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Spring 2013

## CS 7120: Functional and Logic Programming

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# CS 7120 Functional and Logic Programming

- **Instructor** : T. K. Prasad
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- **Email** : t.k.prasad@wright.edu
- **Home Page** : <http://knoesis.wright.edu/tkprasad>
- **Quarter** : Spring, 2013.
- **Class Hrs** : TTh, 5-6:20pm, 129 Med Sci
- **Office Hrs** : TTh, 3:30-4:30pm, 395 Joshi (or by appointment)

## Course Description

This course will discuss important concepts and language features to support (i) functional programming and (ii) logic programming. Specifically:

- (i) The first half of the course will cover functional programming techniques and constructs such as recursive definitions, higher-order functions, type inference, polymorphism, abstract data types, and modules. The programming exercises will illustrate the utility of list-processing, pattern matching, abstraction of data/control, strong typing, and parameterized modules (functors). We will also study the mathematical reasoning (induction) involved in the design of functional programs and for proving properties about functions so defined. The programming assignments will be coded in [SML '97](#) (Standard ML of New Jersey) and [Haskell](#).
- (ii) The second half of the course will cover logic programming paradigm and Prolog. We discuss the syntax and the semantics of Prolog, the workings of a Prolog interpreter, and various applications of Prolog. We consider the use of declarative programming and pattern matching for database querying, parsing, meta-programming, and problem solving in AI. The programming assignments will be coded in [XSB](#) and/or [SWI Prolog](#).

## Prerequisites

- [CS 3180/5180 Comparative Languages](#).

## Course Texts

1. [ML for the working programmer](#) (2nd Ed.), L. C. PAULSON, Cambridge University Press, 1996. ISBN 0-521-56543-X.
2. Ivan Bratko, [Prolog Programming for Artificial Intelligence \(Fourth Edition\)](#). Addison-Wesley Publ. Co., 2012. ISBN-13: 9780321417466.
3. PLUS: Online course material.

## Functional Programming References

1. [Elements of ML Programming](#) (ML 97 Ed.), J. D. ULLMAN, Prentice Hall, 1998. ISBN 0-13-790387-1.
2. [Introduction to Functional Programming in Haskell](#) (2nd Ed.), R. S BIRD, International Series in Computer Science. Prentice Hall, 1998. ISBN: 0-13-484346-0
3. [Programming in Standard ML](#), Robert Harper, Carnegie Mellon University, 2011.
4. [A Gentle Introduction to Haskell](#), Paul Hudak, John Peterson, Joseph Fasel, 2000.
5. [Why Functional Programming Matters](#), John Hughes.
6. [The Semantic Elegance of Applicative Languages](#), David Turner, Proceedings of the 1981 conference on Functional programming languages and computer architecture, pp. 85-92, 1981.
7. [The Standard ML Basis Library](#), Edited by Emden R. Gansner, John H. Reppy, Cambridge University Press, 2004.

## Logic Programming References

1. David S. Warren, [Programming in Tabled Prolog](#) (Online)
2. W. F. Clocksin and C.S.Mellish, [Programming in Prolog](#) (Fourth Edition), Springer-Verlag, 2000.
3. Ulf Nilsson and Jan Maluszynski, [Logic Programming and Prolog](#) (Second Edition), 2000.

## Course Load

The course load includes a mixture of homeworks and programming assignments worth 40 points, a midterm worth 30 points and a final worth 30 points. Exams are typically open book.

## Grading

The letter grades will be assigned using the following scale: A[90-100], B[80-90], C[70-80], D[60-70], and F[0-60]. However, I reserve the right to adjust the scale somewhat to utilize the gaps in the distribution.

## Attendance Policy

All registered students are expected to attend all lectures or access them on Pilot in a timely manner. In any case, the students are responsible for the material covered in the class, as it is typically available from the course web-page well in advance. Furthermore, the student is expected to find out about in-class announcements from their colleagues/instructor.

## Class Schedule and Syllabus

No.	Topic	Readings
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Class 1	<a href="#">Functional Programming Basics; Higher-order functions</a>	Chap. 1,2,5 (LP) Chap. 1,2,5 (JU)
Class 2	<a href="#">Type Inference; Polymorphic Type System</a>	Chap. 2, 3 (LP) ( <a href="#">Fixed Points</a> )
Class 3	<a href="#">Programming with lists: Pattern matching</a>	Chap. 3 (LP) Chap. 3-5 (JU)
Class 4	<a href="#">SML-97 Specifics</a>	(JU)
Class 5	<a href="#">Introduction to Haskell</a>	Adv Haskell (1) (2)
Class 6	<a href="#">Fold operations: <code>foldr</code>, <code>foldl</code></a>	Chap. 5 (LP) Chap. 5 (JU)
Class 7	<a href="#">Types : Concrete and Abstract</a>	Chap 6 (JU) Chap 7 (LP)
Class 8	<a href="#">Modules</a>	Chap 7 (LP) Chap. 8 (JU)
Class 9	<a href="#">Recursion and Induction</a>	Chap. 6 (LP)
Class 10	<a href="#">Examples (Combinatorial Functions)</a>	
Class 11	<a href="#">Efficiency; Streams; Records; Exceptions; References;</a>	Chap 5, 8 (LP) Chap. 7 (JU)
Class 12	<b>MIDTERM EXAM (February 14)</b>	
Class 13	Lambda Calculus Optional (1) (2)	
Class 14	<a href="#">Logic Programming Paradigm</a>	
Class 15	<a href="#">Prolog and Unification</a>	
Class 16	<a href="#">Meaning of Prolog Programs</a>	
Class 17	<a href="#">List Processing: Operators</a>	
Class 18	<a href="#">Arithmetic; Structures</a>	
Class 19	<a href="#">Controlling Backtracking</a>	
Class 20	<a href="#">Negation as Failure and Built-in Predicates</a>	
Class 21	<a href="#">Definite Clause Grammars</a>	
Class 22	<a href="#">Meta-Programming/Interpreters</a>	
Class 23	<a href="#">Constraint Logic Programming</a>	<a href="#">Practical Applications</a>
Class 24	<a href="#">Logic and Models : Semantics of Prolog Programs</a>	
Class 25	(cont'd)	
Class 26	<a href="#">Query Evaluation Strategies; Efficiency</a>	
	<b>Final Exam (April 23 : 5:45pm-7:45pm)</b>	

### Assignments ( Spring 2013 )

- Assignment 1 ([asg-FP.html](#))
- Assignment 2 ([asg-LP.pdf](#))

### Old Examinations

- [FP-Midterm](#)
- [FP-Final](#)
- [LP-Midterm](#)
- [LP-Final](#)