# Programming in Haskell (PUH)

FER, Zagreb, 2024

# The plan

- Why Haskell?
- About the course
- Lecture

# Why Haskell?

①

Haskell is the **flagship language** of functional programming.

So, why **functional programming**?

- Employability
- Improved skills in all languages
- Fun and interesting

②

Haskell is the **breeding ground** for bleeding-edge features and constructs.

Haskell is a **language designer**’s favorite language.

Static typing

List comprehensions

Polymorphic type inference

Metaprogramming

Currying

Non-strict semantics

First-class functions

Sections

Effect systems

Higher order functions

Pattern matching

Lazy evaluation

Algebraic data types

Memory safety

Typeclasses (Ad-hoc polymorphism)

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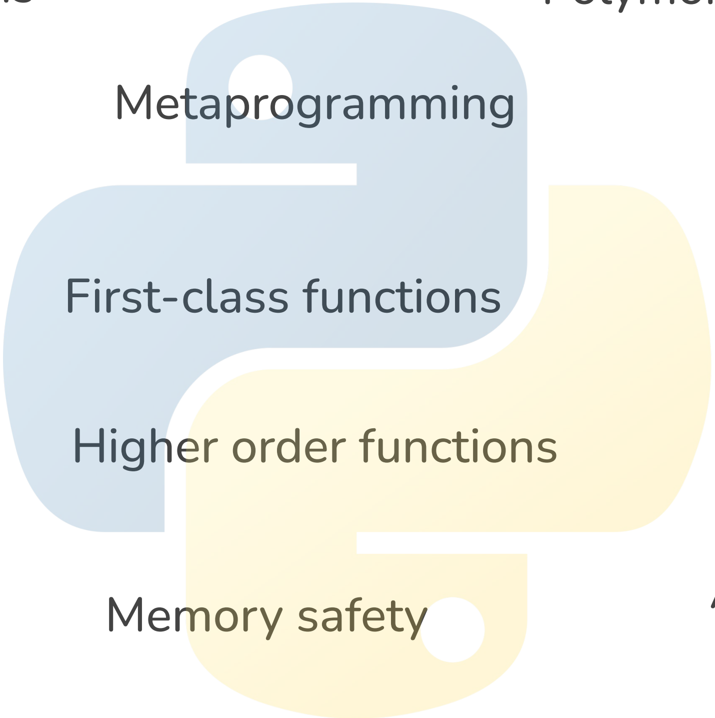

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# Haskell in a nutshell

- **declarative** vs imperative
- **statically-typed** vs dynamically-typed
- **strongly-typed** vs loosely-typed
- **functional** vs procedural vs object-oriented vs …
- **pure** vs allowing side effects
- **lazy** vs eager
- **type inference** vs manifest typing
- **nominal typing** vs structural typing
- **immutable** vs mutable

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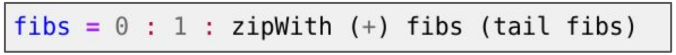
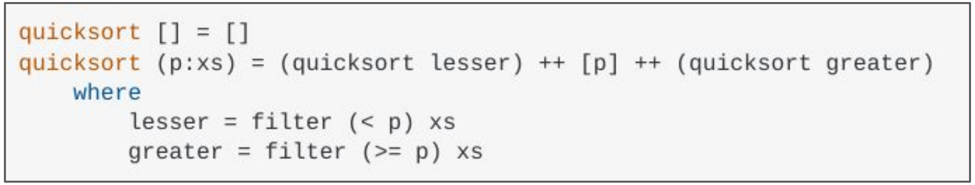
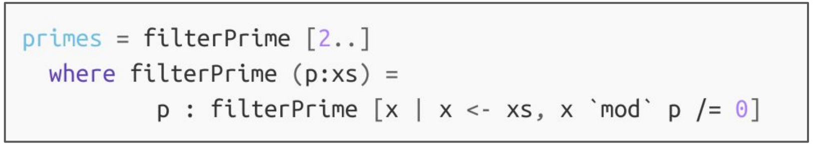


```haskell
fibs = 0 : 1 : zipWith (+) fibs (tail fibs)
```



```haskell
quicksort [] = []
quicksort (p:xs) = (quicksort lesser) ++ [p] ++ (quicksort greater)
    where
        lesser = filter (< p) xs
        greater = filter (>= p) xs
```



```haskell
primes = filterPrime [2..]
  where filterPrime (p:xs) =
          p : filterPrime [x | x <- xs, x `mod` p /= 0]
```

```haskell
data PieceType = Pawn | Knight | Bishop | Rook | Queen | King
  deriving (Eq, Enum, Ord, Show)

data Square = Square File Rank
  deriving (Eq, Ord, Show)

data Board = Board [(Piece, Square)]
  deriving (Eq, Show)

initialBoard :: Board
initialBoard =
  Board $
    concat
      [ capitalPieces Black R8,
        pawns Black R7,
        pawns White R2,
        capitalPieces White R1
      ]
  where
    pawns color rank = (\f -> (Piece color Pawn, Square f rank)) <$> [FA .. FH]
    capitalPieces color rank = zip (Piece color <$> capitalPiecesOrder) ((`Square` rank) <$> [FA .. FH])
    capitalPiecesOrder = [Rook, Knight, Bishop, Queen, King, Bishop, Knight, Rook]

getBoard :: Game -> Board
getBoard (Game moves) = foldl' (\board move -> fromEither $ performMoveOnBoard board move) initialBoard moves

isPlayerInCheck :: Color -> Board -> Bool
isPlayerInCheck currentPlayerColor board@(Board pieces) = any isKingUnderAttackByPiece oponnentPieces
  where
    kingsSquare = findKing currentPlayerColor board
    oponnentColor = oppositeColor currentPlayerColor
    oponnentPieces = filter (\(Piece c _, _) -> c == oponnentColor) pieces
    isKingUnderAttackByPiece piece = kingsSquare `S.member` getValidDstSquaresForPiece piece
    getValidDstSquaresForPiece (Piece _ _, pieceSquare) = getMoveDstSquare `S.map` fromEither (getValidSimpleMoves c

performMove :: Game -> MoveOrder -> Either String Game
performMove game@(Game moves) moveOrder = do
  validMove <- makeValidMove game moveOrder
  return $ Game $ validMove : moves
```

③

You will learn **not only** Haskell…

# You will also...

- Learn to use **Git** and **GitHub**
- Get professional **code reviews**
- Get a bunch of **learning resources** (Haskell or otherwise)
- Learn to use the **CLI** and other industry-standard tools
- Learn more about **programming languages** in general.
- Get to **talk with us** about anything you want (careers, linux, editor setup...)

# About the course...

# Lecturers

Ante Kegalj

Luka Hadžiegrić

Filip Sodić

Mihovil Ilakovac

# Teaching assistants

Anton Vučinić

Nikola Kraljević

Mislav Đomlija

Donik Vršnak

Janko Vidaković

Miho Hren

# Guest Lecturers

Jan Šnajder
(Chief Lecturer)

Martin Šošić
(CTO @ Wasp)

Matija Šošić
(CEO @ Wasp)

# How the course works

- Lectures
  - Held in person
  - **Mandatory**, 1 absence allowed
  - Full schedule available on Ferweb (mostly Thursdays)
- Training Exercises
  - Homeworks given **after each lecture** (give or take)
  - Submitted through GitHub
  - All homeworks must pass **unit tests and TA code review**
- Seminar
  - A larger practical project
  - Handed out in the second cycle
  - Must pass an **in-person review** at the end of the semester

To pass, you must:

- Attend lectures
- Submit homeworks on time
- Hand in the seminar

Our **Discord server** is the source of truth for all materials and announcements:

https://discord.gg/xvGb5jp8