SIP WS 2021
Project 1: *Fancy Lights*

1 Organization

- Group size: 1 (individual work)
- Deadline: 09.11., 23:59
- git repositories: `git.teaching.iaik.tugraz.at` (will be sent out via E-mail)

1.1 Where to ask questions

- In our weekly meetings
- Discord: `https://discord.com/invite/k2Njmev`
- E-Mail: sip-team@iaik.tugraz.at

2 Project 1

For this project, use the template repository for your board:

- `https://extgit.iaik.tugraz.at/sip2020/zybo_base_design`
- `https://extgit.iaik.tugraz.at/sip2020/zybo_z7_base_design`

2.1 Part 1: Bare Metal Program

For Part 1, follow the instructions below. If you have your own idea for another project involving the LEDs, please message us and we can agree on individual requirements.

Part 1a:

- Build **your own IP core** which allows the LEDs to blink according to a specific blinking frequency.
- Write a bare-metal application to specify the blinking frequency of the LEDs.

Part 1b:

- Build **your own IP core** which allows the LEDs to form a binary counter which is updated in a specific interval, starting from the default value 0.
- Write a bare-metal application to specify the starting value of the binary counter.

You can either create two distinct IP cores, or one for both Part 1a and Part 1b.

2.2 Part 2: LED Device Driver

- Access the LEDs from within Linux
- Get Linux running on your board using Buildroot or Yocto. Modify the device tree configurations as needed.
- Write a Linux driver to access the LEDs
  - Part 2a: Specify frequency
  - Part 2b: Set starting value of counter
- Write a small user program to demonstrate the communication with the driver

3 Submission

1. Export your block design within Vivado: write_bd_tcl –force bd.tcl
2. Commit bd.tcl and your constraints file (base.xdc)
3. Commit your custom IP core
4. Try to recreate the project using the template
   - Zybo 7000: https://extgit.iaik.tugraz.at/sip2020/zybo_base_design/-/blob/master/HW/project.tcl
   - Zybo Z7: https://extgit.iaik.tugraz.at/sip2020/zybo_z7_base_design/-/blob/master/HW/project.tcl
   - Be aware of the todos in the file!
   - Adapt if necessary.
5. Commit all the relevant software (device driver, bare metal program, ...)
6. Add a readme including:
   - Where to find which software files
   - Any other relevant information
7. Tag your submission:

```
git tag Project1
git push --tags
```

4 Useful Links

- ZYBO FPGA Board Reference Manual https://reference.digilentinc.com/_media/zybo:zybo_rm.pdf
- ZYBO-Z7 Reference Manual https://reference.digilentinc.com/_media/reference/programmable-logic/zybo-z7/zybo-z7_rm.pdf
- Zybo Embedded Linux Hands-on Tutorial http://www.farnell.com/datasheets/1904568.pdf
- Zybo Embedded Linux Hands-on Tutorial #2 https://www.instructables.com/Embedded-Linux-Tutorial-Zybo/
- Tutorial: Create a custom IP core https://reference.digilentinc.com/learn/programmable-logic/tutorials/zybo-creating-custom-ip-cores/start
- Linux GPIO Drivers on Zynq https://xilinx-wiki.atlassian.net/wiki/spaces/A/pages/18842398/Linux+GPIO+Driver