Semantics and Functional Programming

HHU Spring/Summer semester seminar 2024

Patrick D. Elliott

April 4, 2024

Class homepage: `https://patrickdelliott.com/hhu-haskell`

1 Description

This course is intended primarily as a first introduction to functional programming, aimed at students with an existing background in logic and/or linguistics. The programming language we'll be using in this course is Haskell - a statically-typed, purely functional language. Although not as common as languages such as python, Haskell is a general-purpose programming language with industrial applications.

For our purposes, Haskell is especially compelling since its design is inspired by mathematical tools commonly deployed in linguistic theory, such as the lambda calculus, type theory, and category theory. The main topic of this course is "computational semantics", but from a symbolic/algorithmic, rather than a data-driven perspective. Over the course of the semester, we'll gradually build up a working knowledge of Haskell by implementing logical constructs used in linguistics, such as Context Free Grammars and Montagovian fragments as **programs**.

This will be an extremely hands-on course, and students should ideally expect jto bring a laptop to class. We'll set up a Haskell development environment together, and homework exercises will involve concrete programming tasks.

2 Team

- **Instructor:** Dr. Patrick D. Elliott
  - Patrick.Elliott@hhu.de

  - `https://patrickdelliott.com`
- **Secretary:** Tim Martion
  - tim.marton@phil.hhu.de

3 Practical information

3.1 Laptops

If possible, please bring a laptop with you to class.

3.2 Time and place

- Class takes place on **Tuesday** at 16:30-18:00.
- Class takes place in **2321.U1.72 (Z 34)**.

3.3 Language of instruction

The lectures, as well as the readings for this class will be in **English**.

4 Leistungsnachweis

4.1 BN requirements

- Participate in class.
- Submit solutions to the occasional homework assignments.

4.2 AP requirements

- Fulfill the BN requirements.
- Complete a final project. Exactly what this involves is completely negotiable. Given the nature of the class, two obvious possibilities are (i) a written technical report, (ii) a simple haskell program with documentation.

5 Comms

5.1 Rocketchat

Join the rocketchat channel using the provided link. Note that this is **obligatory**; in an attempt to keep things simple, I'll use this as the main channel of communication for the class, including announcements etc.

5.2 Office hours

I hold office hours at 1-2pm on Wednesdays. You can find me in building 23.21, room 04.73. Please let me know in advance the time that you plan on dropping by, so that I can stagger appointments.

5.3 Email

For any questions regarding the class, please post in rocketchat, so that others can benefit from the response. For any private queries, you can email me at Patrick.Elliott@hhu.de.

6 Readings

6.1 Main readings

- *Haskell from first principles* (FP) (Allen & Moronuki 2020)
- *Computational semantics with functional programming* (CS) (Van Eijck & Unger 2010)

6.2 Supplementary

- *The haskell road to logic, maths, and programming* (LMP) (Doets & van Eijck 2012)

7 Resources for getting started with haskell

- The haskell playground

`https://play.haskell.org/`

8 Tentative schedule

date	class
April 9	Lambda calculus
April 16	Intro to Haskell
April 23	Strings
April 25	Basic datatypes
April 30 (remote)	Types and typeclasses
May 7	Fragments i: syntax
May 14	Fragments ii: semantics
May 21	Model checking
May 28	Meaning composition
June 4	Functors
June 11	Applicatives
June 18	NO CLASS
June 25	Monads
July 2	Monads cont.
July 9	Student presentations
July 16	Student presentations

References

Allen, Christopher & Julie Moronuki. 2020. *Haskell programming from first principles*. Lorepub LLC.

Doets, Kees & Jan van Eijck. 2012. *The Haskell road to logic, maths and programming*. 2. ed (Texts in Computing 4). London: College Publ. 432 pp.

Van Eijck, Jan & Christina Unger. 2010. *Computational Semantics with Functional Programming*. 1st edn. Cambridge University Press. `https://www.cambridge.org/core/product/identifier/9780511778377/type/book` (4 April, 2024).