# AGV Documentation

Student A., Student B., Student C.

# Design brief

We plan to make an AGV that follows a line, stops at an intersection, and carries a tennis Ball Across a track. To do this we will need line followers, motors, and a physical space in the body to carry the cargo. We plan to make an AGV that works well with any line, and stops at all intersections. To do this we need to code all the motions the AGV needs and all the statements in the code for the AGV to follow. Our code also needs to include the emergency stop button that when pushed, just in case of an emergency, it will stop right away with no other code running. With all of these things that are included in our robot we will have an AGV that is able to follow a line, stop at an intersection, and is able to carry a tennis ball.

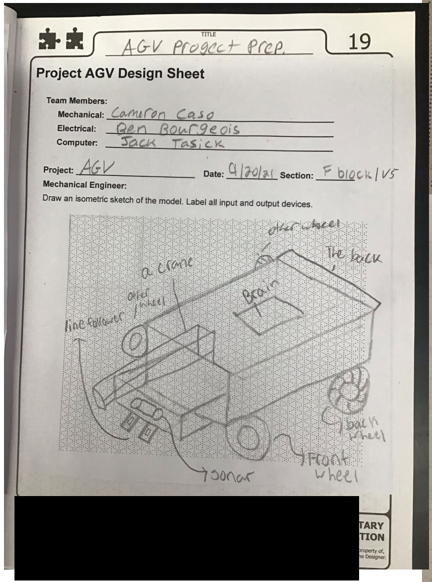
# Decision matrix

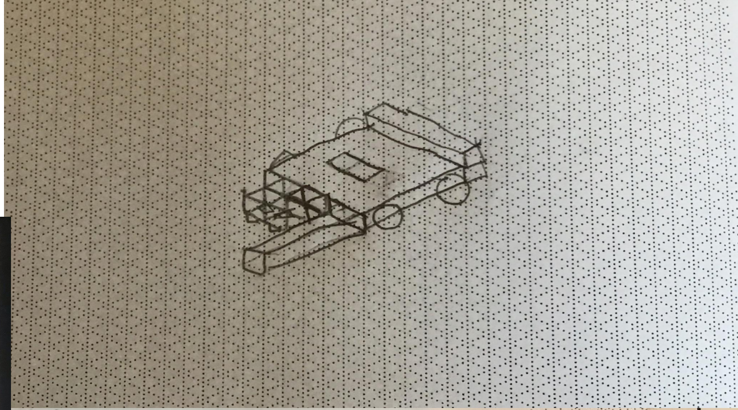
1-5 point scale

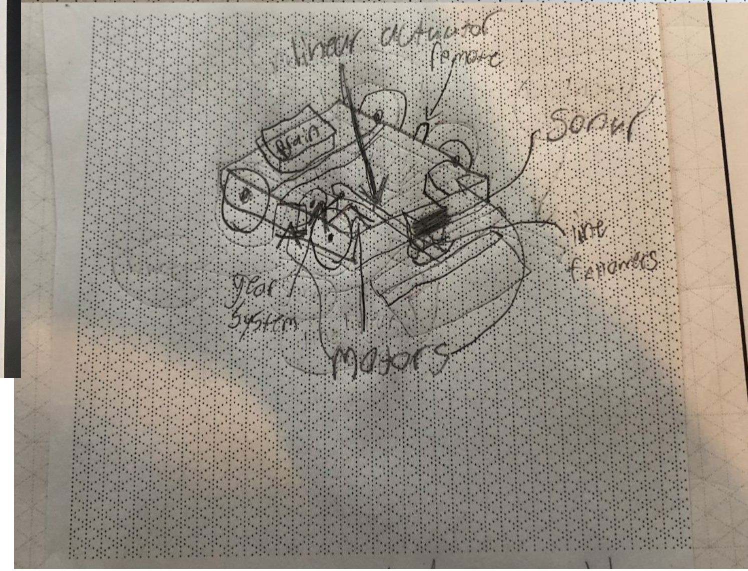
| AGV Decision matrix | Durability | 2 vs 3 line followers | Weight | Placement of the battery and brain | Total score: |
|---|---|---|---|---|---|
| 1st design | 4 points | 2 line trackers far apart (7 in.) — 3 points | 4 points | 2 points | 13 total points |
| 2nd design | 5 points | 3 line trackers medium distance apart (4.5 in.) — 4 points | 3 points | 4 points | 16 total points |
| 3rd design | 4 points | 2 line trackers close together (2 in.) — 2 points | 4 points | 5 points | 15 total points |

# Initial sketches

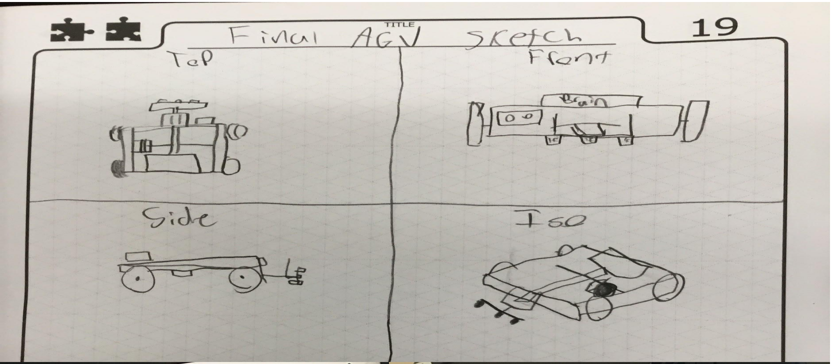
These are our initial sketches. We wanted an AGV that would be able to be light enough to turn quickly but also durable enough so it would not fall apart easily. We came up with these sketches to fit these ideas. We also thought an arm to knock away any objects in the way of the robot would be effective.

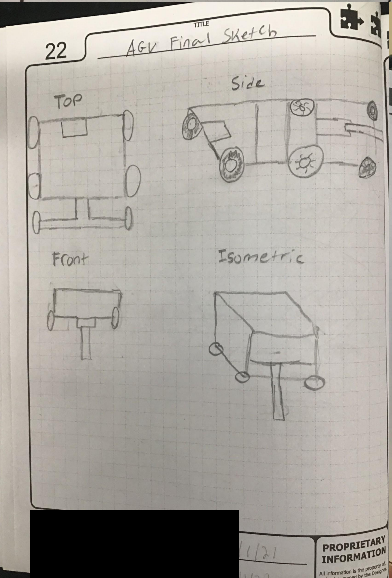


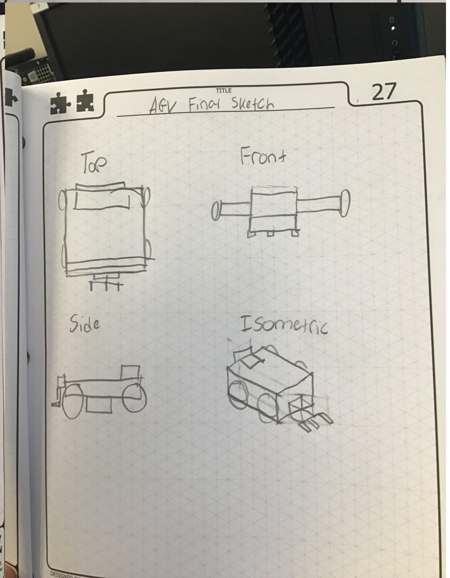





# Final sketches



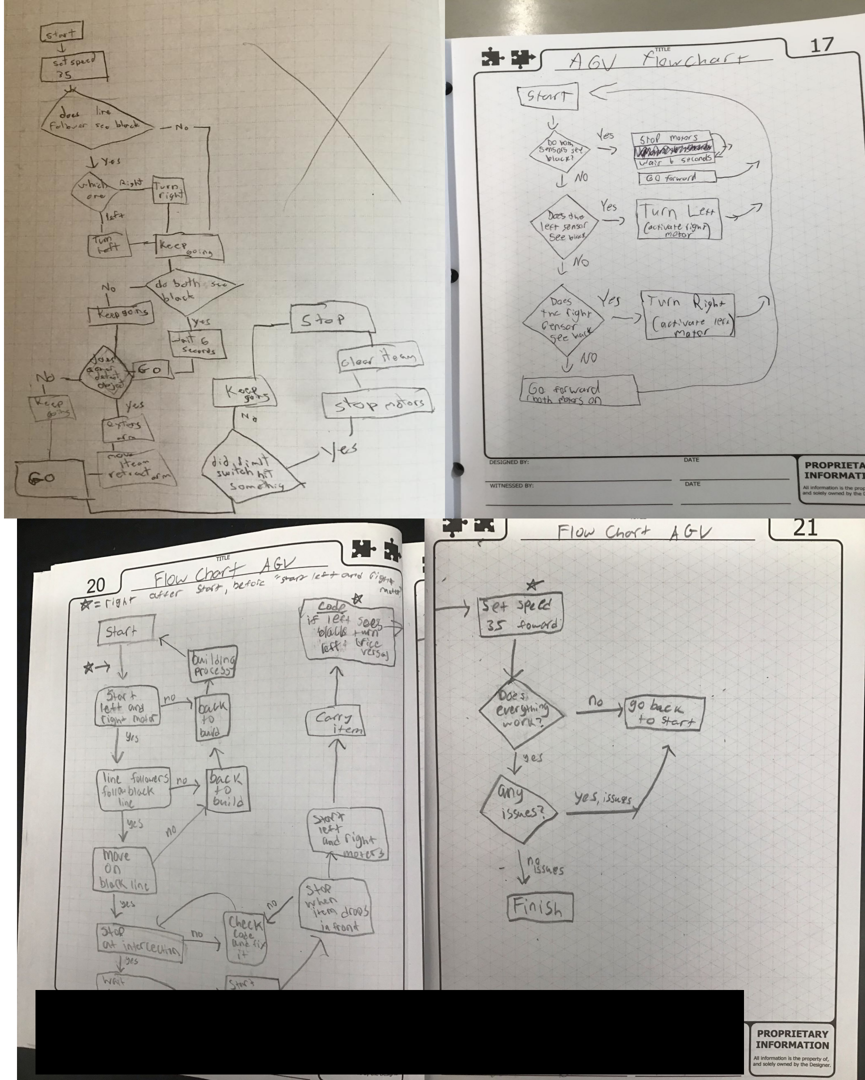




These are our final sketches. As you can see these sketches are very similar to our initial sketches but have slight changes. We released in our building process that the arm might not work how we wanted it to. We had to fix that or keep it in just in case we have enough time to do it. We decided to keep it in but we’re never able to do it. Also in our sketches we have the placement of the battery and brain.

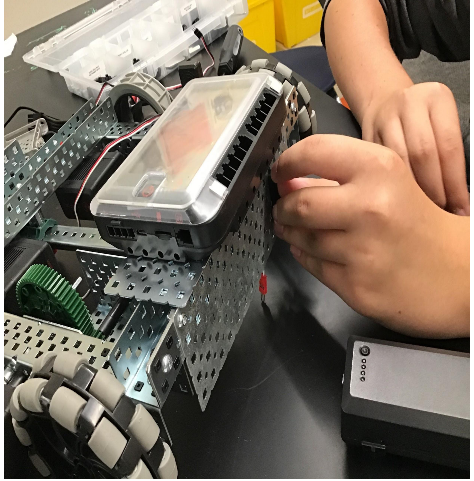
# Flowchart

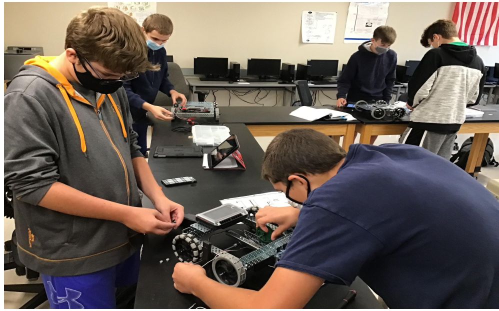
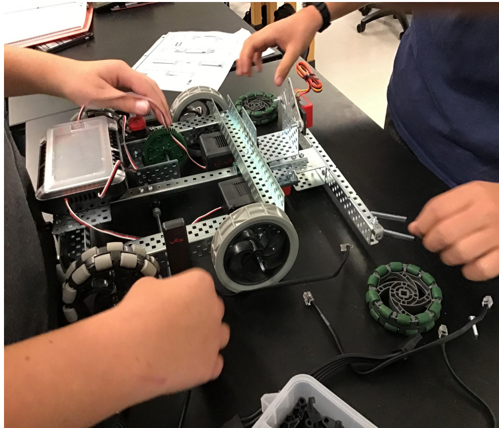
The are our flow charts for the AGV project. You can see that our flow charts include our code and how our robot functions with turns, velocity, and motors. We had to make many decisions in our flow charts to fit the problems that may occur in the project.



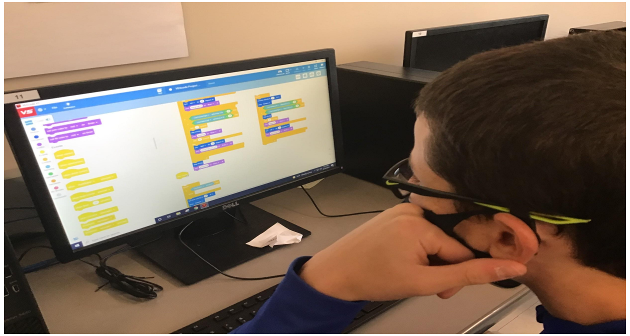
# Building Process

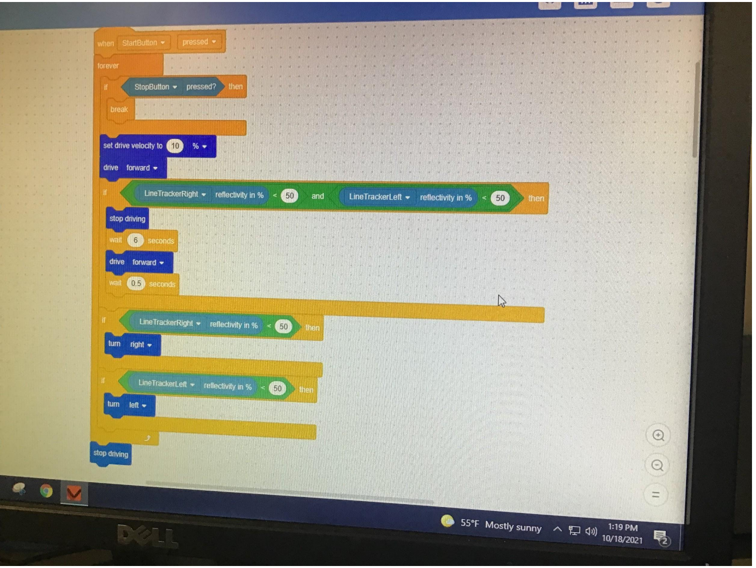
Our building process took about a week or two. We had many failures in our process and it was very tempting just to code the robot how it was. We figured that the arm would not work as we wanted, but decided to keep it in the robot. We fixed the wheels from falling off, we moved the battery and brain position, put 3 line followers on the robot, but only used 2, put an emergency stop button along with the start button, and many gears were put into place along with motors for driving the arm.

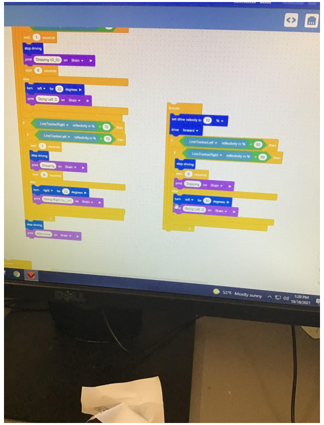


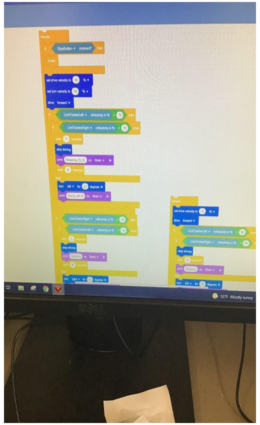




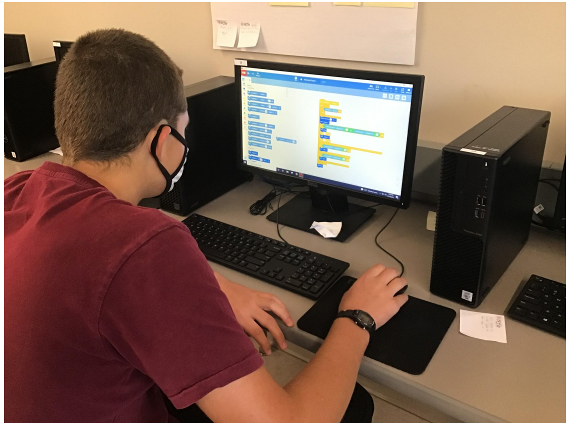
# Pictures of coding





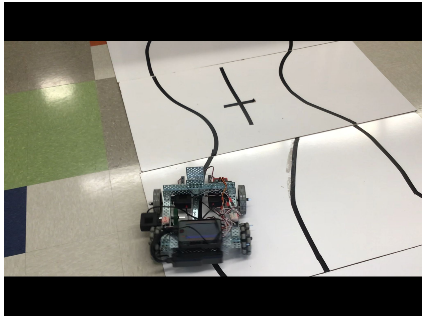
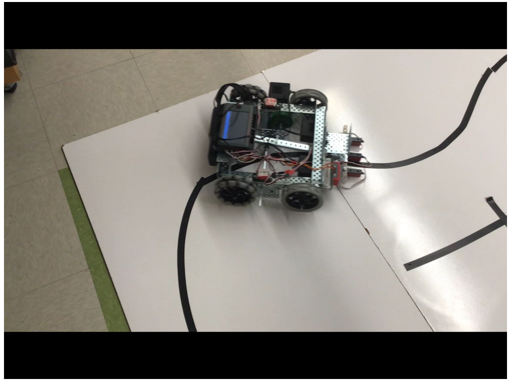
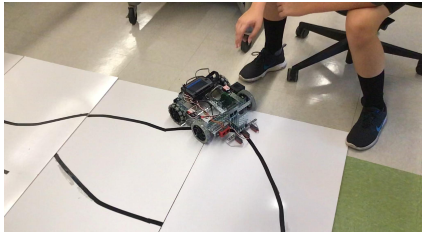
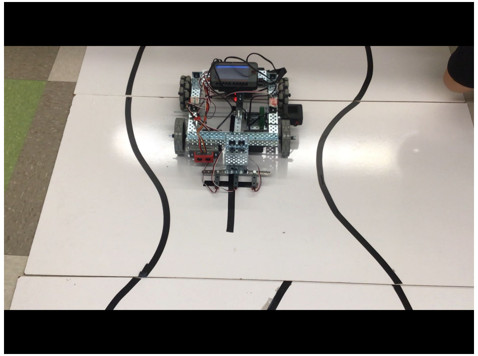
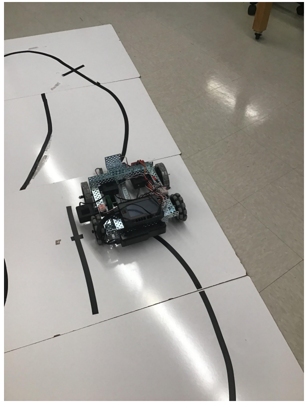
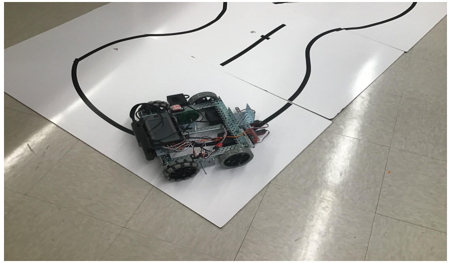




Here are some pictures of our coding. We did a total of 4 if statements and put our emergency stop button code in. It took some troubleshooting and schemes to figure out which code was the best one, and which code worked. We eventually found the code that worked the best and downloaded to our robot to get ready for our testing.

# Pictures of testing

Here are some pictures of our testing. It took about a week of testing before we were confident enough to let the robot go on its own and it di work. We completed the track and then put our focus on the intersection. The intersection was the toughest part of the project because the robot needed to be perfectly across the line for it to be able to stop. We fixed this problem by adding a wait “0.5”. It worked and our intersection was a success.

# AVG cost analysis

AGV NEW PriceListSpreadsheet.xlsx

PLTW Engineering

| Team Members | | Time Employed (Hours) | Employee Rate | Cost of Employees | Total Cost of Employees | Total Cost of Parts | Total Cost |
|---|---|---|---|---|---|---|---|
| Team member 1 | Jack Tasick | 16 | $ 10.00 | $ 159.17 | $ 483.33 | $ 856.02 | $ 1,339.35 |
| Team member 2 | Ben Bourgeois | 17 | $ 10.00 | $ 165.00 | | | |
| Team member 3 | Cameron Caso | 16 | $ 10.00 | $ 159.17 | | | |
| Team member 4 | | | $ 10.00 | | | | |

| Picture | Description | Cost Per Item | Number Used | Total Cost of Item |
|---|---|---|---|---|
|  | **Individual Performance Tool Kit:** A group of performance tools that make working on your VEX Robot easier. Included allen keys fit VEX screws and shaft collars. Includes (1) 5/64" T-Handle, (1) 3/32" T-Handle, and (1) 3/32" Ball End Hex Screwdriver | $ 7.75 | 2 | $ 15.50 |
|  | **USB A-A Tether Cable, 6' (1.8m): Cable for connecting VEXnet components to sync and run in tether mode** | $ 10.00 | 1 | $ 10.00 |
|  | **Jumpers: Used to make changes to the default code. Plug these into the I/O ports of the microcontroller** | $ 0.50 | 0 | $ - |
|  | **VEX v5 Brain Microcontroller:** The brain of every VEX robot. Coordinates the flow of information and power on the robot. All other electronic system components must interface to the Microcontroller. | $ 275.00 | 1 | $ 275.00 |
|  | Vex V5 Battery | $ 54.99 | 1 | $ 54.99 |
|  | V5 Radio: Used to transmit and recieve with the V5 Remote | $ 44.00 | 1 | $ 44.00 |
|  | **7.2V Robot Battery NiMH 2000mAh:** Battery provides a rechargeable power source for use with your VEX robots. | $ 20.00 | 0 | $ - |
|  | V5 Remote | $ 110.00 | 0 | $ - |
| | **Flashlight:** Turn night into day with this powerful 4-LED flashlight. It draws power directly from the VEX Controller. | $ 13.00 | 0 | $ - |
|  | **Line Tracker:** Price based on each sensor. Program your robot to follow a line. This sensor can also be used as a beam trigger. Includes three IR emitter/receivers with custom mounting bracket.This is an analog sensor. | $ 13.25 | 3 | $ 39.75 |
| | **Ultrasonic Range Finder:** Use this sensor to measure distance using high frequency sound waves. Sensor can measure in inches or centiemeters. | $ 30.00 | 1 | $ 30.00 |
|  | **Optical Shaft Encoder:** The Quadrature Encoder can measure both the position and direction of rotation of a VEX shaft. This will allow you to calculate the speed of the shaft, as well as the distance it has traveled. | $ 10.00 | 0 | $ - |
| | **Light Sensor:** Uses a photocell that allows your robot to detect and react to light. Use this sensor to get an analog measurment of various amouts of light and dark. | $ 10.00 | 0 | $ - |

| Name: Jack | | | | | |
|---|---|---|---|---|---|
| Day | Date | Time in (skip) | Time out (skip) | What part you worked on | Minutes |
| 1-7 | september 20-28 | | | building robot | 330 |
| 7-14 | sep 28- oct 8 | | | adjusting robot/ coding | 315 |
| 14-21 | oct 8- oct 19 | | | coding | 310 |

| Name: Ben | | | | | |
|---|---|---|---|---|---|
| Day | Date | Time in (skip) | Time out (skip) | What part you worked on | Minutes |
| 1-7 | september 20-28 | | | building robot/ coding | 365 |
| 7-14 | sep 28- oct 8 | | | adjusting robot/ coding | 315 |
| 14-21 | oct 8- oct 19 | | | testing/ coding | 310 |

| Name: Cam | | | | | |
|---|---|---|---|---|---|
| Day | Date | Time in (skip) | Time out (skip) | What part you worked on | Minutes |
| 1-7 | september 20-28 | | | building robot | 365 |
| 7-14 | sep 28- oct 8 | | | adjusting robot/ testing | 315 |
| 14-21 | oct 8- oct 20 | | | testing/ coding | 275 |

# Video of testing / completing the task YOUTUBE PLAYLIST

Video of AGV at intersection and stopping for 6 seconds

The video is the AGV completing the full course and then stopping by pressing  the emergency stop button.

Video of AGV carrying an object across the track.

# References

Vex AGV Research Sources:


1. https://kb.vex.com/hc/en-us/articles/360039287611-Using-the-V5-3-Wire-Line-Tracker

2. http://cmra.rec.ri.cmu.edu/products/cortex_video_trainer/lesson/media_files/forward_until_dark.pdf

3. https://renegaderobotics.org/vex-sensors-line-tracker/

4. https://www.youtube.com/watch?v=vyDCeGtBvog

5. https://www.vexrobotics.com/vexcode-text