



Version: 03.04.2020

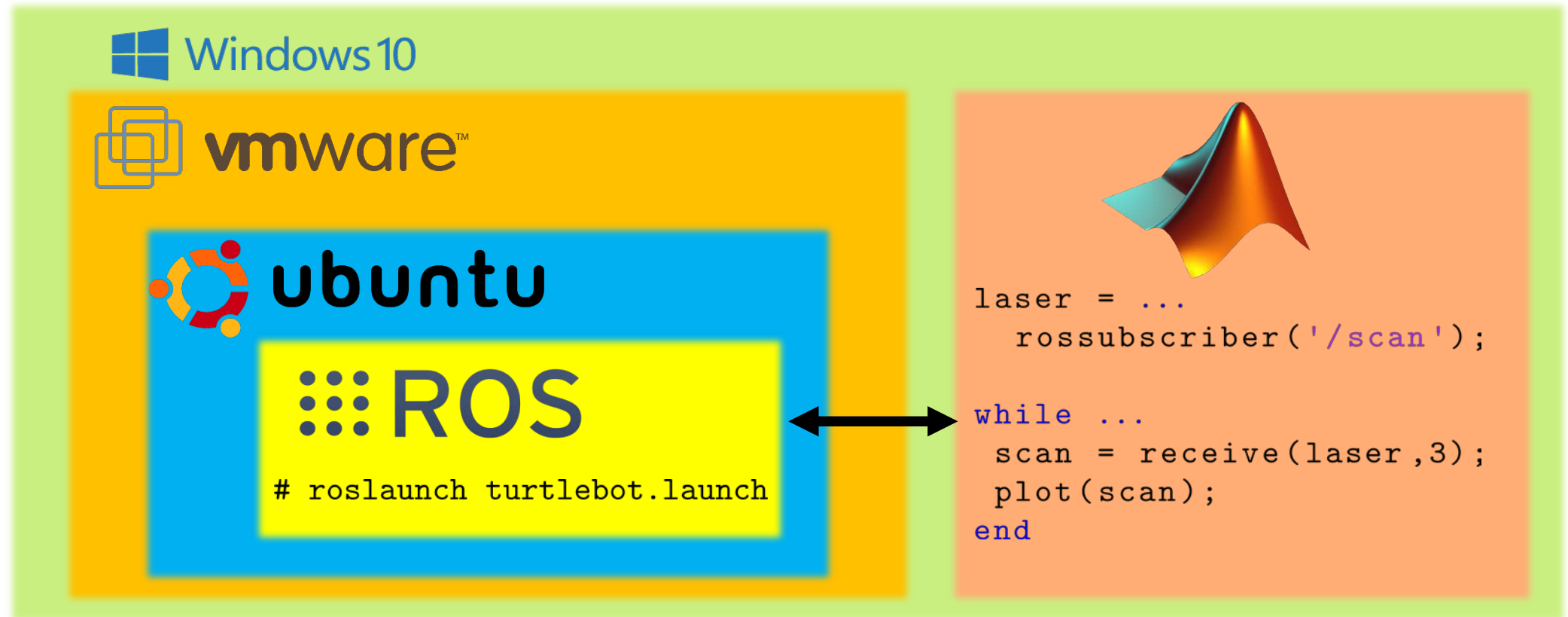
How to: Connect ROS Melodic with Matlab

Franz Albers, Frank Hoffmann

Univ.-Prof. Dr.-Ing. Prof. h.c. Dr. h.c. Torsten Bertram
Lehrstuhl für Regelungssystemtechnik

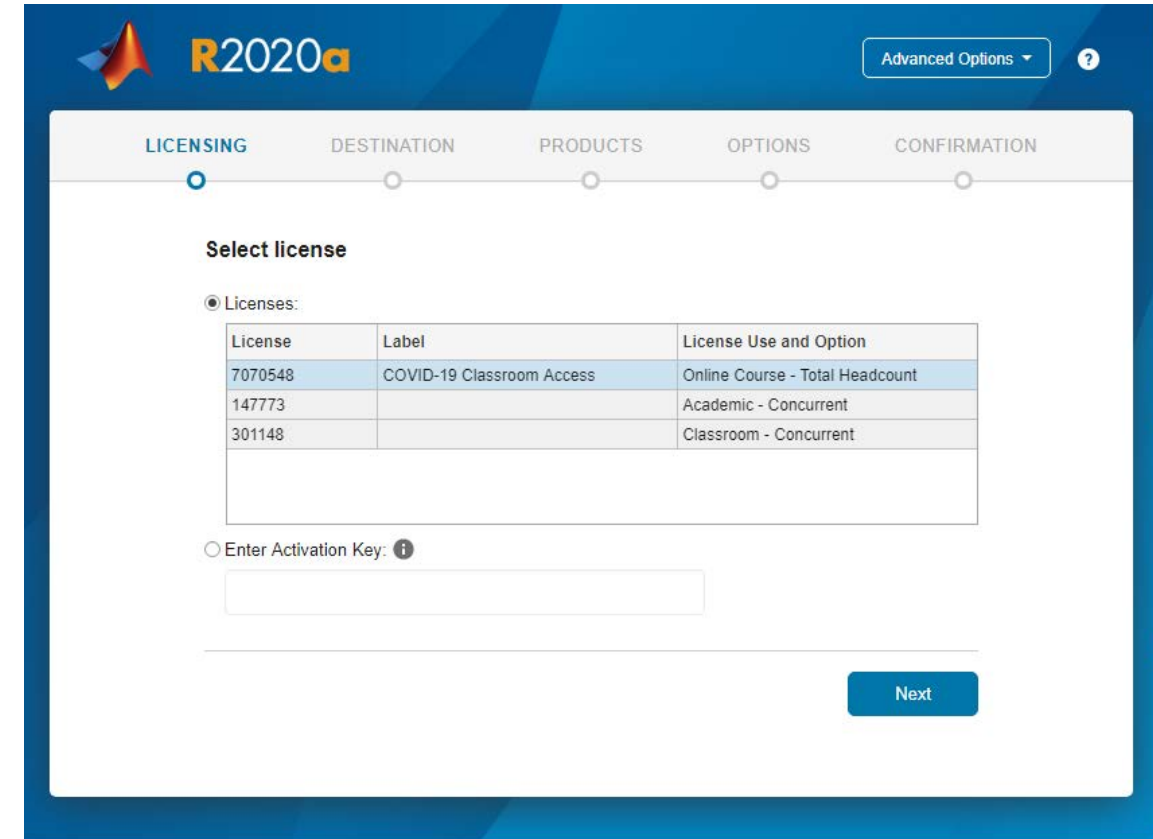
Working Environment Windows & Virtual Machine

- **ROS natively runs on Ubuntu.** To avoid installing Ubuntu as a dual boot OS, this course runs Ubuntu from Windows as a Virtual Machine (VM)
- Matlab is a resource-heavy tool. To avoid running Matlab in the limited memory of the VM, we **connect Matlab from Windows to the ROS network.**



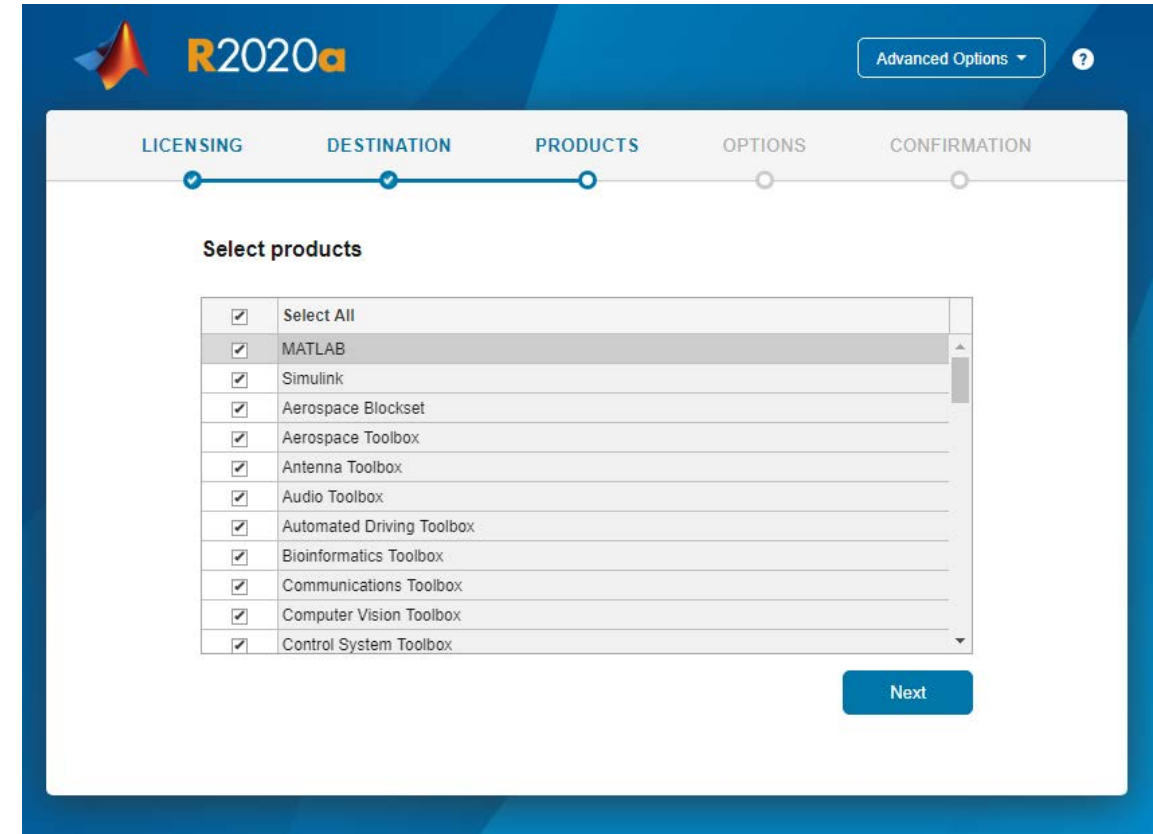
Install Matlab on Windows

- Matlab provides a TU Dortmund **license**
- Create a Mathworks account and add the license via <https://de.mathworks.com/academia/tah-portal/tu-dortmund-31486497.html>
- Download and install Matlab 2020b from your account
- During installation, log in with your **@tu-dortmund.de E-Mail address** and choose the new license



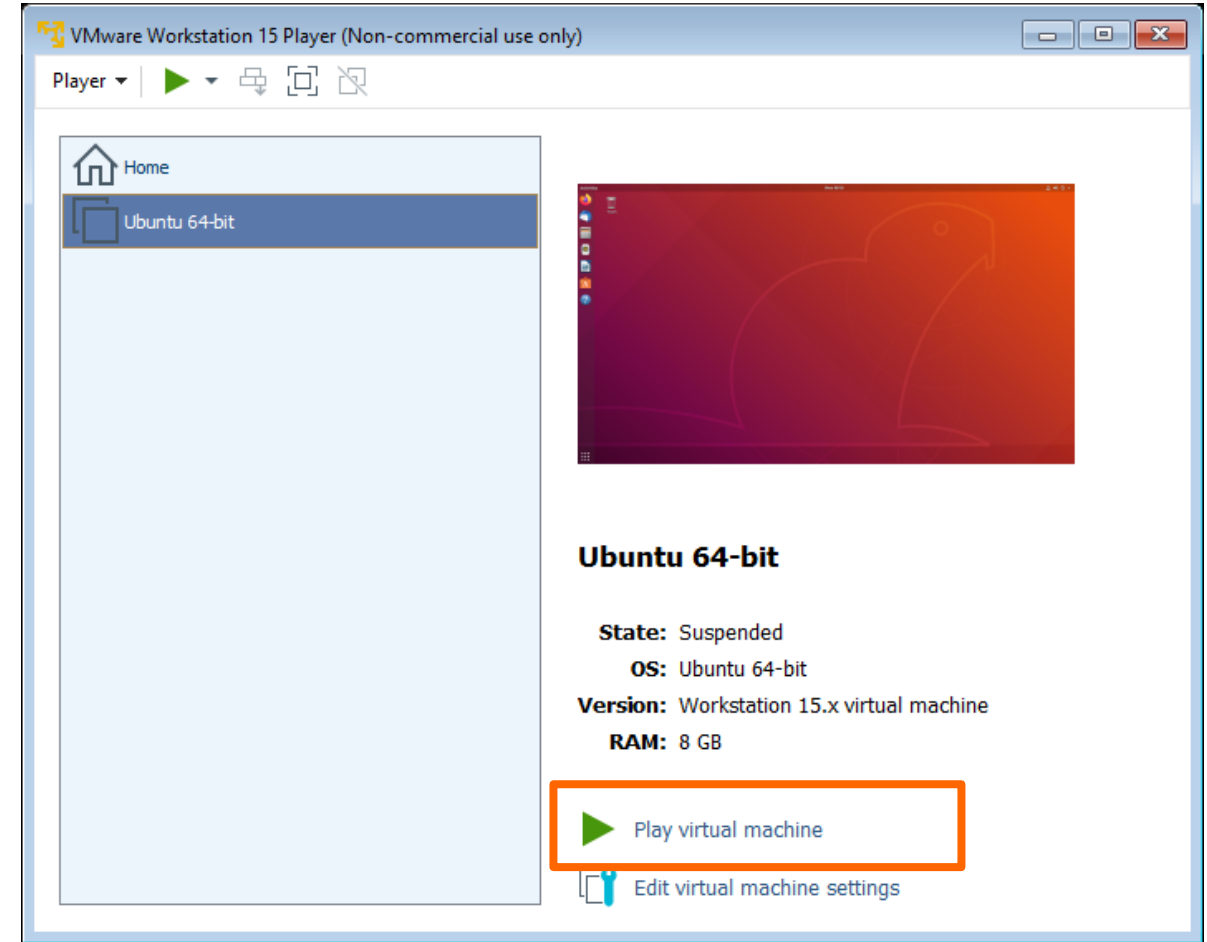
Install Matlab on Windows

- You may unselect toolboxes to save space on your hard disk.
- It is recommended to install at least
 - **MATLAB**
 - **Simulink**
 - **Computer Vision Toolbox**
 - **Control System Toolbox**
 - **Curve Fitting Toolbox**
 - **Image Processing Toolbox**
 - **Optimization Toolbox**
 - **Robotics System Toolbox**
 - **ROS Toolbox**
 - **Statistics and Machine Learning Toolbox**
 - **Symbolic Math Toolboxes.**



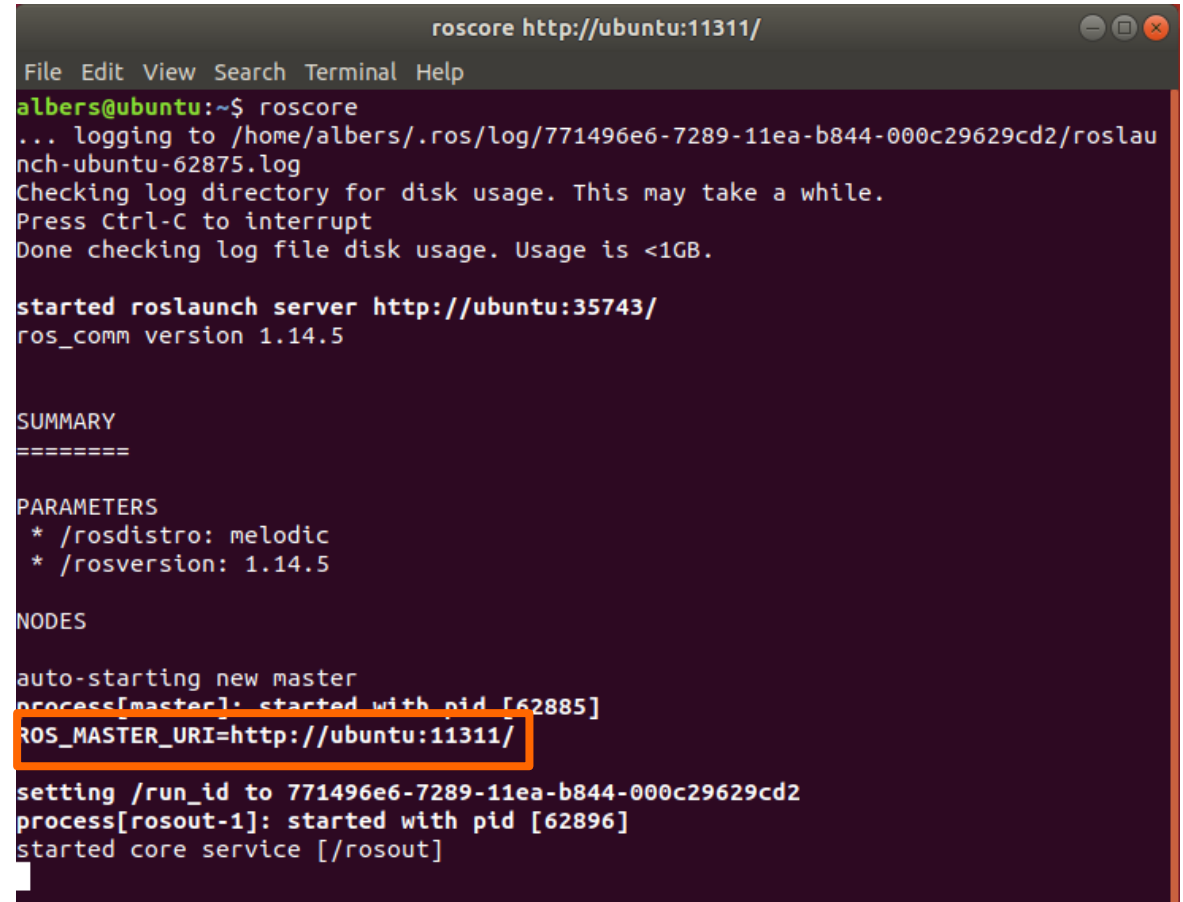
Boot Ubuntu in a VM

- Boot Ubuntu in **VMware**
- Make sure you have the ROS packages installed



Run roscore in Ubuntu

- Open a terminal (**Ctrl + Alt + t**)
- Run the command:
`roscore`
- The **ROS_MASTER_URI** is displayed in the terminal. The ROS_MASTER_URI reflects the virtual machines hostname.

A terminal window titled 'roscore http://ubuntu:11311/' with a menu bar (File, Edit, View, Search, Terminal, Help). The terminal shows the execution of 'roscore' by user 'albers' at 'ubuntu'. It logs into a specific directory, checks disk usage, and starts the roslaunch server. The output includes a summary, parameters (melodic, 1.14.5), and nodes. The line 'ROS_MASTER_URI=http://ubuntu:11311/' is highlighted with an orange box.

```
roscore http://ubuntu:11311/
File Edit View Search Terminal Help
albers@ubuntu:~$ roscore
... logging to /home/albers/.ros/log/771496e6-7289-11ea-b844-000c29629cd2/roslau
nch-ubuntu-62875.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://ubuntu:35743/
ros_comm version 1.14.5

SUMMARY
=====

PARAMETERS
* /rostdistro: melodic
* /rosversion: 1.14.5

NODES

auto-starting new master
process[master]: started with pid [62885]
ROS_MASTER_URI=http://ubuntu:11311/

setting /run_id to 771496e6-7289-11ea-b844-000c29629cd2
process[rosout-1]: started with pid [62896]
started core service [/rosout]
```

Use the hostname to connect Matlab to the ROS network

- To **connect Matlab to the ROS network**, run the following command from Matlab:

```
rosinit( '<YOUR_ROS_MASTER_URI>' )
```

- In case the **Firewall** blocks the access, allow Matlab to access the network
- The Matlab ROS node can be shut down with:

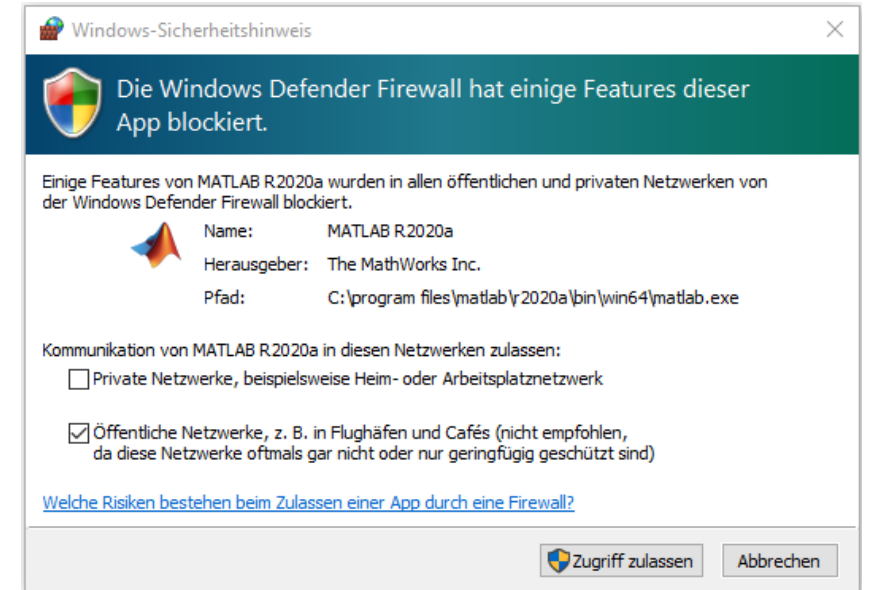
```
roshutdown
```

```
>> rosinit('http://ubuntu:11311/')
```

```
Initializing global node /matlab_global_node_13885  
with NodeURI http://192.168.190.1:61357/
```

```
>> roshutdown
```

```
Shutting down global node /matlab_global_node_13885  
with NodeURI http://192.168.190.1:
```

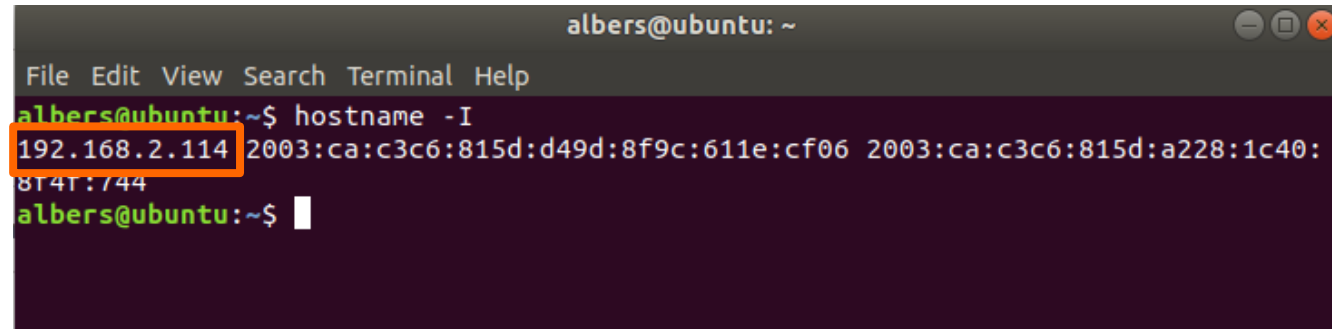


Use IP to connect Matlab to the ROS network

- In case you are having trouble connecting with the hostname, connect via the **IP of your Ubuntu VM**
- Open a Terminal on Ubuntu VM(**Ctrl + Alt + t**)

- Identify the IP of the ubuntu VM, with the command:

```
hostname -I
```

A terminal window titled 'albers@ubuntu: ~' with a menu bar (File, Edit, View, Search, Terminal, Help). The prompt is 'albers@ubuntu:~\$' and the command 'hostname -I' has been entered. The output is '192.168.2.114 2003:ca:c3c6:815d:d49d:8f9c:611e:cf06 2003:ca:c3c6:815d:a228:1c40:8141:744'. The IP address '192.168.2.114' is highlighted with an orange box.

```
albers@ubuntu: ~  
File Edit View Search Terminal Help  
albers@ubuntu:~$ hostname -I  
192.168.2.114 2003:ca:c3c6:815d:d49d:8f9c:611e:cf06 2003:ca:c3c6:815d:a228:1c40:  
8141:744  
albers@ubuntu:~$
```

- Run the `roslaunch` command from Matlab with the IP of the ubuntu VM

```
>> roslaunch('192.168.190.128')  
Initializing global node /matlab_global_node_43057  
with NodeURI http://192.168.190.1:61518/
```


ROS Functionality within Matlab

- After connecting to the ROS network, the **standard ROS terminal commands** become available in Matlab

```
>> rostopic list  
/rosout  
/rosout_agg  
>> rosnode list  
/matlab_global_node_52777  
/rosout
```

- For getting started with Matlab and ROS follow this link:
<https://de.mathworks.com/help/ros/getting-started-with-ros-toolbox.html>

Publishing and Subscribing in Matlab

- **Publishers** and **Subscribers** are available with the `rospublisher` and `rossubscriber` commands
- Instantiate publisher and publish a message

```
>> chatpub=rospublisher('/chatter','std_msgs/String');  
>> msg=rosmessage(chatpub);  
>> msg.Data='test phrase';  
>> send(chatpub,msg);
```

- Instantiate subscriber and receive a message

```
>> chatsub=rossubscriber('chatter');  
>> chatsub.LatestMessage  
ans =  
    ROS String message with properties:  
    MessageType: 'std_msgs/String'  
    Data: 'test phrase'
```

Use `showdetails` to show the contents of the message

Using ROS commands from the Ubuntu terminal

- The **Matlab ROS node** and **published topics** are also available with the usual ROS commands from the Ubuntu Terminal

```
albers@ubuntu:~$ rosnodet list
/matlab_global_node_54630
/rosout
albers@ubuntu:~$ rostopic list
/chatter
/rosout
/rosout_agg
```

- An introduction on ROS terminal commands is provided here:
<http://wiki.ros.org/ROS/Tutorials>