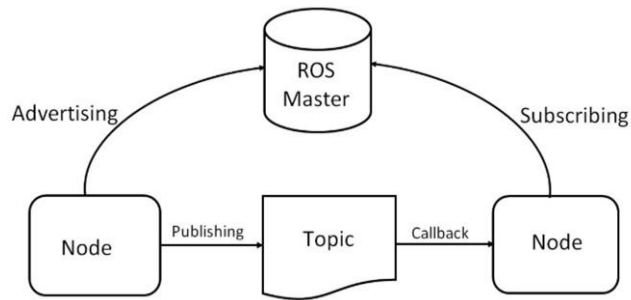


# Hands On With ROS

## Class 1: Introduction to ROS



```
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

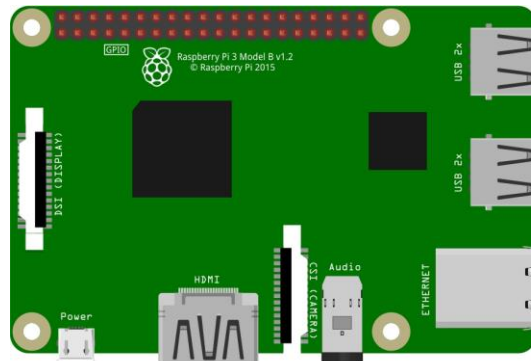
SUMMARY
=====

PARAMETERS
* /rostdistro: 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]
```



March 23, 2020  
Don Wilcher

# Class 1: Introduction to ROS

```
~/ros_ws/src (~/ros_ws-desktop:11311)
File Edit View Search Terminal Help
Done checking log file disk usage. usage is <1GB.
started roslaunch server http://mrdon-desktop:40015/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roslaunch: roslaunch
 * /rosworkspace: 1.14.3

NODES
-----
auto-starting new master
process[master]: started with pid [2024]
ROS_MASTER_URI=http://mrdon-desktop:11311/

setting /run_id to 326d8aa-9470-11ep-975d-b278b9a7583
process[roscpp-1]: started with pid [2033]
started core service [/roscpp]
```

## Agenda

- Introduction to ROS
- ROS Applications
- Installation of ROS
- Lab Project: ROS Hello World!

# Introduction to ROS

```
* rosrevel@jordan-desktop:11317
run: cat /etc/passwd
Done checking log file disk usage, usage is okay.
started roslaunch server http://jordan-desktop:40017/
ros_core version 1.14.3

SUMMARY
=====
PARAMETERS
 * /rostopic: melodic
 * /roscore_name: 1.14.3
MODES

auto-starting new master
process[master]: started with pid [2001]
MFC_MASTER_URI=http://jordan-desktop:11317

setting /run_id to 22688aa8-0478-11e9-9756-b8278bb97583
process[roscpp]: started with pid [2002]
started core service [/roscpp]
```

## The Robot Operating System was first released:

- by two Stanford PhD students around 2007.
- to be a distributed and modular open-source platform for robotics software development.
- allowing makers, engineers, researchers, and educators to use as little or much of the modular library functions for their software application packages.

# Introduction to ROS...

```
~/roscat@mrdon-desktop:11317
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://mrdon-desktop:48511/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /robotns: meloic
 * /rostopic: 1.14.3

NODES
-----
auto-starting new master
process[roscat]: started with pid [2024]
ROS_MASTER_URI=http://mrdon-desktop:11317

setting /run_id to 320d8aa-947b-11e9-9758-ba27e0a7583
process[roscd-21]: started with pid [2033]
started core service [/roscat]
```

## The Robot Operating System has:

- Distributive abilities of sharing modular software components
- Major appeal of the robotics community
- Currently over 3,000 software component packages
- Open Robotics community contributing software component packages continuously.

# Introduction to ROS...

```
~/ros_ws/src/roscpp/roscpp$ ./roscpp_node1
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 1GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
=====
PARAMETERS
 * /roscpp_node1: roscpp
 * /roscpp_node1__ns: /14_3

NODES
auto-starting new master
process[roscpp]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8a8-947b-11e5-9758-b2780a7563
process[roscpp-2]: started with pid [2033]
started core service [/roscpp]
```

## The Robot Operating System is

A software development platform that provides a system of nodes.

- a) Nodes allow interprocesses to occur within the target's intelligent platform.
- b) Interprocesses allow the sharing of functional messages to occur within an robotic architecture

# Question 1



**What year was ROS released?**

# Introduction to ROS...

```
~/ros_ws/src/roscpp_tutorials$ catkin_make
Done checking log file disk usage. Usage is 1GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roscpp_tutorials: roscpp_tutorials
 * /roscpp_tutorials__ros_core: 1.14.3

NODES
-----
auto-starting new master
process[roscpp_tutorials]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 32d6d8a1-947b-11e5-9758-ba27ad0a7563
process[roscpp_tutorials]: started with pid [2033]
started core service [/roscpp_tutorials]
```

## The robotic architecture of ROS consists of 5 components

- a) ROS Master
- b) nodes
- c) publishers
- d) subscribers
- e) topics

# Introduction to ROS...

```
~/ros_ws/src/roscpp/roscpp$ catkin_make
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roscpp: roscpp
 * /roscpp__name: /roscpp
 * /roscpp__ns: /roscpp

NODES
-----
auto-starting new master
process[roscpp]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8a8-947b-11e5-975e-ba2780a7563
process[roscpp-2]: started with pid [2033]
started core service [/roscpp]
```

## Definitions:

**ROS Master** – is responsible for managing names and registration services to the nodes within a ROS System.

**Node** – An executable file within the ROS system to allow communication with another node.

**Publisher** – A message that is transmitted by a node or topic within a ROS system.

**Subscriber** – A message that is received by a node or topic within a ROS system



# Introduction to ROS...

```
~/ros_ws/src/roscpp/roscpp$ catkin_make
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://mrdon-desktop:40011/
ros_core.service 3.14.3

SUMMARY
-----
PARAMETERS
 * /roscpp: roscpp
 * /roscpp__core: 3.14.3

NODES
auto-starting new master
process[roscpp]: started with pid [2024]
ROS_MASTER_URI=http://mrdon-desktop:11311/

setting /run_id to 320d8a8-947b-11e5-9758-b278b0a7563
process[roscpp-2]: started with pid [2033]
started core service [/roscpp]
```

## Definitions:

**Topic** – The publishing and subscribing of a message of a specific name type.

**Note:** Each of these software components allow a robotic system to move, sense, monitor, and process a variety of signal and imaging data.

# Question 2



**Which ROS robotic architecture component is incorrect?**

- a) ROS**
- b) Nodes**
- c) Topics**
- d) Definitions**
- e) publishers**

# ROS Applications

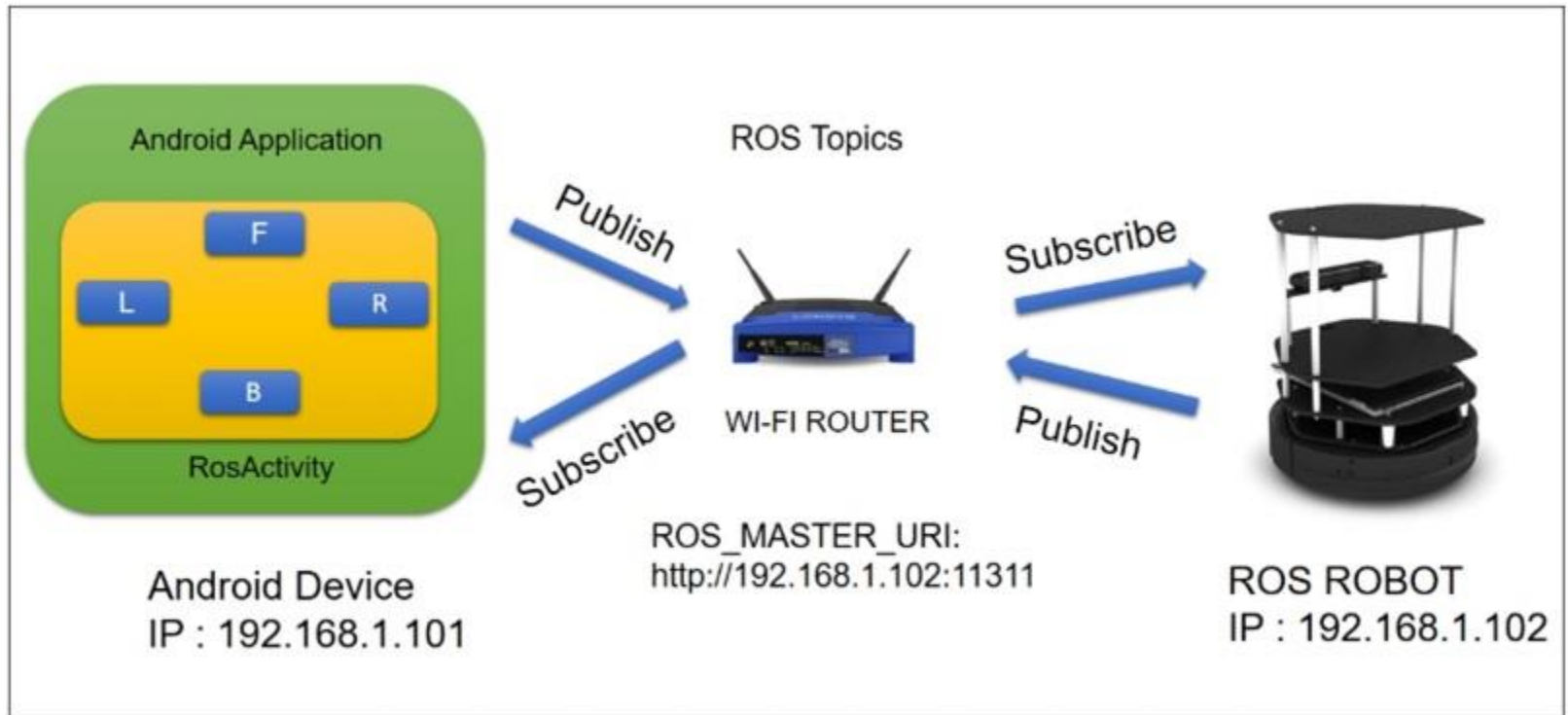
## Teleoperated Robot

```
~/ros_ws/src/roscpp_tutorials/roscpp_tutorials$ catkin_make
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://nrdon-desktop:40011/
ros_core.service: 1.14.3

SUMMARY
=====
PARAMETERS
 * /roscpp_tutorials: roscpp_tutorials
 * /roscpp_tutorials: 1.14.3

NODES
-----
auto-starting new master
process[roscpp_tutorials]: started with pid [2024]
ROS_MASTER_URI=http://nrdon-desktop:11311/

setting /run_id to 320d0ba8-9476-11e5-9758-b2700a7563
process[roscpp_tutorials]: started with pid [2033]
started core service [/roscpp_tutorials]
```



Joseph, L. (2017). *ROS robotics projects*. Birmingham, UK: Packt.

# ROS Applications...

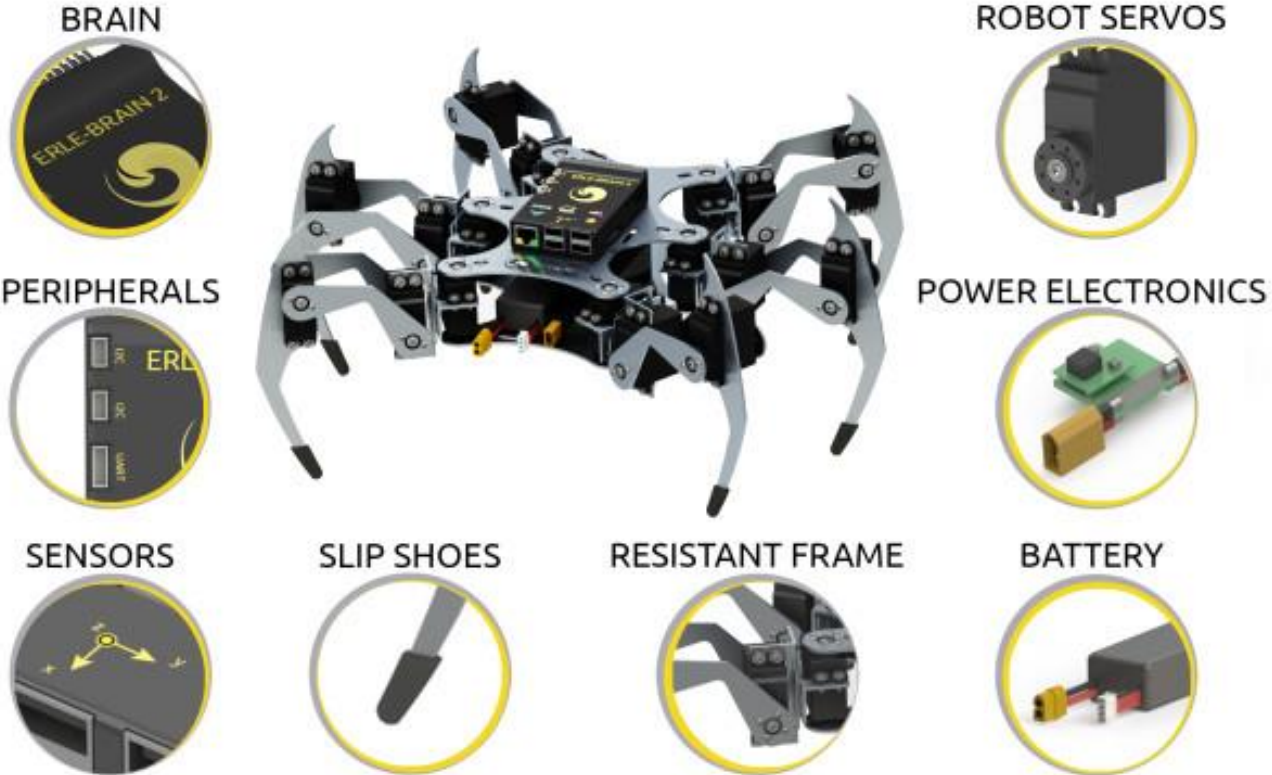
## Erie Spider

```
~/ros_ws/src/erie-spider$ catkin_make
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://mrdon-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roslaunch: roslaunch
 * /roscpp_core: 1.14.3

NODES
-----
auto-starting new master
process[roslaunch]: started with pid [2024]
ROS_MASTER_URI=http://mrdon-desktop:11311/

setting /run_id to 32d0d8a8-9476-11e5-9758-ba2780b97563
process[roscpp_core-1]: started with pid [2033]
started core service [/roscpp_core]
```



ROS.org

# ROS Applications...

## Quadcopters

```
~/roscat@rosdep-desktop:11311/
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 1GB.
started roslaunch server http://rosdep-desktop:40011/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roslauncher: melodic
 * /rosversion: 1.14.3

NODES
-----
auto-starting new master
process[roscat]: started with pid [2024]
ROS_MASTER_URI=http://rosdep-desktop:11311/

setting /run_id to 32d6d8a-947b-11e9-9758-ba2780a7563
process[roscat-2]: started with pid [2033]
started core service [/roscat]
```



Fairfield, C., & Harman, T.L. (2016). *ROS robotics by examples*. Birmingham, UK: Packt.

# Question 3



**How would you implement ROS  
in an industrial setting?**

# Installation of ROS

## Two Essential Parts:

Ubuntu Mate Desktop (version 18.04 or greater for Raspberry Pi 3 Model B+).

```
~$ sudo apt-get install ros-melodic-desktop
...
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
=====
PARAMETERS
 * /roslaunch: melodic
 * /rosversion: 1.14.3

NODES
-----
auto-starting new master
process[roslaunch]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8aa-9476-11e9-9758-ba2780a7563
process[roslaunch-2]: started with pid [2033]
started core service [/roslaunch]
```



<https://ubuntu-mate.org/raspberry-pi/>

# Installation of ROS...

```
~/ros_ws$ cd ~/roscpp_ws/
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

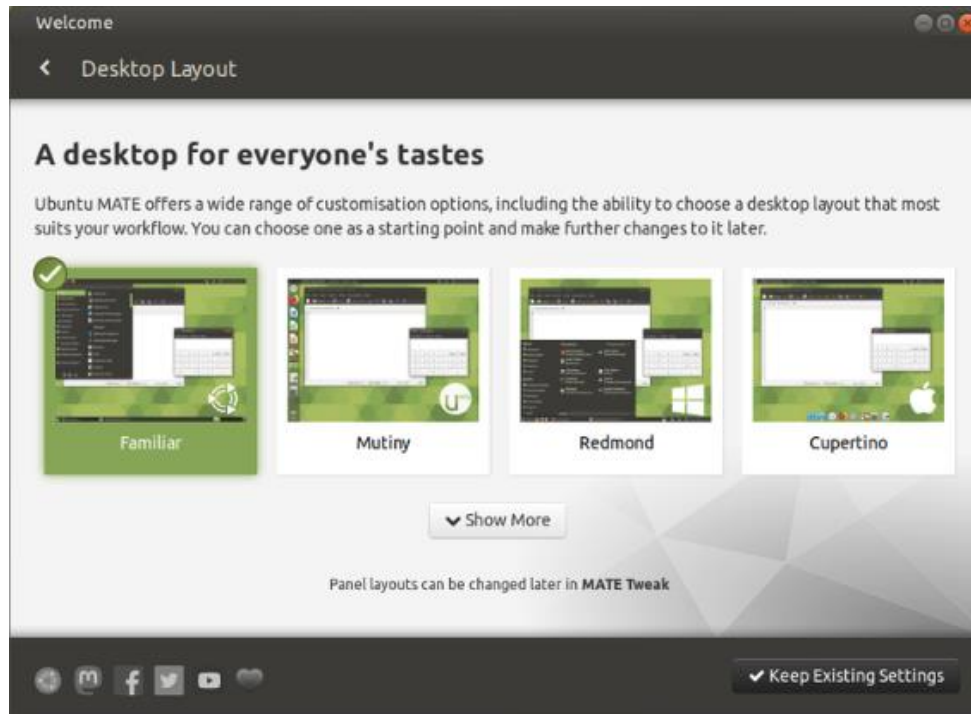
SUMMARY
-----
PARAMETERS
 * /roscpp_ws: roscpp_ws
 * /roscpp_ws: 1.14.3

NODES
-----
auto-starting new master
process[roscpp_ws]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8aa-947b-11e9-9758-ba2780a7563
process[roscpp_ws]: started with pid [2033]
started core service [/roscpp_ws]
```

## Two Essential Parts:

Ubuntu Mate Desktop (version 19.10 for Raspberry Pi 4 Model B).





# Installation of ROS...

```
~/ros_ws$ cat /dev/null && rosrun roscpp node
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 1GB.
started roslaunch server http://rondon-desktop:4001/
ros_core: version 1.14.3

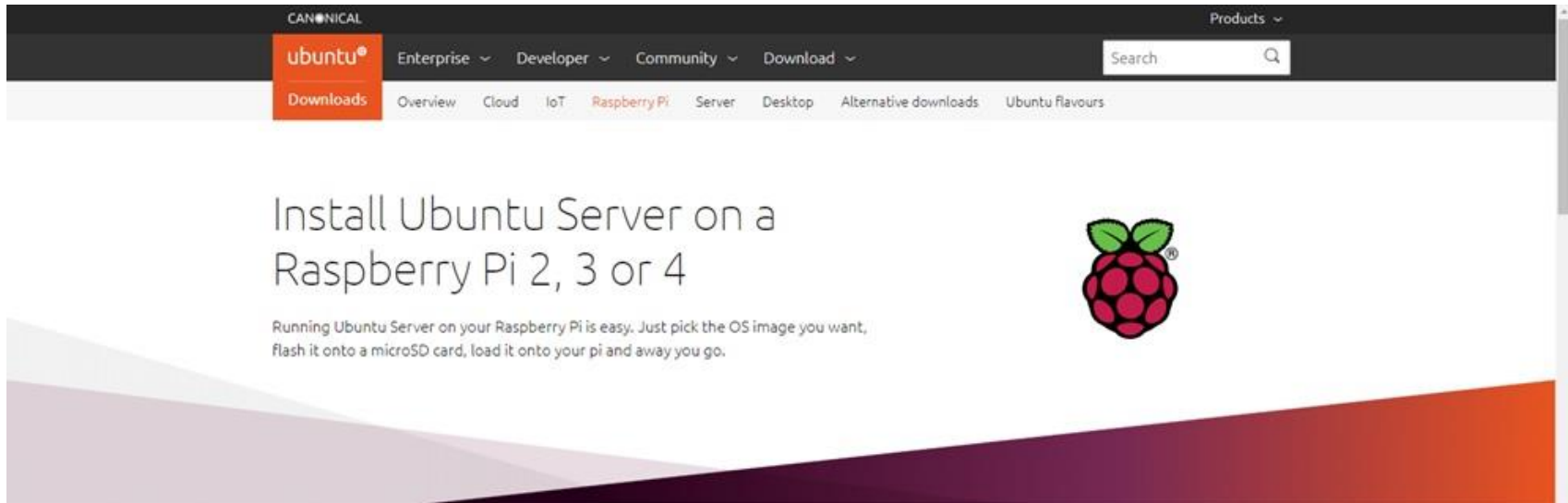
SUMMARY
-----
PARAMETERS
 * /roscpp__node: melodic
 * /roscpp__node__ns: /14.3

NODES
auto-starting new master
process[roscpp]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8a8-947b-11e9-9758-ba2780a7563
process[roscpp-1]: started with pid [2033]
started core service [/roscpp]
```

## Two Essential Parts:

Ubuntu Mate Desktop (version 19.10 for Raspberry Pi 4 Model B).



<https://ubuntu.com/download/raspberry-pi>

# Installation of ROS...

```
~/roscat@/roscat-desktop:11317
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 1GB.
started roslaunch server http://roscat-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roscatros: melodic
 * /roscatros: 1.14.3

NODES
-----
auto-starting new master
process[roscat]: started with pid [2024]
ROS_MASTER_URI=http://roscat-desktop:11317

setting /run_id to 320d8a4-947b-11e9-9758-b278b9a7563
process[roscat-2]: started with pid [2033]
started core service [/roscat]
```

## Two Essential Parts:

YouTube Installation video for Ubuntu Mate Desktop ver. 19.10 on a Raspberry Pi 4 Model B.



<https://www.youtube.com/watch?v=lmQltIK1e04>

# Installation of ROS...

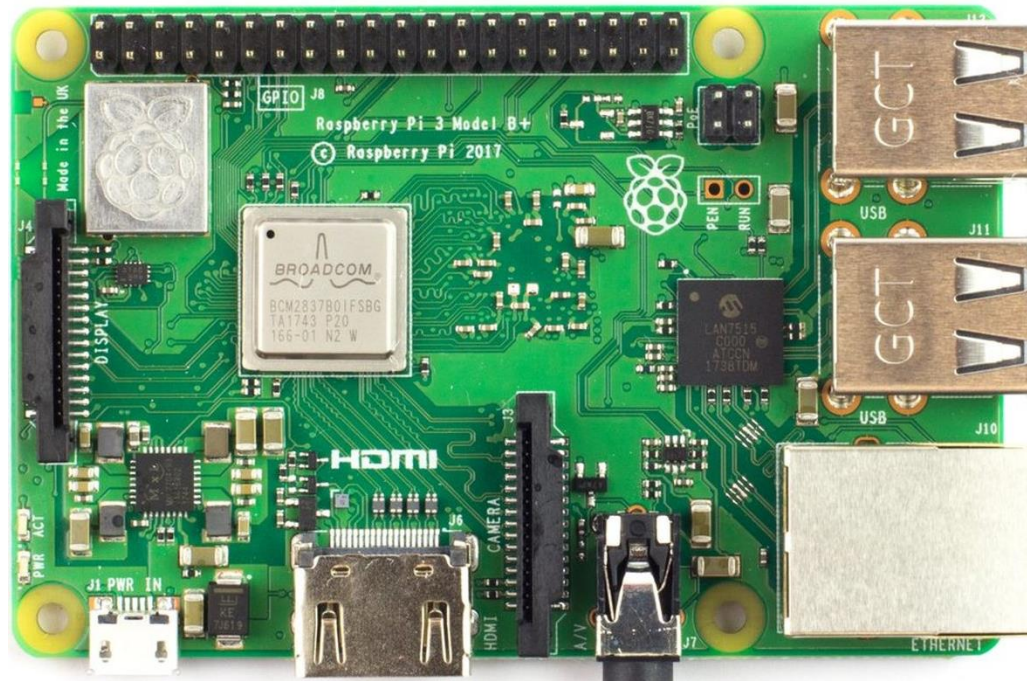
## Two Essential Parts: Raspberry Pi 3 Model B+

```
~/ros_ws/src/roscpp/roscpp1131/
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roscpp_core: roscpp
 * /roscpp_core: 1.14.3

NODES
-----
auto-starting new master
process[roscpp]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:1131/

setting /run_id to 32d0d84-947b-11e9-9758-ba2780a7563
process[roscpp-1]: started with pid [2033]
started core service [/roscpp]
```



# Installation of ROS...

## Two Essential Parts: Raspberry Pi 4 Model B

```
~/ros_ws/src/roscpp-1.13.1/
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

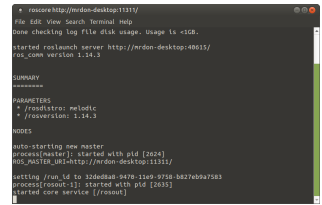
SUMMARY
-----
PARAMETERS
 * /roscpproto: roscpp
 * /rosversion: 1.14.3

NODES
-----
auto-starting new master
process[roscpp]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8a8-947b-11e9-9758-ba2780a97583
process[roscpp-1]: started with pid [2033]
started core service [/roscpp]
```



# Installation of ROS...



## Installing ROS Melodic desktop onto a Raspberry Pi

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" >
/etc/apt/sources.list.d/ros-latest.list'

sudo apt-key adv --keyserver 'hkp://keyserver.ubuntu.com:80' --recv-key
C1CF6E31E6BADE8868B172B4F42ED6FBAB17C654

sudo apt update

sudo apt install ros-melodic-desktop-full

sudo rosdep init

rosdep update

echo "source /opt/ros/melodic/setup.bash" >> ~/.bashrc

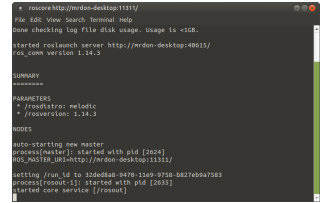
source ~/.bashrc

sudo apt install python-rosinstall python-rosinstall-generator python-wstool build-
essential
```

Wilcher, D. (2019). *ROS 101: An intro to the robot operating system*. Retrieved from

<https://www.designnews.com/gadget-freak/ros-101-intro-robot-operating-system/107053141061075>

# Installation of ROS...



```
~/ros_ws/src/roscpp_tutorials$ catkin_make
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
=====
PARAMETERS
 * /roscpp_tutorials: melodic
 * /roscpp_tutorials__ros_core: 1.14.3

NODES
auto-starting new master
process[roscpp_tutorials]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/
setting /run_id to 320d8aa-947b-11e9-9758-ba27809a7563
process[roscpp_tutorials]: started with pid [2033]
started core service [/roscpp_tutorials]
```

## Installing ROS Melodic desktop onto a Raspberry Pi include the following packages.

- a) Robot programming and simulators
  - i. Turtlesim
  - ii. Gazebo
- b) Turtlesim simulator allows Python robot algorithms to be developed. The simulator is 2D and 3D based.
- c) Gazebo provides a 3D simulation environment where motion planning, object detection, and sensing can be validated. Package uses 3D robotic based systems and mobile platforms.

# Question 4



**Ubuntu ver. 19.10 works with  
the Raspberry Pi 3?**

- a) False**
- b) True**

# Installation of ROS...

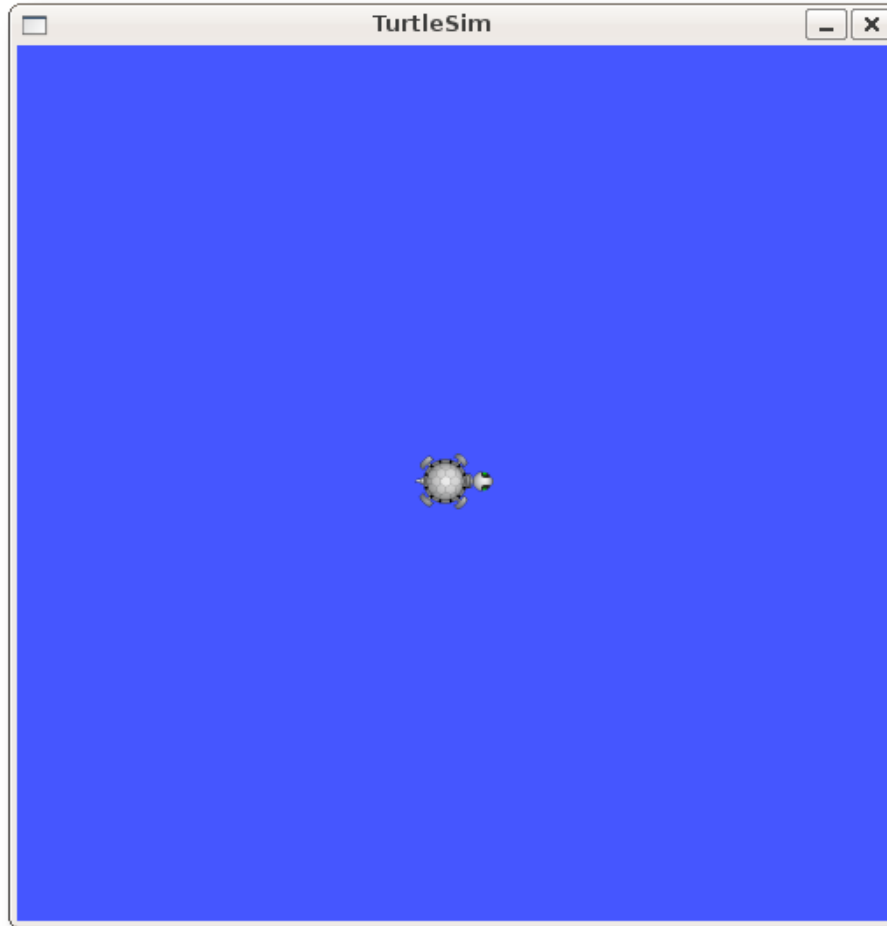
## ROS software packages: Turtlesim

```
~/ros_ws/src/roscpp_tutorials$ catkin_make
Done checking log file disk usage. Usage is 1GB.
started roslaunch server http://mrdon-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roscpp_tutorials: roscpp_tutorials
 * /roscpp_tutorials: 1.14.3

NODES
-----
auto-starting new master
process[roscpp_tutorials]: started with pid [2024]
ROS_MASTER_URI=http://mrdon-desktop:11311/

setting /run_id to 320d8aa-947b-11e5-9758-b278b0a75e3
process[roscpp_tutorials]: started with pid [2033]
started core service [/roscpp]
```





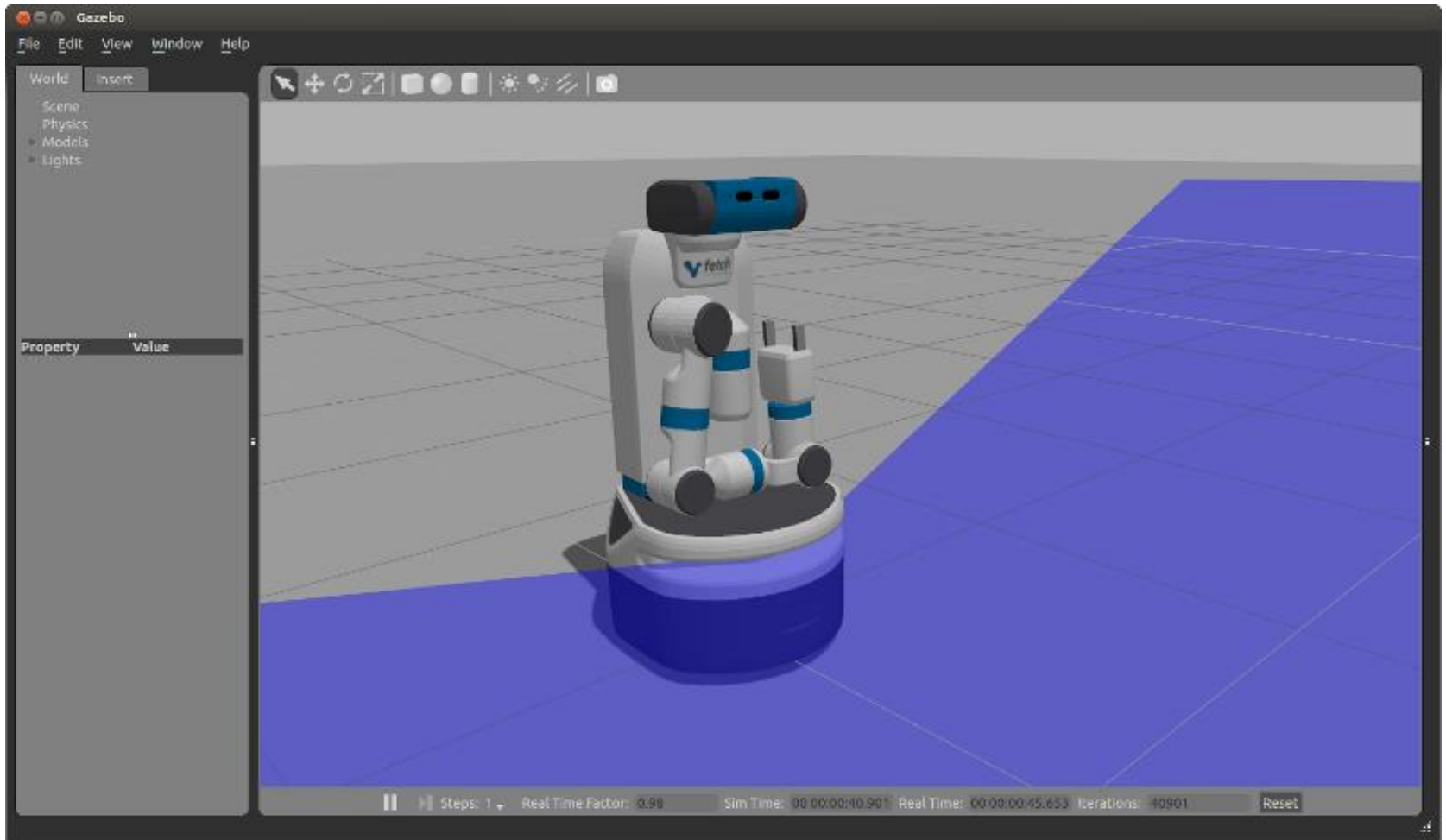
# Installation of ROS... ROS software packages: Gazebo

```
~/ros_ws/src:~/ros_ws/src$ catkin_make
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /rostopic: melodic
 * /rosversion: 1.14.3

NODES
-----
auto-starting new master
process[roscpp]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8a4-9476-11e9-9758-ba2780a7563
process[roscpp-2]: started with pid [2033]
started core service [/roscpp]
```



# Lab Project: ROS Hello World

```
~/roscat@mrdon-desktop:11311/
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 4GB.
started roslaunch server http://mrdon-desktop:40011/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roslaunch: melodic
 * /rosversion: 1.14.3

NODES
-----
auto-starting new master
process[roscat]: started with pid [2024]
ROS_MASTER_URI=http://mrdon-desktop:11311/

setting /run_id to 320d8aa-947b-11e9-9758-ba2780a75e3
process[roscat-2]: started with pid [2033]
started core service [/roscat]
```

```
mrdon@mrdon-desktop: ~
File Edit View Search Terminal Help
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
```

# Lab Project: ROS Hello World

```
~/ros_ws/src/roscpp_tutorials$ catkin_make
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://rondon-desktop:40011/
ros core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roscpp_tutorials: roscpp_tutorials
 * /roscpp_tutorials__ros__param: 1.14.3

NODES
-----
auto-starting new master
process[roscpp_tutorials]: started with pid [2024]
ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 320d8a8-947b-11e9-9758-ba2780b97583
process[roscpp_tutorials]: started with pid [2033]
started core service [/roscpp_tutorials]
```

## Lab Objectives:

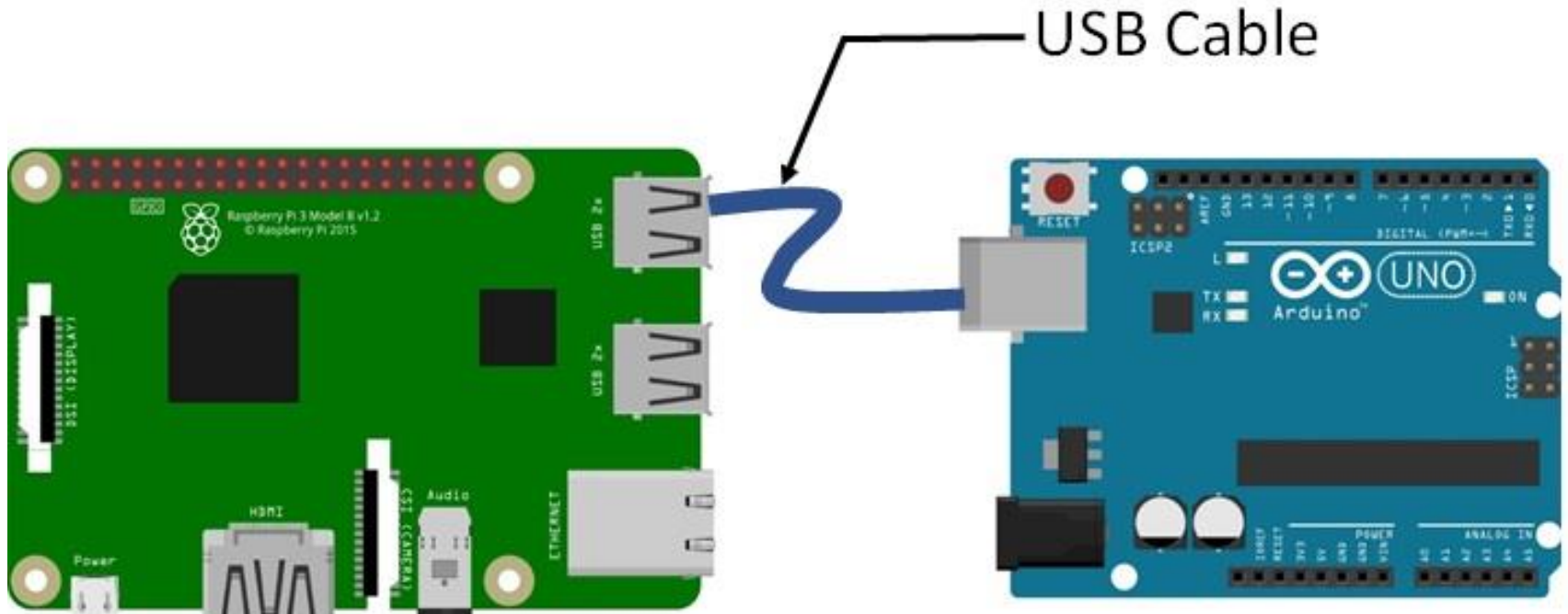
- Learn how attach a Raspberry Pi to an Arduino.
- Learn how to communicate with a ROS node.
- Learn how to publish the Hello World message using rostopic command.
- Learn how to display the Hello World message using the ROS chatter topic command.

# How to attach a Raspberry Pi to an Arduino?

```
~/Downloads/rpi-on-desktop11311/
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 1GB.
started re-launch server http://rpi-on-desktop4051/
rpi-on-desktop 3.14.3

SUMMARY
=====
PARAMETERS
  / rpi-on-desktop: rpi-on-desktop
  / rpi-on-desktop: 3.14.3

NODES
auto-starting new master
process(2042): started with pid (2042)
PID_MASTER_URI=http://rpi-on-desktop11311/
setting /run/ld to 320d8aa9476-1249-9758-b274b0a7563
process(2040-21): started with pid (2043)
started core service (/root)
```



Serial communication between the Raspberry Pi 3 and Arduino Uno

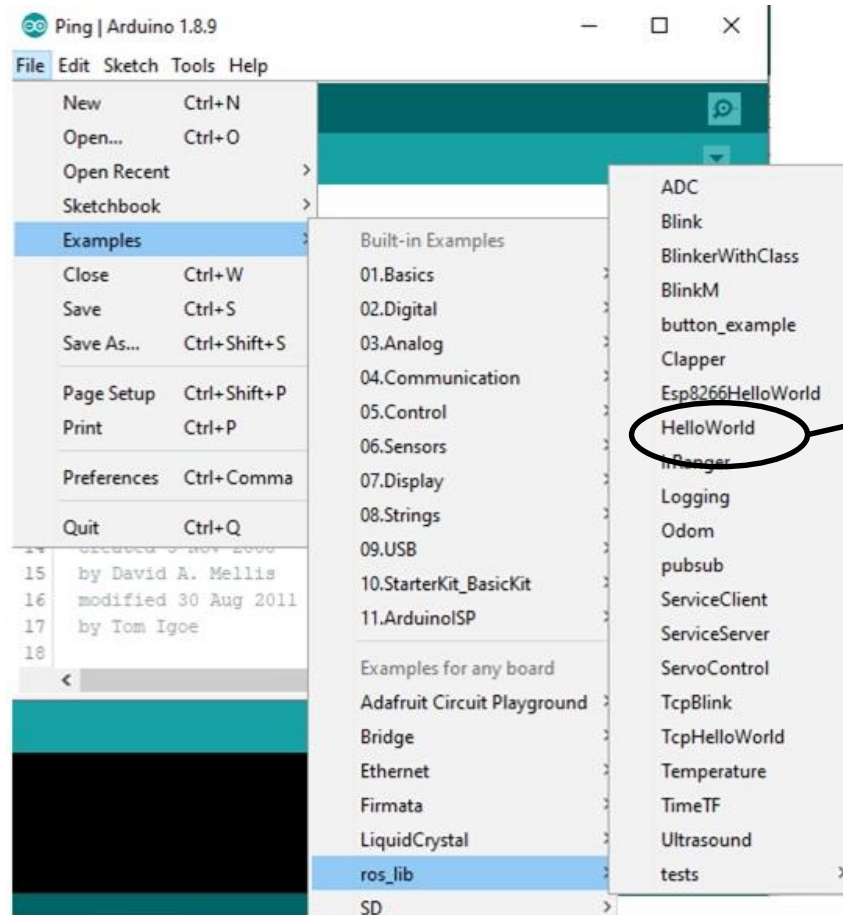
# How to attach a Raspberry Pi to an Arduino?

```
~/ros_ws/src/roscpp_tutorials$ cat /dev/ttyACM0
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 1GB.
started roslaunch server http://rdon-desktop:4001/
ros_core version 1.14.3

SUMMARY
=====
PARAMETERS
 * /roscpp_tutorials: roscpp_tutorials
 * /roscpp_tutorials: 1.14.3

NODES
-----
auto-starting new master
process[roscpp_tutorials]: started with pid [2024]
ROS_MASTER_URI=http://rdon-desktop:11311/

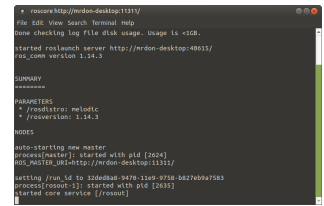
setting /run_id to 320d8a4-9476-11e5-9758-b270b0a7563
process[roscpp_tutorials]: started with pid [2033]
started core service [/roscpp_tutorials]
```



**ros\_lib:**  
Upload the *HelloWorld* Sketch

**ros\_lib:**  
The *HelloWorld* Sketch provides the chatter topic for publishing!

# How to attach a Raspberry Pi to an Arduino?



```
>HelloWorld | Arduino 1.8.9
File Edit Sketch Tools Help
HelloWorld
/*
 * roserial Publisher Example
 * Prints "hello world!"
 */

#include <ros.h>
#include <std_msgs/String.h>

ros::NodeHandle nh;

std_msgs::String str_msg;
ros::Publisher chatter("chatter", &str_msg);

char hello[13] = "hello world!";

void setup()
{
  nh.initNode();
}
```

Partial *HelloWorld* Sketch.

The **hello world!** string can be replaced with other messages.

# How to communicate with a ROS node?

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

```
~/ros_ws/src/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
* /roscpp: 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 http://mrdon-desktop:11311/
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```

**roscore running in an active window**

# How to communicate with a ROS node?...

```
~/ros_ws/src/roscpp/roscpp$ catkin_make
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://rondon-desktop:4001/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /roscpplog: roscpp
 * /roscppport: 1143

NODES
  auto-starting new master
  process[roscpp]: started with pid [2024]
  ROS_MASTER_URI=http://rondon-desktop:11311/

setting /run_id to 32d68a1-9476-11e5-9758-b27809a7563
process[roscpp-2]: started with pid [2033]
started core service [/roscpp]
```

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

\$ `roslaunch roserial_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 display the Hello World message?...

```
~/ros_ws/src/roscpp_tutorials/roscpp_tutorials$ catkin_make
File Edit View Search Terminal Help
Done checking log file disk usage. Usage is 11GB.
started roslaunch server http://nrdon-desktop:40011/
ros_core.service 3.14.3

SUMMARY
-----
PARAMETERS
 * /roscpp_tutorials: roscpp_tutorials
 * /roscpp_tutorials: 3.14.3

NODES
-----
auto-starting new master
process[roscpp_tutorials]: started with pid [2024]
ROS_MASTER_URI=http://nrdon-desktop:11311/

setting /run_id to 320d8a8-947b-11e9-9758-b278b0a7563
process[roscpp_tutorials]: started with pid [2033]
started core service [/roscpp_tutorials]
```

To view the hello world message, open a new terminal window and type the following *ros\_lib* command after the prompt.

**\$ rostopic echo chatter**

# How to display the Hello World message?

```
~/roscat1311/mrdon-desktop11311/
File Edit View Search Terminal Help
Done checking log file disk usage. usage is <1GB.
started roslaunch server http://mrdon-desktop:40511/
ros_core version 1.14.3

SUMMARY
-----
PARAMETERS
 * /rostopic: rostopic
 * /rosworkon: 1:14.3

NODES
-----
auto-starting new master
process[roscat1311]: started with pid [2024]
ROS_MASTER_URI=http://mrdon-desktop:11311/

setting /run_id to 320d8aa1-9476-11e5-9758-b27809a7563
process[roscat1311]: started with pid [2033]
started core service [/roscat]
```

```
mrdon@mrdon-desktop: ~
File Edit View Search Terminal Help
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
data: "hello world!"
---
```

*rostopic echo chatter*  
**running in an active window**

# Question 5



**In the Hello World rosserial sketch (code), what is the instruction name that allows changing the message?**