Important: You have to do this exercise in room 1-250 with special hardware.
You have to use a Hitex STR9 stick and the add-on-board with the seven segment display. In Moodle you will find the documentation of the STR9 microcontroller and the Hitex STR9 stick.

Exercise 1: STR9 stick: toolchain

Get familiar with programming of the STR9 stick.
Therefore you have to insert the stick into an USB-port (USB-hub on the table). Ask the instructor how to connect the add-on-board.

For programming and debugging with Linux you should use
`Openocd` and **`GNUMake`**.

You have to follow these steps:

- Open a konsole terminal and extract `exerciseVIII.tgz`.
- Enter the new generated directory called `exerciseVIII-1`.
- Open a second konsole terminal and enter the same directory. Start openocd in konsole terminal 2. There should be no errors.
  If you have errors, please restart openocd.
- Build the example program (`make`) in konsole terminal 1.
- Flash the program: `str9flash.pl exercise1.hex`

After flashing the program you should observe the blinking of the yellow on-board-LED and the repetition of a series of numbers on the seven segments display.

The yellow LED is connected to GPIO-port 9, bit 0 ! The LED blinks approximately every second. The function halfsecond() toggles the LED. The blinking frequency is controlled by a timer interrupt.

The pins on the add-on-board are connected to the GPIO-port 4 (see document System_Descripton_STR9_Comstick.pdf on Moodle).

Exercise 2: Number on the seven segment display

Copy your exerciseVIII-1 directory or unpack the tgz- file in a new directory (`exerciseVIII-2`).
Rename the main program and change the Makefile accordingly. Change the function segment() so that the program displays your immatriculation id.
Each digit should be shown for 2 seconds, between 2 numbers the display is black for 1 second, at the end the display is black for 2 seconds and the program begins again.
Change the function halfsecond() accordingly.
Flash the program to the Hitex STR9 stick.

The seven- segment display is connected to the following ports:

- segment g at GPIO 4.0,
- segment f at GPIO 4.1,
- segment e at GPIO 4.2,
- segment d at GPIO 4.3,
- segment c at GPIO 4.4,
- segment b at GPIO 4.5,
- segment a at GPIO 4.6.

- The segments on this board are active low, so they light up when writing a 0 to the port.
- You should use the 0.5sec timer (halfsecond()) (see exercise VIII-1). You can change the incrementation of the time counter in that function.
- You can use the LED of exercise VIII-1 as a 'heartbeat'.
- You can switch on data bit x with this command:
  `GPIO4->DATA[1«(2+x)] = BITx;`
- Without the filter function you can set several bits at one time:
  `GPIO4->DATA[255«2]= BITARRAY`;
  e.g. a 1 (segment b and c are active low (0)):
  → `1100 1111 = 0xCF` → `GPIO4` → `DATA[255«2] = 0xCF;`