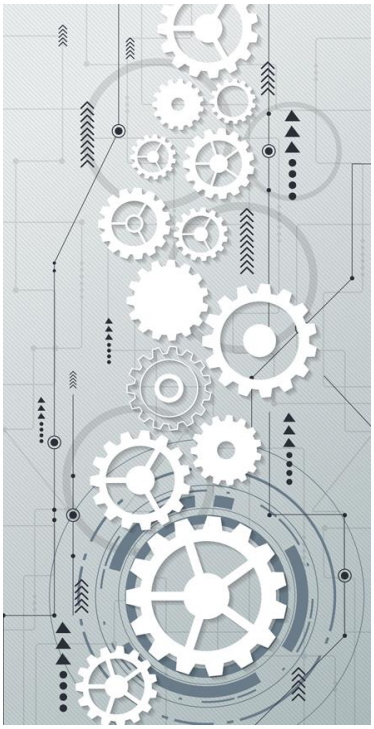

RASPBERRY PI EXERCIES PACKET

PREFACE

Scope of this exercise packet:

1. Perform basic system tasks to administer your PI yourself. In order to do that, you should know about basics in the Linux OS itself including
   - Setting your own user environment
   - File System
   - A bit about remote access
   - Navigating around Linux system
   - Administrate processes
   - Writing Scripts
2. Work with GPIO with sensors
3. Basics in Python

To be added in the future:

Explore IOT

Ref to : online PI Tutorial Packet at http://learn.stormingrobots.com.

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SECTION 1 - GETTING STARTED AND MANAGE YOUR PI

Utilize Tutorial Section I to IV

- Do's and Don'ts
- Installation
- Remote access your PI
- Know basics about the File System
- Setting your own user environment
- Navigating around the file system
- Do remote access with VNC, or ssh
- Install and deinstall software
- Know how to set up your profile / bashrc
- Know how to write basic bash script and run it
- Ping hostnames between your own computer and PI, set up hostnames, etc.
- Know basics about VIM editor and customizing it.
- Set up email sender service
- Do backup

I - 1.A) TRY OUT MOST COMMONLY USED COMMANDS

*****(Observe the behavior after each command. Be Inquisitive)**

```
1.  man ls
2.  cd /
3.  pwd
4.  cd ~/;  pwd
5.  cd .vnc;  pwd
6.  cd .. ;
7.  ls -lS
8.  ls -ltra
9.  ls -ltra | more
10. ls -ltra > allFiles.txt
11. ls -l  |  wc -l  >>  allFiles.txt
12. cat “this is the end !” >> allFiles.txt
13. cat allFiles.txt
14. ls -lt all*
15. rm allFiles.txt
16. dir
17. dir -R
18. ls -lr
19. ls -lR
20. ls -lR | grep "^d”
21. alias ldir=’ls -lR | grep "^d"’              #you just created a new command!
22. ldir
23. clear
24. date
25. date +%D
26. date +"%T"
27. time
28. man -? > help.txt
29. tail -f help.txt
30. ls /root/
31. sudo ls /root/
32. wget  https://www.stormingrobots.com/prod/pdf/csSyllabus.pdf  &      #& == runs in background
33. du
34. du -sh
35. du -h * -d 1
36. du – h * -d 3
37. du -h * | sort -n
38. du -h * | sort -nr
39. du -a . | sort -nr | head
40. du -a . | sort -nr | tail
41. df
42. df -h
43. df /home
```

```
44. echo "echo \"Hello World \"  " > test.sh
45. cat test.sh
46. ls -l test.sh     # you see:  -rw-r--r-- 1   ...   test.sh
47. ./test.sh         #  fail to run
48. chmod +x   test.sh
49. ls -l test.sh     # you see:  -rwxr-xr-x 1   ...   test.sh
50. ./test.sh
51. ls -l | grep "^\."       # list all hidden files and directories
52. ls -l | grep "^d"        # list  directories
53. ls -l | wc -l            # count of nodes (files, directories, links, etc.)
54. ps -ef
55. watch -n 1 "ps -ef" &
56. ps                       # find the PID (process ID) for this watch command
57. kill  3000               #  replace 3000 with  the PID of the "watch" process
58. ps                       # now you see the process is gone
59. clear
60. history
61. top
62. Ctrl+Z
63. Jobs                     # find the job # , e.g. [9]
64. fg 9                     # type the # 9 from, the previous finding
65. bg 9                     # put back to the background
    <now, you need to kill this process... >
66. find   .  -name    lxde-pi-rc.xml
67. find . -print | grep -i lx
68. uptime
```

—Special note about redirection (>)

About standard file descriptors : 1, 2 == standard output and standard errors

- Syntax: command > file   samd as   command 1> file
- echo "hello" > file   == echo "hello" 1> file
- echo "hello" >&2 file   == echo "hello" 1>&2   file
- application 1>/dev/null == suppress the standard output

I - 2) LEARN VIM

1) Go thru the "CRASH COURSE TO LEARN VIM" in the tutorial packet.
   OR
2) Use : http://www.openvim.com/tutorial.html interactive tutorial

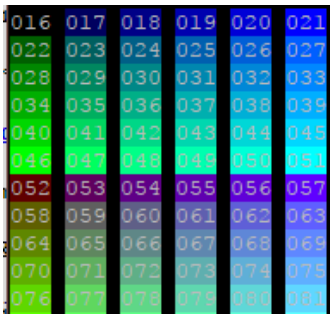
   Go to http://www.openvim.com/sandbox.html to practice. When you are doing trying all the keystrokes in the crash course tutorial. Move onto the next exercise below.

I - 3) SHELL EXERCISES

1. Tracking down where disk space has gone to . find out who has eaten up the most disk space.
2. Try out all the tutorial packet:
   a. "COMMON ERRORS IN PARSING"
   b. "SCRIPTS SAMPLES"
3. Create a few of aliases and put them in ~/.bash_aliases .
4. Display "Good Morning", "Good Afternoon", or "Good Night" based on system time.
5. Read a file into bash array. Display them.
6. Create a script to produce value of factorial of "N" where N is from user input.
7. Redo (6), but make thata factorial codes as a function which takes in a single integer parameters.
8. Create a script to find all prime numbers using Sieve of Eratheosenes under N where N is from user input
9. Write a script to:
   a. ping to find the round-trip delay to www.google.com
   b. Use traceroute to see the network route taken to www.google.com
   c. Run it infinitely with an interval of every 1 minute.
   d. And start it to run in the background.
10. Kill that ping background process.
11. Schedule your PI to say hello in every 5 minutes.
12. Schedule your PI to remind you snack, and lunch time.
13. Schedule your PI to shutdown at 3:00pm, and reboot at 9:00am.
14. Write a script to monitor the growth of disk space, and schedule it to report whenever it increases by 100

Extras:.

15. Customize your Prompt
16. Customize your vi environment and download the c.vim plug-in.
17. Write a script to display all the color from 16 to 255. E.g. printf "\e[48;5;24m Show This"



18. Repeat Ex.9, but save the code to a file.

SECTION II - GPIO EXERCISES

Utilize Tutorial Section V

1. Writing scripts to manipulation basic digital devices via GPIO pins
2. Using WiringPI library to write the C programs to produce the same effect.

Special note for those who do not know C++ at all, do review the following link to at least get yourself familiar with how to read a class declaration and its methods:

Here is a simple Fruit/inventory purchase / sell class:

https://www.element14.com/community/community/code_exchange/blog/2013/03/06/c-tutorial--classes

In order to stay with the scope, this is the extent of OOPS (object-oriented programming system) you need to know.

II - 1) WRITE THREE SCRIPTS :

1. Turn on and off a LED with a push button with pull up . Display :
   "Got Pushed... Light out" // if it is pushed
   "Got Released... Light on" // if it is released
   e.g. code segment

```
# gpio pin 27 to push button and a resistor  to the GND
gpio -g mode 27 up
```

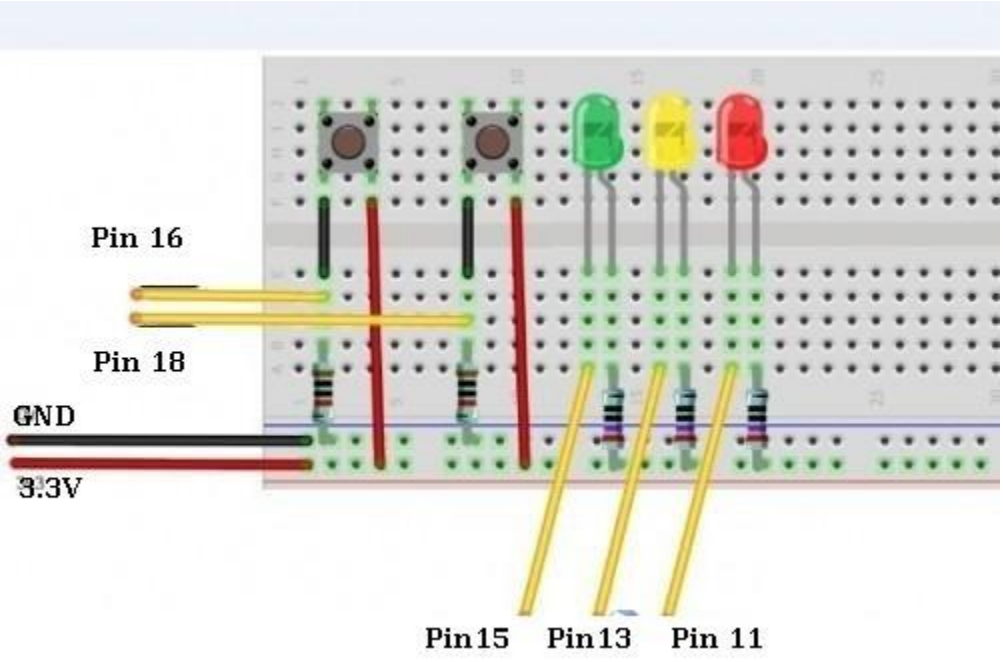
2. Turn on and off a LED with a push button with pull down. Display :
   "Got Pushed... Light on" // if it is pushed
   "Got Released... Light out" // if it is released

   e.g. code segment

```
# gpio pin 27 to push button and a resistor to the 3V line
gpio -g mode 27 down
```

3. Take user input to determine if you want to run pull down or pull down
   e.g.

```
> runLed.sh up
> runLed.sh down
```



II - 2) WRITE THE SAME PROGRAM IN C PROGRAM

```
#include <stdio.h>    // Used for printf() statements
#include <wiringPi.h> // Include WiringPi library!

// Pin number declarations. We're using the Broadcom chip pin numbers.
const int pwmPin = 18; // PWM LED - Broadcom pin 18, P1 pin 12
const int ledPin = 23; // Regular LED - Broadcom pin 23, P1 pin 16
const int butPin = 17; // Active-low button - Broadcom pin 17, P1 pin 11

const int pwmValue = 75; // Use this to set an LED brightness

int main(void)
{
  // Setup stuff:
  wiringPiSetupGpio(); // Initialize wiringPi -- using Broadcom pin numbers

  pinMode(pwmPin, PWM_OUTPUT); // Set PWM LED as PWM output
  pinMode(ledPin, OUTPUT);     // Set regular LED as output
  pinMode(butPin, INPUT);      // Set button as INPUT
  pullUpDnControl(butPin, PUD_UP); // Enable pull-up resistor on button
```

```
    printf("Blinker is running! Press CTRL+C to quit.\n");

    // Loop (while(1)):
    while(1)
    {
        if (digitalRead(butPin)) // Button is released if this returns 1
        {
            pwmWrite(pwmPin, pwmValue); // PWM LED at bright setting
            digitalWrite(ledPin, LOW);     // Regular LED off
        }
        else // If digitalRead returns 0, button is pressed
        {
            pwmWrite(pwmPin, 1024 - pwmValue); // PWM LED at dim setting
            // Do some blinking on the ledPin:
            digitalWrite(ledPin, HIGH); // Turn LED ON
            delay(75); // Wait 75ms
            digitalWrite(ledPin, LOW); // Turn LED OFF
            delay(75); // Wait 75ms again
        }
    }

    return 0;
}

gcc -Wall blinker.c -l wiringPi blinker
```

sudo ./blinker

SECTION III - KERNEL LEVEL PROGRAMMING FOR I2C INTERFACE

Utilize Tutorial Section VI

— Writing Device System Calls to access I2C devices

III - 1) PRACTICE YOUR BASE CONVERSION

Decimal (base-10) to Hexadecimal (base-16) and Binary (base-2)

Decimal (base-10)	Hexadecimal (base-16)	Binary (base-2)
12		
14		
13		
15		
16		
127		
255		
256		
1023		
1024		
2047		
2048		
65535		
65536		

Binary (base-2) to Hexadecimal (base-16) and Decimal (base-10)

Binary (base-2)	Hexadecimal (base-16)	Decimal (base-10)
00001		
00011		
00111		
01001		
110011		
1001110		
00001001		
10001001		
01001001		

10101000		

III - 2) PROGRAM TO COMMUNICATE WITH YOUR I2C DEVICES

Hook up the following i2c sensors and display all the following:

What to test with	What you need to do :
HiTechnic IR Seeker	• Get version • # from all zones. Tested with an IR Ball
Mindsensors light array	• Get version • # from all 8 light sensors. Tested with a lines
Mindsensors I2C adapter connected to ev3 light	• Get the raw data
Mindsensors I2C adapter	• Get version • Modify the I2C address of the module

III - 3) PROGRAM WITH A PING SENSOR

There are four pins on the ultrasound module that are connected to the Raspberry:

- VCC to Pin 2 (VCC)
- GND to Pin 6 (GND)
- TRIG to Pin 12 (GPIO18)
- connect the 330Ω resistor to ECHO.
- On its end you connect it to Pin 18 (GPIO24) and through a 470Ω resistor (pull down) you connect it also to Pin6 (GND).

Pseudo-code

```
Set to BCM

set GPIO Pins
trigger pin  = 18  as output
echo pin = 24      as input


set tigger pin high
wait after 0.01ms
set trigger pin to low
```

```
StartTime = time.time()
StopTime = time.time()

while echo pin  is low (0)
      save the start time

While echo pin == 1
     Save the stop time

elapsed  time = stop time – start time

# sonic speed = 34300 cm/s

distance = (elapsed time * sonic speed) / 2 because it is round trip
```

SECTION IV – PYTHON

Utilize Tutorial Section VII

Know the basic data types and structure about Python 3.X

IV - 1) EXERCISES :

- Array : must use "List"
- Recursion
- More on List and Tuples

From http://learn.stormingrobots.com

IV - 2) WORK WITH ADC TO COMMUNICATE WITH ANALOG INPUT DEVICE

Work with With adafruit ADC

1) Now you will write a python program to detect black & white using the ADC and photocell .
    - Write the photocell and create a voltage divider
    - Program to detect white or black by using hardcoded threshold
2) Do (2) , except using adjustable threshold by using the potentiometer.
    - Photocell
    - Potentiometer
    - Program the potentiometer to create adjustable threshold