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

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

• NOOBS – New Out-of-Box Software

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

• 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+”
# 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")

# 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

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 cedit 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:

```
ifconfig
```

```
eth0  Link encap:Ethernet  HWaddr b8:27:eb:3c:c8:bd
     inet6 addr: fe80::6e2e:5077:935b:69eb/64 Scope:Link
     UP BROADCAST MULTICAST MTU:1500  Metric:1
     RX packets:0 errors:0 dropped:0 overruns:0 frame:0
     TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
     collisions:0 txqueuelen:1000
     RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lo    Link encap:Local Loopback
     inet addr:127.0.0.1  Mask:255.0.0.0
     inet6 addr: ::1/128 Scope:Host
     UP LOOPBACK RUNNING  MTU:65536  Metric:1
     RX packets:136 errors:0 dropped:0 overruns:0 frame:0
     TX packets:136 errors:0 dropped:0 overruns:0 carrier:0
     collisions:0 txqueuelen:0
     RX bytes:11472 (11.2 KiB)  TX bytes:11472 (11.2 KiB)

wlan0 Link encap:Ethernet  HWaddr b8:27:eb:69:9d:e8
     inet addr:192.168.10.141  Bcast:192.168.10.255  Mask:255.255.255.0
     inet6 addr: fe80::da27:ebff:fe69:9de8/64 Scope:Link
     UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
     RX packets:963 errors:0 dropped:47 overruns:0 frame:0
     TX packets:146 errors:0 dropped:0 overruns:0 carrier:0
     collisions:0 txqueuelen:1000
     RX bytes:128173 (125.1 KiB)  TX bytes:23945 (23.3 KiB)
```

Headless setup: no keyboard, display or frustration, April 2014
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:

```r
> 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.