

1. 实验名称及目的

1.1 实验名称

ROS1环境部署及安装测试

1.2 实验目的

主要讲解如何对ROS1环境进行安装与配置，以及在安装后如何判断环境是否安装正常。

1.3 关键知识点

无

2. 实验效果

能够正确判断环境是否安装正确

3. 文件目录

例程目录：[\[安装目录\]](#)\RflySimAPIs\2.RflySimUsage\0.ApiExps\e8_RosInstall

文件夹/文件名称	说明
install-ROS-ubuntu.sh	环境配置文件
RosSwitch.bat	ROS环境切换脚本
WslGUI.bat	GUI窗口启动脚本

4. 运行环境

4.1 软件要求

Windows 10及以上版本；RflySim工具链。

①：若使用Pixhawk 6X飞控，平台安装时的编译命令为：px4_fmu-v6x_default，推荐PX4固件版本为：1.12.3。其他配套飞控及编译命令请见：

<https://rflysim.com/doc/zh/1/Hardware.html>

4.2 硬件要求

笔记本/台式电脑① 1台。

①：推荐配置请见：<https://rflysim.com/doc/zh/HowToInstall.pdf>

5. 实验步骤

Ros1环境的安装与配置

首先，我们需要找到一台空白的Ubuntu电脑或虚拟机，将该实验文件夹进行拷贝。之后，需要在该文件夹下打开终端，运行install-ROS-ubuntu.sh脚本，运行命令./install-ROS-ubuntu.sh，运行命令后，便会进行Ros1环境的安装。

在安装完成之后，需要输入如下命令：

```
sudo gedit ~/.bashrc
```

注：gedit也可以换成vim。

打开文件后，在最后面添加上：source /opt/ros/noetic/setup.bash，之后，保存并退出。

之后，在终端中输入：

```
source ~/.bashrc
```

这样，便能够加载ROS1的环境，后续ROS1的环境就能自动加载。

注：如果不方便配置自己的Ubuntu，也可以使用平台中提供的WinWSL，来测试后续的步骤。

我们同样配置的有已经部署ROS1开发环境的虚拟机，打包放在百度网盘，如果有需要可从百度网盘中进行下载使用。链接：

<https://pan.baidu.com/s/15H1kFjol-uvzn5rWAVD4iw?pwd=ijun> 提取码: ijun

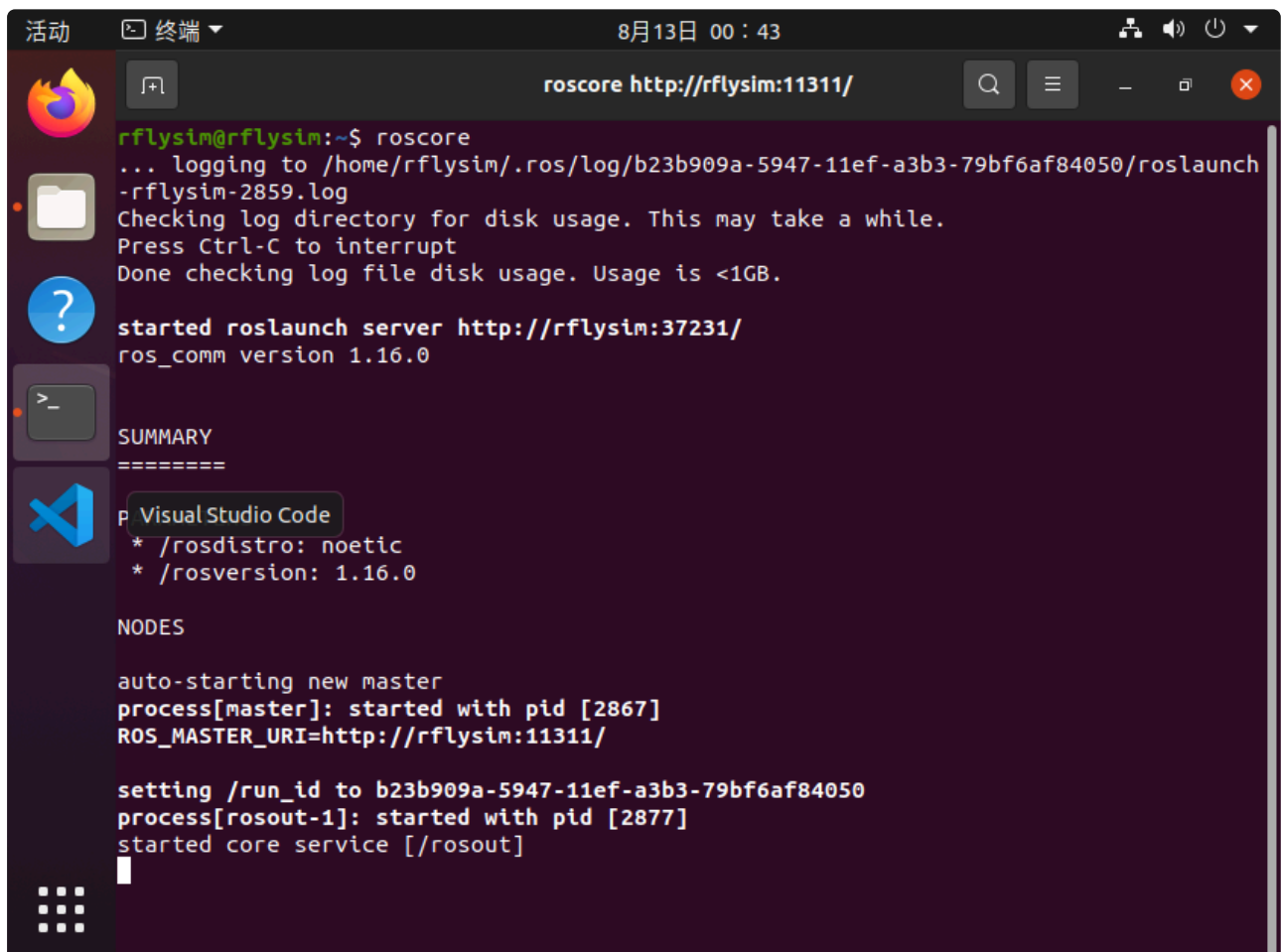
，配置好环境的虚拟机账户名以及密码均为：nvidia。

! Ros1环境的测试

首先，在已经安装Ros1的Ubuntu下，打开一个终端，输入：

```
roscore
```

便能够启动Ros1。



```
活动 终端 8月13日 00:43
roscore http://rflysim:11311/
rflysim@rflysim:~$ roscore
... logging to /home/rflysim/.ros/log/b23b909a-5947-11ef-a3b3-79bf6af84050/roslaunch
-rflysim-2859.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://rflysim:37231/
ros_comm version 1.16.0

SUMMARY
=====
Visual Studio Code
* /rostdistro: noetic
* /rosversion: 1.16.0

NODES

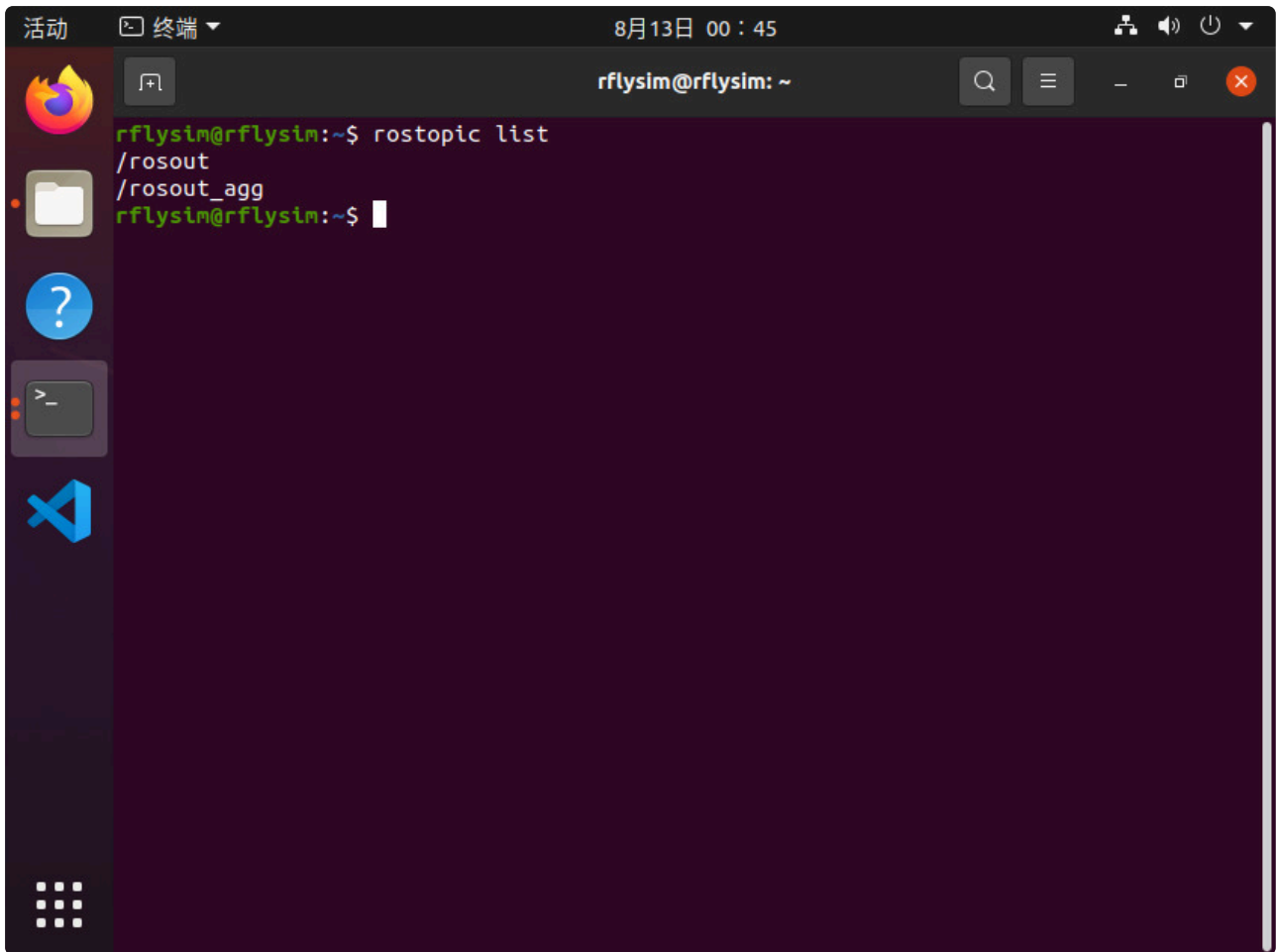
auto-starting new master
process[roscpp]: started with pid [2867]
ROS_MASTER_URI=http://rflysim:11311/

setting /run_id to b23b909a-5947-11ef-a3b3-79bf6af84050
process[rosout-1]: started with pid [2877]
started core service [/rosout]
```

然后另起一个终端，输入：

```
rostopic list
```

就能够看到当前的ros消息。

A terminal window screenshot from Ubuntu. The window title is '终端' (Terminal) and the user is 'rflysim@rflysim: ~'. The terminal shows the command 'rostopic list' being executed, with the output: '/rosout' and '/rosout_agg'. The prompt 'rflysim@rflysim:~\$' is visible at the end of the output.

```
rflysim@rflysim:~$ rostopic list
/rosout
/rosout_agg
rflysim@rflysim:~$
```

如果都能正常运行，如截图显示，则说明环境没有问题。

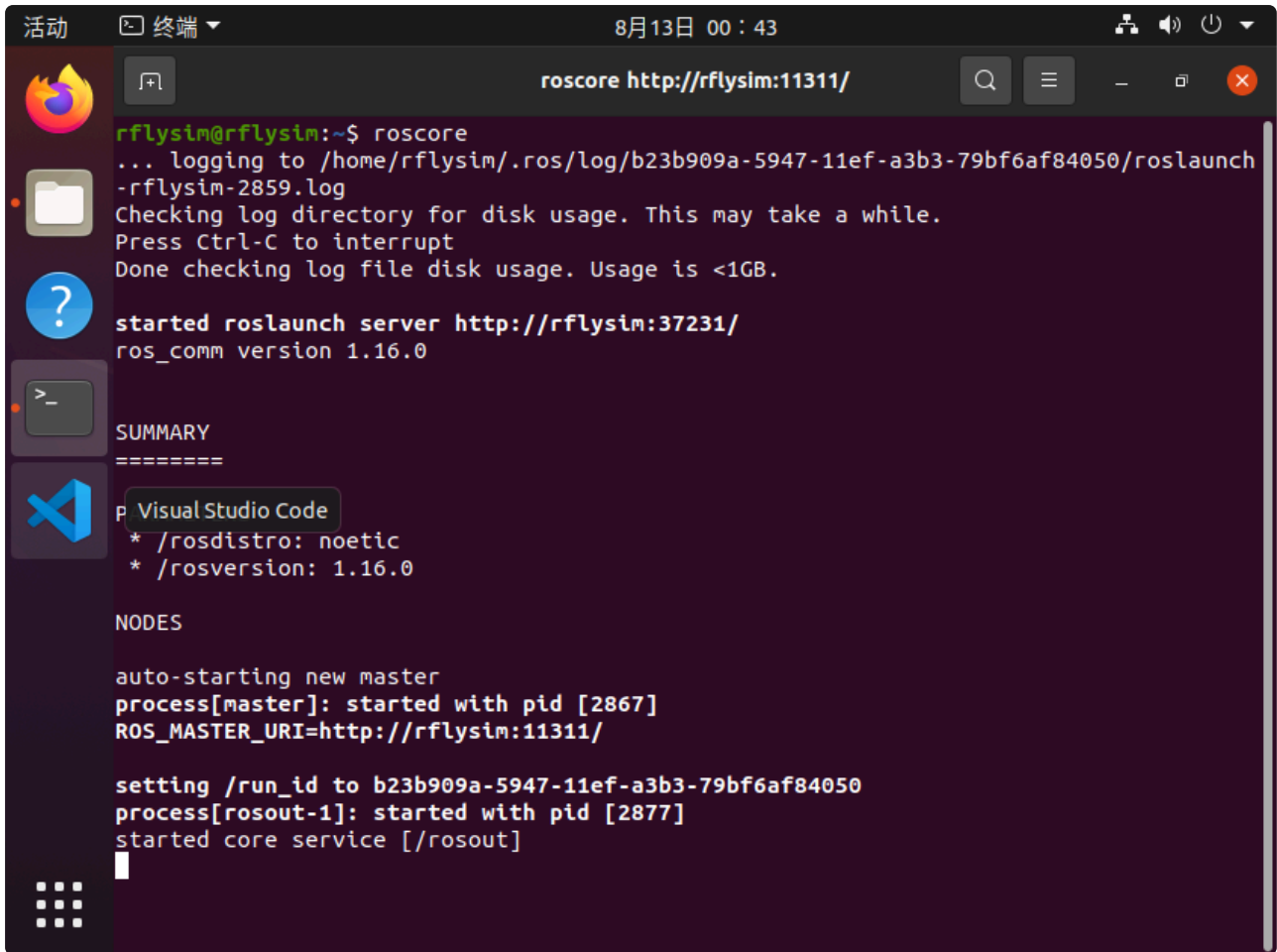
经典海龟控制demo

Step1:

在Ubuntu系统下，按下按下CTRL+ALT+T的快捷键，打开一个终端。输入：

```
roscore
```

来启动ROS Master。

A terminal window with a dark background and light text. The window title is "roscore http://rflysim:11311/". The terminal shows the execution of the "roscore" command. The output includes logging information, a disk usage check, and the start of a roslaunch server. The server is identified as "started roslaunch server http://rflysim:37231/" with "ros_comm version 1.16.0". Below this, a "SUMMARY" section lists the ROS distribution as "noetic" and the version as "1.16.0". A "NODES" section follows, showing the auto-starting of a new master process with PID 2867, setting the ROS_MASTER_URI to "http://rflysim:11311/", and starting a rosout process with PID 2877. The terminal ends with "started core service [/rosout]" and a cursor.

```
rfllysim@rfllysim:~$ roscore
... logging to /home/rfllysim/.ros/log/b23b909a-5947-11ef-a3b3-79bf6af84050/roslaunch
-rfllysim-2859.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://rfllysim:37231/
ros_comm version 1.16.0

SUMMARY
=====
P Visual Studio Code
* /rostdistro: noetic
* /rosversion: 1.16.0

NODES

auto-starting new master
process[master]: started with pid [2867]
ROS_MASTER_URI=http://rflysim:11311/

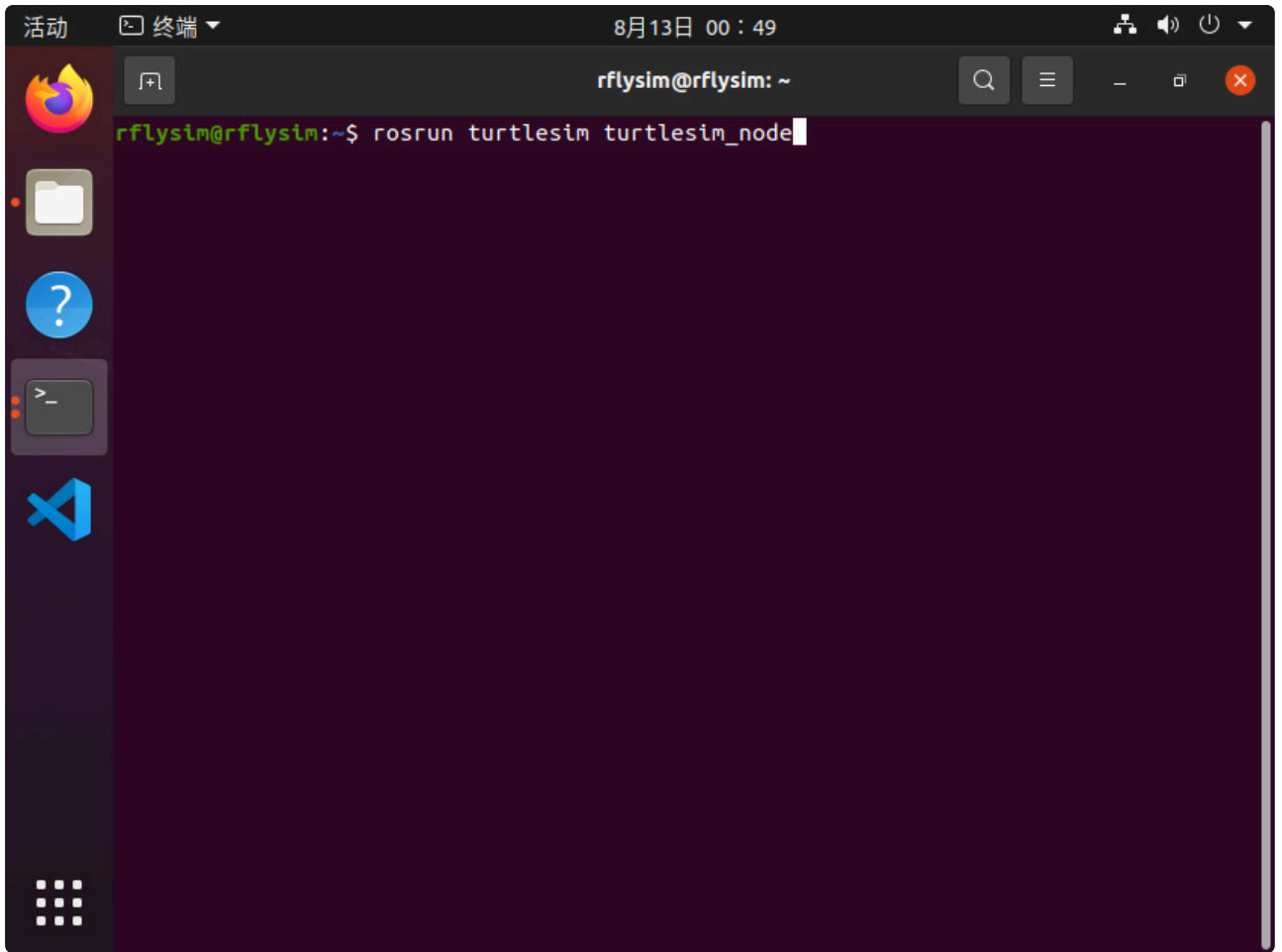
setting /run_id to b23b909a-5947-11ef-a3b3-79bf6af84050
process[rosout-1]: started with pid [2877]
started core service [/rosout]
```

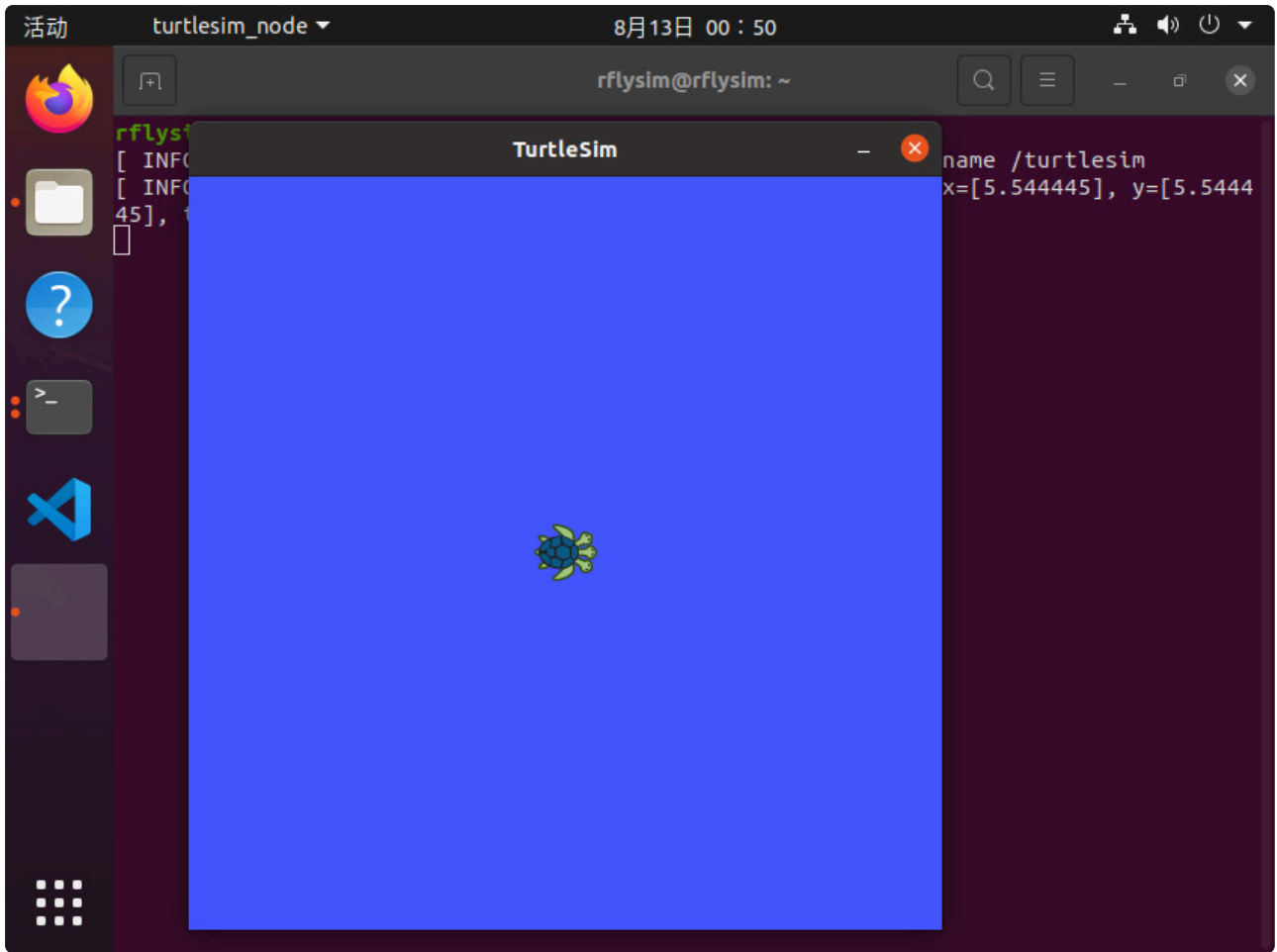
Step2:

之后，同样按下CTRL+ALT+T的快捷键，打开一个新终端。输入：

```
roslaunch turtlesim turtlesim_node
```

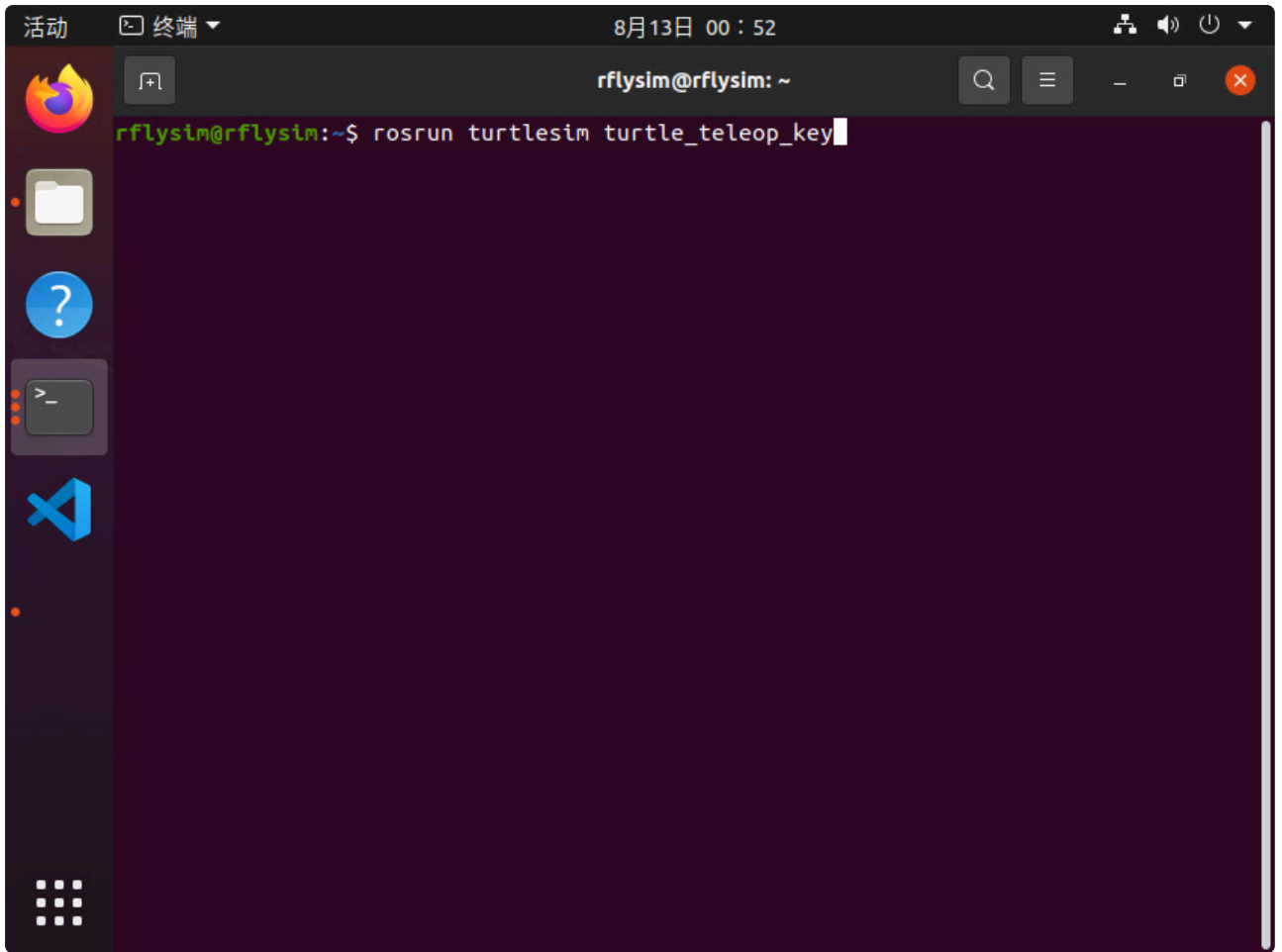
来启动小海龟仿真器。

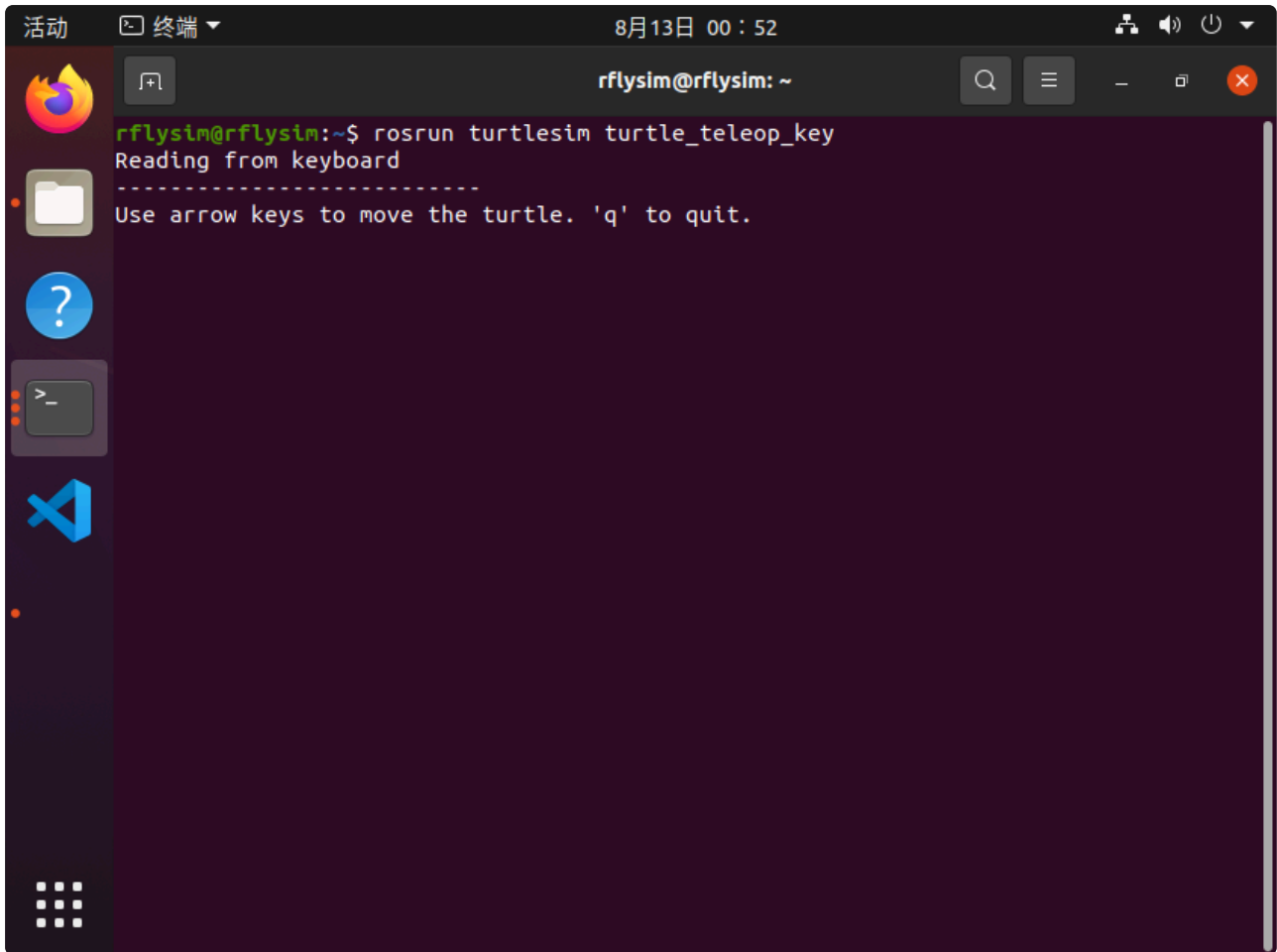




再次打开一个新的终端。输入：

```
roslaunch turtlesim turtlesim
```



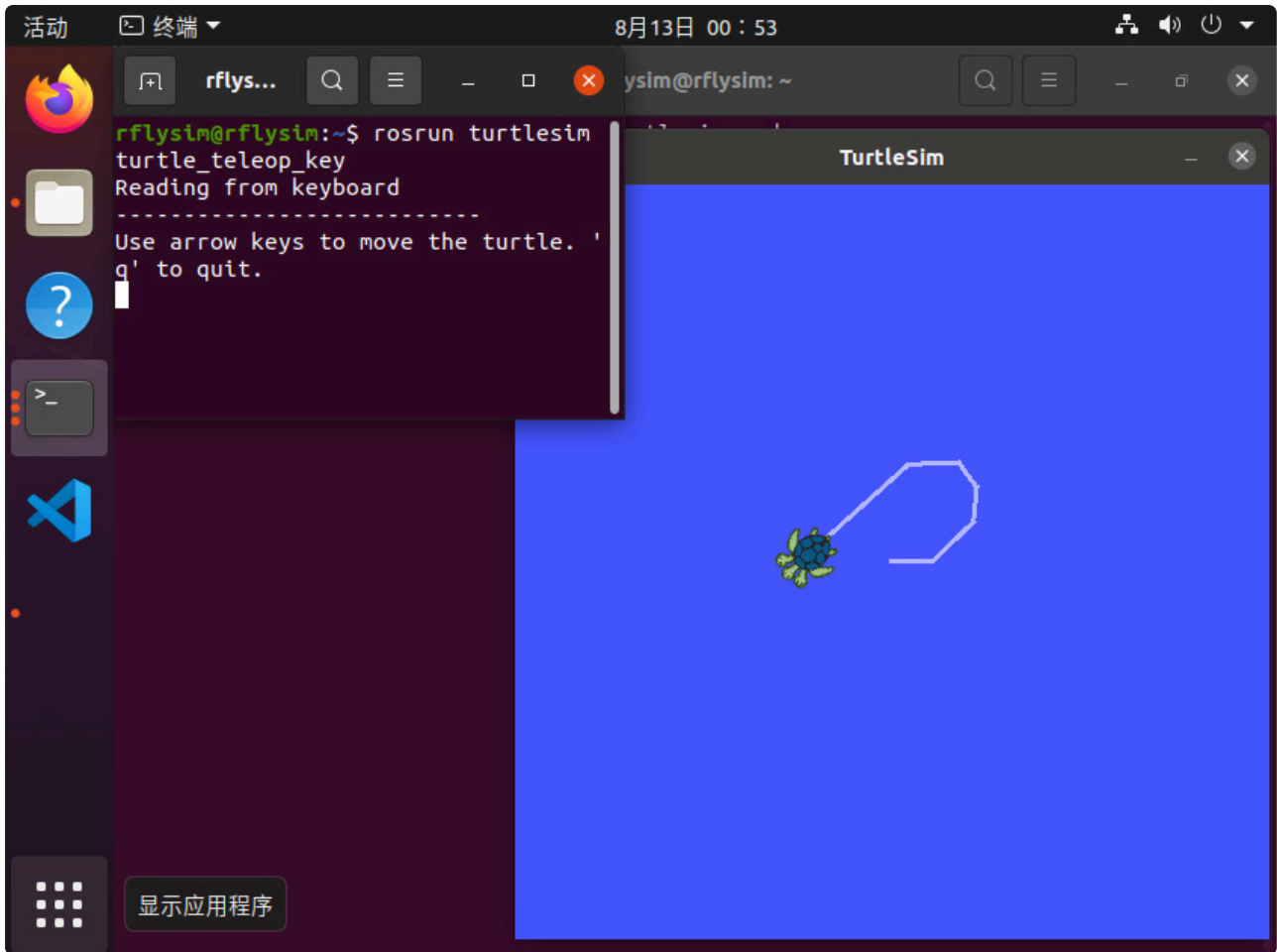
A terminal window titled '终端' (Terminal) with the date and time '8月13日 00:52' in the top right corner. The window shows a terminal session for user 'rflysim' on host 'rflysim'. The command 'roslaunch turtlesim turtlesim_key' has been executed, resulting in the output 'Reading from keyboard' and a dashed line separator. Below the separator, the text 'Use arrow keys to move the turtle. 'q' to quit.' is displayed. The terminal window includes standard Linux window controls (minimize, maximize, close) and a search icon. On the left side of the terminal, there is a vertical sidebar with icons for Firefox, a folder, a question mark, a terminal icon, and Visual Studio Code. At the bottom left, there is a grid icon for application switching.

```
rflysim@rflysim:~$ roslaunch turtlesim turtlesim_key
Reading from keyboard
-----
Use arrow keys to move the turtle. 'q' to quit.
```

启动海龟键盘控制节点。

Step3:

在该节点中，可以通过控制键盘方向键，来控制海龟的运动。（其中上下键控制前进后退，左右键控制方向）



注：同样可以通过WinWSL来完成实验，步骤如下：

1.运行本文件夹中的“[RosSwitch.bat](#)”脚本，确认当前ROS环境，如果不是ROS1，则切换到ROS1。

2.运行文件夹中的“[WslGUI.bat](#)”，打开一个GUI窗口。

3.在GUI窗口中，按下CTRL+ALT+T的快捷键，打开一个终端。输入：

```
roscore
```

来启动ROS Master。

4.按下CTRL+ALT+T的快捷键，打开一个新终端。输入

```
roslaunch turtlesim turtlesim_node
```

来启动小海龟仿真器。

5.按下CTRL+ALT+T的快捷键，打开一个新终端。输入

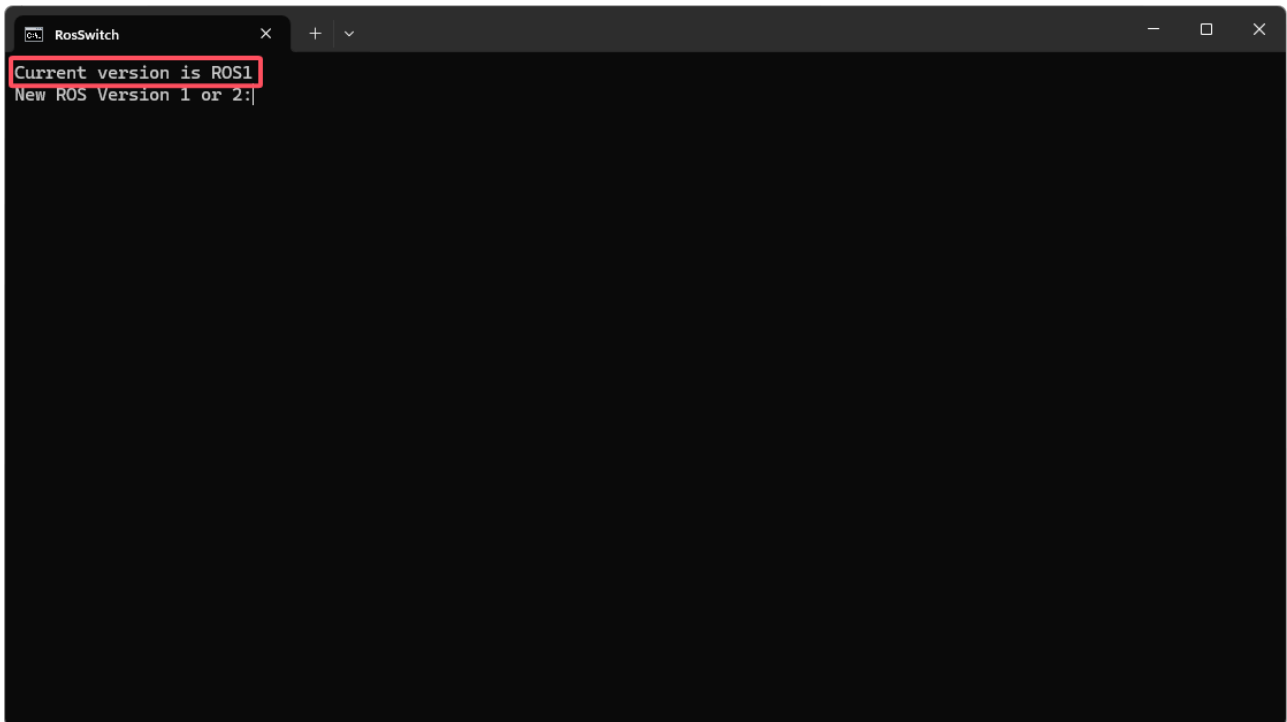
```
roslaunch turtlesim turtle_teleop_key
```

启动海龟键盘控制节点。通过键盘方向键，就能控制海龟运动了。（其中上下键控制前进后退，左右键控制方向）

ROS例程C++版（WinWSL，必做）

Step1:

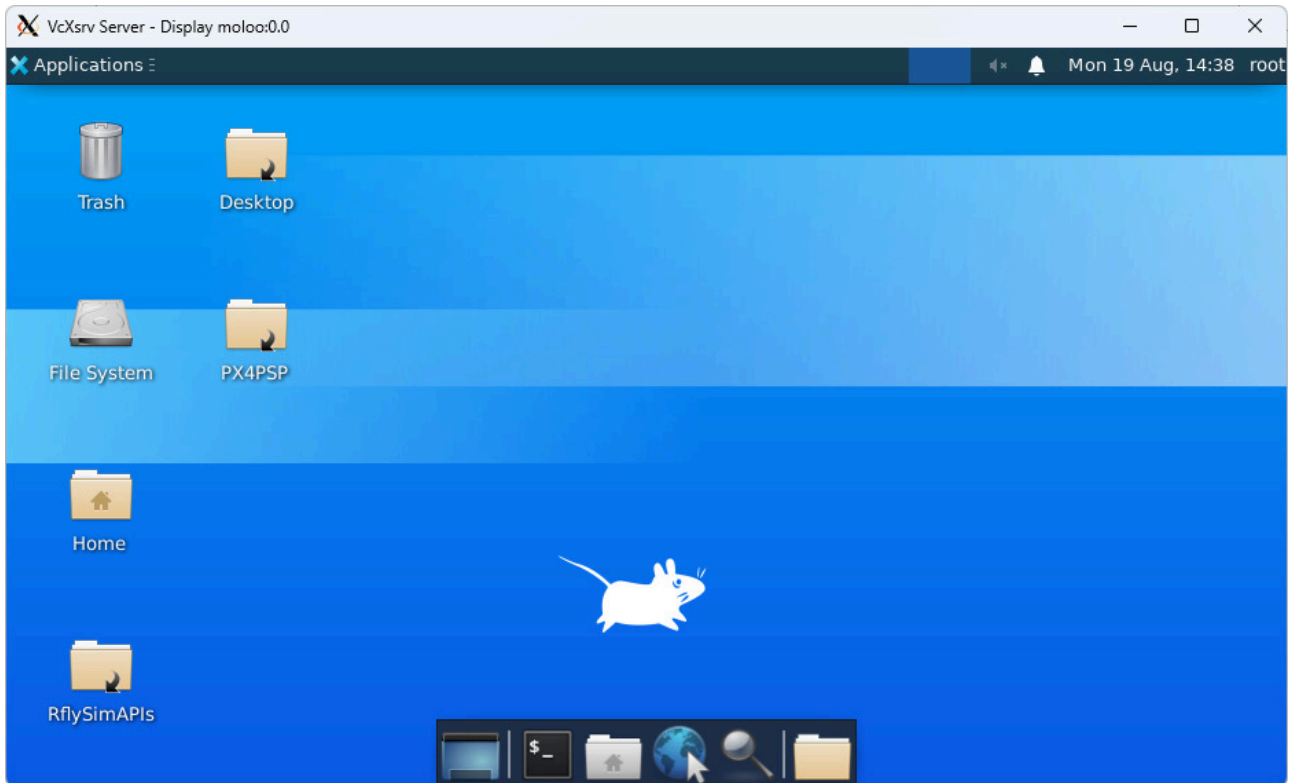
确认环境。打开“桌面\RflyTools\RosSwitch”，查看自己当前的ROS环境。请确认当前环境为ROS1，如果不是ROS1，请输入1并按回车，切换为ROS1环境。



```
Current version is ROS1
New ROS Version 1 or 2:
```

Step2:

打开“桌面\RflyTools\WslGUI”，为WinWSL的图形化界面。



Step3:

创建工作空间并初始化。打开命令行窗口输入如下的命令，创建工作空间并初始化。

```
mkdir -p 自定义空间名称/src cd 自定义空间名称 catkin_make
```

例如，这里将自定义空间名称命名为“ros1_ws”，则上面三条命令改入如下：

```
mkdir -p ros1_ws/src cd ros1_ws catkin_make
```

如果 catkin_make 出现未安装的问题，运行下面这条命令就可以解决此类问题。

```
source /opt/ros/<ros-version>/setup.bash
```

其中“<ros-version>”是安装的ros1的版本，例如这里使用的是noetic版本，则命令应该改为：

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

```
VcXsrv Server - Display moloo:0.0
Applications: Terminal - root@moloo: ...
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws
File Edit View Terminal Tabs Help
root@moloo:/mnt/c/PX4PSP/VcXsrv# mkdir -p ros1_ws/src
root@moloo:/mnt/c/PX4PSP/VcXsrv# cd ros1_ws/
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# catkin_make
Base path: /mnt/c/PX4PSP/VcXsrv/ros1_ws
Source space: /mnt/c/PX4PSP/VcXsrv/ros1_ws/src
Build space: /mnt/c/PX4PSP/VcXsrv/ros1_ws/build
Devel space: /mnt/c/PX4PSP/VcXsrv/ros1_ws/devel
Install space: /mnt/c/PX4PSP/VcXsrv/ros1_ws/install
Creating symlink "/mnt/c/PX4PSP/VcXsrv/ros1_ws/src/CMakeLists.txt" pointing to "/opt/ros/noetic/share/catkin/cmake/toplevel.cmake"
####
#### Running command: "cmake /mnt/c/PX4PSP/VcXsrv/ros1_ws/src -DCATKIN_DEVEL_PREFIX=/mnt/c/PX4PSP/VcXsrv/ros1_ws/devel -DCMAKE_INSTALL_PREFIX=/mnt/c/PX4PSP/VcXsrv/ros1_ws/install -G Unix Makefiles" in "/mnt/c/PX4PSP/VcXsrv/ros1_ws/build"
####
-- The C compiler identification is GNU 9.4.0
-- The CXX compiler identification is GNU 9.4.0
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done
-- Check for working C compiler: /usr/lib/ccache/cc - skipped
-- Detecting C compile features
-- Detecting C compile features - done
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
```

```
VcXsrv Server - Display moloo:0.0
Applications: Terminal - root@moloo: ...
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws
File Edit View Terminal Tabs Help
CMake Deprecation Warning at /usr/src/gtest/gtest/CMakeLists.txt:56 (cmake_minimum_required):
  Compatibility with CMake < 2.8.12 will be removed from a future version of CMake.

  Update the VERSION argument <min> value or use a ...<max> suffix to tell CMake that the project does not need compatibility with older versions.

-- Found PythonInterp: /usr/bin/python3 (found version "3.8.10")
-- Found Threads: TRUE
-- Using Python nosetests: /usr/bin/nosetests3
-- catkin 0.8.10
-- BUILD_SHARED_LIBS is on
-- BUILD_SHARED_LIBS is on
-- Configuring done
-- Generating done
-- Build files have been written to: /mnt/c/PX4PSP/VcXsrv/ros1_ws/build
####
#### Running command: "make -j16 -l16" in "/mnt/c/PX4PSP/VcXsrv/ros1_ws/build"
####
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws#
```

Step4:

创建一个功能包。

```
cd src catkin_create_pkg hello roscpp rospy std_msgs
```

自定义ROS包名hello一般是我们要实现的功能包的名字。

```
VcXsrv Server - Display moloo:0.0
Applications Terminal - root@moloo: ... Mon 19 Aug, 14:44 root
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws/src
File Edit View Terminal Tabs Help
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# cd src
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# catkin_create_pkg hello roscpp rospy std_msgs
Created file hello/package.xml
Created file hello/CMakeLists.txt
Created folder hello/include/hello
Created folder hello/src
Successfully created files in /mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello. Please adjust the values in package.xml.
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src#
```

此步骤成功之后，会出现CMakeLists文件和hello包文件夹。在hello包文件夹下，会出现src和include文件目录。接下来在hello/src实现我们的功能—添加文件hello.cpp。

```
VcXsrv Server - Display moloo:0.0
Applications Terminal - root@moloo: ... Mon 19 Aug, 14:46 root
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws/src
File Edit View Terminal Tabs Help
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# cd src
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# catkin_create_pkg hello roscpp rospy std_msgs
Created file hello/package.xml
Created file hello/CMakeLists.txt
Created folder hello/include/hello
Created folder hello/src
Successfully created files in /mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello. Please adjust the values in package.xml.
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# ls -l
total 0
lrwxrwxrwx 1 root root 49 Aug 19 14:41 CMakeLists.txt -> /opt/ros/noetic/share/catkin/cmake/toplevel.cmake
drwxrwxrwx 1 root root 4096 Aug 19 14:44 hello
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# ls
CMakeLists.txt hello
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src#
```

```
VcXsrv Server - Display moloo:0.0
Applications: Terminal - root@moloo: ...
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello
File Edit View Terminal Tabs Help
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# cd src
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# catkin_create_pkg hello roscpp rospy std_msgs
Created file hello/package.xml
Created file hello/CMakeLists.txt
Created folder hello/include/hello
Created folder hello/src
Successfully created files in /mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello. Please adjust the values in package.xml.
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# ls -l
total 0
lrwxrwxrwx 1 root root 49 Aug 19 14:41 CMakeLists.txt -> /opt/ros/noetic/share/catkin/cmake/toplevel.cmake
drwxrwxrwx 1 root root 4096 Aug 19 14:44 hello
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# ls
CMakeLists.txt hello
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# cd hello/
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello# ls -l
total 12
-rwxrwxrwx 1 root root 7042 Aug 19 14:44 CMakeLists.txt
drwxrwxrwx 1 root root 4096 Aug 19 14:44 include
-rwxrwxrwx 1 root root 2854 Aug 19 14:44 package.xml
drwxrwxrwx 1 root root 4096 Aug 19 14:44 src
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello#
```

Step5: 编辑源文件

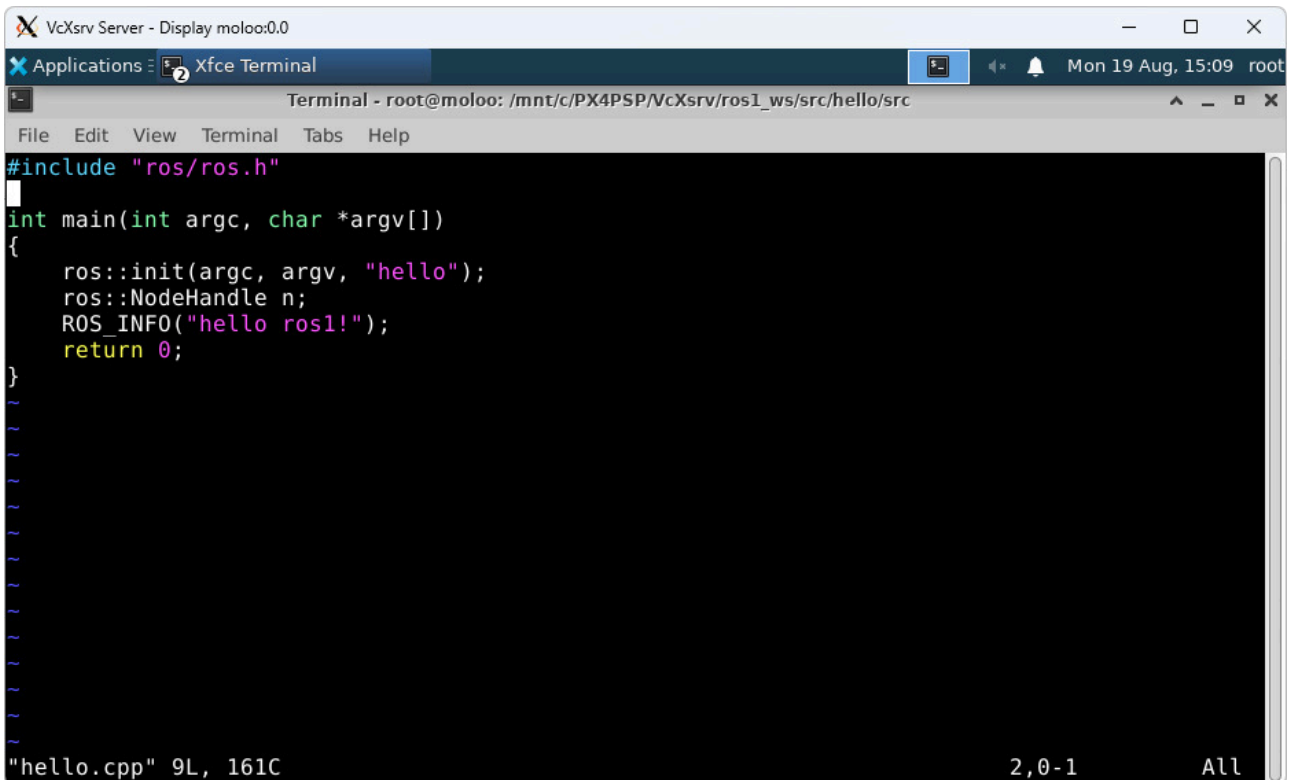
首先要创建一个文件。

```
cd hello/src touch hello.cpp
```

```
VcXsrv Server - Display moloo:0.0
Applications: Terminal - root@moloo: ...
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello/src
File Edit View Terminal Tabs Help
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# cd hello/src/
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello/src# touch hello.cpp
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello/src# ls -l
total 0
-rwxrwxrwx 1 root root 0 Aug 19 14:50 hello.cpp
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello/src#
```

然后使用vim或gedit将下面的代码写入进去，也可以直接复制例程目录中的代码。

```
#include "ros/ros.h" int main(int argc, char *argv[]) { //执行 ros 节点初始化 ros::
init(argc,argv,"hello");//创建 ros 节点句柄(非必须) ros::NodeHandle n; ROS_INF
O("hello!"); return 0; }
```



```
VcXsrv Server - Display moloo:0.0
Applications: Xfce Terminal
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello/src
File Edit View Terminal Tabs Help
#include "ros/ros.h"
int main(int argc, char *argv[])
{
    ros::init(argc, argv, "hello");
    ros::NodeHandle n;
    ROS_INFO("hello ros1!");
    return 0;
}
"hello.cpp" 9L, 161C 2,0-1 All
```

Step6: 编辑配置文件

在功能包hello的目录下的CmakeLists.txt文件中修改配置信息。如果下面的gedit命令报错,说明没有安装gedit,运行“apt install gedit”进行安装。

```
cd .. gedit CmakeLists.txt
```

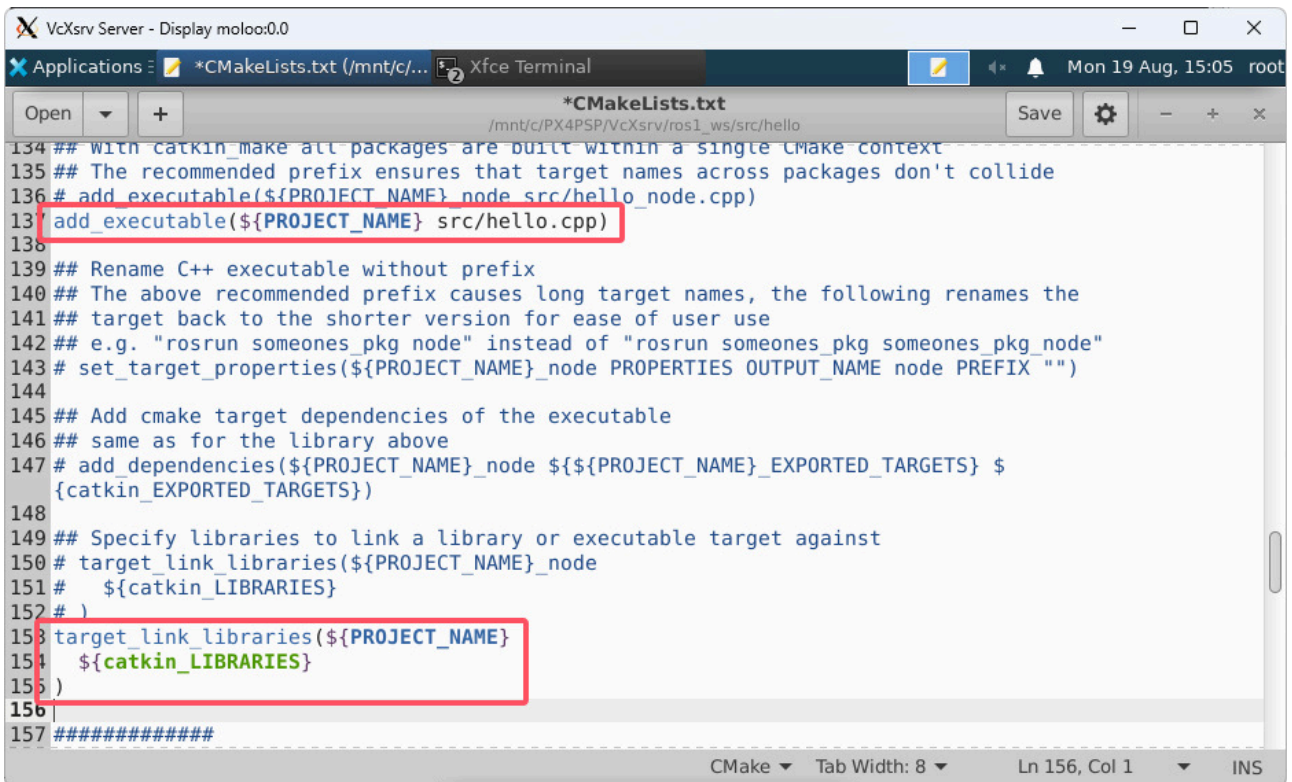
下面的代码都可以从注释中复制得到。下面这部分代码是告诉CMake哪些源文件应该编译并链接在一起生成一个可执行文件。

```
add_executable(要生成的目标文件 src/源文件.cpp )
```

下面这部分代码是 CMake 中的一个指令,用于指定一个目标(例如一个可执行文件或库)需要链接的外部库或内部库。这里的 `${catkin_LIBRARIES}` 包含了编译时需要的所有 ROS 相关的库和依赖项。

```
target_link_libraries(要生成的目标文件 ${catkin_LIBRARIES} )
```

下面是修改后的截图，注意注释中的代码在命名后面都追加了“_node”，为方便实验以及符合前面的命名，这里把“_node”全部进行了删除。否则，在运行的时候节点名称后面要加“_node”。



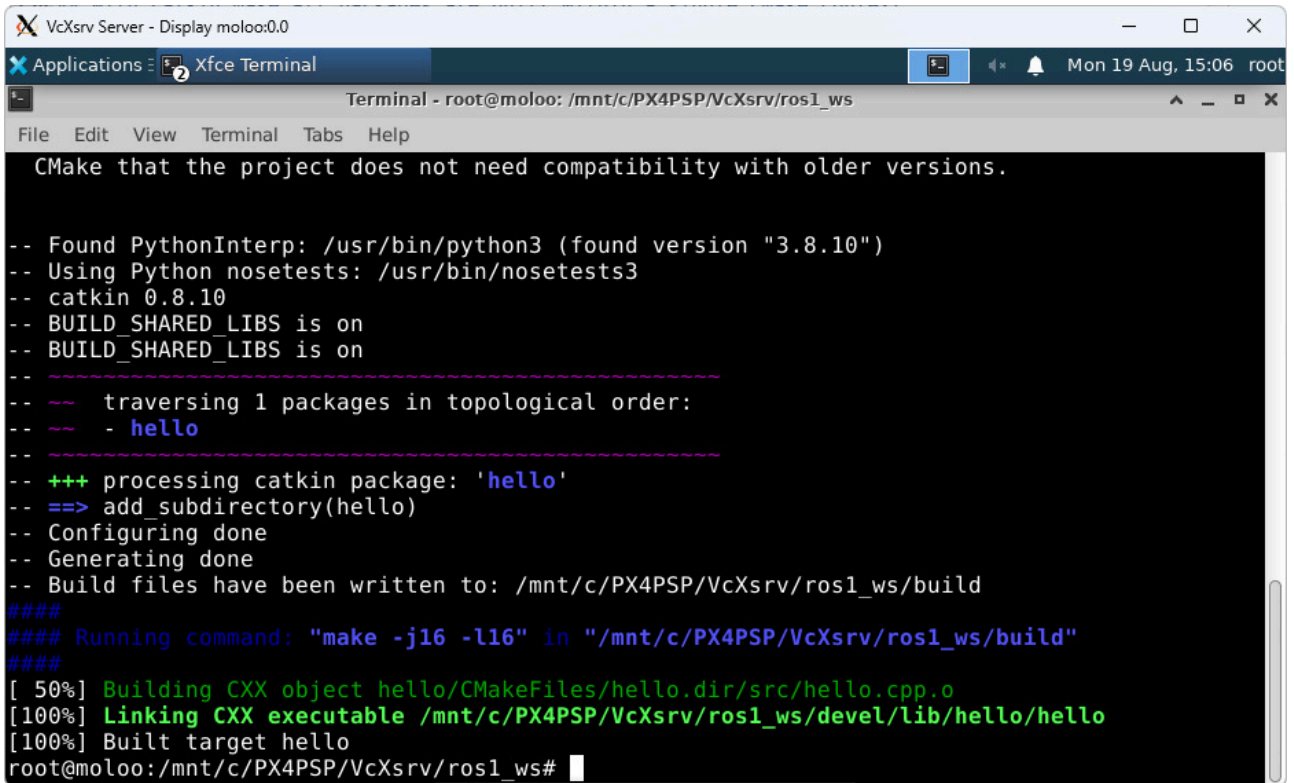
```
134 ## with catkin_make all packages are built within a single CMake context
135 ## The recommended prefix ensures that target names across packages don't collide
136 # add_executable(${PROJECT_NAME}_node src/hello_node.cpp)
137 add_executable(${PROJECT_NAME} src/hello.cpp)
138
139 ## Rename C++ executable without prefix
140 ## The above recommended prefix causes long target names, the following renames the
141 ## target back to the shorter version for ease of user use
142 ## e.g. "roslaunch someones_pkg node" instead of "roslaunch someones_pkg someones_pkg_node"
143 # set_target_properties(${PROJECT_NAME}_node PROPERTIES OUTPUT_NAME node PREFIX "")
144
145 ## Add cmake target dependencies of the executable
146 ## same as for the library above
147 # add_dependencies(${PROJECT_NAME}_node ${${PROJECT_NAME}_EXPORTED_TARGETS} $
  {catkin_EXPORTED_TARGETS})
148
149 ## Specify libraries to link a library or executable target against
150 # target_link_libraries(${PROJECT_NAME}_node
151 #   ${catkin_LIBRARIES}
152 # )
153 target_link_libraries(${PROJECT_NAME}
  ${catkin_LIBRARIES}
154 )
155
156
157 #####
```

修改完成之后 在工作空间下面执行catkin_make 进行编译。

Step7: 编译

修改完成之后 在工作空间下面执行catkin_make 进行编译。下面使用了两次返回上一级路径的命令，是为了回到“ros1_ws”目录下。

```
cd .. cd .. catkin_make
```



```
VcXsrv Server - Display moloo:0.0
Applications: Xfce Terminal
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws
File Edit View Terminal Tabs Help
CMake that the project does not need compatibility with older versions.

-- Found PythonInterp: /usr/bin/python3 (found version "3.8.10")
-- Using Python nosetests: /usr/bin/nosetests3
-- catkin 0.8.10
-- BUILD_SHARED_LIBS is on
-- BUILD_SHARED_LIBS is on
-- ~~~~ traversing 1 packages in topological order:
-- ~~~~ - hello
-- ~~~~
-- +++ processing catkin package: 'hello'
-- ==> add_subdirectory(hello)
-- Configuring done
-- Generating done
-- Build files have been written to: /mnt/c/PX4PSP/VcXsrv/ros1_ws/build
#####
##### Running command: "make -j16 -l16" in "/mnt/c/PX4PSP/VcXsrv/ros1_ws/build"
#####
[ 50%] Building CXX object hello/CMakeFiles/hello.dir/src/hello.cpp.o
[100%] Linking CXX executable /mnt/c/PX4PSP/VcXsrv/ros1_ws/devel/lib/hello/hello
[100%] Built target hello
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws#
```

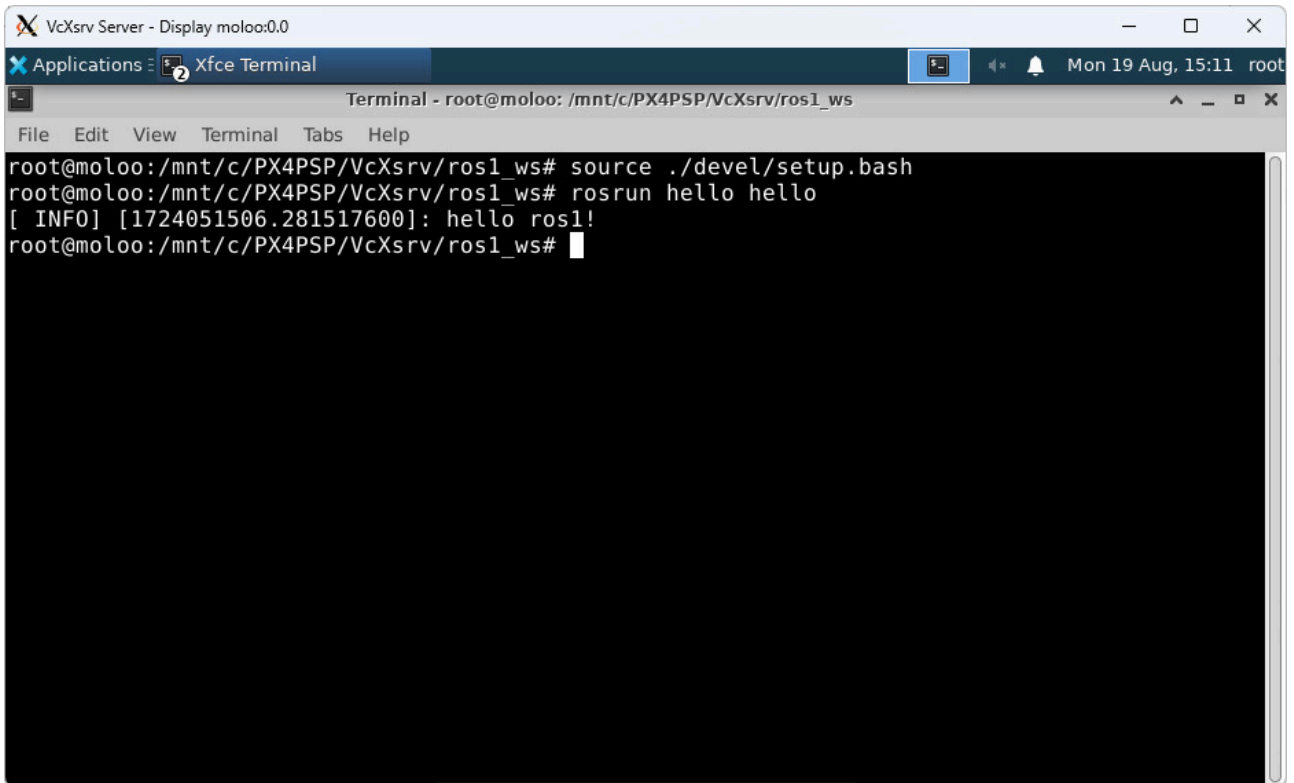
Step8: 执行

下面的命令是通用的运行命令。

```
roscore // 打卡一个新的命令窗口 cd 工作空间 source ./devel/setup.bash rosrn 包名 目标生成的文件
```

根据自定义的命名，上面的代码应该修改为下面的代码。

```
roscore // 打卡一个新的命令窗口 cd ros1_ws source ./devel/setup.bash rosrn hello hello
```

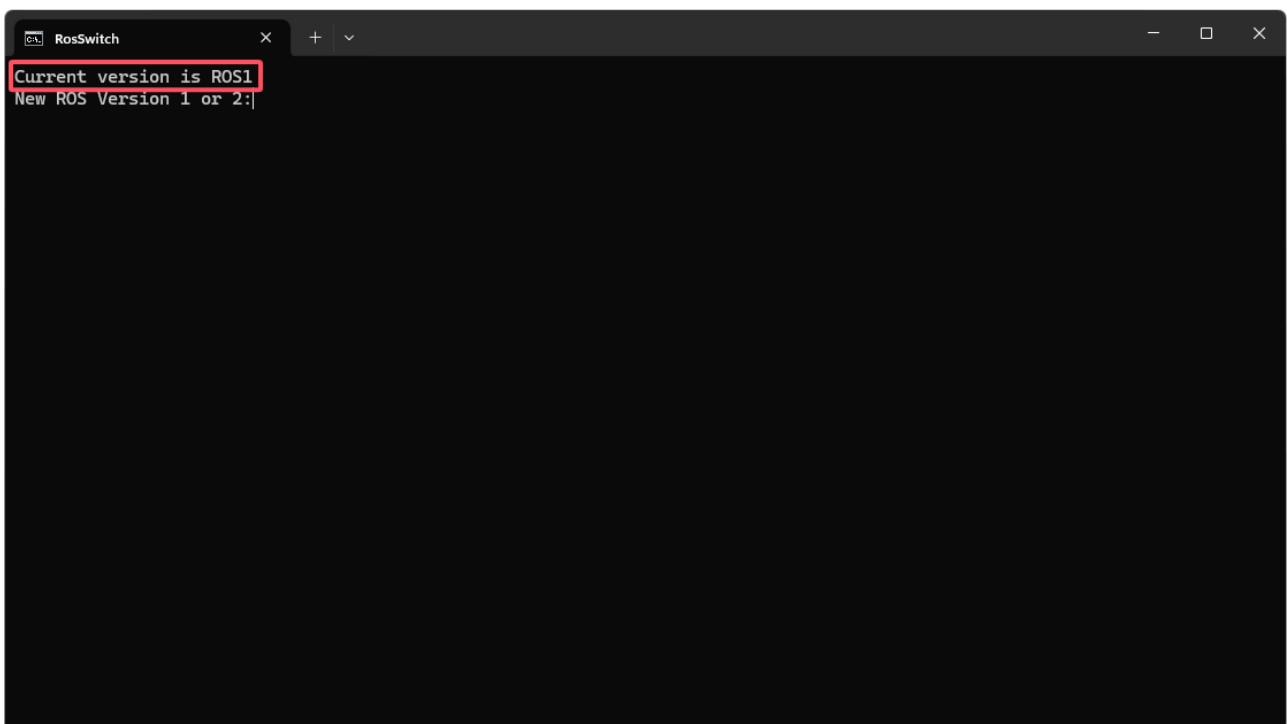


```
VcXsrv Server - Display moloo:0.0
Applications: Xfce Terminal
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws
File Edit View Terminal Tabs Help
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# source ./devel/setup.bash
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# rosrunc hello hello
[ INFO] [1724051506.281517600]: hello ros1!
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws#
```

ROS例程python版 (WinWSL, 必做)

Step1:

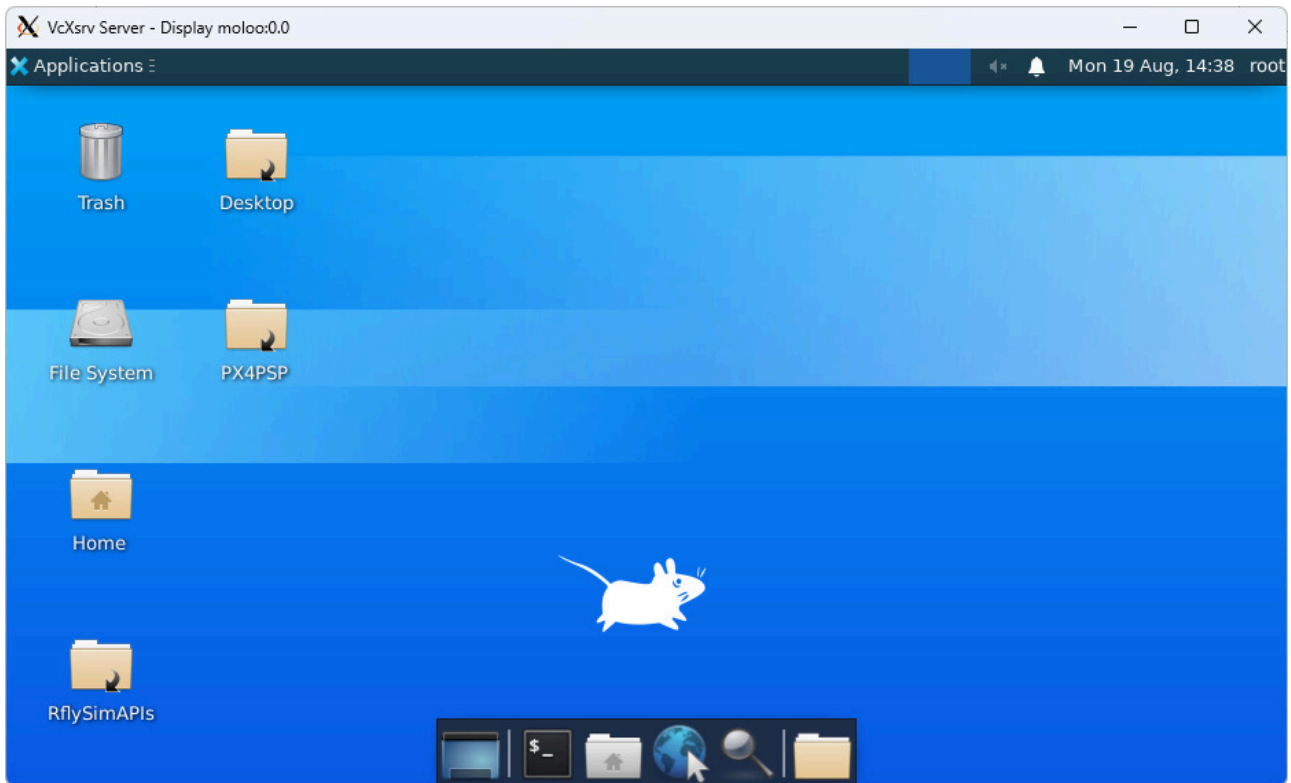
确认环境。打开“桌面\RflyTools\RosSwitch”，查看自己当前的ROS环境。请确认当前环境为ROS1，如果不是ROS1，请输入1并按回车，切换为ROS1环境。



```
RosSwitch
Current version is ROS1
New ROS Version 1 or 2:
```

Step2:

打开“桌面\RflyTools\WslGUI”，为WinWSL的图形化界面。



Step3: 创建工作空间

首先，你需要一个ROS工作空间，在上一节中如果创建了空间则无需继续操作后面的内容。如果你还没有，可以通过以下命令创建一个：

```
source /opt/ros/<ros-version>/setup.bash # <ros-version> 替换为你的ROS版本，如melodic或noetic mkdir -p ~/ros1_ws/src cd ~/ros1_ws/ catkin_make # 或者使用 catkin build，如果你安装了catkin_tools
```

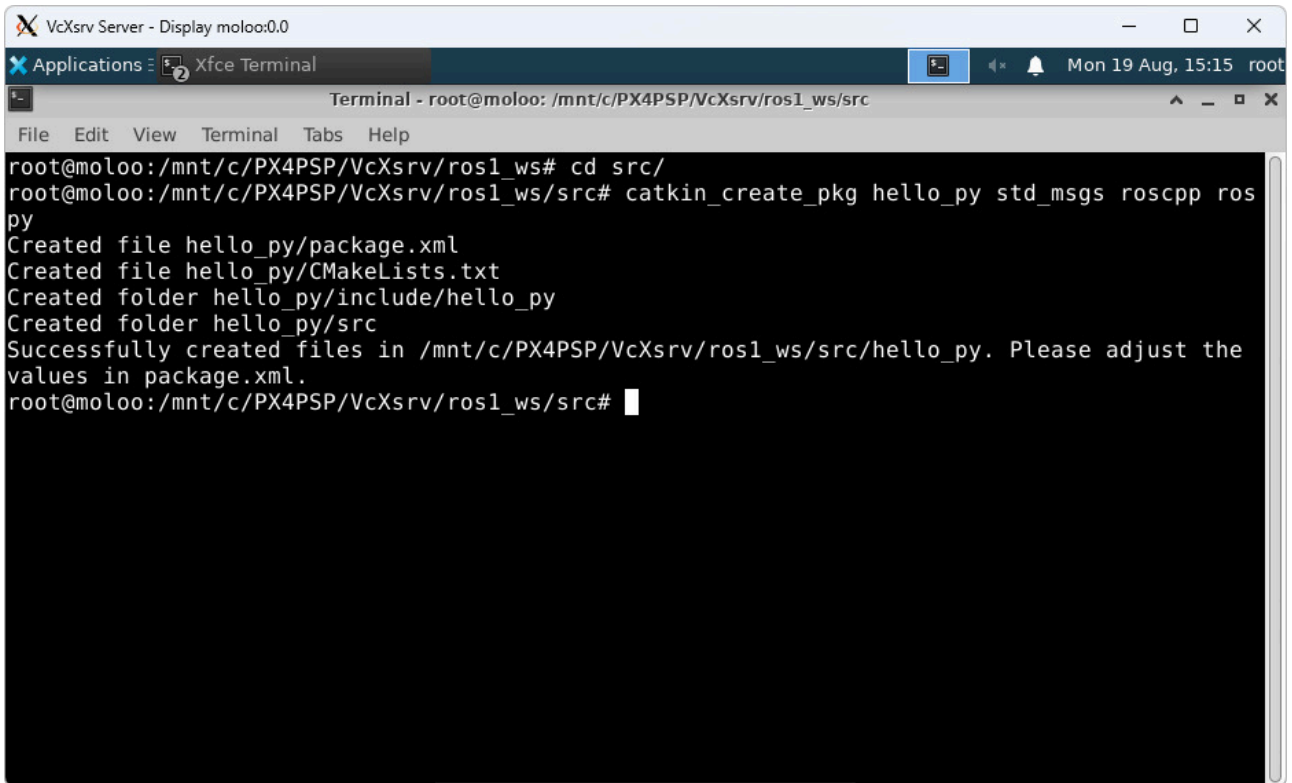
根据平台的版本，上面的代码修改为如下：

```
source /opt/ros/noetic/setup.bash mkdir -p ros1_ws/src cd ros1_ws catkin_make
```

Step4: 创建ROS包

在你的工作空间内创建一个新的ROS包：

```
cd src catkin_create_pkg hello_py std_msgs roscpp rospy
```



```
VcXsrv Server - Display moloo:0.0
Applications: Xfce Terminal
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws/src
File Edit View Terminal Tabs Help
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# cd src/
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src# catkin_create_pkg hello_py std_msgs roscpp ros
py
Created file hello_py/package.xml
Created file hello_py/CMakeLists.txt
Created folder hello_py/include/hello_py
Created folder hello_py/src
Successfully created files in /mnt/c/PX4PSP/VcXsrv/ros1_ws/src/hello_py. Please adjust the
values in package.xml.
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws/src#
```

Step5: 编写Python代码

发布者 (Publisher)

在hello_py/scripts/目录下创建一个名为 [talker.py](#) 的文件 (如果scripts目录不存在, 请创建它), 并添加以下代码:

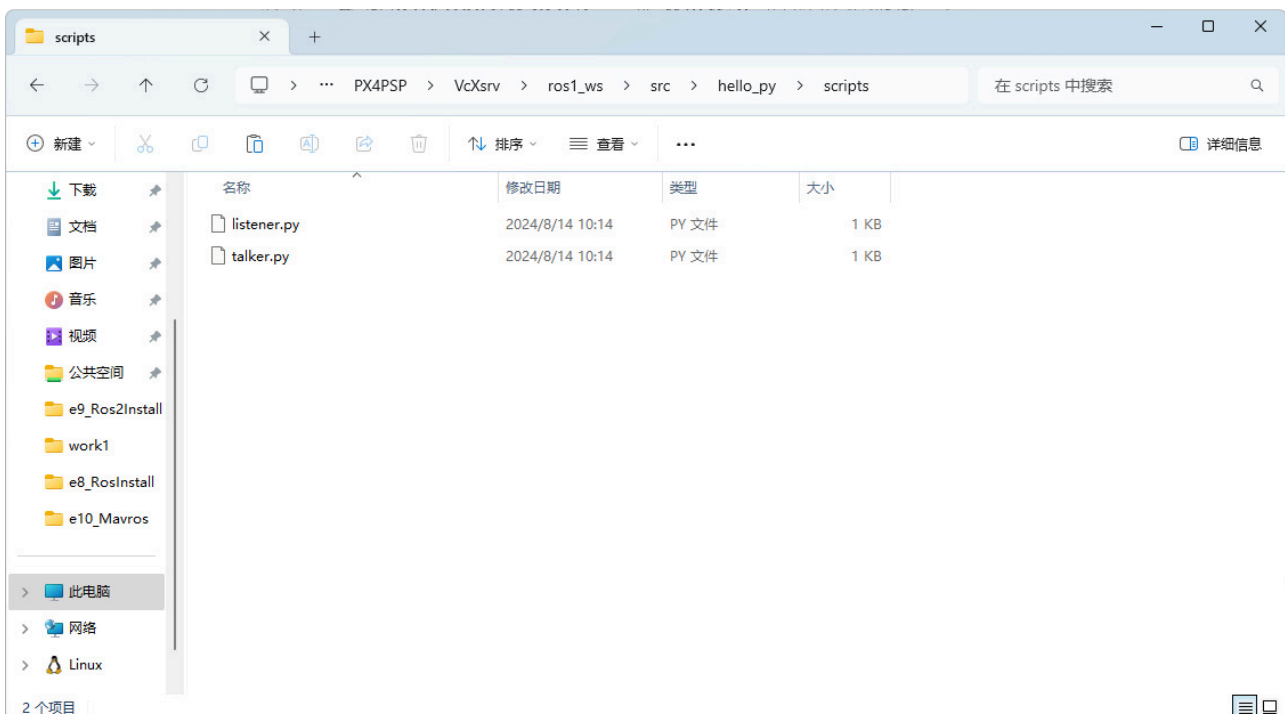
```
#!/usr/bin/env python import rospy from std_msgs.msg import String def talker(): pub = rospy.Publisher('chatter', String, queue_size=10) rospy.init_node('talker', anonymous=True) rate = rospy.Rate(10) # 10hz while not rospy.is_shutdown(): hello_str = "hello world %s" % rospy.get_time() rospy.loginfo(hello_str) pub.publish(hello_str) rate.sleep() if __name__ == '__main__': try: talker() except rospy.ROSInterruptException: pass
```

订阅者 (Subscriber)

在同一个 scripts 目录下, 创建一个名为 [listener.py](#) 的文件, 并添加以下代码:

```
#!/usr/bin/env python import rospy from std_msgs.msg import String def call
back(data): rospy.loginfo(rospy.get_caller_id() + "I heard %s", data.data) def l
istener(): # In ROS, nodes are uniquely named. If two nodes with the same # n
ode are launched, the previous one is kicked off. The # anonymous=True flag
means that rospy will choose a unique # name for our 'listener' node so that m
ultiple listeners can # run simultaneously. rospy.init_node('listener', anonymo
us=True) rospy.Subscriber("chatter", String, callback) # spin() simply keeps py
thon from exiting until this node is stopped rospy.spin() if _name_ == 'main': li
stener()
```

可以使用复制粘贴的方式快速的放入对应的文件夹中，该WinWSL中的目录对应如下图片中的Windows目录：



Step6: 给予脚本执行权限

给这两个Python脚本执行权限：

```
chmod +x talker.py chmod +x listener.py
```

Step7: 编译ROS包（对于Python脚本其实不需要，但确保环境是最新的）

返回工作空间的根目录并编译（尽管对于Python脚本这步不是必需的，但确保环境是最新的）：

```
cd .. cd .. cd .. catkin_make
```

```
VcXsrv Server - Display moloo:0.0
Applications: Xfce Terminal
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws
File Edit View Terminal Tabs Help

-- Found PythonInterp: /usr/bin/python3 (found version "3.8.10")
-- Using Python nosetests: /usr/bin/nosetests3
-- catkin 0.8.10
-- BUILD_SHARED_LIBS is on
-- BUILD_SHARED_LIBS is on
-- ~~~~
-- ~~~ traversing 2 packages in topological order:
-- ~~~ - hello
-- ~~~ - hello_py
-- ~~~~
-- +++ processing catkin package: 'hello'
-- ==> add_subdirectory(hello)
-- +++ processing catkin package: 'hello_py'
-- ==> add_subdirectory(hello_py)
-- Configuring done
-- Generating done
-- Build files have been written to: /mnt/c/PX4PSP/VcXsrv/ros1_ws/build
####
#### Running command: "make -j16 -l16" in "/mnt/c/PX4PSP/VcXsrv/ros1_ws/build"
####
Consolidate compiler generated dependencies of target hello
[100%] Built target hello
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws#
```

Step8: 运行例程

首先，确保ROS核心正在运行：

```
roscore
```

然后，在新的终端窗口中启动发布者：

```
source ./devel/setup.bash rosrund hello_py talker.py
```

```
VcXsrv Server - Display moloo:0.0
Applications: Xfce Terminal
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# source ./devel/setup.bash
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# rosrn hello_py talker.py
[INFO] [1724052119.409818]: hello world 1724052119.409634
[INFO] [1724052119.510132]: hello world 1724052119.5098338
[INFO] [1724052119.610094]: hello world 1724052119.6098
[INFO] [1724052119.710119]: hello world 1724052119.7099469
[INFO] [1724052119.810579]: hello world 1724052119.8102965
[INFO] [1724052119.910204]: hello world 1724052119.9098973
[INFO] [1724052120.010212]: hello world 1724052120.0100634
[INFO] [1724052120.110102]: hello world 1724052120.1098309
[INFO] [1724052120.210283]: hello world 1724052120.2100015
[INFO] [1724052120.310108]: hello world 1724052120.3098056
[INFO] [1724052120.410138]: hello world 1724052120.4098818
[INFO] [1724052120.510422]: hello world 1724052120.5101807
[INFO] [1724052120.610661]: hello world 1724052120.610308
[INFO] [1724052120.710254]: hello world 1724052120.709972
[INFO] [1724052120.810115]: hello world 1724052120.8099675
[INFO] [1724052120.910087]: hello world 1724052120.9099019
[INFO] [1724052121.010375]: hello world 1724052121.0101166
```

在另一个新的终端窗口中启动订阅者：

```
source ./devel/setup.bash rosrn hello_py listener.py
```

```
VcXsrv Server - Display moloo:0.0
Applications: Xfce Terminal
Terminal - root@moloo: /mnt/c/PX4PSP/VcXsrv/ros1_ws
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# source ./devel/setup.bash
root@moloo:/mnt/c/PX4PSP/VcXsrv/ros1_ws# rosrn hello_py listener.py
[INFO] [1724052169.615184]: /listener_2960_1724052169373I heard hello world 1724052169.6097982
[INFO] [1724052169.711598]: /listener_2960_1724052169373I heard hello world 1724052169.7097025
[INFO] [1724052169.812685]: /listener_2960_1724052169373I heard hello world 1724052169.8100252
[INFO] [1724052169.922650]: /listener_2960_1724052169373I heard hello world 1724052169.909621
[INFO] [1724052170.012362]: /listener_2960_1724052169373I heard hello world 1724052170.0097308
[INFO] [1724052170.115657]: /listener_2960_1724052169373I heard hello world 1724052170.1097684
[INFO] [1724052170.216920]: /listener_2960_1724052169373I heard hello world 1724052170.2104318
[INFO] [1724052170.316044]: /listener_2960_1724052169373I heard hello world 1724052170.3098905
[INFO] [1724052170.413607]: /listener_2960_1724052169373I heard hello world 1724052170.409928
[INFO] [1724052170.515959]: /listener_2960_1724052169373I heard hello world 1724052170.5098376
[INFO] [1724052170.616157]: /listener_2960_1724052169373I heard hello world 1724052170.6102347
```

现在你应该会在终端窗口中看到发布者发布的信息和订阅者接收到的消息。如果运行完提示：

```
/usr/bin/env: “python” : 没有那个文件或目录
```

如果是安装的平台提供的虚拟机，所有运行环境应该是，则需要设置一下软连接。

```
# 找Python3.8位置 whereis python3.8 # 配置软连接 cd /usr/bin ln -s /usr/bin/python3.8 python
```

I ROS例程C++版（虚拟机，选做）

ROS中涉及的编程语言以C++和Python为主，实现流程大致如下：

1.先创建一个工作空间；2.再创建一个功能包；3.编辑源文件；4.编辑配置文件；5.编译并执行。

Step1: 创建工作空间并初始化

```
mkdir -p 自定义空间名称/src cd 自定义空间名称 catkin_make
```

例如，这里将自定义空间名称命名为“ros1_ws”，则上面三条命令改入如下：

```
mkdir -p ros1_ws/src cd ros1_ws catkin_make
```

如果 catkin_make 出现未安装的问题，运行下面这条命令就可以解决此类问题。

```
source /opt/ros/<ros-version>/setup.bash
```

其中“<ros-version>”是安装的ros1的版本，例如这里使用的是noetic版本，则命令应该改为：

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

Step2: 创建一个功能包

```
cd src catkin_create_pkg hello roscpp rospy std_msgs
```

自定义ROS包名hello一般是我们要实现的功能包的名字

此步骤成功之后，会出现src和include文件目录。接下来在hello/src实现我们的功能—添加文件hello.cpp。

Step3: 编辑源文件

首先要创建一个文件。

```
cd hello/src touch hello.cpp
```

然后使用gedit将下面的代码写入进去。

```
#include "ros/ros.h" int main(int argc, char *argv[]) { //执行 ros 节点初始化 ros::  
init(argc,argv,"hello"); //创建 ros 节点句柄(非必须) ros::NodeHandle n; ROS_INF  
O("hello ros1!"); return 0; }
```

Step4: 编辑配置文件

在功能包hello的目录下的CmakeLists.txt文件中修改配置信息。

```
cd .. gedit CmakeLists.txt
```

下面的代码都可以从注释中复制得到。下面这部分代码是告诉CMake哪些源文件应该编译并链接在一起生成一个可执行文件。

```
add_executable(要生成的目标文件 src/源文件.cpp )
```

下面这部分代码是 CMake

中的一个指令，用于指定一个目标（例如一个可执行文件或库）需要链接的外部库或内部库。这里的

`${catkin_LIBRARIES}` 包含了编译时需要的所有 ROS 相关的库和依赖项。

```
target_link_libraries(要生成的目标文件 ${catkin_LIBRARIES} )
```

下面是修改后的截图，注意注释中的代码在命名后面都追加了“_node”，为方便实验以及符合前面的命名，这里把“_node”全部进行了删除。

```
133 ## Declare a C++ executable
134 ## With catkin_make all packages are built within a single CMake context
135 ## The recommended prefix ensures that target names across packages don't
    collide
136 # add_executable(${PROJECT_NAME}_node src/hello_node.cpp)
137 add_executable(${PROJECT_NAME} src/hello.cpp)
138
139 ## Rename C++ executable without prefix
140 ## The above recommended prefix causes long target names, the following renames
    the
141 ## target back to the shorter version for ease of user use
142 ## e.g. "roslaunch someones_pkg node" instead of "roslaunch someones_pkg
    someones_pkg_node"
143 # set_target_properties(${PROJECT_NAME}_node PROPERTIES OUTPUT_NAME node PREFIX
    "")
144
145 ## Add cmake target dependencies of the executable
146 ## same as for the library above
147 # add_dependencies(${PROJECT_NAME}_node ${${PROJECT_NAME}_EXPORTED_TARGETS} $
    {catkin_EXPORTED_TARGETS})
148
149 ## Specify libraries to link a library or executable target against
150 # target_link_libraries(${PROJECT_NAME}_node
151 #   ${catkin_LIBRARIES}
152 # )
153 target_link_libraries(${PROJECT_NAME}
154   ${catkin_LIBRARIES}
155 )
156
```

修改完成之后 在工作空间下面执行catkin_make 进行编译

Step6: 编译

修改完成之后 在工作空间下面执行catkin_make

进行编译。下面使用了两次返回上一级路径的命令，是为了回到“ros1_ws”目录下。

```
cd .. cd .. catkin_make
```

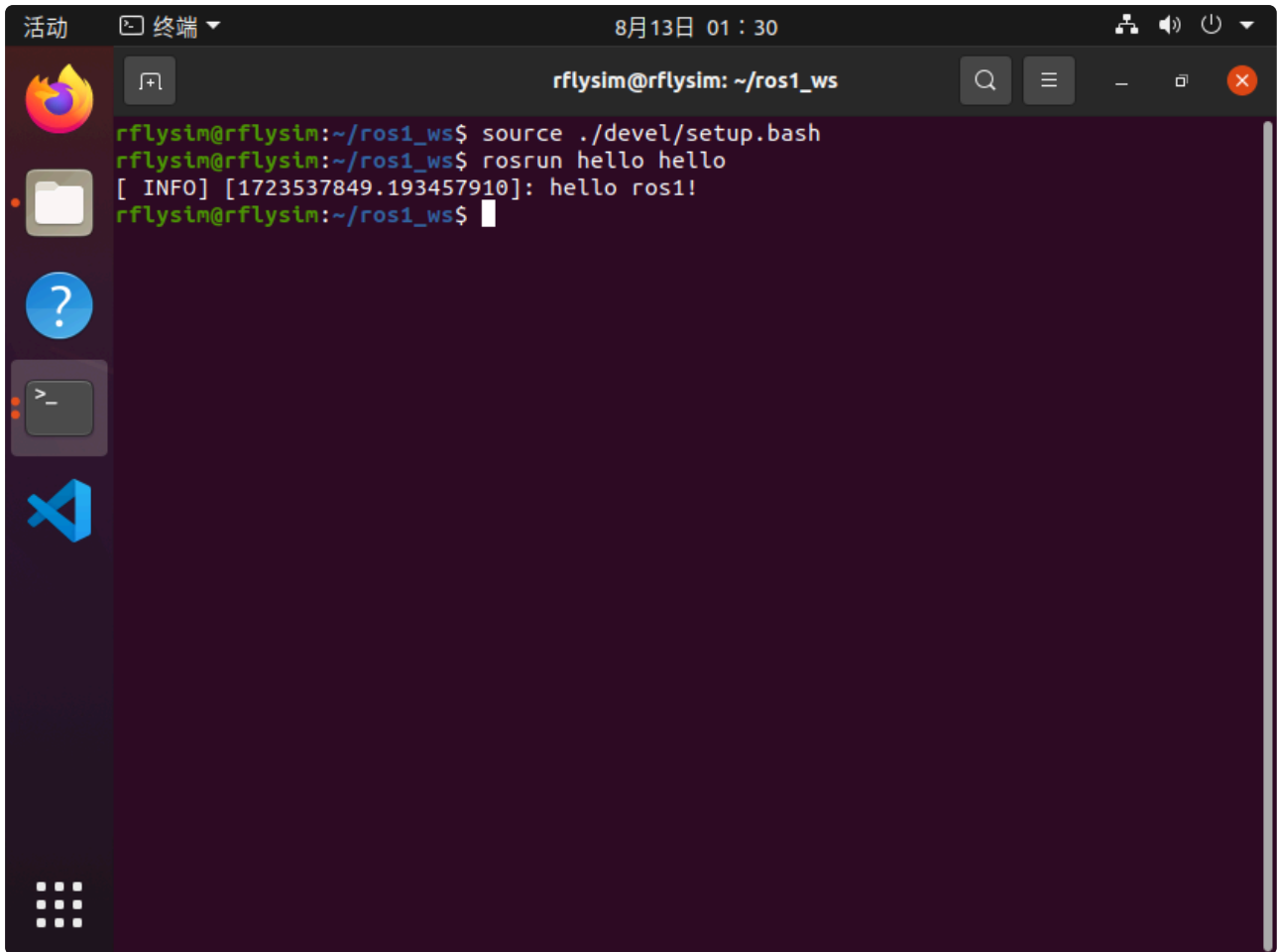
Step7: 执行

下面的命令是通用的运行命令。

```
roscore cd 工作空间 source ./devel/setup.bash roslaunch 包名 目标生成的文件
```

根据自定义的命名，上面的代码应该修改为下面的代码。

```
roscore cd ros1_ws source ./devel/setup.bash roslaunch hello hello
```

A terminal window titled 'rflysim@rflysim: ~/ros1_ws' with a dark background. The terminal shows the following commands and output:

```
rflysim@rflysim:~/ros1_ws$ source ./devel/setup.bash
rflysim@rflysim:~/ros1_ws$ rosruntime hello hello
[ INFO] [1723537849.193457910]: hello ros1!
rflysim@rflysim:~/ros1_ws$
```

The terminal window includes a sidebar with icons for Firefox, a folder, a question mark, a terminal, and VS Code. The top bar shows system icons and the date '8月13日 01:30'.

ROS例程python版（虚拟机，选做）

Step1: 创建工作空间

首先，你需要一个ROS工作空间，在上一节中如果创建了空间则无需继续操作后面的内容。如果你还没有，可以通过以下命令创建一个：

```
source /opt/ros/<ros-version>/setup.bash # <ros-version> 替换为你的ROS版本，如melodic或noetic
mkdir -p ~/ros1_ws/src cd ~/ros1_ws/ catkin_make # 或者使用 catkin build，如果你安装了catkin_tools
```

根据平台的版本，上面的代码修改为如下：

```
source /opt/ros/noetic/setup.bash mkdir -p ros1_ws/src cd ros1_ws catkin_make
```

Step2: 创建ROS包

在你的工作空间内创建一个新的ROS包：

```
cd src catkin_create_pkg hello_py std_msgs roscpp rospy
```

Step3: 编写Python代码

发布者 (Publisher)

在hello_py/scripts/目录下创建一个名为 `talker.py` 的文件 (如果scripts目录不存在, 请创建它), 并添加以下代码:

```
#!/usr/bin/env python import rospy from std_msgs.msg import String def talker(): pub = rospy.Publisher('chatter', String, queue_size=10) rospy.init_node('talker', anonymous=True) rate = rospy.Rate(10) # 10hz while not rospy.is_shutdown(): hello_str = "hello world %s" % rospy.get_time() rospy.loginfo(hello_str) pub.publish(hello_str) rate.sleep() if __name__ == '__main__': try: talker() except rospy.ROSInterruptException: pass
```

订阅者 (Subscriber)

在同一个 scripts 目录下, 创建一个名为 `listener.py` 的文件, 并添加以下代码:

```
#!/usr/bin/env python import rospy from std_msgs.msg import String def callback(data): rospy.loginfo(rospy.get_caller_id() + "I heard %s", data.data) def listener(): # In ROS, nodes are uniquely named. If two nodes with the same # name are launched, the previous one is kicked off. The # anonymous=True flag means that rospy will choose a unique # name for our 'listener' node so that multiple listeners can # run simultaneously. rospy.init_node('listener', anonymous=True) rospy.Subscriber("chatter", String, callback) # spin() simply keeps python from exiting until this node is stopped rospy.spin() if __name__ == '__main__': listener()
```

Step4: 给予脚本执行权限

给这两个Python脚本执行权限:

```
chmod +x talker.py chmod +x listener.py
```

Step5: 编译ROS包 (对于Python脚本其实不需要, 但确保环境是最新的)

返回工作空间的根目录并编译 (尽管对于Python脚本这步不是必需的, 但确保环境是最新的):

```
cd .. cd .. cd .. catkin_make
```

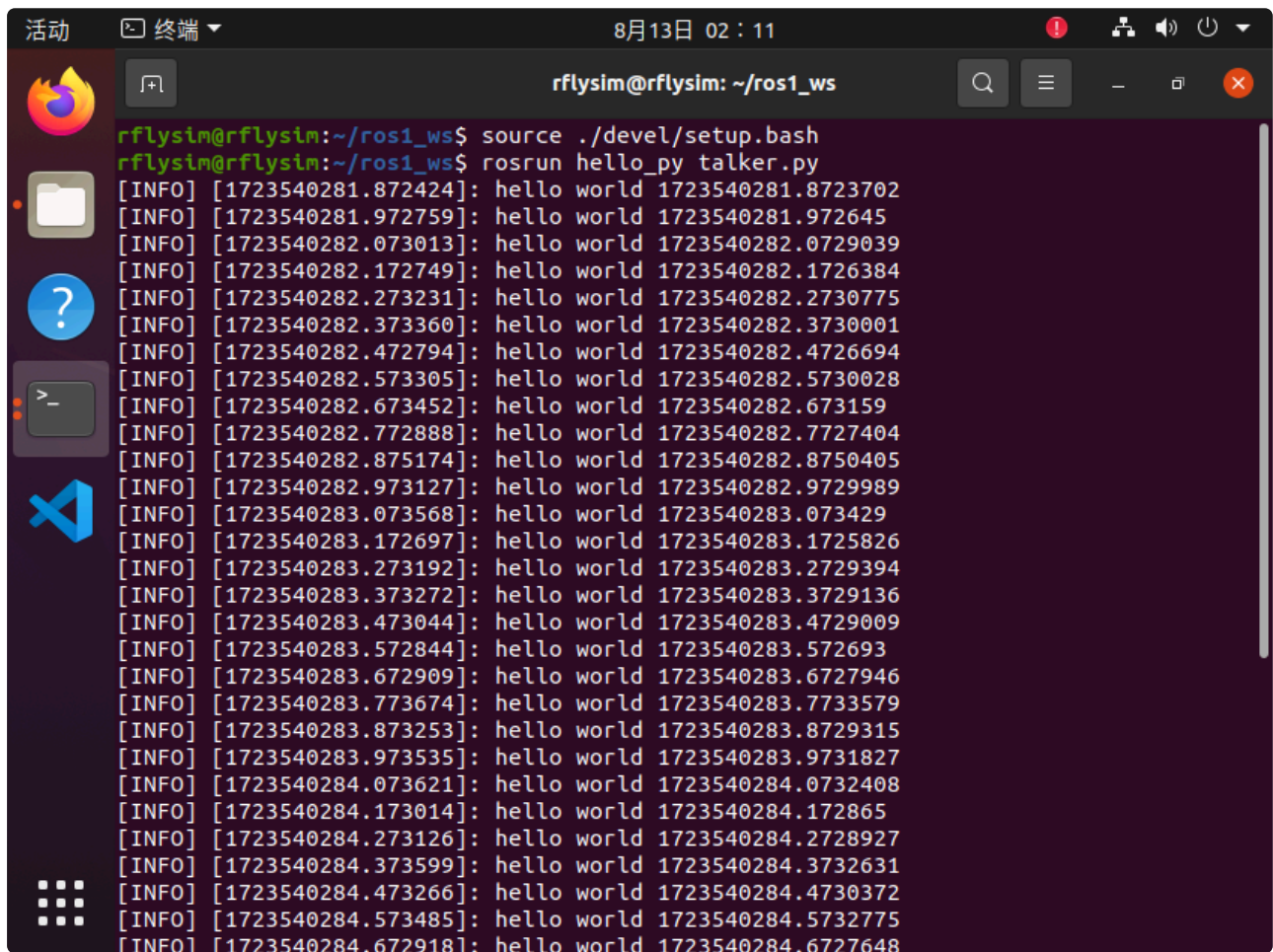
Step5: 运行例程

首先，确保ROS核心正在运行：

```
roscore
```

然后，在新的终端窗口中启动发布者：

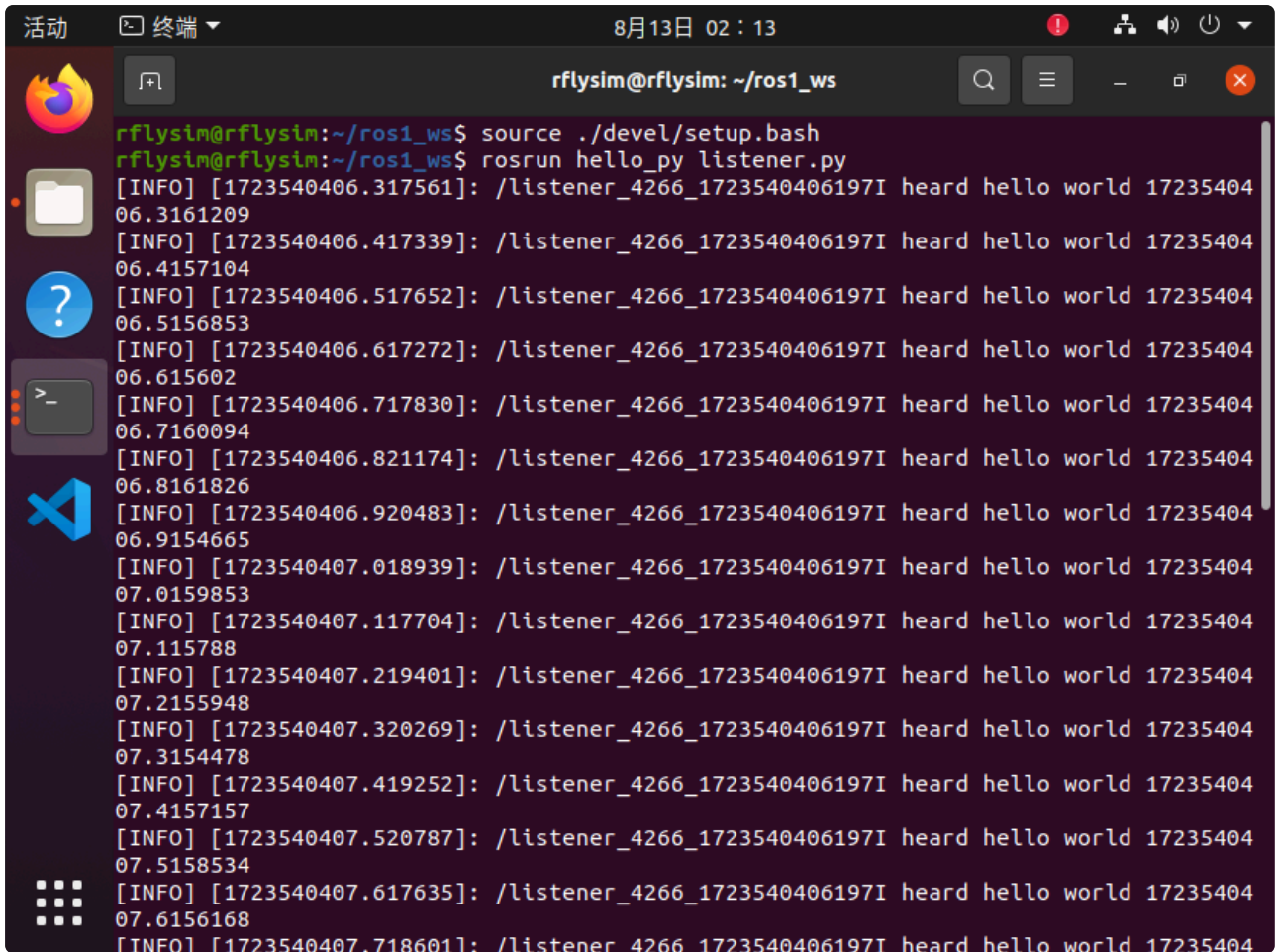
```
source ./devel/setup.bash rosrun hello_py talker.py
```

A terminal window titled 'rflaysim@rflaysim: ~/ros1_ws' with a timestamp of '8月13日 02:11'. The terminal shows the execution of 'source ./devel/setup.bash' and 'rosrun hello_py talker.py'. The output consists of 20 lines of log messages, each starting with '[INFO]' and containing a unique IP address followed by 'hello world' and another IP address. The terminal window includes standard Linux window controls and a sidebar with application icons like Firefox, Files, and VS Code.

```
rflaysim@rflaysim:~/ros1_ws$ source ./devel/setup.bash
rflaysim@rflaysim:~/ros1_ws$ rosrun hello_py talker.py
[INFO] [1723540281.872424]: hello world 1723540281.8723702
[INFO] [1723540281.972759]: hello world 1723540281.972645
[INFO] [1723540282.073013]: hello world 1723540282.0729039
[INFO] [1723540282.172749]: hello world 1723540282.1726384
[INFO] [1723540282.273231]: hello world 1723540282.2730775
[INFO] [1723540282.373360]: hello world 1723540282.3730001
[INFO] [1723540282.472794]: hello world 1723540282.4726694
[INFO] [1723540282.573305]: hello world 1723540282.5730028
[INFO] [1723540282.673452]: hello world 1723540282.673159
[INFO] [1723540282.772888]: hello world 1723540282.7727404
[INFO] [1723540282.875174]: hello world 1723540282.8750405
[INFO] [1723540282.973127]: hello world 1723540282.9729989
[INFO] [1723540283.073568]: hello world 1723540283.073429
[INFO] [1723540283.172697]: hello world 1723540283.1725826
[INFO] [1723540283.273192]: hello world 1723540283.2729394
[INFO] [1723540283.373272]: hello world 1723540283.3729136
[INFO] [1723540283.473044]: hello world 1723540283.4729009
[INFO] [1723540283.572844]: hello world 1723540283.572693
[INFO] [1723540283.672909]: hello world 1723540283.6727946
[INFO] [1723540283.773674]: hello world 1723540283.7733579
[INFO] [1723540283.873253]: hello world 1723540283.8729315
[INFO] [1723540283.973535]: hello world 1723540283.9731827
[INFO] [1723540284.073621]: hello world 1723540284.0732408
[INFO] [1723540284.173014]: hello world 1723540284.172865
[INFO] [1723540284.273126]: hello world 1723540284.2728927
[INFO] [1723540284.373599]: hello world 1723540284.3732631
[INFO] [1723540284.473266]: hello world 1723540284.4730372
[INFO] [1723540284.573485]: hello world 1723540284.5732775
[INFO] [1723540284.672918]: hello world 1723540284.6727648
```

在另一个新的终端窗口中启动订阅者：

```
source ./devel/setup.bash rosrun hello_py listener.py
```

A terminal window titled 'rflysim@rflysim: ~/ros1_ws' showing the execution of a ROS launch file. The user runs 'source ./devel/setup.bash' and 'roslaunch hello_py listener.py'. The output consists of a series of INFO messages from the 'listener' node, each reporting 'heard hello world' with a unique timestamp. The messages are: [INFO] [1723540406.317561]: /listener_4266_1723540406197I heard hello world 1723540406.3161209, [INFO] [1723540406.417339]: /listener_4266_1723540406197I heard hello world 1723540406.4157104, [INFO] [1723540406.517652]: /listener_4266_1723540406197I heard hello world 1723540406.5156853, [INFO] [1723540406.617272]: /listener_4266_1723540406197I heard hello world 1723540406.615602, [INFO] [1723540406.717830]: /listener_4266_1723540406197I heard hello world 1723540406.7160094, [INFO] [1723540406.821174]: /listener_4266_1723540406197I heard hello world 1723540406.8161826, [INFO] [1723540406.920483]: /listener_4266_1723540406197I heard hello world 1723540406.9154665, [INFO] [1723540407.018939]: /listener_4266_1723540406197I heard hello world 1723540407.0159853, [INFO] [1723540407.117704]: /listener_4266_1723540406197I heard hello world 1723540407.115788, [INFO] [1723540407.219401]: /listener_4266_1723540406197I heard hello world 1723540407.2155948, [INFO] [1723540407.320269]: /listener_4266_1723540406197I heard hello world 1723540407.3154478, [INFO] [1723540407.419252]: /listener_4266_1723540406197I heard hello world 1723540407.4157157, [INFO] [1723540407.520787]: /listener_4266_1723540406197I heard hello world 1723540407.5158534, [INFO] [1723540407.617635]: /listener_4266_1723540406197I heard hello world 1723540407.6156168, [INFO] [1723540407.718601]: /listener_4266_1723540406197I heard hello world 1723540407.7186011.

现在你应该会在终端窗口中看到发布者发布的信息和订阅者接收到的消息。如果运行完提示：

```
/usr/bin/env: “python” : 没有那个文件或目录
```

如果是安装的平台提供的虚拟机，所有运行环境应该是，则需要设置一下软连接。

```
# 找Python3.8位置 whereis python3.8 # 配置软连接 cd /usr/bin ln -s /usr/bin/python3.8 python
```

ROS学习

ROS1 (Robot Operating System

1) 的学习网站众多，以下是一些推荐的学习资源，包括官方网站、教程、社区和博客等，它们为初学者和进阶用户提供了丰富的学习内容：

ROS官方Wiki：

地址：<https://wiki.ros.org/cn/ROS/>

描述：ROS的官方Wiki是学习和访问ROS进程的主要网站，它包含了大量的教程文档和资源链接。

创客制造：

地址：<https://www.ncnynl.com/>

描述：这是一个针对初学者的官网，提供了ROS+Ubuntu集成版，方便初学者直接使用。

大学生MOOC：

地址：<https://www.icourse163.org/>

描述：这是一个在线教育平台，用户可以在上面找到ROS相关的视频课程进行学习。

ROS问答社区：

地址：<https://answers.ros.org/questions/>

描述：ROS的问答社区，用户可以在这里提问和回答关于ROS的问题。

博客专栏：

地址：如https://blog.csdn.net/zhangrelay/category_9267010.html

描述：一些专业的博客专栏，如张瑞雷ZhangRelay老师的博客，提供了关于ROS的深入教程和案例分析。

官方文档和示例：

描述：ROS的官方文档和示例代码也是学习ROS的重要资源，它们提供了详细的API说明和使用示例。

在学习ROS时，建议从官方Wiki开始，了解ROS的基本概念和架构，然后通过上述网站和社区进一步深入学习。同时，也可以参考一些具体的项目案例，通过实践来加深理解和掌握。

6. 参考资料

1. 无。

7. 常见问题

Q:在进行ROS环境部署失败?

N:检查网络是否正常，在可能的情况下，尝试使用代理再次运行。