

## COURSE DESCRIPTION

<b>Department and Course Number</b>	CS 486	<b>Course Coordinator</b>	Valentino Crespi
<b>Course Title</b>	Computability and Intractability	<b>Total Credits</b>	4

### Current Catalog Description:

Theory of Computing; nondeterminisms, decidability and unsolvable problems; NP completeness and intractable computations.

### Textbook:

Michael Sipser. *Introduction to the Theory of Computation*. PWS Publishing Company, 1997. ISBN: 0-534-94728-X.

### References:

- Arto Salomaa. *Computation and Automata*. Cambridge University Press.
- J. Hopcroft, R. Motwani, J. Ullman. *Introduction Automata Theory, Languages and Computation*. Addison-Wesley.
- Peter Linz. *An Introduction to Formal Languages and Automata*. Jones and Barlett Publishers.
- Hartley Rogers, Jr. *Theory of Recursive Functions and Effective Computability*. The MIT Press.
- Michael Sipser. *Introduction to the Theory of Computation*. Thomson.
- Michael R. Garey and David S. Johnson. *Computers and Intractability: A Guide to the Theory of Np-Completeness*. W.H. Freeman & Company (June 1979).
- [Christos H. Papadimitriou](#). *Computational Complexity*. Addison-Wesley.

### Course Goals:

At the end of the course, students are able to

- Understand the rigorous notion of algorithm and study the decidability of computational problems. In particular students will learn to distinguish between recursive, recursively enumerable and non recursively enumerable problems.
- Understand the role of nondeterministic computations and characterize the class of problems NP. In particular students will learn the concept of NP-completeness and its importance in the P vs NP question.

These course goals contribute to the success of **Student Learning Outcomes 1.c, 5, and 6**.

### Prerequisites by Topic:

- Automata Theory.

**Major Topics Covered in the Course:**

- Turing Machines. Decision problems and languages. The Halting Problem. Recursive, Recursively Enumerable and non Recursively Enumerable languages. Reductions. Rice's Theorem and the Recursion Theorem.
- Time and Space Complexity of a Turing Machine. Nondeterministic Turing Machines.
- The classes P and NP. Polynomial time many-one reductions.
- Cook's Theorem. NP-completeness and the P vs NP question.

**Laboratory Projects (specify number of weeks on each):**

At the discretion of the instructor. Projects range from weekly assignments to a couple of class projects over the course of the term.

**Estimate Curriculum Category Content (Quarter Hours)**

Area	Core	Advanced	Area	Core	Advanced
Algorithms			Data Structures		
Software Design			Prog. Languages		
Comp. Arch.			Other*	4	

(\*) Automata, Theory of Computation and Structural Complexity Theory.

**Oral and Written Communications:**

No significant component.

**Social and Ethical Issues:**

No significant component.

**Theoretical Content:**

- Automata Theory and Theory of Computation.
- Computational Complexity Theory: NP-completeness.

**Problem Analysis:**

Students identify the issues involved with determining the decidability and intractability of decision problems. In particular they focus on Turing computability and Turing complexity.

**Solution Design:**

Solutions design involve the implementation of algorithms for the manipulation of Automata and Formal Languages.