Course Information and Syllabus
[Compiled on April 21, 2011]

The Formosan Summer School on Logic, Language, and Computation (FLOLAC) is a series of summer schools started in 2007, each assembling a selection of mini-course modules that aim at preparing the students for conducting research in foundational subjects of computing or in related application areas. Its focus this year is Logic and Formal Verification, which is also the official title of the associated summer course administered by the School of Professional and Continuing Studies, National Taiwan University.

Dates
June 27 (Monday) – July 8 (Friday), 2011

Venue
School of Professional and Continuing Studies, NTU (台大進修推廣部)

Instructors
Yu-Fang Chen (陳郁方), Academia Sinica and National Taiwan University
Chung-Yang (Ric) Huang (黃鍾揚), National Taiwan University
Jie-Hong Roland Jiang (江介宏), National Taiwan University
Yih-Kuen Tsay (蔡益坤), National Taiwan University
Farn Wang (王凡), National Taiwan University
Fang Yu (郁方), National Chengchi University

Prerequisites
1. The student must have taken a Computer Programming course and a Discrete Mathematics course, or their equivalents.
2. The student is strongly recommended to bring a notebook computer for working on assignments during or off the class meetings.

Textbook
Class Notes and Selected Readings

Syllabus/Schedule

• Elementary Logic and Computation Theory (Y.-K. Tsay: 6 hours)
  – Preliminaries: sets, relations, functions, orders, induction
  – Propositional logic: syntax and semantics, satisfiability, tautology, normal forms, proofs, soundness, completeness
  – First-order logic: syntax and semantics, validity, theories, expressiveness
  – Automata and Turing machines: languages, finite-state automata, pushdown automata, Turing machines, nondeterminism
- Complexity: decidability/undecidability, P, NP, coNP, PSPACE, reduction and completeness

- **Verification of String-Manipulating Programs** (F. Yu: 9 hours)
  - Introduction to string analysis, string automata and its symbolic representation
  - Pre- and post-image computations on automata of common string operations
  - Widening and fixpoint acceleration, forward and backward reachability analyses of string-manipulating programs
  - From string analysis to size analysis, composite analysis and relational analysis
  - String abstractions for string verification
  - Automatic detection and removal of Web application vulnerabilities
  - Stranger tool demonstration

- **Temporal Logics and Model Checking** (F. Wang: 9 hours)
  - LTL
  - CTL, CTL*
  - Expressiveness
  - LTL satisfiability: tableau-based techniques
  - CTL model-checking
  - Simulation-checking
  - ATL and game graphs
  - ATL model-checking

- **Automata-Theoretic Model Checking** (Y.-K. Tsay: 6 hours)
  - Automata on infinite words: Büchi automata, boolean operations, other ω-automata, conversion algorithms, relations with logic
  - Linear temporal logic: syntax and semantics, expressiveness, classification of temporal properties, translation to Büchi automata
  - Linear-time model checking: explicit-state algorithms, the SPIN model checker

- **Boolean Satisfiability and Its Applications in Hardware Synthesis and Verification** (C.-Y. Huang and J.-H. R. Jiang: 15 hours)
  - Introduction to Boolean Satisfiability (SAT) solvers
  - SAT-based hardware verification
  - SAT and interpolation in logic synthesis
  - QBF evaluation and applications

- **Satisfiability Modulo Theories and Its Applications in Software Model Checking** (Y.-F. Chen: 9 hours)
  - Introduction to Satisfiability Modulo Theories (SMT)
  - Software model checking using SMT and tool demonstration
  - DPLL(T)
  - Theory of linear arithmetic
  - Theory of equalities and uninterpreted functions

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Web Site
   http://flolac.iis.sinica.edu.tw/flolac11/

TA
   Ming-Hsien Tsai (蔡明憲), National Taiwan University

Grading
   Homework 40%, Final (2011/07/08) 60%