UCSD Embedded Linux Assignment 1

By

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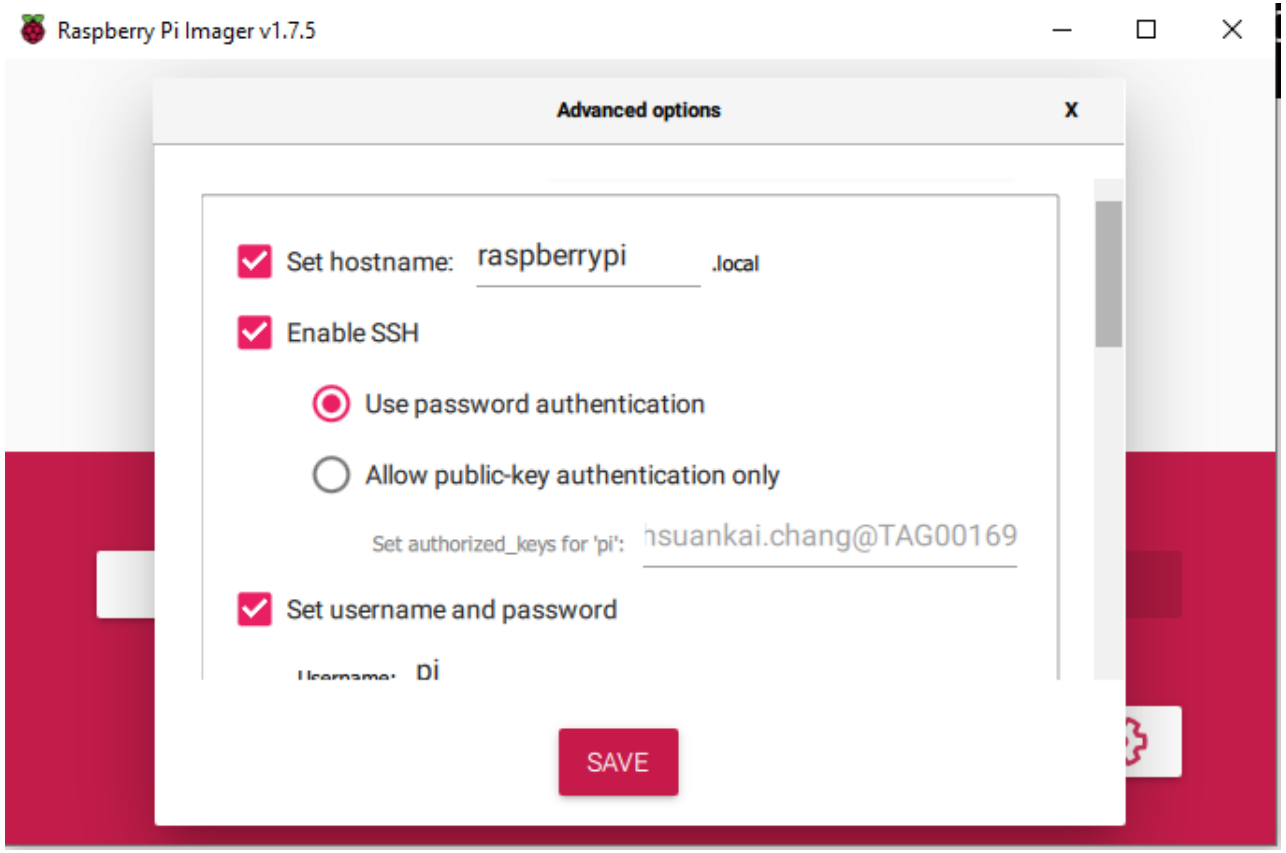
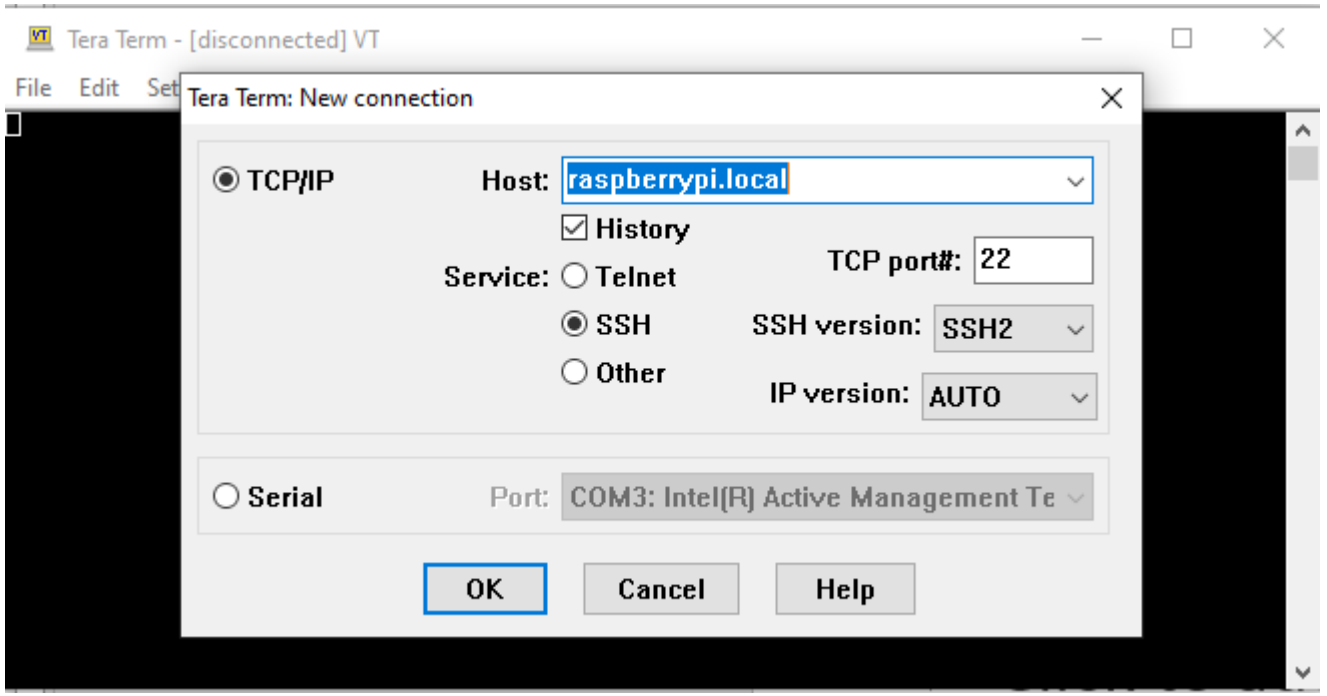
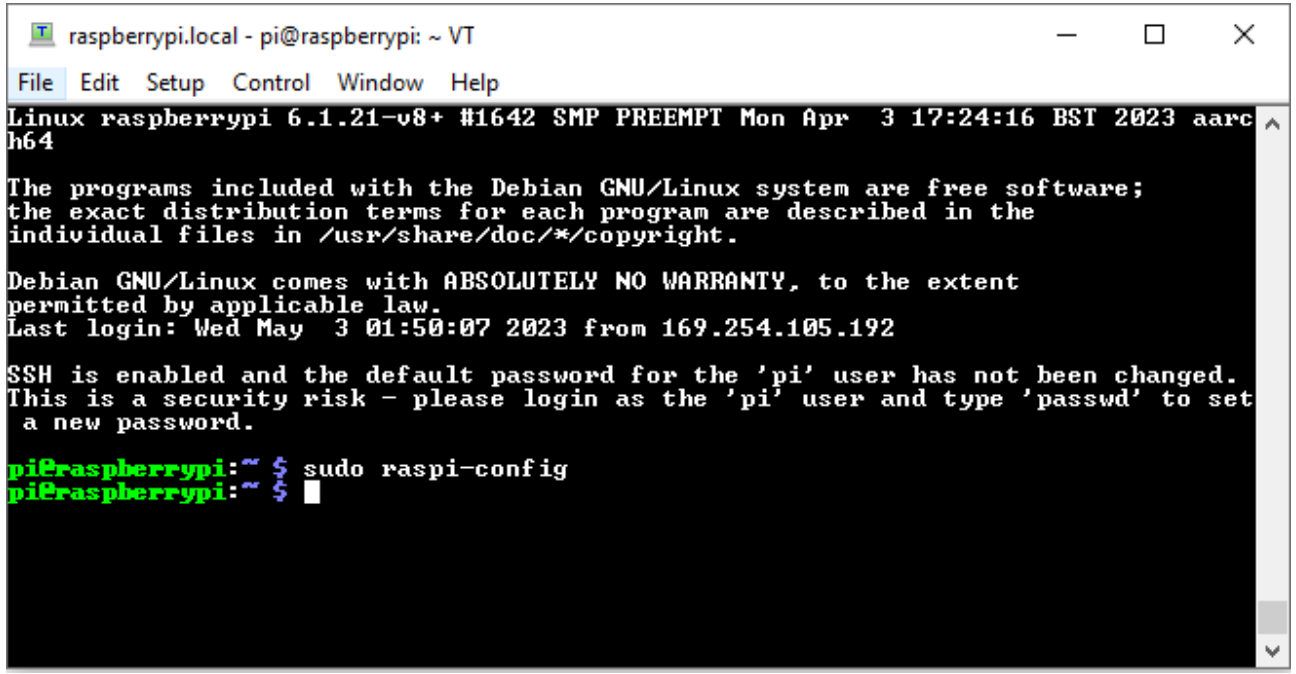
Step 1. Flash the image file of the raspberrypi using rasperrypi imager into the micro sd card. Since I am using the headless connection way, I will have to enable to SSH connection in the advanced settings. Noted that I still set my raspberrypi as default username: pi and password: raspberry.

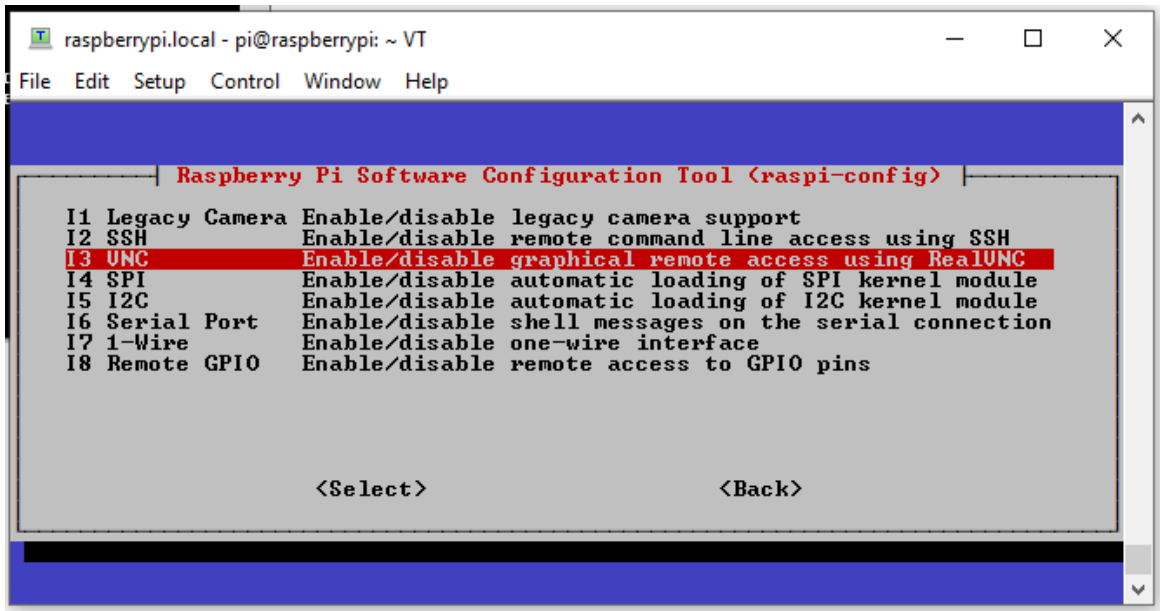


Step 2. After writing the image to the SD card is complete, plug the SD card into raspberrypi, connect the power and ethernet cable. Start the power and use tera term to log into the raspberrypi.

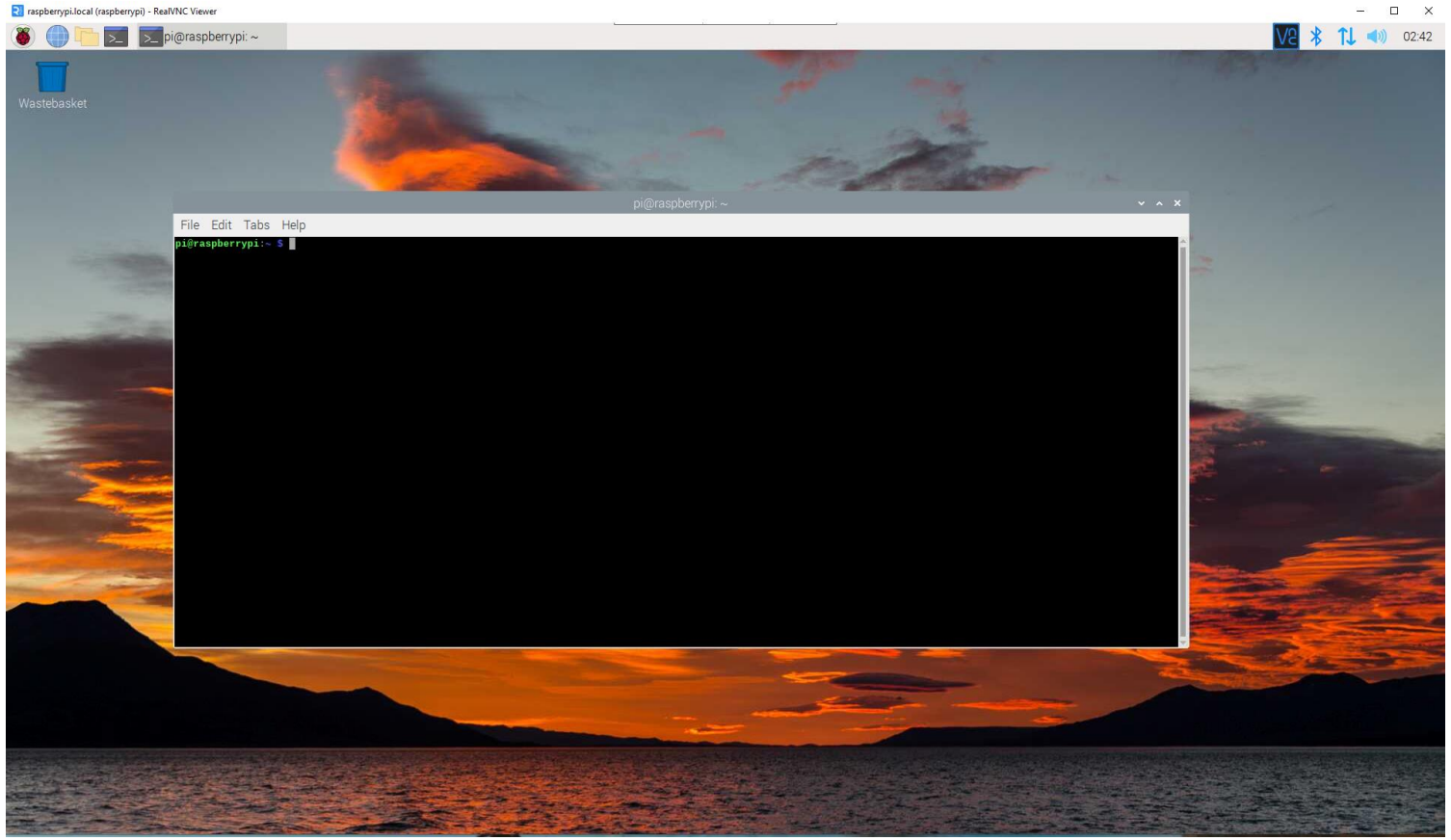


Step 3. Type the username and password for the pi, then enable the VNC connection by typing in sudo raspi-config. Then go to interface options, VNC, choose yes to enable

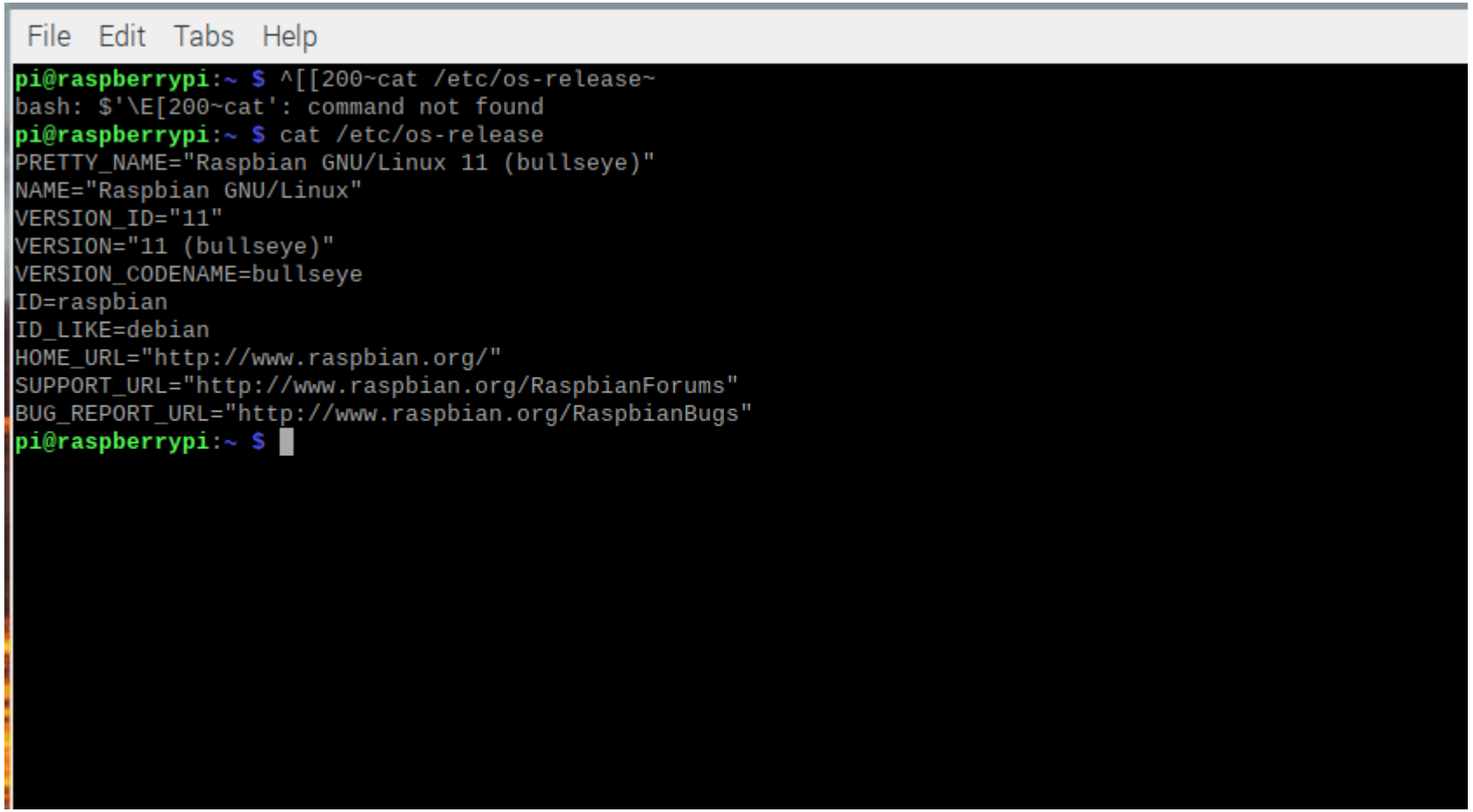




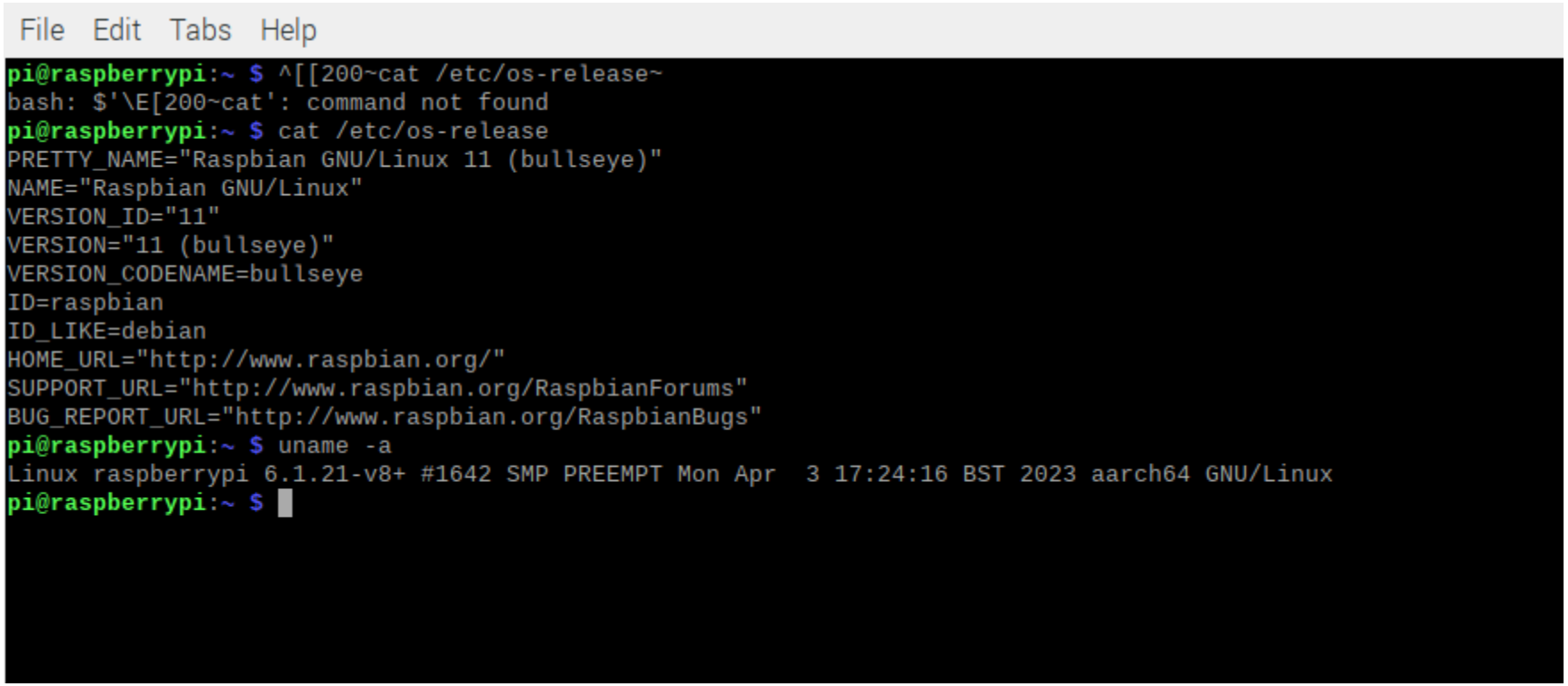
Step 4. Install VNC software, then log into the PI. Username and password is the same as SSH log in



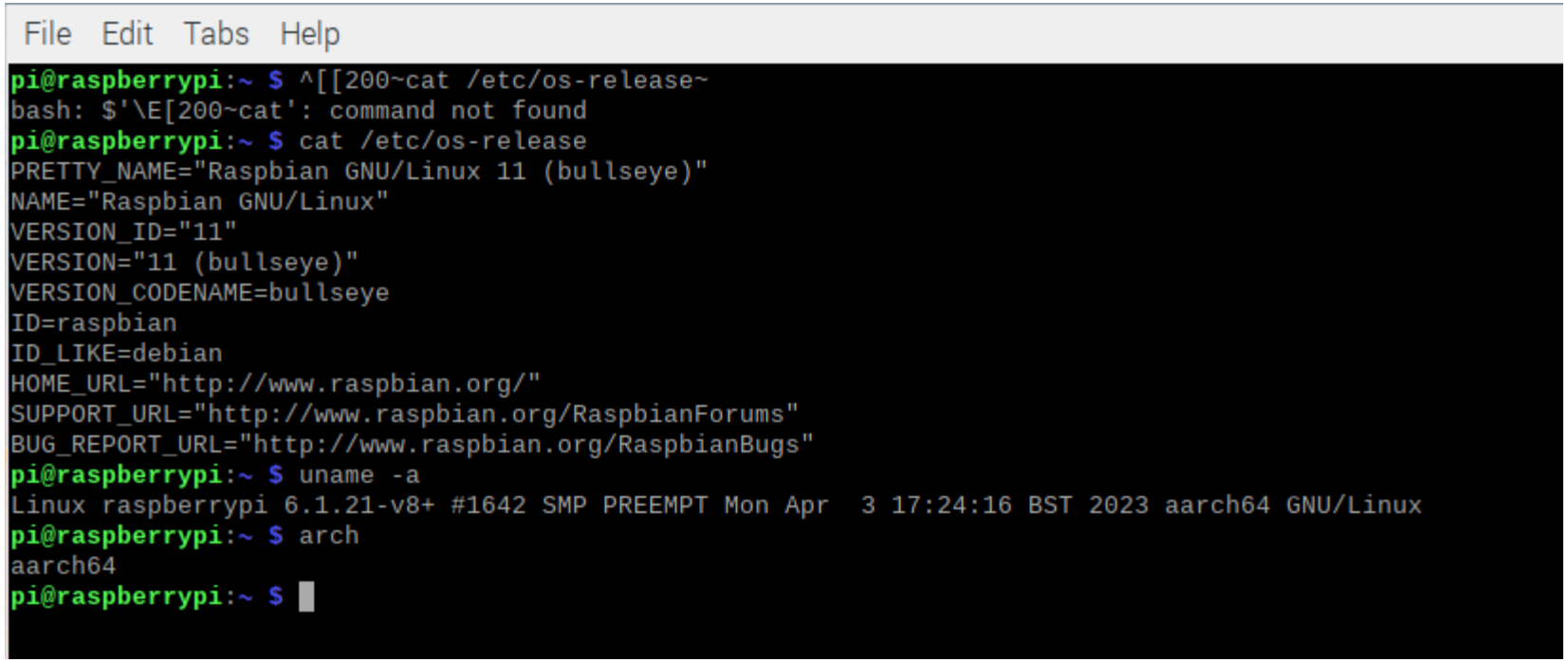
Step 5. Output for the command cat /etc/os-release



Step 6. Output for the command uname -a



Step 7. Output for the command arch



Step 8. Build and run the hello.c file, test is successful

```
pi@raspberrypi:~ $ cat hello.c
#include <stdio.h>

int main() {

        puts("Hello World");
        return 0;
}
pi@raspberrypi:~ $ gcc -Wall -o hello hello.c
pi@raspberrypi:~ $ ./hello
Hello World
pi@raspberrypi:~ $
```

Step 9. Try to build the hello.o file, test is successful

```
pi@raspberrypi:~ $ gcc -Wall -c hello hello.c
gcc: warning: hello: linker input file unused because linking not done
pi@raspberrypi:~ $ ls
Bookshelf  Documents  hello    hello.o     math.c  math.o     math-test.c         math-test-dynamic.c  Pictures  Templates
Desktop    Downloads  hello.c  libmath.so  math.h  math-test  math-test-dynamic   Music                Public    Videos
pi@raspberrypi:~ $
```

```
pi@raspberrypi:~ $ file hello.o
hello.o: ELF 32-bit LSB relocatable, ARM, EABI5 version 1 (SYSV), not stripped
pi@raspberrypi:~ $
```

Step 10. Show your math.h, math.c source code and also the commands/output of building and running of the code

```
pi@raspberrypi:~ $ cat math.h
#ifndef _MATH_H_
#define _MATH_H_

int sum(int a, int b);
int prod(int a, int b);

#endif


pi@raspberrypi:~ $ cat math.c
#include "math.h"

int sum(int a, int b) {
        return a + b;
}

int prod(int a, int b) {
        return a * b;
}

pi@raspberrypi:~ $ gcc -Wall -c math.c
pi@raspberrypi:~ $ file math.o
math.o: ELF 32-bit LSB relocatable, ARM, EABI5 version 1 (SYSV), not stripped
pi@raspberrypi:~ $
```

Step 11. Show your math-test.c source code and also the commands/output of building and running of the code

```
pi@raspberrypi:~ $ cat math-test.c
#include <stdio.h>
#include "math.h"

int main() {
        int value = sum(10, 20);
        printf("value: %d\n", value);

        value = prod(10, 20);
        printf("value: %d\n", value);

        return 0;
}
pi@raspberrypi:~ $ gcc -Wall -o math-test math.o math-test.c
pi@raspberrypi:~ $ ./math-test
value: 30
value: 200
pi@raspberrypi:~ $ ldd math-test
        /usr/lib/arm-linux-gnueabihf/libarmmem-${PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmem-v8l.so (0xf7ed9000)
        libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0xf7d72000)
        /lib/ld-linux-armhf.so.3 (0xf7eee000)
pi@raspberrypi:~ $
```

Step 12. Show your commands for creating libmath.so. Compile math-test.c and libmath.so

```
pi@raspberrypi:~ $ gcc -Wall -shared -o libmath.so math.c
pi@raspberrypi:~ $ file libmath.so
libmath.so: ELF 32-bit LSB shared object, ARM, EABI5 version 1 (SYSV), dynamically linked, BuildID[sha1]=a268dcd293b017e288884667572225f02d17c02f, not stripped
pi@raspberrypi:~ $ gcc -Wall -o math-test math-test.c -lmath -L.
pi@raspberrypi:~ $ ldd math-test
        /usr/lib/arm-linux-gnueabihf/libarmmem-${PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmem-v8l.so (0xf7d63000)
        libmath.so => not found
        libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0xf7bfc000)
        /lib/ld-linux-armhf.so.3 (0xf7d78000)
pi@raspberrypi:~ $ LD_LIBRARY_PATH=. ldd math-test
        /usr/lib/arm-linux-gnueabihf/libarmmem-${PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmem-v8l.so (0xf79c1000)
        libmath.so => ./libmath.so (0xf79af000)
        libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0xf7848000)
        /lib/ld-linux-armhf.so.3 (0xf79d6000)
pi@raspberrypi:~ $ ./math-test
./math-test: error while loading shared libraries: libmath.so: cannot open shared object file: No such file or directory
pi@raspberrypi:~ $ LD_LIBRARY_PATH=. ./math-test
value: 30
value: 200
pi@raspberrypi:~ $
```

Step 13. Show your math-test-dynamic.c source code and also the commands/output of building and running of the code

```
pi@raspberrypi:~ $ cat math-test-dynamic.c
#include <stdio.h>
#include <dlfcn.h>
#include "math.h"

int main() {
        void *handle = dlopen("libmath.so", RTLD_LAZY);
        if(!handle) {
                fprintf(stderr, "%s\n", dlerror());
                return 1;
        }

        int (*sum)(int a, int b);
        sum = dlsym(handle, "sum");
        if(!sum) {
                fprintf(stderr, "%s\n", dlerror());
        }
        else{
                int value = sum(10, 20);
                printf("value: %d\n", value);
        }
        dlclose(handle);
        return 0;
}
pi@raspberrypi:~ $ gcc -Wall -o math-test-dynamic math-test-dynamic.c -ldl
pi@raspberrypi:~ $ ldd math-tet-dynamic
ldd: ./math-tet-dynamic: No such file or directory
pi@raspberrypi:~ $ ldd math-test-dynamic
        /usr/lib/arm-linux-gnueabihf/libarmmem-${PLATFORM}.so => /usr/lib/arm-linux-gnueabihf/libarmmem-v8l.so (0xf7f97000)
        libdl.so.2 => /lib/arm-linux-gnueabihf/libdl.so.2 (0xf7f70000)
        libc.so.6 => /lib/arm-linux-gnueabihf/libc.so.6 (0xf7e1c000)
        /lib/ld-linux-armhf.so.3 (0xf7fac000)
pi@raspberrypi:~ $ LD_LIBRARY_PATH=. ./math-test-dynamic
value: 30
pi@raspberrypi:~ $
```