# MOD08: Functional Programming

## Functional Programming Project

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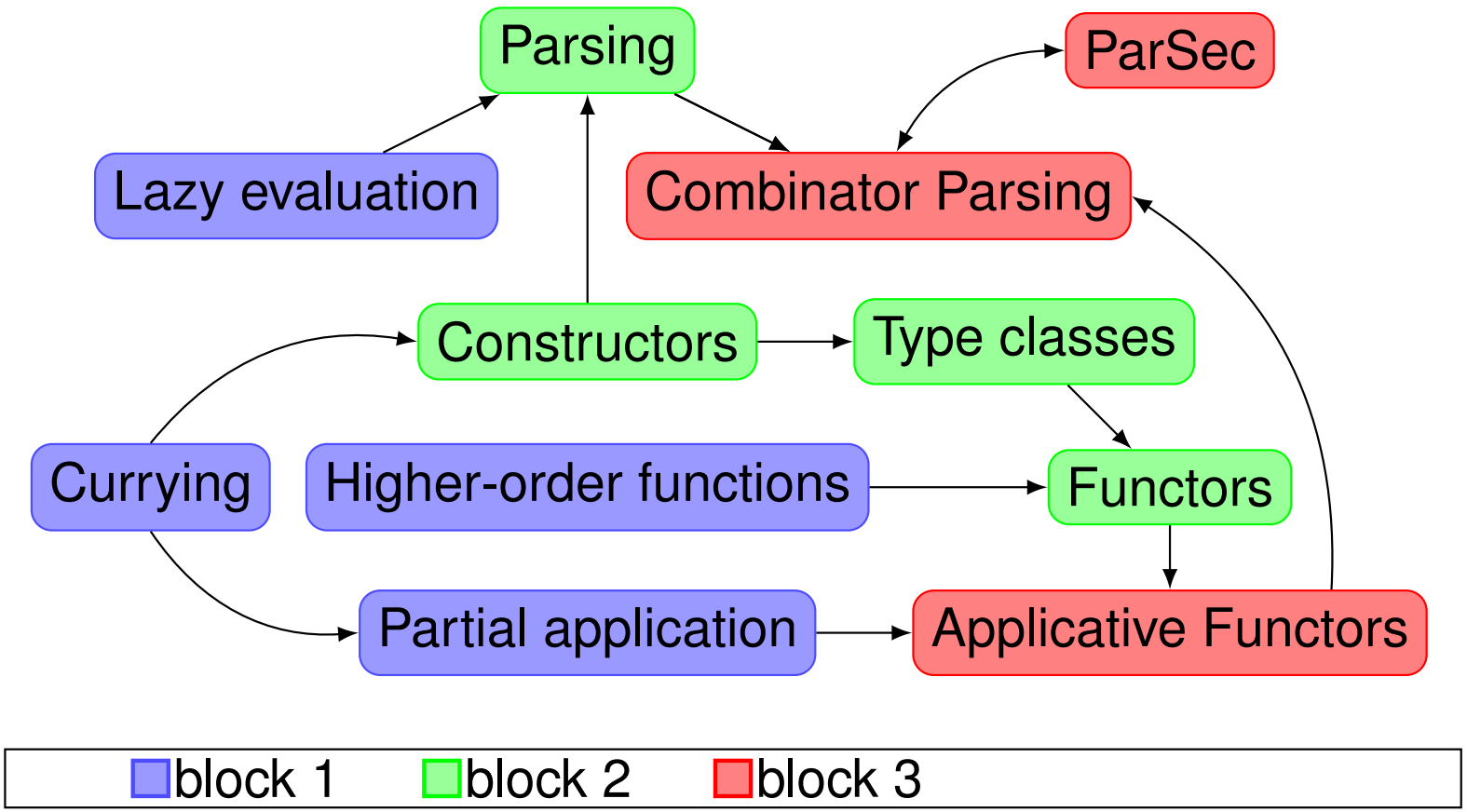
# Goal of this lecture

- Introduce the main project goals
- Introduce the subgoals and give some hints
- Explanation of a QuickCheck feature you may use
- Organizational aspects

# Connection of some of the topics between blocks



# $\mu$FP

⟨*program*⟩ ::=( ⟨*function*⟩ )+

⟨*function*⟩ ::=`identifier` (`identifier` | `integer`) ∗ ':=' ⟨*expr*⟩ ';'

⟨*expr*⟩ ::=⟨*term*⟩ | ⟨*term*⟩ ( '+' | '-' ) ⟨*expr*⟩

⟨*term*⟩ ::=⟨*factor*⟩ | ⟨*factor*⟩ '*' ⟨*term*⟩

⟨*factor*⟩ ::=`integer`

| `identifier` ( '(' ⟨*expr*⟩ (',' ⟨*expr*⟩) ∗ ')' )?

|'`if`' '(' ⟨*expr*⟩ ⟨*ordering*⟩ ⟨*expr*⟩ ')' '`then`'

'{' ⟨*expr*⟩ '}' '`else`' '{' ⟨*expr*⟩ '}'

|'(' ⟨*expr*⟩ ')'

⟨*ordering*⟩ ::='<' | '==' | '>'

# $\mu$FP examples (1/2)

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fibonacci 0 := 0;
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fibonacci n := fibonacci (n-1) + fibonacci (n-2);
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          } else {
          fib (n-1) + fib (n-2)
         };
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sum 0 := 0;
sum a := sum (a-1) + a;
```

# $\mu$FP examples (2/2)

```
div x y :=
    if (x < y) then
      {
        0
      } else {
        1 + div ((x-y), y)
      };

main := div (999, 2);
```

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add x y := x + y;
inc := add (1);
eleven := inc (10);
```

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- Read the assignment for details about grading and points

# Material

- Canvas: zip-file containing
  - `PComb.hs` for the parser combinator
  - `BasicParsers.hs` for the tokenizer
  - `MicroFP.hs` for the EDSL, evaluator, parser and QuickCheck

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  - GHC
  - The Prelude, except for parser combinators
  - QuickCheck
  - twentefp-eventloop-trees

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  - QuickCheck
  - twentefp-eventloop-trees
- Do not use Parsec or other libraries / parser combinators

# Parser definition

- Given parser:

```
data Stream = Stream [Char]
              deriving Show

data Parser r = P {
  runParser :: Stream -> [(r, Stream)]
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- Lacks:
  - Parsers and parser combinators
    - <$>, <*>, <|>
    - `some` and `many` (define an Alternative instance!)
    - `char`, `integer`, `symbol`, etc.
  - Error handling

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- In the project:
  - `p <|> q` tries parser `p` first, on failure it tries `q`
    - Do not use your practicum code: it behaves differently
  - `p <> q` gives *all* possible ways of parsing (uses both `p` *and* `q`)
    - Use `Monoids`
    - *Almost* how Parsec works
    - `mconcat` can now be used to define other parsers/combinators

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- Define a function `pretty` for pretty printing
  - Inverse of compilation

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- How to generate random programs?
  - Provide an `Arbitrary` instance

# Organisation

- Work in pairs; same pairs as in the practical sessions
- Indicate in your code where you implement a certain feature
  - Features are numbered from FP1.1 to FP5.6
  - See the project description
- Your work is processed using scripts:
  - Submit a PKZip (.zip-file); no 7Zip/RAR/tar/etc.
  - Create a directory `sxxxxxxxx_syyyyyyyy`
    - Replace `sxxxxxxxx` and `sxxxxxxxx` by your student numbers!
  - In this directory add: `PComb.hs`, `BasicParsers.hs` and `MicroFP.hs`
  - Name of zip: `sxxxxxxxx_syyyyyyyy.zip`
  - When you work alone: `sxxxxxxxx.zip` (directory: `sxxxxxxxx`)
  - `MakeZip.hs` may be used; no support, you remain responsible
  - Submit only once per group (by one student)
- Points are deducted for not following instructions

# MakeZip.hs

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- No support is given on `MakeZip.hs`
  - if it does not work, make the zip by hand!
  - check the zip-file, you are responsible for the content

# Plagiarism

Definition of fraud, from the Faculty of Applied Science (TUD):

> Intentional acts or omissions on the part of a student, which render correct or fair evaluations of his/her knowledge, insight of skills totally or partially impossible.

All submissions are checked for plagiarism and code similarity

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- Assessment criteria
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  - Appropriate FP concepts and constructs
  - Appropriate abstractions (HO functions, type classes, Applicative Functors, Monoids, etc.)
  - Comments and small tests
  - Features

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  - Comments and small tests
  - Features
- Preferred: quality over quantity

# Submission

- Submission deadline: June 7th, 23:59
- Late submissions: points are deducted (module guide, Ch. 1)
- Submissions via Canvas only