

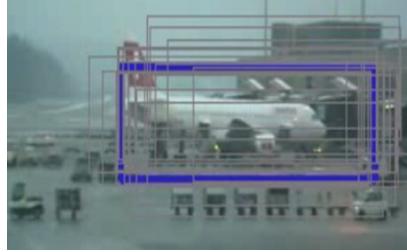
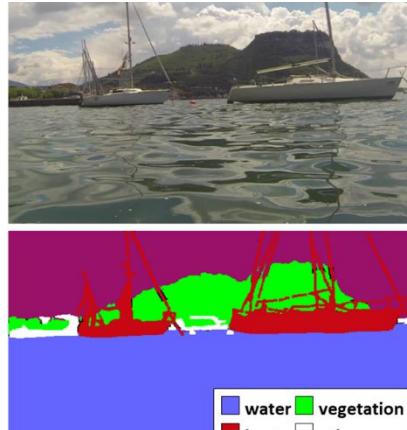
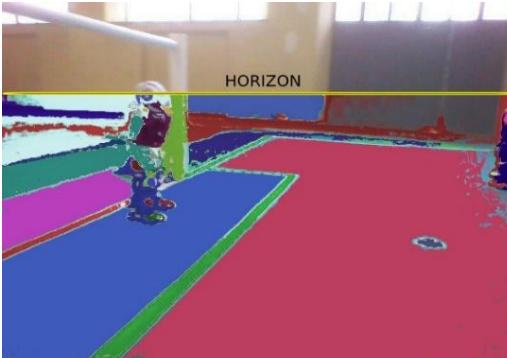


UNIVERSITÀ DEGLI STUDI
DELLA BASILICATA

Corso di Visione e Percezione



ROS (Python)



Domenico Daniele Bloisi

- Ricercatore RTD B

Dipartimento di Matematica, Informatica
ed Economia

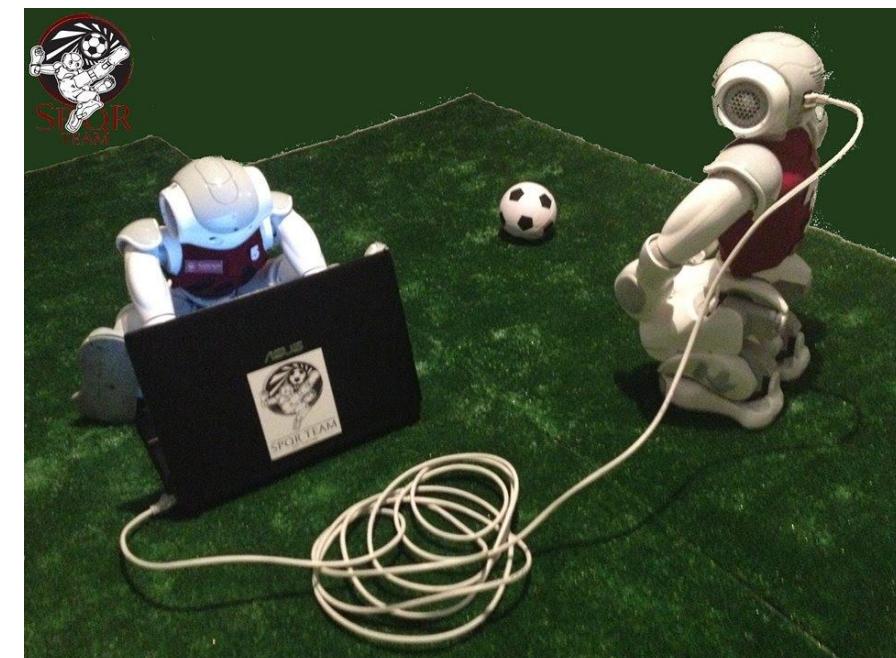
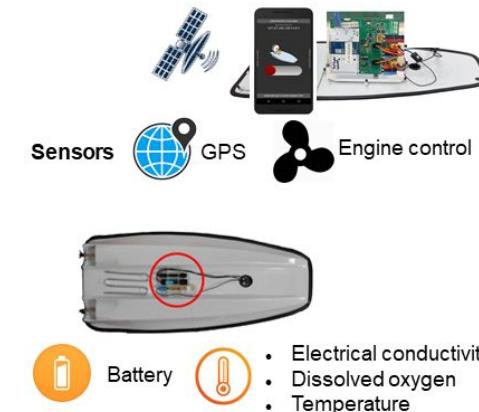
Università degli studi della Basilicata

<http://web.unibas.it/bloisi>

- SPQR Robot Soccer Team

Dipartimento di Informatica, Automatica
e Gestionale Università degli studi di
Roma “La Sapienza”

<http://spqr.diag.uniroma1.it>



Informazioni sul corso

- Home page del corso
<http://web.unibas.it/bloisi/corsi/visione-e-percezione.html>
- Docente: Domenico Daniele Bloisi
- Periodo: **Il semestre** marzo 2021 – giugno 2021

Martedì 17:00-19:00 (Aula COPERNICO)

Mercoledì 8:30-10:30 (Aula COPERNICO)



Codice corso Google Classroom:
<https://classroom.google.com/c/Njl2MjA4MzgzNDFa?cjc=xgolays>

Ricevimento

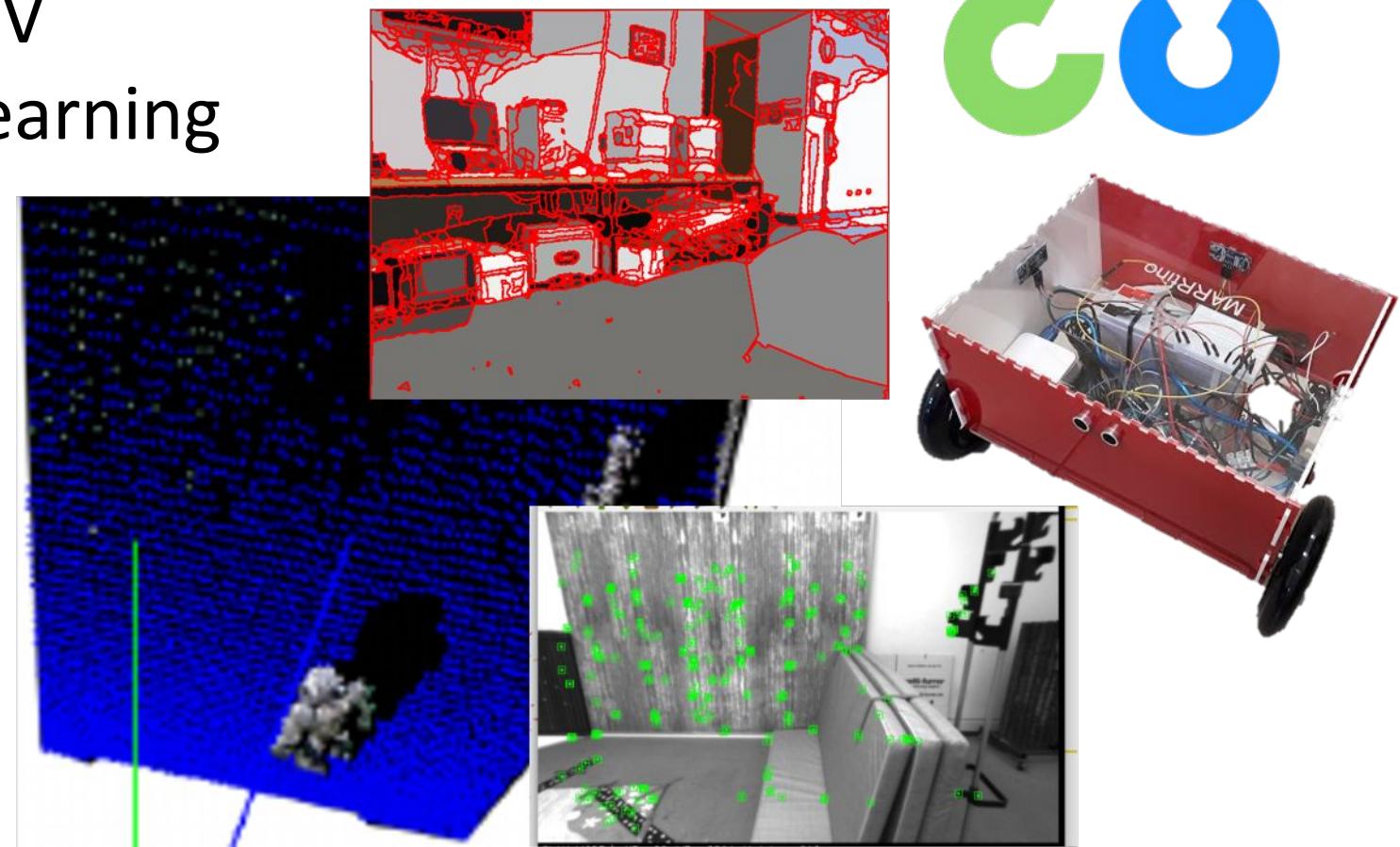
- Su appuntamento tramite Google Meet

Per prenotare un appuntamento inviare
una email a
domenico.bloisi@unibas.it



Programma – Visione e Percezione

- Introduzione al linguaggio Python
- Elaborazione delle immagini con Python
- Percezione 2D – OpenCV
- Introduzione al Deep Learning
- ROS
- Il paradigma publisher and subscriber
- Simulatori
- Percezione 3D - PCL



git + ROS

Esempio pratico

1. creare un repository git
2. creare un nodo ROS
3. condividere il nodo ROS
tramite il repository git
4. modificare il nodo ROS
usando git



Prerequisiti

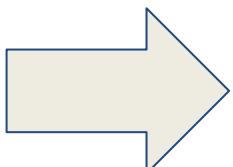
Avere un workspace per Catkin

The screenshot shows a web browser displaying the ROS.org documentation site. The URL in the address bar is wiki.ros.org/catkin/Tutorials/create_a_workspace. The page title is "catkin/ Tutorials/ create_a_workspace". The main content is titled "Creating a workspace for catkin". Below the title, there is a "Description" section stating: "This tutorial covers how to setup a catkin workspace in which one or more catkin packages can be built." There are also sections for "Keywords" (catkin workspace), "Tutorial Level" (BEGINNER), and "Next Tutorial" (Creating catkin packages). At the bottom of the page, there are links for different ROS distributions: "kinetic", "melodic", and "noetic" (which is highlighted in dark blue). A checkbox labeled "Show EOL distros" is also present. On the right side of the page, there is a sidebar with links for "ROS 2 Documentation", "Wiki", "Distributions", "ROS/Installation", "ROS/Tutorials", "RecentChanges", and "create_a_workspace" (which is highlighted in light blue). Below the sidebar, there are sections for "Pagina", "Informazioni", "Allegati", "Altre azioni:", and "Utente". The "Altre azioni:" section includes a dropdown menu set to "Mostra il testo grezzo" and a button labeled "Esegui". The "Utente" section includes a link to "Accedi".

[http://wiki.ros.org/catkin/Tutorials/create_a_workspace](https://wiki.ros.org/catkin/Tutorials/create_a_workspace)

Compatibilità Python in Melodic

Nota per
Melodic
Python 3
compatibility



1. Prerequisites

This tutorial assumes that you have [installed catkin](#) and sourced your environment. If you installed catkin via apt-get for ROS noetic, your command would look like this:

```
$ source /opt/ros/noetic/setup.bash
```

Let's create and build a [catkin workspace](#):

```
$ mkdir -p ~/catkin_ws/src
$ cd ~/catkin_ws/
$ catkin_make
```

The [catkin_make](#) command is a convenience tool for working with [catkin workspaces](#). Running it the first time in your workspace, it will create a `CMakeLists.txt` link in your 'src' folder.

Python 3 users in ROS Melodic and earlier: note, if you are building ROS from source to achieve Python 3 compatibility, and have setup your system appropriately (ie: have the Python 3 versions of all the required ROS Python packages installed, such as catkin) the first [catkin_make](#) command in a clean [catkin workspace](#) must be:

```
$ catkin_make -DPYTHON_EXECUTABLE=/usr/bin/python3
```

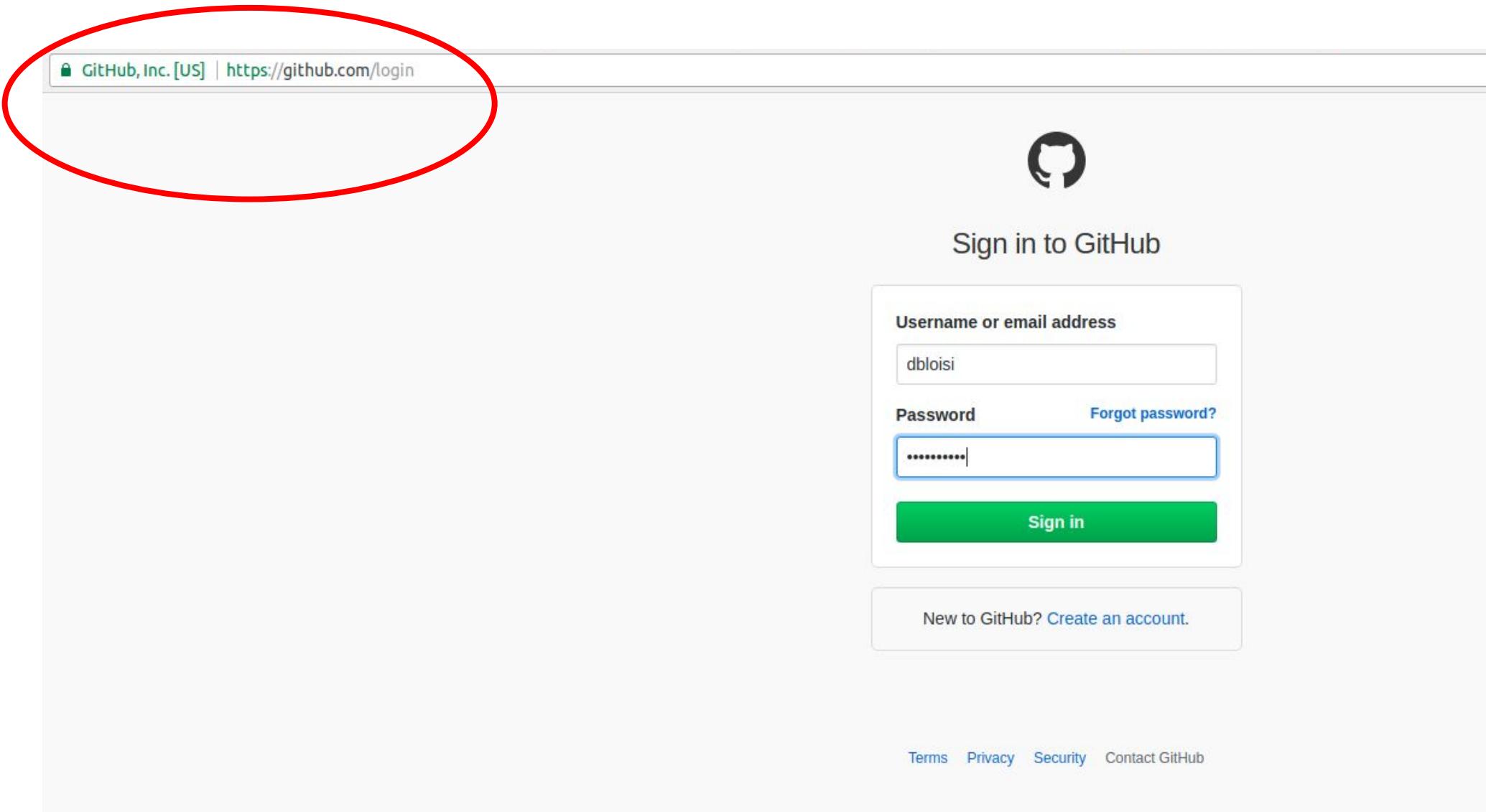
This will configure [catkin_make](#) with Python 3. You may then proceed to use just [catkin_make](#) for subsequent builds.

Additionally, 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. To understand more about this see the general catkin documentation: [catkin](#). Before continuing source your new `setup.sh` file:

```
$ source devel/setup.bash
```

To make sure your workspace is properly overlayed by the setup script, make sure `ROS_PACKAGE_PATH` environment variable includes the directory you're in.

Server git



A screenshot of a web browser showing the GitHub login page. The URL bar at the top left contains the text "GitHub, Inc. [US] | https://github.com/login". A large red oval has been drawn around this URL bar. The main content area features the GitHub logo (a black octocat icon) and the text "Sign in to GitHub". Below this is a form with fields for "Username or email address" (containing "dbloisi") and "Password" (containing a masked password). To the right of the password field is a "Forgot password?" link. A large green "Sign in" button is at the bottom of the form. At the very bottom of the page, there is a footer with links for "Terms", "Privacy", "Security", and "Contact GitHub".

GitHub, Inc. [US] | https://github.com/login

Sign in to GitHub

Username or email address

dbloisi

Password [Forgot password?](#)

.....

Sign in

New to GitHub? [Create an account.](#)

Terms Privacy Security Contact GitHub

Creare un repository git

The screenshot shows the GitHub dashboard with a red circle highlighting the 'New repository' button in the top right corner of the header. The 'New repository' button is part of a dropdown menu that also includes 'Import repository', 'New gist', and 'New organization'. The dashboard features a sidebar on the left with user activity and repository discovery options, and a main area displaying recent repository updates from other users.

You've been added to the **SPQRTTeam** organization!

Here are some quick tips for a first-time organization member.

- Use the switch context button in the upper left corner of this page to switch between your personal context (**dbloisi**) and organizations you are a member of.
- After you switch contexts you'll see an organization-focused dashboard that lists out organization repositories and activities.

Repositories you contribute to

- rossialice/intcatch_asl_luglio_2... 0 ★
- SPQRTTeam/SPQRBallPerceptor 0 ★

Your repositories 25

New repository

Find a repository...

All Public Private Sources Forks

- Guilucand/intcatch_projects
- SPQRTTeam/SPQRBallPerceptor
- lorenzosteccanella/Intcatch_Deep_Pixel...
- labrobotica-bloisi/realsense_r200_viewer
- detectball
- labrobotica-bloisi/mousekalman
- fabioprev/Publications

Load more...

Your teams 0

Find a team...

You don't belong to any teams yet!

Recent activity:

- Guilucand pushed to `master` in `Guilucand/intcatch_projects` 5 days ago
e42cbae Improved hline drawing
- Guilucand pushed to `master` in `Guilucand/intcatch_projects` 6 days ago
0f56118 Add basic point metrics
- tiziano90 pushed to `master` in `SPQRTTeam/spqrnao2018` 10 days ago
2f23917 mask+ballspots
- EMES92 pushed to `master` in `SPQRTTeam/spqrnao2018` 11 days ago
7d14bb4 Striker with PathPlanner and SPQRWalkTo
- Guilucand pushed to `master` in `Guilucand/intcatch_projects` 16 days ago
56c5daa Merge branch 'master' of https://github.com/Guilucand/intcatch_p...
daffedf Charged stabilization func

Repository name

Create a new repository

A repository contains all the files for your project, including the revision history.

Owner: dbloisi / Repository name: hello_ros ✓

Great repository names are short and memorable. Need inspiration? How about [furry-parakeet](#).

Description (optional): my first ros package

Public: Anyone can see this repository. You choose who can commit.

Private: You choose who can see and commit to this repository.

Initialize this repository with a README: This will let you immediately clone the repository to your computer. Skip this step if you're importing an existing repository.

Add .gitignore: None Add a license: **GNU General Public License v3.0** ⓘ

Create repository

- 1
- 2
- 3
- 4
- 5

Repository create

The screenshot shows a GitHub repository page for the user 'dbloisi' with the repository name 'hello_ros'. A red circle highlights the top navigation bar, and a larger red circle highlights the main content area below the commit list.

Top Navigation Bar:

- Unwatched (1)
- Starred (0)
- Forked (0)

Repository Summary:

- Code
- Issues (0)
- Pull requests (0)
- Projects (0)
- Wiki
- Insights
- Settings

Repository Details:

- my first ros package
- Add topics
- Edit

Statistics:

- 1 commit
- 1 branch
- 0 releases
- 1 contributor

Branch Selection:

- Branch: master
- New pull request

Commit List:

File	Author	Commit Message	Time
LICENSE	dbloisi	Initial commit	Latest commit 54aaaf4 just now
README.md		Initial commit	just now
README.md		Initial commit	just now

Actions:

- Create new file
- Upload files
- Find file
- Clone or download

File Content Preview:

```
hello_ros

my first ros package
```

Indirizzo del repository remoto

The screenshot shows a GitHub repository page for the user 'dbloisi' with the repository name 'hello_ros'. The page displays basic statistics: 1 commit, 1 branch, 0 releases, and 1 contributor. Below these stats, there are buttons for 'Create new file', 'Upload files', 'Find file', and a prominent green 'Clone or download' button. A red circle highlights this 'Clone or download' button. To its right, a dropdown menu is open, showing the URL 'https://github.com/dbloisi/hello_ros.' followed by a copy icon and a 'Download ZIP' button.

dbloisi / hello_ros

Unwatch 1 Star 0 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Insights Settings

my first ros package Edit

Add topics

1 commit 1 branch 0 releases 1 contributor

Branch: master New pull request

dbloisi Initial commit

LICENSE Initial commit

README.md Initial commit

README.md

Clone with HTTPS Use SSH

Use Git or checkout with SVN using the web URL.

https://github.com/dbloisi/hello_ros

Download ZIP

hello_ros

my first ros package

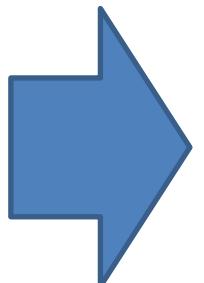
Creazione del repository locale

Il repository remoto si trova in

https://github.com/dbloisi/hello_ros

Spostiamoci nella cartella src del nostro workspace ROS che si trova in [~/catkin_ws/src](#)

```
bloisi@bloisi-U36SG: ~/catkin_ws/src
File Edit View Search Terminal Help
bloisi@bloisi-U36SG:~$ cd catkin_ws/
bloisi@bloisi-U36SG:~/catkin_ws$ ls
build  devel  src
bloisi@bloisi-U36SG:~/catkin_ws$ cd src/
bloisi@bloisi-U36SG:~/catkin_ws/src$ █
```



Clone del repository remoto

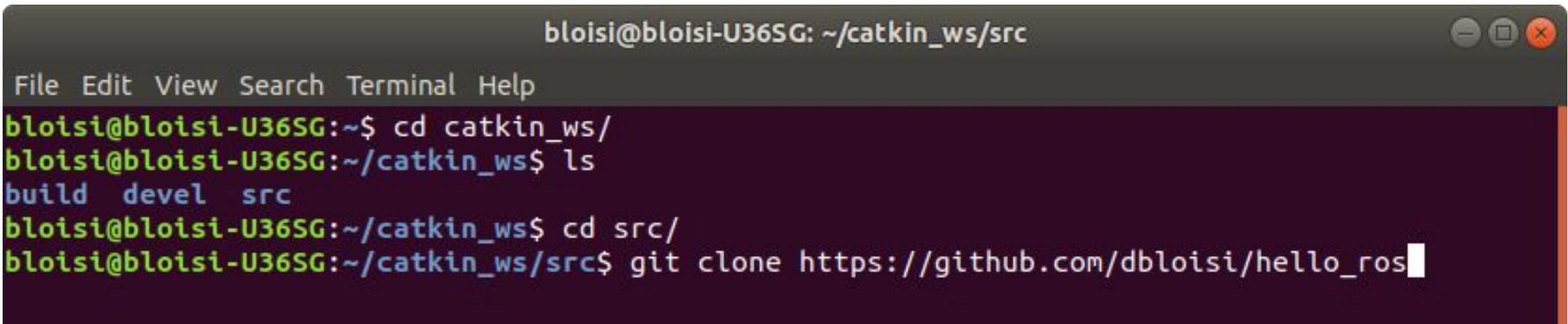
1. Cloniamo il repository remoto che si trova in

https://github.com/dbloisi/hello_ros

con il comando

```
git clone https://github.com/dbloisi/hello_ros
```

2. Verrà creato un repository locale in [~/catkin_ws/src/hello_ros](#)



A screenshot of a terminal window titled "bloisi@bloisi-U36SG: ~/catkin_ws/src". The window has a standard Linux desktop interface with a title bar, menu bar, and close/minimize buttons.

The terminal content shows the following command sequence:

```
bloisi@bloisi-U36SG: ~$ cd catkin_ws/
bloisi@bloisi-U36SG:~/catkin_ws$ ls
build  devel  src
bloisi@bloisi-U36SG:~/catkin_ws$ cd src/
bloisi@bloisi-U36SG:~/catkin_ws/src$ git clone https://github.com/dbloisi/hello_ros
```

The last line of the command sequence is partially cut off at the bottom of the terminal window.

Creating a ROS package

① wiki.ros.org/ROS/Tutorials/CreatingPackage

The screenshot shows the ROS.org website with the URL wiki.ros.org/ROS/Tutorials/CreatingPackage. The page title is "Creating a ROS Package". The page content includes a note about previous tutorials, a tip about asking questions on answers.ros.org, and a description of the tutorial. It also lists the tutorial level as "BEGINNER" and the next tutorial as "Building a ROS package". A sidebar on the right contains links for "Wiki", "Distributions", "ROS/Installation", "ROS/Tutorials", "RecentChanges", and "CreatingPackage" (which is highlighted). Below that are "Page" links for "Immutable Page", "Info", and "Attachments", and a "More Actions" dropdown. At the bottom left, there are two buttons: "catkin" and "rosbuild". A sidebar on the left contains a "Contents" section with a list of topics, including "What makes up a catkin Package?", "Packages in a catkin Workspace", "Creating a catkin Package", "Building a catkin workspace and sourcing the setup file", "package dependencies", "Customizing Your Package", and "Customizing the CMakeLists.txt".

<http://wiki.ros.org/ROS/Tutorials/CreatingPackage>

1. What makes up a catkin Package?

For a package to be considered a catkin package it must meet a few requirements:

- The package must contain a [catkin compliant package.xml](#) file.

catkin_create_pkg



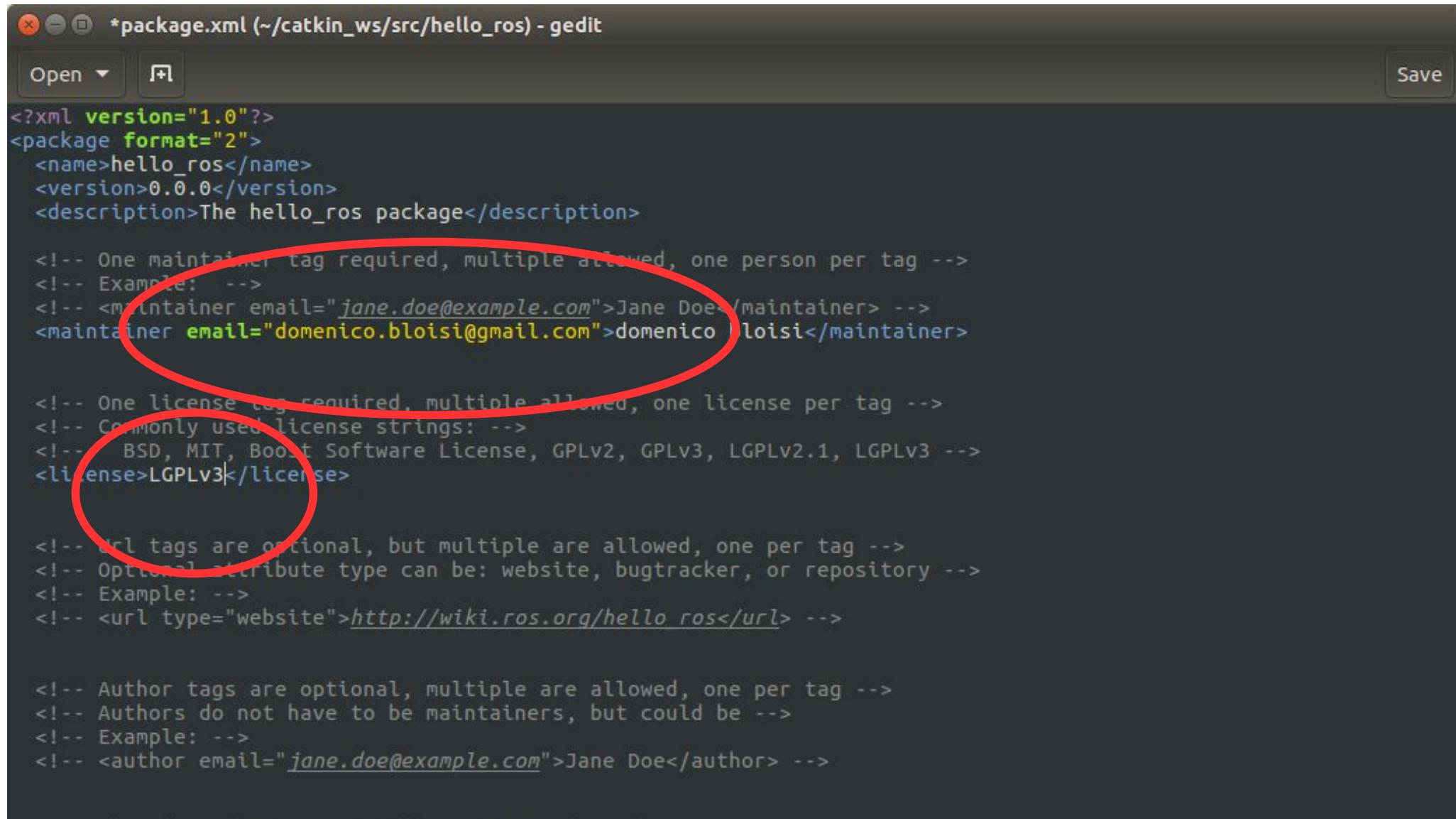
```
nvidia@tegra-ubuntu: ~/catkin_ws/src
nvidia@tegra-ubuntu:~/catkin_ws/src$ catkin_create_pkg hello_ros std_msgs rospy roscpp
```

```
nvidia@tegra-ubuntu: ~/catkin_ws/src
nvidia@tegra-ubuntu:~/catkin_ws/src$ catkin_create_pkg hello_ros std_msgs rospy roscpp
Created file hello_ros/package.xml
Created file hello_ros/CMakeLists.txt
Created folder hello_ros/include/hello_ros
Created folder hello_ros/src
Successfully created files in /home/nvidia/catkin_ws/src/hello_ros. Please adjust the values in package.xml.
nvidia@tegra-ubuntu:~/catkin_ws/src$
```

package.xml

```
nvidia@tegra-ubuntu: ~/catkin_ws/src/hello_ros
nvidia@tegra-ubuntu:~/catkin_ws/src$ catkin_create_pkg hello_ros std_msgs rospy roscpp
Created file hello_ros/package.xml
Created file hello_ros/CMakeLists.txt
Created folder hello_ros/include/hello_ros
Created folder hello_ros/src
Successfully created files in /home/nvidia/catkin_ws/src/hello_ros. Please adjust the values in package.xml.
nvidia@tegra-ubuntu:~/catkin_ws/src$ cd hello_ros
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$ gedit package.xml
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$
```

Inserimento dati in package.xml



The screenshot shows a terminal window titled '*package.xml (~/catkin_ws/src/hello_ros) - gedit'. The file contains XML code for a ROS package named 'hello_ros'. Several sections of the code are highlighted with red circles:

- A red circle highlights the entire section from the opening `<package format="2">` tag to the closing `</package>` tag.
- A red circle highlights the `<maintainer email="domenico.bloisi@gmail.com">domenico bloisi</maintainer>` tag.
- A red circle highlights the `<license>LGPLv3</license>` tag.
- A red circle highlights the `<url type="website">http://wiki.ros.org/hello_ros</url>` tag.

```
<?xml version="1.0"?>
<package format="2">
  <name>hello_ros</name>
  <version>0.0.0</version>
  <description>The hello_ros package</description>

  <!-- One maintainer tag required, multiple allowed, one person per tag -->
  <!-- Example: -->
  <!-- <maintainer email="jane.doe@example.com">Jane Doe</maintainer> -->
  <maintainer email="domenico.bloisi@gmail.com">domenico bloisi</maintainer>

  <!-- One license tag required, multiple allowed, one license per tag -->
  <!-- Commonly used license strings: -->
  <!-- BSD, MIT, Boost Software License, GPLv2, GPLv3, LGPLv2.1, LGPLv3 -->
  <license>LGPLv3</license>

  <!-- Url tags are optional, but multiple are allowed, one per tag -->
  <!-- Optional attribute type can be: website, bugtracker, or repository -->
  <!-- Example: -->
  <!-- <url type="website">http://wiki.ros.org/hello\_ros</url> -->

  <!-- Author tags are optional, multiple are allowed, one per tag -->
  <!-- Authors do not have to be maintainers, but could be -->
  <!-- Example: -->
  <!-- <author email="jane.doe@example.com">Jane Doe</author> -->
```

Dipendenze in package.xml

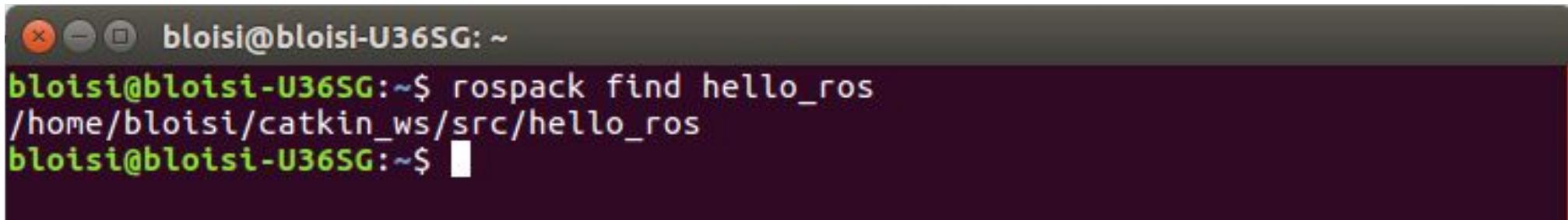
```
<!-- Examples: -->
<!-- Use depend as a shortcut for packages that are both build and exec dependencies -->
<!-- <depend>roscpp</depend> -->
<!-- Note that this is equivalent to the following: -->
<!-- <build_depend>roscpp</build_depend> -->
<!-- <exec_depend>roscpp</exec_depend> -->
<!-- Use build_depend for packages you need at compile time: -->
<!-- <build_depend>message_generation</build_depend> -->
<!-- Use build_export_depend for packages you need in order to build against this package: -->
<!-- <build_export_depend>message_generation</build_export_depend> -->
<!-- Use buildtool_depend for build tool packages: -->
<!-- <buildtool_depend>catkin</buildtool_depend> -->
<!-- Use exec_depend for packages you need at runtime: -->
<!-- <exec_depend>message_runtime</exec_depend> -->
<!-- Use test_depend for packages you need only for testing: -->
<!-- <test_depend>gtest</test_depend> -->
<!-- Use doc_depend for packages you need only for building documentation: -->
<!-- <doc_depend>doxygen</doc_depend> -->
<buildtool_depend>catkin</buildtool_depend>
<build_depend>roscpp</build_depend>
<build_depend>rospy</build_depend>
<build_depend>std_msgs</build_depend>
<build_export_depend>roscpp</build_export_depend>
<build_export_depend>rospy</build_export_depend>
<build_export_depend>std_msgs</build_export_depend>
<exec_depend>roscpp</exec_depend>
<exec_depend>rospy</exec_depend>
<exec_depend>std_msgs</exec_depend>

<!-- The export tag contains other, unspecified, tags -->
<export>
    <!-- Other tools can request additional information be placed here -->
</export>
</package>
```

Finding a ROS package

Now that your package has a manifest, ROS can find it. Try executing the command:

```
rospack find hello_ros
```

A screenshot of a terminal window titled "bloisi@bloisi-U36SG: ~". The window contains the command "rospack find hello_ros" and its output, which is the path "/home/bloisi/catkin_ws/src/hello_ros".

```
bloisi@bloisi-U36SG: ~
bloisi@bloisi-U36SG:~$ rospack find hello_ros
/home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~$ █
```

if ROS is set up correctly you should see the physical location where your package is stored

<http://wiki.ros.org/ROS/Tutorials/Creating%20a%20Package%20by%20Hand>

Finding a ROS package

Se il comando

```
rospack find hello_ros
```

non va a buon fine

```
bloisi@bloisi-U36SG:~/catkin_ws$ rospack find hello_ros
[rospack] Error: package 'hello_ros' not found
```

provare con il comando

```
source devel/setup.bash
```

```
bloisi@bloisi-U36SG:~/catkin_ws$ source devel/setup.bash
bloisi@bloisi-U36SG:~/catkin_ws$ rospack find hello_ros
/home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~/catkin_ws$ █
```

Esempio Publisher/Subscriber Python

The screenshot shows a web browser displaying the ROS.org website. The URL in the address bar is wiki.ros.org/ROS/Tutorials/WritingPublisherSubscriber%28python%29. The page title is "ROS/ Tutorials/ WritingPublisherSubscriber(python)". The main content is titled "Writing a Simple Publisher and Subscriber (Python)". It includes a note about prerequisites, a tip for asking questions, and a description of the tutorial. Below the content are sections for "Tutorial Level: BEGINNER", "Next Tutorial: Examining the simple publisher and subscriber", and a sidebar with tags like "catkin" and "rosbuild". A sidebar on the right provides links for "Wiki", "Page", and "User" actions.

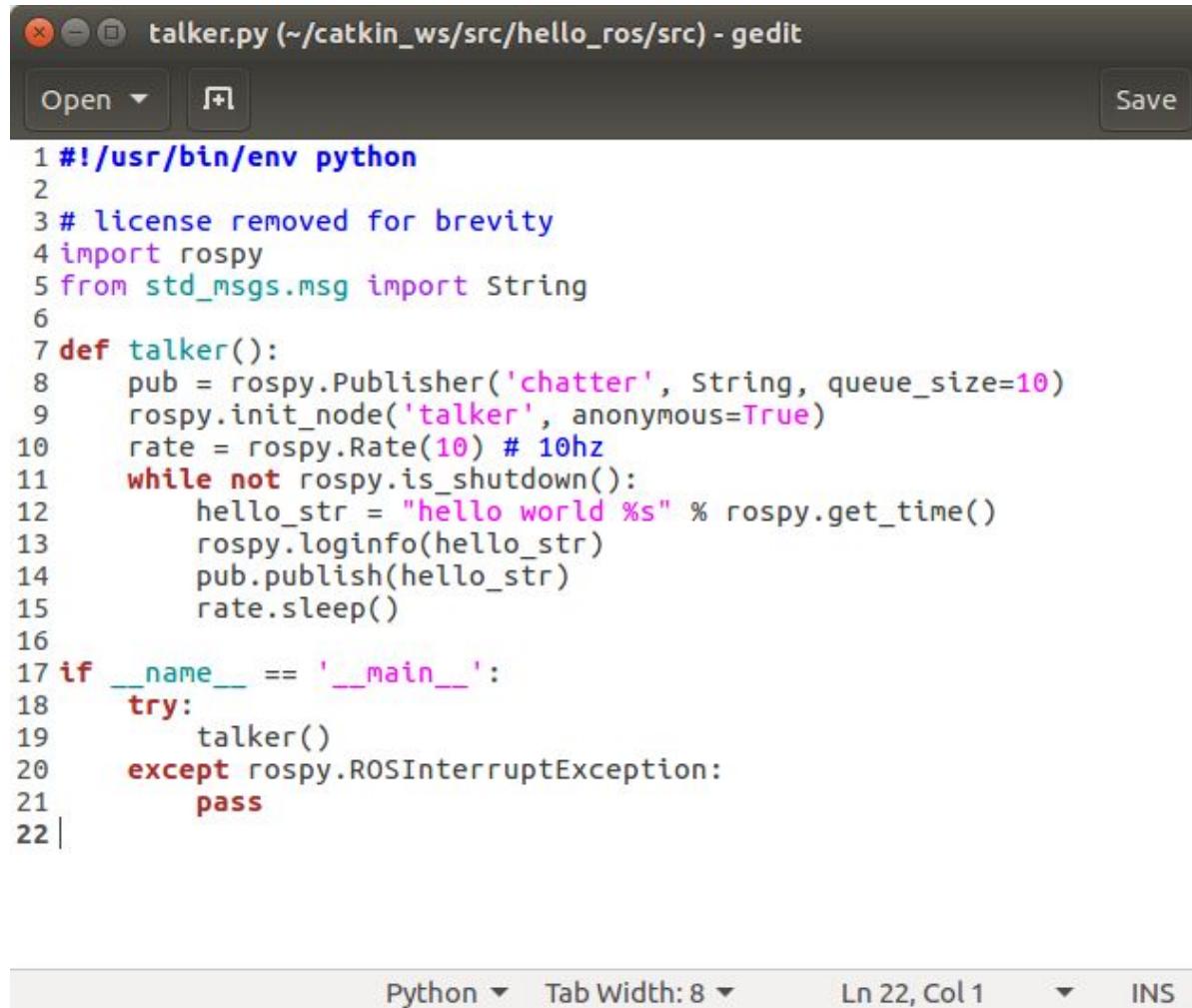
<http://wiki.ros.org/ROS/Tutorials/WritingPublisherSubscriber%28python%29>

Creiamo il publisher (talker.py)

The screenshot shows a terminal window with a dark background and light-colored text. The terminal title is "bloisi@bloisi-U36SG: ~/catkin_ws/src/hello_ros/src". The user runs several commands to navigate to the directory and open a file:

```
bloisi@bloisi-U36SG:~$ rospack find hello_ros
/home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~$ cd /home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ ls
CMakeLists.txt  hello-ros.pdf  images  LICENSE  package.xml  README.md  src
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ cd src/
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ gedit talker.py
```

Codice del publisher (talker.py)



The image shows a screenshot of a Gedit text editor window. The title bar reads "talker.py (~/catkin_ws/src/hello_ros/src) - gedit". The menu bar includes "Open", "Save", and other standard options. The code area contains the following Python script:

```
1 #!/usr/bin/env python
2
3 # license removed for brevity
4 import rospy
5 from std_msgs.msg import String
6
7 def talker():
8     pub = rospy.Publisher('chatter', String, queue_size=10)
9     rospy.init_node('talker', anonymous=True)
10    rate = rospy.Rate(10) # 10hz
11    while not rospy.is_shutdown():
12        hello_str = "hello world %s" % rospy.get_time()
13        rospy.loginfo(hello_str)
14        pub.publish(hello_str)
15        rate.sleep()
16
17 if __name__ == '__main__':
18     try:
19         talker()
20     except rospy.ROSInterruptException:
21         pass
22 |
```

The status bar at the bottom shows "Python" as the language, "Tab Width: 8", "Ln 22, Col 1", and "INS" indicating an insert mode.

https://raw.githubusercontent.com/ros/ros_tutorials/kinetic-devel/rospy_tutorials/001_talker_listener/talker.py

publisher (talker.py) eseguibile

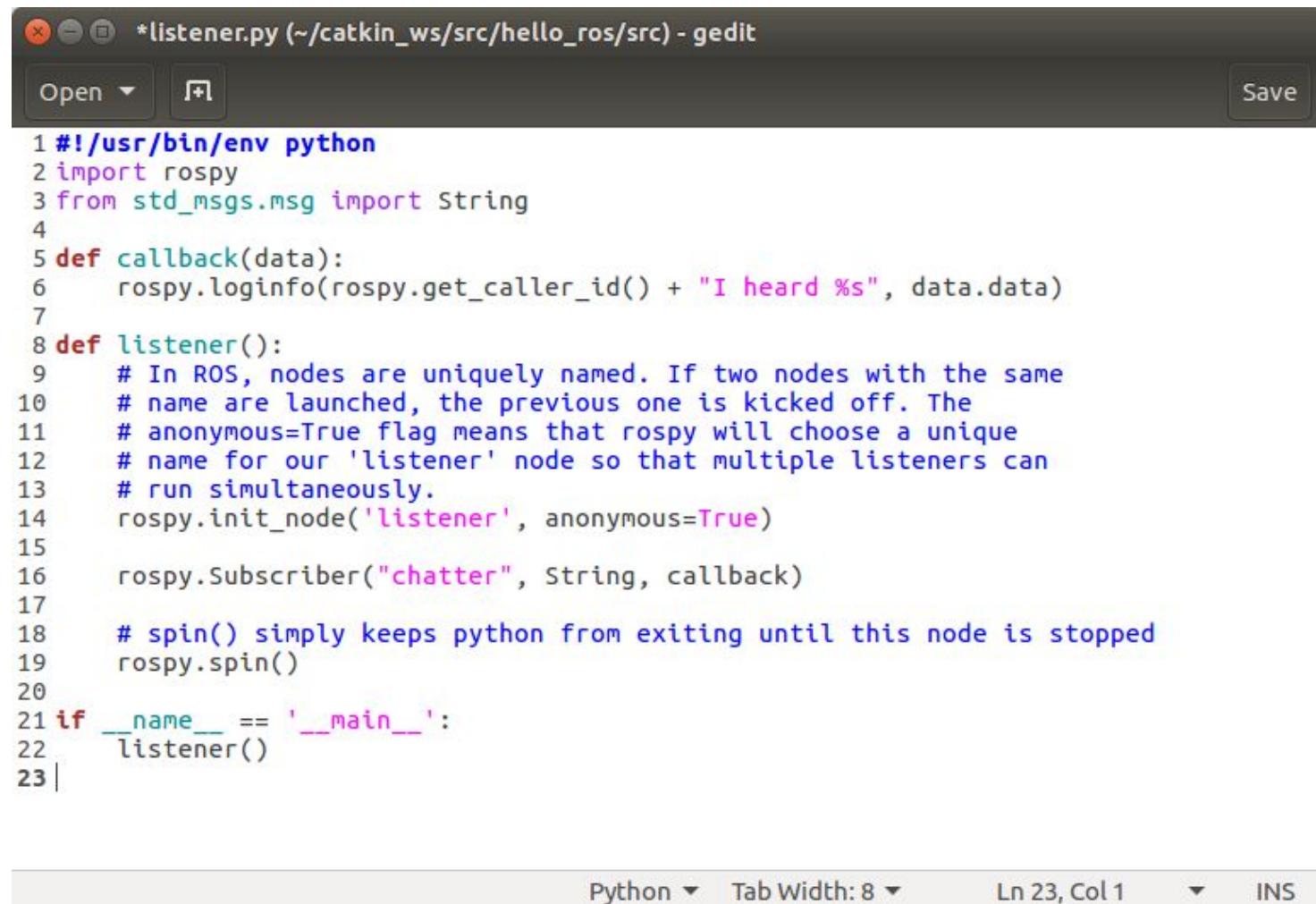
```
bloisi@bloisi-U36SG: ~/catkin_ws/src/hello_ros/src
bloisi@bloisi-U36SG:~$ rospack find hello_ros
/home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~$ cd /home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ ls
CMakeLists.txt  hello-ros.pdf  images  LICENSE  package.xml  README.md  src
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ cd src/
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ gedit talker.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ chmod +x talker.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ █
```

Creiamo il subscriber (listener.py)

The screenshot shows a terminal window with a dark background and light-colored text. The terminal title is "bloisi@bloisi-U36SG: ~/catkin_ws/src/hello_ros/src". The user runs several commands to find the package, change directory, list files, and finally open the "listener.py" file with gedit. The commands and their outputs are:

```
bloisi@bloisi-U36SG:~$ rospack find hello_ros
/home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~$ cd /home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ ls
CMakeLists.txt  hello-ros.pdf  images  LICENSE  package.xml  README.md  src
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ cd src/
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ gedit talker.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ chmod +x talker.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ gedit listener.py
```

Codice del subscriber (listener.py)

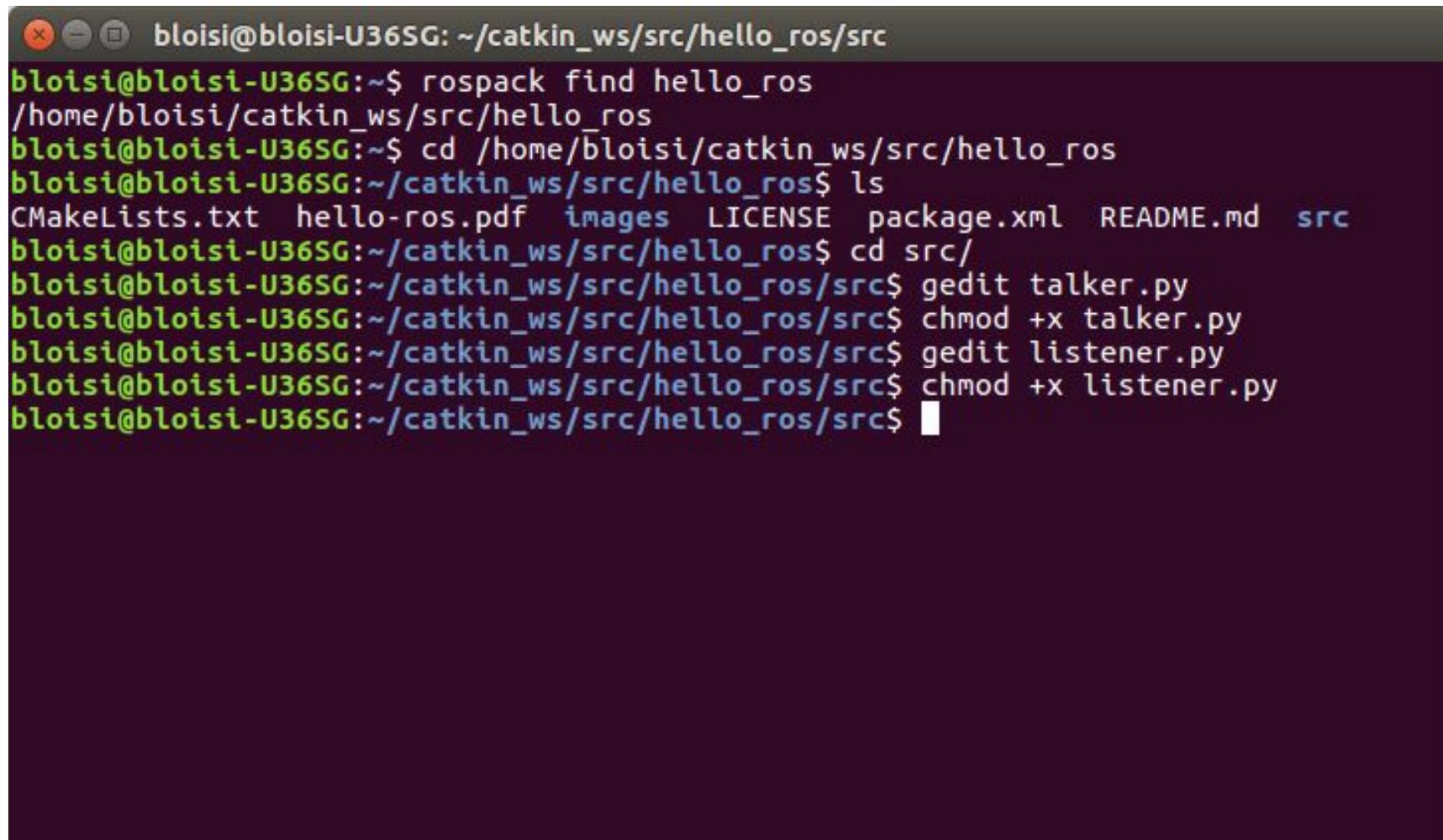


```
1 #!/usr/bin/env python
2 import rospy
3 from std_msgs.msg import String
4
5 def callback(data):
6     rospy.loginfo(rospy.get_caller_id() + "I heard %s", data.data)
7
8 def listener():
9     # In ROS, nodes are uniquely named. If two nodes with the same
10    # name are launched, the previous one is kicked off. The
11    # anonymous=True flag means that rospy will choose a unique
12    # name for our 'listener' node so that multiple listeners can
13    # run simultaneously.
14    rospy.init_node('listener', anonymous=True)
15
16    rospy.Subscriber("chatter", String, callback)
17
18    # spin() simply keeps python from exiting until this node is stopped
19    rospy.spin()
20
21 if __name__ == '__main__':
22     listener()
23 |
```

Python ▾ Tab Width: 8 ▾ Ln 23, Col 1 ▾ INS

https://raw.githubusercontent.com/ros/ros_tutorials/kinetic-devel/rospy_tutorials/001_talker_listener/listener.py

Creiamo il subscriber (listener.py)

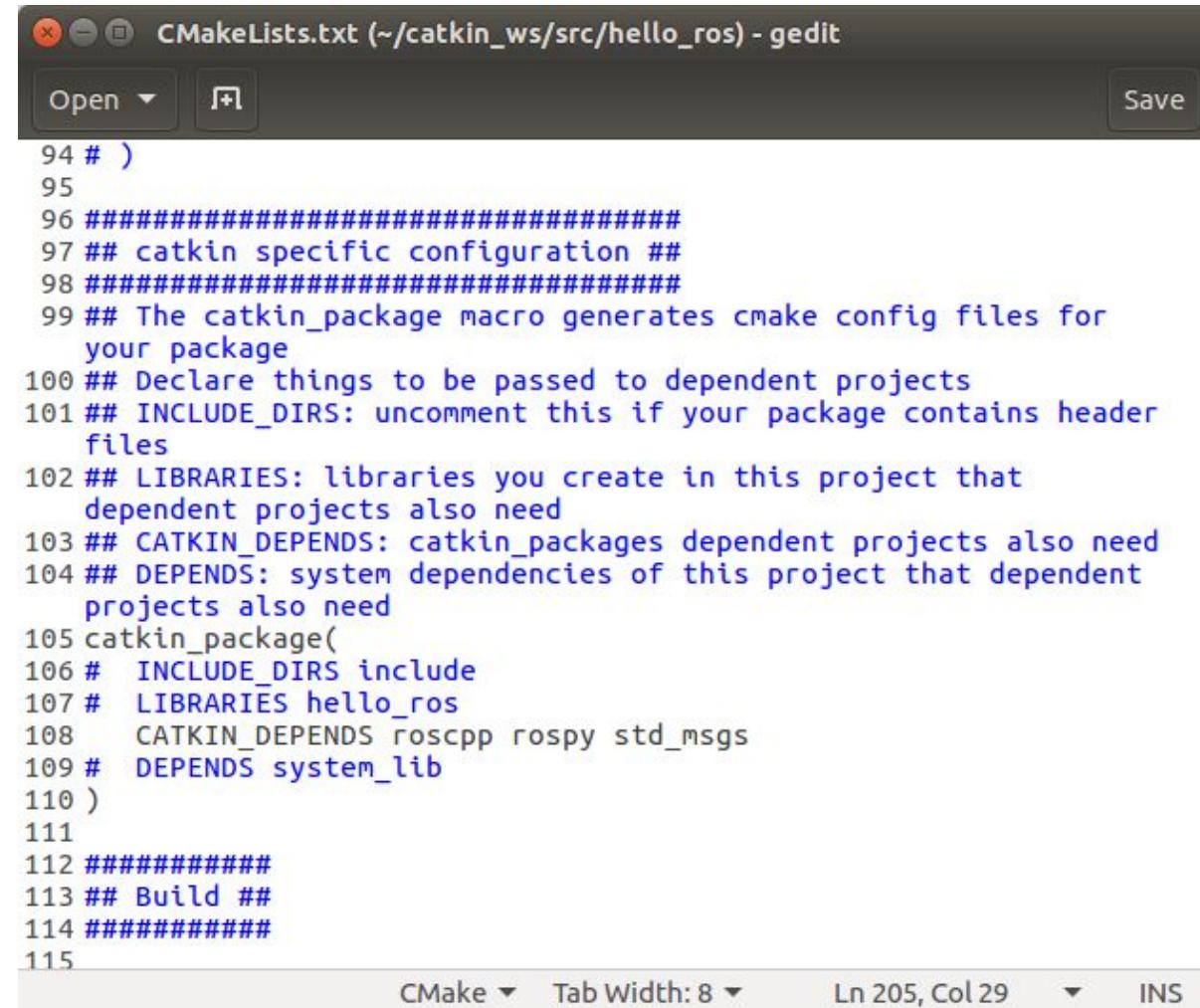


A screenshot of a terminal window titled "bloisi@bloisi-U36SG: ~ /catkin_ws/src/hello_ros/src". The terminal displays a series of commands used to find the package, change directory, list files, and edit scripts:

```
bloisi@bloisi-U36SG:~$ rospack find hello_ros
/home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~$ cd /home/bloisi/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ ls
CMakeLists.txt  hello-ros.pdf  images  LICENSE  package.xml  README.md  src
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$ cd src/
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ gedit talker.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ chmod +x talker.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ gedit listener.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$ chmod +x listener.py
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros/src$
```

Compiliamo il package hello_ros

Modifichiamo il file CMakeLists.txt in modo da poter compilare il package hello_ros contenente i due nodi talker e listener



The screenshot shows a terminal window titled "CMakeLists.txt (~/catkin_ws/src/hello_ros) - gedit". The file contains the following CMake configuration code:

```
94 # )
95
96 #####
97 ## catkin specific configuration ##
98 #####
99 ## The catkin_package macro generates cmake config files for
   your package
100 ## Declare things to be passed to dependent projects
101 ## INCLUDE_DIRS: uncomment this if your package contains header
   files
102 ## LIBRARIES: libraries you create in this project that
   dependent projects also need
103 ## CATKIN_DEPENDS: catkin_packages dependent projects also need
104 ## DEPENDS: system dependencies of this project that dependent
   projects also need
105 catkin_package(
106 #   INCLUDE_DIRS include
107 #   LIBRARIES hello_ros
108   CATKIN_DEPENDS roscpp rospy std_msgs
109 #   DEPENDS system_lib
110 )
111
112 #####
113 ## Build ##
114 #####
115
```

The code is color-coded: comments are in blue, and variable names and macros are in black.

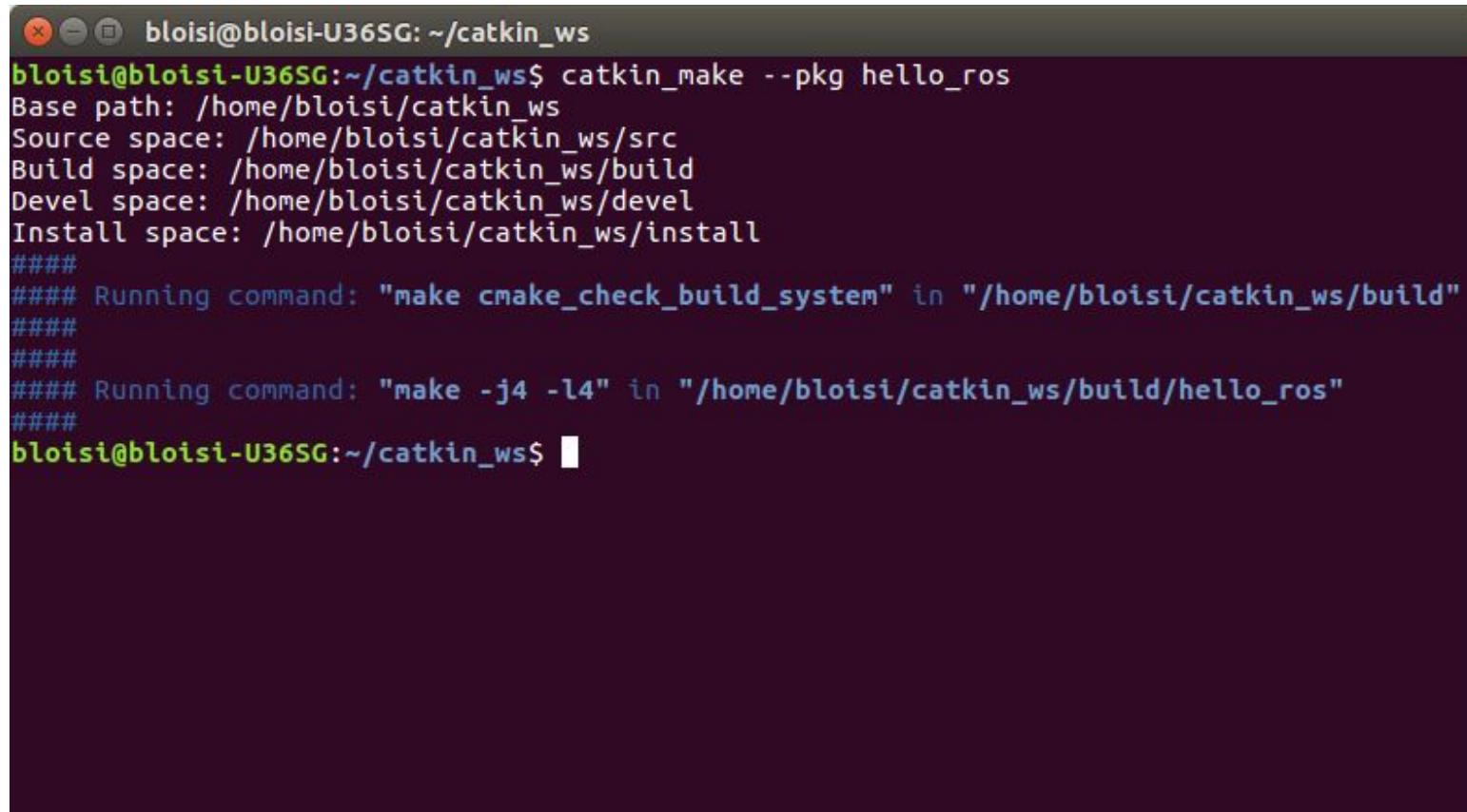
CMakeLists.txt

We need the CMakeLists.txt file so that catkin_make, which uses CMake for its more powerful flexibility when building across multiple platforms, builds the package



Compilazione con catkin_make

```
catkin_make --pkg hello_ros
```

A screenshot of a terminal window titled "bloisi@bloisi-U36SG: ~/catkin_ws". The window contains the command "catkin_make --pkg hello_ros" and its execution output. The output shows the base path as "/home/bloisi/catkin_ws", source space as "/home/bloisi/catkin_ws/src", build space as "/home/bloisi/catkin_ws/build", devel space as "/home/bloisi/catkin_ws/devel", and install space as "/home/bloisi/catkin_ws/install". It also shows the execution of "make cmake_check_build_system" and "make -j4 -l4" commands in the build directory. The terminal prompt "bloisi@bloisi-U36SG:~/catkin_ws\$" is visible at the bottom.

```
bloisi@bloisi-U36SG:~/catkin_ws$ catkin_make --pkg hello_ros
Base path: /home/bloisi/catkin_ws
Source space: /home/bloisi/catkin_ws/src
Build space: /home/bloisi/catkin_ws/build
Devel space: /home/bloisi/catkin_ws/devel
Install space: /home/bloisi/catkin_ws/install
#####
##### Running command: "make cmake_check_build_system" in "/home/bloisi/catkin_ws/build"
#####
#####
##### Running command: "make -j4 -l4" in "/home/bloisi/catkin_ws/build/hello_ros"
#####
bloisi@bloisi-U36SG:~/catkin_ws$
```

Esecuzione del nodo talker

The screenshot shows a web browser window with the URL <http://wiki.ros.org/ROS/Tutorials/ExaminingPublisherSubscriber>. The page content is as follows:

1. Running the Publisher

Make sure that a roscore is up and running:

```
$ roscore
```

catkin specific If you are using catkin, make sure you have sourced your workspace's setup.sh file after calling `catkin_make` but before trying to use your applications:

```
# In your catkin workspace
$ cd ~/catkin_ws
$ source ./devel/setup.bash
```

In the last tutorial we made a publisher called "talker". Let's run it:

```
$ rosrun beginner_tutorials talker      (C++)
$ rosrun beginner_tutorials talker.py   (Python)
```

You will see something similar to:

```
[INFO] [WallTime: 1314931831.774057] hello world 1314931831.77
[INFO] [WallTime: 1314931832.775497] hello world 1314931832.77
[INFO] [WallTime: 1314931833.778937] hello world 1314931833.78
[INFO] [WallTime: 1314931834.782059] hello world 1314931834.78
[INFO] [WallTime: 1314931835.784853] hello world 1314931835.78
[INFO] [WallTime: 1314931836.788106] hello world 1314931836.79
```

The publisher node is up and running. Now we need a subscriber to receive messages from the publisher.

2. Running the Subscriber

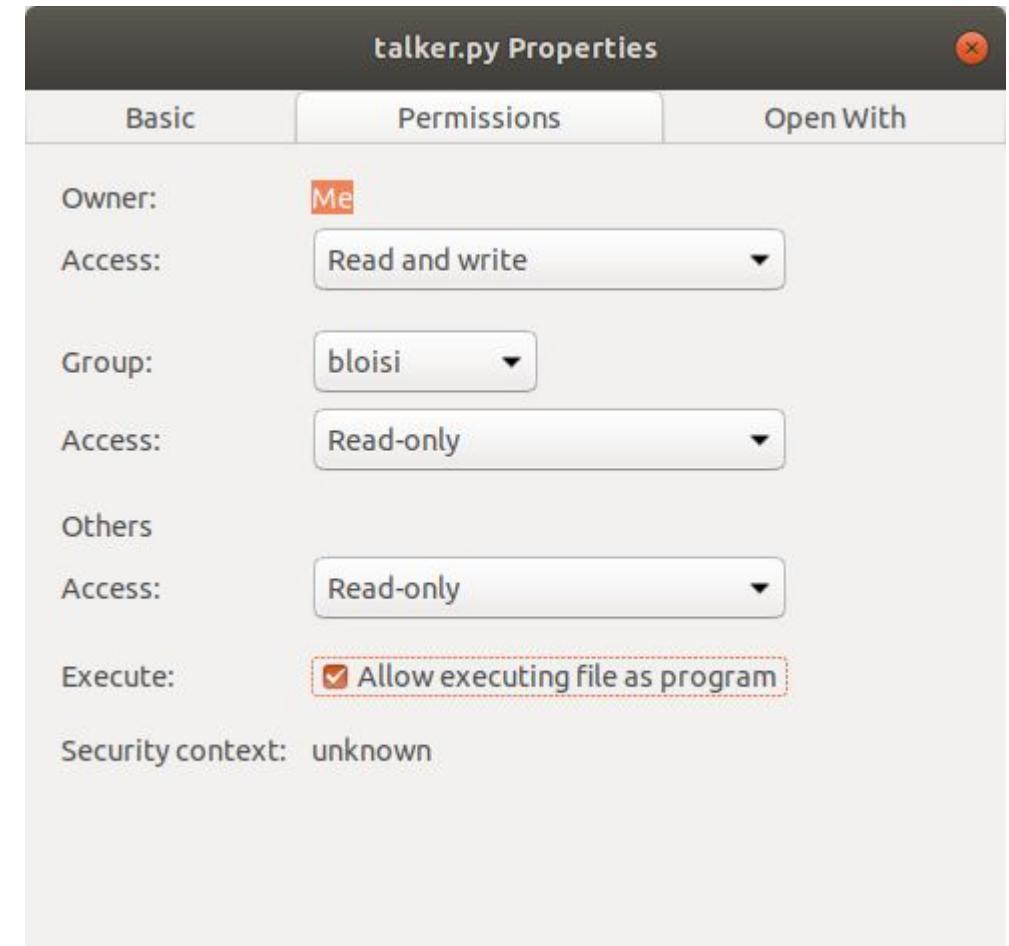
In the last tutorial we made a subscriber called "listener". Let's run it:

```
$ rosrun beginner_tutorials listener      (C++)
$ rosrun beginner_tutorials listener.py   (Python)
```

<http://wiki.ros.org/ROS/Tutorials/ExaminingPublisherSubscriber>

Esecuzione del nodo talker

Per mandare in esecuzione il file `talker.py` assicuriamoci di aver assegnato ad esso i permessi per poter essere eseguito dal sistema operativo



roscore + rosrun

Apriamo un terminale e lanciamo roscore

```
roscore http://localhost:11311/
bloisi@bloisi-U36SG:~$ roscore
... logging to /home/bloisi/.ros/log/d8f5ca3a-6a54-11e9-953a-dc85de574b1d/roslau
nch-bloisi-U36SG-12291.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://localhost:34051/
ros_comm version 1.12.14

SUMMARY
=====

PARAMETERS
* /rosdistro: kinetic
* /rosversion: 1.12.14

NODES

auto-starting new master
process[master]: started with pid [12303]
ROS_MASTER_URI=http://localhost:11311/

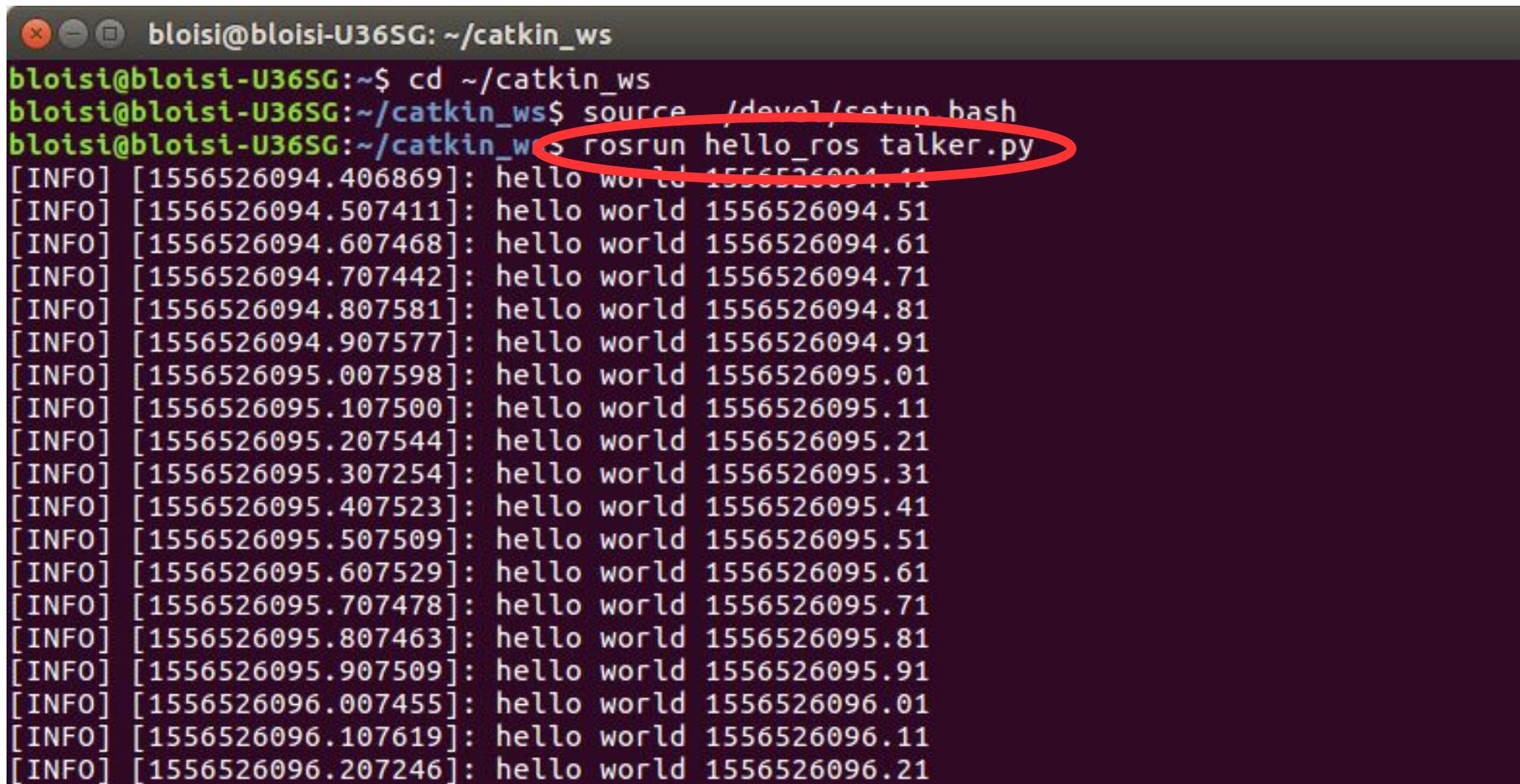
setting /run_id to d8f5ca3a-6a54-11e9-953a-dc85de574b1d
process[rosout-1]: started with pid [12316]
started core service [/rosout]
```

Apriamo un secondo terminale e
lanciamo
rosrun hello_ros talker.py

```
bloisi@bloisi-U36SG:~/catkin_ws
bloisi@bloisi-U36SG:~$ cd ~/catkin_ws
bloisi@bloisi-U36SG:~/catkin_ws$ source ./devel/setup.bash
bloisi@bloisi-U36SG:~/catkin_ws$ rosrun hello_ros talker.py
```

Cosa accade?

Esecuzione del nodo talker



The screenshot shows a terminal window with a dark background and light-colored text. The terminal title is "bloisi@bloisi-U36SG: ~/catkin_ws". The user has run several commands:

```
bloisi@bloisi-U36SG:~$ cd ~/catkin_ws
bloisi@bloisi-U36SG:~/catkin_ws$ source ./devel/setup.bash
bloisi@bloisi-U36SG:~/catkin_ws$ rosrun hello_ros talker.py
```

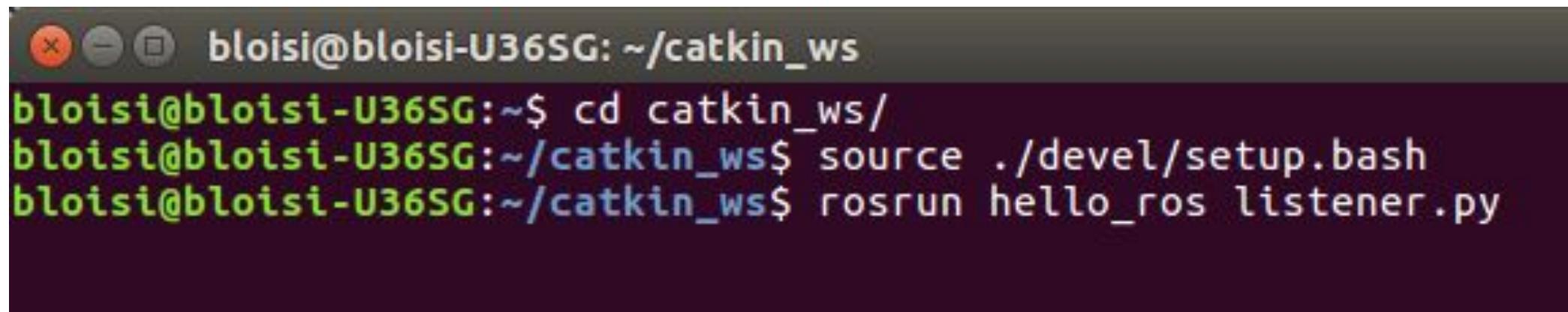
The command `rosrun hello_ros talker.py` is highlighted with a red oval. The output of the node is displayed below, showing repeated "hello world" messages with timestamps:

```
[INFO] [1556526094.406869]: hello world 1556526094.11
[INFO] [1556526094.507411]: hello world 1556526094.51
[INFO] [1556526094.607468]: hello world 1556526094.61
[INFO] [1556526094.707442]: hello world 1556526094.71
[INFO] [1556526094.807581]: hello world 1556526094.81
[INFO] [1556526094.907577]: hello world 1556526094.91
[INFO] [1556526095.007598]: hello world 1556526095.01
[INFO] [1556526095.107500]: hello world 1556526095.11
[INFO] [1556526095.207544]: hello world 1556526095.21
[INFO] [1556526095.307254]: hello world 1556526095.31
[INFO] [1556526095.407523]: hello world 1556526095.41
[INFO] [1556526095.507509]: hello world 1556526095.51
[INFO] [1556526095.607529]: hello world 1556526095.61
[INFO] [1556526095.707478]: hello world 1556526095.71
[INFO] [1556526095.807463]: hello world 1556526095.81
[INFO] [1556526095.907509]: hello world 1556526095.91
[INFO] [1556526096.007455]: hello world 1556526096.01
[INFO] [1556526096.107619]: hello world 1556526096.11
[INFO] [1556526096.207246]: hello world 1556526096.21
```

Esecuzione del nodo listener

Apriamo un terzo terminale e
lanciamo

```
rosrun hello_ros listener.py
```



The screenshot shows a terminal window with a dark background and light-colored text. The title bar reads "bloisi@bloisi-U36SG: ~/catkin_ws". The command history is as follows:

```
bloisi@bloisi-U36SG:~$ cd catkin_ws/
bloisi@bloisi-U36SG:~/catkin_ws$ source ./devel/setup.bash
bloisi@bloisi-U36SG:~/catkin_ws$ rosrun hello_ros listener.py
```

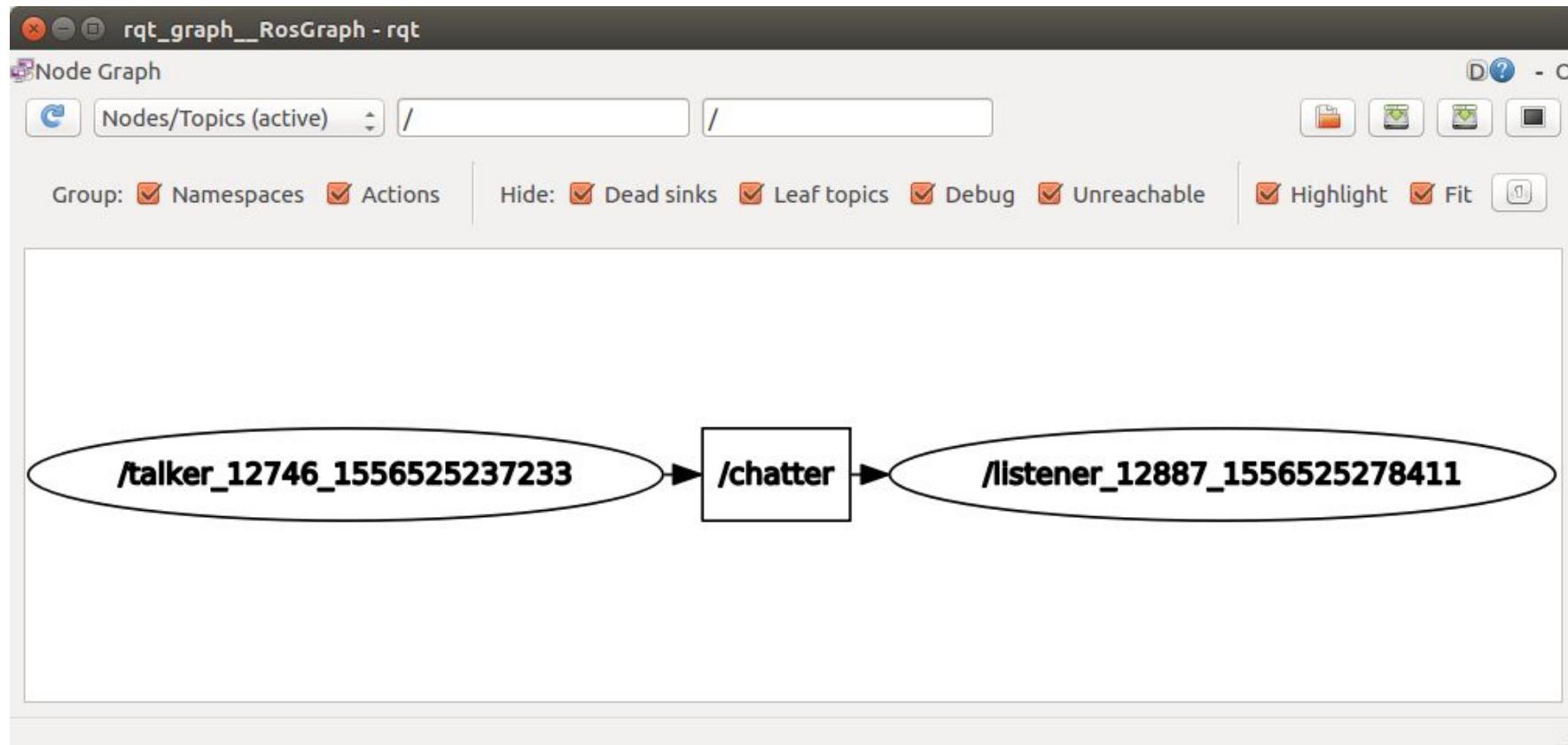
anche per `listener.py` assicuriamoci di aver assegnato i permessi per poter essere eseguito

Esecuzione del nodo listener

```
bloisi@bloisi-U36SG:~/catkin_ws$ cd catkin_ws/
bloisi@bloisi-U36SG:~/catkin_ws$ source ./devel/setup.bash
bloisi@bloisi-U36SG:~/catkin_ws$ rosrun hello_ros listener.py
[INFO] [1556526343.908437]: /listener_13845_1556526343630I heard hello world 1556526343.91
[INFO] [1556526344.009033]: /listener_13845_1556526343630I heard hello world 1556526344.01
[INFO] [1556526344.109351]: /listener_13845_1556526343630I heard hello world 1556526344.11
[INFO] [1556526344.209091]: /listener_13845_1556526343630I heard hello world 1556526344.21
[INFO] [1556526344.309455]: /listener_13845_1556526343630I heard hello world 1556526344.31
[INFO] [1556526344.409235]: /listener_13845_1556526343630I heard hello world 1556526344.41
[INFO] [1556526344.509644]: /listener_13845_1556526343630I heard hello world 1556526344.51
[INFO] [1556526344.609792]: /listener_13845_1556526343630I heard hello world 1556526344.61
[INFO] [1556526344.709825]: /listener_13845_1556526343630I heard hello world 1556526344.71
[INFO] [1556526344.809585]: /listener_13845_1556526343630I heard hello world 1556526344.81
[INFO] [1556526344.909382]: /listener_13845_1556526343630I heard hello world 1556526344.91
[INFO] [1556526345.009174]: /listener_13845_1556526343630I heard hello world 1556526345.01
[INFO] [1556526345.108972]: /listener_13845_1556526343630I heard hello world 1556526345.11
[INFO] [1556526345.208554]: /listener_13845_1556526343630I heard hello world 1556526345.21
[INFO] [1556526345.308504]: /listener_13845_1556526343630I heard hello world 1556526345.31
[INFO] [1556526345.408364]: /listener_13845_1556526343630I heard hello world 1556526345.41
[INFO] [1556526345.509007]: /listener_13845_1556526343630I heard hello world 1556526345.51
[INFO] [1556526345.608739]: /listener_13845_1556526343630I heard hello world 1556526345.61
[INFO] [1556526345.708979]: /listener_13845_1556526343630I heard hello world 1556526345.71
[INFO] [1556526345.809620]: /listener_13845_1556526343630I heard hello world 1556526345.81
[INFO] [1556526345.909187]: /listener_13845_1556526343630I heard hello world 1556526345.91
```

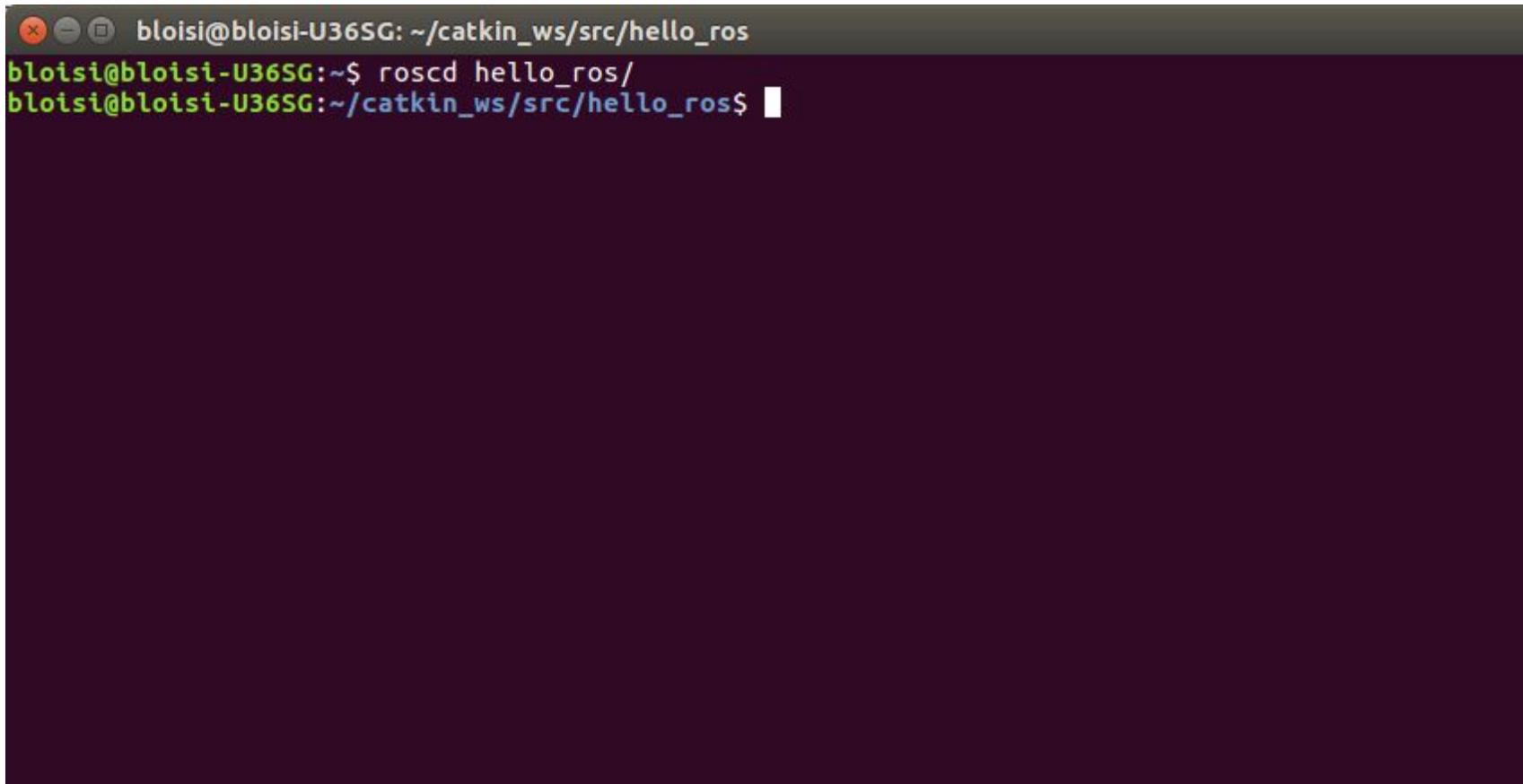
rqt_graph

```
bloisi@bloisi-U36SG: ~
bloisi@bloisi-U36SG:~$ rqt_graph
```



roscd

Con roscd possiamo navigare nel filesystem per portarci nella directory del nostro package



A screenshot of a terminal window titled "bloisi@bloisi-U36SG: ~/catkin_ws/src/hello_ros". The window shows the command "roscd hello_ros/" being typed and then executed, resulting in the prompt "bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros\$". The background of the slide is dark purple.

```
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros
bloisi@bloisi-U36SG:~$ roscd hello_ros/
bloisi@bloisi-U36SG:~/catkin_ws/src/hello_ros$
```

Aggiorniamo il repository locale

Aggiorniamo il repository locale con la cartella src

git add

git commit

```
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ross$ git add src/
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ross$ git commit -m 'src files'
[master f7d5a4f] src files
 1 file changed, 93 insertions(+)
  create mode 100644 src/listener.cpp
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ross$ █
```

Aggiorniamo il repository locale (package.xml)

git add

git commit

```
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$ git add package.xml
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$ git commit -m 'package.xml'
[master 96ed373] package.xml
 1 file changed, 68 insertions(+)
 create mode 100644 package.xml
```

Aggiorniamo il repository locale (CMakeLists.txt)

```
git add
```

```
git commit
```

```
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$ git add CMakeLists.txt
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$ git commit -m 'cmake files'
[master 8a57151] cmake files
 1 file changed, 205 insertions(+)
 create mode 100644 CMakeLists.txt
```

Aggiorniamo il repository remoto

git push

```
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$ git push origin master
Username for 'https://github.com': dbloisi
Password for 'https://dbloisi@github.com':
Counting objects: 14, done.
Delta compression using up to 4 threads.
Compressing objects: 100% (13/13), done.
Writing objects: 100% (14/14), 7.10 KiB | 0 bytes/s, done.
Total 14 (delta 4), reused 0 (delta 0)
remote: Resolving deltas: 100% (4/4), done.
To https://github.com/dbloisi/hello_ros.git
  54aaaf4..8a57151  master -> master
nvidia@tegra-ubuntu:~/catkin_ws/src/hello_ros$
```

Verranno richieste le credenziali di accesso (username e password) per il server git

Repository remoto aggiornato

GitHub, Inc. [US] | https://github.com/dbloisi/hello_ros

5 commits 1 branch 0 releases 1 contributor GPL-3.0

Branch: master ▾ New pull request Find file Clone or download ▾

dbloisi cmake files	Latest commit 8a57151 3 hours ago
src	src files 3 hours ago
CMakeLists.txt	cmake files 3 hours ago
LICENSE	Initial commit 4 hours ago
README.md	Initial commit 4 hours ago
package.xml	package.xml 3 hours ago

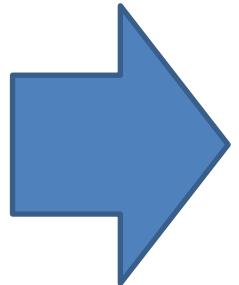
README.md

hello_ros

my first ros package

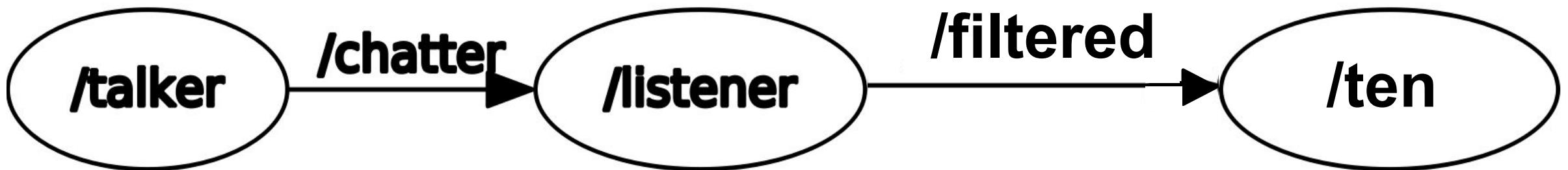
Esercitazione

1. Creare un account su un server git (es. GitHub, BitBucket, GitLab)
2. Creare un repository denominato my_hello_ros
3. Creare un package my_hello_ros contenente i nodi talker e listener
4. Caricare il codice sul proprio repository



Esercitazione

5. Modificare il codice del listener in modo che pubblichi a sua volta un messaggio dopo aver ascoltato 10 messaggi provenienti dal talker
6. Creare un nuovo nodo **ten** che ascolti i messaggi del listener e li stampi a video
7. Aggiornare il repository remoto



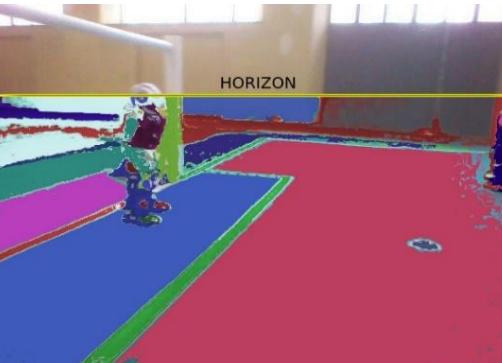
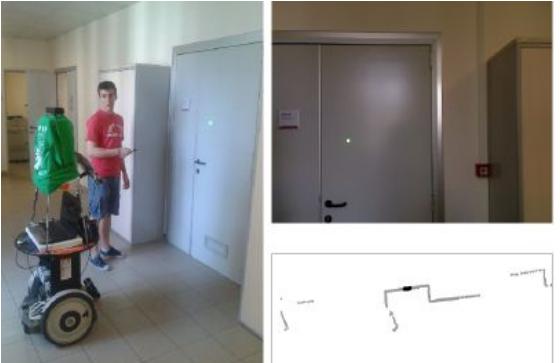


UNIVERSITÀ DEGLI STUDI
DELLA BASILICATA

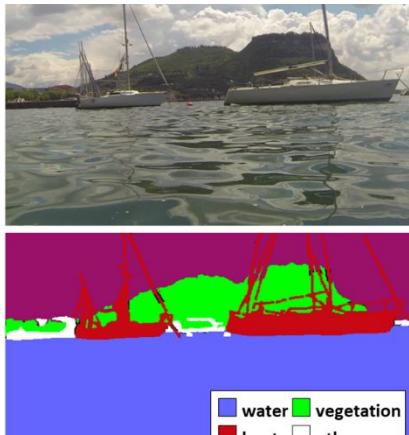
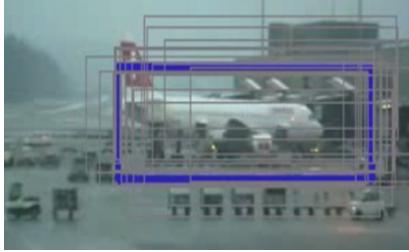
Corso di Visione e Percezione



ROS (Python)



Docente
Domenico D. Bloisi



■ water ■ vegetation
■ boat ■ other