

Arquiteturas de Alto Desempenho 2024/2025

Practical class AAD_P11 (2024-12-02 and 2024-12-03)

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1 Objectives

Simulate some simple sequential circuits described using VHDL.

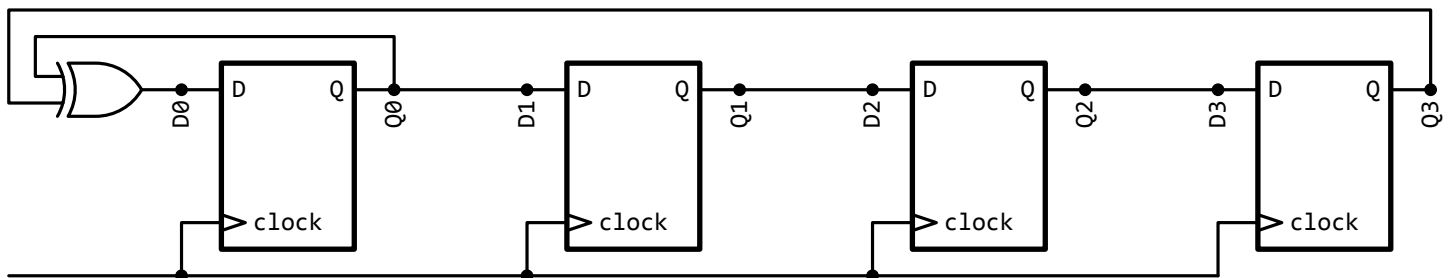
2 Exercise 1: D-type flip-flop

The D-type flip-flop is one of the most useful digital circuits. It can be used to store one bit of information. The file `d_flip_flop.vhd` contains a VLDH description of a simple D-type flip-flop. Study it. File `ex1_tb.vhd` contains a test bench that can be used to generate waveforms that illustrate how the flip-flop works. Load both to `edaplayground.com` and run the simulation. As an alternative, if you have `ghdl` just do

```
$ make ex1.vcd
$ gtkwave ex1.vcd
```

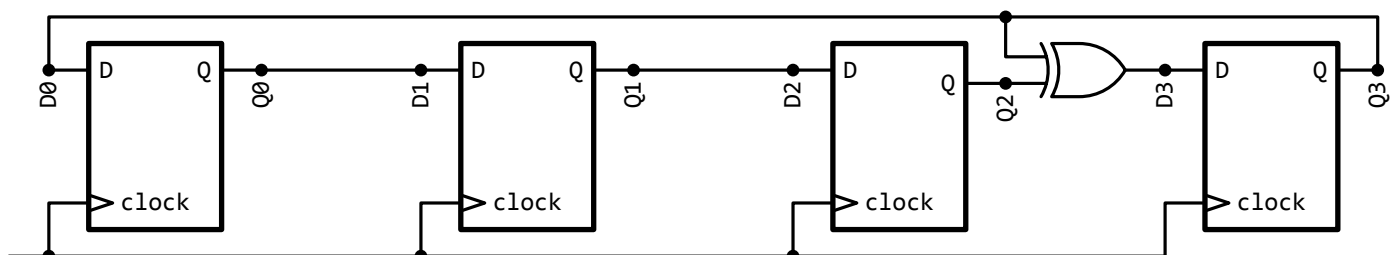
3 Exercise 2: more complex circuits using flip-flops

Create a VHDL entity that implements the following digital circuit.



Starting with all flip-flops in the '1' state, simulate the circuit for 50 clock cycles.

Repeat the above but for this other circuit.



4 Exercise 3: dual-port memory

The file `dual_port_memory.vhd` contains the description of a dual port memory. It provides four implementations (architectures): either the reads are synchronous or they are asynchronous, and either the reads read old data when the read address is equal to the write address or they read the new data. Study it with extra care. File `ex3_tb.vhd` contains a test bench that can be used to generate waveforms that illustrate how the dual port memory works. Load both to `edaplayground.com` and run the simulation. As an alternative, if you have `ghdl` just do

```
$ make ex3.vcd  
$ gtkwave ex3.vcd
```

In the second practical assignment you will need to adapt the dual port entity to your needs, so study with extra care.

Advice: in order to make the simulation easier to understand, use first very small delays. In particular, edit the file `dual_port_memory.vhd` in order to make the delays a little smaller. For example, replace “200 ps” by “100 ps” (or less).