SJSU SAN JOSÉ STATE UNIVERSITY

College of Science · Computer Science

Machine Learning on Graphs Section 01

CS 276

Fall 2024 3 Unit(s) 08/21/2024 to 12/09/2024 Modified 08/20/2024

Contact Information

Class Days/Time: Mondays-Wednesdays 10:30-11:45 am
Classroom: MacQuarrie Hall 225
Prerequisites: CS 146 (with a grade of "C-" or better in each); or instructor consent.

Office Location: MacQuarrie Hall 215
Email: katerina.potika@sjsu.edu
Office Hours: Mondays-Wednesdays 1:30-2:30 pm or by appointment

Course Information

Graphs are a powerful way to model networks. Networks contain a plethora of valuable information about the underlying data of various scientific fields. Students are introduced to various network analysis and machine learning techniques to help them extract, analyze, and visualize networks.

Course materials such as syllabus, handouts, notes, assignment instructions, etc. can be found on Canvas Learning Management System course login website at http://sjsu.instructure.com. You are responsible for regularly checking with the messaging system through MySJSU at http://my.sjsu.edu (or other communication systems as indicated by the instructor) to learn of any updates.

Classroom Protocols

Attendance is highly recommended. Please avoid disturbing the class: turn off cell phones (or put them on vibrate mode), no text messaging in the class or the exams, **no taking pictures and videos**, and avoid coming late. You may not publicly share or upload material for this course without my consent, such as exam questions, lecture notes, or solutions.

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 Learning Outcomes (CLOs)

Upon successful completion of this course, students will be able to:

- CLO1 Select techniques for analyzing complex networks.
- CLO2 Recognize and compute network properties and features, like node centralities, similarities, graphlets, and graph kernels.
- CLO3 Integrate machine learning techniques, like clustering and classification, for graph problems.
- CLO4 Create and use deep learning techniques for graph, node, and edge problems.

Course Materials

Textbooks recommended

Graph Representation Learning, by William L. Hamilton

Networks, Crowds, and Markets: Reasoning About a Highly Connected World, by David Easley and Jon Kleinberg, Cambridge University Press, ISBN-13 978-0521195331

Network Science by Albert-László Barabási, Cambridge University Press, ISBN-13 978-1107076266

Introduction to Machine Learning with Applications in Information Security by By Mark Stamp, 2nd edition, Chapman & Hall, ISBN-13 978-1032204925

Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT press, ISBN-13 978-0262035613

Knowledge Graphs: Fundamentals, Techniques, and Applications, by Mayank Kejriwal, Craig A. Knoblock and Pedro Szekely, MIT press, ISBN-13 978-0262045094

Online resources: paper, tutorials.

Course Requirements and Assignments

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course-related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Final Examination or Evaluation

Faculty members are required to have a culminating activity for their courses, which can include a final examination, a final research paper or project, a final creative work or performance, a final portfolio of work, or other appropriate assignments.

Homework assignments: individual, regularly assigned will include written problem assignments, and perhaps some online exercises. Solutions will not be posted. The homework is a tool for you to learn the material and prepare for the exams.

Reading assignments: Reading assignments will regularly be for the next class (see schedule).

Quizzes: Unannounced quizzes may be given during class, each of 10 minutes total. These will generally be problems from the reading assignment and/or the homework.

Class notes and Activities: In-class note-taking of a topic, writing a small report, and hands-on examples of the problems and methods we cover using various datasets. Class notes 700-900 words.

Group Project: A programming project of your choice related to the course's topics in groups of no more than three students. Never use any code you find on the web unless given by me. The penalty for late submission is 5% for every 3 days up to 9 days, after that, no submission will be accepted. The final presentation at the end of the semester is mandatory.

Participation: In-class participation and activities, online polls etc.

Midterm exam: There will be one written Midterm exam during the semester.

Final exam: One written final exam.

The exams will contain multiple-choice questions, short answer questions, and questions that require pseudocode and/or computations.

✔ Grading Information

Grading Information

Determination of Grades

Final Grade:

15% Homework and Activities

10% Participation & Discussions

15% Quizzes

5% Class notes

25% Project

15% Midterm

15% Final

The final exam is comprehensive.

Grade	*Percentage*
A plus	96 to 100%
A	93 to 95%
A minus	90 to 92%
B plus	86 to 89 %
B	82 to 85%
B minus	78 to 82%
C plus	74 to 77%
C	70 to 73%
C minus	65 to 69%
D plus	62 to 64%
D	58 to 61%
D minus	55 to 57%
F	<54%

University Policies

Per University Policy 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) web page. Make sure to visit this page to review and be aware of these university policies and resources.

Course Schedule

The schedule is subject to change with fair notice and how the notice will be made available

Lesson	Date	Topic	Reading/Projects (part of chapters covered)
1	8/21	Introduction	
2	8/26	Motivation and problems	
3	8/28	Graph Algorithms for Network Science	
4	9/4	Network Science tools, Node Statistics intro	
5	9/9	Node statistics	
6	9/11	Edge statistics	
7	9/16	Graph statistics	9/17 add/drop
8	9/18	Traditional ML approaches basics	
9	9/23	Traditional ML approaches on graphs	
10	9/25	Deep Learning basics	
11	9/30	Natural Language Processing and graphs	

12	10/2	Node, edge, and graph representations	
13	10/7	Random walks	Project proposal
14	10/9	Link analysis and web search	
15	10/14	Recommender Systems	
	10/16	**Midterm**	
16	10/21	Community detection	
17	10/23	Homophily and CNNs	
18	10/28	Graph Neural Networks message passing	
19	10/30	Graph Neural Networks neighborhood aggregation	
20	11/4	Graph Neural Networks applications	
21	11/6	Hierarchical graph representation, GenAI Transformers	
22	11/13	Influence maximization	Project demo
23	11/18	Knowledge graphs embeddings	
24	11/20	GenAI GraphRAG	Project presentations due
25	11/25	Random graphs	
26	12/2	GenAI Graph Generation	Project due
27	12/4	Project presentations	
28	12/9	Project presentations	

		Final exam Thursday, December 12, 2024•9:45am – 12:00pm	