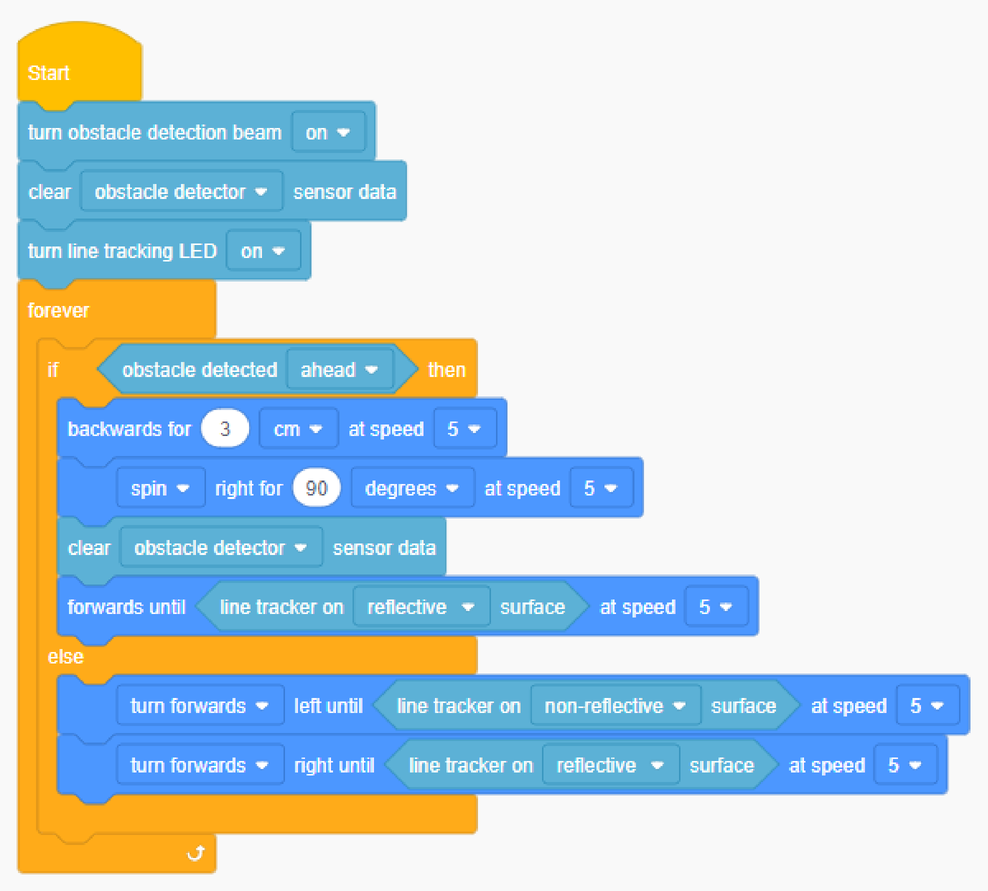
Check for obstacles



Change into right lane

Second activity: Obstacle Avoidance

One Solution



Thank You!

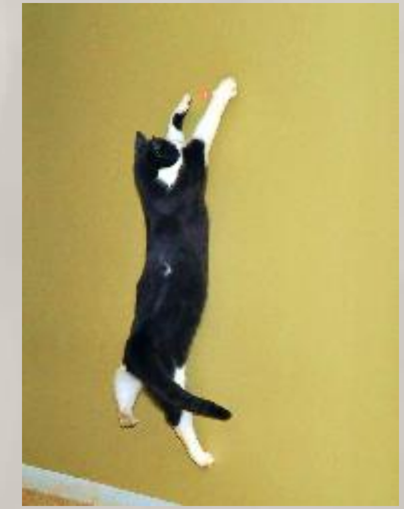
Questions?

Back Up Slides:
But…How do real Driverless Cars do it?

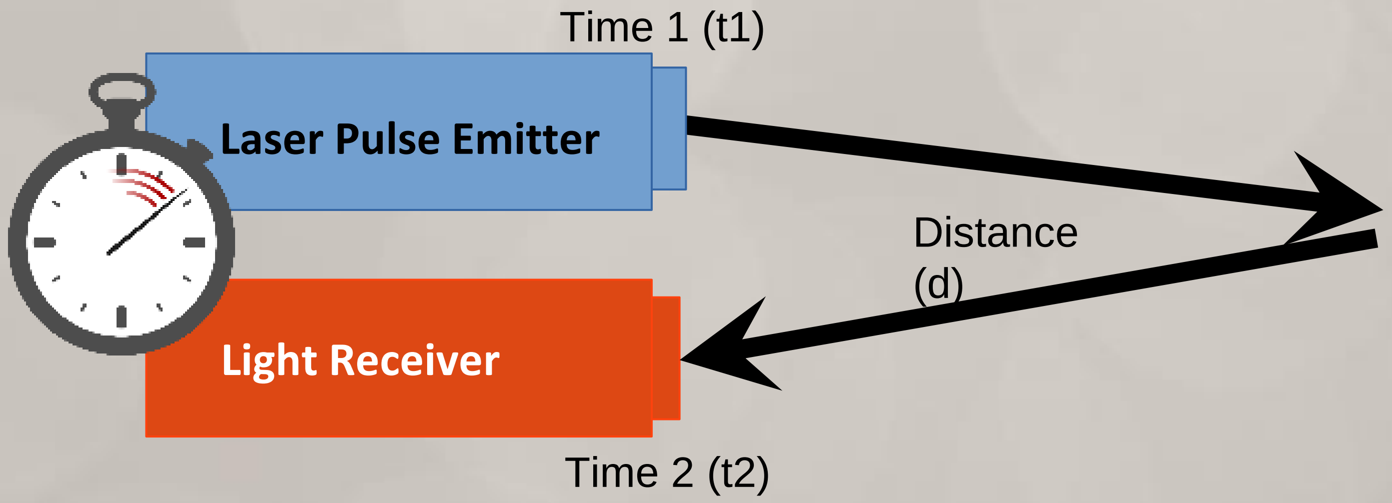
Decision-making and actuation

Engineers use simple algorithms as building blocks for more complicated programs

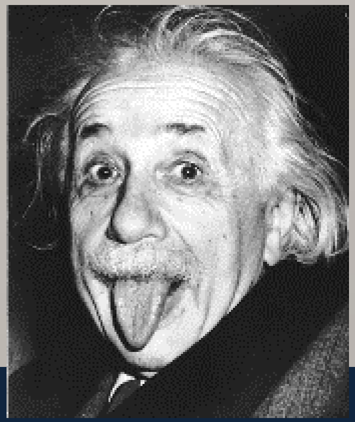
Lasers in the Real World



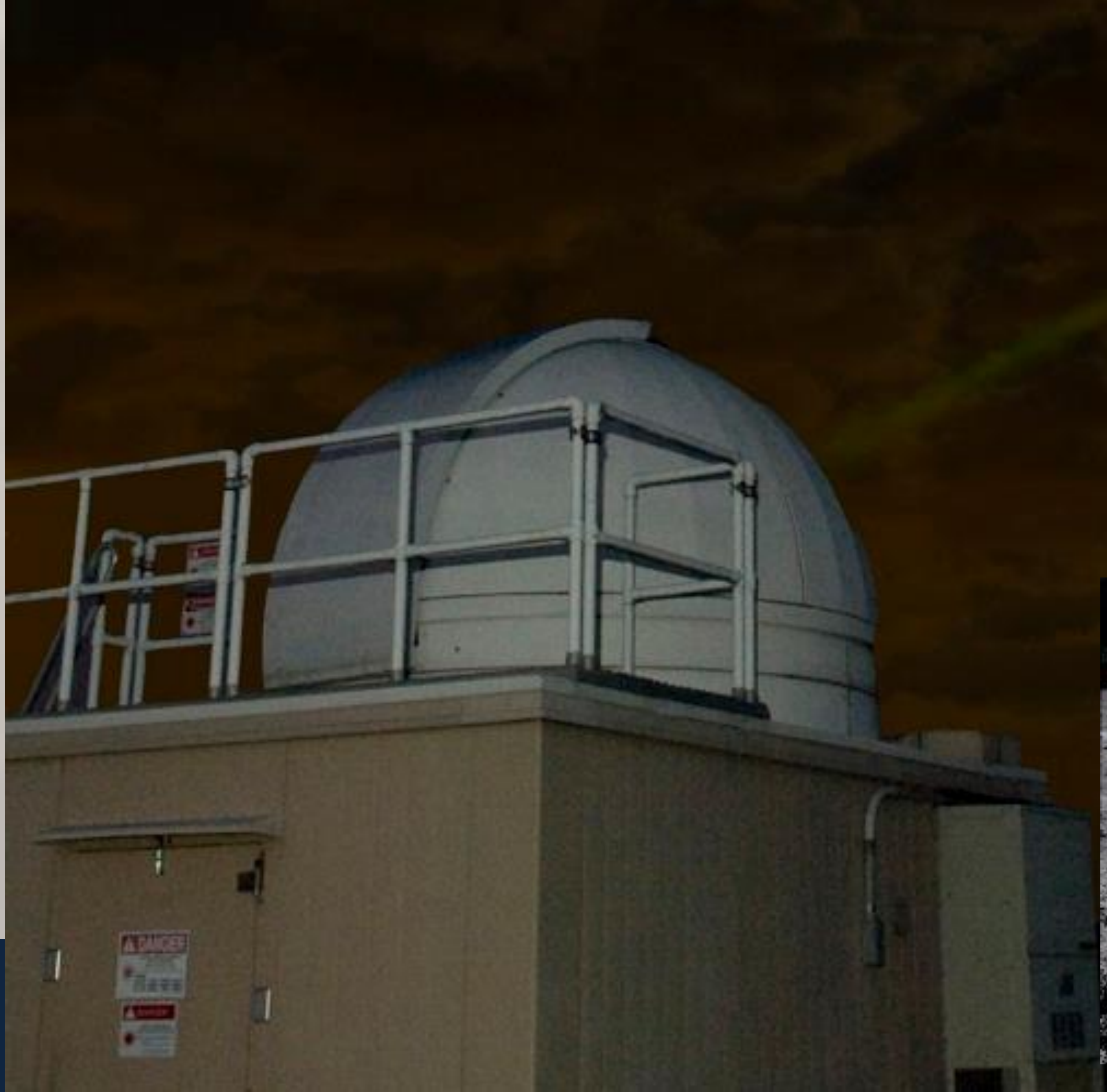
Laser Range Sensors

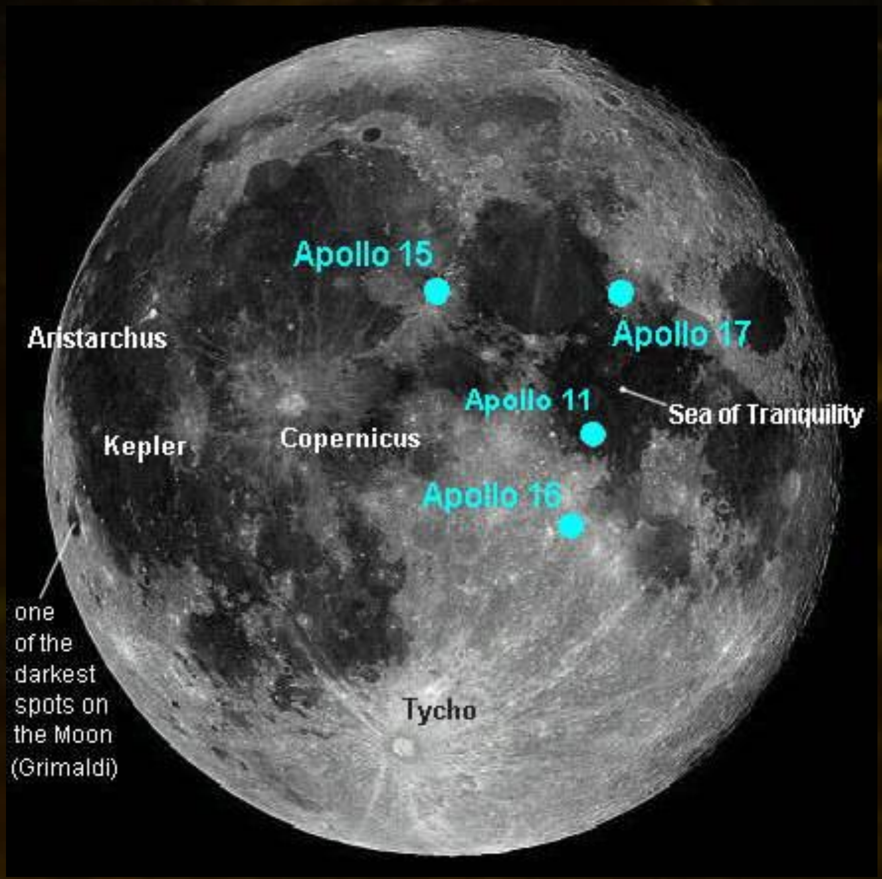


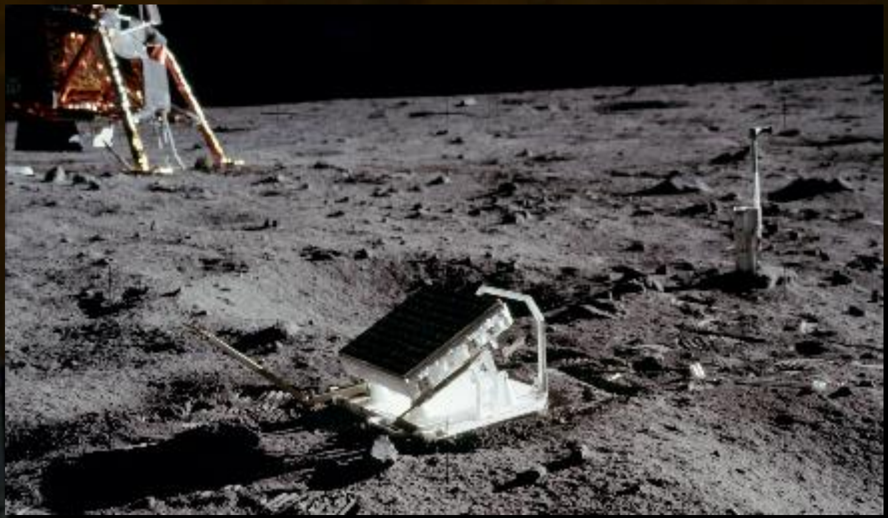
$$d = \frac{1}{2}\frac{t_2 - t_1}{c}$$



Lunar Laser Ranging Experiment







Planar Lidar

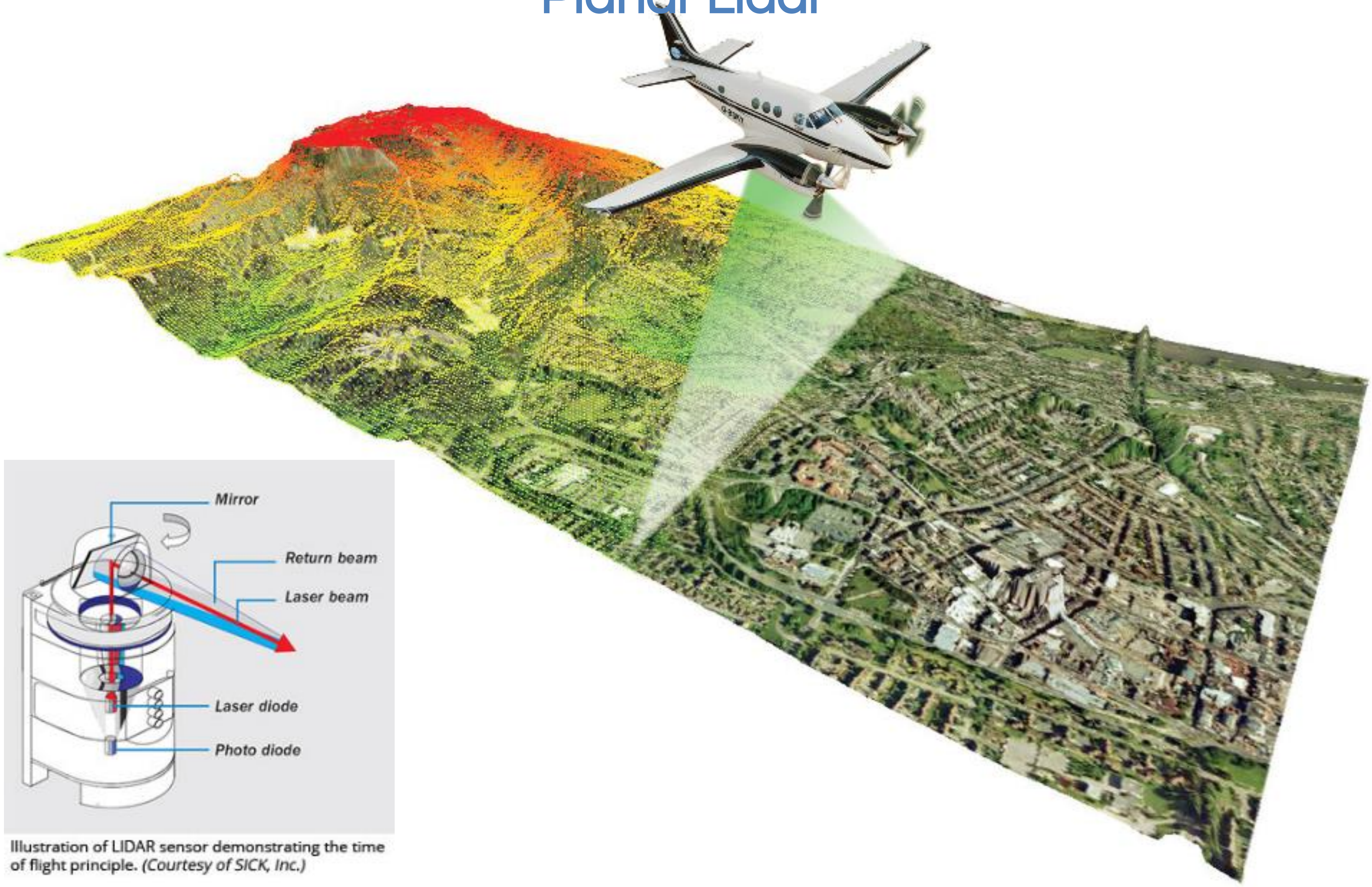
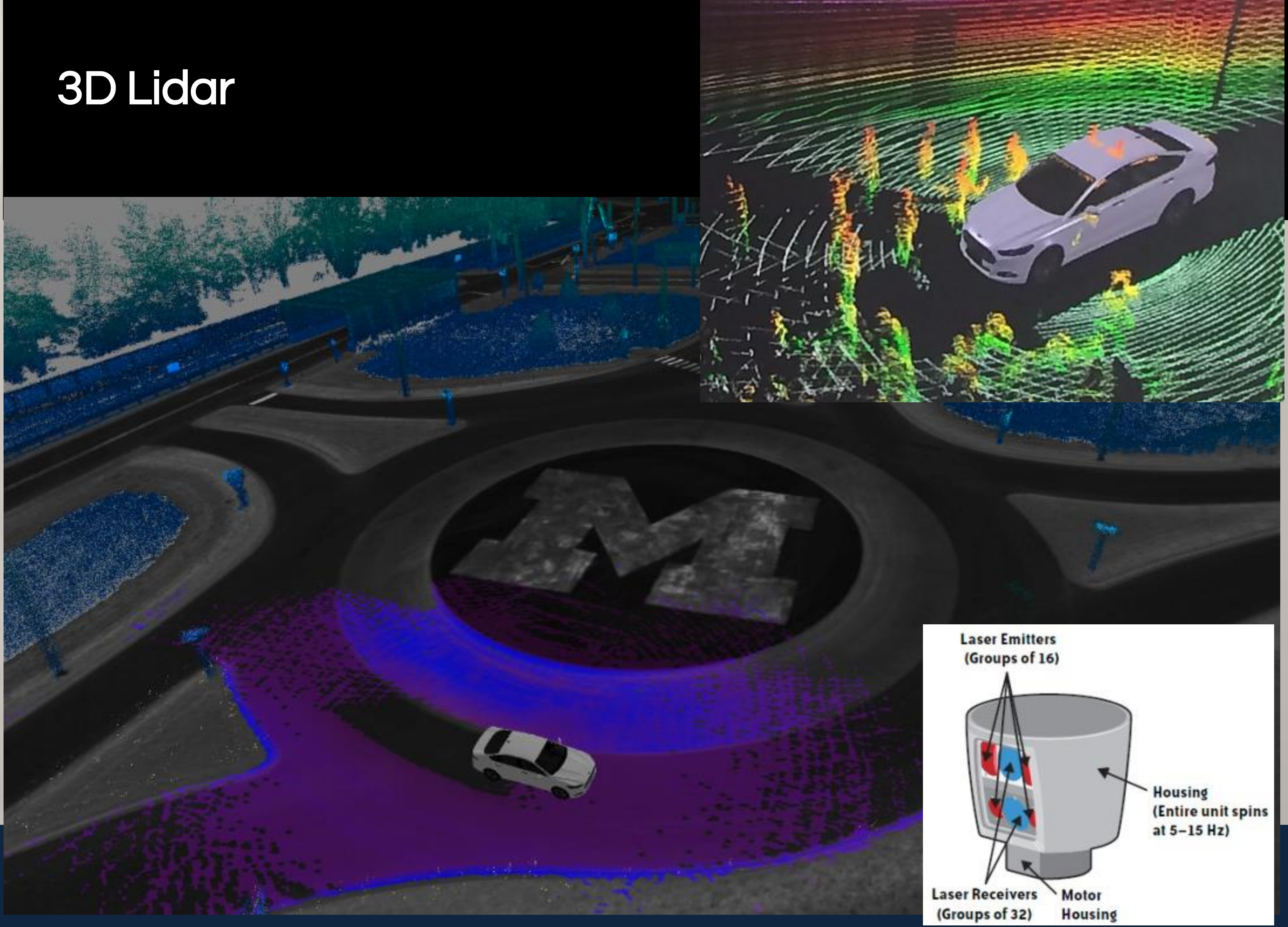


Illustration of LIDAR sensor demonstrating the time of flight principle. *(Courtesy of SICK, Inc.)*

3D Lidar


Laser Emitters
(Groups of 16)
Housing
(Entire unit spins
at 5–15 Hz)
Laser Receivers
(Groups of 32)
Motor
Housing