R on the Raspberry Pi 3

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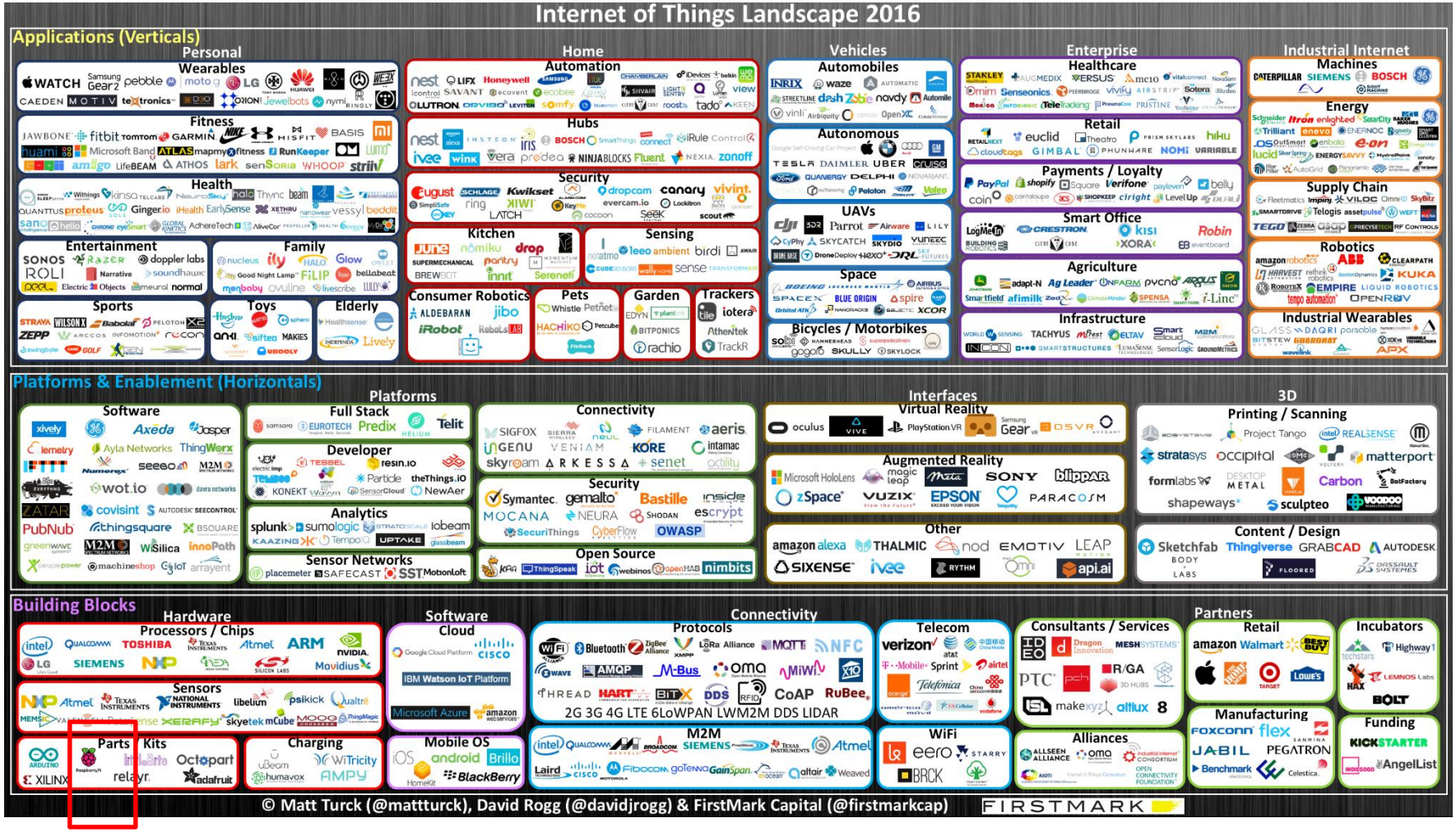
http://earlglynn.github.io/kc-r-users-raspberry-pi-3/

R on the Raspberry Pi 3

- Internet of Things
- Raspberry Pi 3
- Hardware for a Raspberry Pi 3 System
- Raspbian Operating System
- Installing R on Raspberry Pi 3
- Running R on Raspberry Pi 3
- Running “Headless”
- What’s Next?
- Raspberry Pi Resources

Internet of Things



2016 Internet of Things Landscape

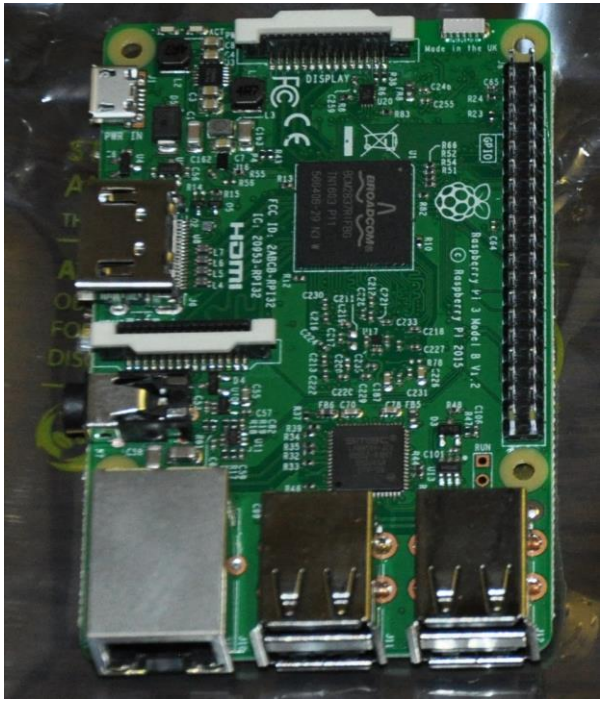
http://mattturck.com/2016/03/28/2016-iot-landscape/

Raspberry Pi 3

- CPU: 1.2 GHZ quad-core ARM Cortex A53
- GPU: Broadcom VideoCore IV @ 400 MHz
- Memory: 1 GB
- USB ports: 4
- Network: 10/100 MBPS Ethernet, 802.11n Wireless LAN, Bluetooth 4.0

New Features

- Built-in WiFi and Bluetooth
- 33% faster processor



Introducing the Raspberry Pi 3, Feb. 28, 2016
http://hackaday.com/2016/02/28/introducing-the-raspberry-pi-3/

Hardware for a Raspberry Pi 3 System

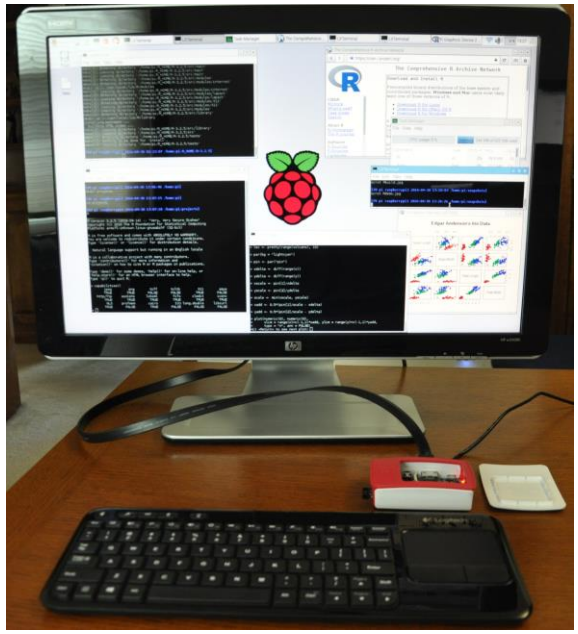
- Raspberry Pi 3, $35
- Official Pi 3 case, $9
- 16 GB Micro SDHC memory card, $5.50 (Microcenter)
- Power supply, $12 (can use phone charger if no other peripherals)

Hardware for a Raspberry Pi 3 System

Run “Headless”

Desktop System

- Keyboard
- Mouse
- HDMI cable
- HDMI monitor
- Audio



Raspbian Operating System

RASPBIAN

- Raspbian – Official Raspberry Pi operating system, which is based on Debian Linux

NOOBS

- NOOBS – New Out-of-Box Software

https://www.raspberrypi.org/downloads/

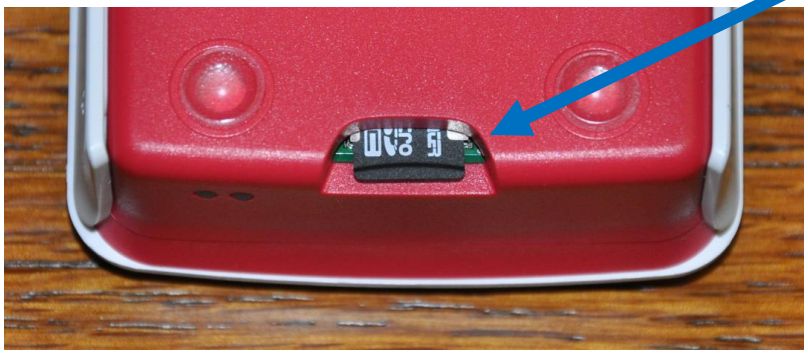
RPi Easy SD Card Setup
http://elinux.org/RPi_Easy_SD_Card_Setup

Installing Raspbian Operating System

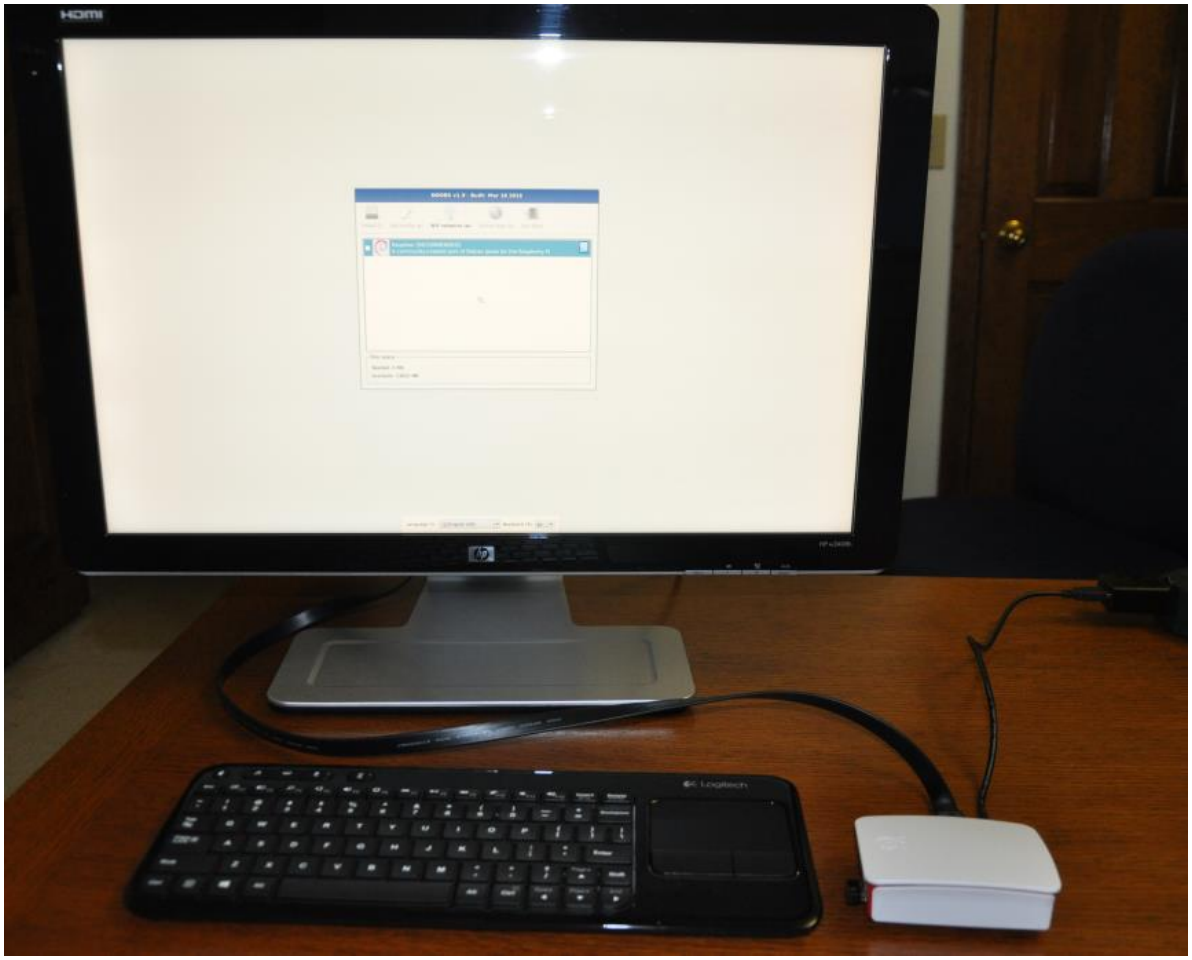
- Use Formatter for Windows or Mac to Format MicroSD Card
  https://www.sdcard.org/downloads/index.html
- Download NOOBS (New Out-of-Box Software), Unzip, and Copy to MicroSD Card
  https://www.raspberrypi.org/downloads/noobs/

NOOBS_v1_9_0.zip 4/29/2016 9:12 PM Compressed (zipped) Folder 1,044,661 KB

- Install MicroSD card in Raspberry Pi

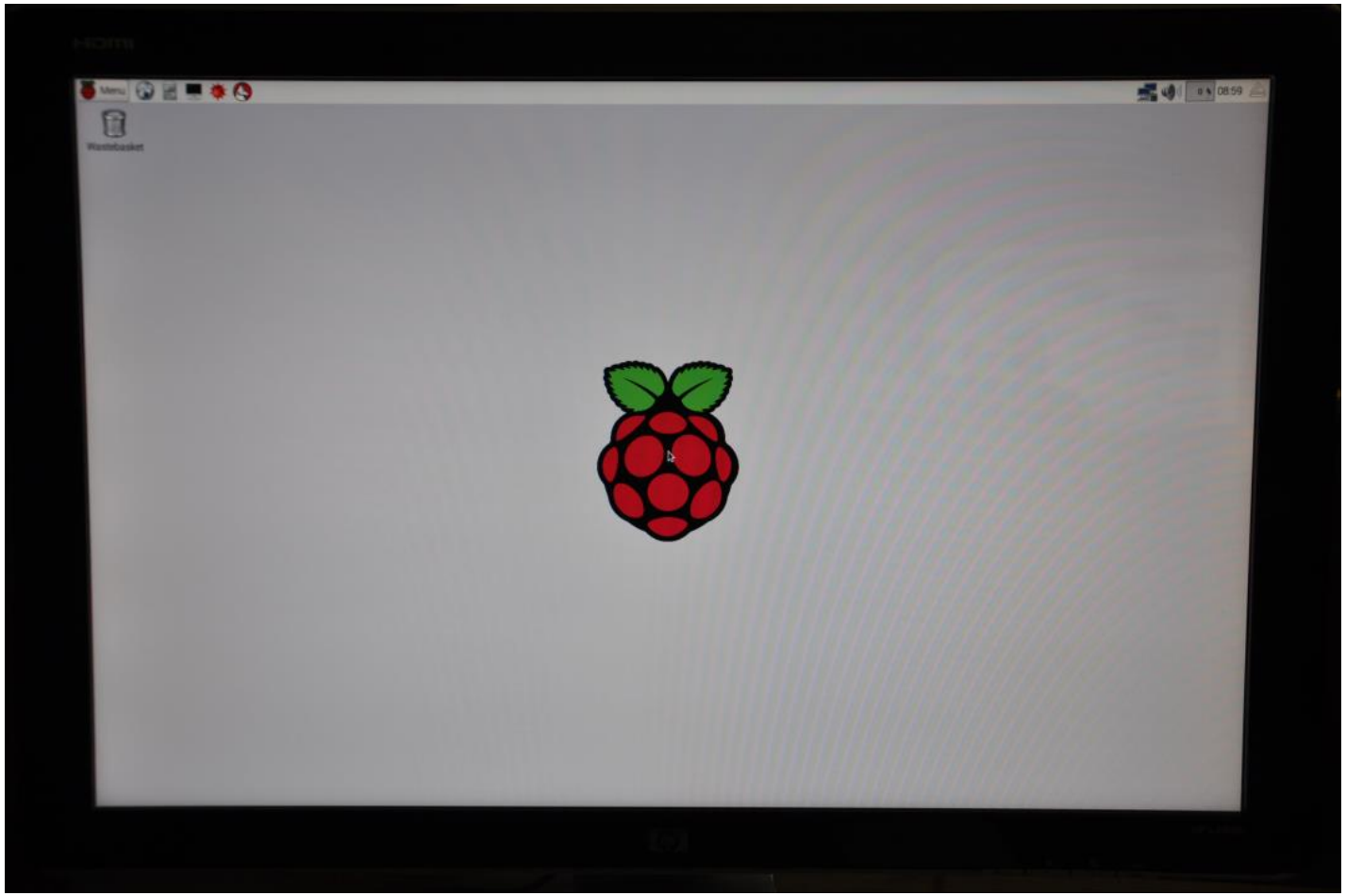


Installing Raspbian Operating System



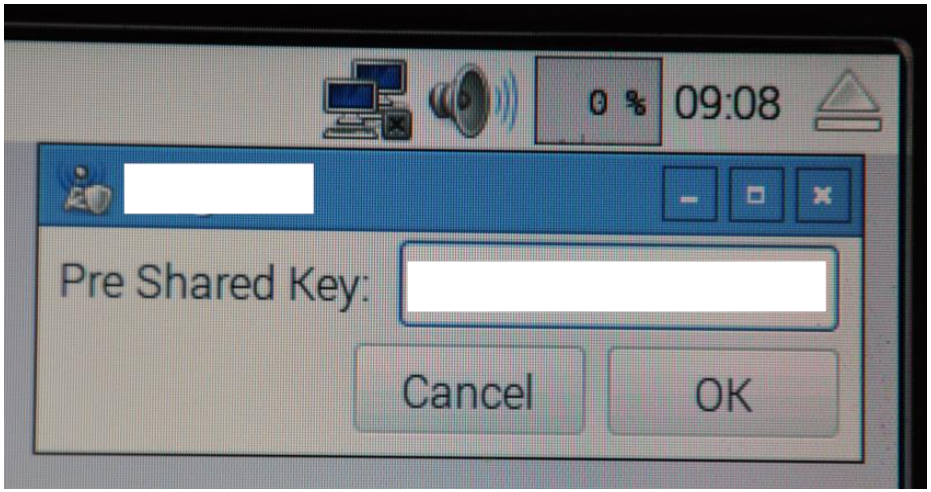
Loading Raspbian takes 10+ minutes

Initial Boot Raspbian Operating System



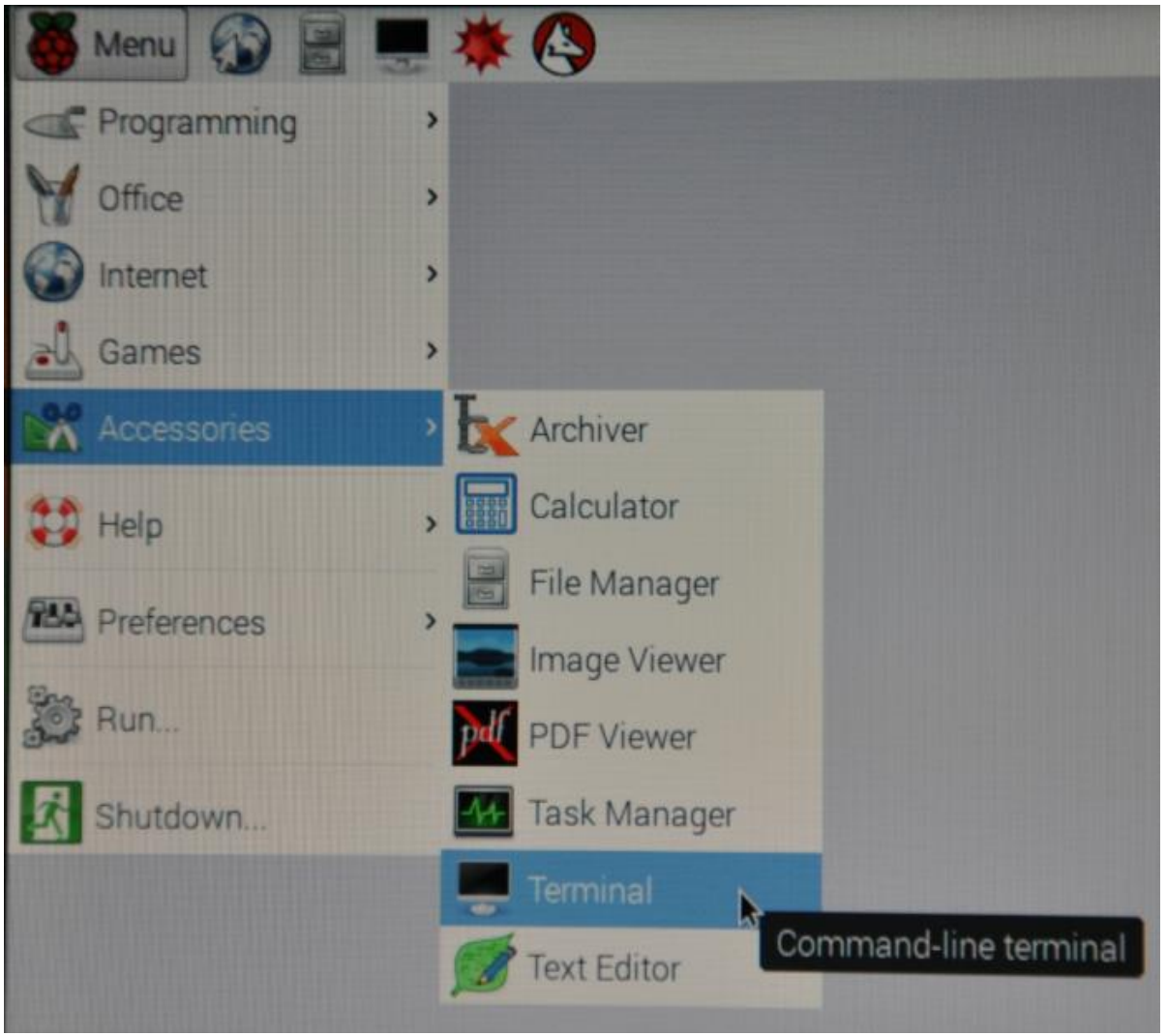
Internet Connection

Raspberry Pi 3 New Feature: Built-in WiFi



Wired connection is still possible

Prepare to Install R



Prepare to Install R

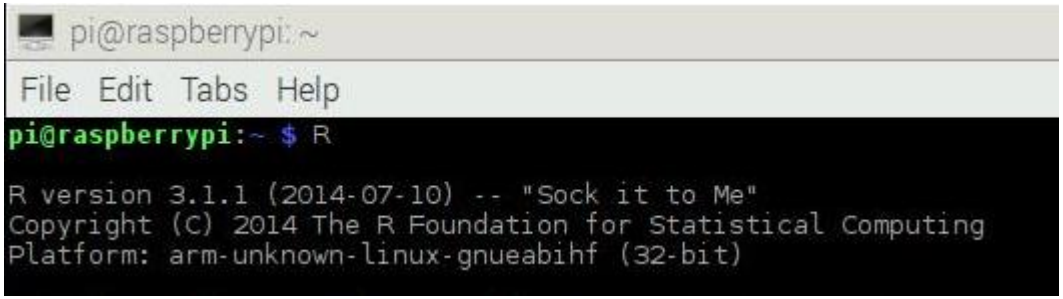
```
# Update and upgrade Raspbian
sudo apt-get update
sudo apt-get upgrade

# Install useful tools
sudo apt-get install gedit
```

Installing R on Raspberry Pi 3

"Easy" install

```
sudo apt-get install r-base
```



Installs *old* version of R from 2014

Installing R on Raspberry Pi 3

Build current R version (3.2.5) from Source Code

```
# Fetch dependencies
sudo apt-get install gfortran libreadline6-dev libx11-dev libxt-dev
libpng-dev libjpeg-dev libcairo2-dev xvfb

# Fetch latest R source code
mkdir R_HOME && cd R_HOME
wget http://cran.rstudio.com/src/base/R-3/R-3.2.5.tar.gz && tar zxvf R-
3.2.5.tar.gz

# Build R from source (takes about an hour)
cd R-3.2.5
./configure --with-cairo --with-jpeglib && make && sudo make install

# Set link to R executable in one of $PATH directories
cd /usr/bin
sudo ln -s  /home/pi/R_HOME/R-3.2.5/bin/R .
```

Based on “Compile and Install R-3.1.2 (32-bit) in Raspberry Pi Model B/B+”
http://mygeeks014.blogspot.com/2015/09/compiling-and-install-r-312-32-bit-in.html

Installing R on Raspberry Pi 3

Installing R Packages from Online Source Code

```
# Install additional packages from KU repository
repo <- "http://rweb.crmda.ku.edu/cran/src/contrib"

# RColorBrewer has no other package dependencies
install.packages( file.path(repo, "RColorBrewer_1.1-
2.tar.gz"), repo=NULL, type="source")
```

Installing R on Raspberry Pi 3

Installing R Packages from Online Source Code

```
# stringr has two dependencies.
# Install dependencies first, then stringr package
install.packages( file.path(repo,
"stringi_1.0-1.tar.gz"), repo=NULL, type="source")

install.packages( file.path(repo,
"magrittr_1.5.tar.gz"), repo=NULL, type="source")

install.packages( file.path(repo,
"stringr_1.0.0.tar.gz"), repo=NULL, type="source")
```

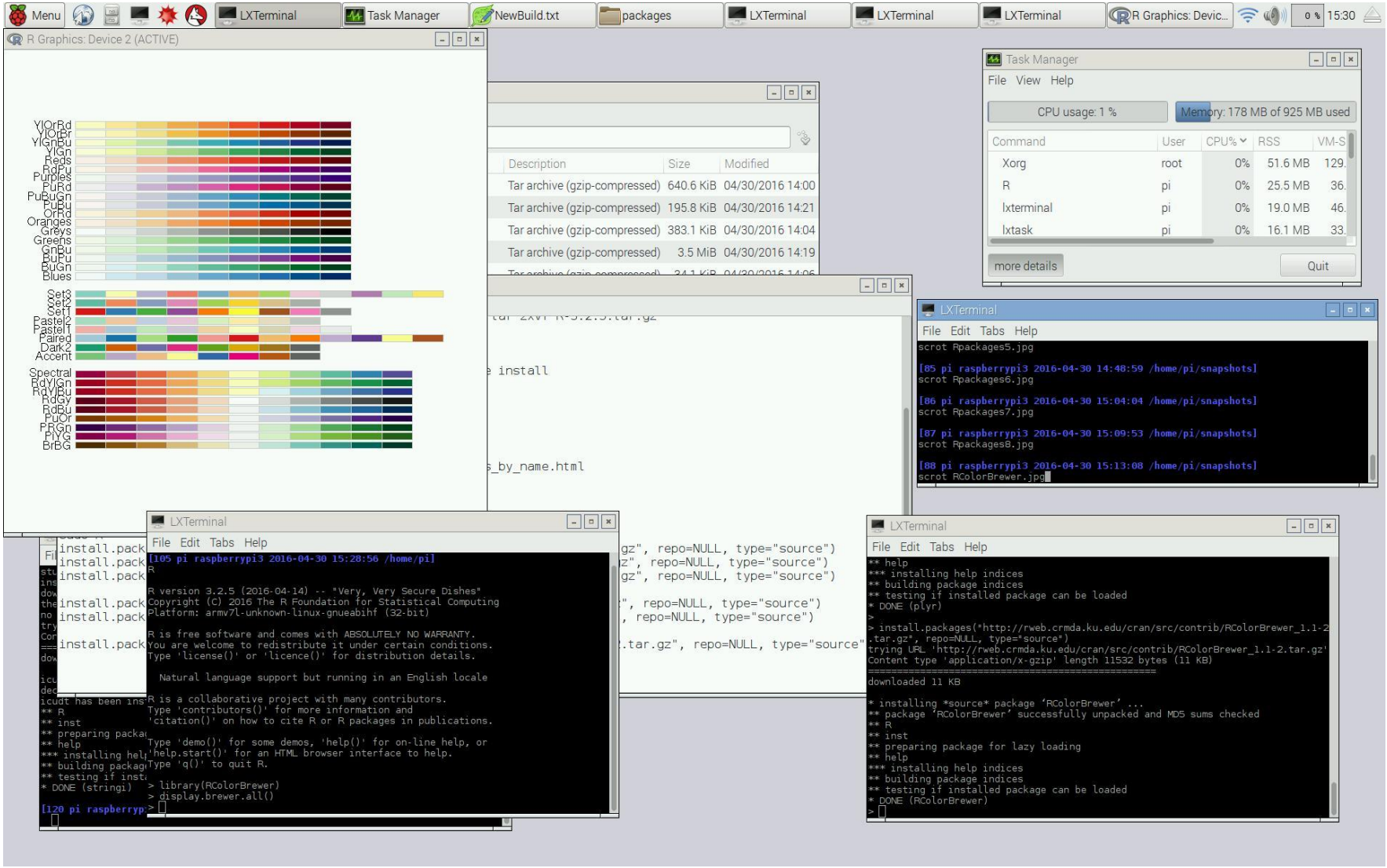
Running R on Raspberry Pi 3

```
[87 pi raspberrypi3 2016-04-30 13:07:18 /home/pi/projects]
R

R version 3.2.5 (2016-04-14) -- "Very, Very Secure Dishes"
Copyright (C) 2016 The R Foundation for Statistical Computing
Platform: armv7l-unknown-linux-gnueabihf (32-bit)
```

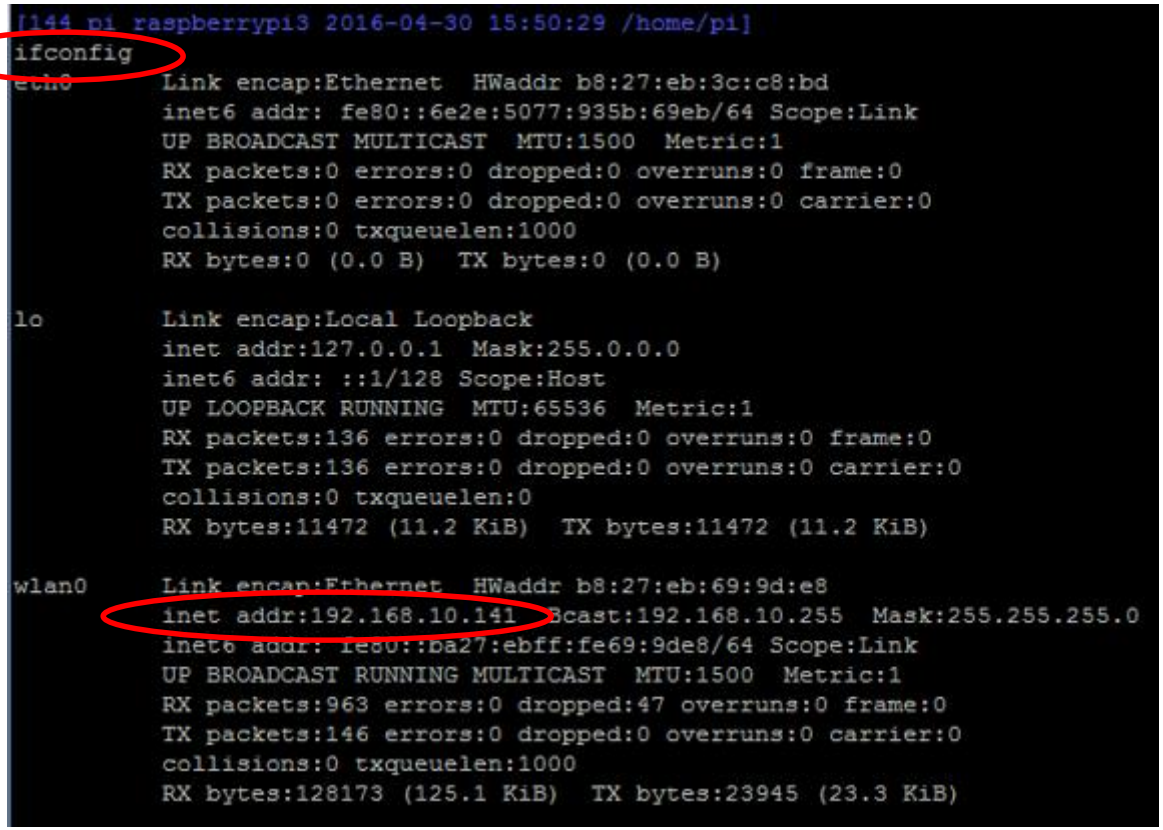
```
> capabilities()
      jpeg        png       tiff      tcltk        X11       aqua
      TRUE       TRUE      FALSE      FALSE       TRUE      FALSE
  http/ftp    sockets     libxml       fifo     cledit      iconv
      TRUE       TRUE       TRUE       TRUE       TRUE       TRUE
       NLS    profmem      cairo        ICU long.double    libcurl
      TRUE      FALSE       TRUE      FALSE      FALSE      FALSE
```

Running R on Raspberry Pi 3



Running “Headless”

Find IP address of Pi:

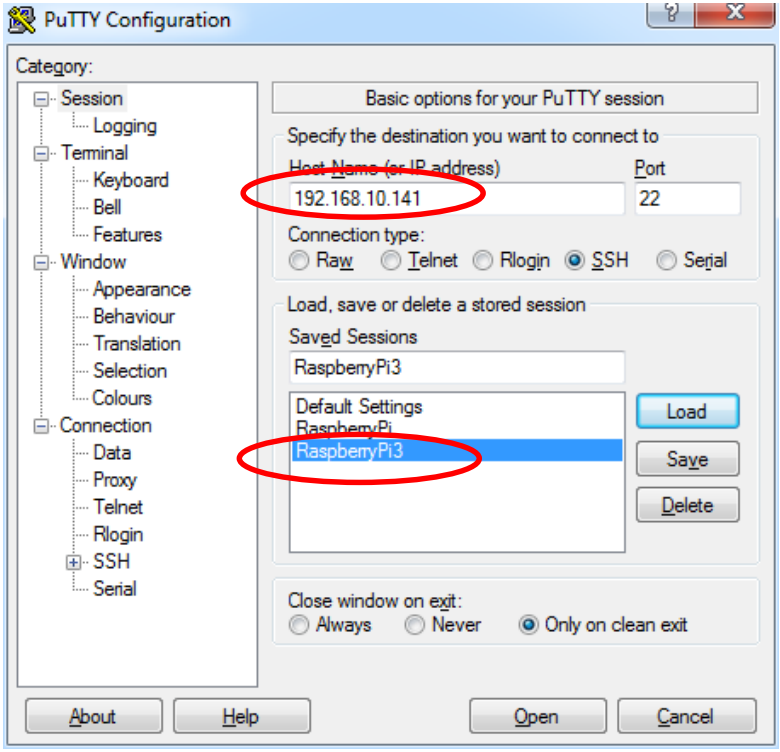


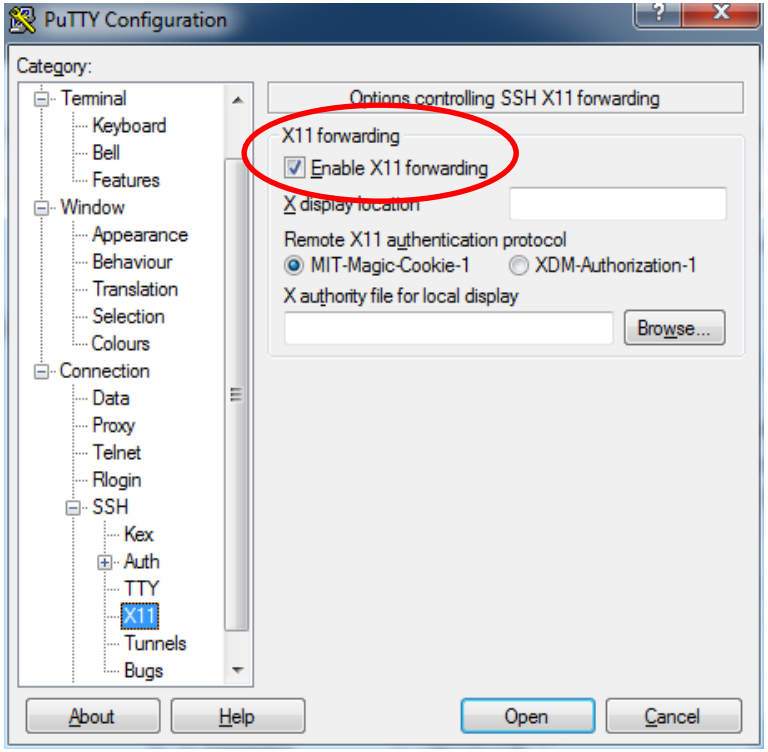
Headless setup: no keyboard, display or frustration, April 2014
https://www.raspberrypi.org/forums/viewtopic.php?t=74176

Running “Headless”

From PC or Mac using SSH:

Install and configure X11 client, such as PuTTY:



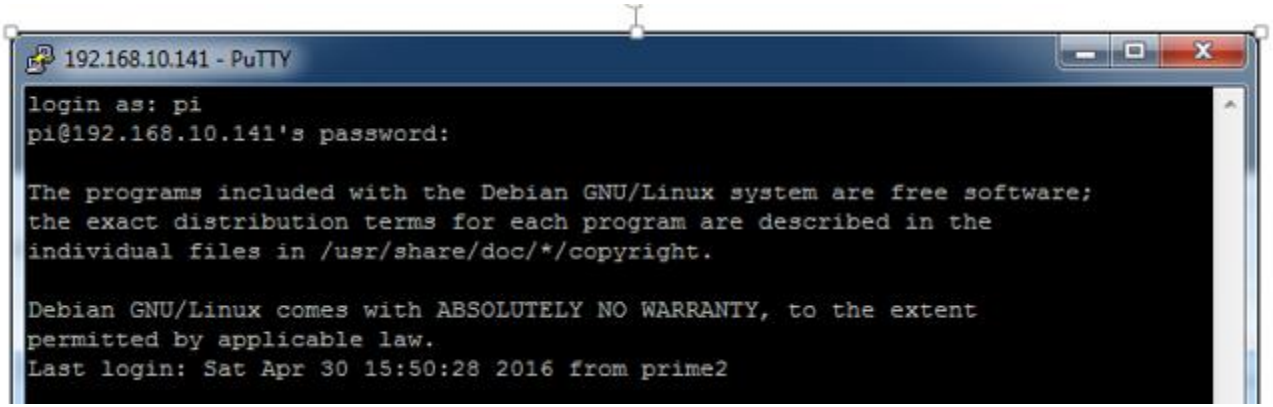


Installing/Configuring PuTTy and Xming

http://www.geo.mtu.edu/geoschem/docs/putty_install.html

Running “Headless”

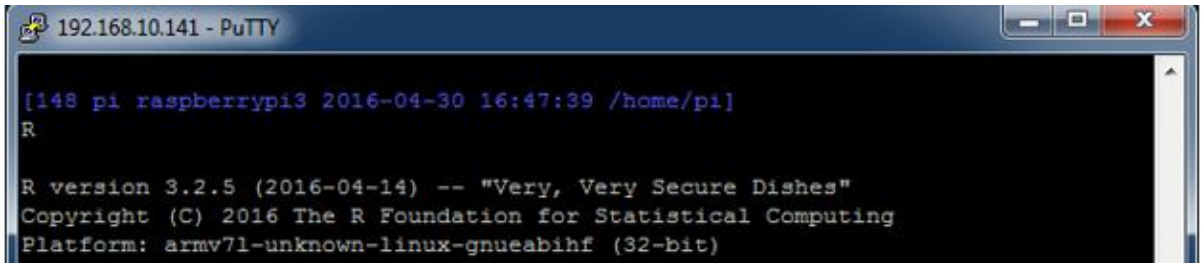
Login to Pi from PC, Mac or Linux with X11:



- Default Login: pi
- Default Password: raspberry

Running “Headless”

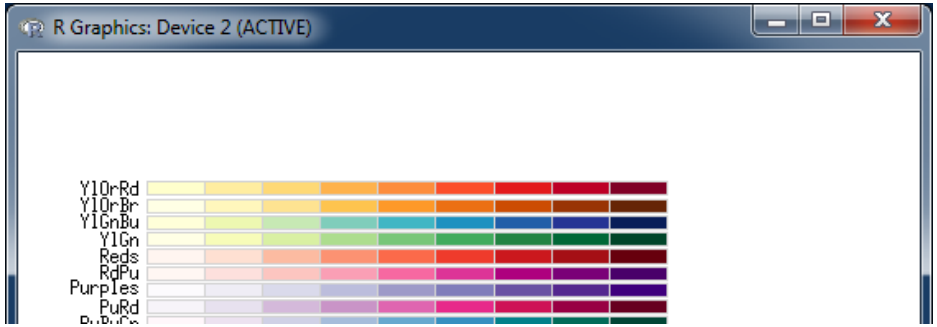
Run R on Raspberry Pi:



Invoke R commands on Pi creating graphics:

```
> library(RColorBrewer)
> display.brewer.all()
```

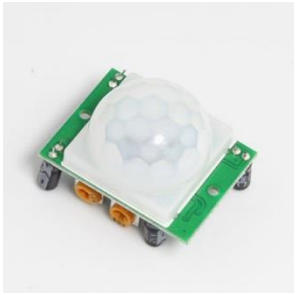
See R output from Pi on PC in new window (slow):



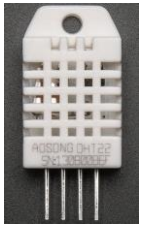
What's Next?

- Use sensors attached to Raspberry Pi to collect real-time data.
- Use R to analyze and visualize data in near real-time.

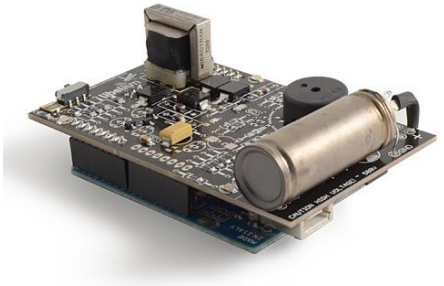
Gas sensor



Motion sensor



Temperature/
Humidity



Radiation sensor

http://www.wirelesshack.org/the-top-10-raspberry-pi-sensors-for-your-projects.html

Raspberry Pi Resources

- Raspberry Pi Weekly Newsletter
  https://www.raspberrypi.org/weekly/
- coursera

An Introduction to Programming the Internet of Things Specialization https://www.coursera.org/specializations/iot

  - Raspberry Pi Platform and Python Programming for the Raspberry Pi
  - Interfacing with the Raspberry Pi
- Install Shiny Server on Raspberry Pi
  http://withr.me/install-shiny-server-on-raspberry-pi/

Take Home Messages

- The “Internet of Things” may provide great new opportunities for real-time data collection with a wide variety of sensors.
- The Raspberry Pi open hardware platform is a great way to experiment with “Internet of Things” sensors to collect data.
- R is a great tool for near real-time data analysis on the Raspberry Pi 3 processor.