

## Functional and Logic Programming

**Web-page:** <http://casper.unbc.ca/Semesters/2019F/370.php>

**Prerequisites:** A grade of C<sup>-</sup> or better in CPSC 141, and CPSC 281; or permission of instructor.

**Instructor:** David Casperson;   **Office:** T&L 10-2040;   **Phone:** 960-6672;   **Departmental Assistant:** Marva Byfield (T&L 10-2074 960-6490);   **e-mail:** David.Casperson@unbc.ca .

**Accommodations:** If there is any student in this course who, because of a disability, may have a need for special academic accommodations, please come and discuss this with me, or contact the Access Resource Centre located in Teaching & Learning 10-1048.

### Grading Scheme and Dates:

Note that the mid-term exams are scheduled on Fridays following holiday Mondays.

Homework:	25%	
First class:		Wed, Sep 4
Thanksgiving:		Mon, Oct 14
Midterm 1:	20%	Wed, Oct 09
Midterm 2:	20%	cancelled
U. closed:		Mon, Nov 11
Last class:		Fri, Dec 13
Final Exam:	35%	cancelled

Grades for midterm II and the final are to be calculated as described in class.

**Programming Assignments:** There will be approximately weekly programming as-

signments during the semester. Programming languages include HASKELL, PROLOG and SCHEME.

**Lecture times:** MWF 08:30–09:20. **Room:** 8-161. There are *no* assigned lab or tutorial times.

**Office Hours:** Scheduled for:

M F 10:00–11:00

Please feel to interrupt me whenever you can find me, or schedule alternate times.

**Text Books:** None are required. [5] is a great introduction to HASKELL conveniently found on the web. [6, 1] are both in the library.

## References

- [1] W. F. Clocksin and C. S. Mellish, *Programming in prolog*, Springer Verlag, 1981.
- [2] Matthias Felleisen and Dan Friedman, *The little MLer*, MIT Press, 1998, in the UNBC library.
- [3] Daniel P. Friedman and Matthias Felleisen, *The little Schemer*, fourth ed., The MIT Press, 1996.
- [4] ———, *The seasoned Schemer*, The MIT Press, 1996.
- [5] Miran Lipovaca, *Learn you a haskell for great good!: A beginner's guide*, 1st ed., No Starch Press, San Francisco, CA, USA, 2011.
- [6] Richard A. O'Keefe, *The craft of prolog*, Logic Programming, MIT Press, 1990.
- [7] Riccardo Pucella, *Notes on programming in Standard ML of New Jersey*, Cornell University, January 2001, also available from <http://www.smlnj.org/doc/literature.html#tutorials>.
- [8] P. L. Wadler, *Comprehending monads*, Proceedings of the 1990 ACM Conference on LISP and Functional Programming, Nice (New York, NY), ACM, 1990, pp. 61–78.

Students who successfully complete CPSC 370 will:

- have an appreciation of the functional logic programming paradigms;
- be cognizant of the associated theory and language implementation techniques (for instance, the  $\lambda$ -calculus, closures, unification, and thunks),

and consequently will be stronger programmatic problem solvers in whatever programming environment they work.

### Approximate Course Content:

#### GENERAL

- Characteristics of functional programming languages,
- Basic syntax.
- Language concepts: Static and dynamic typing. Strict and non-strict evaluation. “Pure” versus “impure” languages.
- Mathematical concepts: Relations, Functions, partial functions, Cartesian products, Disjoint unions, “Currying”, categories, monads, combinators
- Programming: recursion, tail recursion, tail recursion strategies.

#### HASKELL:

- Types, polymorphic types, type classes
- data structures.
- immutability and its consequences
- Laziness: its implementation consequences
- Monads, do-notation, monadic programming.

#### SCHEME:

- Space and time complexity for functional programs and data structures.
- the pure  $\lambda$ -calculus.

#### PROLOG

- What logic programming is.
- Facts. Rules. Goals. Variables. Conjunctions. Horn Clauses.
- The Unification algorithm.
- Programming strategies: Accumulator arguments, difference lists.
- Cuts. Negation.
- Arithmetic.