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 (黃鐘揚), 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 equivalences.

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*
  - Expressivenss
  - 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

	6/27 Mon	6/28 Tue	6/29 Wed	6/30 Thur	7/1 Fri	7/4 Mon	7/5 Tue	7/6 Wed	7/7 Thur	7/8 Fri
9:00–12:00	Tsay	Yu	Yu	Wang	Tsay	Huang	Huang	Jiang	Chen	Exam
12:00–14:00	Lunch					Lunch				
14:00–17:00	Tsay	Yu	Wang	Wang	Tsay	Huang	Jiang	Chen	Chen	Seminar

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%