Programming Paradigms 2022
Session 3 : Types and classes

Preparing for the session

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Where nothing else is mentioned, chapters and page numbers refer to *Programming in Haskell*.

The video podcast

You can watch the podcast on YouTube via the course page on Moodle.

Tuesday 19 September 2023 – Types and classes

The text is Chapters 3 of *Programming in Haskell* and the short note about the λ-calculus.

Learning goals for the session

Please note that *the learning goals for Haskell and the theoretical foundations for this session are not related.*

Haskell

- To be able to explain and use the central notions of types in Haskell – basic types, list types, function types and tuple types
- To be able to explain and use curried and uncurried functions and how these notions relate to higher-order functions
- To be able to explain and use the notion of type classes
- To be able to explain the notions of polymorphism and overloading (parametric and ad hoc-polymorphism), the difference between them and the relationship to type classes

The theoretical foundations

- To be able to explain and use the syntax and reduction semantics of the pure λ-calculus
- To be able to explain why renaming of bound variables is a necessary notion

How you should prepare before we meet on Monday

Before we meet, watch the podcast and read the text. You can do this in any order you like.

Also see if you can solve the following two small discussion problems. We will talk about them in class.

1. Write down Haskell definitions of quango and tango that have the following types; it is not important what the definitions do as long as they are type correct.

   ```
   quango :: a -> [a]
   tango :: Num p1 => (a, b) -> p2 -> p1
   ```

   Are quango and tango polymorphic? If so, tell us if for each of them if this involves parametric polymorphism or overloading (ad hoc polymorphism) or maybe both – and how. If not, tell us why.

2. *Please note:* This problem is about the λ-calculus (as presented in the short note) and is not related to the content on types. Find a terminating reduction sequence of the λ-expression

   $$(\lambda x.xy)(\lambda z.(\lambda u.uu))$$

   To do this, use the reduction rules of the note.

What happens on Tuesday?

When we meet, students that have been contacted by me who will present the solutions to the small discussion problems above.

Problems for Tuesday

For the plenary session we will solve and discuss a collection of problems that can be found on a separate page, available on the day of the session.