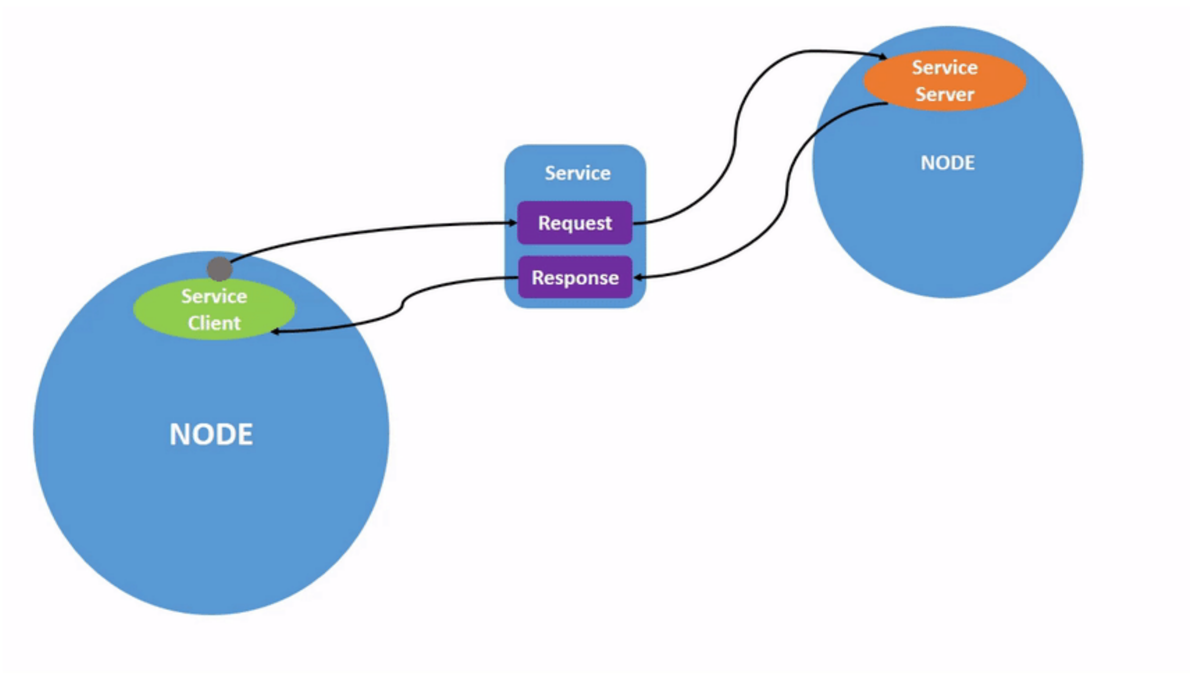
8. ROS2 Service Communication

1. Introduction to Service Communication

Service communication is a request-response communication model. On both sides of the communication chain, the client sends a request to the server, and the server responds to the client.

The client/server model is as follows:



From the perspective of service implementation, this Q&A format is called the client/server model, or CS model for short. When a client needs certain data, it sends a request to a specific service. After receiving the request, the server processes the request and returns a response.

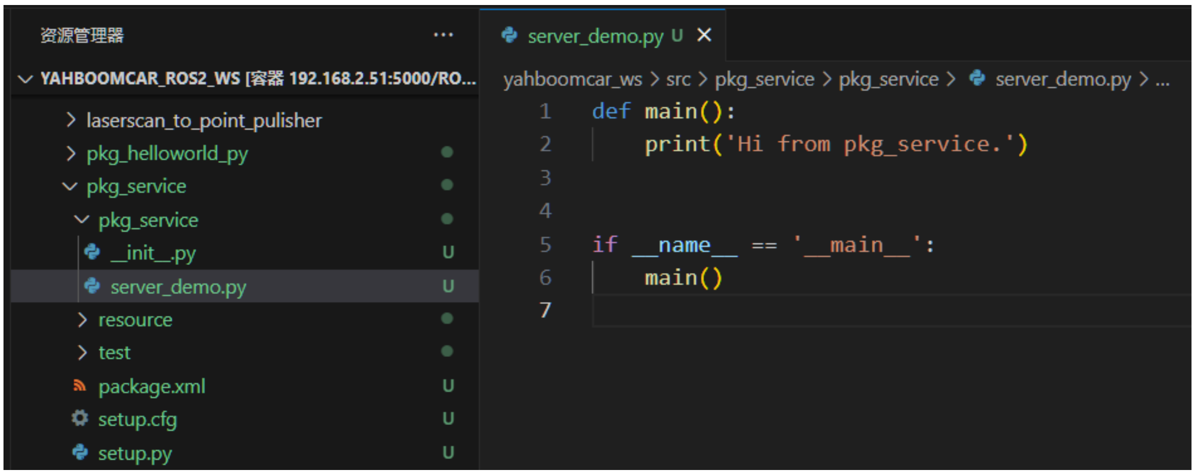
This communication mechanism is also very common in everyday life. For example, in the various web pages we frequently browse, your computer browser is the client. It sends a request to the website server using a domain name or various operations. The server then responds with the page data to be displayed.

2. Create a new package

- In the src directory of the workspace:

```
ros2 pkg create pkg_service --build-type ament_python --dependencies rclpy --
node-name server_demo
```

After executing the above command, the pkg_service package will be created, along with a server_demo node and the relevant configuration files.


资源管理器
YAHBOOMCAR_ROS2_WS [容器 192.168.2.51:5000/RO...
laserscan_to_point_pulisher
pkg_helloworld_py
pkg_service
pkg_service
__init__.py
server_demo.py
resource
test
package.xml
setup.cfg
setup.py
server_demo.py
yahboomcar_ws > src > pkg_service > pkg_service > server_demo.py > ...

```python
def main():
    print('Hi from pkg_service.')


if __name__ == '__main__':
    main()
```

3. Server Implementation

3.1 Creating the Server

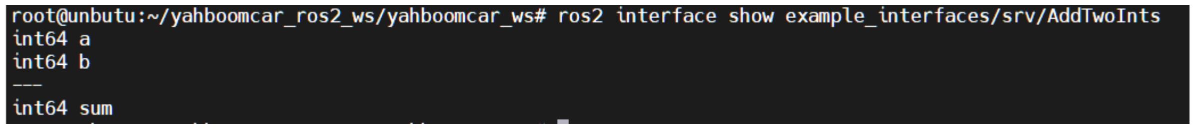
Next, edit [server_demo.py] to implement the server functionality and add the following code:

```python
#Import related libraries
import rclpy
from rclpy.node import Node
from example_interfaces.srv import AddTwoInts

class Service_Server(Node):
    def __init__(self,name):
        super().__init__(name)
        #Create a server using the create_service function. The parameters
passed in are:
        #Service data type, service name, service callback function (i.e.,
service content)
        self.srv = self.create_service(AddTwoInts, '/add_two_ints',
self.Add2Ints_callback)
    #The service callback function here adds two integers and returns the result.

    def Add2Ints_callback(self,request,response):
        response.sum = request.a + request.b
        print("response.sum = ",response.sum)
        return response
def main():
    rclpy.init()
    server_demo = Service_Server("publisher_node")
    rclpy.spin(server_demo)
    server_demo.destroy_node()                    #Destroy the node object
    rclpy.shutdown()                              #Shut down the ROS2 Python
interface
```

Focus on the service callback function, Add2Ints_callback. Besides self, the required parameters here are request and response. Request is the parameter required by the service, and response is the service's feedback. Request.a and request.b are the contents of the request, and response.sum is the contents of the response. First, let's take a look at what the data type AddTwoInts looks like.

- You can use the following command to view it:

```
ros2 interface show example_interfaces/srv/AddTwoInts
```



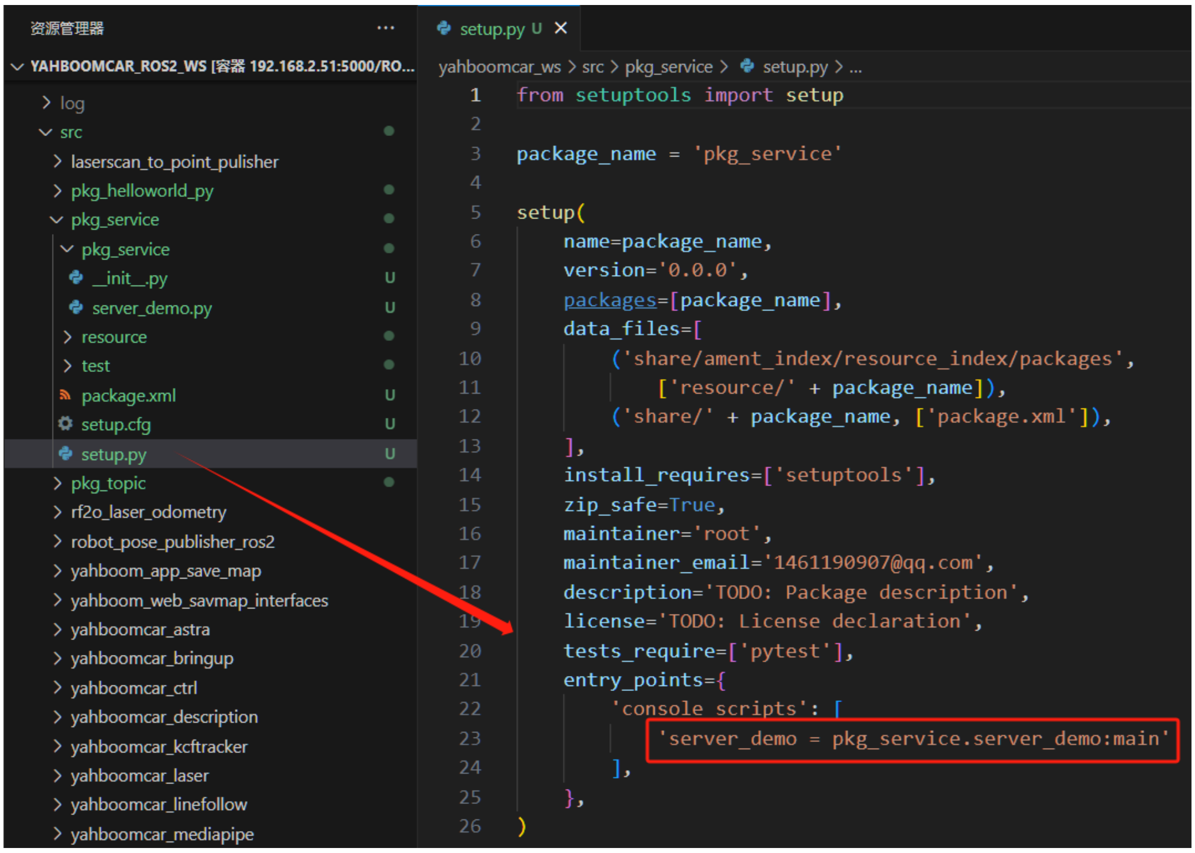
```
root@unbutu:~/yahboomcar_ros2_ws/yahboomcar_ws# ros2 interface show example_interfaces/srv/AddTwoInts
int64 a
int64 b
---
int64 sum
```

The "---" character divides the data type into two parts: the top part represents the request, and the bottom part represents the response. Each field then contains its own variable, such as int64 a and int64 b. When passing parameters, you must specify the values of a and b. Similarly, the feedback result also needs to specify the sum value.

3.2 Editing the Configuration File

- Open setup.py and add the following line to the console_scripts list:

```
'server_demo = pkg_service.server_demo:main',
```

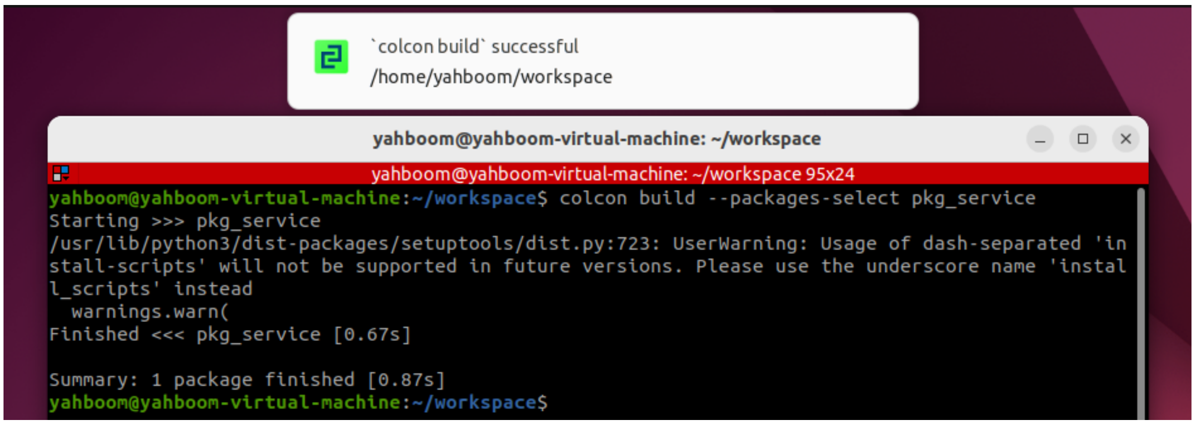


```
from setuptools import setup

package_name = 'pkg_service'

setup(
    name=package_name,
    version='0.0.0',
    packages=[package_name],
    data_files=[
        ('share/ament_index/resource_index/packages',
            ['resource/' + package_name]),
        ('share/' + package_name, ['package.xml']),
    ],
    install_requires=['setuptools'],
    zip_safe=True,
    maintainer='root',
    maintainer_email='1461190907@qq.com',
    description='TODO: Package description',
    license='TODO: License declaration',
    tests_require=['pytest'],
    entry_points={
        'console_scripts': [
            'server_demo = pkg_service.server_demo:main'
        ],
    },
)
```

3.3 Compiling the Package

- Compiling the Package

```
colcon build --packages-select pkg_service
```

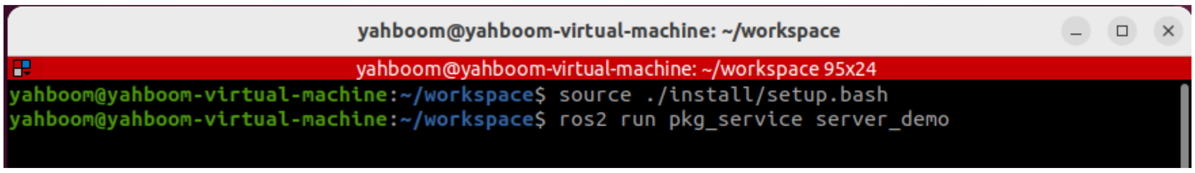


```
`colcon build` successful
/home/yahboom/workspace

yahboom@yahboom-virtual-machine:~/workspace$ colcon build --packages-select pkg_service
Starting >>> pkg_service
/usr/lib/python3/dist-packages/setuptools/dist.py:723: UserWarning: Usage of dash-separated 'in
stall-scripts' will not be supported in future versions. Please use the underscore name 'instal
l_scripts' instead
  warnings.warn(
Finished <<< pkg_service [0.67s]

Summary: 1 package finished [0.87s]
yahboom@yahboom-virtual-machine:~/workspace$
```

3.4 Running the Program

- Refresh the environment variables and run the node.

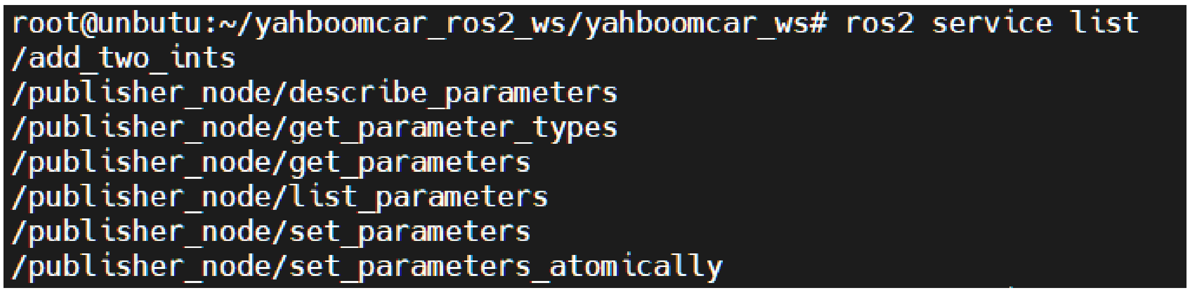
```
ros2 run pkg_service server_demo
```



```
yahboom@yahboom-virtual-machine:~/workspace$ source ./install/setup.bash
yahboom@yahboom-virtual-machine:~/workspace$ ros2 run pkg_service server_demo
```

After running, since the service is not called, there is no feedback. You can call the service through the command line. First, query the current services. In another terminal, enter:

```
ros2 service list
```

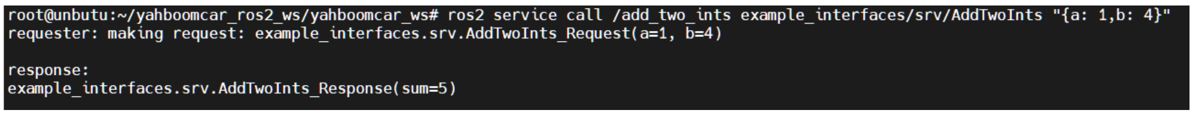


```
root@unbutu:~/yahboomcar_ros2_ws/yahboomcar_ws# ros2 service list
/add_two_ints
/publisher_node/describe_parameters
/publisher_node/get_parameter_types
/publisher_node/get_parameters
/publisher_node/list_parameters
/publisher_node/set_parameters
/publisher_node/set_parameters_atomically
```

/add_two_ints is the service we need to call. Call it with the following command. In the terminal, enter:

```
ros2 service call /add_two_ints example_interfaces/srv/AddTwoInts "{a: 1, b: 4}"
```

Here, we assign the value of a to 1 and the value of b to 4, effectively calling the service to calculate the sum of 1 and 4:



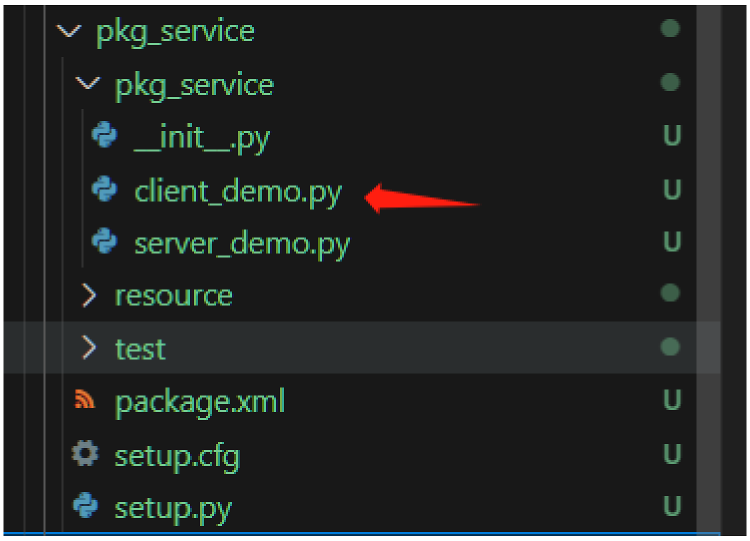
```
root@unbutu:~/yahboomcar_ros2_ws/yahboomcar_ws# ros2 service call /add_two_ints example_interfaces/srv/AddTwoInts "{a: 1,b: 4}"
requester: making request: example_interfaces.srv.AddTwoInts_Request(a=1, b=4)

response:
example_interfaces.srv.AddTwoInts_Response(sum=5)
```

As shown in the image above, after calling the service, the result returned is 5, and the terminal running the server also prints the returned value.

4. Client Implementation

4.1 Creating the Client

Create a new file, [client_demo.py], in the same directory as [server_demo.py].



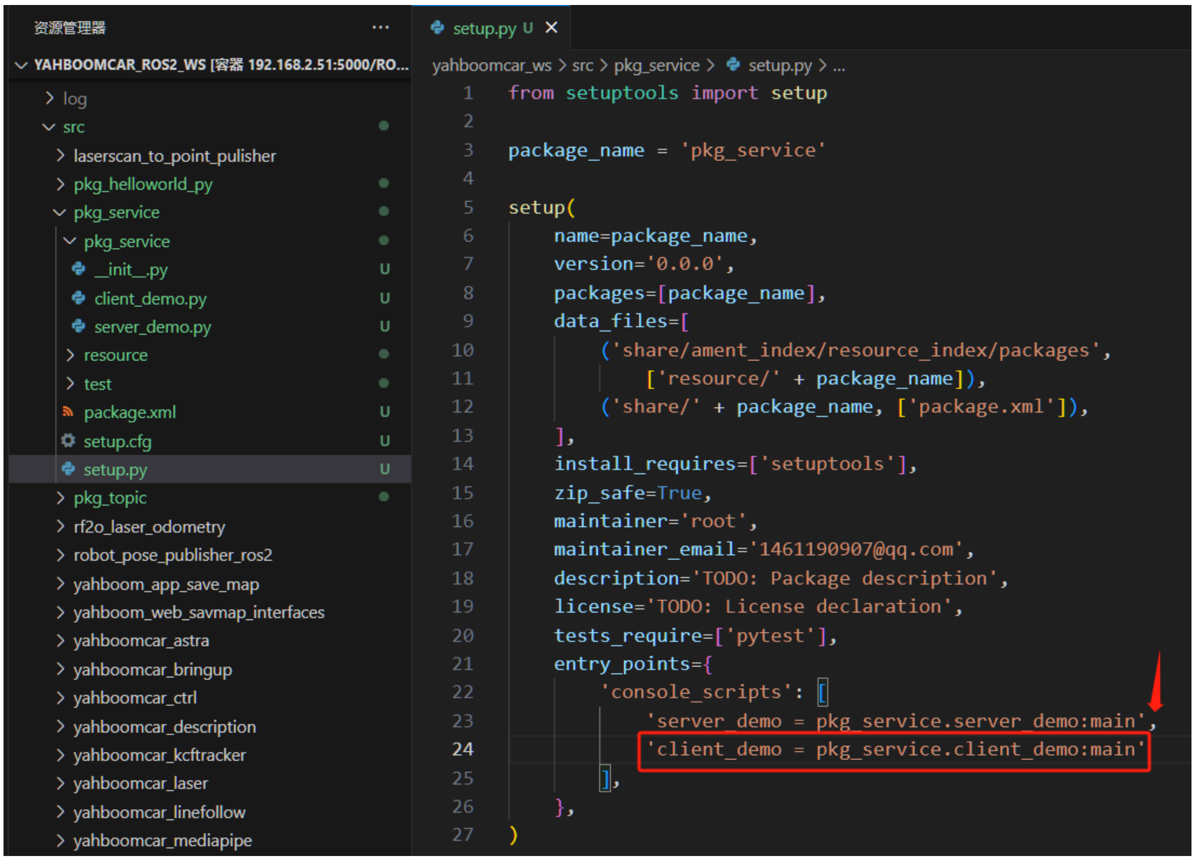
Next, edit [client_demo.py] to implement the client functionality and add the following code:

```
#Import related libraries
import rclpy
from rclpy.node import Node
from example_interfaces.srv import AddTwoInts

class Service_Client(Node):
    def __init__(self,name):
        super().__init__(name)
        #Create the client using the create_client function, passing in the
service data type and service topic name as parameters.
        self.client = self.create_client(AddTwoInts,'/add_two_ints')
        #Loop waiting for the server to successfully start
        while not self.client.wait_for_service(timeout_sec=1.0):
            print("service not available, waiting again...")
        #Create the service request data object
        self.request = AddTwoInts.Request()

    def send_request(self):
        self.request.a = 10
        self.request.b = 90
        #Send the service request
        self.future = self.client.call_async(self.request)

def main():
    rclpy.init() #Node initialization
    service_client = Service_Client("client_node") #Create object
    service_client.send_request() #Send service request
    while rclpy.ok():
        rclpy.spin_once(service_client)
        #Determine if data processing is complete
        if service_client.future.done():
            try:
                #Get service feedback and print it
                response = service_client.future.result()
                print("service_client.request.a = ",service_client.request.a)
                print("service_client.request.b = ",service_client.request.b)
                print("Result = ",response.sum)
            except Exception as e:
                service_client.get_logger().info('Service call failed %r' %
(e,))
        break
    service_client.destroy_node()
    rclpy.shutdown()
```

4.2 Edit the Configuration File

- Open setup.py and add the following line to the console_scripts list:

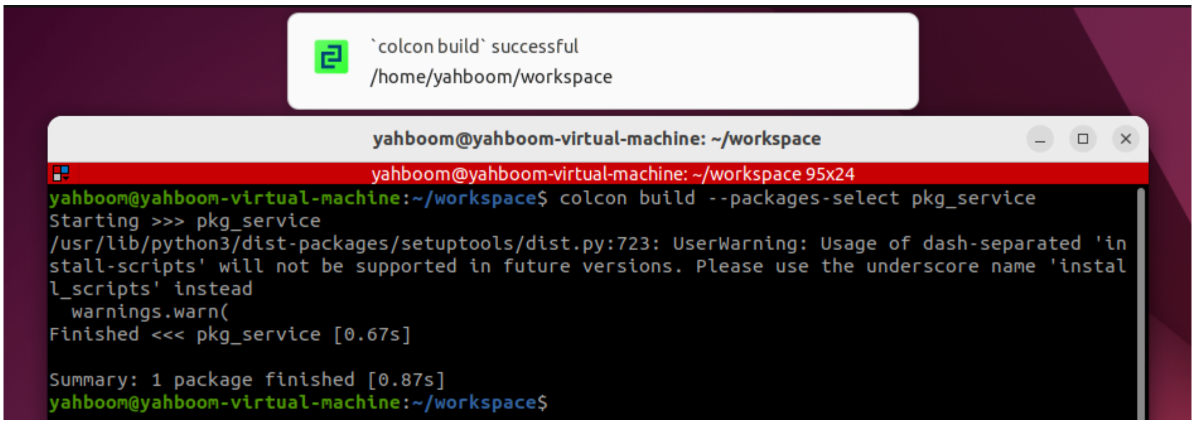
```
'client_demo = pkg_service.client_demo:main'
```



```
from setuptools import setup

package_name = 'pkg_service'

setup(
    name=package_name,
    version='0.0.0',
    packages=[package_name],
    data_files=[
        ('share/ament_index/resource_index/packages',
            ['resource/' + package_name]),
        ('share/' + package_name, ['package.xml']),
    ],
    install_requires=['setuptools'],
    zip_safe=True,
    maintainer='root',
    maintainer_email='1461190907@qq.com',
    description='TODO: Package description',
    license='TODO: License declaration',
    tests_require=['pytest'],
    entry_points={
        'console_scripts': [
            'server_demo = pkg_service.server_demo:main',
            'client_demo = pkg_service.client_demo:main'
        ],
    },
)
```

4.3 Compile the Package

```
colcon build --packages-select pkg_service
```


yahboom@yahboom-virtual-machine: ~/workspace
yahboom@yahboom-virtual-machine: ~/workspace 95x24

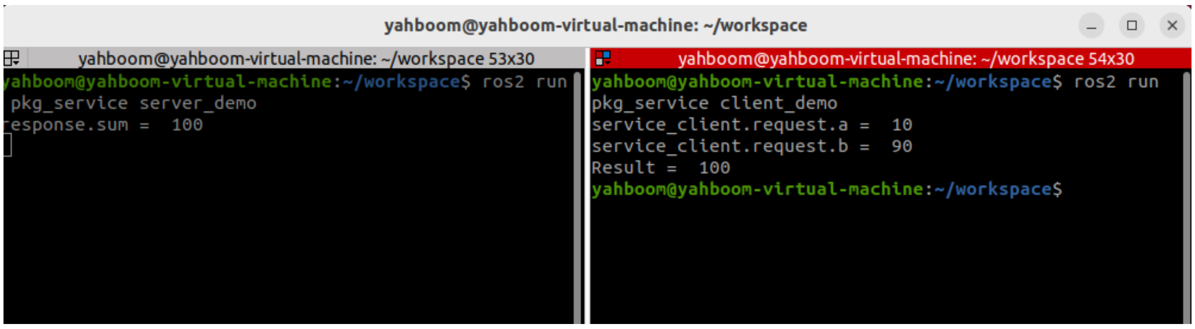
`colcon build` successful
/home/yahboom/workspace

```
yahboom@yahboom-virtual-machine:~/workspace$ colcon build --packages-select pkg_service
Starting >>> pkg_service
/usr/lib/python3/dist-packages/setuptools/dist.py:723: UserWarning: Usage of dash-separated 'in
stall-scripts' will not be supported in future versions. Please use the underscore name 'instal
l_scripts' instead
  warnings.warn(
Finished <<< pkg_service [0.67s]

Summary: 1 package finished [0.87s]
yahboom@yahboom-virtual-machine:~/workspace$
```

4.4 Run the Program

- Refresh the environment variables and run the node

```
# Start the server node
ros2 run pkg_service server_demo
# Start the client node
ros2 run pkg_service client_demo
```



```
yahboom@yahboom-virtual-machine: ~/workspace
yahboom@yahboom-virtual-machine: ~/workspace 53x30
yahboom@yahboom-virtual-machine:~/workspace$ ros2 run
 pkg_service server_demo
response.sum =   100
```

```
yahboom@yahboom-virtual-machine: ~/workspace 54x30
yahboom@yahboom-virtual-machine:~/workspace$ ros2 run
pkg_service client_demo
service_client.request.a =  10
service_client.request.b =  90
Result =  100
yahboom@yahboom-virtual-machine:~/workspace$
```

First run the server, then the client. The client provides a=10 and b=90. The server performs the sum and obtains 100. The result is printed on both terminals.