Hochschule
Bonn-Rhein-Sieg
University of Applied Sciences

b-it Bonn-Aachen International Center for Information Technology

ROS Nodes, Topics, and Messages

Foundation Course

September 1, 2019

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Recap

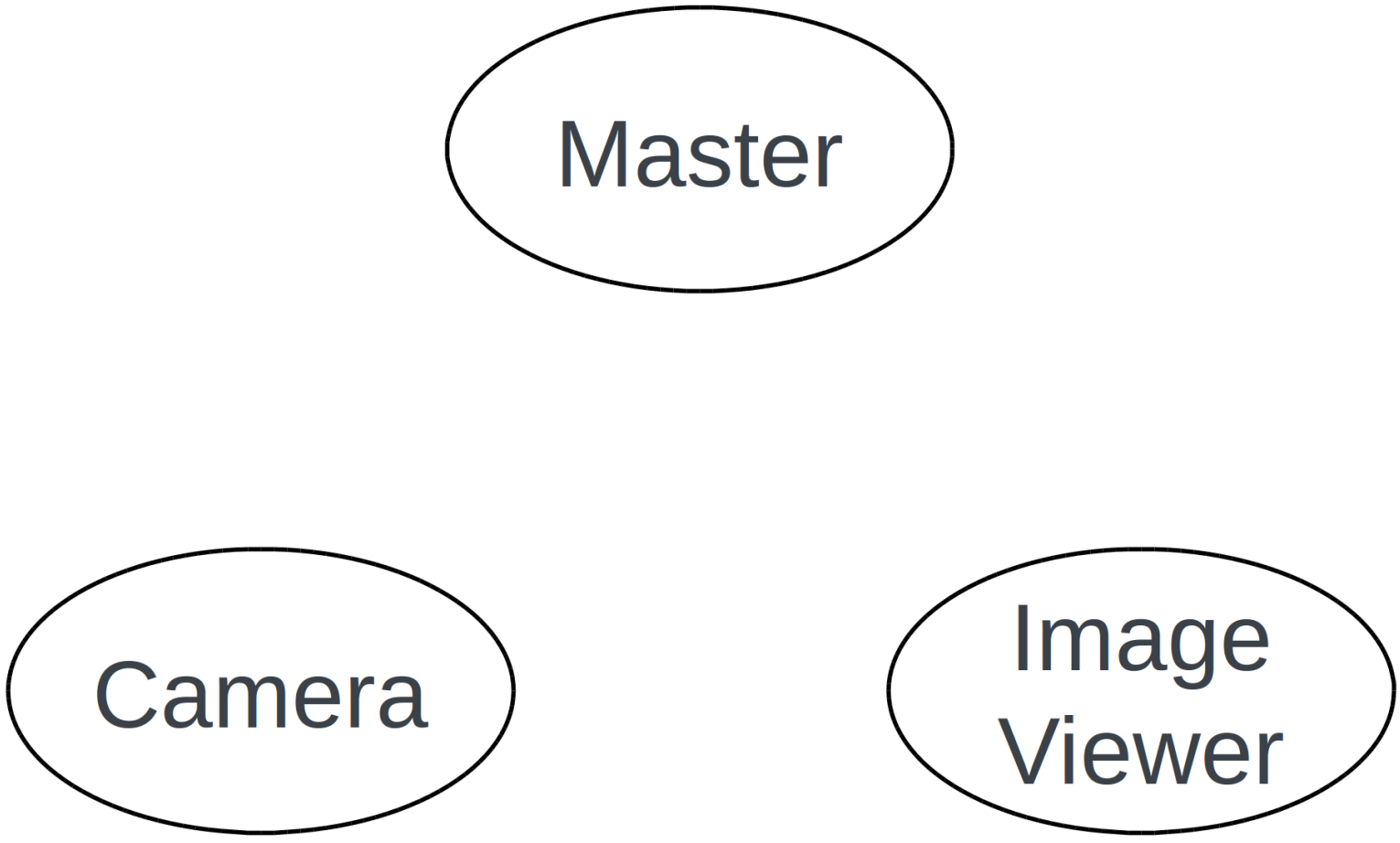
Summary of yesterday's session

- ROS is a collection of libraries and tools that helps you when you develop software for robots.
- ROS provides several ways to transfer data between nodes:
  1. ROS topics and messages (**publish/subscribe**).
  2. ROS services (**request/reply**).
  3. ROS actions (**request/reply**).
  4. Parameter server.

Recap

Summary of yesterday's session

- We will focus today on ROS topics and messages..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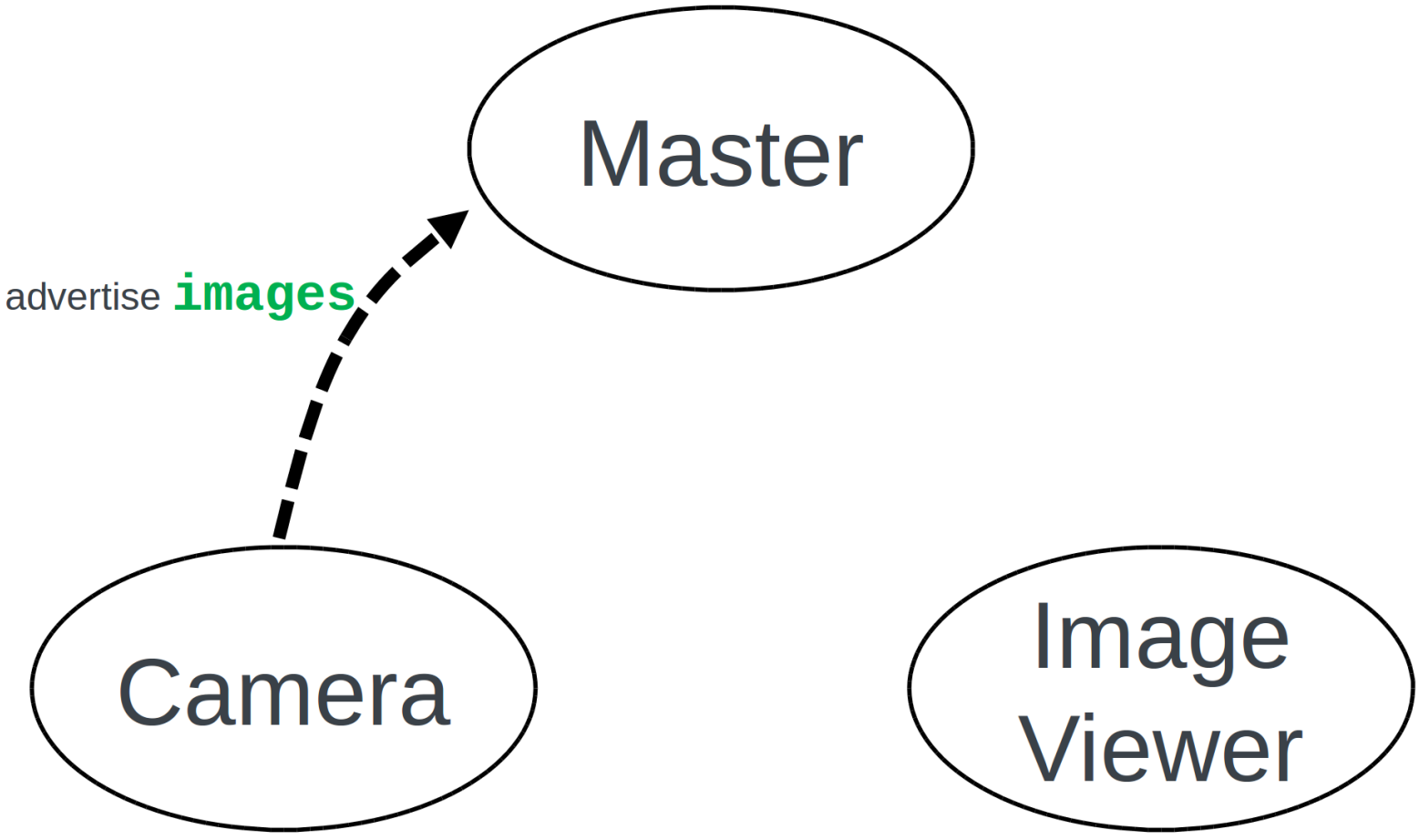
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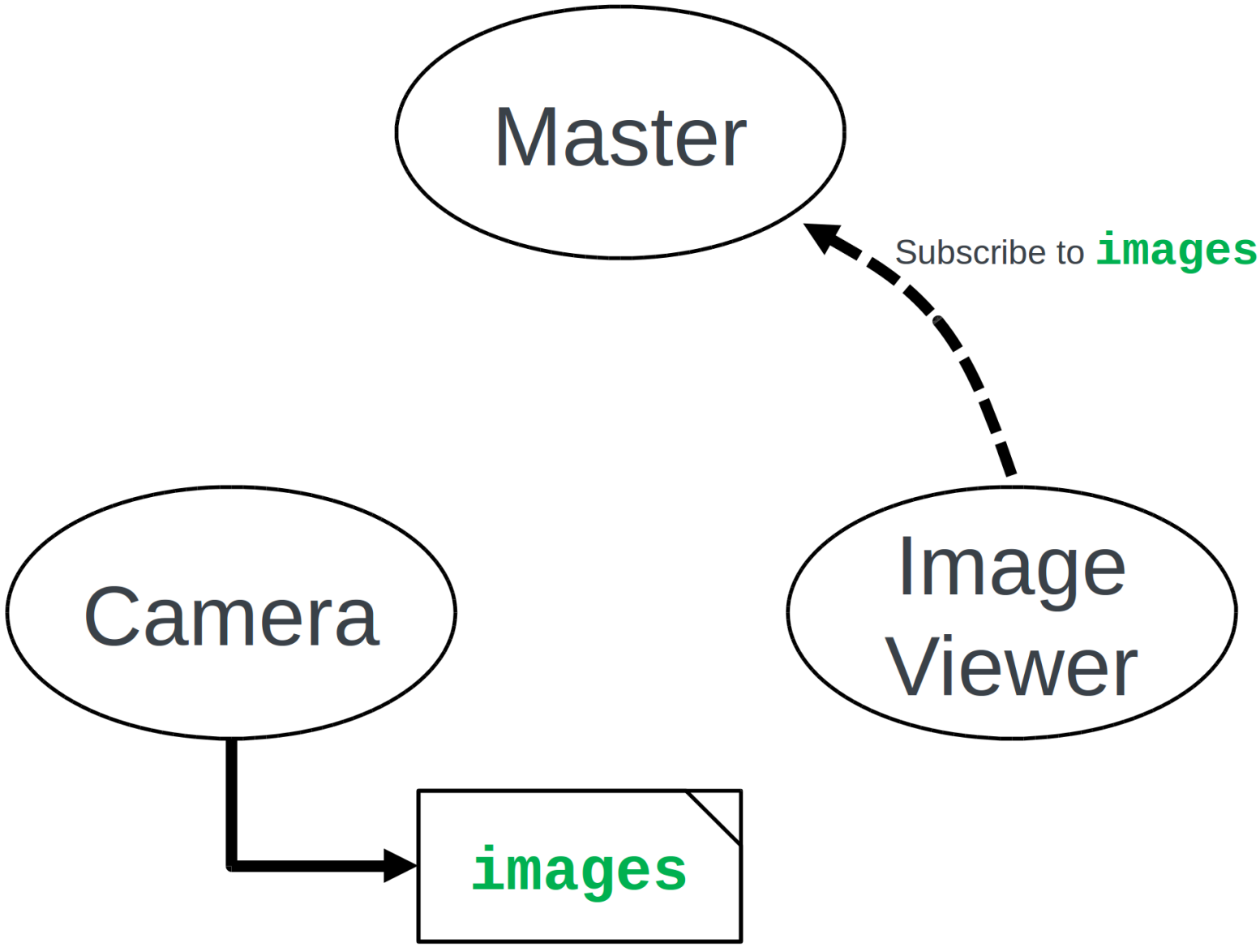
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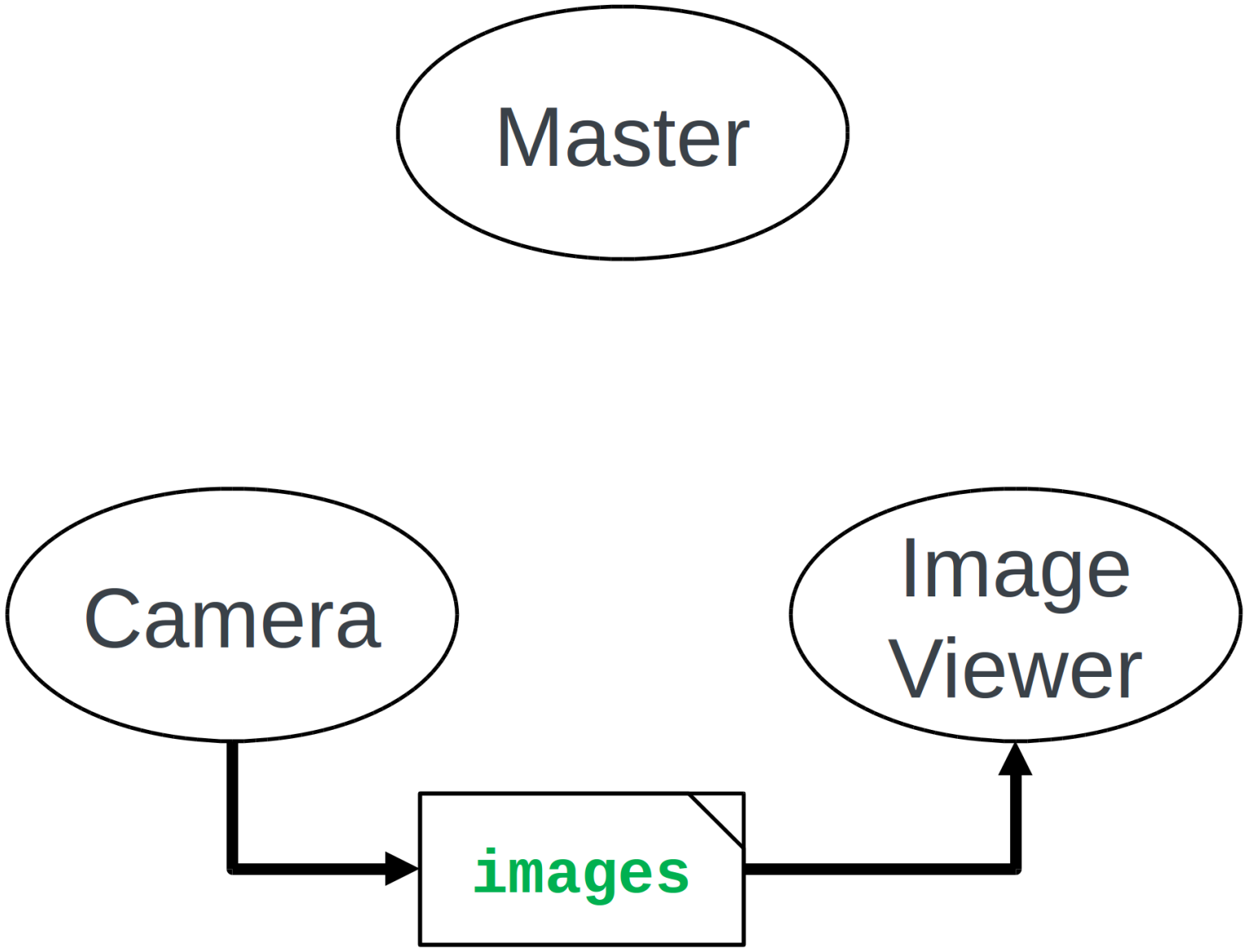
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A simple ROS node

../scripts/00_simple_node.py

```
#!/usr/bin/env python


import rospy
from time import sleep

rospy.init_node("print_text")


while True:
    print "Hello world!"
    sleep(1)
```

A simple ROS node

../scripts/01_simple_node.py

```
#!/usr/bin/env python

import rospy


rospy.init_node("print_text")
rate = rospy.Rate(1)

while not rospy.is_shutdown():
    print "Hello world!"
    rate.sleep()
```

Writing a publisher node in Python

../scripts/02_simple_publisher.py

```
rospy.init_node('node name')
```

- nodes name must be unique. If you want to make sure the name of the node is unique:

```
rospy.init_node('node name', anonymous= True)
```

- node name will look like this:
  `/print_text_19637_1567065017476`

Three ways to run a node

ROS Nodes

There are 3 ways to run a node:

1. Like you normally do (not recommended). Example (in case of python node):

```
python <file name>
```

2. using rosrun command:

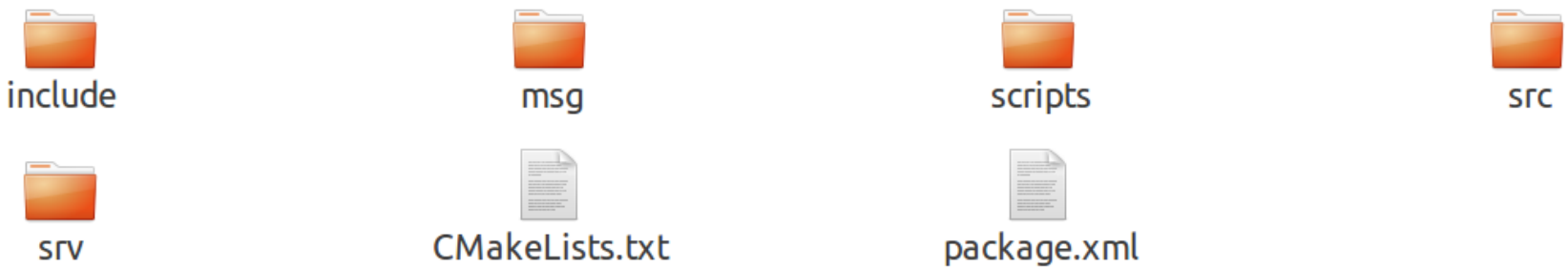
```
rosrun <package name> <node name>
```

3. Using launch files. (we'll see it later)

Let's create a package first!

ROS Nodes

- ROS commands find your files (python scripts, cpp files, launch files, message definitions) if they are located in a package inside the workspace.
- Normally, a package looks like this:



Let's create a package first!

ROS Nodes

- go to the README and do the steps for **creating a package**.

ROS commands

ROS Nodes

- Navigate to a ROS package directly:

```
roscd <package name>
```

- run a node without navigating to it's directory:

```
rosrun <package name> <executable>
```

Let's create a package first!

ROS Nodes

- go to the README and do the steps for **running a node**.

More ROS commands

ROS Nodes, Topics, and Messages

- List all the running nodes:

```
rosnode list
```

- Get more info. about a certain node:

```
rosnode info <node name>
```

Writing a publisher node in Python

ROS Nodes, Topics, and Messages

- Let's extend our previous node and make it publish a String ROS message.

Writing a publisher node in Python

../scripts/02_simple_publisher.py

```
#!/usr/bin/env python

import rospy

from std_msgs.msg import String

rospy.init_node('talker')

pub = rospy.Publisher('myFirstTopic', String, queue_size=10)

rate = rospy.Rate(1)

my_message = String()
my_message.data = "Hello there! How are you?"

while not rospy.is_shutdown():
    pub.publish(my_message)
    rate.sleep()
```

Writing a publisher node in Python

../scripts/02_simple_publisher.py

```
rospy.Publisher(name, data_class, queue_size)
```

- `name`: Name of the topic to publish on.
- `data_class`: The type of message. It is a ROS message class.
- `queue_size`: The size of the outgoing message queue.

Writing a publisher node in Python

../scripts/02_simple_publisher.py

```
rospy.Publisher(
name,
data_class,
subscriber_listener=None,
tcp_nodelay=False,
latch=False,
headers=None,
queue_size=None
)
```

Writing a publisher node in Python

Things to note..

- ROS messages are implemented as classes.
- To publish a message you also need to define a **Publisher** class.
- Most of ROS concepts and functionalities are implemented as classes. This is why understanding OOP helps you understand ROS better.

Writing a publisher node in Python

ROS Nodes, Topics, and Messages

- Go to the README file and do the instructions of section: **some of ROS commands**.

More ROS commands

ROS Nodes, Topics, and Messages

- Get the current list of topics:

```
rostopic list
```

- Print published messages:

```
rostopic echo <topic name>
```

More ROS commands

ROS Nodes, Topics, and Messages

- Publish a message from terminal:

```
rostopic pub <topic name> <msg type> <msg>
```

- Get message type of a topic:

```
rostopic type <topic name>
```

How to use ROS messages

ROS Nodes, Topics, and Messages

- ROS messages are just classes with attributes you can fill.
- ROS messages are defined in separate files and have to be placed in a package. (will be covered today).
- The following command can be used to see the class attributes, or the description, of a ROS message:

```
rosmsg show <package/msg>
```

How to use ROS messages

Example

```
rosmsg show std_msgs/String
```

The output is:

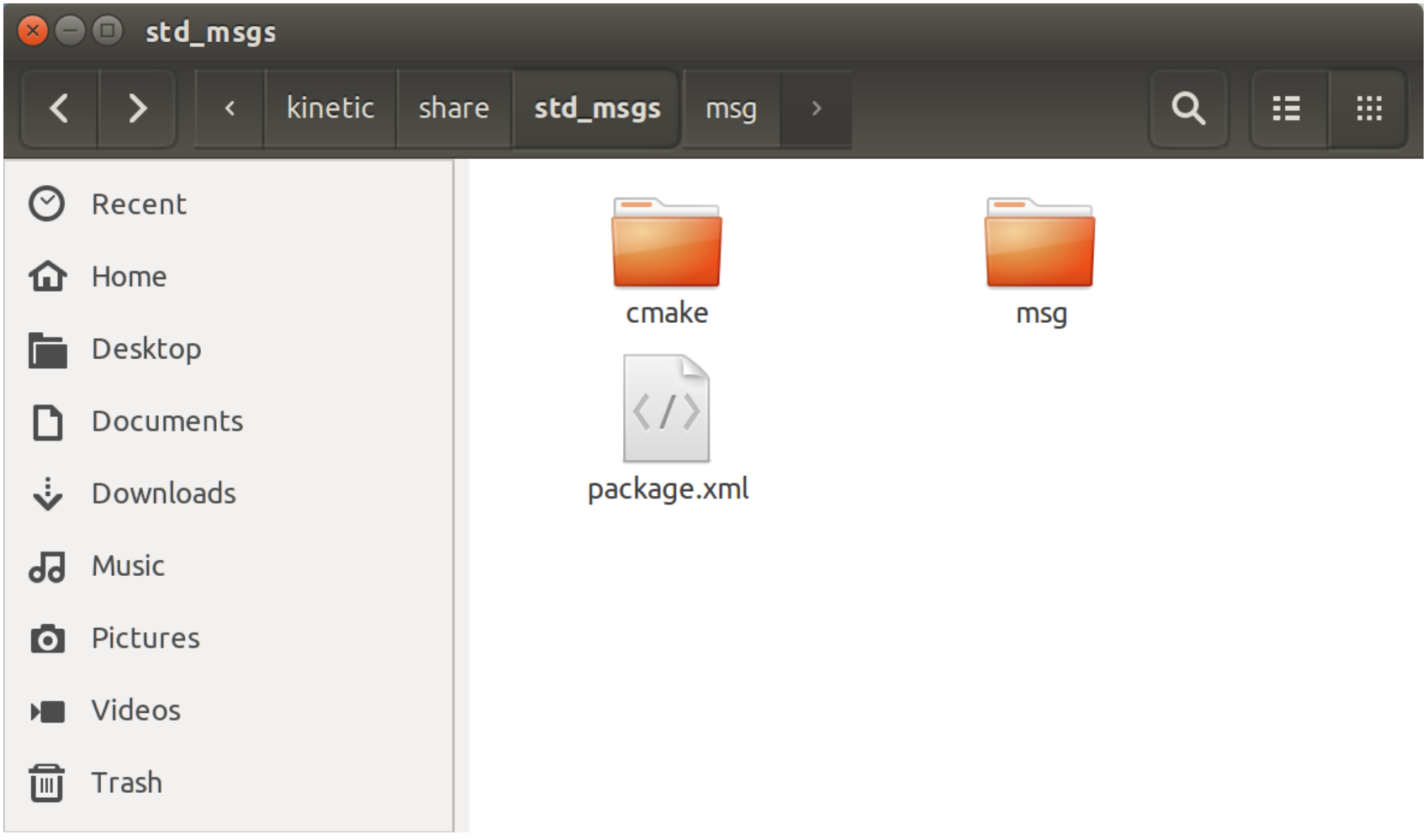
```
string data
```

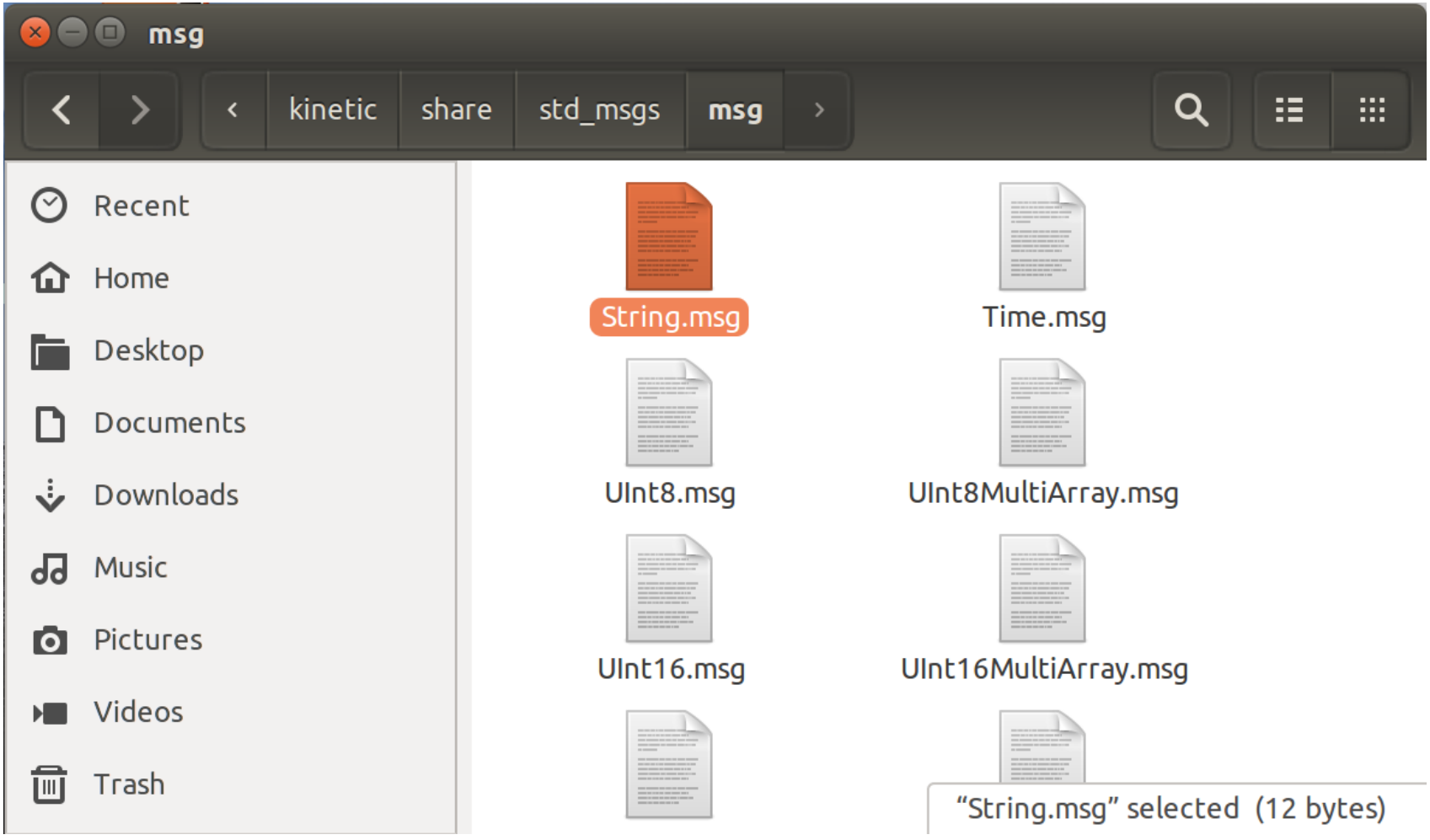
- It means ROS `String` message is a class with an attribute named `data` of type string (Python string).

How to use ROS messages

Importing a ROS message

- `String` message is located in the `std_msgs` package.


std_msgs
kinetic
share
std_msgs
msg
Recent
Home
Desktop
Documents
Downloads
Music
Pictures
Videos
Trash
cmake
msg
package.xml



Note: this is not the file that is imported in our script though! this file is not even Python nor C++. We will see later what this file is.

How to use ROS messages

Importing a ROS message

Python

```
from std_msgs.msg import String
```

C++

```
#include "std_msgs/String.h"
```

Exercise 1

Writing a subscriber node in Python

../scripts/03_simple_subscriber.py

```
#!/usr/bin/env python

import rospy
from std_msgs.msg import String

def my_callback_function(msg):
    print msg

rospy.init_node('listener')
rate = rospy.Rate(100)
sub = rospy.Subscriber('myFirstTopic', String,
                       callback=my_callback_function)

while not rospy.is_shutdown():
    pass
```

Writing a subscriber node in Python

../scripts/04_simple_subscriber.py

```
#!/usr/bin/env python

import rospy
from std_msgs.msg import String


def my_callback_function(msg):
    print msg

rospy.init_node('listener')
rate = rospy.Rate(100)

rospy.Subscriber('myFirstTopic', String, callback=my_callback_function)

rospy.spin()
```

Writing a subscriber node in Python

Subscriber class

- go to the README, and let's do section:
  Simple subscriber

Writing a subscriber node in Python

Subscriber class

```
rospy.Subscriber(
name,
data_class,
callback=None,
callback_args=None,
queue_size=None,
buff_size=65536,
tcp_nodelay=False
)
```

Writing a subscriber node in Python

Subscriber class

- go to the README, and let's do section:
  Simple subscriber

General notes

more on ROS nodes

- You can define multiple publishers and subscribers in a node.
- You can call `init_node` function once only!
- To make your code look neat, you can wrap ROS stuff in a class and hide them!

Let's see an example with multiple publishers/subscribers and let's define them in a class...

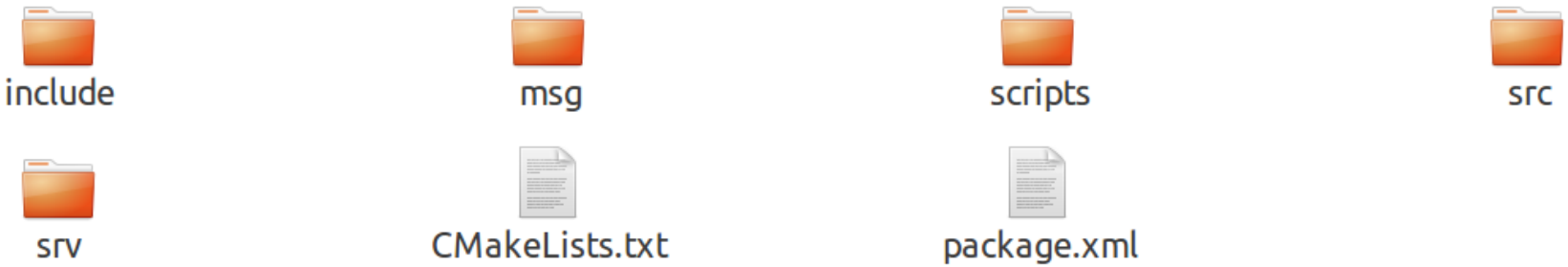
Let’s see script
05_node_example.py

Catkin

- In ROS, packages are combiled and built using Catkin.

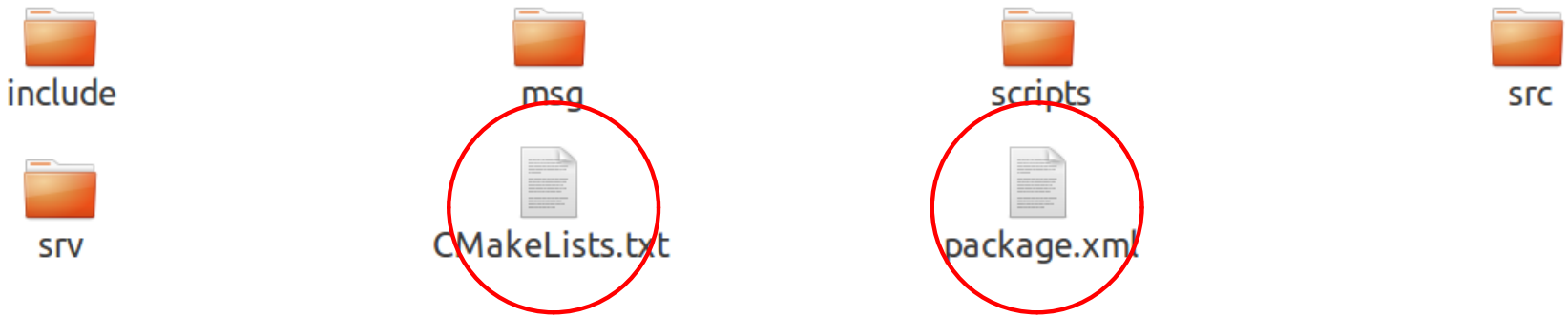
A ROS package

- A ROS package might look like this:



A ROS package

- A ROS package might look like this:



rospy reference

- rospy full documentation (all the classes, all the functions ..etc):

  `http://docs.ros.org/kinetic/api/rospy/html/`