

CS 254 - Theory of Computation

CS 254

Fall 2023 Section 02 3 Unit(s) 08/21/2023 to 12/06/2023 Modified 08/21/2023

Contact Information

Instructor	Dr. Anant Dhayal
Email	anant.dhayal@sjsu.edu
Class Timings	Tuesday - Thursday 13:30 to 14:45 in DH 450
Office Hours	Wednesday 3pm to 4pm over zoom
	zoom link >> https://sjsu.zoom.us/j/86415116245

Course Description and Requisites

Models of computation; decidability; complexity measures; hierarchies; P, NP and other complexity classes; intractable problems.

Prerequisite(s): [CS 154 \(https://catalog.sjsu.edu/preview_course_nopop.php?catoid=13&coid=116279\)](https://catalog.sjsu.edu/preview_course_nopop.php?catoid=13&coid=116279) and Graduate standing.

Allowed Declared Major: Computer Science, Bioinformatics, Data Science. Or instructor consent.

Letter Graded

* Classroom Protocols

1. Students are advised to attend all lectures.
2. Regrade requests should only be made through Canvas:
 - Requests made during the class will not be entertained.
 - Requests that don't address the (instructor) comments will not be entertained.
 - If canvas replies are not satisfying, only then office hours should be used.
3. Office hours are only for:
 - Clarifying doubts regarding the class material.
 - Clarifying the exact meaning of assignments questions (in case of any discrepancies).
4. When in doubt, use canvas discussion tab (in appropriate threads):
 - For assignment related doubts and ideas: This is fair since all the students will have the same set of hints while solving assignments.
 - For class material related doubts: This will reduce the workload of instructors since each post will help multiple students simultaneously and students will also be able to help each other.

Program Information

Diversity Statement - At SJSU, it is important to create a safe learning environment where we can explore, learn, and grow together. We strive to build a diverse, equitable, inclusive culture that values, encourages, and supports students from all backgrounds and experiences.

🎯 Course Goals

To understand various computational resources, classes of problems based on these resources, and connections between these classes.

📊 Course Learning Outcomes (CLOs)

1. Understand variants of Turing machines and the concept of non-determinism.
2. Understand computability and reducibility of functions.
3. Understand the notion of completeness for complexity classes.
4. Understand various complexity classes including P, NP, L, NL, and PSPACE.
5. Understand basic relationships between these classes.

📖 Course Materials

We will not follow any specific book but we might refer some parts of the following books:

- Computational Complexity: A Modern Approach, Sanjeev Arora and Boaz Barak, 1st edition, 2009.
- Introduction to the Theory of Computation, Michael Sipser, 3rd edition, 2012.

* Free pdfs of these books will be provided (but only for personal use).

** The course theme will remain the same but exact material is subject to change with fair notice and changes will only be made to make the class more inclusive for the attending students.

📋 Course Requirements and Assignments

1. Midterm exam will be over zoom where you can only refer class material.
 - Any case of plagiarism will get a straight F.
2. Final exam will be 48 hours take home where you can only refer class material.
 - Any case of plagiarism will get a straight F.
3. Project presentations will be in class in groups of 2 or 3.
4. Each student will have to volunteer for preparing class notes for at least one class.
 - This activity constitutes 5% of the total grade.
 - The notes will be posted on the canvas and should meet a certain standard.
 - Instructors will provide extra help if needed.
5. Students may discuss assignments but should write the solutions individually.
 - Any case of plagiarism will get a straight F.
 - Any collaborators and sources (other than class material) should be cited for each answer.

✓ Grading Information

Breakdown:

Item	Percentage
Take Home Final	30
Mid Term	20
Assignments *	30
Project PPT	15
Class Notes	5

* best x of x+1 will be considered where x will be 3 or 4

Criteria:

Percentage **	Grade
> = 90	A+
85 - 89	A
80 - 84	A-
75 - 79	B+
70 - 74	B
65 - 69	B-
60 - 64	C+
55 - 59	C
50 - 54	C-
40 - 49	D
< = 39	F

** ceiling of the actual percentage

University Policies

Per [University Policy S16-9 \(PDF\)](http://www.sjsu.edu/senate/docs/S16-9.pdf) (<http://www.sjsu.edu/senate/docs/S16-9.pdf>), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on the [Syllabus Information](https://www.sjsu.edu/curriculum/courses/syllabus-info.php) (<https://www.sjsu.edu/curriculum/courses/syllabus-info.php>) web page. Make sure to visit this page to review and be aware of these university policies and resources.

Course Schedule

Week	Dates	Topic
1	08/22 - 08/24	Variants of Turing machines and non-determinism
2	08/29 - 08/31	Recognizable, decidable, and undecidable languages
3	09/05 - 09/07	Time and Space Hierarchies
4	09/12 - 09/14	Complexity classes and completeness
5	09/19 - 09/21	NP-completeness
6	09/26 - 09/28	Web of NP-complete problems
7	10/03 - 10/05	Polynomial Hierarchy
8	10/10 - 10/12	Review and Midterm Exam
9	10/17 - 10/19	NL-completeness
10	10/24 - 10/26	Savitch's Theorem: NL in L ²

11	10/31 - 11/02	NL = Co-NL
12	11/07 - 11/09	Circuits and non-uniform classes
13	11/14 - 11/16	Karp-Lipton Theorems
14	11/21 - 11/23	Project Presentations
15	11/28 - 11/30	Project Presentations
16	12/05 - 12/07	Review and Final Exam