

로보티즈 터틀봇3 e-매뉴얼

<https://emanual.robotis.com/docs/en/platform/turtlebot3/overview/>

ros 튜토리얼

<https://docs.ros.org/en/dashing/Installation.html>

[우분투 리눅스 환경설정]

<https://ubuntu.com/>

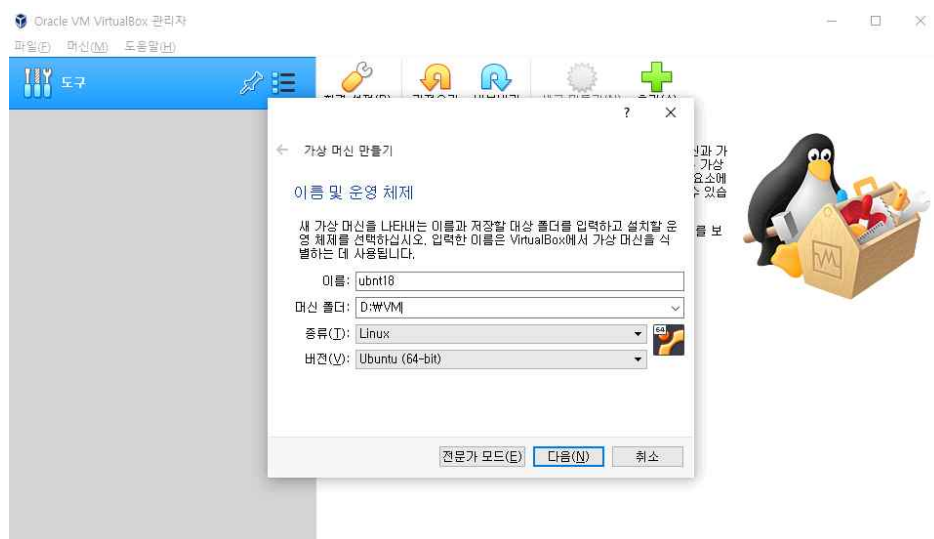
The screenshot shows the Ubuntu website. At the top, there's a navigation bar with 'ubuntu' logo and links for Enterprise, Developer, Community, and Download. A search bar is highlighted with a red box, containing the text 'ubuntu 18'. Below the search bar, the search results for 'ubuntu 18' are displayed. The first result is 'Ubuntu 18.04.5 LTS (Bionic Beaver)'. To the right, there's a large orange banner for 'Ubuntu 18.04.5 LTS (Bionic Beaver)'. Below the banner, there's a section titled 'Select an image' with a sub-header 'Ubuntu is distributed on three types of images described below.' Under this section, there are three boxes: 'Desktop image', '64-bit PC (AMD64) desktop image' (highlighted with a red box), and 'ARM64 desktop image'. The '64-bit PC (AMD64) desktop image' box contains text about choosing this image for AMD64 or EM64T architecture.

<https://www.virtualbox.org/wiki/Downloads>

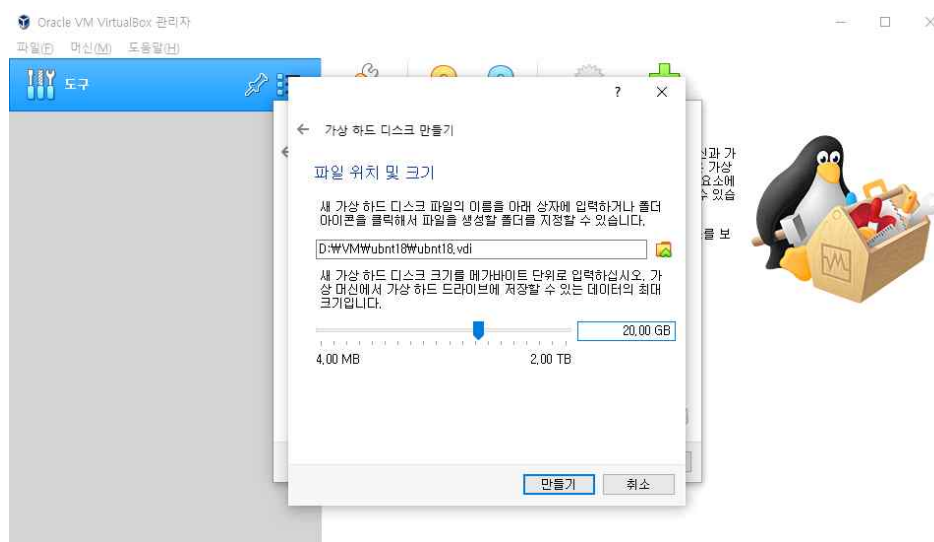
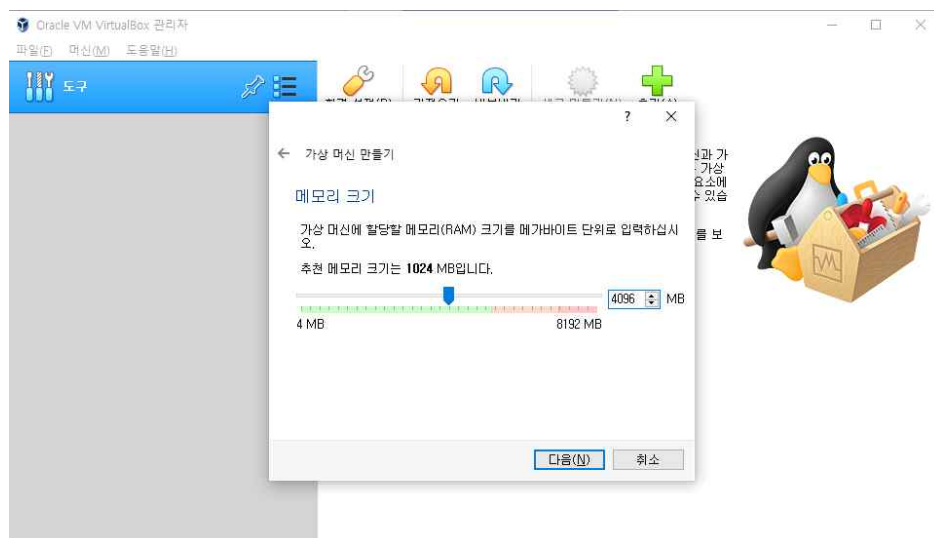
The screenshot shows the VirtualBox website. At the top, there's a navigation bar with 'virtualbox.org/wiki/Downloads' and links for About, Screenshots, Downloads (highlighted with a red box), Documentation, End-user docs, Technical docs, Contribute, and Community. Below the navigation bar, there's a large banner for 'VirtualBox Download VirtualBox'. To the left of the banner, there's a sidebar with the same navigation links. The main content area has a heading 'VirtualBox binaries' and text about downloading and agreeing to terms. It also mentions 'VirtualBox 6.0 builds' and 'VirtualBox 5.2 builds'. Below this, there's a section titled 'VirtualBox 6.1.22 platform packages' with a list of links: 'Windows hosts' (highlighted with a red box), 'OS X hosts', 'Linux distributions', 'Solaris hosts', and 'Solaris 11 IPS hosts'. At the bottom, there's text about the binaries being released under the terms of the GPL version 2 and a link to the changelog.

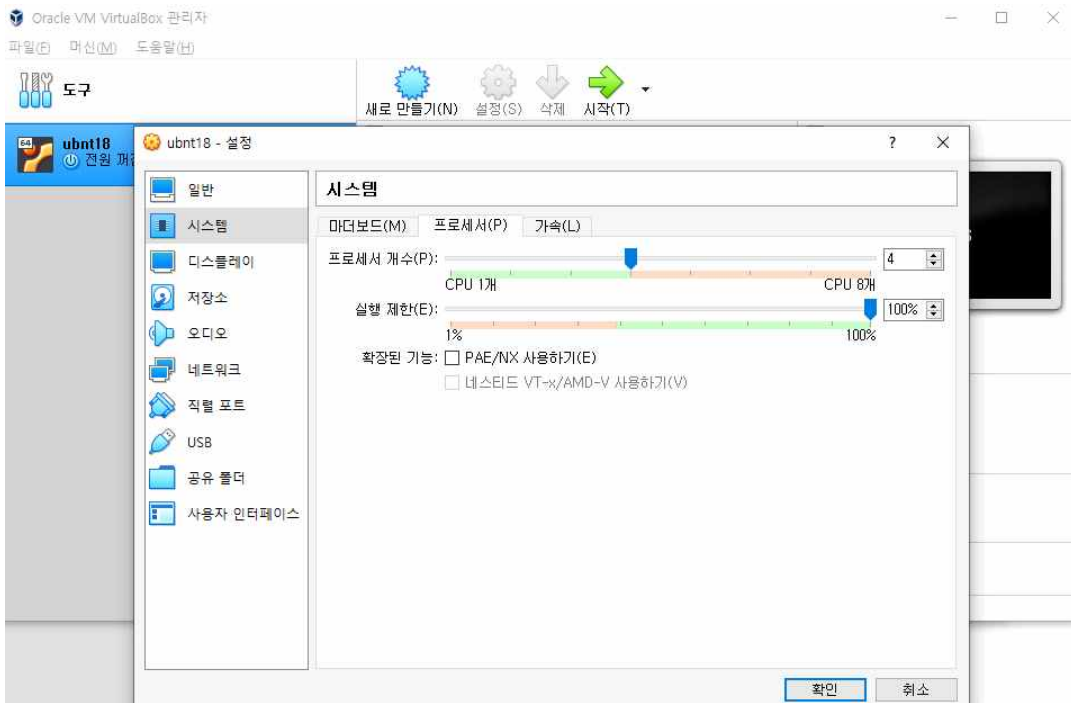
next next next yes ...

# [ Virtual Box ]

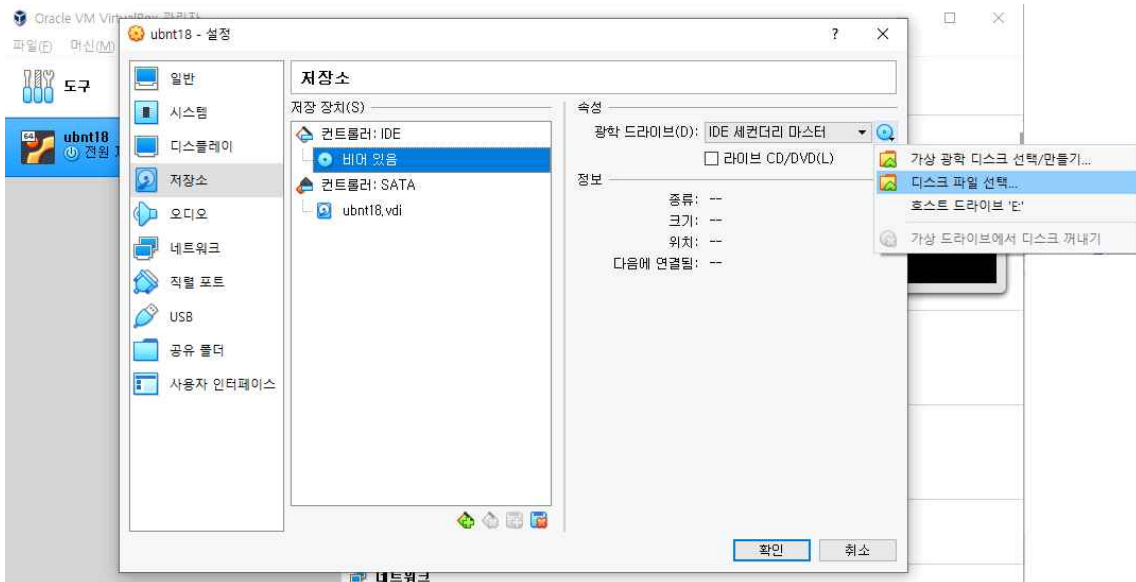


ubnt18, D:\VM





설정 - 시스템 - 프로세서 - 프로세서 개수 4개



설정 - 저장소 - 비어있음 - cd모양 - 디스크파일선택 - 우분투

D:\VM 폴더 하나 만들고 지정

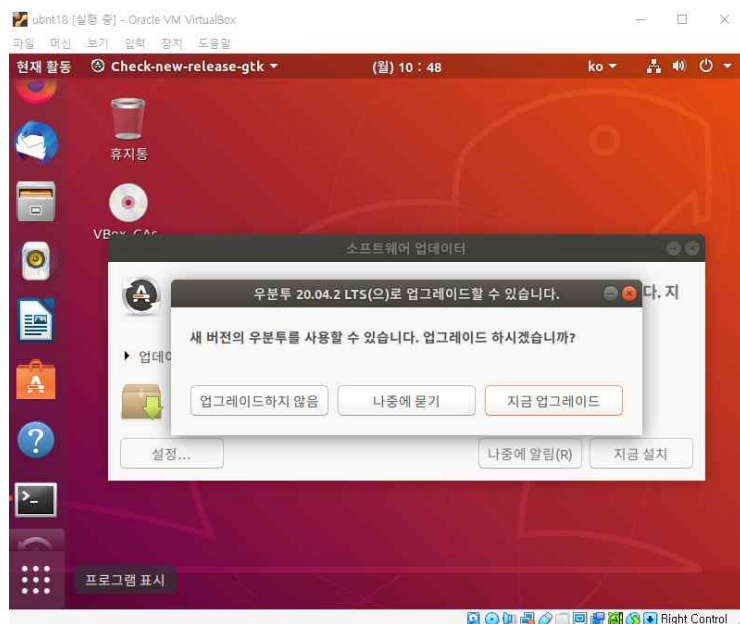


## 시작

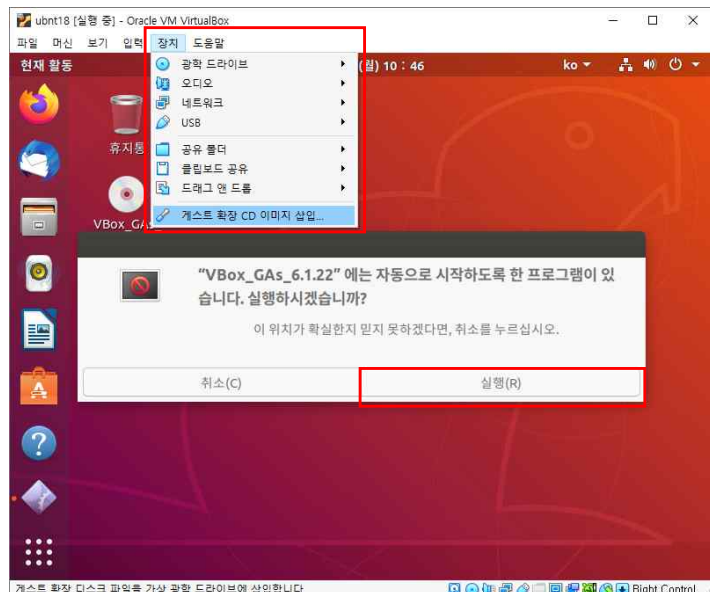


이름	phil (다르게 주기,,, 길게 주지말기)
컴퓨터이름	phil-VM
사용자이름선택	phil
암호	1q2w3e

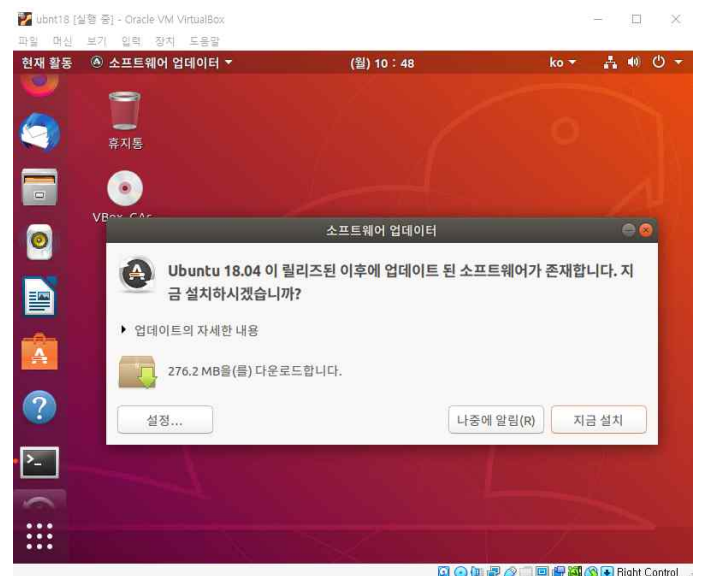
설치 후, 시스템 다시 시작버튼... >> enter



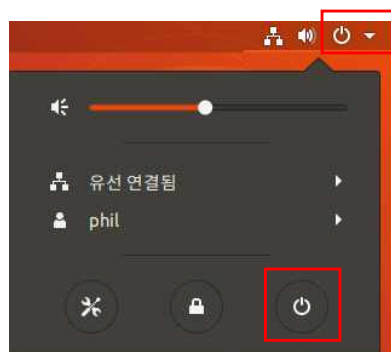
업그레이드 하지않기



장치 - 게스트 확장 CD 이미지 삽입.. >> 실행

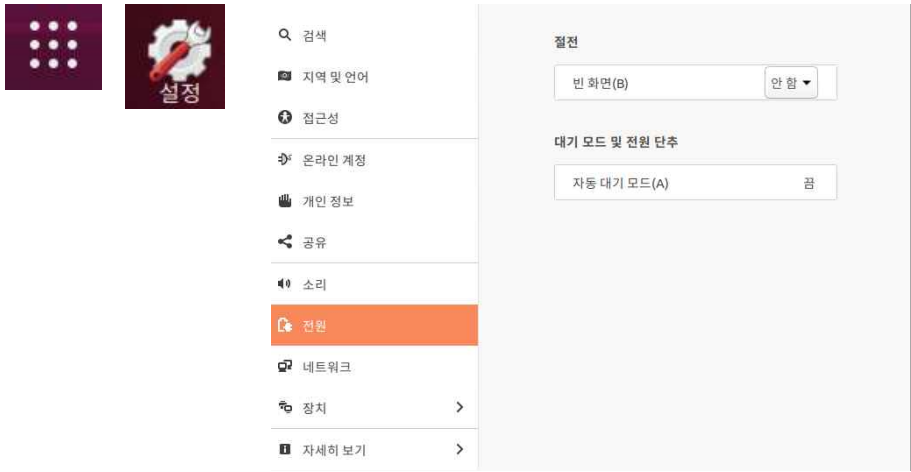


지금설치 >> 다시 시작

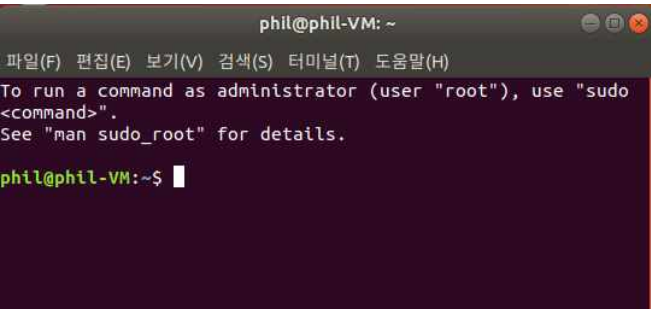


화면 오른쪽 위 전원버튼 - 다시 시작

보기 - 전체화면. (화면아래로 마우스 내리면 다시 원래대로 돌아갈 수 있음)



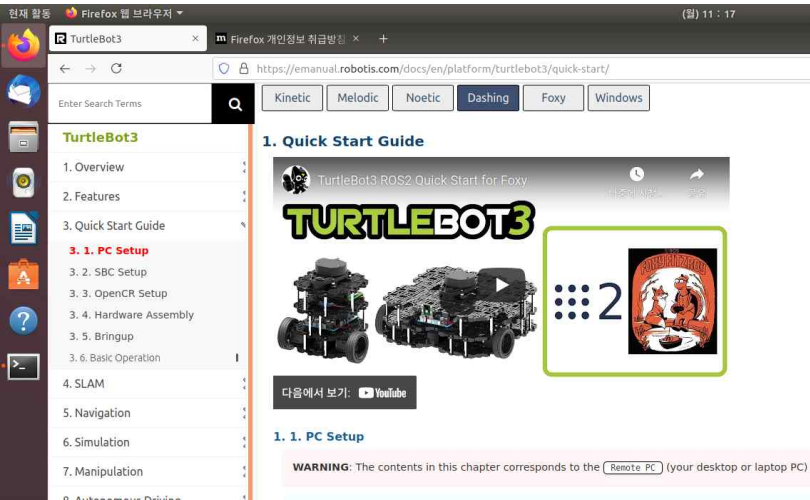
(화면보호기 끄기)  
 프로그램표시 - 설정 - 전원 - 절전 - 안함



Ctrl + Alt + T (터미널창)

whoami ↵ # phil  
 pwd ↵ # /home/phil # print working directory  
 ls ↵ # examples.desktop 공개 다운로드 ....

파이어폭스 실행 - google.com - robotis turtlebot3 emanual  
 Quick Start Guide - Dashing





### 1. 1. 2. Install ROS 2 on Remote PC

3.1.2

Open the terminal with `Ctrl` + `Alt` + `T` and enter below commands one at a time.  
In order to check the details of the easy installation script, please refer to [the script file](#).

```
$ sudo apt-get update
$ sudo apt-get upgrade
$ wget https://raw.githubusercontent.com/ROBOTIS-GIT/robotis_tools/master/install_ros2_dashing.sh
$ chmod 755 ./install_ros2_dashing.sh
$ bash ./install_ros2_dashing.sh
```

명령어 복사(마우스 오른쪽버튼-복사)한 후,  
터미널창에서 붙여넣기 ( `Ctrl+Shift+V` (붙여넣기))

sudo	superuser do	관리자권한 실행
apt-get	devian리눅스의 패키지 설치할 때 사용	
update	업그레이드 할 항목이 있는지 확인	

.sh                셸스크립트 파일 - 로보티즈에서 로스2를 위해 만들어놓음.,

ls -al            자세히 보기

d rwx	directory, read-write-execute
rwX/rwx/rwx	소유자, 그룹, 다른사용자

chmod            change mode

```
-rwxr-xr-x  1 phil phil 2323  6월 28 11:30 install_ros2_dashing.sh
```

install >> enter >> 암호 >> 암호

### 1. 1. 3. Install Dependent ROS 2 Packages

3.1.3 임...

1. Open the terminal with `Ctrl` + `Alt` + `T` from **Remote PC**.
2. Install Colcon

```
$ sudo apt install python3-colcon-common-extensions
```

colcon : 빌드

3. Install Gazebo9

```
$ curl -sSL http://get.gazebosim.org | sh
```

3D 시뮬레이션 툴

4. Uninstall Gazebo11 if installed previously

```
$ sudo apt remove gazebo11 libgazebo11-dev
$ sudo apt install gazebo9 libgazebo9-dev
$ sudo apt install ros-dashing-gazebo-ros-pkgs
```

4번 실행하지않기

5. Install Cartographer

```
$ sudo apt install ros-dashing-cartographer
$ sudo apt install ros-dashing-cartographer-ros
```

6. Install Navigation2

```
$ sudo apt install ros-dashing-navigation2
$ sudo apt install ros-dashing-nav2-bringup
```

7. Install vcstool

```
$ sudo apt install python3-vcstool
```

### 1. 1. 4. Install TurtleBot3 Packages

3.1.4

Install TurtleBot3 via Debian Packages.

```
$ source /opt/ros/dashing/setup.bash
$ sudo apt install ros-dashing-dynamixel-sdk
$ sudo apt install ros-dashing-turtlebot3-msgs
$ sudo apt install ros-dashing-turtlebot3
```

코드 복사 -> 터미널에서 실행

### 1. 1. 5. Environment Configuration

3.1.5

1. Set the ROS environment for PC.

```
$ echo 'source ~/turtlebot3_ws/install/setup.bash' >> ~/.bashrc
$ echo 'export ROS_DOMAIN_ID=30 #TURTLEBOT3' >> ~/.bashrc
$ source ~/.bashrc
```

bashrc에 echo 두 줄을 추가

cat ~/.bashrc                      bashrc파일 보기

터미널창을 끄고 다시 열면 bash파일이 실행이 됨..?

<https://docs.ros.org/en/dashing/Tutorials/Turtlesim/Introducing-Turtlesim.html>

터미널

sudo apt install ros-dashing-turtlesim

거북이 시뮬레이터 설치

ros2 pkg excutables turtlesim

패키지 안의 실행가능한 파일들 보여줌

## 3 Use turtlesim

Open a new terminal and source ROS 2 again.

Now you will run a new node to control the turtle in the first node:

```
ros2 run turtlesim turtle_teleop_key
```

새로운 터미널창(Ctrl+Alt+T)에서 명령어 입력

tele\_operator

ros2 node list                      node - 프로그램 단위

ros2 topic list

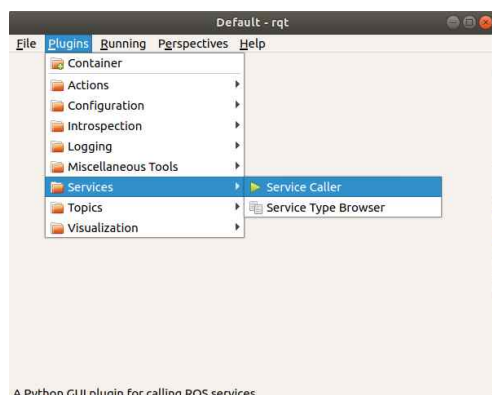
ros2 service list

ros2 action list

또 새로운 터미널 창을 열고...(Ctrl+Alt+T)

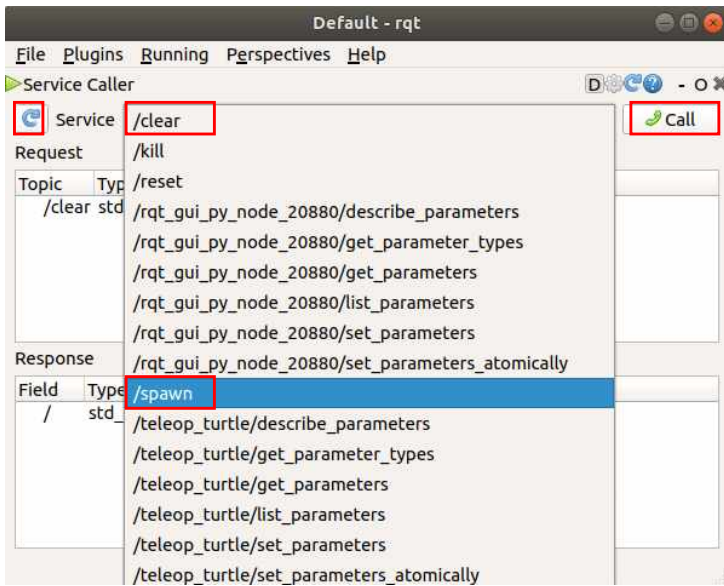
rqt

ros qt - ui 만드는 프로그램



plugins - Services - Service Caller





[경로 지우기]

Service원쪽의 화살표 누르고 - /clear 선택 - Call버튼 클릭

목록에서 /spawn 선택

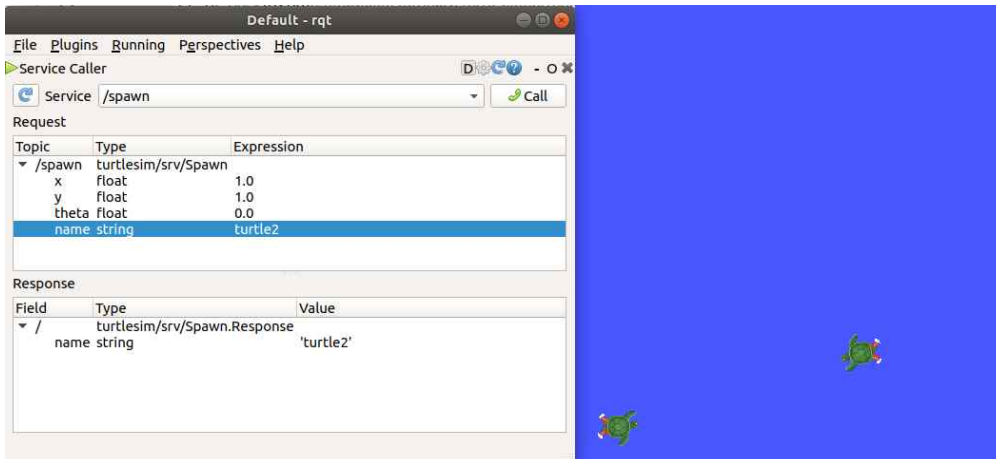
x float 1.0

y float 1.0

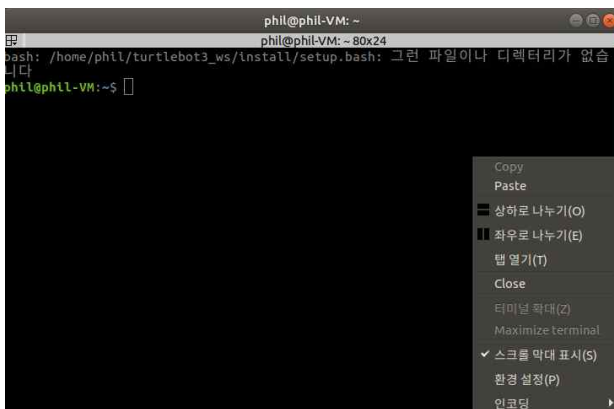
theta float 0.0

name string turtle2

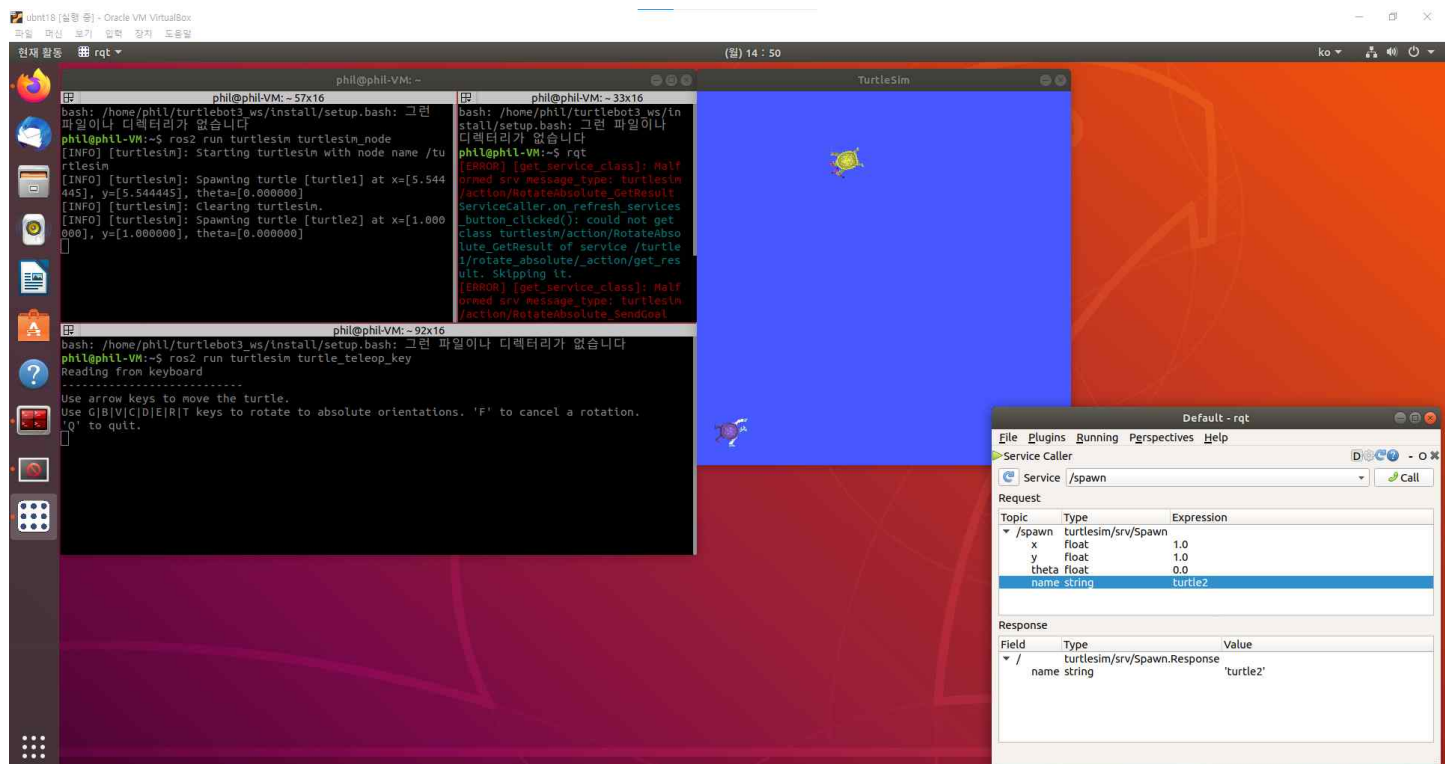
값 변경 후 콜버튼



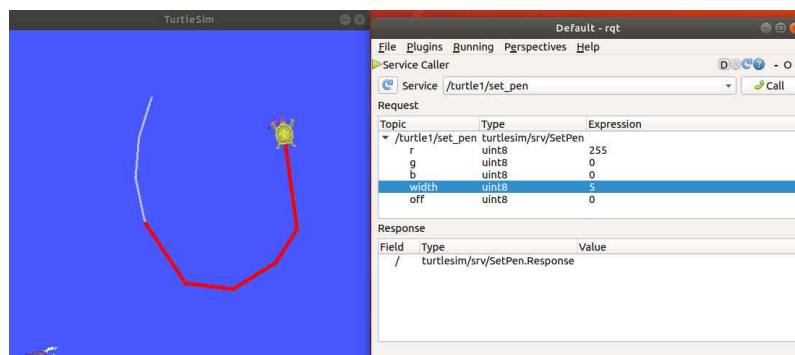
sudo apt-get install terminator



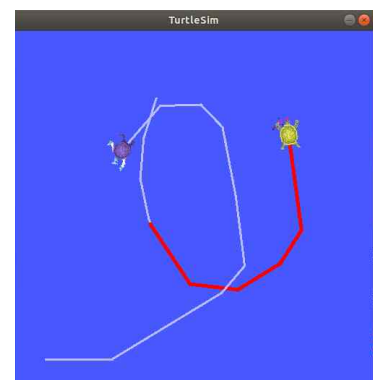
터미널창 다 끄고 다시 연 후  
 상하로 나누기, 좌우로 나누기 하여 여러개 띄움



`ros2 run turtlesim turtlesim_node`  
`ros2 run turtlesim turtle_teleop_key`  
`rqt`



[이동경로선 특징 변경 (색,굵기)]  
 Service -> `/turtle1/set_pen`  
 255, 0, 0, 5



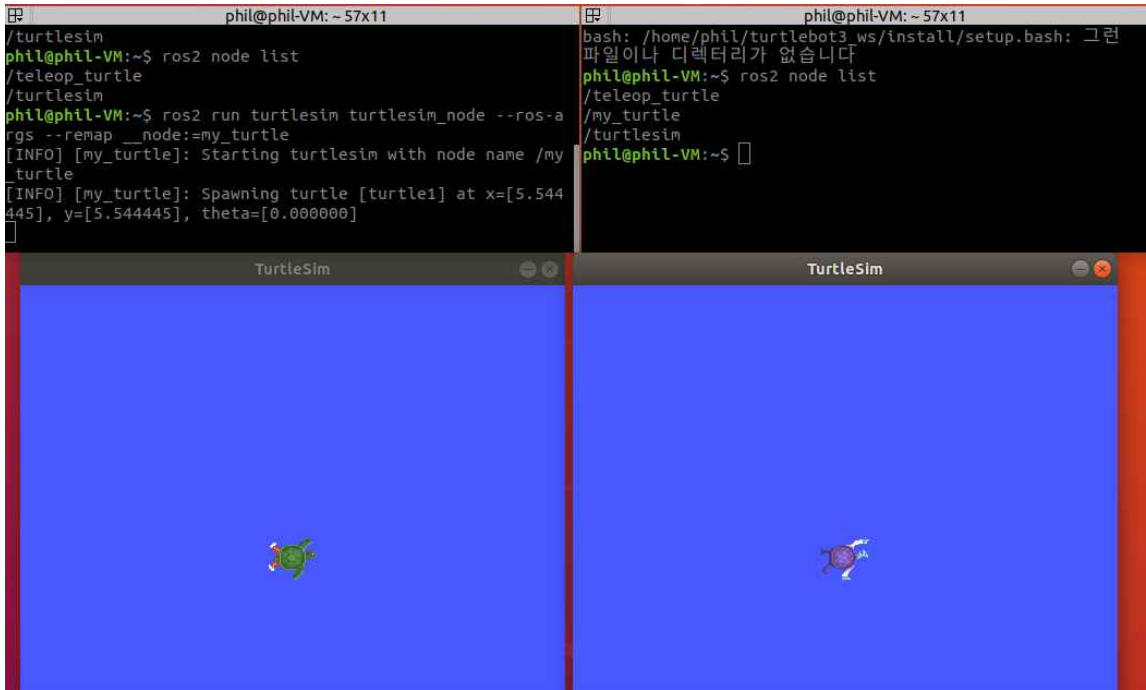
`ros2 run turtlesim turtle_teleop_key turtle1/cmd_vel:=turtle2/cmd_vel`

노드 - 특정 프로그램을 실행하는 단위

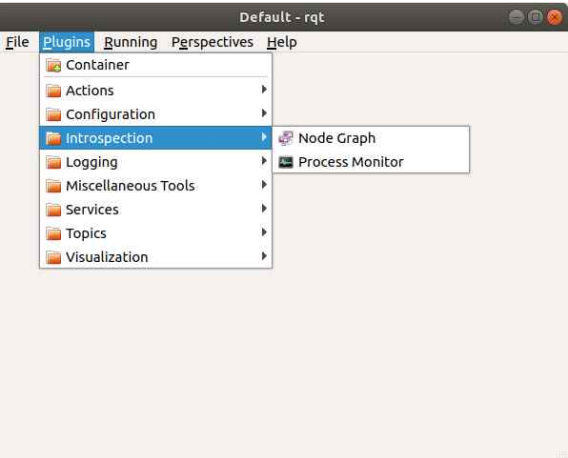
토픽으로 발행(publish)을 하면, 해당 토픽을 구독(subscribe)하는 사람들에게 전달됨

```
phil@phil-VM: ~ 57x11
bash: /home/phil/turtlebot3_ws/install/setup.bash: 그런
파일이나 디렉터리가 없습니다
phil@phil-VM:~$ ros2 run turtlesim turtlesim_node
[INFO] [turtlesim]: Starting turtlesim with node name /tu
rlesim
[INFO] [turtlesim]: Spawning turtle [turtle1] at x=[5.54
445], y=[5.544445], theta=[0.000000]
phil@phil-VM:~$ ros2 run turtlesim turtle_teleop_key
Reading from keyboard
-----
Use arrow keys to move the turtle.
Use G|B|V|C|D|E|R|T keys to rotate to absolute orientatio
ns. 'F' to cancel a rotation.
'Q' to quit.
phil@phil-VM:~$ ros2 node list
/turtlesim
phil@phil-VM:~$ ros2 node list
/teleop_turtle
/turtlesim
phil@phil-VM:~$
```

node가 1개였는데, 하나더 실행(teleop\_key)하니 노드가 하나 더 추가됨

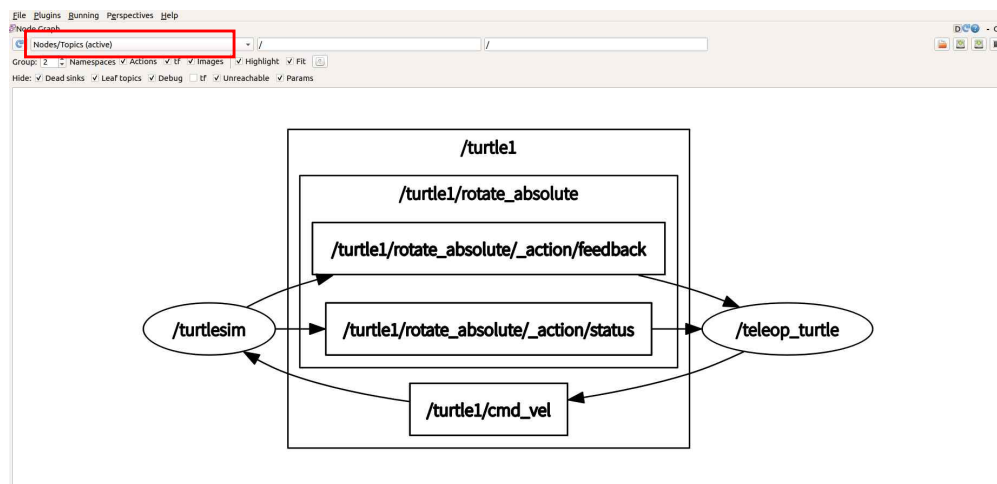


노드 - 특정 기능 하나에 해당하는 단위 프로그램



Plugins - Introspection - NodeGraph

목록에서 Nodes/Topics(active) 선택



ros2 topic list

ros2 topic list -t

메시지 타입 보여줌

ros2 topic echo /turtle1/cmd\_vel

이동좌표 및 방향값 보여줌

(위 창에서 방향이동하면, 아래에서 좌표 표시함 - 발행자, 구독자)

```
phil@phil-VM: ~ 47x15
bash: /home/phil/turtlebot3_ws/install/setup.ba
th: 그런 파일이나 디렉터리가 없습니다
phil@phil-VM:~$ ros2 run turtlesim turtle
No executable found
phil@phil-VM:~$ ros2 run turtlesim turtle_tele
op_key
Reading from keyboard
-----
Use arrow keys to move the turtle.
Use G|B|V|C|D|E|R|T keys to rotate to absolute
orientations. 'F' to cancel a rotation.
'Q' to quit.

phil@phil-VM: ~ 47x16
parameter_events [rc1_interfaces/msg/Parameter
Event]
[rosout [rc1_interfaces/msg/Log]
/turtle1/cmd_vel [geometry_msgs/msg/Twist]
/turtle1/color_sensor [turtlesim/msg/Color]
/turtle1/pose [turtlesim/msg/Pose]
phil@phil-VM:~$ ros2 topic echo /turtle1/cmd_ve

linear:
x: 0.0
y: 0.0
z: 0.0
angular:
x: 0.0
y: 0.0
z: 2.0
```

ros2 service list

ros2 service list -t

-t : type

어떤식으로 작성하는지 보여줌

ros2 service call /clear std\_srvs/srv/Empty

ros2 service call /spawn turtlesim/srv/Spawn "{x: 2.0, y: 2.0, theta: 0.2, name: ''}"

ros node list

### <용어>

- node 시스템 구성하는 싱글모듈, 작은단위의 실행모듈, 노드들이 각각 통신하여 시스템 작동
- package 노드 모음
- topic 토픽을 통해 전송
- publisher / subscriber
- service / service call
- request / response

통신방법 두가지 -> 토픽, 서비스

// 아주 일부분 액션으로 통신

### <명령어>

- ros2 run turtlesim turtlesim\_node 노드실행
- ros2 node list -t 노드 대신 topic, service
- ros2 topic echo subscribe 만들
- ros2 topic pub publish 만들
- ros2 service call