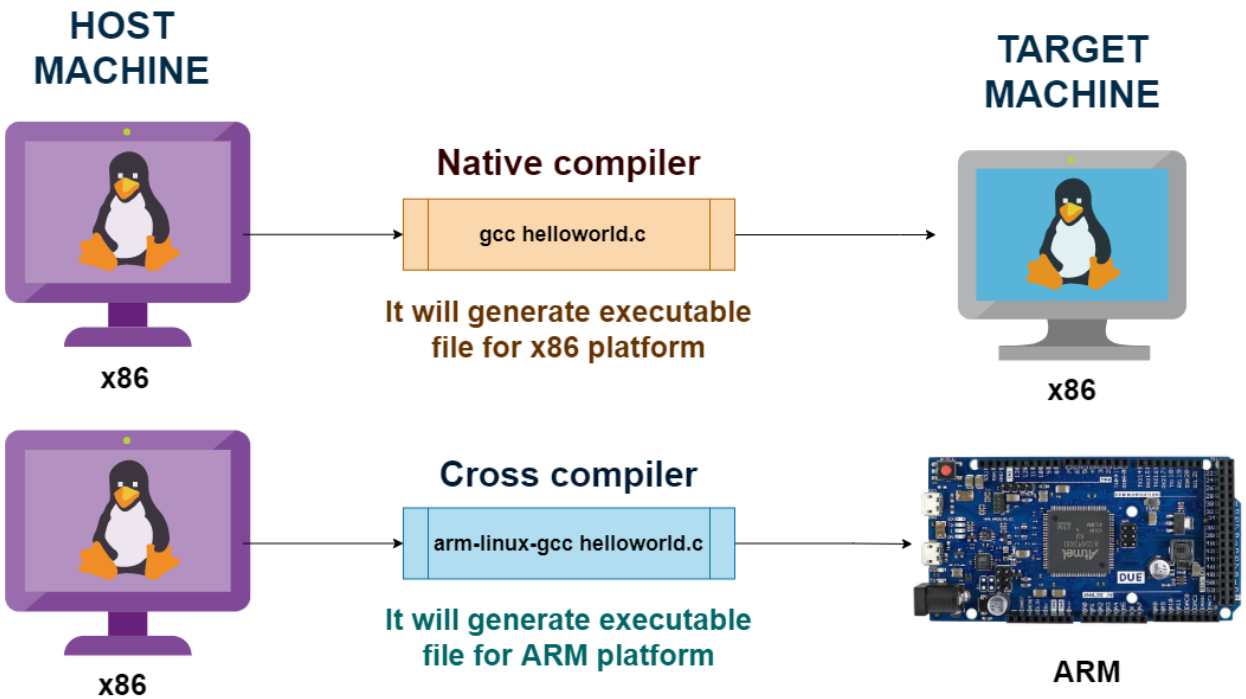
DE10-Nano development board
HPS and Linux

ALTERA®

Cross-compilation

- The host machine where we run the compiler (Linux-VM under WIN) and the target machine for which we make the compilation (DE10-Nano) both are different platforms: this is called cross-platform-compilation or cross-compilation



Creating a Project Folder

- A project usually includes the design files .c/.h and a make file. These files are generally stored under the same folder.
- So, it is suggested to create a project folder where you can store your design file and make file.
- Developer can create such a folder in the “Home” directory

Environment variables

- Some environment variables are already available:
- osboxes@osboxes:~$ echo $**SOCEDS_DEST_ROOT**

  /home/osboxes/intelFPGA_lite/20.1/embedded

- osboxes@osboxes:~$ echo $**CROSS_COMPILE**

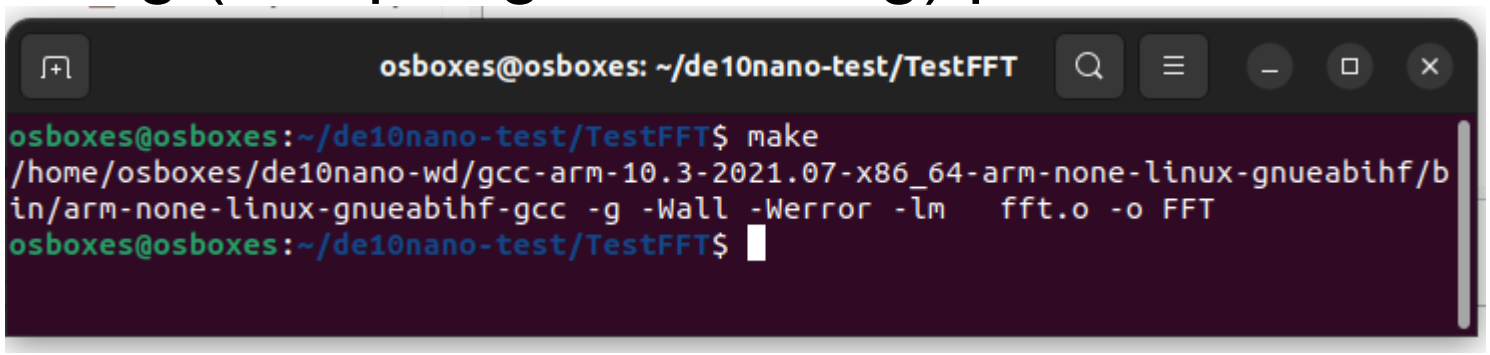
  /home/osboxes/de10nano-wd/gcc-arm-10.3-2021.07-x86_64-arm-none-linux-gnueabihf/bin/arm-none-linux-gnueabihf-

Make file

- A makefile is required for the Altera SoC EDS in order for it to know how to compile and link your project
- Inside the makefile, the "TARGET" variable defines the output file name.
- The makefile also specifies which compiler to use, in this case we use ARM gcc cross compiler.
- The gcc compiler paramater “-I${SOCEDS_DEST_ROOT}/path-to-include” defines the searching path for the gcc including header files.
- The gcc compiler paramater “-l” defines additional library to be linked

Execute the Make file

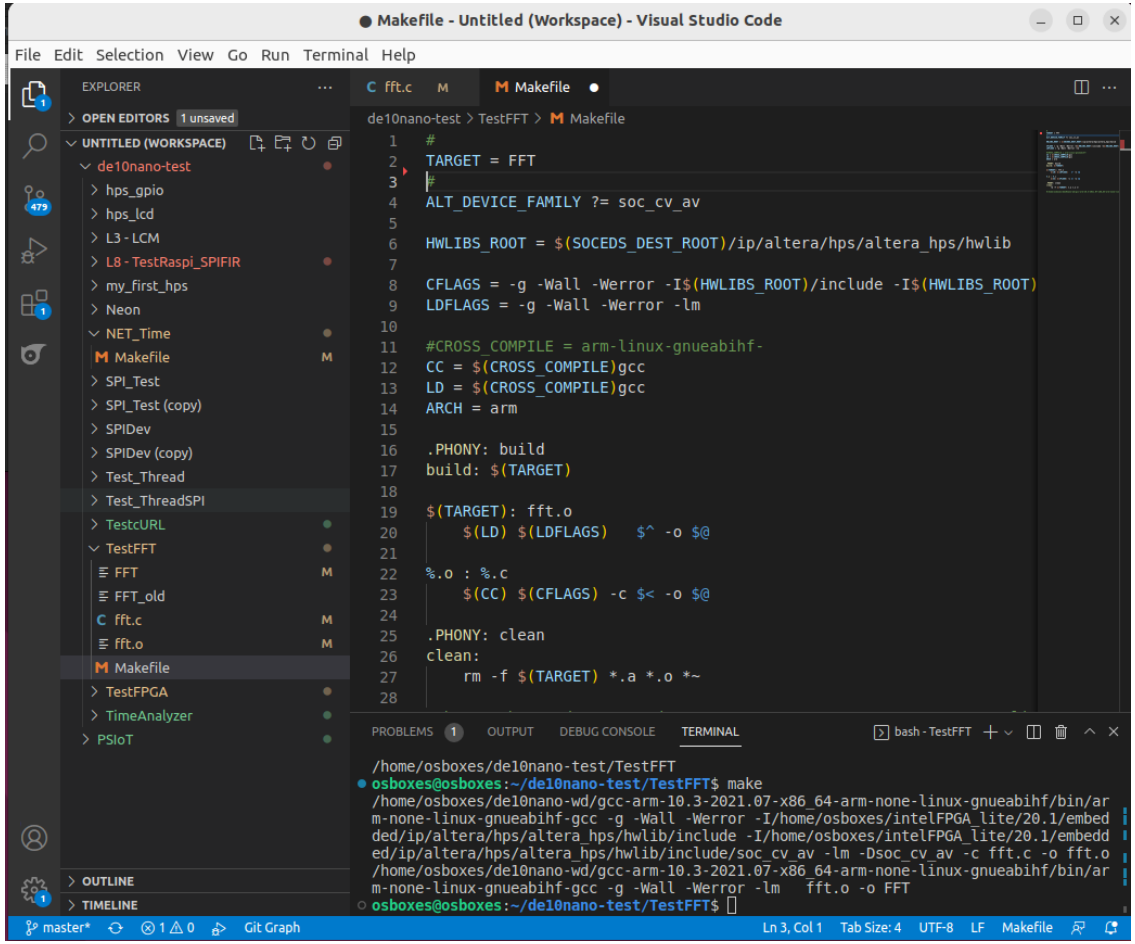
- In the Command Shell, please use the Linux “cd” command to change current directory to your project folder.
- Then, type the “make” command to start the building (compiling and linking) process.



- After the building process is finished, type "ls" to list all the files in the current directory: the executable should be there!

Execute the Make file

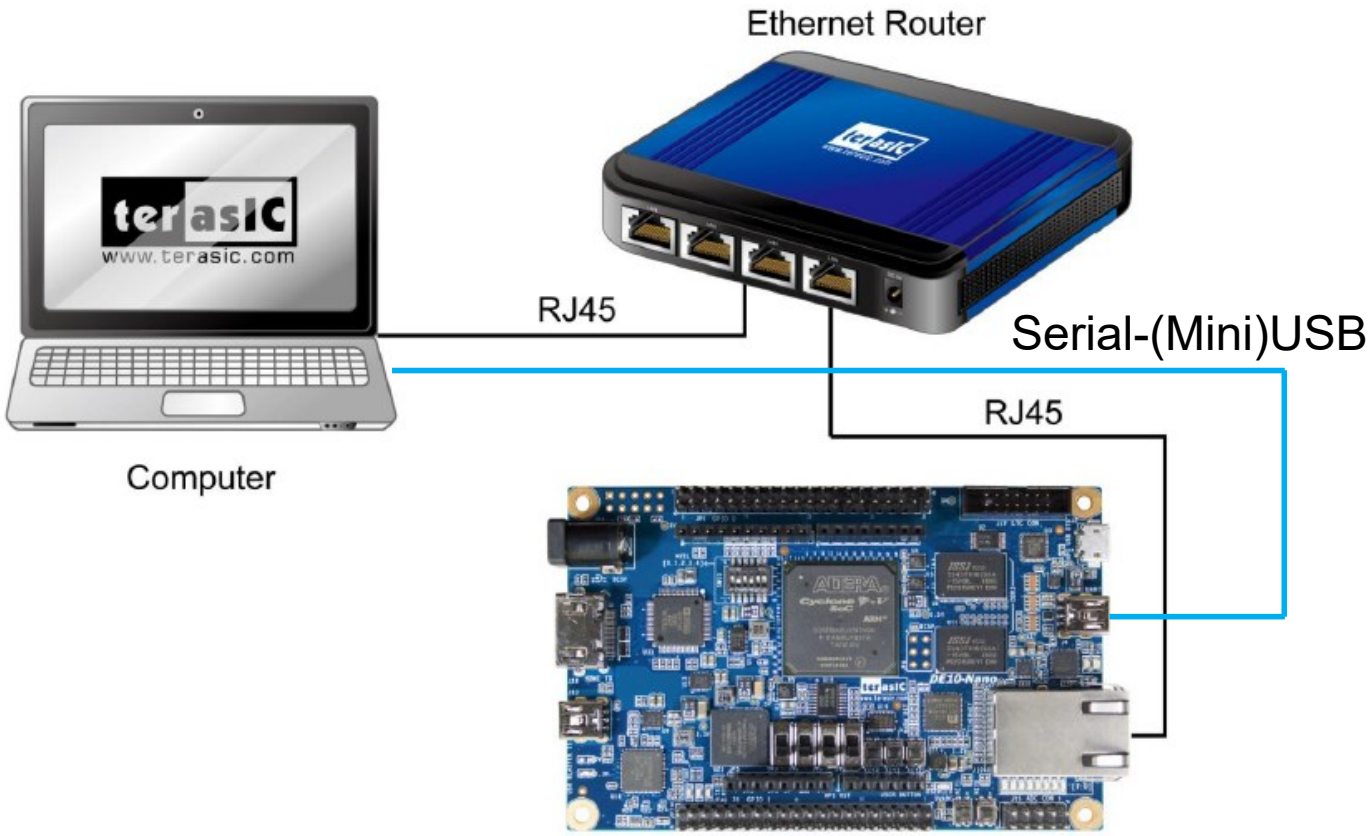
- The “terminal” tab of VS Code can be used to start the makefile as well!



Check that the current folder is the right one (type «pwd»)

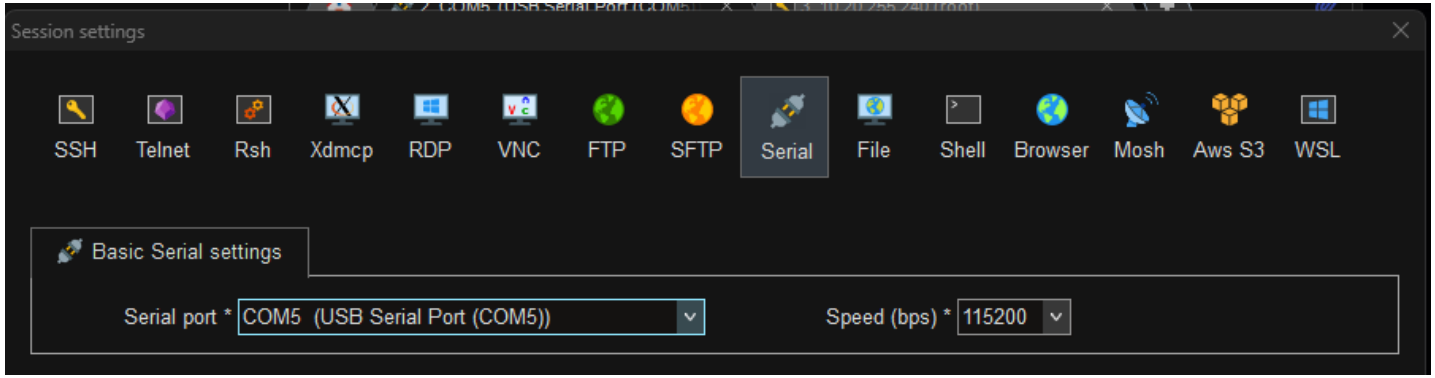
Copy the executable

- Setup



Copy the executable

- Discover the IP address: use Moba Xterm to create a «Serial» session: 115200 bps



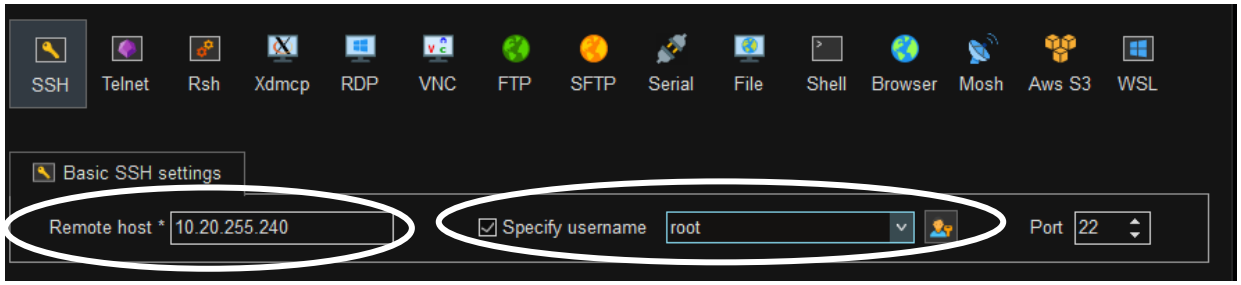
- Run «ifconfig»:

```
root@socfpga:~# ifconfig
eth0      Link encap:Ethernet  HWaddr c2:61:91:09:02:ea
          inet addr:10.20.255.240  Bcast:10.20.255.255  Mask:255.255.0.0
```

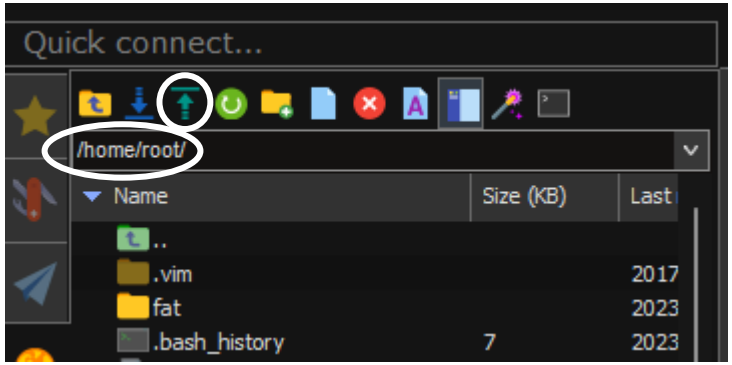
- If needed, exec «udhcpc» to make a DHCP request

Copy the executable

- Use Moba Xterm to start a «SSH» session:
  Remore host: the IP-addr previously find
  Username: root
- You are redirected to: /home/root

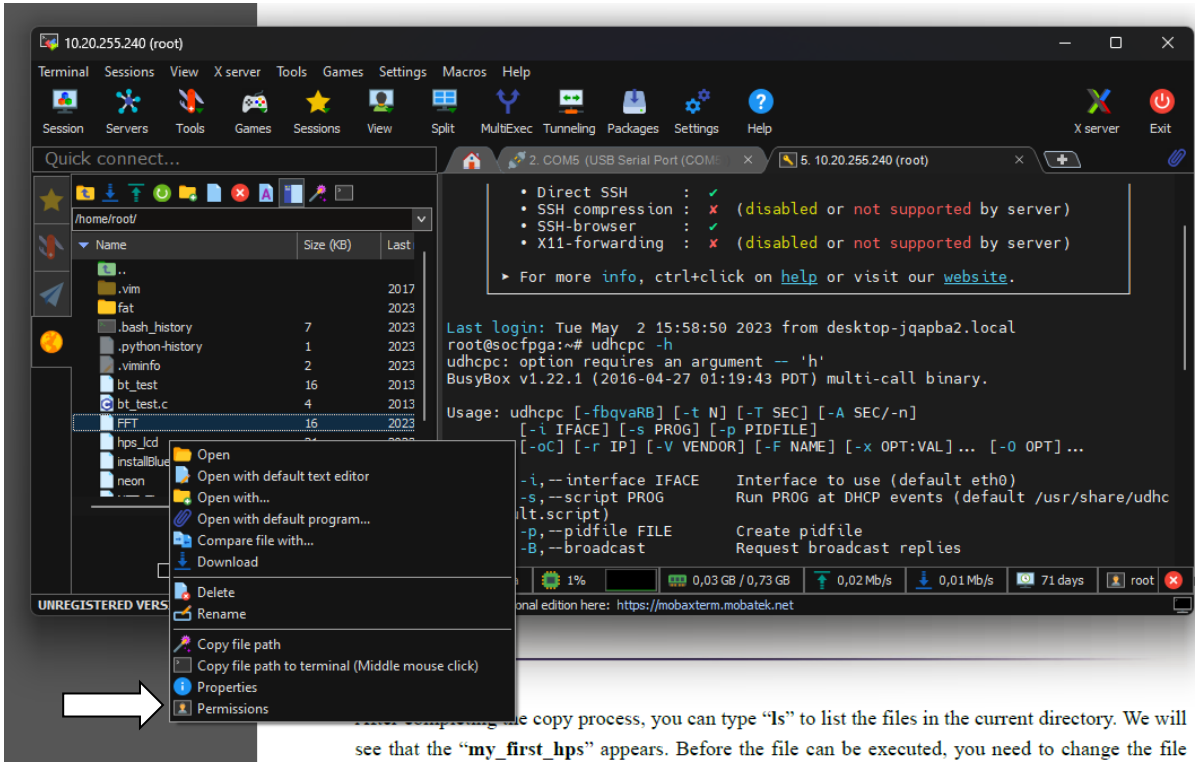


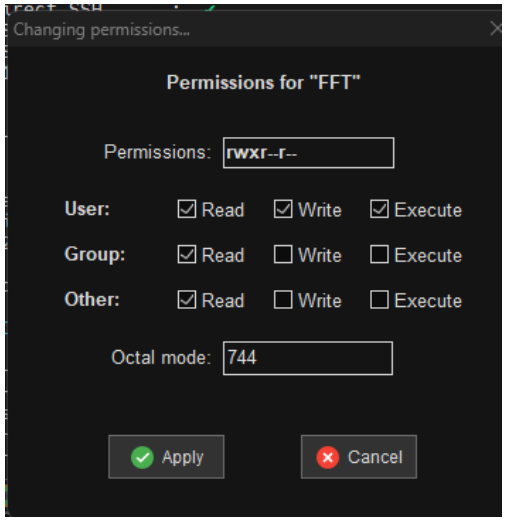
- In the «Quick connect» choose «Upload Current Folder»



Copy the executable

- Upload the executable and provide «exec» permssion (instead of executing «chmod 744 *executable_name*»)





the copy process, you can type "**ls**" to list the files in the current directory. We will see that the "**my_first_hps**" appears. Before the file can be executed, you need to change the file

Run the program

- That’s all!

```
root@socfpga:~# ./FFT
Orig (dim=8):  0.12, 0.00   0.09, 0.00   0.00, 0.00  -0.09, 0.00  -0.12, 0.00  -0.09, 0.00  -0.00, 0.00   0.09, 0.00
 FFT (dim=8): -0.00, 0.00   0.50,-0.00   0.00, 0.00   0.00, 0.00  -0.00, 0.00   0.00,-0.00   0.00, 0.00   0.50, 0.00
iFFT (dim=8):  1.00, 0.00   0.71, 0.00   0.00,-0.00  -0.71, 0.00  -1.00, 0.00  -0.71, 0.00  -0.00, 0.00   0.71, 0.00
Orig (dim=8):  0.30,-0.00   0.21,-0.21   0.00,-0.30  -0.21,-0.21  -0.30,-0.00  -0.21, 0.21  -0.00, 0.30   0.21, 0.21
 FFT (dim=8): -0.00,-0.00   0.00,-0.00   0.00,-0.00   0.00, 0.00  -0.00,-0.00   0.00,-0.00   0.00,-0.00   2.40, 0.00
iFFT (dim=8):  2.40, 0.00   1.70,-1.70   0.00,-2.40  -1.70,-1.70  -2.40,-0.00  -1.70, 1.70  -0.00, 2.40   1.70, 1.70
root@socfpga:~#
```

- What about debugging? Let’s try remotely use the «gdbserver» and «gdbgui»

Remote debugging

- On the remote system, launch the gdbserver:
  gdbserver *RemoteIPaddr*:*Port# file_name*

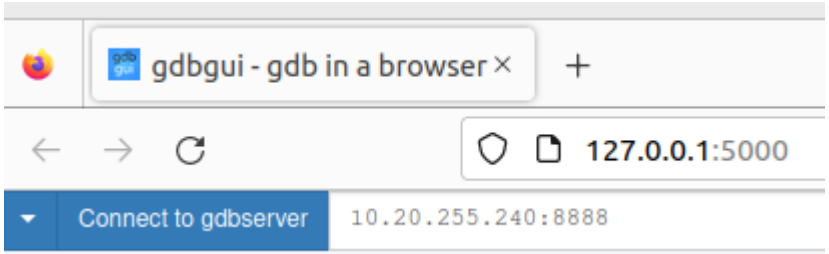
```
root@socfpga:~# gdbserver 10.20.255.240:8888 FFT
Process FFT created; pid = 10824
Listening on port 8888
```

- On the host system, open a web browser and launch the web gui:
  gdbgui -g gdb-multiarch

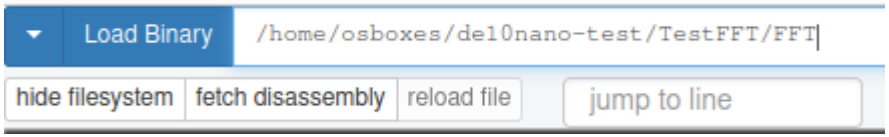
```
osboxes@osboxes: ~/de10nano-test/TestFFT
osboxes@osboxes:~/de10nano-test/TestFFT$ gdbgui -g gdb-multiarch
Opening gdbgui with default browser at http://127.0.0.1:5000
View gdbgui dashboard at http://127.0.0.1:5000/dashboard
exit gdbgui by pressing CTRL+C
```

Remote debugging

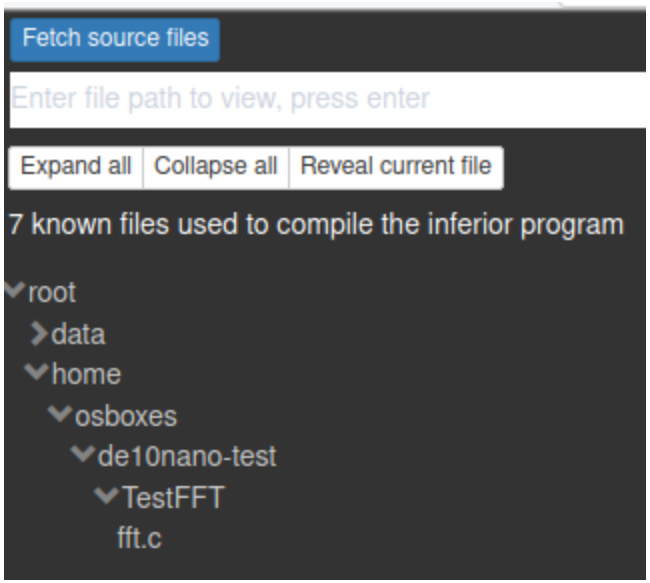
- Connect to the remote server:



- Load the binary file on the host:



- Fetch the source files:

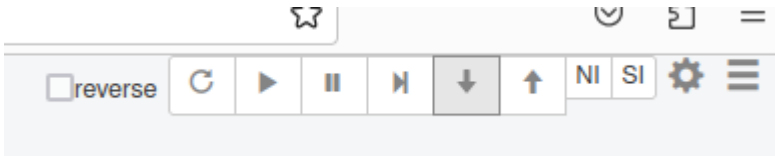


Remote debugging

- Insert a breakpoint:

```
122  for(k=0; k<N; k++) {
123    v[k].Re = 0.125*cos(2*PI*k/(double)N);
124    v[k].Im = 0; //0.125*sin(2*PI*k/(double)N);
125    v1[k].Re =  0.3*cos(2*PI*k/(double)N);
126    v1[k].Im = -0.3*sin(2*PI*k/(double)N);
127  }
128
129  /* FFT, iFFT of v[]: */
130  print_vector("Orig", v, N);
131  fft( v, N, scratch );
132  print_vector(" FFT", v, N);
133  ifft( v, N, scratch );
134  print_vector("iFFT", v, N);
```

- Execute step by step:
- And check:




```
root@socfpga:~# ./FFT
Orig (dim=8):  0.12, 0.00   0.09, 0.00   0.00, 0.00  -0.09, 0.00  -0.12, 0.00  -0.09, 0.00  -0.00, 0.00   0.09, 0.00
 FFT (dim=8): -0.00, 0.00   0.50,-0.00   0.00, 0.00   0.00, 0.00  -0.00, 0.00   0.00,-0.00   0.00, 0.00   0.50, 0.00
iFFT (dim=8):  1.00, 0.00   0.71, 0.00   0.00,-0.00  -0.71, 0.00  -1.00, 0.00  -0.71, 0.00  -0.00, 0.00   0.71, 0.00
Orig (dim=8):  0.30,-0.00   0.21,-0.21   0.00,-0.30  -0.21,-0.21  -0.30,-0.00  -0.21, 0.21  -0.00, 0.30   0.21, 0.21
 FFT (dim=8): -0.00,-0.00   0.00,-0.00   0.00,-0.00   0.00, 0.00  -0.00,-0.00   0.00,-0.00   0.00,-0.00   2.40, 0.00
iFFT (dim=8):  2.40, 0.00   1.70,-1.70   0.00,-2.40  -1.70,-1.70  -2.40,-0.00  -1.70, 1.70  -0.00, 2.40   1.70, 1.70
root@socfpga:~#
```