

# CS 375: Discrete Event Systems

Instructor: Sherif Abdelwahed

## Introduction

This course provides a detailed coverage of the diagnosis and supervisory control problem for discrete, asynchronous, nondeterministic systems like manufacturing, traffic and communication systems. The underlying theory is developed in an elementary framework of automata and formal languages, and is supported by a software package for creating applications. The course will be given in lecture form, two per week for approximately 14 weeks. The course will use material from the following references:

- W. M. Wonham. *Notes on Control of Discrete-Event Systems*. ECE Department, University of Toronto. Available for download from: [www.control.utoronto.ca/DES](http://www.control.utoronto.ca/DES)
- C. G. Cassandras and S. Lafortune, *Introduction to Discrete Event Systems*, Kluwer Publishers, 1999.

## Course syllabus

- 1 Algebraic preliminaries
  - Partial orders, lattices, and equivalence relations
  - Equivalence kernel and canonical factorization
- 2 Basic automata and formal language theory
  - Formal languages and regular expressions
  - Nerode equivalence and right congruence
  - Canonical recognizers and automata
  - Processes modeling using finite-state automata
- 3 Supervisory control theory
  - Representation of controlled Discrete Event Systems
  - Controllability and supervision
  - Supremal controllable sublanguage and optimal supervision
  - Implementation of Supervisory controls by automata
  - Modular supervision of discrete event systems
  - Supervisory control with partial observations
- 4 Supervisory control of real-time systems
  - Timed discrete event systems and time bounded specifications
  - Controllability of timed discrete event systems
  - Supremal controllable sublanguages and optimal supervision
- 5 Fault Diagnosis in Discrete Event System
  - Systems diagnosability
  - Diagnoser design for finite state systems
  - Modular diagnosis of discrete event systems

## Prerequisite

A previous course in discrete mathematics (elementary logic and set theory) would be helpful but not essential.

## Grades

To encourage hands-on experience, there will be four modeling, supervisory control and diagnosis assignments involving the CTCT tool for supervisory control of DES. In addition, each student will have to complete a research project for a complete design and specification of a medium size practical system. Reports on the projects will be written up, and results will be presented in class.

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| • Assignments          | 60% |
| • Project              | 30% |
| • Project presentation | 10% |

## Credit hours

Students will receive 3 hours of credit for this course.