RSelenium: Docker

Introduction

The goal of this document to illustrate the use of docker and the Selenium project. The selenium project has released a number of containers to run various tools in the suite.

Why docker?

Running a docker container standardises the build across OS's and removes many of the issues user may have relating to JAVA/browser version/selenium version etc.

Preparing docker on Windows

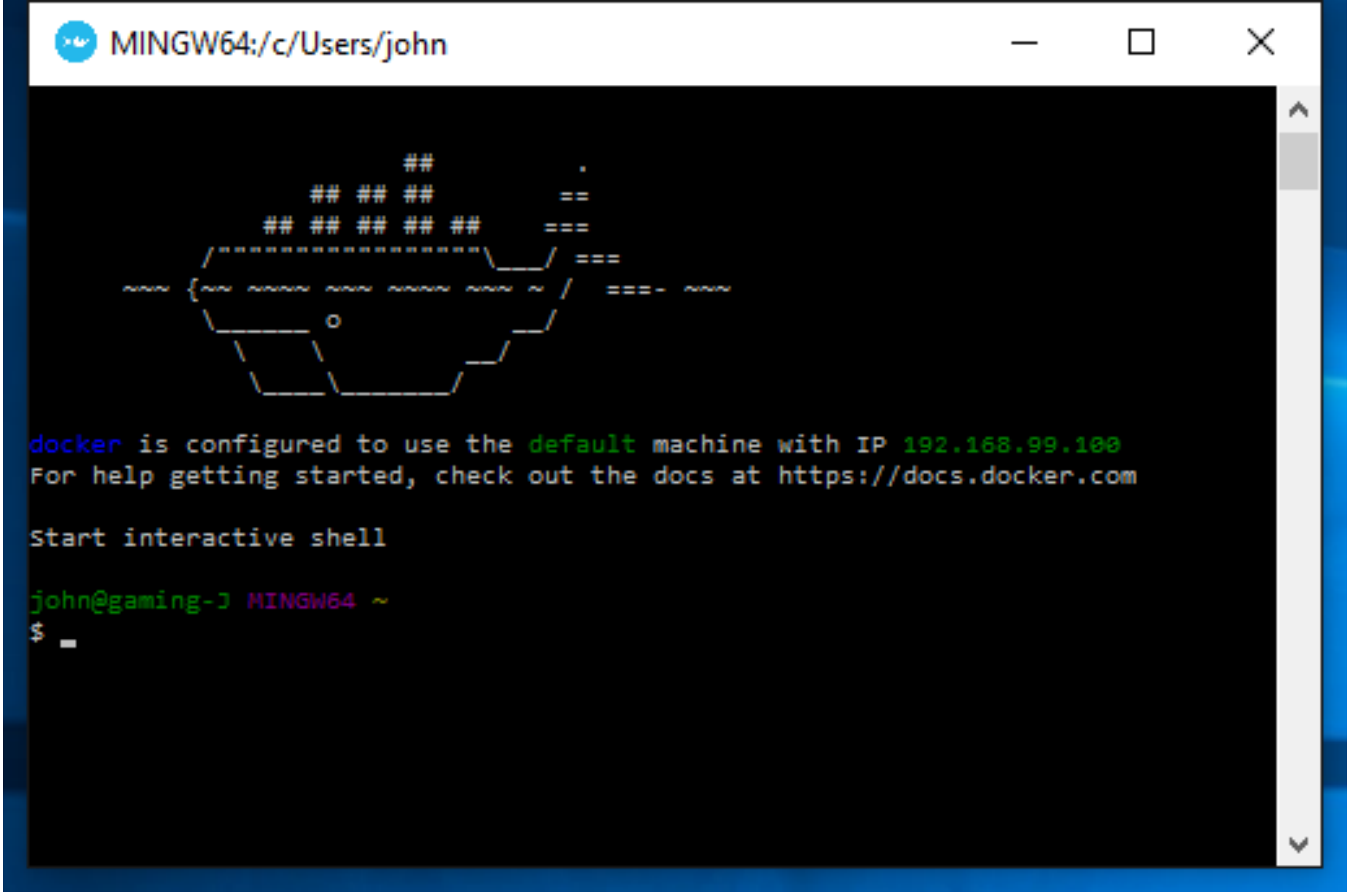
The following outlines preparing a windows 10 home installation to run docker containers.

Installing docker

Depending on your version of windows there are currently two ways of running docker. Details are given at Docker (https://docs.docker.com/engine/installation/windows/). For the version of windows Being used in this vignette (win 10 home) the older Docker toolbox (https://www.docker.com/products/docker-toolbox) is what we are going to use to run containers.

Download the `.exe` for Docker toolbox and begin the install. Follow the instructions on the toolbox install windows (https://docs.docker.com/toolbox/toolbox_install_windows/) page.

Clicking on the Docker Quickstart terminal link should eventually give you a terminal that resembles the following:



```
                        ##         .
                  ## ## ##        ==
               ## ## ## ## ##    ===
           /"""""""""""""""""\___/ ===
      ~~~ {~~ ~~~~ ~~~ ~~~~ ~~~ ~ /  ===- ~~~
           \______ o           __/
             \    \         __/
              \____\_______/

docker is configured to use the default machine with IP 192.168.99.100
For help getting started, check out the docs at https://docs.docker.com

Start interactive shell

john@gaming-J MINGW64 ~
$ 
```

Preparing docker on Linux

The following outlines preparing a ubuntu 16.04 installation to run docker containers.

Installing docker

For a general guide for various Linux distros see Docker (https://docs.docker.com/engine/installation/linux/)

Ubuntu 16.04

Run system update firstly

```
$ sudo apt-get update
```

Add the official Docker GPG key to your system

```
$ sudo apt-key adv --keyserver hkp://p80.pool.sks-keyservers.net:80 --recv-keys 58118
E89F3A912897C070ADBF76221572C52609D
```

Add the Docker repository to APT sources:

```
$ echo "deb https://apt.dockerproject.org/repo ubuntu-xenial main" | sudo tee /etc/ap
t/sources.list.d/docker.list
```

Update the package database:

```
sudo apt-get update
```

Now you should be able to install Docker

```
sudo apt-get install -y docker-engine
```

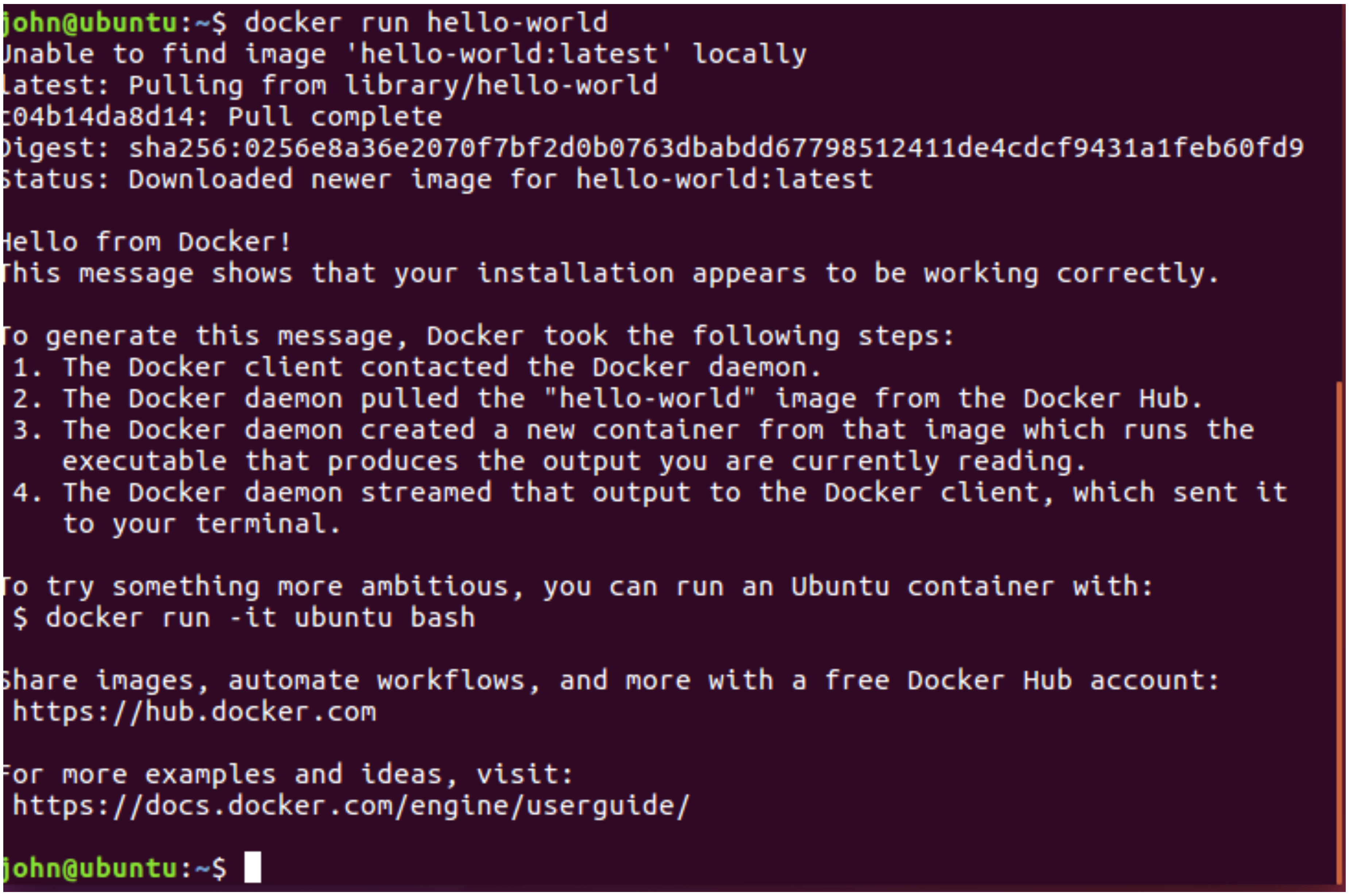
Start the docker daemon.

```
$ sudo service docker start
```

You can check that the Docker is working by running a test container:

For now run as `sudo`

```
$ sudo docker run hello-world
```



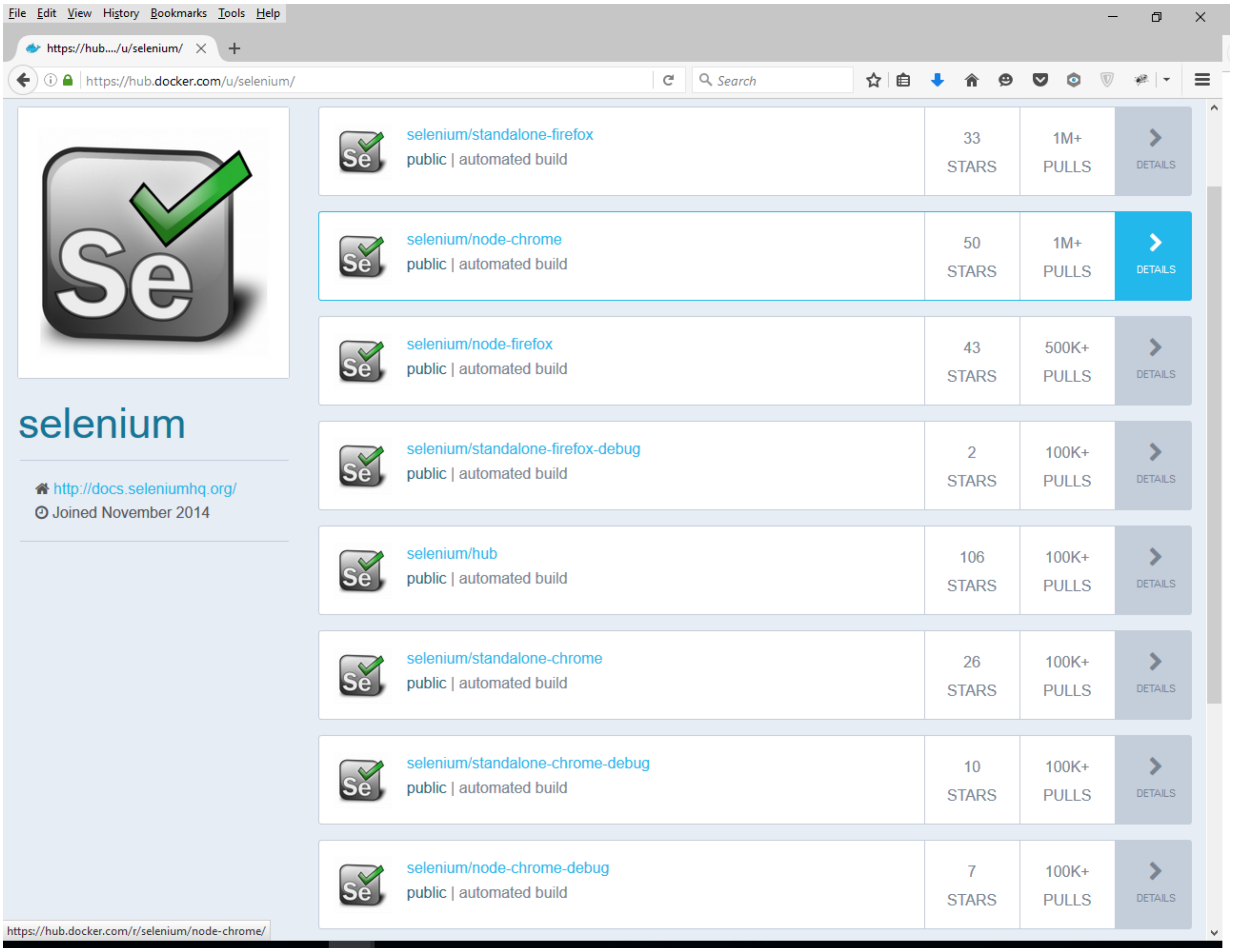
```
john@ubuntu:~$ docker run hello-world
nable to find image 'hello-world:latest' locally
atest: Pulling from library/hello-world
04b14da8d14: Pull complete
igest: sha256:0256e8a36e2070f7bf2d0b0763dbabdd67798512411de4cdcf9431a1feb60fd9
tatus: Downloaded newer image for hello-world:latest

ello from Docker!
his message shows that your installation appears to be working correctly.

o generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

o try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

hare images, automate workflows, and more with a free Docker Hub account:
 https://hub.docker.com

or more examples and ideas, visit:
 https://docs.docker.com/engine/userguide/

john@ubuntu:~$
```

Running without sudo

If you want to run `docker` without `sudo` you can create a docker group and add the appropriate user to that group see Docker (https://docs.docker.com/engine/installation/linux/ubuntulinux/#create-a-docker-group).

Using Selenium Docker images

The official docker repository can be viewed here (https://hub.docker.com/u/selenium/) at Docker Hub.


File Edit View History Bookmarks Tools Help
https://hub..../u/selenium/
Search

https://hub.docker.com/u/selenium/

selenium

http://docs.seleniumhq.org/

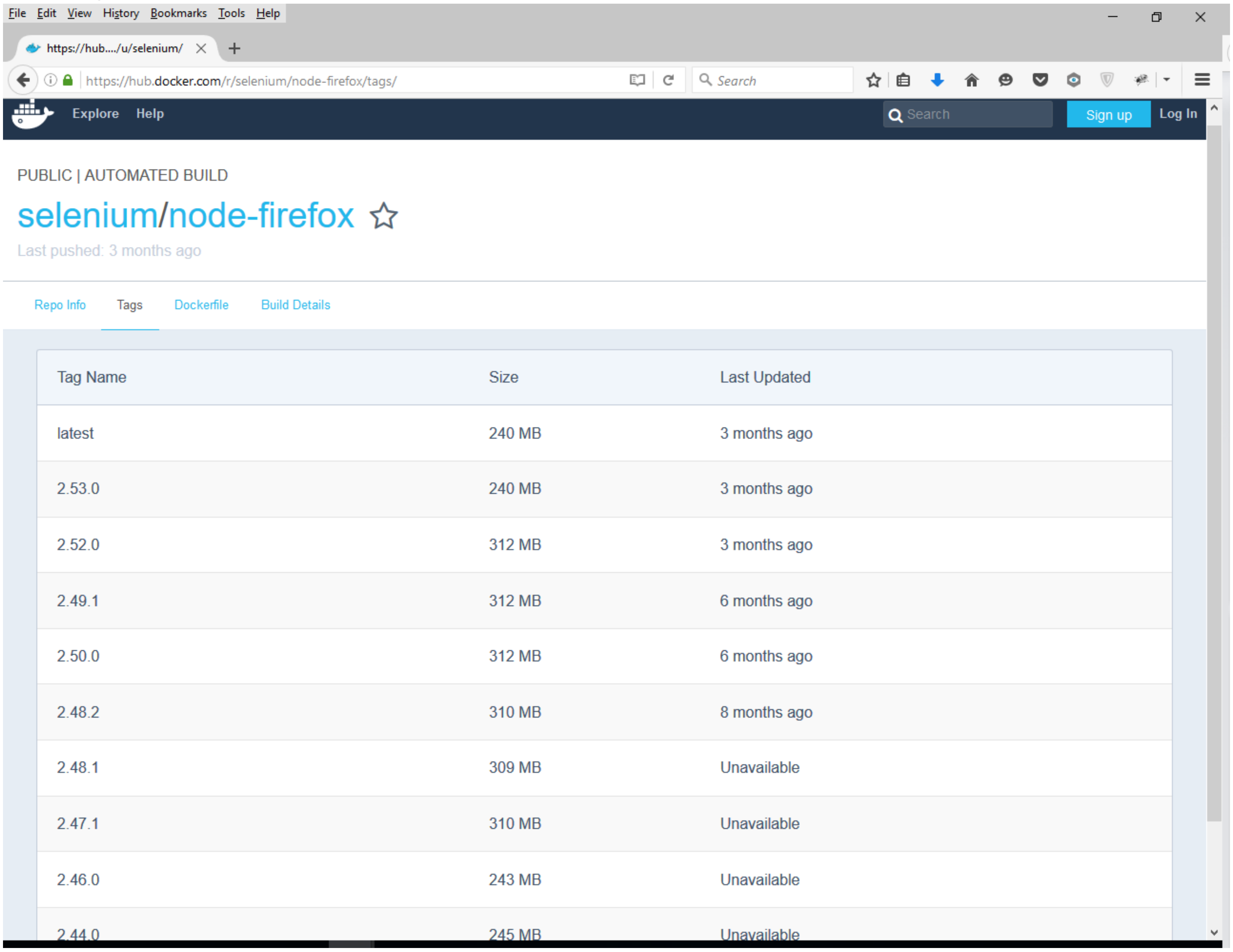
Joined November 2014

selenium/standalone-firefox public | automated build	33 STARS	1M+ PULLS	DETAILS
selenium/node-chrome public | automated build	50 STARS	1M+ PULLS	DETAILS
selenium/node-firefox public | automated build	43 STARS	500K+ PULLS	DETAILS
selenium/standalone-firefox-debug public | automated build	2 STARS	100K+ PULLS	DETAILS
selenium/hub public | automated build	106 STARS	100K+ PULLS	DETAILS
selenium/standalone-chrome public | automated build	26 STARS	100K+ PULLS	DETAILS
selenium/standalone-chrome-debug public | automated build	10 STARS	100K+ PULLS	DETAILS
selenium/node-chrome-debug public | automated build	7 STARS	100K+ PULLS	DETAILS

https://hub.docker.com/r/selenium/node-chrome/

Whats in an image?

Lets examine the `selenium/node-firefox` (https://hub.docker.com/r/selenium/node-firefox/) image. The first thing to note is the `Tags`.


File Edit View History Bookmarks Tools Help
https://hub..../u/selenium/
https://hub.docker.com/r/selenium/node-firefox/tags/
Explore Help
Search
Sign up
Log In

PUBLIC | AUTOMATED BUILD

selenium/node-firefox

Last pushed: 3 months ago

Repo Info Tags Dockerfile Build Details

Tag Name	Size	Last Updated
latest	240 MB	3 months ago
2.53.0	240 MB	3 months ago
2.52.0	312 MB	3 months ago
2.49.1	312 MB	6 months ago
2.50.0	312 MB	6 months ago
2.48.2	310 MB	8 months ago
2.48.1	309 MB	Unavailable
2.47.1	310 MB	Unavailable
2.46.0	243 MB	Unavailable
2.44.0	245 MB	Unavailable

Clicking this gives us the various tagged versions of this image. Clicking Dockerfile allows us to view the source behind the image:

```
FROM selenium/node-base:2.53.0
MAINTAINER Selenium <selenium-developers@googlegroups.com>

USER root #=========
# Firefox
#=========
ENV FIREFOX_VERSION 45.0.2
```

we can see that this image will run selenium server and contain firefox version 45.0.2.

We will be interested not in the node-firefox image but the selenium/standalone-firefox (https://hub.docker.com/r/selenium/standalone-firefox/) image. Looking at its Dockerfile we see however that it is built on the first image we looked at.

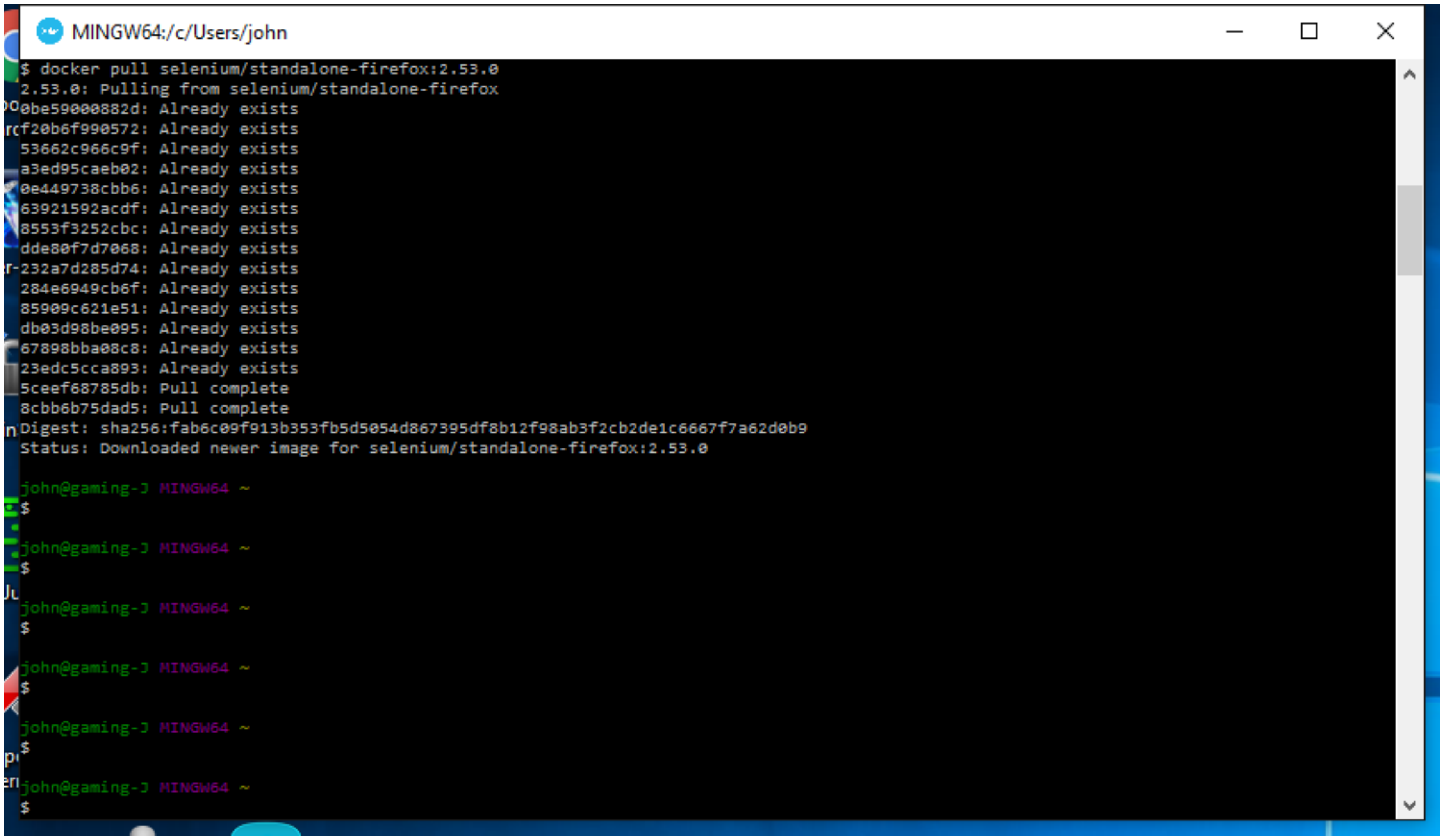
Pulling an image

Windows 10 - Docker toolbox

To get the image we are interested in we first click our quickstart link to open a terminal. We then issue the following command:

```
$docker pull selenium/standalone-firefox:2.53.0
```

Notice we appended a tag version so we are asking for the `2.53.0` version of this image.



```
$ docker pull selenium/standalone-firefox:2.53.0
2.53.0: Pulling from selenium/standalone-firefox
0be59000882d: Already exists
f20b6f990572: Already exists
53662c966c9f: Already exists
a3ed95caeb02: Already exists
0e449738cbb6: Already exists
63921592acdf: Already exists
8553f3252cbc: Already exists
dde80f7d7068: Already exists
232a7d285d74: Already exists
284e6949cb6f: Already exists
85909c621e51: Already exists
db03d98be095: Already exists
67898bba08c8: Already exists
23edc5cca893: Already exists
5ceef68785db: Pull complete
8cbb6b75dad5: Pull complete
Digest: sha256:fab6c09f913b353fb5d5054d867395df8b12f98ab3f2cb2de1c6667f7a62d0b9
Status: Downloaded newer image for selenium/standalone-firefox:2.53.0

john@gaming-J MINGW64 ~
$

john@gaming-J MINGW64 ~
$

john@gaming-J MINGW64 ~
$

john@gaming-J MINGW64 ~
$

john@gaming-J MINGW64 ~
$

john@gaming-J MINGW64 ~
$
```

Ubuntu 16.04

Similar to windows we use the `docker pull` command. If you did not create and add your user to a `Docker` group you will need to `sudo`

```
$ sudo docker pull selenium/standalone-firefox:2.53.0
```

Start your servers!

When we run an image we refer to that instance of the running image as a container. Importantly for Selenium we are dealing with a server so we require a port. We will have a port on the container and a port on the host machine (the machine that is running the container). The only complexity will involve mapping the host port and container port.

By default the Selenium images expose port 4444 and use this port for serving. This is not a problem for us and we can map as we see fit on the host machine.

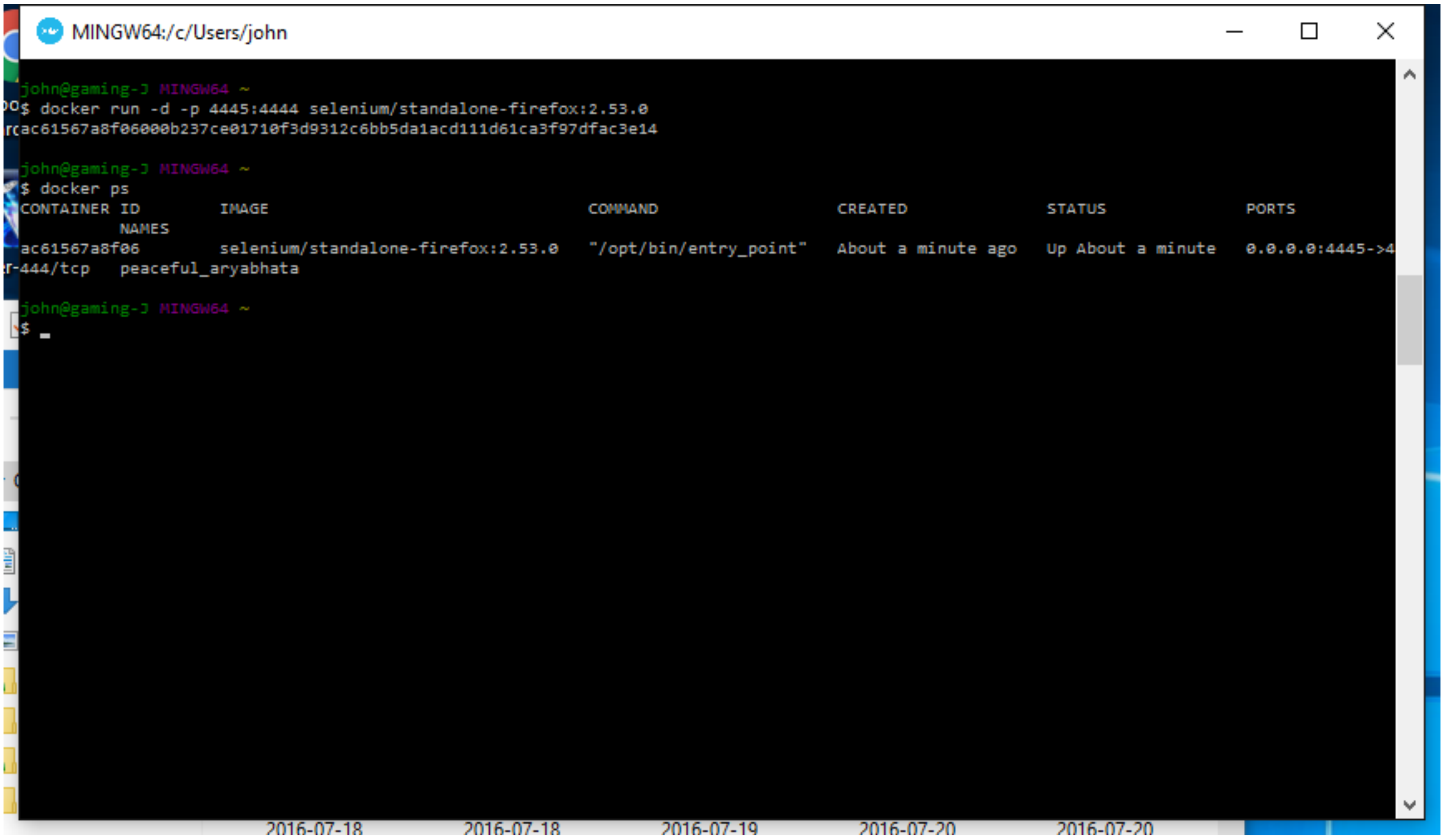
Windows 10 running an image

Again we run docker and this time use the `run` (https://docs.docker.com/engine/reference/commandline/run/) command.

```
$ docker run -d -p 4445:4444 selenium/standalone-firefox:2.53.0
```

For illustration here we are mapping the container port 4444 to the host port 4445 so when we want to refer to our server on the host machine we will use 4445 as the port.

We also run the `ps` (https://docs.docker.com/engine/reference/commandline/ps/) command after running to show our current running containers.



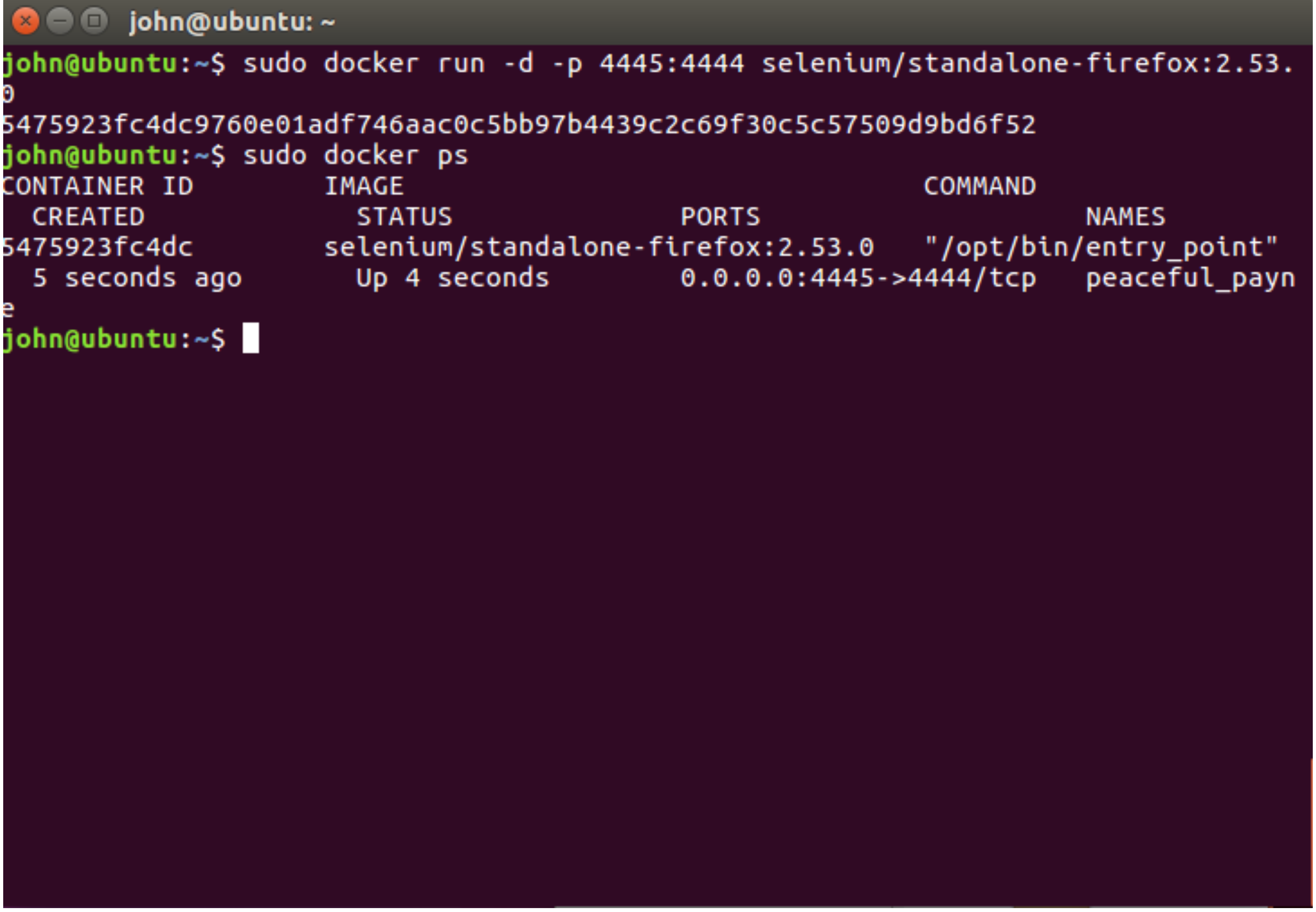
```
john@gaming-J MINGW64 ~
$ docker run -d -p 4445:4444 selenium/standalone-firefox:2.53.0
ac61567a8f06000b237ce01710f3d9312c6bb5da1acd111d61ca3f97dfac3e14

john@gaming-J MINGW64 ~
$ docker ps
CONTAINER ID        IMAGE                                COMMAND                   CREATED              STATUS              PORTS
         NAMES
ac61567a8f06        selenium/standalone-firefox:2.53.0   "/opt/bin/entry_point"    About a minute ago   Up About a minute   0.0.0.0:4445->4
444/tcp   peaceful_aryabhata

john@gaming-J MINGW64 ~
$ _
```

So we can see an instance of standalone-firefox:2.53.0 is running. It has `id=ac61567a8f06` and is named `peaceful_aryabhata`.

Ubuntu 16.04 running an image

For ubuntu we also issue a `run` command followed by a listing of running containers with `ps`. Again run as `sudo` if necessary:

```
$ sudo docker run -d -p 4445:4444 selenium/standalone-firefox:2.53.0
$ sudo docker ps
```



```
john@ubuntu:~$ sudo docker run -d -p 4445:4444 selenium/standalone-firefox:2.53.
0
5475923fc4dc9760e01adf746aac0c5bb97b4439c2c69f30c5c57509d9bd6f52
john@ubuntu:~$ sudo docker ps
CONTAINER ID        IMAGE                                  COMMAND
  CREATED             STATUS              PORTS                    NAMES
5475923fc4dc        selenium/standalone-firefox:2.53.0   "/opt/bin/entry_point"
  5 seconds ago       Up 4 seconds        0.0.0.0:4445->4444/tcp   peaceful_payn
e
john@ubuntu:~$ 
```

The `Ubuntu` container has `id=5475923fc4dc` and is named `peaceful_payne`.

A tip if you dont want to strain your eyes is to use the `--format` argument:

```
john@ubuntu:~$ sudo docker ps --format 'table {{.Names}}\t{{.Image}}\t{{.ID}}'
NAMES               IMAGE                                 CONTAINER ID
peaceful_payne      selenium/standalone-firefox:2.53.0    5475923fc4dc
```

RSelenium and running containers

Now that we have a container running a selenium server and its own firefox we can call it using `RSelenium`

Utilising the firefox standalone container in Windows 10

With Windows 10 we have Docker toolbox which creates a virtual machine on windows to run our containers. So the virtual machine is the host rather than Win 10. We need the ip address of this virtual machine. This is the only added complication. We can get the ip address of the virtual machine using `docker-machine.exe`:

```
john@gaming-J MINGW64 ~
$ docker-machine ip
192.168.99.100
```

So as we can see the virtual machine has `ip = 192.168.99.100` and as we noted previously we mapped port 4444 to port 4445 on the host (the virtual machine in this case). So we should have a Selenium server accesible on port 4445 of the virtual machine. Lets try it:

```
> library(RSelenium)
> remDr <- remoteDriver(remoteServerAddr = "192.168.99.100",
+                       port = 4445L)
> remDr$open()
[1] "Connecting to remote server"
$applicationCacheEnabled
[1] TRUE

$rotatable
[1] FALSE

$handlesAlerts
[1] TRUE

$databaseEnabled
[1] TRUE

$version
[1] "45.0.2"

$platform
[1] "LINUX"

$nativeEvents
[1] FALSE

$acceptSslCerts
[1] TRUE

$webdriver.remote.sessionid
[1] "bfe1c24d-8b17-4e64-a062-cba14e99472b"

$webStorageEnabled
[1] TRUE

$locationContextEnabled
[1] TRUE

$browserName
[1] "firefox"

$takesScreenshot
[1] TRUE

$javascriptEnabled
[1] TRUE
```

```
$cssSelectorsEnabled
[1] TRUE

$id
[1] "bfe1c24d-8b17-4e64-a062-cba14e99472b"


> remDr$navigate("http://www.google.com/ncr")
> remDr$getTitle()
[[1]]
[1] "Google"
```

So as expected we have version `45.0.2` of firefox running in `Linux`. We note that no browser popped up and we dont see any signs in the `MINGW64` console. This is expected the browser is headless. If you are using `RStudio` you can use the `Viewer` pane to get a screenshot `remDr$screenshot(display = TRUE)`. Later we will see how we can run a debug version that uses `VNC` to allow us to interact with the containers browser.

Utilising the firefox standalone container in Ubuntu 16.04

On our ubuntu 16.04 box life is simpler. The host in this case is the machine itself. The ip address is therefore `localhost` the default for `RSelenium`:

```
> library(RSelenium)
> remDr <- remoteDriver(port = 4445L)
> remDr$open()
[1] "Connecting to remote server"
$applicationCacheEnabled
[1] TRUE

$rotatable
[1] FALSE

$handlesAlerts
[1] TRUE

$databaseEnabled
[1] TRUE

$version
[1] "45.0.2"

$platform
[1] "LINUX"

$nativeEvents
[1] FALSE

$acceptSslCerts
[1] TRUE
```

```
$webdriver.remote.sessionid
[1] "644c353a-34b8-4bb4-bcff-746df5a30af8"

$webStorageEnabled
[1] TRUE

$locationContextEnabled
[1] TRUE

$browserName
[1] "firefox"

$takesScreenshot
[1] TRUE

$javascriptEnabled
[1] TRUE

$cssSelectorsEnabled
[1] TRUE

$id
[1] "644c353a-34b8-4bb4-bcff-746df5a30af8"

> remDr$navigate("http://www.google.com/ncr")
> remDr$getTitle()
[[1]]
[1] "Google"
```

Again we see that we have `Firefox` 45.0.2 running on `Linux` . So running docker containers allows us to run a standard setup OS independent and we dont need to worry about machine specifics.

Debugging using VNC

Often it is useful to be able to interact with the browser spawned by Selenium. In this regard the `Selenium` project provides debug versions of their images which include `VNC` . This means with a VNC viewer we can remote logon to the container and interact with the browser.

Remote logging/debugging with Windows

First lets stop the running container. To stop the running container we need its ID. We then pass this id to the `stop` (https://docs.docker.com/engine/reference/commandline/stop/) command:

```
john@gaming-J MINGW64 ~
$ docker ps -q
ac61567a8f06

john@gaming-J MINGW64 ~
$ docker stop $(docker ps -q)
ac61567a8f06

john@gaming-J MINGW64 ~
$ docker ps
CONTAINER ID        IMAGE                   COMMAND                 CREATED                 STATU
S               PORTS                   NAMES

john@gaming-J MINGW64 ~
$
```

So we have stopped our container and will have no issues with blocked ports. Next we need to `pull` (https://docs.docker.com/engine/reference/commandline/pull/) the `Firefox standalone debug` (https://hub.docker.com/r/selenium/standalone-firefox-debug/) image. Again this has various tags and we will choose the `2.53.0` one:

```
john@gaming-J MINGW64 ~
$ docker pull selenium/standalone-firefox-debug:2.53.0
2.53.0: Pulling from selenium/standalone-firefox-debug

0be59000882d: Already exists
f20b6f990572: Already exists
53662c966c9f: Already exists
a3ed95caeb02: Already exists
0e449738cbb6: Already exists
63921592acdf: Already exists
8553f3252cbc: Already exists
dde80f7d7068: Already exists
232a7d285d74: Already exists
284e6949cb6f: Already exists
85909c621e51: Already exists
db03d98be095: Already exists
67898bba08c8: Already exists
23edc5cca893: Already exists
5ceef68785db: Already exists
8cbb6b75dad5: Already exists
d18b13cc4e51: Pull complete
4a3e92e6c855: Pull complete
1f5786a4b2ff: Download complete
3a29027ac709: Download complete
a70ecef6edbc: Download complete
10672504dfa1: Pull complete
1f5786a4b2ff: Pull complete
3a29027ac709: Pull complete
a70ecef6edbc: Pull complete
Digest: sha256:9b03c047b68b4e1c43f6d09edd952c1200766408104f76fa055e04028390491b
Status: Downloaded newer image for selenium/standalone-firefox-debug:2.53.0
```

Next we start the container as before. This time we have two ports to map. The Selenium port as before and also now the VNC port. The Selenium image expose the VNC port on `5900` by default and we map this port to a port on the host. We will choose `5901` just to illustrate host v container:

```
john@gaming-J MINGW64 ~
$ docker run -d -p 4445:4444 -p 5901:5900 selenium/standalone-firefox-debug:2.53.0
ee0c0bb8b711723e653ccc26219e314a37c28d2027f939046adcfc90a4beb645

john@gaming-J MINGW64 ~
$ docker-machine ip
192.168.99.100

john@gaming-J MINGW64 ~
$ docker ps --format 'table {{.Names}}\t{{.Image}}\t{{.ID}}'
NAMES               IMAGE                                   CONTAINER ID
focused_tesla       selenium/standalone-firefox-debug:2.53.0   ee0c0bb8b711

john@gaming-J MINGW64 ~
$
```

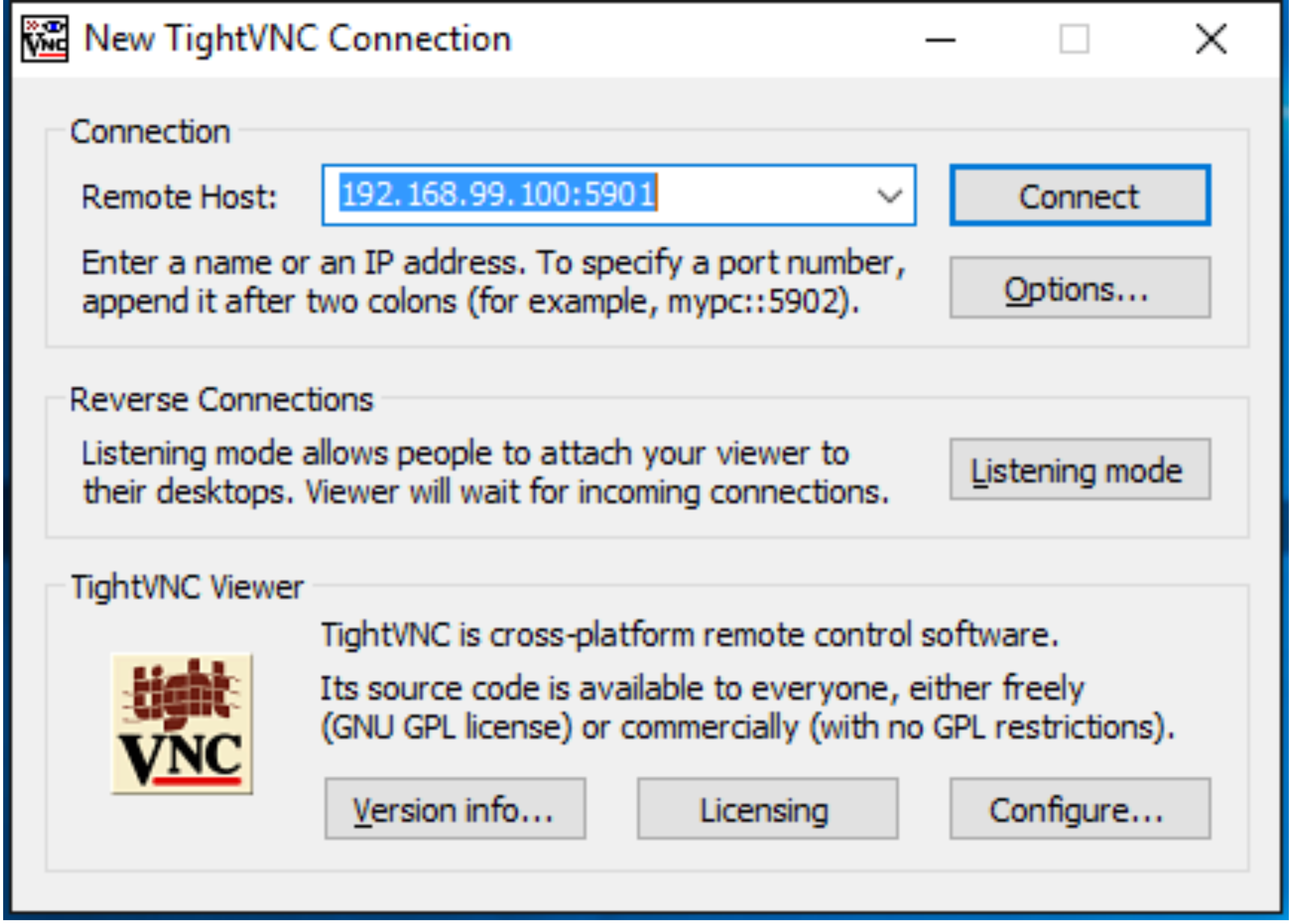
Again we note that the container is ran on a virtual machine not on our Windows 10 box so we expose the ip of said virtual machine. Next we download a VNC viewer if we dont have one.

TightVNC (http://www.tightvnc.com/download.php) has worked for me so I use it here.

Our Selenium server is running so lets use RSelenium again to browse to `Google`:

```
library(RSelenium)
remDr <- remoteDriver(remoteServerAddr = "192.168.99.100",
                      port = 4445L)
remDr$open(silent = TRUE)
remDr$navigate("http://www.google.com/ncr")
remDr$getTitle()
remDr$screenshot(display = TRUE)
```

Now we open `TightVNC` and use the VM ip with appropriate port for VNC:


New TightVNC Connection

Connection

Remote Host: 192.168.99.100:5901

Enter a name or an IP address. To specify a port number, append it after two colons (for example, mypc::5902).

Reverse Connections

Listening mode allows people to attach your viewer to their desktops. Viewer will wait for incoming connections.

TightVNC Viewer

TightVNC is cross-platform remote control software.

Its source code is available to everyone, either freely (GNU GPL license) or commercially (with no GPL restrictions).

You will be asked for a password which is `secret`. This can be seen by reading the images dockerfile:

```
RUN apt-get update -qqy \
  && apt-get -qqy install \
    x11vnc \
  && rm -rf /var/lib/apt/lists/* \
  && mkdir -p ~/.vnc \
&& x11vnc -storepasswd secret ~/.vnc/passwd
```

Enter the password and you should have access to the container browser. Navigate to another website;

```
> remDr$navigate("http://www.bbc.com")
> remDr$getTitle()
[[1]]
[1] "BBC - Homepage"
```

and you should observe the action on the containers browser. Finally stop your containers:

```
john@gaming-J MINGW64 ~
$ docker stop $(docker ps -q)
ee0c0bb8b711

john@gaming-J MINGW64 ~
$
```

Remote logging with Linux/debugging

Firstly we stop any running containers which may block our ports:

```
john@ubuntu:~$ docker stop $(docker ps -q)
5475923fc4dc
john@ubuntu:~$ docker ps
CONTAINER ID        IMAGE               COMMAND             CREATED             STATU
S               PORTS               NAMES
```

Like in windows we `pull` the `2.53.0` version of the `Firefox` standalone debug image (again using `sudo` if necessary:

```
john@ubuntu:~$ sudo docker pull selenium/standalone-firefox-debug:2.53.0
2.53.0: Pulling from selenium/standalone-firefox-debug

0be59000882d: Already exists
f20b6f990572: Already exists
53662c966c9f: Already exists
a3ed95caeb02: Already exists
0e449738cbb6: Already exists
63921592acdf: Already exists
8553f3252cbc: Already exists
dde80f7d7068: Already exists
232a7d285d74: Already exists
284e6949cb6f: Already exists
85909c621e51: Already exists
db03d98be095: Already exists
67898bba08c8: Already exists
23edc5cca893: Already exists
5ceef68785db: Already exists
8cbb6b75dad5: Already exists
d18b13cc4e51: Pull complete
4a3e92e6c855: Pull complete
10672504dfa1: Downloading 7.915 MB/16.87 MB
1f5786a4b2ff: Downloading 5.487 MB/5.528 MB
3a29027ac709: Download complete
a70ecef6edbc: Download complete
```

Once the image is downloaded we can start it as we did with Windows. We map Selenium to port 4445 on the host and VNC to port 5901. As noted before the host in the case of Ubuntu 16.04 is the machine itself so `localhost` is the relevant ip:

```
john@ubuntu:~$ sudo docker run -d -p 4445:4444 -p 5901:5900 selenium/standalone-firef
ox-debug:2.53.0
dd36811562e83e66ab145efcedca2825a621741f10d8c81a5fb3fb5ba3019032
john@ubuntu:~$ sudo docker ps --format 'table {{.Names}}\t{{.Image}}\t{{.ID}}'
NAMES                IMAGE                                    CONTAINER ID
thirsty_swanson      selenium/standalone-firefox-debug:2.53.0   dd36811562e8
john@ubuntu:~$
```

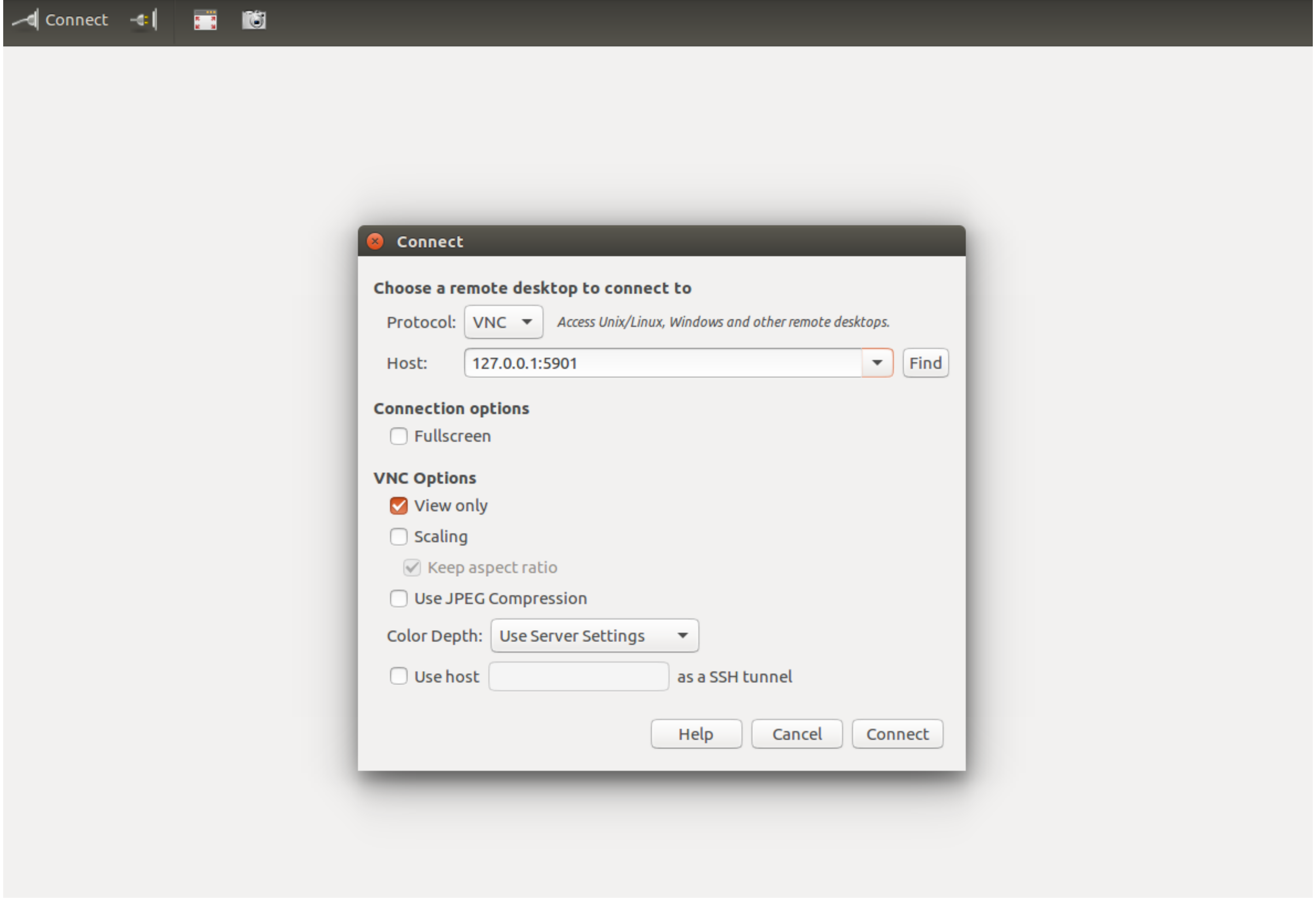
So we can see that Selenium server is running. Like in Windows we need a VNC viewer. You can use `TightVNC` as with windows and a guide to running it is here (https://www.digitalocean.com/community/tutorials/how-to-install-and-configure-vnc-on-ubuntu-16-04). We will use `Vinagre` however. A guide to install `Vinagre` is here (https://www.howtoinstall.co/en/ubuntu/xenial/vinagre). Basically we just need to `apt-get` it:

```
sudo apt-get update
sudo apt-get install vinagre
```

Again we navigate to `Google` :

```
> library(RSelenium)
> remDr <- remoteDriver(port = 4445L)
> remDr$open(silent = TRUE)
> remDr$navigate("http://www.google.com/ncr")
> remDr$getTitle()
[[1]]
[1] "Google"
```

Now open Vinagre and input the correct ip/port (127.0.0.1:5901 in this case0:


Choose a remote desktop to connect to

Protocol: VNC — Access Unix/Linux, Windows and other remote desktops.

Host: 127.0.0.1:5901

Connection options

- [ ] Fullscreen

VNC Options

- [✓] View only
- [ ] Scaling
- [✓] Keep aspect ratio
- [ ] Use JPEG Compression

Color Depth: Use Server Settings

- [ ] Use host as a SSH tunnel

Again it will ask for a password which as before is `secret`.

You should now be able to interact with the containers browser. Again navigate to another website and observe the containers browser:

```
> remDr$navigate("http://www.bbc.com")
> remDr$getTitle()
[[1]]
[1] "BBC - Homepage"
```

Finally close the session:

```
remDr$close()
```

And close down any running containers:

```
john@ubuntu:~$ sudo docker stop $(sudo docker ps -q)
dd36811562e8
john@ubuntu:~$
```