# COURSE DESCRIPTION

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| **Department and Course Number** | CS 486 | **Course Coordinator** | Valentino Crespi |
| **Course Title** | Computability and Intractability | **Total Credits** | 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.