FRC 6995 NOMAD

SOFTWARE TRAINING 101

INTRODUCTIONS

- Sharon Rigg – Software Lead Mentor
- Greg Shue – Software Mentor
- Jeremiah & Ben S – Returning students

2019 SOFTWARE TEAM VISION

- My vision is to enable you, the students, to be successful in developing the software for our robot.
- I will do what I can to provide the training you need to do your job. I am here to advise, but I will encourage you to work as a team and learn through trial and error.
- I will help provide structure to the planning process and scheduling of tasks (I am a WEST after all!).

HOW ARE ROBOTS DIFFERENT THAN MACHINES?

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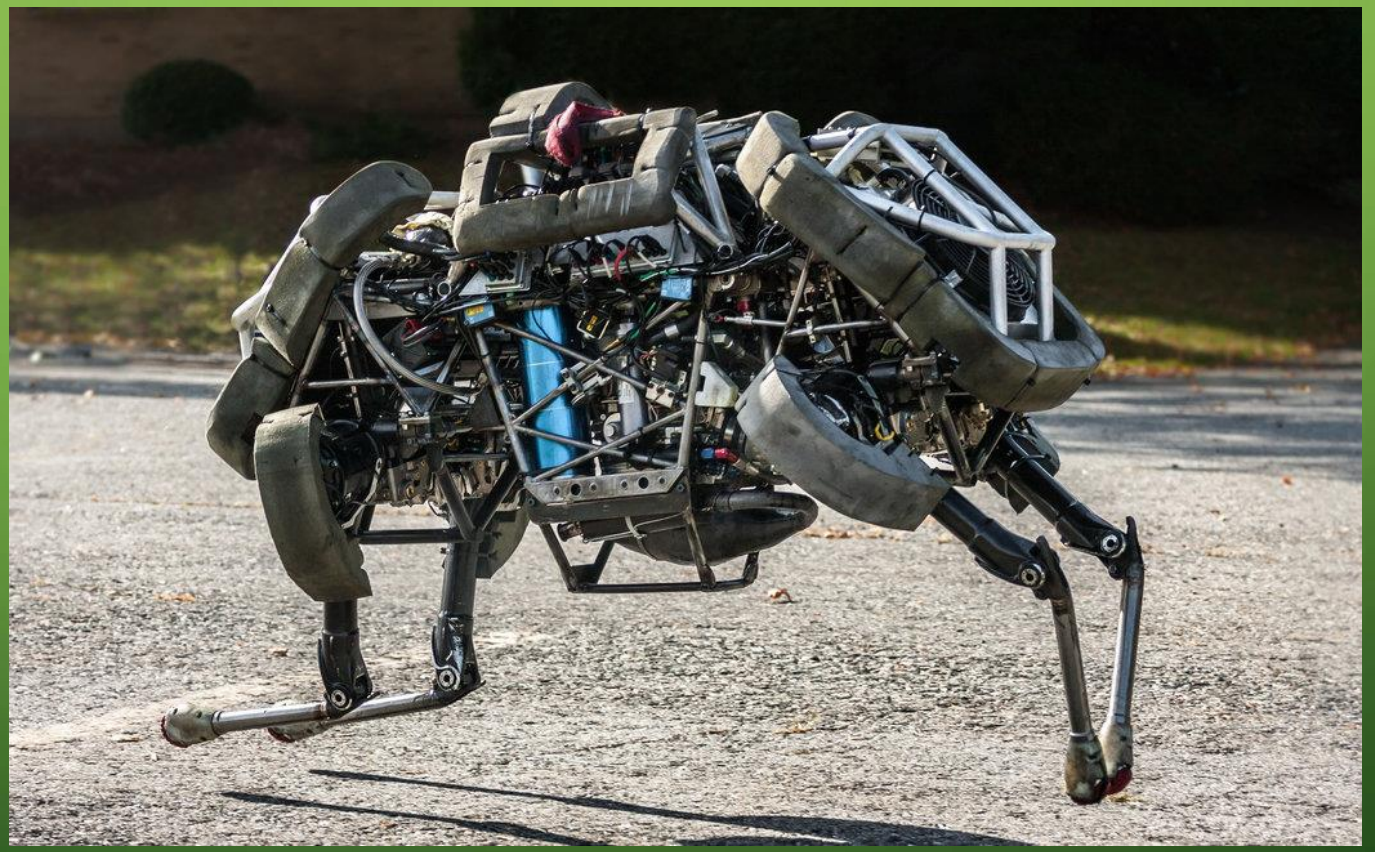
- Machines can precisely repeat predetermined motions automatically (like a washing machine or dishwasher).
- Robots can perform tasks either automatically or by remote control.

HOW ARE ROBOTS USED TODAY?



HOW ARE ROBOTS USED TODAY?

- Retrieve bombs
- Build things like cars, candy bars, and electronics.
- Used in medicine
- Military tactics
- Finding objects underwater
- Explore other planets.

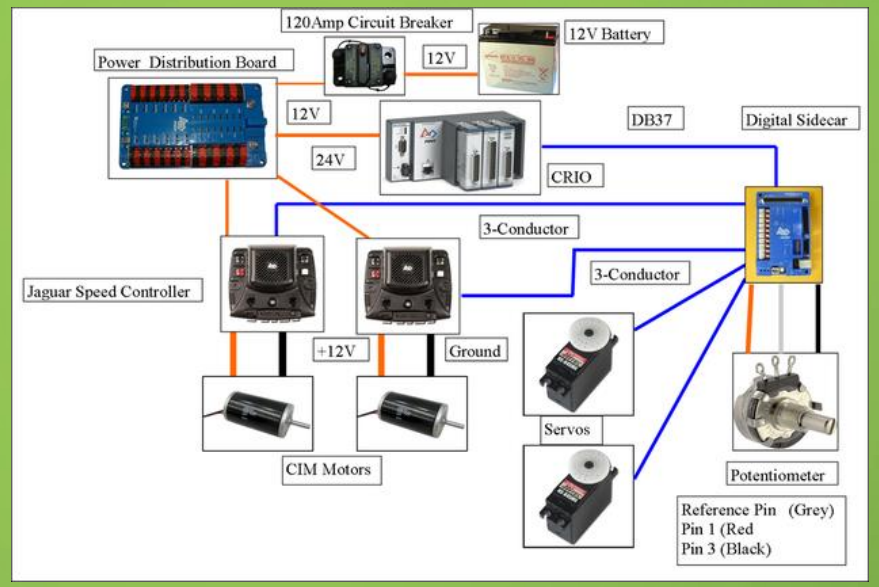
PARTS OF A ROBOT

Most robots are composed of 3 main parts:

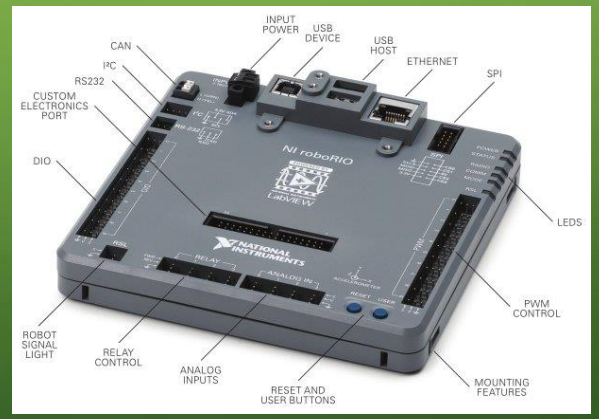
- The Controller - also known as the "brain" which is run by a computer program. Often, the program is very detailed as it gives commands for the moving parts of the robot to follow.
- Mechanical Parts - motors, pistons, grippers, wheels, and gears that make the robot move, grab, turn, and lift. These parts are usually powered by air, water, or electricity.
- Sensors - to tell the robot about its surroundings. Sensors allow the robot to determine sizes, shapes, space between objects, direction, and other relations and properties of substances. Many robots can even identify the amount of pressure necessary to apply to grab an item without crushing it.

THE FRC ROBOT

Driver Station
Joystick, PC running Smart Dashboard



Electronics
Gathers information or causes mechanics to move.
Includes Limit Switches, Encoders, NavX, Spark, Talon, CIM, Solenoid, and more



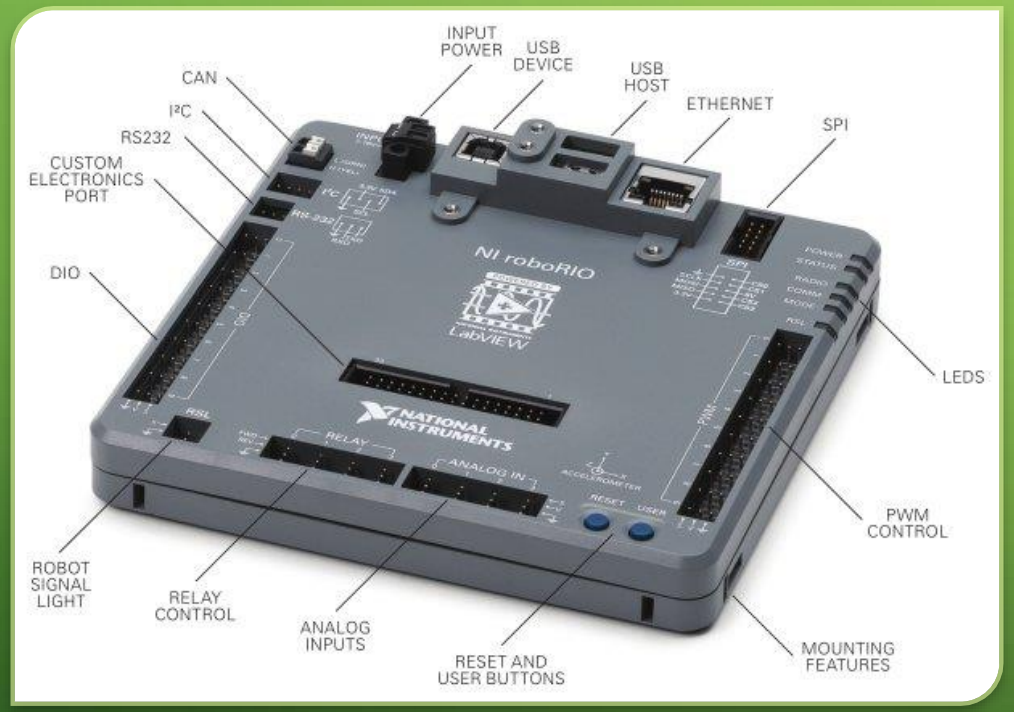
roboRIO (brain)
Sends and receives information to/from the Electronics.

Robot

OPERATION MODES

- Autonomous – first 15 seconds of a match. – The robot moves only by preset instructions (like a machine), no user interaction.
- Teleop – Drivers control the robot through use of external devices like a joystick.
- Disable – Robot is disabled
- Practice – This mode simulates a regular match, putting the robot in autonomous, then teleop, then disable. Great for scrimmages.

WHAT DOES THE SOFTWARE TEAM WORK ON?



- The software team will work directly with the brain of the robot
- In FRC, the controller/brain of the robot is the roboRIO (a mini computer)
- The code we write is transferred to the roboRIO.
- We must also have knowledge of the electrical and mechanical parts of the robot.

SOFTWARE TERMINOLOGY - IDE

IDE (Integrated Development Environment) –

- An IDE is a software suite that consolidates basic tools required to write and test software such as
  - Text editors,
  - Code libraries
  - Compilers
  - Test platforms
- The integrated toolset is designed to simplify software development and can identify and minimize coding mistakes and typos.
- In 2018 we used Eclipse. In 2019 we will switch to Visual Studio Code (https://wpilib.screenstepslive.com/s/currentCS/m/79833/l/932382-installing-vs-code)

SOFTWARE TERMINOLOGY - JAVA

- Java is an object-oriented programming language
- Java code can run on all platforms that support Java without the need for recompilation.
- It compiles to bytecode that can run on any Java virtual machine (JVM) regardless of computer architecture.

FRC Teams also have a choice of programming in LabView or C++.

SOFTWARE TERMINOLOGY - WPILIB

- WPILib is a robotics software library used in the FIRST Robotics Competition
- It was initially developed by WPI professor Brad Miller as a way to simplify program development for the FRC robot control system.
- It contains software that handles lower level details of the hardware (interrupt routines, voltage measurements and conversions, communications details, etc.) so students can focus on solving higher level problems.

https://www.firstinspires.org/robotics/frc/blog/2019-wpilib

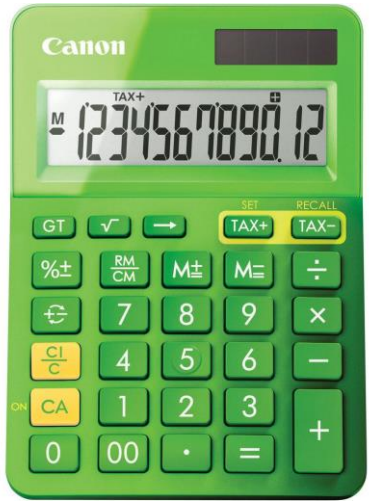
SOFTWARE TERMINOLOGY – GIT AND GITHUB

- Git is a version control system for tracking changes in computer files and coordinating work on those files among multiple people.
  - Allows you to revert back to previous versions of your code (when it worked)
  - Keeps track of who made what changes to a file.
- GitHub is a web-based hosting service for version control using Git.
  - Everything is stored on the Internet (easy access for all)

SOFTWARE DEVELOPMENT IN A NUTSHELL

- Write Java code using an IDE
- Compile Code
- Transfer code to roboRIO (via cable or radio signal)
- Test code on robot
- Upload changes to GitHub for code review and integration

ROLE PLAYING EXERCISE



ROLE PLAYING EXERCISE - CLASSES

- Acrobat
- Dice
- Blackboard
- Calculator
- Bamboozler
- LazyCalculator
- Decider

ROLE PLAYING EXERCISE - METHODS

- Acrobat – clap(*x*), kneeBend(*x*), count
- Dice – roll(*x*), numRolls(*x*), reset
- Blackboard – drawCircle, drawSquare, drawText(*text*), clear
- Calculator – add(*x*,*x*), subtract(*x*,*x*), multiply(*x*,*x*)
- Bamboozler - add(*x*,*x*), subtract(*x*,*x*),
- LazyCalculator – add(*x*,*x*), add(*x*,*x*,*x*,*x*)
- Decider – dayOfWeek(*date*), rate(*text*)

ROLE PLAYING EXERCISE - OBJECT

- ?? is a class type of Acrobat
- ?? is a class type of Dice
- ?? and ?? is a class type of Blackboard
- ?? is a class type of Calculator
- ?? is a class type of Bamboozler
- ?? is a class type of LazyCalculator
- ?? is a class type of Decider

ROLE PLAYING EXERCISE - COMMANDS

- clap
- kneebends
- count
- tripleBackFlip
- roll
- numRolls
- drawSquare
- drawCircle
- drawText
- clear
-
- add
- subtract
- multiply
- dayOfWeek
- rate

ROLE PLAYING EXERCISE

Java syntax for giving commands to (or requesting service from) an object:

- <acrobat>.clap(3)
- <dice>.roll()
- <calculator>.add(10, 4)
- <Decider>.rate(“Ginger Spice”)

FRC COMMAND BASED PROGRAMMING

- Our robot is programmed as a command based robot.
- This makes it easier to program and modify.
  - Activities happen over time, for example a sequence of steps to shoot a Frisbee or raise an elevator and place a tube on a goal.
  - These activities occur concurrently, that is it might be desirable for an elevator, wrist and gripper to all be moving into a pickup position at the same time to increase robot performance.
  - You can test the robot mechanisms and activities each individually to help debug your robot.

FRC COMMAND BASED PROGRAMMING

OI.java

Input/Output devices are defined here

Robot.java

VM runs this file (starting point)

.

RobotMap.java

Literals defined here so it is easy to change

Commands

Perform task

Subsystems

What the robot can do.

FRC SUBSYSTEMS

Subsystem classes break the robot into smaller parts. Each subsystem defines what the subsystem is made of and what that part of the robot can do (possible behaviors).

- Drive Train can move forward, backward, turn, and stop
- Lifter can move up or down
- Claw can open or close

FRC COMMANDS

- Command classes tell the robot to perform the actions incorporating the capabilities defined in the subsystems.
- Commands run when scheduled or in response to buttons being pressed or virtual buttons from the SmartDashboard.
- Examples
  - Move forward
  - Open Claw

ACTIVITY – DESIGN OUR ROBOT CODE

Pair off with another student and perform the following tasks.

- OI.java – List the input or output devices needed to operate the robot.
- RobotMap.java – <Don't worry about this for now>
- Subsystems – Identify the subsystems that should be designed. List types of activities that subsystem may perform.
- Commands – Identify the different actions that will be necessary to operate the robot. A command could be something that automatically happens or could be initiated by input from a device.

ROBOT BUILDER - HOMEWORK

- Using the information gathered during your exercise, use Robot Builder to create the framework for your program.
- Watch videos to learn about Robot Builder at https://www.youtube.com/playlist?list=PLYA9eZLlgz7t9Oleid2wtIgnvhGObeKzp
- Use SamePage chat feature under Software team to ask questions.