Fortgeschrittene funktionale Programmierung

LVA 185.A05, VU 2.0, ECTS 3.0
SS 2018

– Vorbesprechung –

(Stand: 01.03.2018)

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Topics and Objectives

...advanced principles of functional programming, applications, implementation issues of functional programming languages.

- Functional data structures and algorithms, functional pearls
- Programming with streams, combinators, monads, arrows
- Testing, verification, correctness by construction
  - Automatic testing, automatic test case generation
  - Induction, coinduction, equational reasoning
- Combinator libraries, embedded domain-specific languages
- Parallelism in functional languages
- Applications
  - Monadic parsing, combinator parsing, pretty printing
  - Functional logic programming
  - Functional reactive systems
  - ...
- ...

Outline

- Part I: Motivation
  - Why functional programming matters.
- Part II: Programming Principles
  - Programming with streams, higher-order functions, algorithm patterns, equational reasoning, memoization.
- Part III: Quality Assurance
  - Automatic testing, verification, correctness by construction.
- Part IV: Advanced Language Concepts
  - Functional arrays, abstract data types, monoids, functors, monads, arrows.
- Part V: Applications
  - Parsing, logical programming functionally, pretty printing, functional reactive programming.
- Part VI: Extensions, Perspectives
  - Parallelism, 'real world' programming.

Goals

- Overview, insight, and profound understanding of advanced principles of functional programming and their application in practice.
- Profound understanding of the foundations of functional programming.
- Insight in advantages and limitations of a purely functional style of programming.

Accounts for

- Elective course (Wahlfach) for the Master program 066 937 Software Engineering&Internet Computing (3.0 ECTS)
- Elective course (Wahlfach) for the Master program 066 931 Computational Intelligence (3.0 ECTS)
- Elective course (Wahlfach) for the Master program 066 950 Informatikdidaktik (3.0 ECTS)
- Examination course (Prüfungsfach) for the Erasmus-Mundus Master program 066 011 DDP Computational Logic (Erasmus-Mundus) (3.0 ECTS)

Prerequisites

- Completed Bachelor program
- Basic knowledge of the functional programming style as imparted e.g. in the course LVA 185.A03 Funktionale Programmierung, VU 2.0, ECTS 3.0

Overall Organization

- Lectures
  - Usually once a week, block-style.
- (Programming) assignments
  - Usually weekly, to be worked on and solved by teams of (typically) 2 students.
- Final oral examination
  - About course material and assignments.

Overall Organization in more Detail

Lectures

- Block style: Usually every Thursday, 4.15pm to 5.45pm, FH 2 Hörsaal, Freihausgebäude, Turm B, gelber Bereich, 2. OG, Wiedner Hauptstr. 8.

Assignments

- Issued: Usually every Wednesday, about 8 assignments in total, starting on March 14, 2018.
- Submission, 1st round: Automatically collected and checked one week after issueing at 3.00pm in the afternoon, must be stored in the home directory of your group account.
- Submission, 2nd round, after bug fixing: One week later, if the 1st round results are available on Monday, 9.00am, otherwise another week later.

Course Material

- Lecture slides, assignments, available on the homepage of the course.

Assessment, Grades

Grade on Programming Assignments

- Points per assignment: max. 100.
- Point achieved per assignment: Half of the sum of the points of the 1st and 2nd submission round.
- Minimum requirement for a positive grade: $\geq 50\%$ of the max. number of points achievable.

Final Grade

- Based on grades for the programming assignments and the final oral examination.
- Positive overall grade only, if both parts are positive.

Registration, Accounts, Passwords

Registration

- Via TISS on or before March 9, 2018, in teams of 2 students (in exceptional cases of 1 or 3 students)
- *Cancelling a registration:* Via TISS on or before March 30, 2018.

Accounts

- Each team of students receives an account for the machine `g0.complang.tuwien.ac.at`
- Account information and initial password are sent to every team member via email to the generic standard address `e<Matr.Nr>@student.tuwien.ac.at`

For further information

- Visit the homepage of the course: `www.complang.tuwien.ac.at/knoop/ffp185A05_ss2018.html`

Usage of Computers, Working at Lab/at Home

- Server: `g0.complang.tuwien.ac.at`
- Lab and terminals for course usage: Institutsgebäude EA, Argentinierstr. 8, ground floor
- Usage of other computers: is encouraged (e.g., at home)
- Required software: Hugs (available free of charge)
- Solutions of assignments: must be up-loaded to the server `g0.complang.tuwien.ac.at`

Recommended Reading: Basics

1. Jens Knoop. Slides and companion material of the course LVA 185.A03 Funktionale Programmierung. Institute of Computer Languages, TU Vienna, 2017/2018.
2. Simon Thompson. Haskell: The Craft of Functional Programming. Addison-Wesley/Pearson, 3rd edition, 2011.
3. Richard Bird. Introduction to Functional Programming using Haskell. Prentice-Hall, 2nd edition, 1998.
4. Peter Pepper. Funktionale Programmierung in OPAL, ML, Haskell und Gofer. Springer-V., 2. Auflage, 2003.
5. Peter Pepper, Petra Hofstedt. Funktionale Programmierung. Springer-V., 2006.
6. ...

Recommended Reading: Advanced

1. Jeremy Gibbons, Oege de Moor. The Fun of Programming. Palgrave Macmillan, 2003.
2. Chris Okasaki. Purely Functional Data Structures. Cambridge University Press, 1999.
3. Simon L. Peyton Jones. The Implementation of Functional Programming Languages. Prentice-Hall, 1987.
4. Andrew W. Appel. Modern Compiler Implementation in ML. Cambridge University Press, 1998.
5. Ravi Sethi. Programming Languages: Concepts and Constructs. Addison-Wesley, 2nd edition, 1995.
6. Lectures on Advanced Functional Programming. International Summer Schools 1995, 1996, 1998, 2002; Springer-V., LNCS volumes 925, 1129, 1608, 2638.
7. ...

Further Reading, Web Ressources

Further Reading Recommendations

- Specific reading recommendations are provided for every chapter on-the-fly of the course.

Web Ressources

- Haskell Homepage: `www.haskell.org/`
- Haskell Tutorial: `www.haskell.org/tutorial/`
- Hugs Interpreter: `www.haskell.org/hugs`

Team, Course Homepage

Team

- Jens Knoop
- Ulrich Neumerkel

Course homepage

http://www.complang.tuwien.ac.at/knoop/ffp185A05_ss2018.html

Perfect Add-Ons this Term (1)

- o.Univ.Prof.(em.) Dr. Andreas Frank
  Institut für Geoinformation und Kartographie

  LVA 127.008 VU 2.0, ECTS 3.0
  Haskell-Praxis: Programmieren mit der Funktionalen Programmiersprache Haskell
  Tue, 3.00 pm to 4.30 pm
  Seminar room 127, 3rd floor, Gußhausstr. 25-29.

  (The course will be held in English.)

...double-check, if this course will be held this term!

Perfect Add-Ons this Term (2)

- ao.Prof. Dr. Thomas Grechenig
  Institut für Information Systems Engineering

  LVA 183.653 VU 2.0, ECTS 3.0
  Methodisches, industrielles Software-Engineering mit funktionalen Sprachen am Fallbeispiel von Haskell
  Mon, 5.30 pm to 7.00 pm
  Hörsaal 14, Hauptgebäude, Stiege 3, 3rd floor,
  Karlsplatz 13.

...double-check, if this course will be held this term!

Interested in Studying Abroad?

The Erasmus Programme of the European Union offers a plenty of exciting opportunities, e.g.

- Linköping University, Sweden
- Aalto University, Finland
- The University of Copenhagen, Denmark
- Universität Halle-Wittenberg, Germany
- Universität Paderborn, Germany
- Universidad Politècnica de València, Spain
- ...

For further information, please, visit:
`http://www.complang.tuwien.ac.at/knoop/erasmus`

Ich wünsche Ihnen

...viel Erfolg bei dieser Lehrveranstaltung und dass Sie auch über die unmittelbare Veranstaltung hinaus davon profitieren!

Nicht zuletzt:
Vorlesung und Übung leben mit Ihnen! Ihre Rückmeldungen, Anregungen, Verbesserungsvorschläge sind willkommen!
Natürlich auch Hinweise, wenn Ihnen etwas gut gefallen hat!