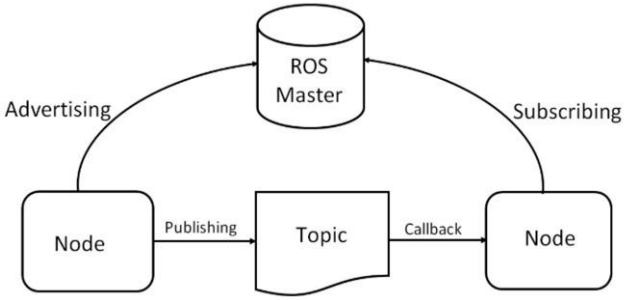
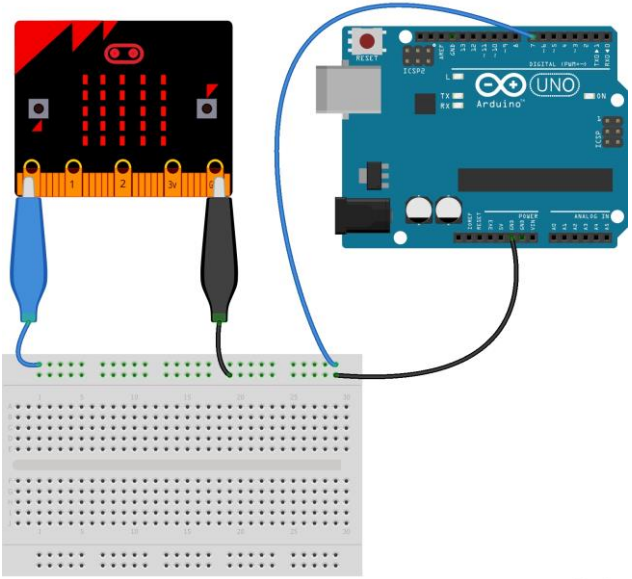
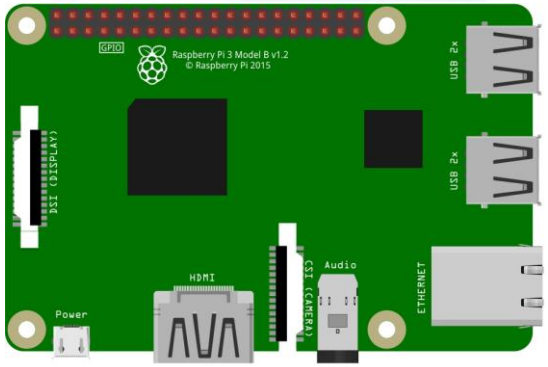
Hands On With ROS

Class 5: Exploring a Publisher-Subscriber ROS Controller







March 27, 2020

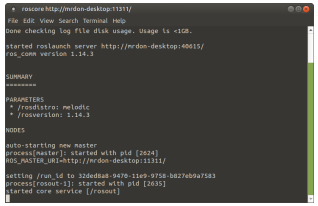
Don Wilcher

DesignNews

CEC CONTINUING EDUCATION CENTER

Presented by: Digi-Key ELECTRONICS

Class 5: Exploring a Publisher-Subscriber ROS Controller

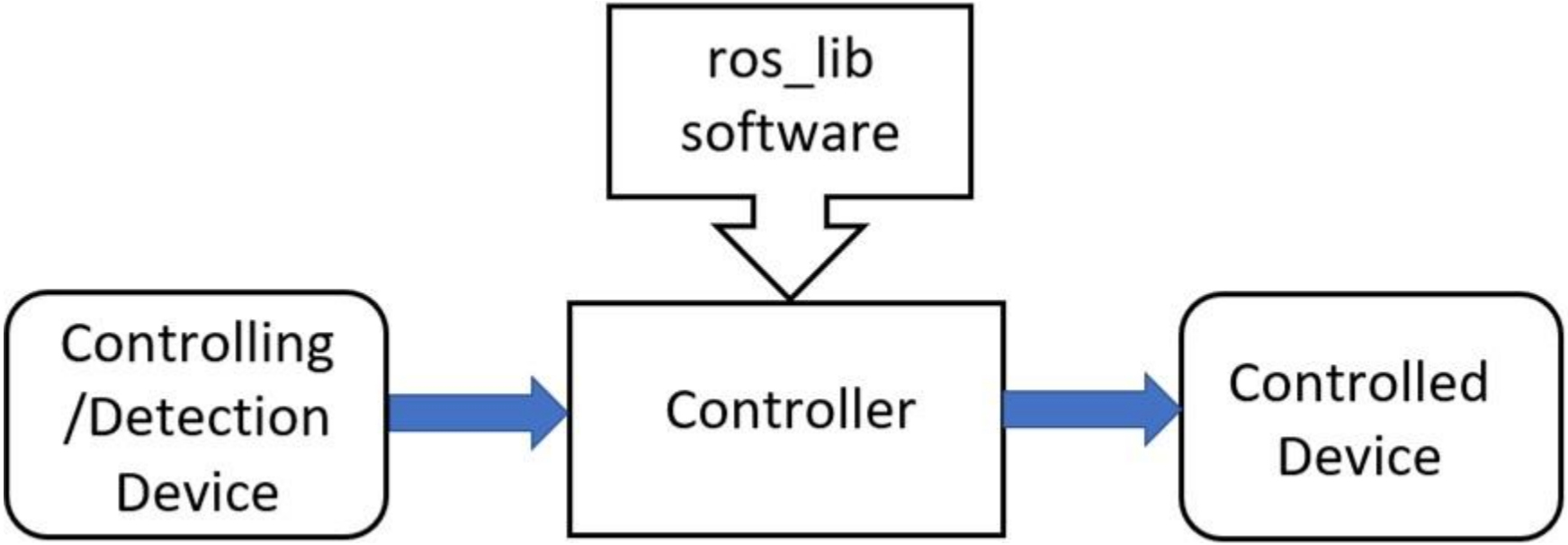


Agenda

- Enhancing the Pushbutton ROS Concept
- ROS Control Concepts
  a) Transistor Driver Circuit
  b) Programmable Switch Controller
- Lab Project: Build a Simple Pushbutton Controller

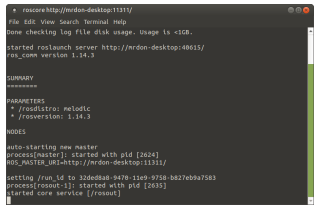
Enhancing the Pushbutton ROS Concept…

How do we enhance the Pushbutton ROS example to control devices?



A ROS based Controller Concept Block Diagram

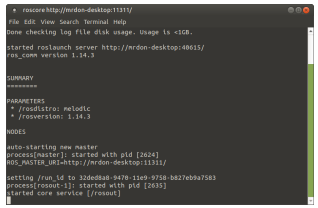
Enhancing the Pushbutton ROS Concept…



The BIG IDEAS

- With the use of the Pushbutton ROS example, a variety of controller device concepts can be rapidly developed.
- Exploring other consumer and industrial applications besides robotics using ROS.
- Allows additional ROS research among technical educators, makers, engineers, and hobbyists

Enhancing the Pushbutton ROS Concept…



A electromechanical tester

ros_lib software

PLC Ladder Logic program tester

Controlling /Detection Device

Controller

Controlled Device

A small DC motor controller

Small electronics technology trainer

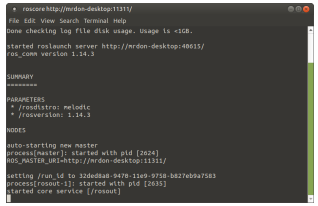
ROS Controller and Tester Applications

Presented by:

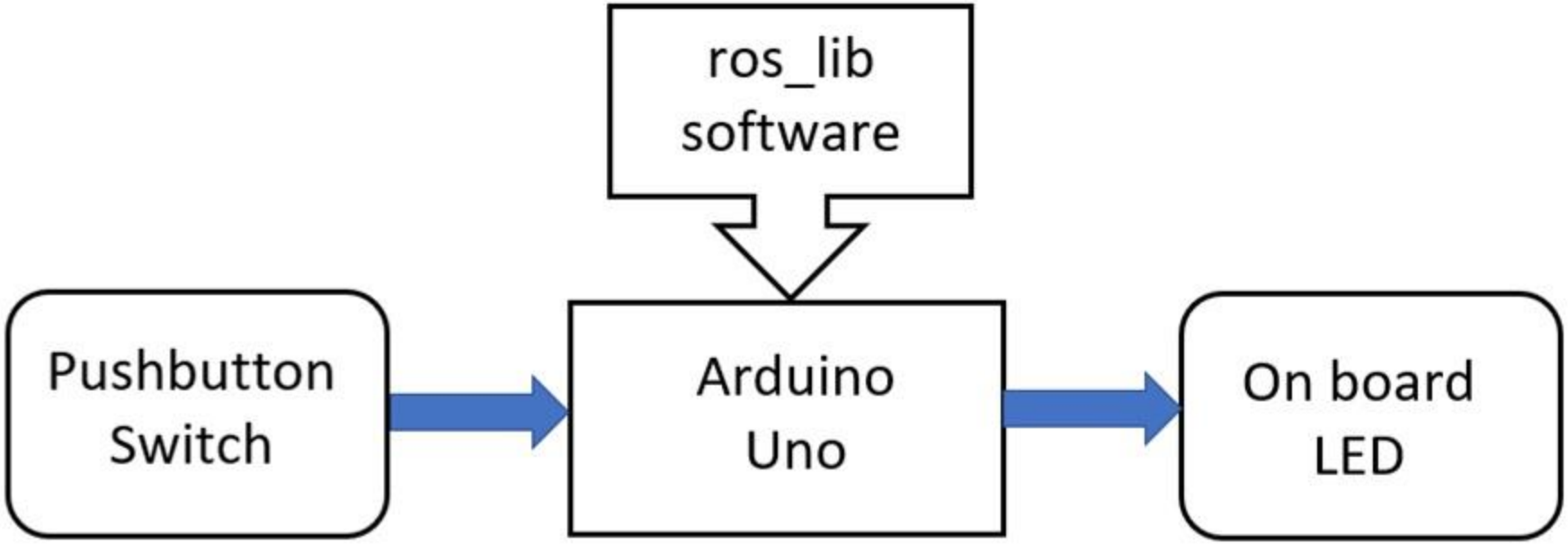
Question 1

What are the four components used to build a ROS Controller and Tester Applications?

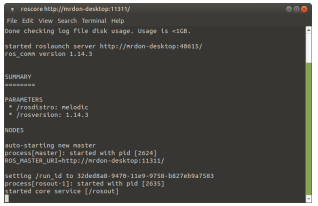
ROS Control Concepts



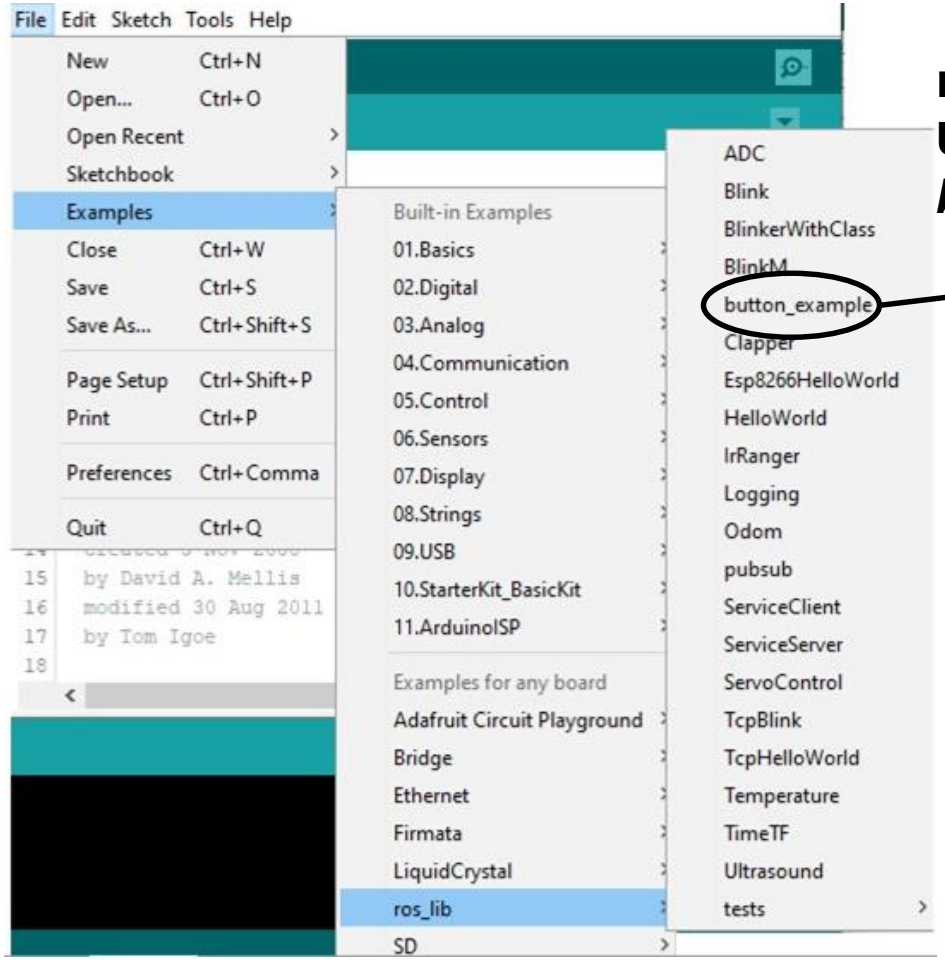
ROS Controller Concept 1



ROS Control Concepts…



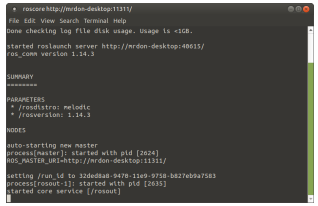
ROS Controller Concept 1



ros_lib:
Upload the *button_example* Sketch

ros_lib:
The *button_example* Sketch provides the pushed topic for publishing!

ROS Control Concepts…



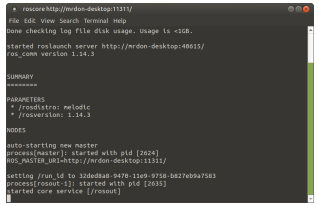
ROS Controller Concept 1

```
const int button_pin = 7;
const int led_pin = 13;
```

Can make modifications here!

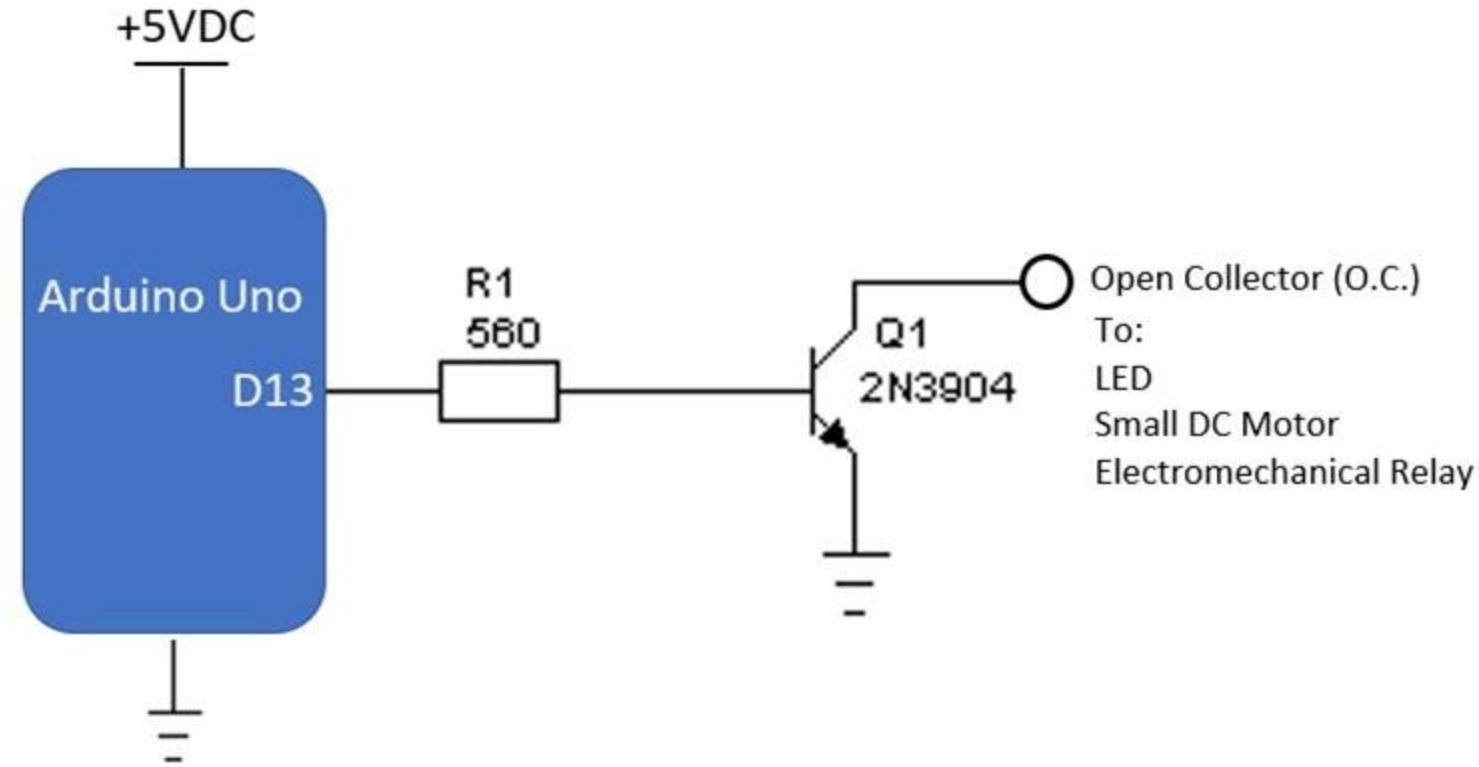
```
bool last_reading;
long last_debounce_time=0;
long debounce_delay=50;
bool published = true;

void setup()
{
  nh.initNode();
  nh.advertise(pub_button);

  //initialize an LED output pin
  //and a input pin for our push button
  pinMode(led_pin, OUTPUT);
  pinMode(button_pin, INPUT);
```

ros_lib:
***button_example* Sketch**

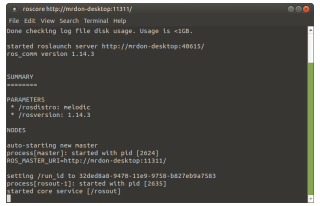


ROS Control Concepts…

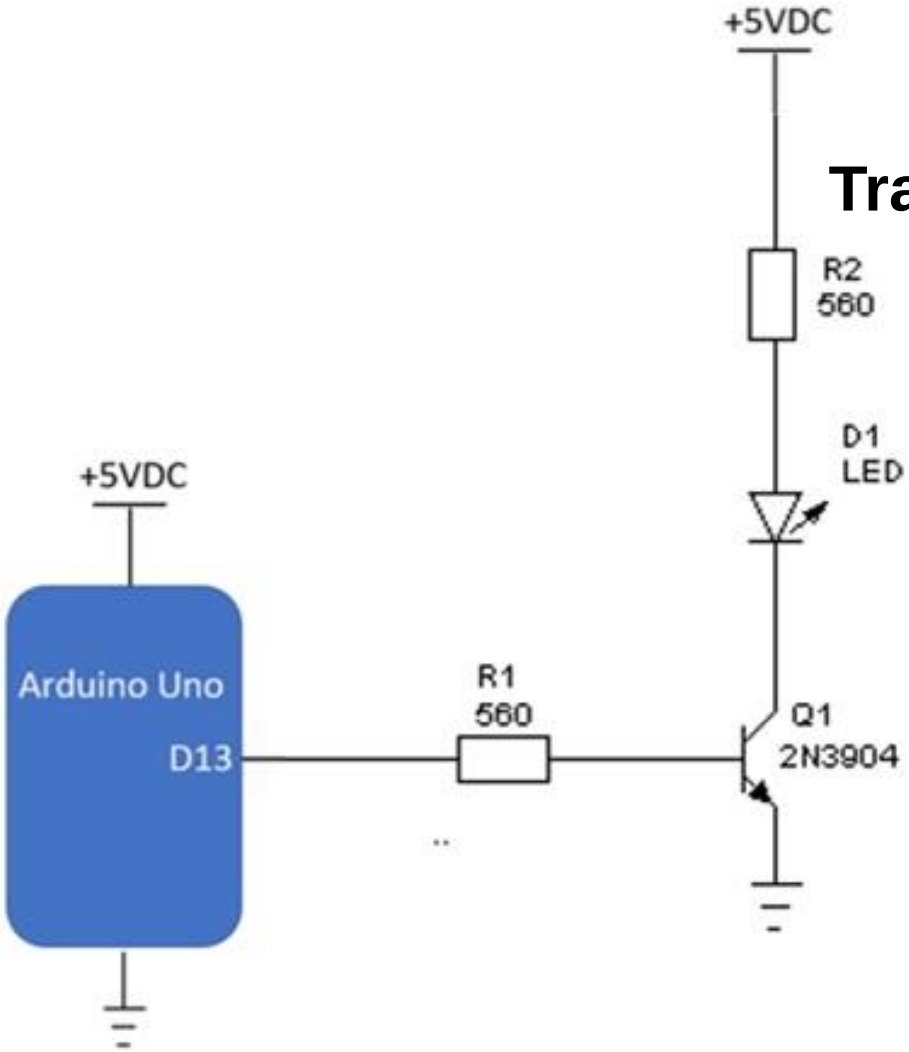
ROS Controller Concept 1: Open Collector Transistor Driver Circuit for the Arduino Uno



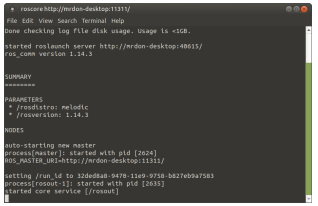
ROS Control Concepts…



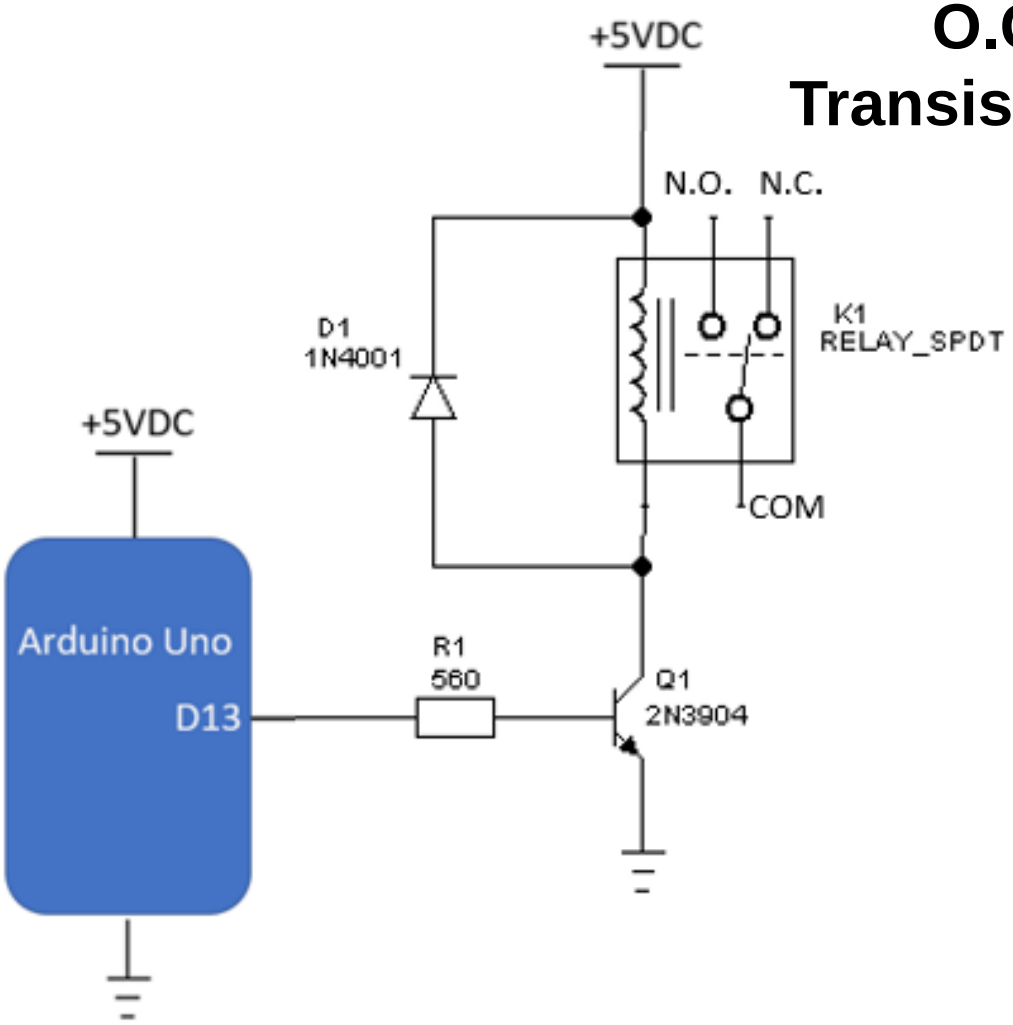
O.C Circuit Example: Transistor LED Driver Circuit



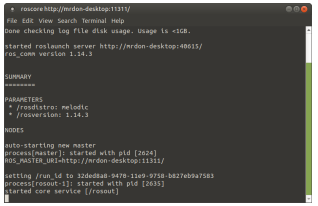
ROS Control Concepts…



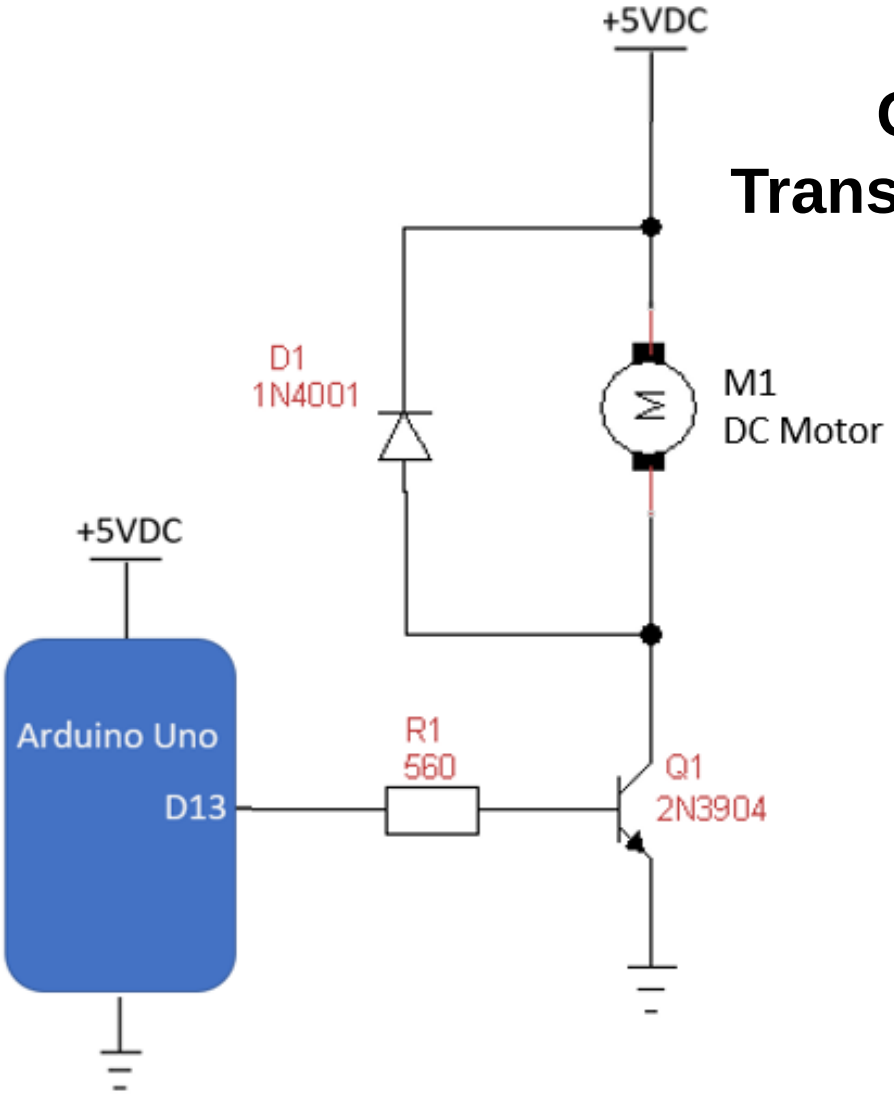
O.C Circuit Example: Transistor Relay Driver Circuit



ROS Control Concepts…



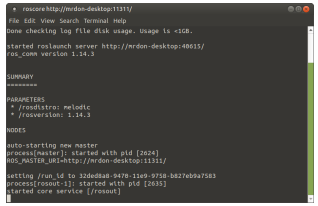
O.C Circuit Example: Transistor Motor Driver Circuit



Question 2

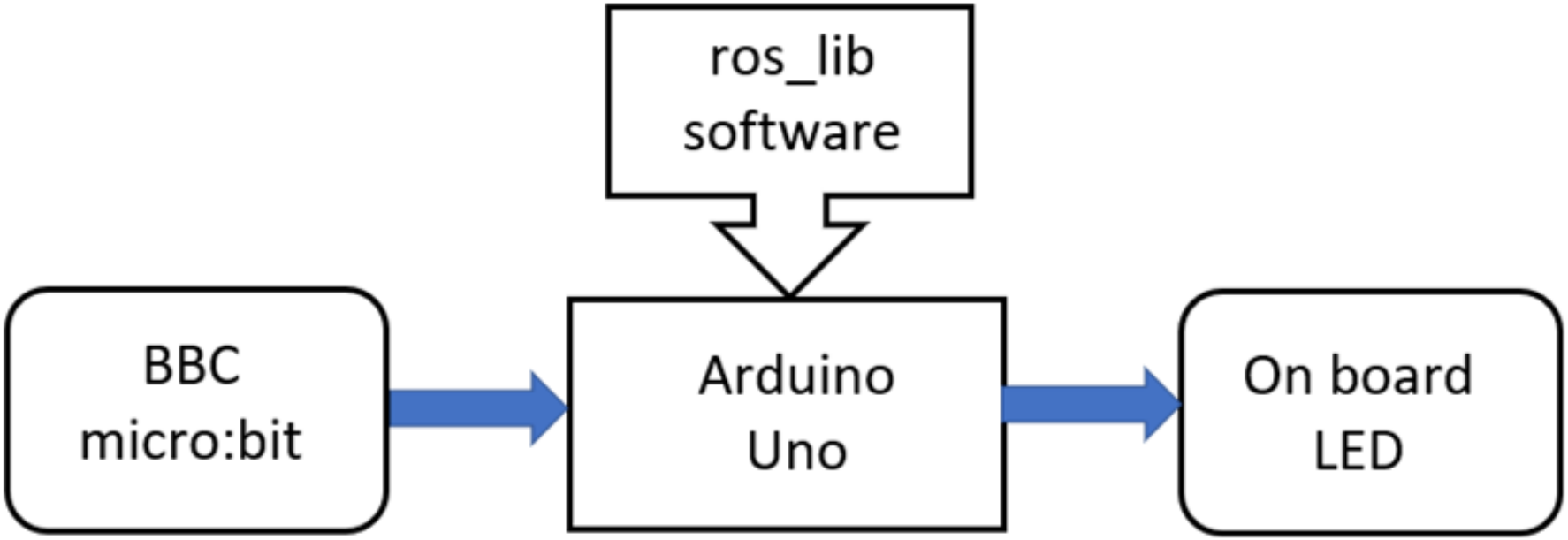
What is the primary component used to create an electronic driver circuit?

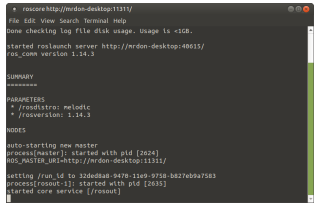
ROS Control Concepts…



Programmable Switch Controller

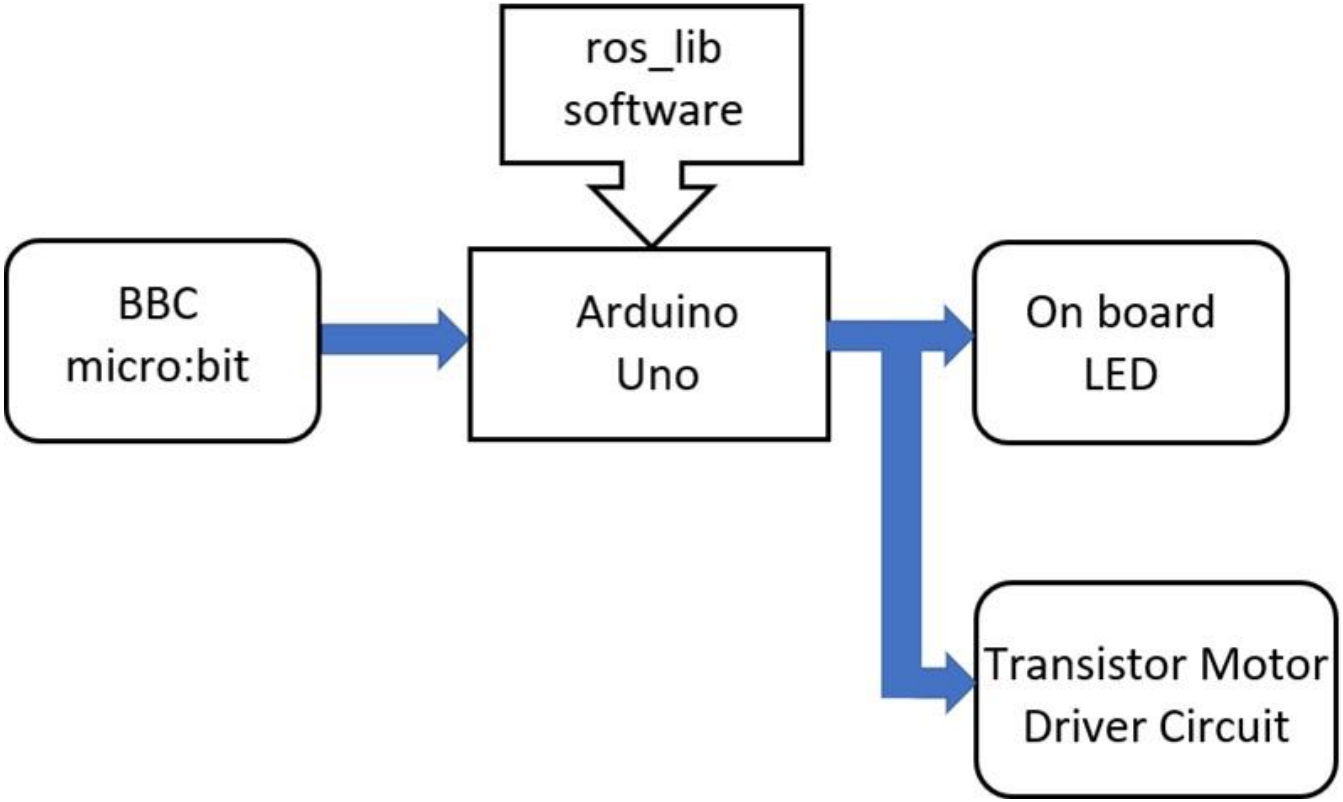
ROS Controller Concept 2

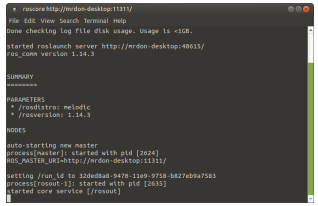




ROS Control Concepts…

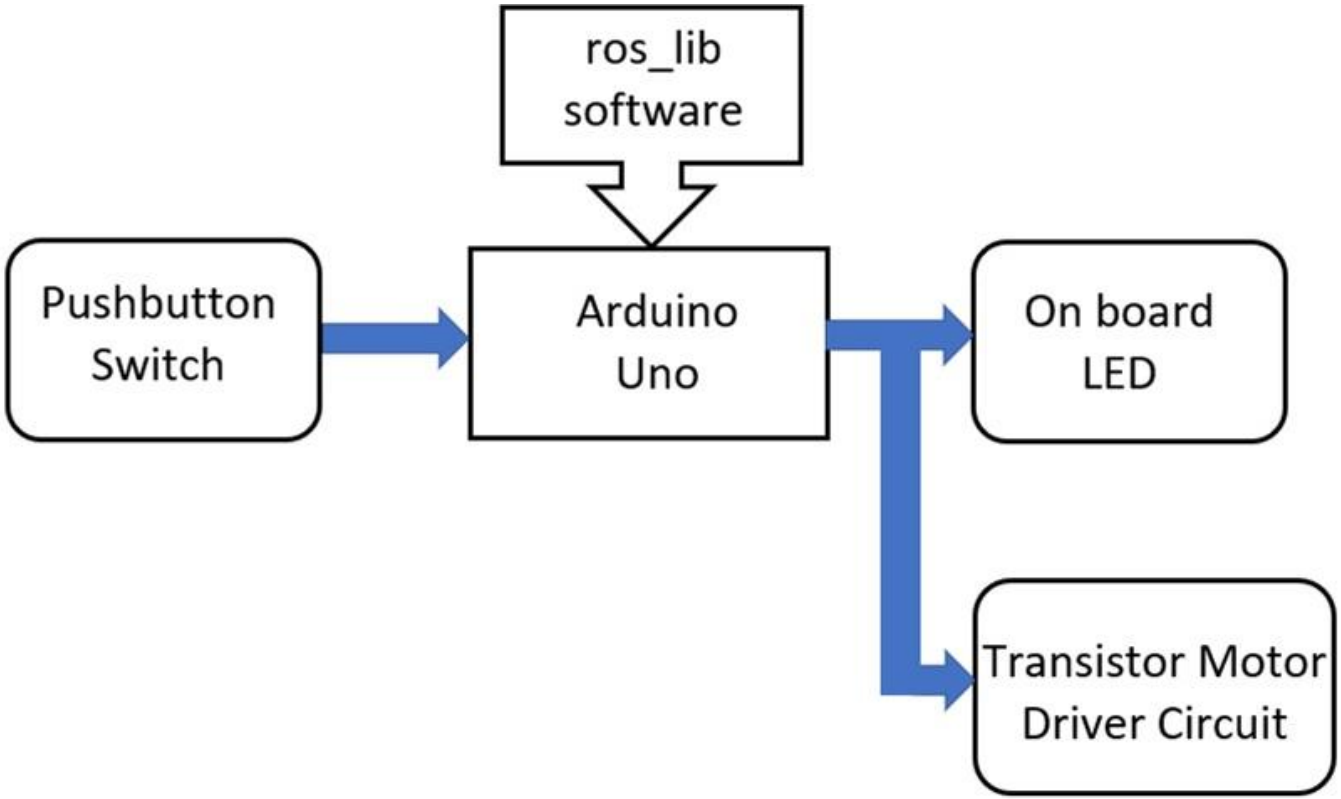
ROS Controller Concept 2a



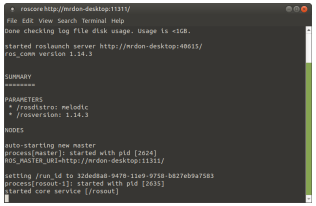


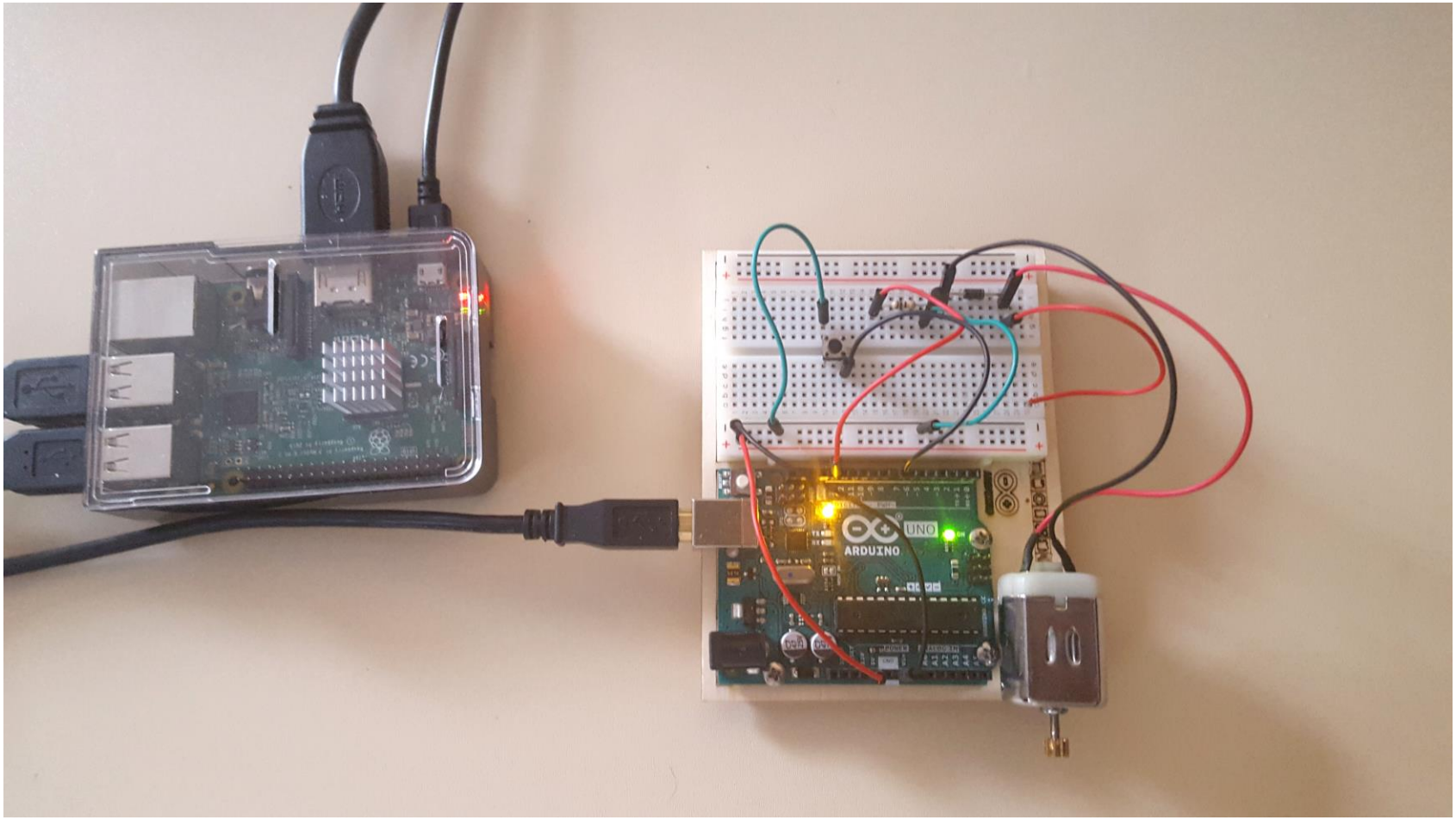
ROS Control Concepts…

ROS Controller Concept 2b



Lab Project: Build A ROS Simple Pushbutton Controller





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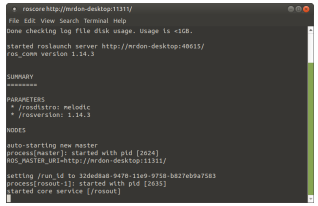
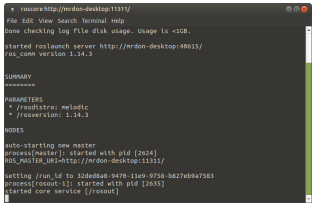


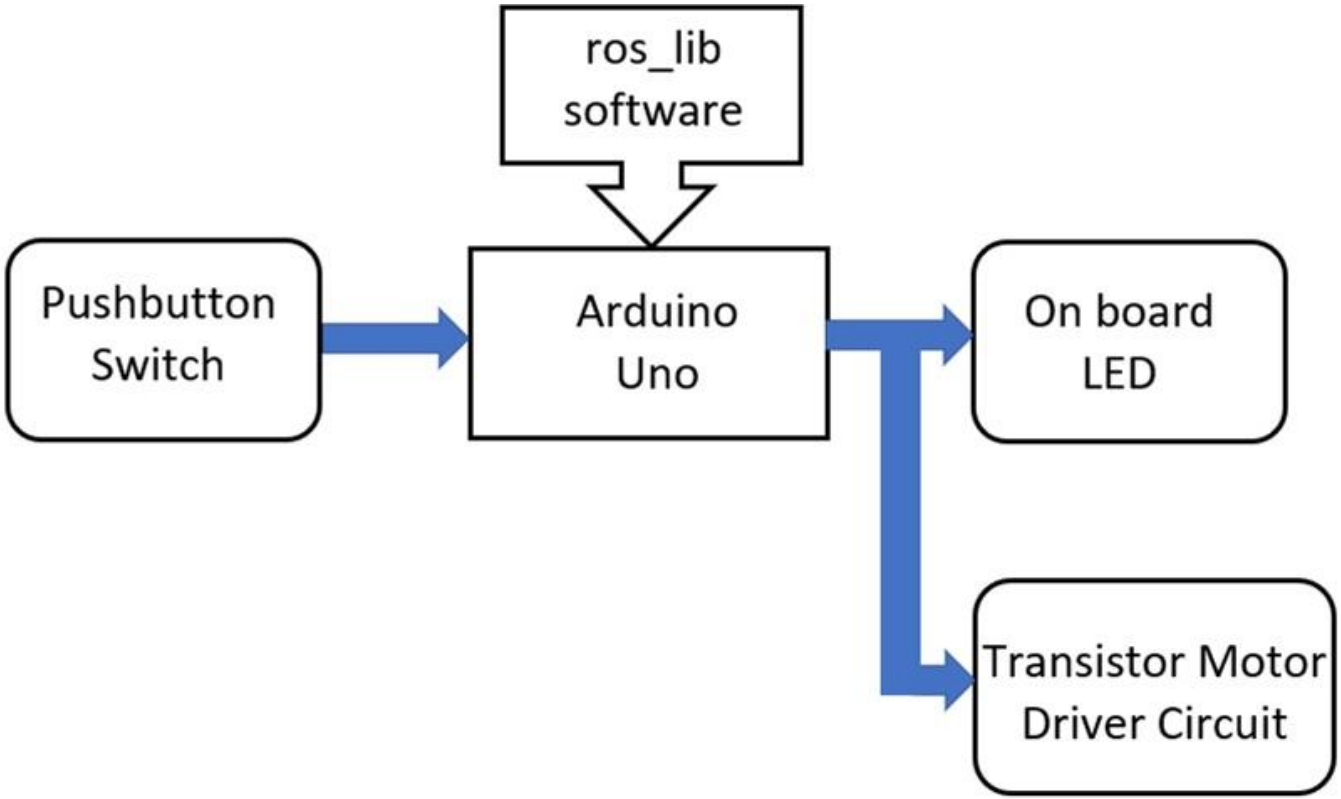
Lab Objectives:

- Learn how attach a Raspberry Pi to an Arduino.
- Learn how to communicate with a ROS node.
- Learn how to display the dynamic graph of the pushbutton rostopic.
- Learn how to control a dc motor using the rostopic pub echo command.

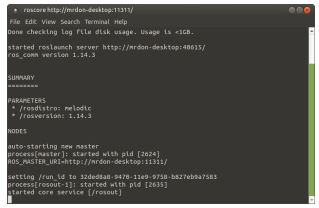


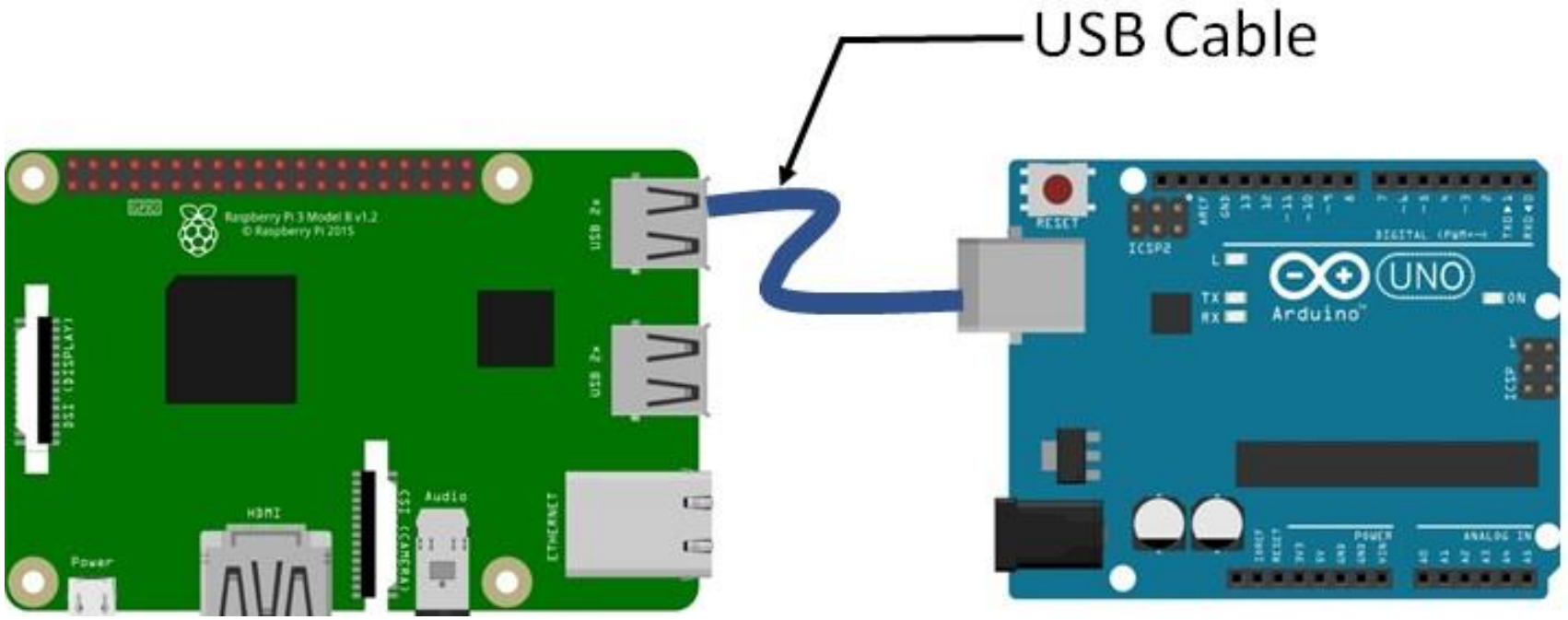
ROS Control Concepts…

ROS Controller Concept 2b



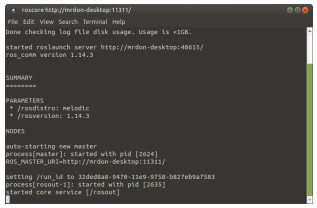
How to attach a Raspberry Pi to an Arduino?...

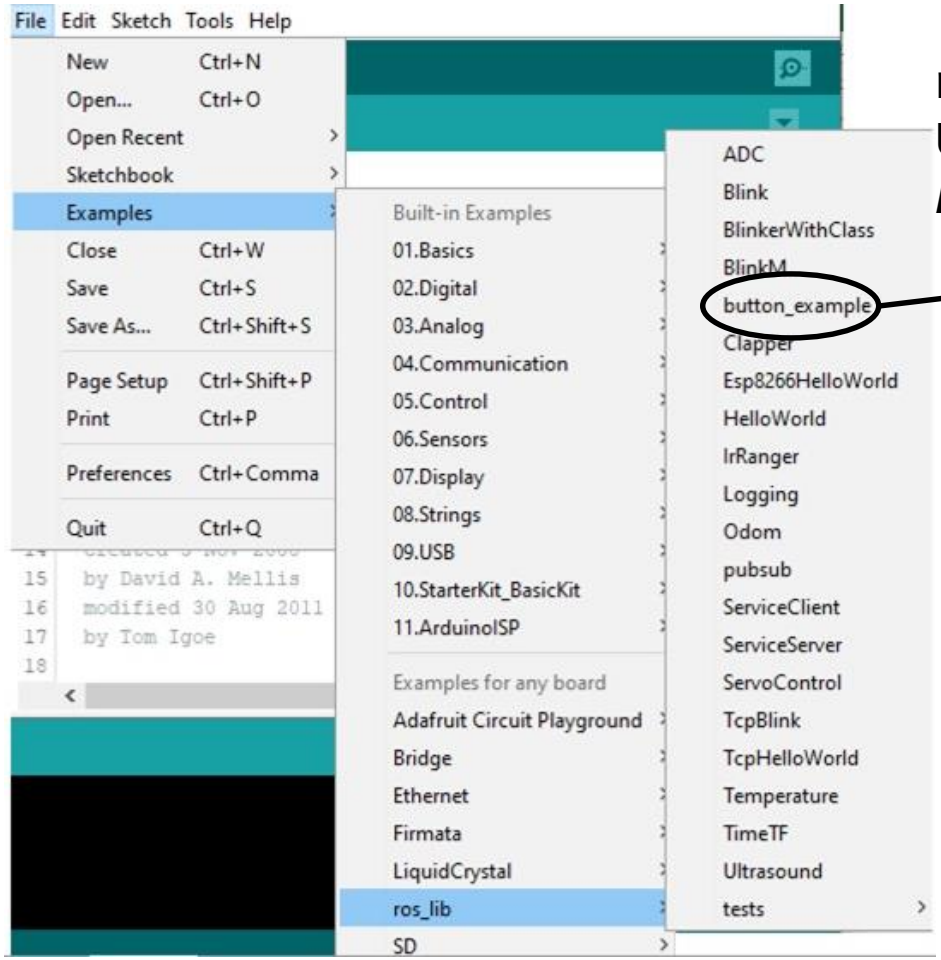




Serial communication between the Raspberry Pi 3 and Arduino Uno

How to attach a Raspberry Pi to an Arduino?...





ros_lib:
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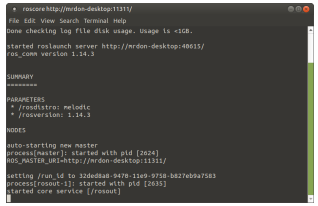
Lab Project: Build A ROS Simple Pushbutton Controller…



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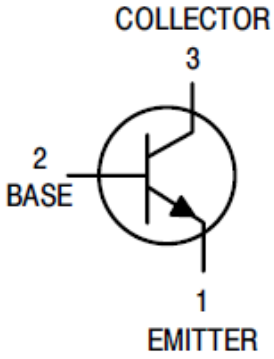
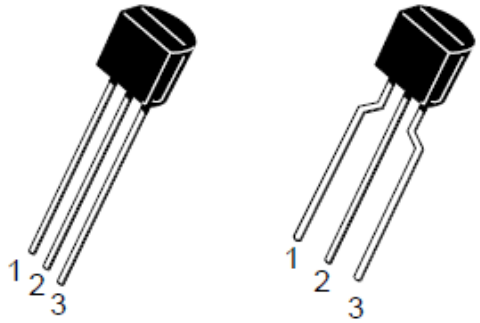
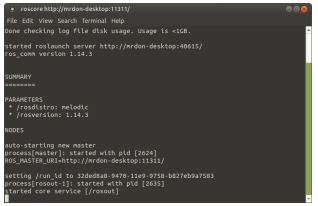


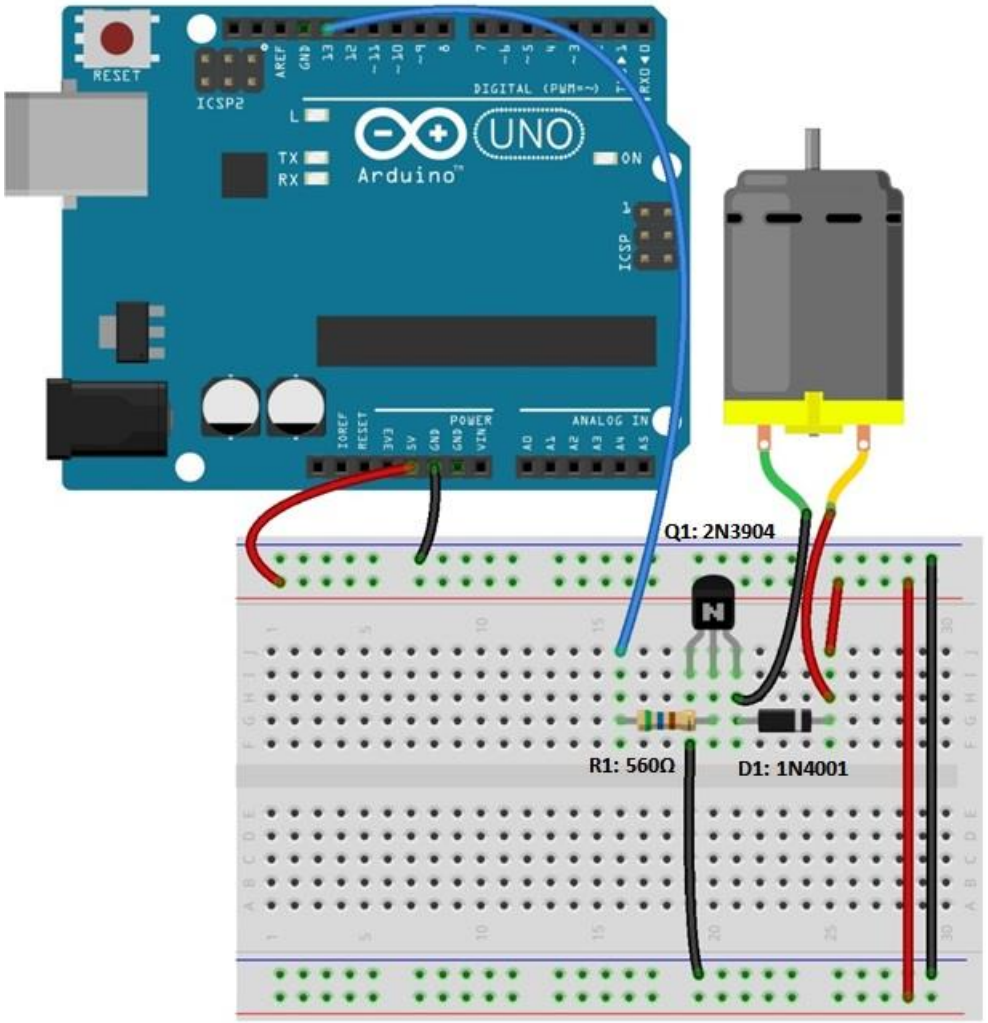
TO–92
CASE 29
STYLE 1



Note: Q1 can be a MPS2222A or 2N3904 NPN Transistor. The pinout of each transistor are equivalent.

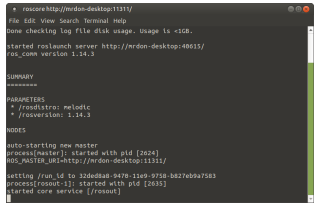
Lab Project: Build A ROS Simple Pushbutton Controller…

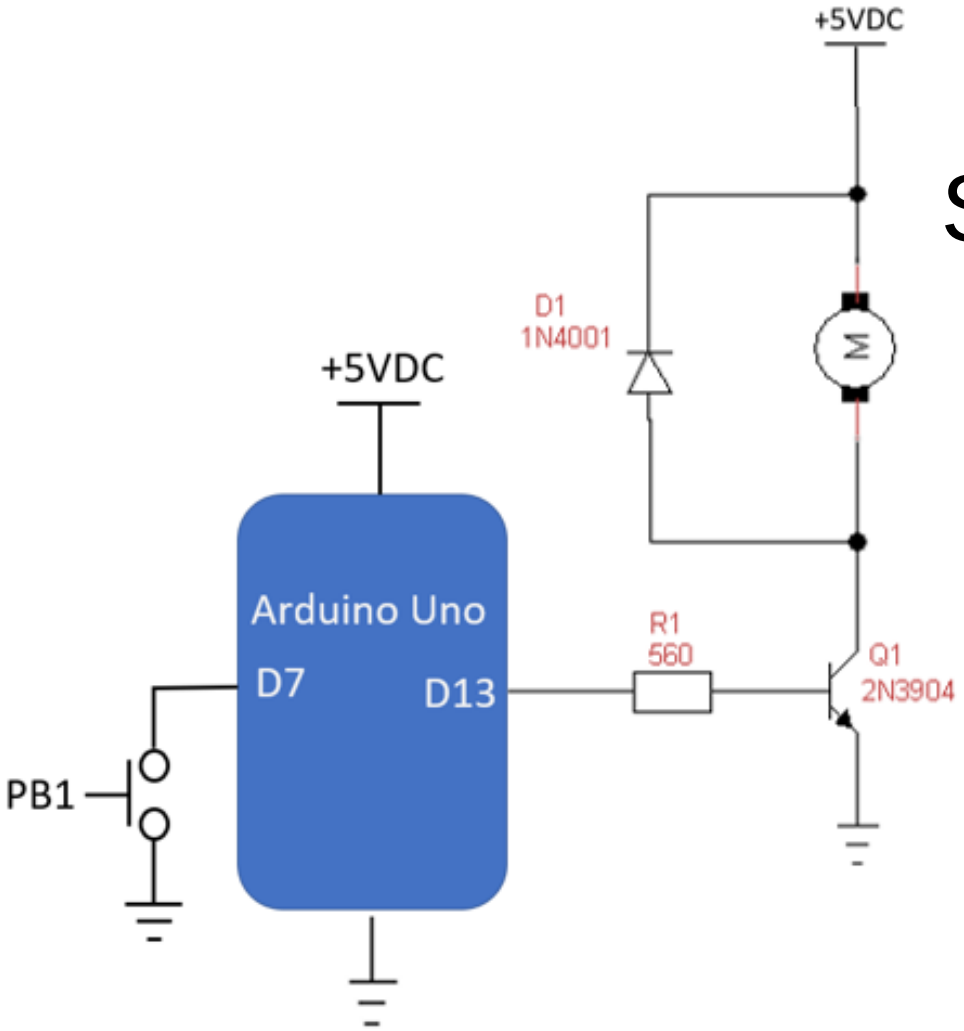




Simple Pushbutton Controller Electrical Wiring Diagram

Lab Project: Build A ROS Simple Pushbutton Controller…





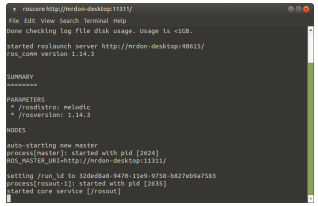
Simple Pushbutton Controller Electronic Circuit Diagram

Note: Q1 can be a MPS2222A or 2N3904 NPN Transistor

Question 3

Of the driver circuits discussed in slides 11-13, what circuit was selected for the ROS Simple Pushbutton Controller?

How to attach a Raspberry Pi to an Arduino?



Open a linux terminal: At the prompt type: roscore.

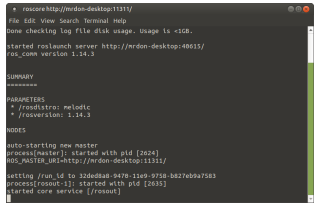
roscore http://mrdon-desktop:11311/

File Edit View Search Terminal Help

```
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://mrdon-desktop:40615/
ros_comm version 1.14.3


SUMMARY
========

PARAMETERS
 * /rosdistro: melodic
 * /rosversion: 1.14.3

NODES

auto-starting new master
process[master]: started with pid [2624]
ROS_MASTER_URI=http://mrdon-desktop:11311/

setting /run_id to 32ded8a8-9470-11e9-9758-b827eb9a7583
process[rosout-1]: started with pid [2635]
started core service [/rosout]
```

roscore **running in an active window**

How to communicate with a ROS node?...



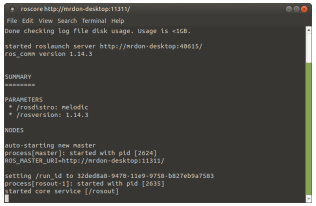
To run the rosserial client application for communicating with the attached Arduino Uno, open a new window and type the following *ros_lib* command after the prompt.

$ rosrun rosserial_python serial_node.py /dev/***serial port*****.**

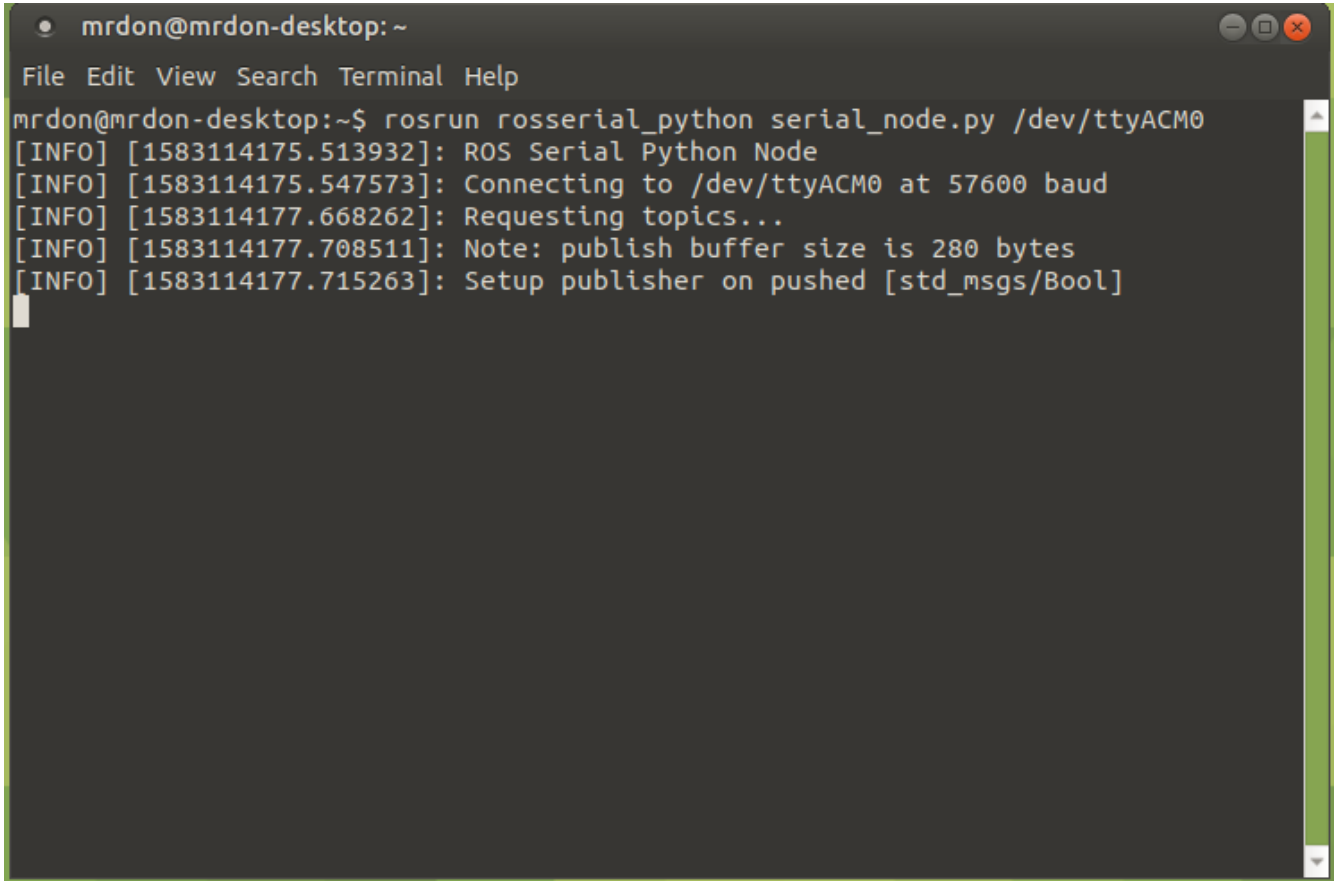
Note: *serial port* is the communication port used on the Arduino Uno to talk to the Raspberry Pi.

For example: ttyACM0 **is the Arduino Uno's serial port to communicate with the Raspberry Pi.**

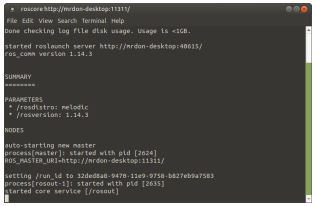
How to communicate with a ROS node?...



Open linux terminal: rosrun rosserial_python running



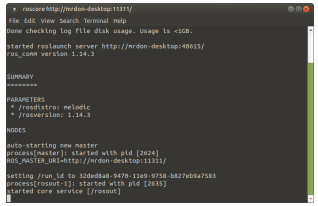
How to display the Binary message?...

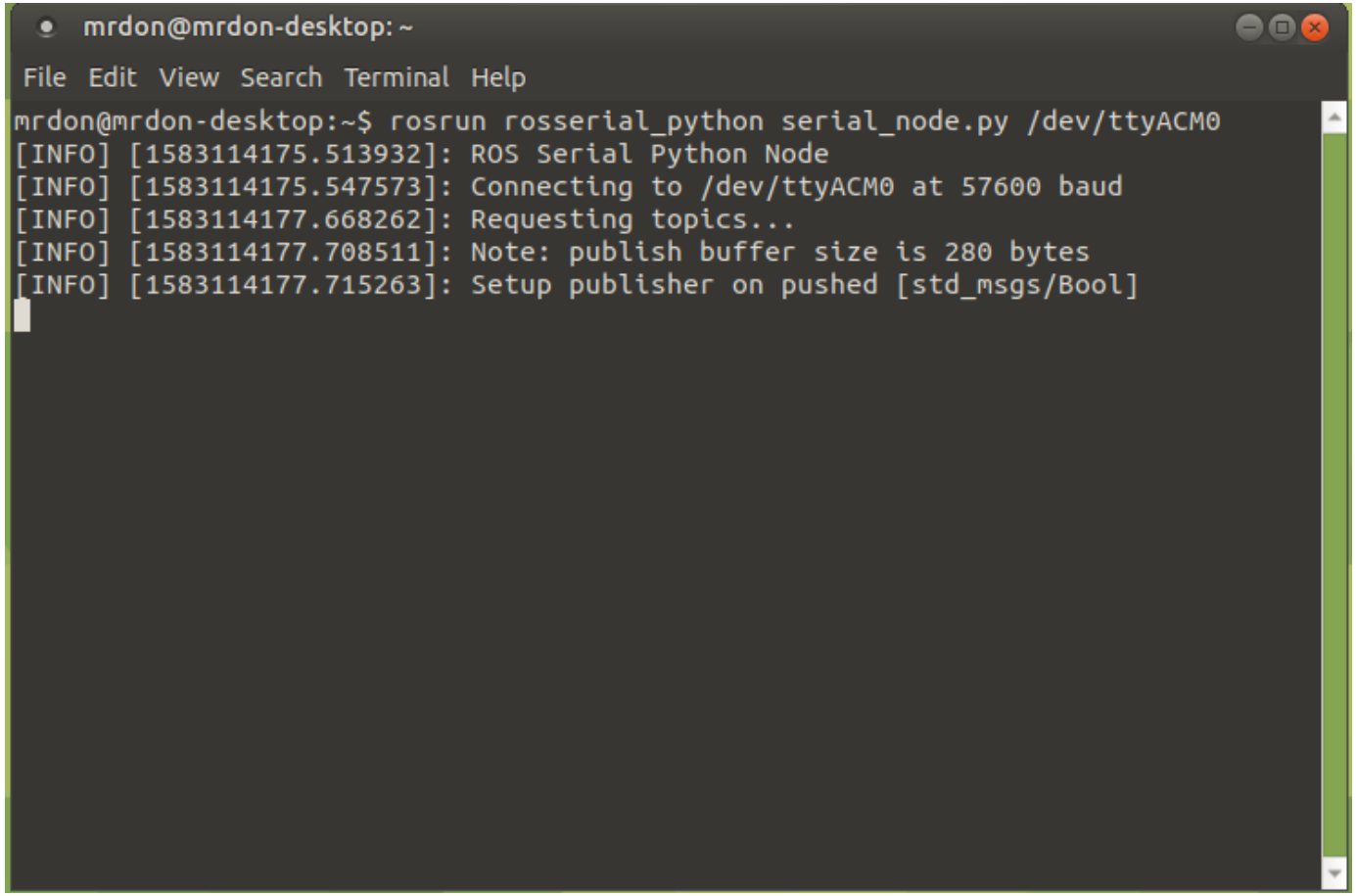


To watch the binary message (True or False), open a new terminal window and type the following *ros_lib* command after the prompt.

$ rostopic echo pushed

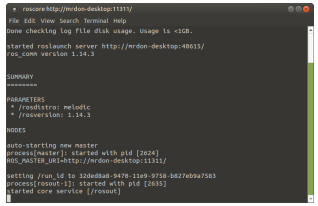
How to display the Binary message?...



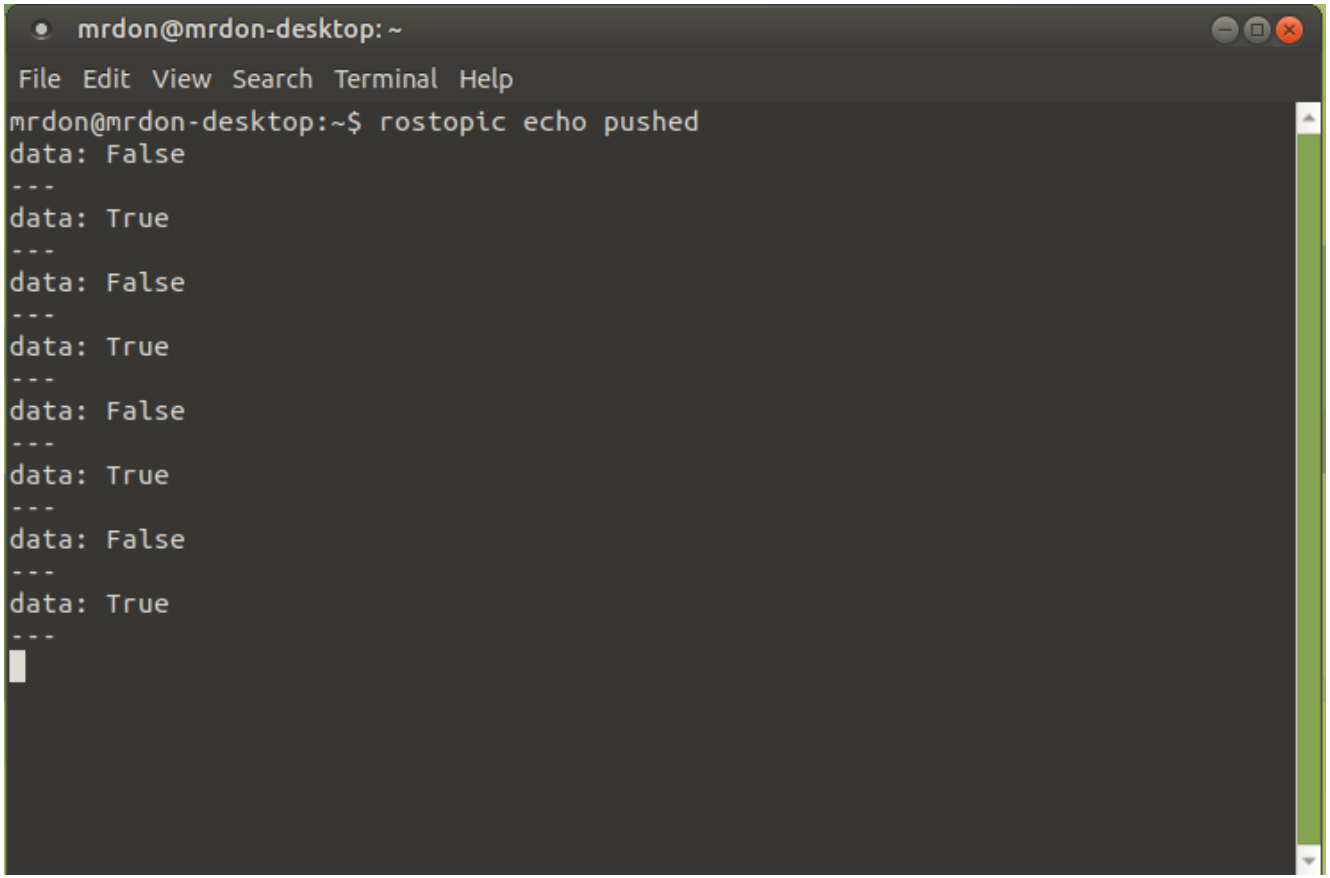


rosserial **running in an active window**

How to display the Binary message?...



Open linux terminal: press and release button “A” on micro:bit

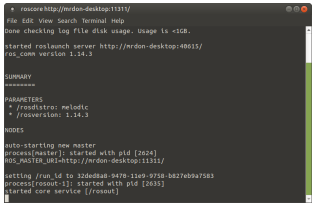


rostopic **running in an active window**

Question 4

What ros_lib command is used to display the binary (True or False)?

How to display a dynamic graph of the pushbutton rostopic?...



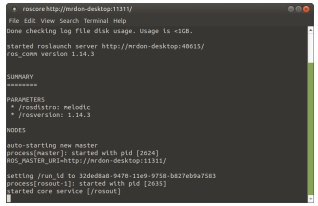
mrdon@mrdon-desktop: ~

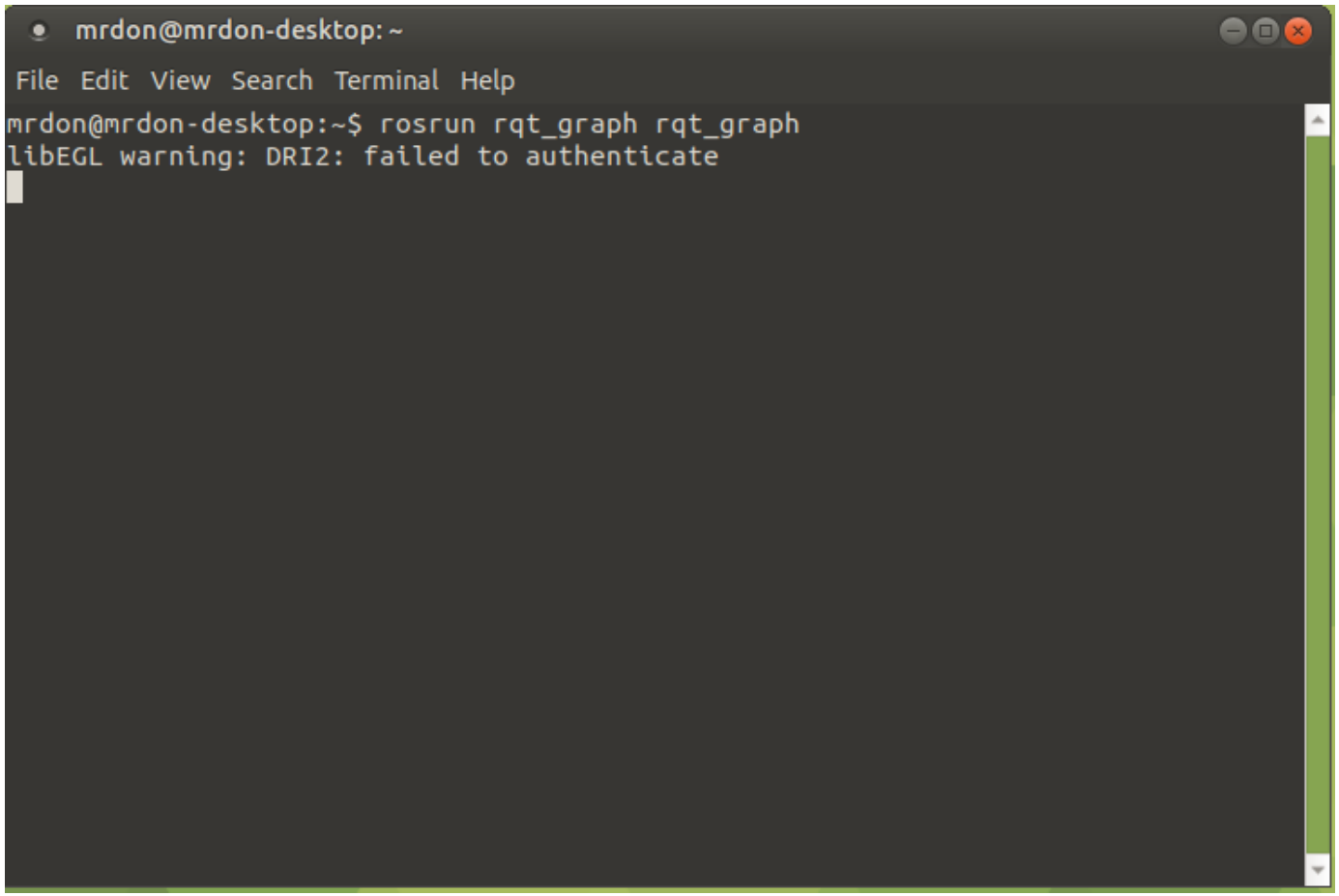
File Edit View Search Terminal Help

```
mrdon@mrdon-desktop:~$ sudo apt-get install ros-melodic-rqt
[sudo] password for mrdon:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  apt-clone archdetect-deb cryptsetup-bin dpkg-repack gir1.2-json-1.0
  gir1.2-nm-1.0 gir1.2-nma-1.0 gir1.2-timezonemap-1.0 gir1.2-xkl-1.0
  grub-common libdebian-installer4 libpng12-0 libtimezonemap-data
  libtimezonemap1 os-prober python3-icu python3-pam rdate
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  ros-melodic-rqt
0 upgraded, 1 newly installed, 0 to remove and 31 not upgraded.
Need to get 2,232 B of archives.
After this operation, 14.3 kB of additional disk space will be used.
Err:1 http://packages.ros.org/ros/ubuntu bionic/main arm64 ros-melodic-rqt arm64
 0.5.0-0bionic.20190602.130423
  404  Not Found [IP: 2600:3402:200:227::2 80]
E: Failed to fetch http://packages.ros.org/ros/ubuntu/pool/main/r/ros-melodic-rq
t/ros-melodic-rqt_0.5.0-0bionic.20190602.130423_arm64.deb  404  Not Found [IP: 2
600:3402:200:227::2 80]
E: Unable to fetch some archives, maybe run apt-get update or try with --fix-mis
sing?
```

Installing *rqt*

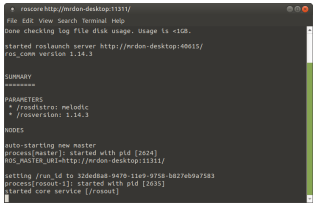
How to display a dynamic graph of the servo rostopic?...

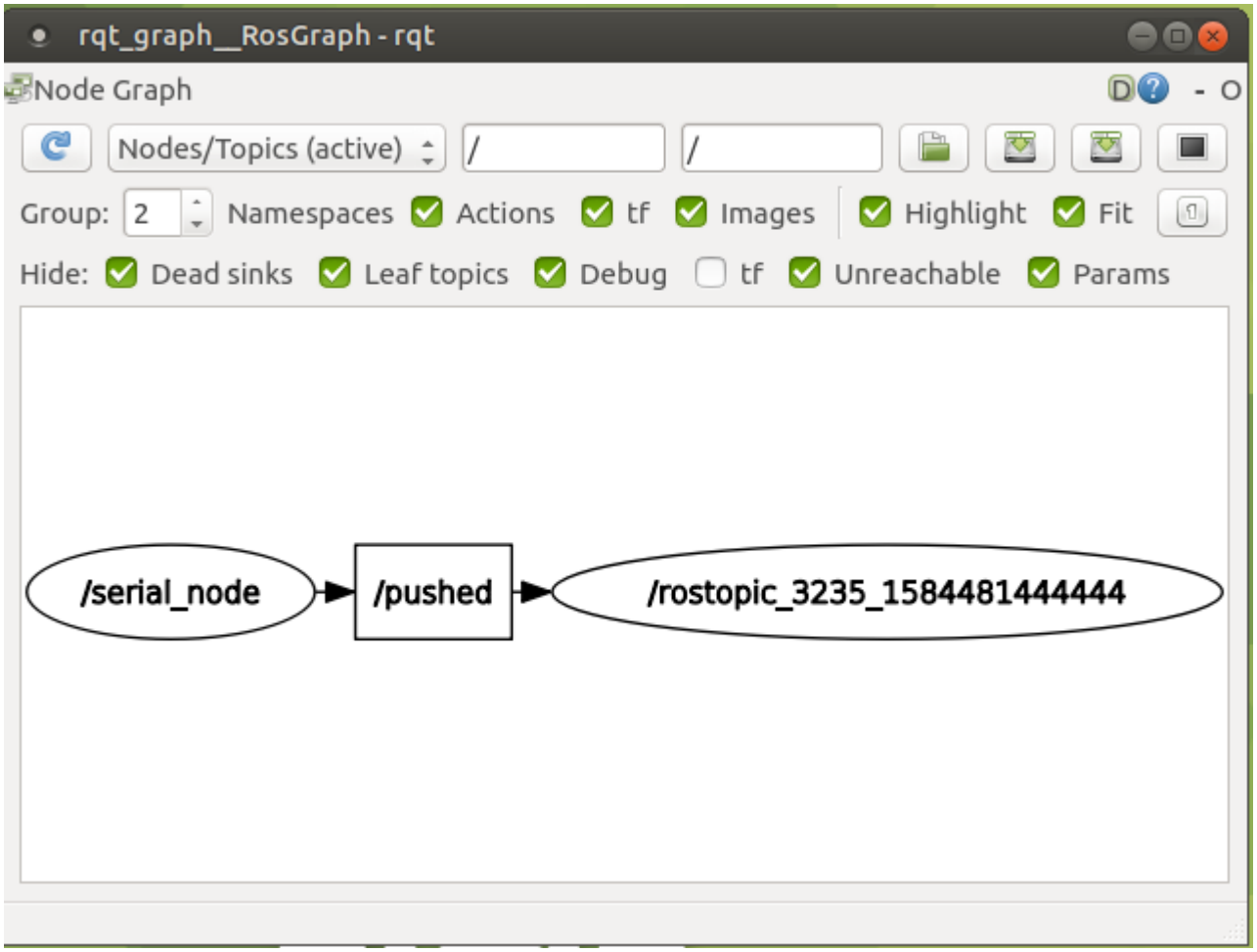




Running *rqt_graph*

How to display a dynamic graph of the pushed rostopic?...





pushed *rqt_graph*
Place your mouse over */pushed* to highlight the ROS Nodes. Nodes will be displayed blue and green and topic(s) in red.

Question 5

What color is displayed for topics viewed in the pushed rostopic dynamic graph?

Congratulations!