

13.ROS custom interface information

Although ros provides us with a variety of message types, sometimes we need to define some data types ourselves to use. Commonly used ros include topic data and service data. This course explains how to customize the interface message type and how to call it in the program.

13.1 Customized topic messages and usage

Generally, we will create a new folder under the function package folder, named msg, to store customized topic messages. Therefore, we will create a new folder msg under the directory of the learn_topic function package and enter it in the terminal.

```
cd ~/ros_ws/src/learn_topic
mkdir msg
```

13.1.1 Define msg file

Switch to the msg directory and create a new blank msg file. The suffix msg indicates that it is an msg file. Here we take Information.msg as an example. Copy the following code into the msg file you just created.

```
string company
string city
```

13.1.2 Add function package dependencies in package.xml

```
<build_depend>message_generation</build_depend>
<exec_depend>message_runtime</exec_depend>
```

13.1.3 Add compilation options to CMakeLists.txt

```
#Add message_generation to find_package
add_message_files(FILES Information.msg)
generate_messages(DEPENDENCIES std_msgs)
```

13.1.4 Compile files

```
cd ~/ros_ws
catkin_make
```

After compilation is completed, enter `rosmmsg show learn_topic/Information` to query the customized message type.

```
yahboom@yahboom-virtual-machine:~/Desktop$ rosmmsg show learn_topic/Information
string company
string city
```

When the above screen appears, it means that a custom message type has been generated. Next, let's see how to use it.

13.1.5 C++ program uses custom topic message type

We write a publisher and a subscriber to use custom topic messages. Create two new files in the src directory of the function package learn_topic. The commands are Information_publisher.cpp and Information_subscriber.cpp respectively. Copy the following codes into them.

Information_publisher.cpp

```
/**
 * This routine will publish the /company_info topic, the message type is the
 custom learn_topic::Information
 */
#include <ros/ros.h>
#include "learn_topic/Information.h"
int main(int argc, char **argv)
{
    // ROS node initialization
    ros::init(argc, argv, "company_Information_publisher");
    // Create node handle
    ros::NodeHandle n;
    // Create a Publisher, publish a topic named /company_info, the message type
 is learn_topic::Person, and the queue length is 10
    ros::Publisher Information_pub = n.advertise<learn_topic::Information>
("/company_info", 10);
    // Set the loop frequency
    ros::Rate loop_rate(1);
    int count = 0;
    while (ros::ok())
    {
        // Initialize messages of type learn_topic::Information
        learn_topic::Information info_msg;
        info_msg.company = "Yahboom";
        info_msg.city = "Shenzhen";
        // Release the news
        Information_pub.publish(info_msg);
        ROS_INFO("Information: company:%s city:%s ", info_msg.company.c_str(),
info_msg.city.c_str());
        loop_rate.sleep();// Delay according to cycle frequency
    }
    return 0;
}
```

Information_subscriber.cpp

```
/**
 * This routine will subscribe to the /company_info topic and customize the
 message type learn_topic::Information
 */
#include <ros/ros.h>
#include "learn_topic/Information.h"
// After receiving the subscribed message, the message callback function will be
 entered to process the data.
void CompanyInfoCallback(const learn_topic::Information::ConstPtr& msg)
{
    // Print received messages
    ROS_INFO("This is: %s in %s", msg->company.c_str(), msg->city.c_str());
}
```

```

int main(int argc, char **argv)
{
    ros::init(argc, argv, "company_Information_subscriber");// Initialize ROS
node
    ros::NodeHandle n;// Here is the created node handle
    // Create a Subscriber, subscribe to the topic named topic/company_info, and
register the callback function CompanyInfoCallback
    ros::Subscriber person_info_sub = n.subscribe("/company_info",
10,CompanyInfoCallback);
    ros::spin();// Loop waiting for callback function
    return 0;
}

```

Modify the CMakeLists.txt file and add the following content,

```

add_executable(Information_publisher src/Information_publisher.cpp)
target_link_libraries(Information_publisher ${catkin_LIBRARIES})
add_dependencies(Information_publisher ${PROJECT_NAME}_generate_messages_cpp)

add_executable(Information_subscriber src/Information_subscriber.cpp)
target_link_libraries(Information_subscriber ${catkin_LIBRARIES})
add_dependencies(Information_subscriber ${PROJECT_NAME}_generate_messages_cpp)

```

Compile the function package and enter it in the terminal,

```

cd ~/ros_ws
catkin_make

```

After the compilation is passed, reopen the two terminals and run Information_publisher and Information_subscriber respectively. Start roscore first and enter in the terminal.

```

roscore

```

Open another terminal,

```

roslaunch learn_topic Information_publisher

```

Open another terminal,

```

roslaunch learn_topic Information_subscriber

```

```
yahboom@yahboom-virtual-machine:~$ rosrn learn_topic Information_publisher
[ INFO] [1698221521.519299724]: Information: company:Yahboom city:Shenzhen
[ INFO] [1698221522.520065577]: Information: company:Yahboom city:Shenzhen
[ INFO] [1698221523.519530621]: Information: company:Yahboom city:Shenzhen
[ INFO] [1698221524.519748756]: Information: company:Yahboom city:Shenzhen
[ INFO] [1698221525.519626897]: Information: company:Yahboom city:Shenzhen
[ INFO] [1698221526.519602684]: Information: company:Yahboom city:Shenzhen
[ INFO] [1698221527.519622343]: Information: company:Yahboom city:Shenzhen
[ INFO] [1698221528.520093418]: Information: company:Yahboom city:Shenzhen

yahboom@yahboom-virtual-machine: ~
turtle_pose_subscriber      turtle_velocity_publisher.py
yahboom@yahboom-virtual-machine:~$ rosrn learn_topic Information_subscriber
[ INFO] [1698221555.520338388]: This is: Yahboom in Shenzhen
[ INFO] [1698221556.519799882]: This is: Yahboom in Shenzhen
[ INFO] [1698221557.519554121]: This is: Yahboom in Shenzhen
[ INFO] [1698221558.519909456]: This is: Yahboom in Shenzhen
[ INFO] [1698221559.519642196]: This is: Yahboom in Shenzhen
[ INFO] [1698221560.520310013]: This is: Yahboom in Shenzhen
[ INFO] [1698221561.520314968]: This is: Yahboom in Shenzhen
[ INFO] [1698221562.519960709]: This is: Yahboom in Shenzhen
[ INFO] [1698221563.519662167]: This is: Yahboom in Shenzhen
[ INFO] [1698221564.520790291]: This is: Yahboom in Shenzhen
[ INFO] [1698221565.519695649]: This is: Yahboom in Shenzhen
[ INFO] [1698221566.520490274]: This is: Yahboom in Shenzhen
[ INFO] [1698221567.519836292]: This is: Yahboom in Shenzhen
```

- Information_publisher, as the publisher, continuously publishes message content to the topic "/company_info" and prints the published message; and Information_subscriber, as the subscriber, also continuously receives the content of the topic "/company_info" and then prints it out in the callback function. .

So how does the program call custom data? The core parts are as follows:

- Introduce header files

```
#include "learn_topic/Information.h"
```

The former learn_topic is the name of the function package, and the latter Information.h is the name of the header file generated by the msg file just created.

- Use custom message files

```
//Define custom message type variables
learning_topic::Information info_msg;
//To copy a defined message, company and city are members of the message
info_msg.company = "Yahboom";
info_msg.city = "Shenzhen";
//callback function definition data type
void CompanyInfoCallback(const learning_topic::Information::ConstPtr& msg)
```

13.1.6 Python program uses custom message types

In the scripts folder of the function package, create two new files, named Information_publisher.py and Information_subscriber.py, and copy the following codes into them respectively.

```
#!/usr/bin/env python
# -*- coding: utf-8 -*-
import rospy
from learn_topic.msg import Information #Import custom msg
def information_publisher():
```

```

    rospy.init_node('information_publisher', anonymous=True)# ROS node
initialization
    # Create a Publisher and publish a topic named /company_info. The message
type is learn_topic::Information and the queue length is 6.
    info_pub = rospy.Publisher('/company_info', Information, queue_size=6)
    rate = rospy.Rate(10) #Set the loop frequency
    while not rospy.is_shutdown():
        # Initialize messages of type learn_topic::Information
        info_msg = Information()
        info_msg.company = "Yahboom";
        info_msg.city = "Shenzhen";
        info_pub.publish(info_msg)# Release the news
        rospy.loginfo("This is %s in %s.", info_msg.company, info_msg.city)#
Print release message
        rate.sleep()# Delay according to cycle frequency
if __name__ == '__main__':
    try:
        information_publisher()
    except rospy.ROSInterruptException:
        pass

```

Information_subscriber.py

```

#!/usr/bin/env python
# -*- coding: utf-8 -*-
import rospy
from learning_topic.msg import Information #Import custom msg
def CompanyInfoCallback(msg):
    rospy.loginfo("company: name:%s city:%s ", msg.company, msg.city)#Print
subscription received information
def Infomation_subscriber():
    rospy.init_node('Infomation_subscriber', anonymous=True)# ROS node
initialization
    #Create a Subscriber, subscribe to the topic named /company_info, and
register the callback function personInfoCallback
    rospy.Subscriber("/company_info", Information, CompanyInfoCallback)
    rospy.spin()# Loop waiting for callback function
if __name__ == '__main__':
    Infomation_subscriber()

```

After saving the two files, execution permissions need to be given.

```

cd ~/ros_ws/src/learn_topic/scripts
sudo chmod a+x Information_publisher.py
sudo chmod a+x Information_subscriber.py

```

Similarly, let's run these two programs to see, first start roscore,

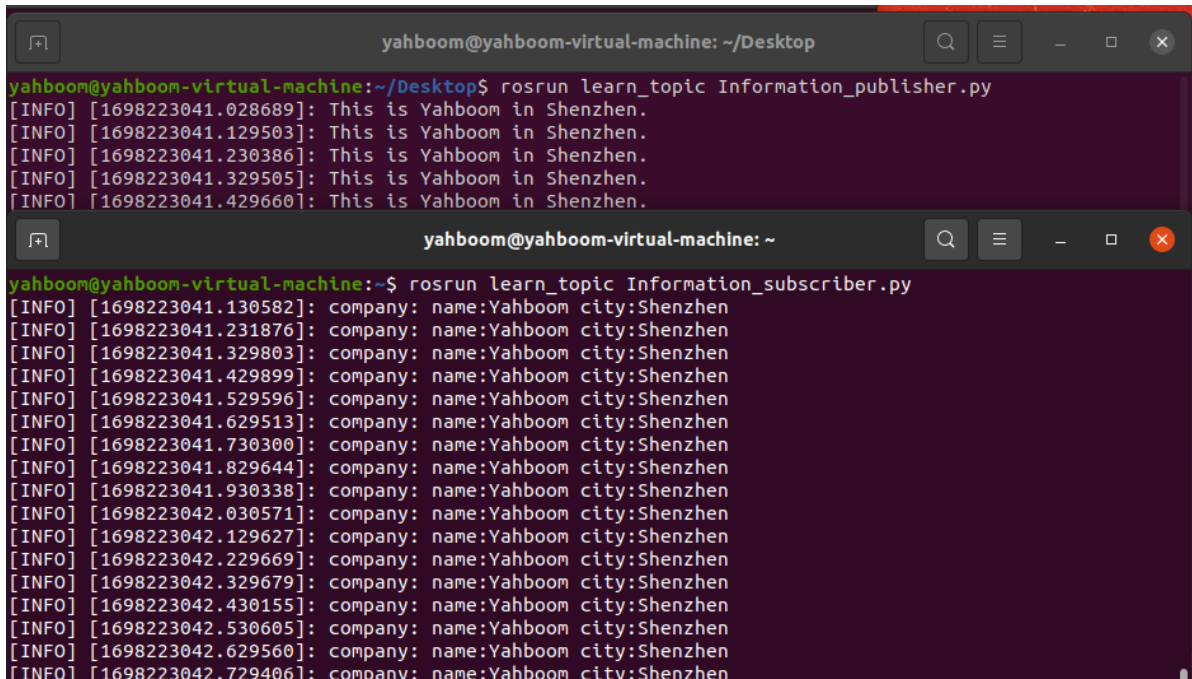
```
roscore
```

Reopen the terminal and enter,

```
roslaunch learn_topic Information_publisher.py
```

Enter from another terminal,

```
roslaunch learn_topic Information_subscriber.py
```



```
yahboom@yahboom-virtual-machine: ~/Desktop
yahboom@yahboom-virtual-machine:~/Desktop$ roslaunch learn_topic Information_publisher.py
[INFO] [1698223041.028689]: This is Yahboom in Shenzhen.
[INFO] [1698223041.129503]: This is Yahboom in Shenzhen.
[INFO] [1698223041.230386]: This is Yahboom in Shenzhen.
[INFO] [1698223041.329505]: This is Yahboom in Shenzhen.
[INFO] [1698223041.429660]: This is Yahboom in Shenzhen.

yahboom@yahboom-virtual-machine: ~
yahboom@yahboom-virtual-machine:~$ roslaunch learn_topic Information_subscriber.py
[INFO] [1698223041.130582]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.231876]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.329803]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.429899]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.529596]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.629513]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.730300]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.829644]: company: name:Yahboom city:Shenzhen
[INFO] [1698223041.930338]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.030571]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.129627]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.229669]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.329679]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.430155]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.530605]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.629560]: company: name:Yahboom city:Shenzhen
[INFO] [1698223042.729406]: company: name:Yahboom city:Shenzhen
```

Python programs do not need to add header files, but they need to import libraries. Please refer to the following content for import and use.

```
#Import, learn_topic represents the function package, msg represents the msg
folder under the function package, and Information represents the name of the
custom msg file.
from learn_topic.msg import Information
```

use

```
info_msg = Information()
info_msg.company = "Yahboom";
info_msg.city = "Shenzhen";
```

13.2 Customized service messages and usage

Generally, we will create a new folder under the function package folder, named `srv`, to store customized topic messages. Therefore, we will create a new folder `srv` under the directory of the `learn_service` function package and enter it in the terminal.

```
cd ~/ros_ws/src/learn_service
mkdir srv
```

13.2.1 Define `srv` file

Switch to the `srv` directory and create a new blank `srv` file. The suffix `srv` indicates that it is an `srv` file. Here we take `IntPlus.srv` as an example. Copy the following code into the `srv` file you just created.

```
uint8 a
uint8 b
---
uint8 result
```

Here is an explanation of the structure of the srv file, which is divided into upper and lower parts by the symbol ---. The upper part represents the request and the lower part represents the response.

13.2.2 Add function package dependencies in package.xml

```
<build_depend>message_generation</build_depend>
<exec_depend>message_runtime</exec_depend>
```

13.2.3 Add compilation options to CMakeList.txt

```
#Add message_generation to find_package
add_service_files(FILES IntPlus.srv)
generate_messages(DEPENDENCIES std_msgs)
```

13.2.4 Compile function package

```
cd ~/ros_ws
catkin_make
```

After the compilation is successful, enter the following command in the terminal to check whether a customized service message is generated.

```
rossrv show learn_service/IntPlus
```

```
yahboom@yahboom-virtual-machine:~/ros_ws$ rossrv show learn_service/IntPlus
uint8 a
uint8 b
---
uint8 result
```

The above screen appears, indicating that a customized service message has been generated. Next, let's talk about how to use it in the program.

13.2.5 C++ program uses custom topic message type

We write a client and a server to use customized topic messages. Create two new files in the src directory of the function package learn_service. The commands are IntPlus_client.cpp and IntPlus_server.cpp respectively. Copy the following codes into them.

IntPlus_client.cpp

```
/*
This routine will request the /Two_Int_Plus service, service data type
learn_service::IntPlus
Add two integers and find the sum
*/
#include <ros/ros.h>
#include "learn_service/IntPlus.h"
```

```

#include <iostream>
using namespace std;
int main(int argc, char** argv)
{
    int i,k;
    cin>>i;
    cin>>k;
    ros::init(argc, argv, "IntPlus_client");// Initialize ROS node
    ros::NodeHandle node;// Create node handle
    // After discovering the /Two_Int_Plus service, create a service client
    ros::service::waitForService("/Two_Int_Plus");
    ros::ServiceClient IntPlus_client =
node.serviceClient<learn_service::IntPlus>("/Two_Int_Plus");
    // Initialize the request data of learn_service::IntPlus
    learn_service::IntPlus srv;
    srv.request.a = i;
    srv.request.b = k;
    ROS_INFO("Call service to plus %d and %d", srv.request.a,
srv.request.b);//Request service call
    IntPlus_client.call(srv);
    // Display service call results
    ROS_INFO("Show the result : %d", srv.response.result);// Display service
call results
    return 0;
}

```

IntPlus_server.cpp

```

/**
 *This routine will execute the /Two_Int_Plus service, the service data type
 learn_service::IntPlus
 */
#include <ros/ros.h>
#include "learn_service/IntPlus.h"
// service callback function, input parameter req, output parameter res
bool IntPlusCallback(learn_service::IntPlus::Request
&req,learn_service::IntPlus::Response &res)
{
    ROS_INFO("number 1 is:%d ,number 2 is:%d ", req.a, req.b);// Show request
data
    res.result = req.a + req.b ;// The feedback result is the sum of two numbers
    return res.result;
}
int main(int argc, char **argv)
{
    ros::init(argc, argv, "IntPlus_server"); //ROS node initialization
    ros::NodeHandle n;// Create node handle
    // Create a server and register the callback function IntPlusCallback
    ros::ServiceServer Int_Plus_service =
n.advertiseService("/Two_Int_Plus",IntPlusCallback);
    // Loop waiting for callback function
    ROS_INFO("Ready to caculate.");
    ros::spin();
    return 0;
}

```

Modify the CMakeLists.txt file and add the following content,


```
add_executable(IntPlus_server src/IntPlus_server.cpp)
target_link_libraries(IntPlus_server ${catkin_LIBRARIES})
add_dependencies(IntPlus_server ${PROJECT_NAME}_generate_messages_cpp)

add_executable(IntPlus_client src/IntPlus_client.cpp)
target_link_libraries(IntPlus_client ${catkin_LIBRARIES})
add_dependencies(IntPlus_client ${PROJECT_NAME}_generate_messages_cpp)
```

Compile the function package and enter it in the terminal,

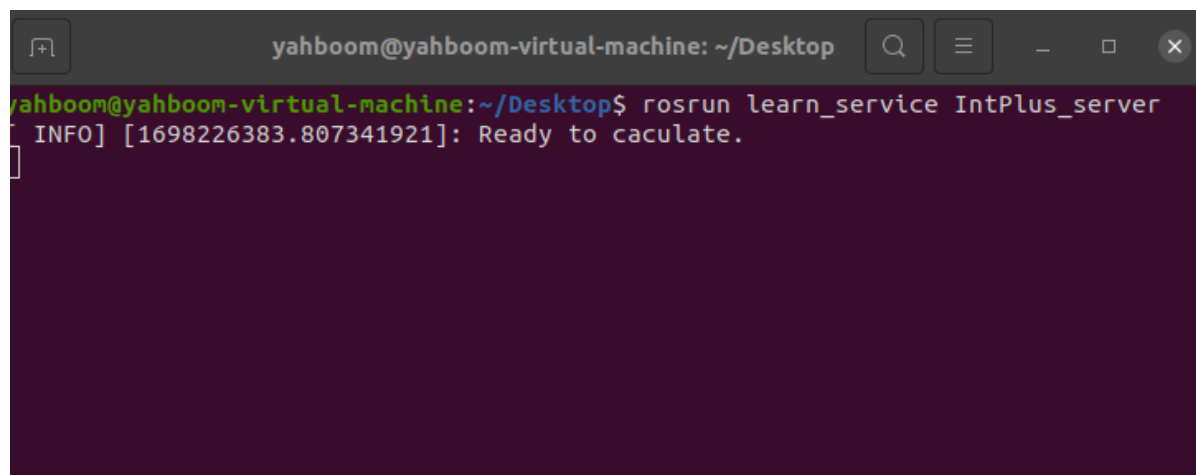
```
cd ~/ros_ws
catkin_make
```

After the compilation is passed, reopen the two terminals and run IntPlus_server and IntPlus_client respectively. Start roscore first and enter in the terminal.

```
roscore
```

Then reopen a terminal,

```
roslaunch learn_service IntPlus_server
```

A terminal window titled 'yahboom@yahboom-virtual-machine: ~/Desktop' with standard window controls. The prompt is 'yahboom@yahboom-virtual-machine:~/Desktop\$'. The command 'roslaunch learn_service IntPlus_server' has been entered and executed. The output is 'INFO] [1698226383.807341921]: Ready to caculate.' (note the typo 'caculate'). A cursor is visible on the line following the output.

```
yahboom@yahboom-virtual-machine:~/Desktop$ roslaunch learn_service IntPlus_server
INFO] [1698226383.807341921]: Ready to caculate.
```

Open another terminal and enter,

```
roslaunch learn_service IntPlus_client
```

Then enter two numbers in the terminal and press Enter. The server will calculate and return the value. The returned value is printed on the client terminal.

```
yahboom@yahboom-virtual-machine: ~/Desktop
yahboom@yahboom-virtual-machine:~/Desktop$ rosrn learn_service IntPlus_server
[ INFO] [1698226383.807341921]: Ready to caculate.
[ INFO] [1698226517.457715061]: number 1 is:12 ,number 2 is:23

yahboom@yahboom-virtual-machine:~/Desktop$ rosrn learn_service IntPlus_client
12 23
[ INFO] [1698226517.456199849]: Call service to plus 12 and 23
[ INFO] [1698226517.457972109]: Show the result : 35
yahboom@yahboom-virtual-machine:~/Desktop$
```

- IntPlus_serverr serves as the server. After running, it provides the operation of calculating the addition of two int data. When no client calls the service, it will display and print `Ready to caculate`. When IntPlus_client is run, it will look for `/Two_Int_Plus` For the service, after entering two int-type data, press Enter to confirm; the server starts computing after receiving the data, and then returns a result to the client, and the client terminal will print out this value. So how does the program call custom data? The core parts are as follows:

- Introduce header files

```
#include "learn_service/IntPlus.h"
```

The former learn_service is the name of the function package, and the latter IntPlus.h is the name of the header file generated by the srv file just created.

- Use custom service files

```

client:
learning_server::IntPlus srv;
srv.request.a = i;
srv.request.b = k;
#i, k is the addend input by the terminal
ros::ServiceClient IntPlus_client =
node.serviceClient<learning_server::IntPlus>
("/Two_Int_Plus");
IntPlus_client.call(srv);
server:
ros::ServiceServer Int_Plus_service =
n.advertiseService("/Two_Int_Plus",IntPlusCallback);
bool IntPlusCallback(learning_server::IntPlus::Request
&req, learning_server::IntPlus::Response &res)

```

13.2.6 Python program uses custom message types

In the scripts folder of the function package, create two new files, named IntPlus_client.py and IntPlus_server.py, and copy the following codes into them respectively.

IntPlus_client.py

```

#!/usr/bin/env python
# -*- coding: utf-8 -*-
import sys
import rospy
from learn_service.srv import IntPlus, IntPlusRequest
def Plus_client():
    #ROS node initialization
    rospy.init_node('IntPlus_client')
    rospy.wait_for_service('/Two_Int_Plus')
    try:
        Plus_client = rospy.ServiceProxy('/Two_Int_Plus', IntPlus)
        response = Plus_client(22, 20)# Request service call, enter request data
        return response.result
    except rospy.ServiceException as e:
        print ("failed to call service : %s"%e)
if __name__ == "__main__":
    #Call the service and display the call results
    print ("Show two_int_plusresult : %s" %(Plus_client()))

```

IntPlus_server.py

```

#!/usr/bin/env python
# -*- coding: utf-8 -*-
import rospy
from learn_service.srv import IntPlus, IntPlusResponse
def IntPlusCallback(req):
    rospy.loginfo("Ints: a:%d b:%d", req.a, req.b)# Show request data
    return IntPlusResponse(req.a+req.b)# feedback data
def IntPlus_server():
    rospy.init_node('IntPlus_server')# ROS node initialization
    # Create a server and register the callback function IntPlusCallback
    s = rospy.Service('/Two_Int_Plus', IntPlus, IntPlusCallback)
    print ("Ready to caculate two ints.")# Loop waiting for callback function
    rospy.spin()

```

```
if __name__ == "__main__":  
    IntPlus_server()
```

After saving the two files, execution permissions need to be given.

```
cd ~/ros_ws/src/learn_topic/scripts  
sudo chmod a+x IntPlus_client.py  
sudo chmod a+x IntPlus_server.py
```

Similarly, let's run these two programs to see, first start roscore,

```
roscore
```

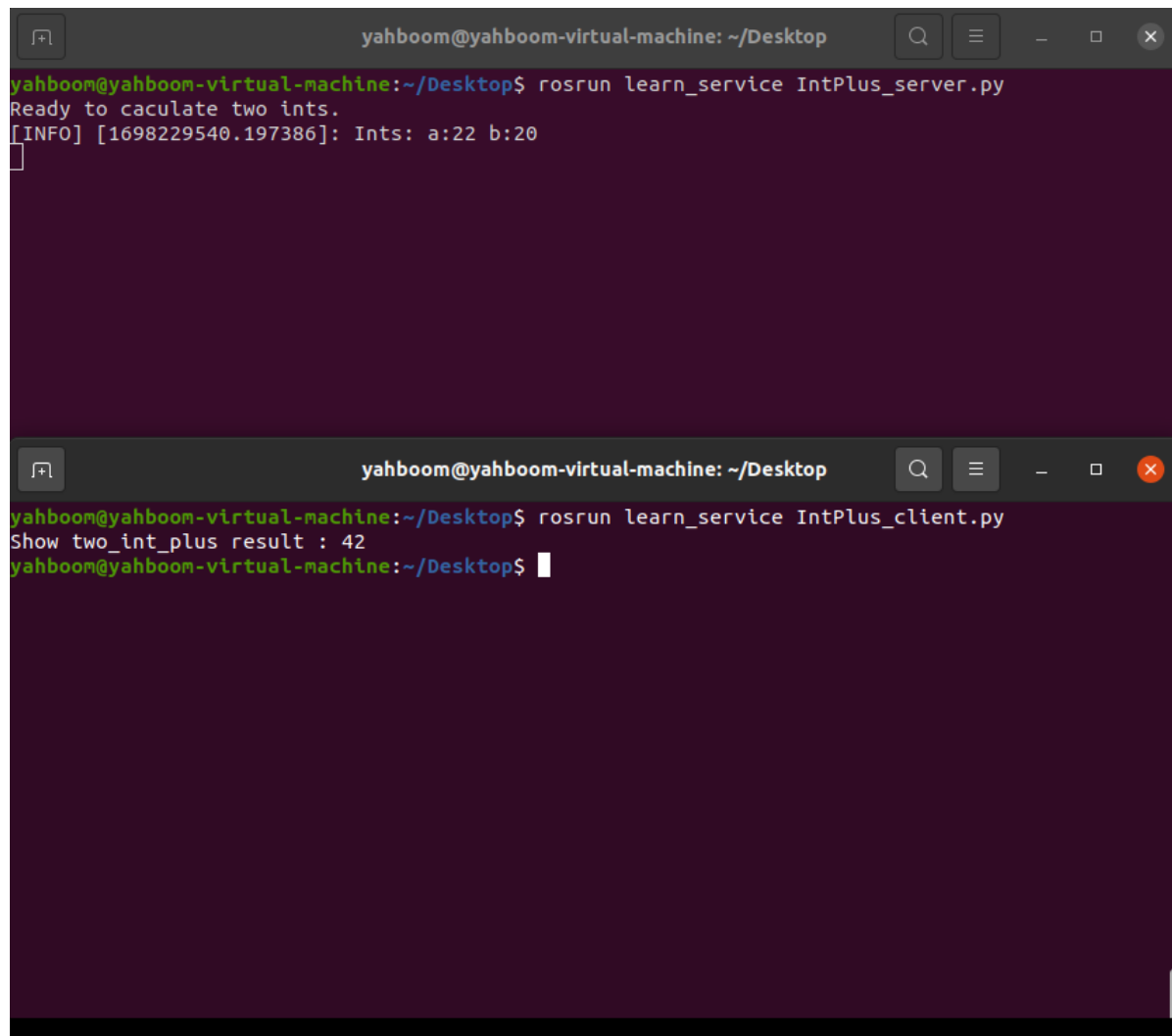
Open another terminal and enter,

```
roslaunch learn_service IntPlus_server.py
```

Open another terminal and enter,

```
roslaunch learn_service IntPlus_client.py
```

The effect is half that of the C++ version, but there is no need to enter numbers after running IntPlus_client.py here. 22 and 20 have been specified in the program. After finding the service, the server directly calculates the result, and then returns it to the client for display.



The screenshot shows two terminal windows from a user named 'yahboom' on a 'yahboom-virtual-machine' at the '~/Desktop' location. The top terminal window shows the command 'roslaunch learn_service IntPlus_server.py' being executed. The output indicates the server is ready to calculate two integers and displays an INFO message: '[1698229540.197386]: Ints: a:22 b:20'. The bottom terminal window shows the command 'roslaunch learn_service IntPlus_client.py' being executed. The output shows the client displaying the result: 'Show two_int_plus result : 42'.

```
yahboom@yahboom-virtual-machine: ~/Desktop  
yahboom@yahboom-virtual-machine:~/Desktop$ roslaunch learn_service IntPlus_server.py  
Ready to caculate two ints.  
[INFO] [1698229540.197386]: Ints: a:22 b:20  
yahboom@yahboom-virtual-machine:~/Desktop$  
  
yahboom@yahboom-virtual-machine: ~/Desktop  
yahboom@yahboom-virtual-machine:~/Desktop$ roslaunch learn_service IntPlus_client.py  
Show two_int_plus result : 42  
yahboom@yahboom-virtual-machine:~/Desktop$
```

Python programs do not need to add header files, but they need to import libraries. Please refer to the following content for import and use.

```
#server
from learning_server.srv import IntPlus, IntPlusResponse
#client
from learning_server.srv import IntPlus, IntPlusRequest
```

use,

```
#server
s = rospy.Service('/Two_Int_Plus', IntPlus, IntPlusCallback)
return IntPlusResponse(req.a+req.b)#feedback data
#client
response = Plus_client(12, 20)# Request service call, enter request data
return response.result
```