Functional Programming Lecture Summary

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February 22, 2025

1 Introduction

The lecture began with an announcement about the upcoming SIG Fair, which will take place on September 21st from 3 p.m. to 5:30 p.m. This event will introduce various special interest groups (SIGs) related to AI, theoretical computer science, cybersecurity, and more. Free pizza will be provided, and attendees are encouraged to join the event's Discord for further announcements.

2 Overview of Functional Programming

The main focus of the lecture was on functional programming, specifically using the Haskell programming language. The first half of the lecture discussed the importance of functional programming and its differences from object-oriented programming (OOP).

2.1 What is Functional Programming?

Functional programming emphasizes the use of functions as the primary building blocks of programs, contrasting with OOP, which focuses on objects and mutable state. In functional programming:

- Functions are first-class citizens.
- There is no assignment of values to variables; once a value is assigned, it cannot be changed.
- Programs tend to be shorter and more concise compared to OOP.

2.2 Programming Paradigms

A programming paradigm is a way of thinking about programming and its relationship to the real world. Functional programming and OOP are two distinct paradigms:

- In functional programming, data values are manipulated using functions.
- In OOP, objects are manipulated using methods that change their state.

3 Importance of Functional Programming

Functional programming is less widely used than OOP but is still relevant in various industries. Examples include:

- **Google:** Uses functional programming concepts in its MapReduce framework for processing large data sets.
- **Finance:** Many banks use functional programming for automated trading systems to minimize errors and improve reliability.
- **Telecommunications:** Ericsson successfully developed a reliable phone switch using a functional programming language called Erlang.

4 Key Concepts in Haskell

The second half of the lecture introduced basic concepts in Haskell, including types and values.

4.1 Values and Types

In Haskell, every value has a type. Some basic types include:

- `Int`: Represents integers.
- `String`: Represents strings of characters.
- `Bool`: Represents Boolean values (true or false).

Functions are also considered values, and their types are denoted using the arrow notation (e.g., `Int -> Int`).

4.2 Function Definitions

Functions in Haskell are defined using a simple syntax:

- A function name followed by its parameters and an expression that defines its output.

For example, a function that doubles a number can be defined as:

```
double x = x * 2
```

4.3 Combining Functions

Functions can be combined to create more complex operations. For instance, the `beside` function can be used to place two pictures next to each other:

```
beside (invert knight) (flipV knight)
```

This demonstrates how functional programming allows for higher-level thinking by applying functions to entire data structures rather than manipulating individual elements.

5 Conclusion

The lecture concluded with a discussion on the importance of learning multiple programming paradigms and the benefits of functional programming in developing reliable and maintainable code. Students were encouraged to practice Haskell and utilize the university's computing resources for their assignments.