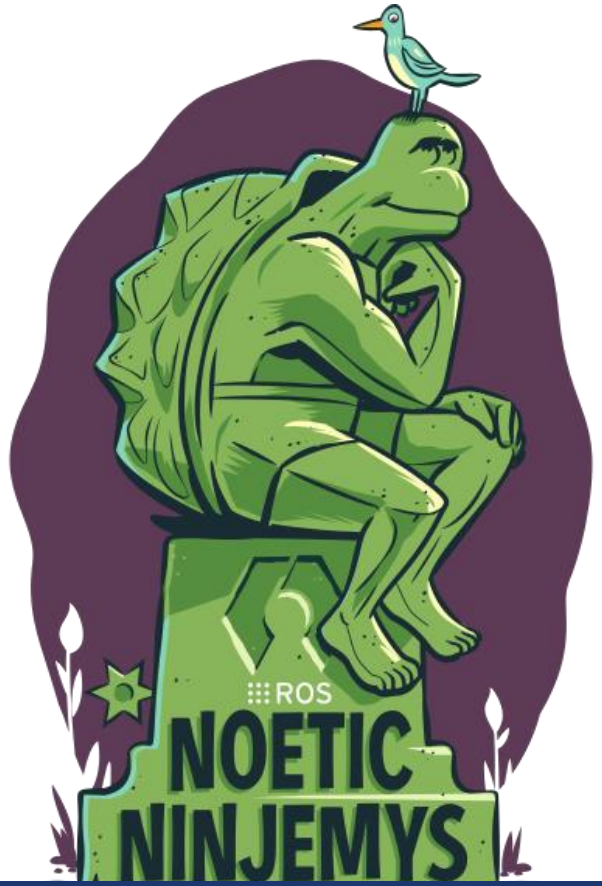

2022

INFO 802

Master Advanced Mechatronics

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UNIVERSITÉ SAVOIE MONT BLANC

POLYTECH ANNECY-CHAMBÉRY

ROS

Environment Setup
Tutorial 1

Objectives

At the end of this tutorial, you are excepted to :

- ☑ Be able to create a ROS `catkin workspace`
- ☑ Be able to create a ROS `package`
- ☑ Know what is and how to `source a file`

ROS Environment

Set up the environment

- In order to work properly, ROS uses the **setup.bash** and **setup.sh** files
- It is located in in the following directory: */opt/ros/noetic/*

- The main function of these files is to set environment variables used by ROS and other apps.
- During the installation of ROS, you will see that you are prompted to source one of several setup.*sh files, or even add this 'sourcing' to your shell startup script

- If you are ever having problems finding or using your ROS packages make sure that you have your environment properly setup. Sourcing these setup.*sh files might help sometimes.

ROS Environment

Set up the environment:

- You will need to run source /opt/ros/noetic/setup.bash on every new shell you open to have access to the ROS commands, unless you add this line to your bash startup file (~/.bashrc)

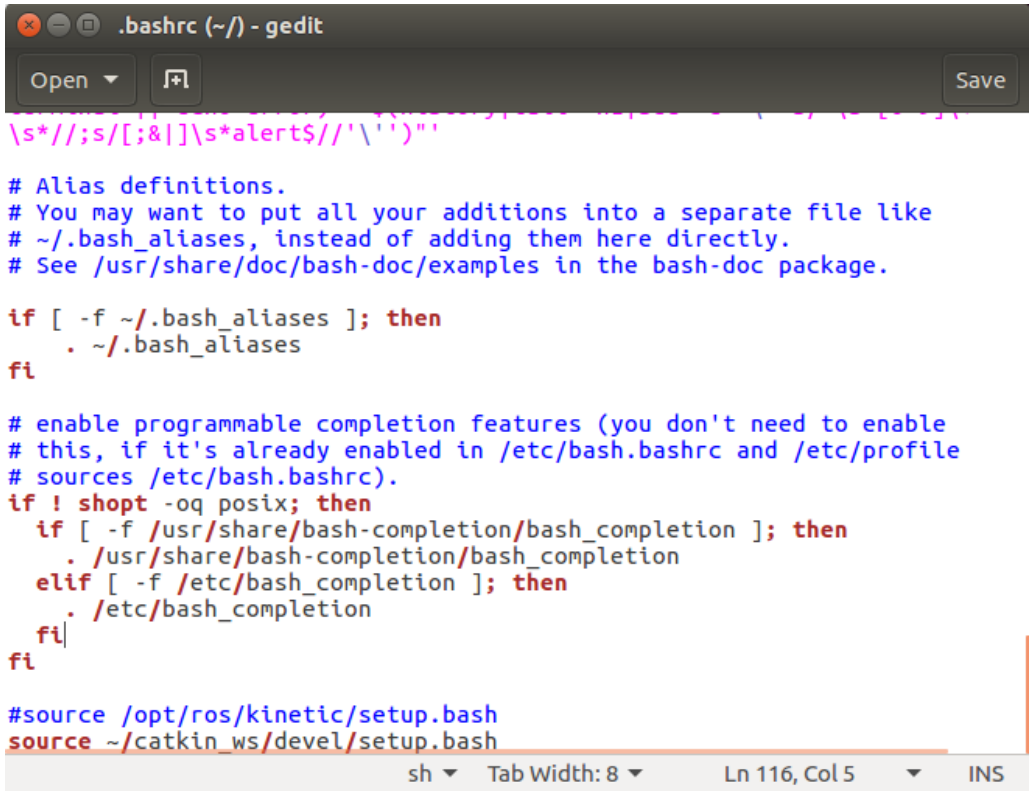
- This will allow you to run roscore from any directory in your terminal window. To do so, we will modify the .bashrc.

Edit *.bashrc* file

```
> gedit ~/.bashrc
```

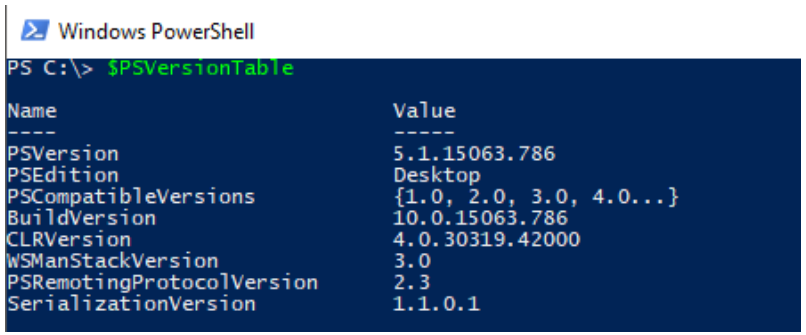
add the the line at the bottom

```
> source ~/catkin_ws/devel/setup.bash
```

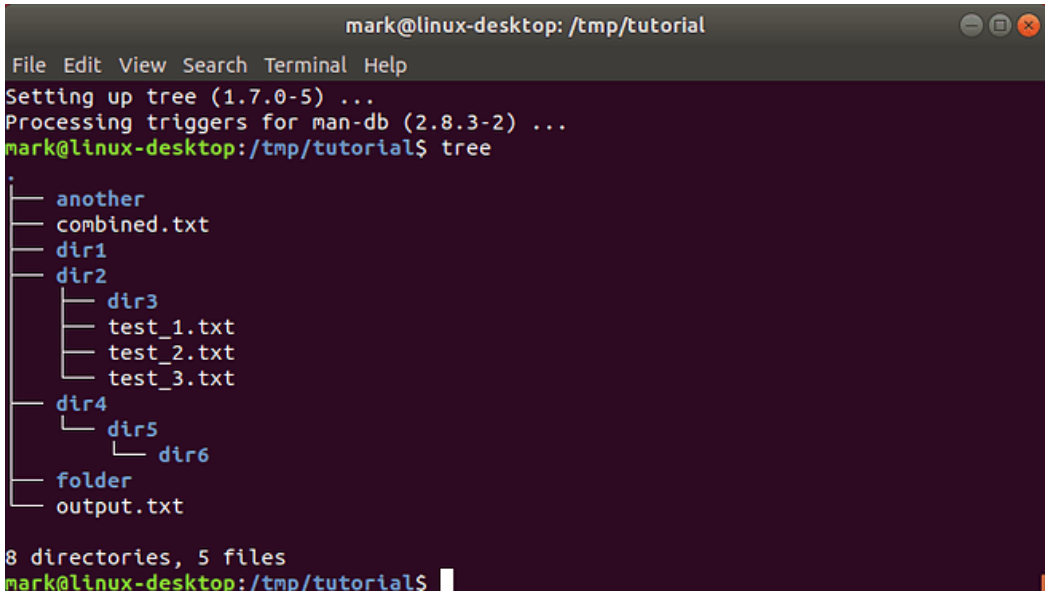


Bash (Unix shell)

- Bash is the Unix basic **shell** used in the terminal. (the $ character is the default prompt.)
- The shell is an interface between the user and the operating system.
- It uses either a **command-line interface** (CLI) or graphical user interface (GUI) to control the computer.
- The CLI used in Ubuntu is **Terminal**



an example of CLI shell for Windows is PowerShell



.bashrc

- *.bashrc* is a script file hidden is the /home /<username> directory.
- When you open a new terminal window by pressing CTRL + ALT + T or simply to open a new terminal tab, bash reads and executes commands from *~/.bashrc*, if that file exists.
- In particular, it reads the environment variables that are in the file.

Edit the file

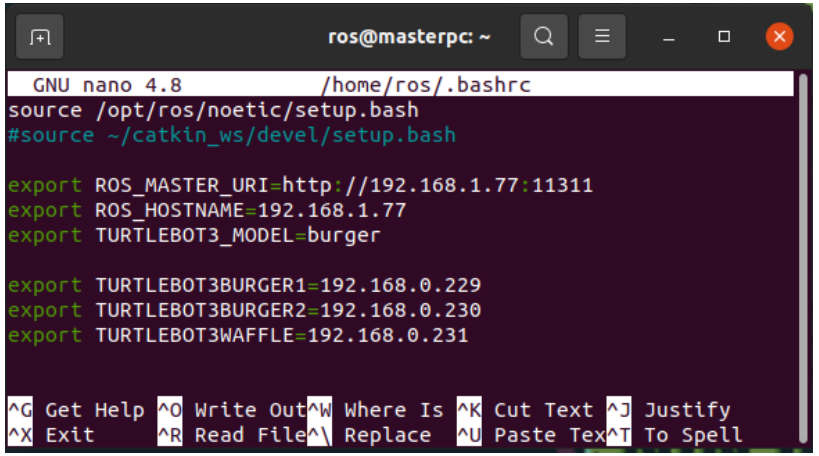
```
> nano ~/.bashrc
```

Remarks

`nano` is an easy to use command line text editor for Unix OS

`~` is a shortcut for the /home/<username> directory

`.file` means the file is hidden



In this ~/.bashrc file, the variable:
- TURTLEBOT3_MODEL has the value “burger”
- TURTLEBOT3BURGER1 has the value “192.168.0.229”

ROS catkin workspace

Any ROS project begins with making a workspace.

In this workspace, you will put all the things related to this particular project.

Here we will create : - a workspace named : **catkin_ws**

- a package named : **beginner_tutorials_pkg**

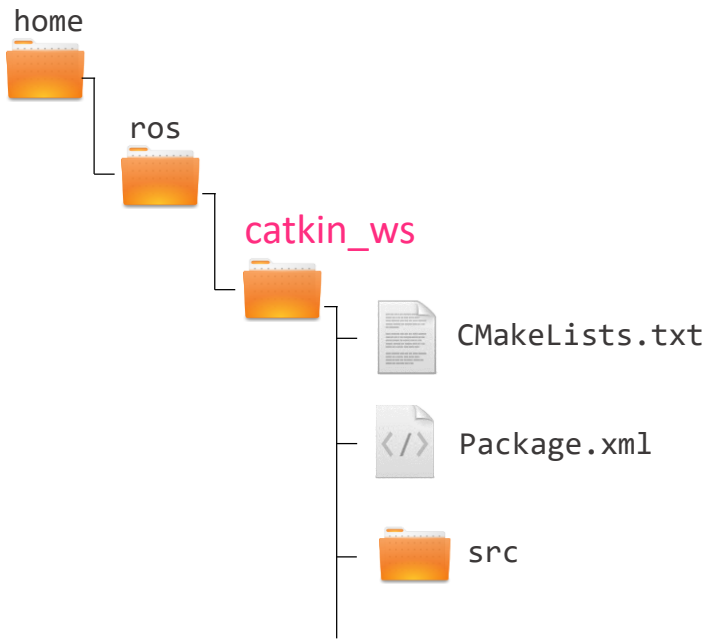
in which we will create our nodes

Ubuntu

Your ROS workspace will be created in your home directory

In a Terminal:

`~/` is a shortcut for `/home/username`



The ROS workspace will then be created at this location :

`~/catkin_ws` = `/home/ros/catkin_ws`

Exercice 1 – Create your catkin workspace

1 – Create a catkin ROS Workspace named : *catkin_ws*

Explain each command

```
> mkdir -p ~/catkin_ws/src
> cd ~/catkin_ws/src
> catkin_init_workspace
> cd ~/catkin_ws
> catkin_make
```

--> create a new folder named catkin_ws and inside a folder named *src*

--> navigate to folder ~/catkin_ws/src

--> catkin_init_workspace

--> navigate to folder ~/catkin_ws

--> build any packages located in ~/catkin_ws/src.
always call catkin_make in the root of your catkin workspace

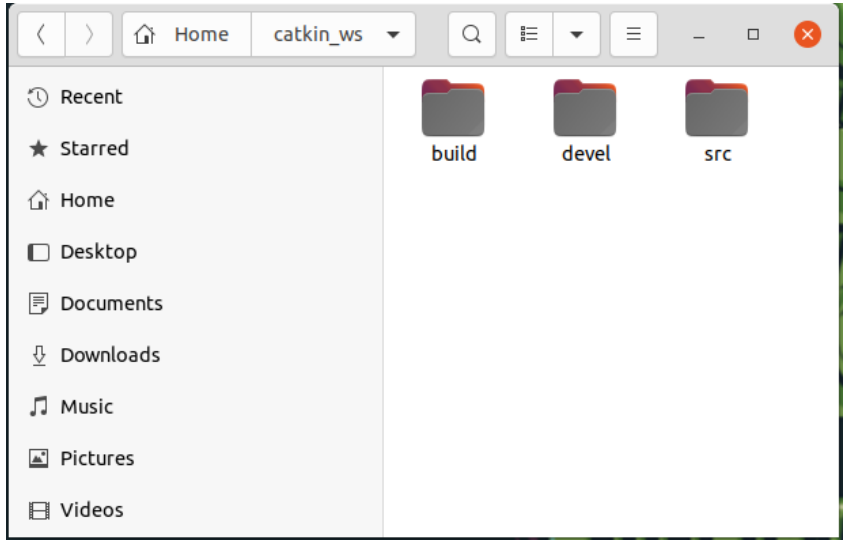
More info
http://wiki.ros.org/catkin/Tutorials/create_a_workspace

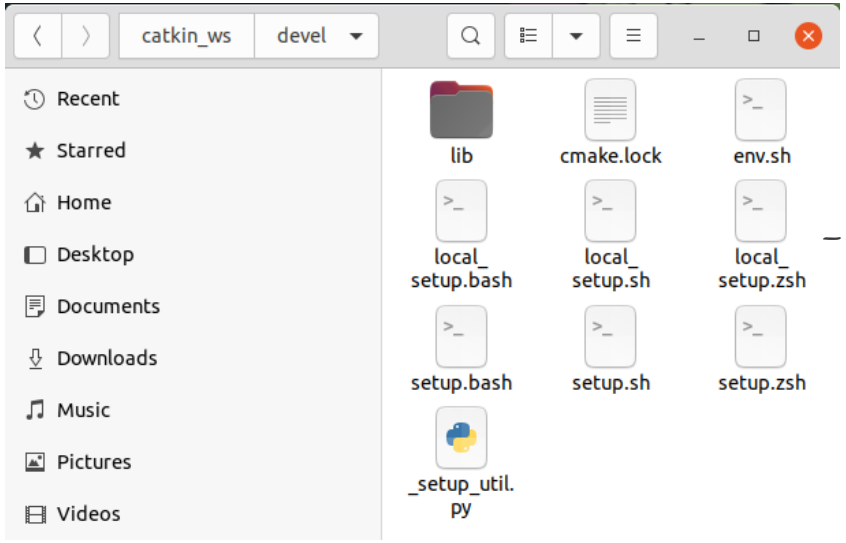
Exercice 1 – Create your catkin workspace

If you look in your current directory you should now have a 'build' and 'devel' folder.

Inside the 'devel' folder you can see that there are now several setup.*sh files.

Sourcing any of these files will overlay this workspace on top of your environment.



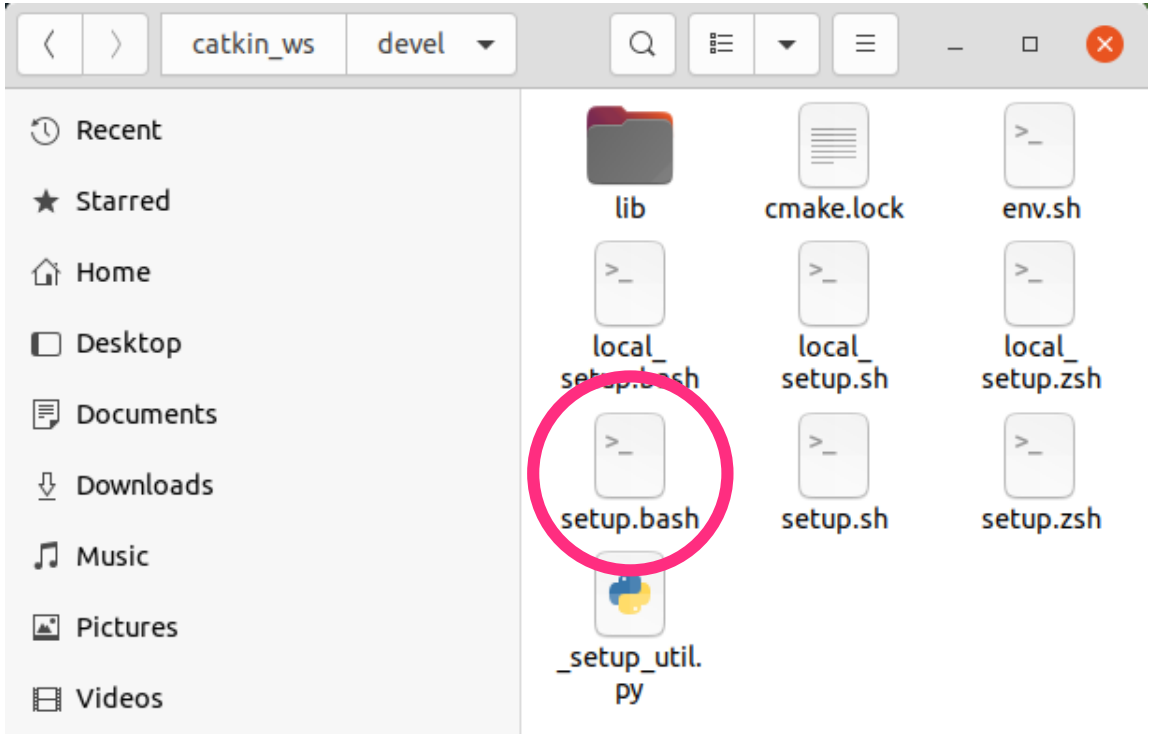


--> Automatically generated when you create a catkin workspace

More info

http://wiki.ros.org/catkin/Tutorials/create_a_workspace

What does "sourcing a file" mean in Linux?



Before continuing, you must **source** the **setup.bash** file

This allows the terminal to understand where it needs to look to execute the ROS and catkin commands.

The setup.bash file is merely adding environment variables to your path to allow ROS to function

Linux Command : *Source*

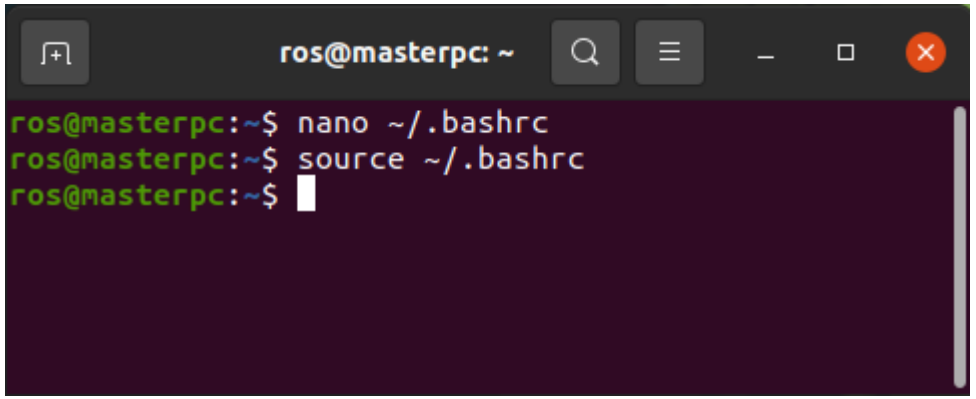
- When a file is sourced, the lines of code in the file are executed as if they were printed at the command line.
- It updates functions and variables in the file for the curent shell
- Any changes in /home/<username>/.bashrc file will only be taken into acount after sourcing

Sourcing a file

```
> source file_name.sh
```

Or

```
> . file_name.sh
```



sourcing the bashrc file

Source your environment

Every time you create a new workspace or a package or a node you must source your environment.

2 – source the setup.bash file

Explain what it does

```
> source ~/catkin_ws/devel/setup.bash
```

--> It adds the workspace to your ROS environment

3 – Check your workspace is properly overlayed by the setup script, make sure *ROS_PACKAGE_PATH* environment variable includes the directory you're in.

```
> echo $ROS_PACKAGE_PATH
```

Exercice 2 – Create a ROS Package

1 – Create a ROS package named : *beginner_tutorials_pkg*

```
> cd ~/catkin_ws/src        (you must be in the src folder of the catkin workspace)
> catkin_create_pkg beginner_tutorials_pkg rospy std_msgs
```

Catkin function

Package name

Dependencies

(i.e other packages that we will use and that already exist elsewhere)

2 - Whenever you build a new package, source your environment

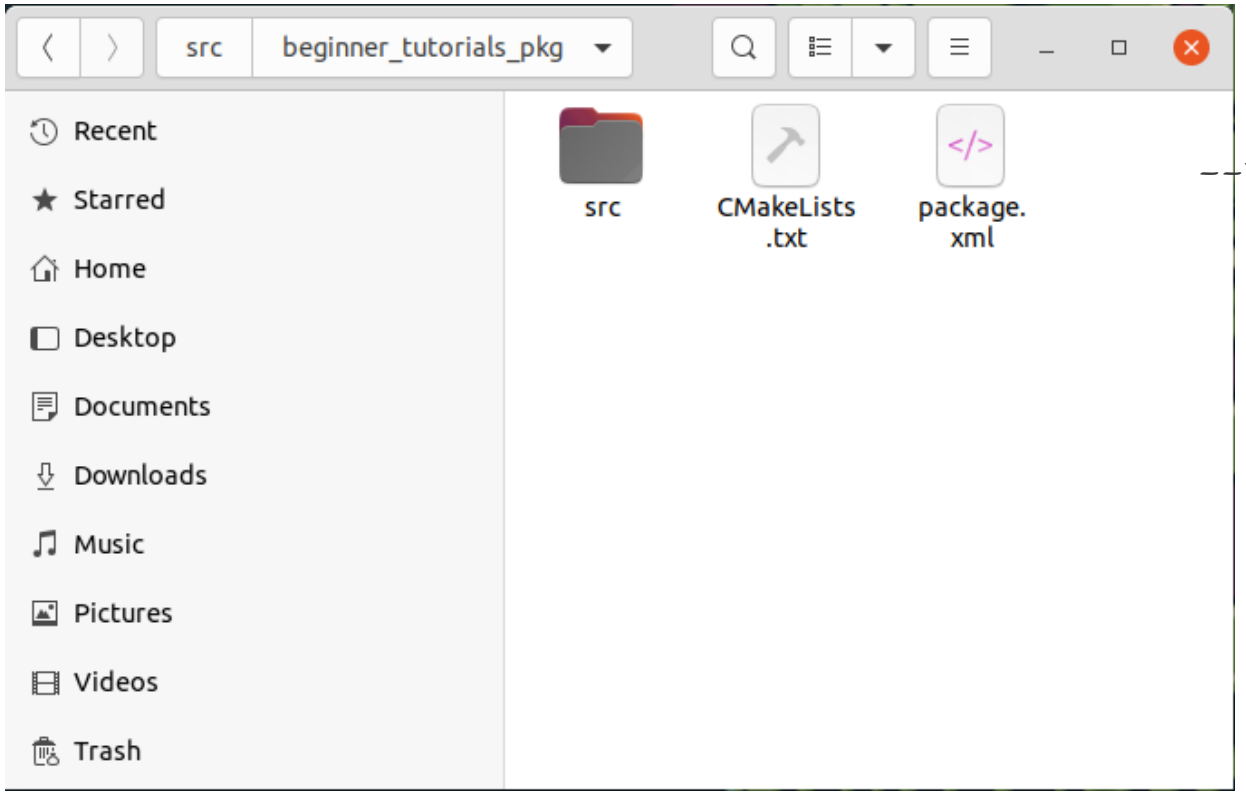
```
> source ~/catkin_ws/devel/setup.bash
```

More info

http://wiki.ros.org/Packages

ROS Package

package.xml and CMakeLists.txt files



--> Automatically generated when you create a package

ROS Package

package.xml

- The package.xml defines properties of the package
  - <name> Package name
  - <version> Version numbers
  - <description> Description of the content
  - <maintainer> Person maintaning the package
  - <licence> Type of licence (usualy BSD)
  - Dependencies on other catkin packages

  The dependencies are split into :
  build_depend, buildtool_depend, exec_depend, test_depend

  - and more

```
<?xml version="1.0"?>
<package format="2">
<name>beginner_tutorials_pkg</name>
<version>0.1.0</version>
<description>A ROS packages for beginnner</description>
<maintainer email="luc.marechal@univ-smb.fr">Luc</maintainer>
<license>BSD</license>

<url type="website">https://github.com/my_project/ros_…</url>
<author email="luc.marechal@univ-smb.fr">Luc Mare</author>

<buildtool_depend>catkin</buildtool_depend>

<build_depend>rospy</build_depend>
<build_depend>std_msgs</build_depend>

<run_depend>rospy</run_depend>
<run_depend>std_msgs</run_depend>
</package>
```

This file must be included with the catkin package's root folder

If dependencies are missing or incorrect, you may be able to build from source and run tests on your own machine, but your package will not work correctly when released to the ROS community.

ROS Package

CMakeLists.txt

The `CMakeLists.txt` is the input to the CMakebuild system

1. Required CMake Version (`cmake_minimum_required`)
2. Package Name (`project()`)
3. Find other CMake/Catkin packages needed for build (`find_package()`)
4. Message/Service/Action Generators (`add_message_files()`, `add_service_files()`, `add_action_files()`)
5. Invoke message/service/action generation (`generate_messages()`)
6. Specify package build info export (`catkin_package()`)
7. Libraries/Executables to build (`add_library()`/`add_executable()`/`target_link_libraries()`)
8. Tests to build (`catkin_add_gtest()`)
9. Install rules (`install()`)

CMakeLists.txt

```
cmake_minimum_required(VERSION 2.8.3)
project(ros_package_template)

## Use C++11
add_definitions(--std=c++11)

## Find catkin macros and libraries
find_package(catkin REQUIRED
  COMPONENTS
    roscpp
    sensor_msgs
)

…
```

More info
http://wiki.ros.org/catkin/CMakeLists.txt

ROS Package

CMakeLists.txt Example

```
cmake_minimum_required(VERSION 2.8.3)
project(husky_highlevel_controller)
add_definitions(--std=c++11)

find_package(catkin REQUIRED
  COMPONENTS roscpp sensor_msgs
)

catkin_package(
  INCLUDE_DIRS include
  # LIBRARIES
  CATKIN_DEPENDS roscpp sensor_msgs
  # DEPENDS
)

include_directories(include ${catkin_INCLUDE_DIRS})

add_executable(${PROJECT_NAME} src/${PROJECT_NAME}_node.cpp
src/HuskyHighlevelController.cpp)

target_link_libraries(${PROJECT_NAME} ${catkin_LIBRARIES})
```

Use the same name as in the `package.xml`

We use C++11 by default

List the packages that your package requires to build (have to be listed in `package.xml`)

Specify build export information

- `INCLUDE_DIRS`: Directories with header files
- `LIBRARIES`: Libraries created in this project
- `CATKIN_DEPENDS`: Packages dependent projects also need
- `DEPENDS`: System dependencies dependent projects also need (have to be listed in `package.xml`)

Specify locations of header files

Declare a C++ executable

Specify libraries to link the executable against

What is the .bashrc file in Linux ?

1– What is the .bashrc file ? --> it is a script file that's executed every time you open a Terminal
it contains your preferences, configurations and environmental variables.

2 – Where is located your .bashrc file? --> In the home folder: ~/

3 – Edit your .bashrc file and add *your country name* in the following environment variable to your system:

MY_COUNTRY

```
> nano ~/.bashrc
```

4 – Source your environment

```
> source  ~/.bashrc
```

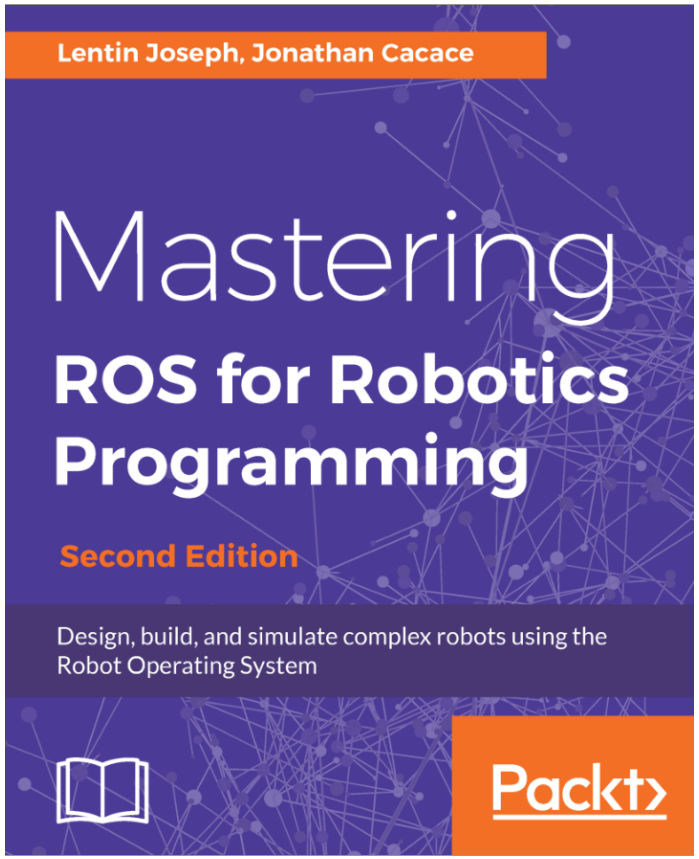
5 – Check that your variable exists with the command: ***echo***

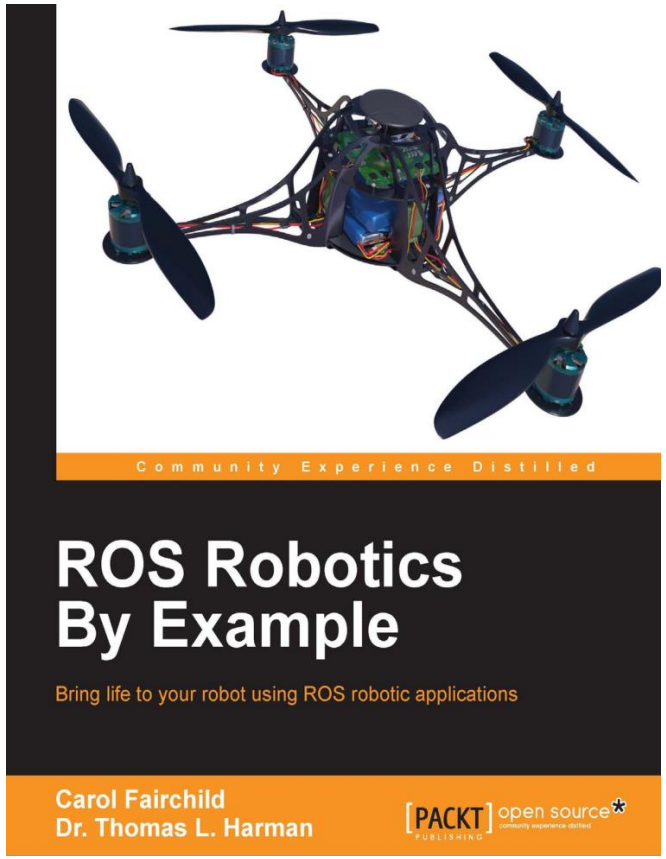
```
> echo $MY_COUNTRY
```

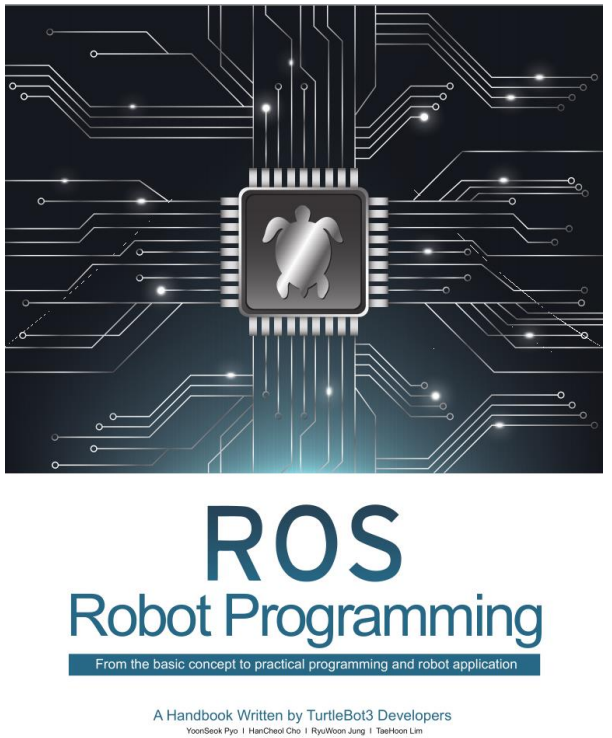
Further References

- ROS Wiki
  - http://wiki.ros.org/
- Installation
  - http://wiki.ros.org/ROS/Installation
- Tutorials
  - http://wiki.ros.org/ROS/Tutorials
- Available packages
  - http://www.ros.org/browse/
- ROS Cheat Sheet
  - https://www.clearpathrobotics.com/ros-robot-operating-system-cheat-sheet/
  - https://kapeli.com/cheat_sheets/ROS.docset/
- ROS Best Practices
  - https://github.com/leggedrobotics/ros_best_practices/wiki
- ROS Package Template
  - https://github.com/leggedrobotics/ros_best_practices/tree/master/ros_package_template

Relevant books







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