

Clash training

Syllabus

Modules

- M1: Introduction to Functional Programming
- M2: Introduction to digital circuits and FPGAs
- M3: Clash – building circuits with Haskell
- M4: Deriving circuits from formulas through transformations
- M5: State machines and CPUs in Clash
- M6: Verification in Clash
- M7: Advanced design – integrating existing IP
- M8: Customer challenge

M1: Introduction to Functional Programming

- What you will learn:
 - Solving programming challenges in a functional language
 - Standard techniques such as: recursion, higher-order functions, and function composition
 - Define, use, and modify algebraic and recursive data types
- Teaching method: lecture and exercises
- Duration: 1.5 days

M2: Introduction to digital circuits and FPGAs

- What you will learn:
 - Elemental digital building blocks such as multiplexers and dflip-flops
 - The core concepts of synchronous digital design, and what meta-stability is.
 - What constitutes an FPGA, and the process of going from a textual circuit description to an FPGA configuration
- Teaching method: lecture
- Duration: half day

M3: Clash – building circuits with Haskell

- What you will learn:
 - How to describe synchronous digital circuits in Haskell using Clash
 - Abstracting common (parallel) compositions using higher-order functions.
 - Core data types of Clash, and how types are used to model arbitrary precision arithmetic, to avoid meta-stability, and track pipeline depth.
- Teaching method: lecture and exercises
- Duration: one day

M4: Deriving circuits from formulas through transformations

- What you will learn:
 - How math, functional programs, and digital circuits are the same thing but viewed through a different lens
 - Correct-by-construction transformations to derive efficient implementations from a high-level specification
- Teaching method: lecture and exercises
- Duration: 1.5 days

M5: State machines and CPUs in Clash

- What you will learn:
 - Build state machines and controllers in Clash
 - Develop CPU-like circuits and compilers for these CPUs in tandem
- Teaching method: lecture and exercises
- Duration: 1.5 days

M6: Verification in Clash

- What you will learn:
 - Set up a testing framework in Haskell for your Clash design
 - How to use some of Haskell's random testing libraries to exercise your circuit
- Teaching method: lecture
- Duration: half day

M7: Advanced design – integrating existing IP

- What you will learn:
 - The extensible code-generation and templating system of the Clash compiler to generate custom code of user-annotated functions.
 - How this mechanism is used to integrate PLLs and IO pins into a Clash design
- Teaching method: lecture
- Duration: half day

M8: Customer challenge

- QBayLogic will take on a design challenge suggested by the client and give a workshop on how to solve the challenge using Clash.
- What you will learn:
 - Expert methods to solve your design challenges in Clash
- Teaching method: lecture
- Duration: day

5 day course – No existing FP or HW experience

	09:00 – 11:00	11:30 – 12:30	13:30 – 15:30	16:00-18:00
Monday	M1 lecture	M1 lecture	M1 exercise	M1 lecture
Tuesday	M1 exercise	M1 lecture	M2 lecture	M2 lecture
Wednesday	M3 lecture	M3 lecture	M3 exercise	M3 lecture
Thursday	M4/M5 lecture	M4/M5 lecture	M4/M5 exercise	M4/M5 lecture
Friday	M4/M5 exercise	M4/M5 lecture	M6 lecture	M6 lecture

In case client desires “M8: customer challenge”, M4/M5 is shorted to 1 day, and M6 is omitted

5 day course – Existing FP experience, no HW experience

	09:00 – 11:00	11:30 – 12:30	13:30 – 15:30	16:00-18:00
Monday	M2 lecture	M2 lecture	M3 lecture	M3 lecture
Tuesday	M3 exercise	M3 lecture	M4 lecture	M4 lecture
Wednesday	M4 exercise	M4 lecture	M4 exercise	M4 lecture
Thursday	M5 lecture	M5 lecture	M5 exercise	M5 lecture
Friday	M5 exercise	M5 lecture	M6 lecture	M6 lecture

In case client desires “M8: customer challenge”, M4 and M5 are shorted to 2 days

5 day course – Existing FP and HW experience

	09:00 – 11:00	11:30 – 12:30	13:30 – 15:30	16:00-18:00
Monday	M3 lecture	M3 lecture	M3 exercise	M3 lecture
Tuesday	M4 lecture	M4 lecture	M4 exercise	M4 lecture
Wednesday	M4 exercise	M4 lecture	M5 lecture	M5 lecture
Thursday	M5 exercise	M5 lecture	M5 exercise	M5 lecture
Friday	M6 lecture	M6 lecture	M7 lecture	M7 lecture

In case client desires “M8: customer challenge”, M4 and M5 are shorted to 2 days