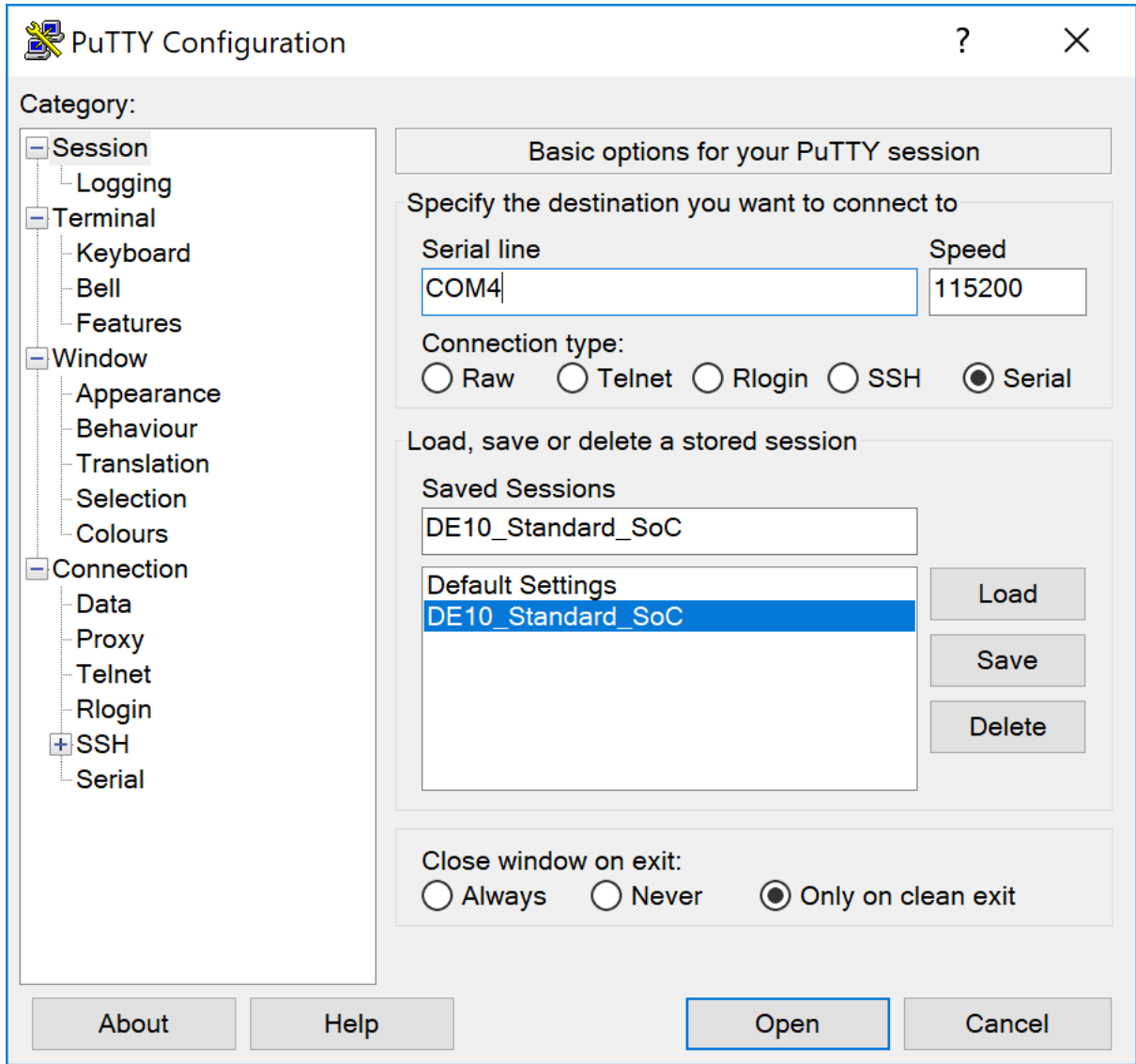
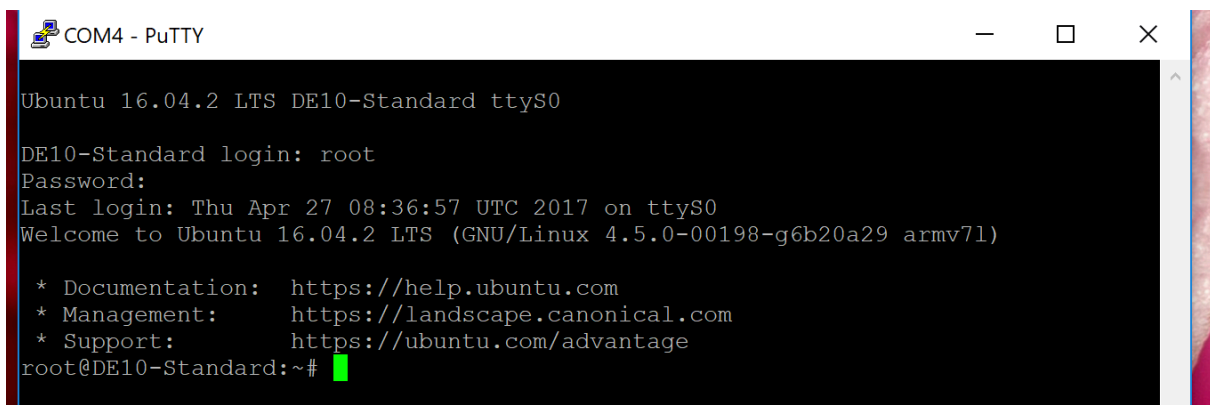


## Connect to DE10 Board with Putty

Connect UART Cable (Micro USB Connector on DE10 Board) with PC.  
Open Putty and load DE10\_Standard Config (If not working check port)



Login: root  
No password (press enter to skip)



## Compile code with Embedded Command Shell

The embedded command shell is found inside the SoC EDS installation directory.  
e.g. C:\intelFPGA\18.1\embedded

To compile c code we need a makefile in the same folder as the c file

```
#
TARGET = my_first_hps

ALT_DEVICE_FAMILY ?= soc_cv_av
SOCEDS_ROOT ?= $(SOCEDS_DEST_ROOT)
HWLIBS_ROOT = $(SOCEDS_ROOT)/ip/altera/hps/altera_hps/hwlib
CROSS_COMPILE = arm-linux-gnueabi-
CFLAGS = -g -Wall -D$(ALT_DEVICE_FAMILY) -
I$(HWLIBS_ROOT)/include/$(ALT_DEVICE_FAMILY) -I$(HWLIBS_ROOT)/include/
LDFLAGS = -g -Wall
CC = $(CROSS_COMPILE)gcc
ARCH= arm

build: $(TARGET)

$(TARGET): main.o
    $(CC) $(LDFLAGS) $^ -o $@

%.o : %.c
    $(CC) $(CFLAGS) -c $< -o $@

.PHONY: clean
clean:
    rm -f $(TARGET) *.a *.o *~
```

**and of course the c file itself (this is called main.c):**

```
#include <stdio.h>

int main(int argc, char **argv) {

    printf("Hello World!\r\n");

    return( 0 );
}
```

Now we can cd to the directory where these two files are and use the make command of the embedded shell to create an object file.

```

yannicschneider@YANNICSCHNEA27D /cygdrive/x/Uni/Master_Thesis/DE10-Standard_v/Demonstration/SoC
$ cd my_first_hps

yannicschneider@YANNICSCHNEA27D /cygdrive/x/Uni/Master_Thesis/DE10-Standard_v/Demonstration/SoC/my_first_hps
$ ls
main.c  Makefile  my_first_hps

yannicschneider@YANNICSCHNEA27D /cygdrive/x/Uni/Master_Thesis/DE10-Standard_v/Demonstration/SoC/my_first_hps
$ make
arm-linux-gnueabihf-gcc -g -Wall -Dsoc_cv_av -IC:/intelFPGA/18.1/embedded/ip/altera/hps/altera_hps/hwlib/include/soc_c
v_av -IC:/intelFPGA/18.1/embedded/ip/altera/hps/altera_hps/hwlib/include/ -c main.c -o main.o
arm-linux-gnueabihf-gcc -g -Wall main.o -o my_first_hps

```

## Copying files to the SoC

If the DE10 board is connected via Ethernet to the PC, we can send files with the scp command.

Before we do this, we need to get the IP of the board. We get this from the Putty terminal we opened earlier.

With the udhcpd command we can query an IP address from the DHCP Server.

With ifconfig we get the IP Address of our board.

```

root@DE10-Standard:~# udhcpd
root@DE10-Standard:~# idfconfig
-bash: idfconfig: command not found
root@DE10-Standard:~# ifconfig
eth0      Link encap:Ethernet  HWaddr 32:e5:af:c8:8b:ea
          inet addr:192.168.0.136  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::1b30:aba9:8f6e:90f7/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:15726 errors:0 dropped:0 overruns:0 frame:0
          TX packets:54 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3921055 (3.9 MB)  TX bytes:6404 (6.4 KB)
          Interrupt:39

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:164 errors:0 dropped:0 overruns:0 frame:0
          TX packets:164 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1
          RX bytes:12200 (12.2 KB)  TX bytes:12200 (12.2 KB)

```

With the command `scp my_first_hps root@192.168.0.136:/home/root` (in embedded shell) we can now copy the `my_first_hps` file to the SoC.

```

yannicschneider@YANNICSCHNEA27D /cygdrive/x/Uni/Master_Thesis/DE10-Standard_v/Demonstration/SoC/my_first_hps
$ scp my_first_hps root@192.168.21.136:/home/root

yannicschneider@YANNICSCHNEA27D /cygdrive/x/Uni/Master_Thesis/DE10-Standard_v/Demonstration/SoC/my_first_hps
$ scp my_first_hps root@192.168.0.136:/home/root
Could not create directory '/home/yannicschneider/.ssh'.
The authenticity of host '192.168.0.136 (192.168.0.136)' can't be established.
ECDSA key fingerprint is SHA256:YAVGTDiDJ5Pwbx1o4bkeYZtfVcVyKJiITZwZVRnIJP4.
Are you sure you want to continue connecting (yes/no)? yes
Failed to add the host to the list of known hosts (/home/yannicschneider/.ssh/known_hosts).
my_first_hps                                     100% 7177      7.0KB/s   00:00

```

With `ls` (in putty) we can see if the file is now on our system.

```
root@DE10-Standard:~# ls
BT_LED_AP      Desktop      alsa_play    gsensor      hps_lcd      opencv
ControlPanel   NET_Time     expand_rootfs.sh  hps_gpio    my_first_hps
```

### Running code on the SoC

Before we can run the code, we need to change the file access permissions with the following command: `chmod 777 my_first_hps`

Now it can be executed with `./my_first_hps`

```
root@DE10-Standard:~# chmod 777 my_first_hps
root@DE10-Standard:~# ./my_first_hps
Hello World!
```

### Sending udp messages with netcat

Install netcat on the DE10 board: `apt-get install netcat`.

Start server on PC: `nc -u 192.168.0.136 1234`

Start client on DE10:

`nc -u -l -p 1234 (-u udp, -l: listen, -p: portnumber, 1234 is the port number)`

## DE 10 Demo CD Content from terasic

### GHRD

The GHRD does not compile if the libraries used by the platform designer are updated. If the project is simply loaded into Quartus and compiled, it works.

## Intel Workbook Labs for DE1 on DE10

The right FPGA has to be selected. Then a .tcl script can be generated from the GHRD design of the DE10. Then the .sof file needs to be created by compiling in quartus and flashed with the Tools -> Programmer. Now the system can be analyzed with the System Monitor.

## Create C Project to run on Linux

Reference: SoC-FPGA Design Guide [De-1 SoC Edition].pdf

Start at 13.8 if linux is running