

# Welcome to Math 39, Section 4

San José State University

Prof. Guangliang Chen

August 23, 2022

## Agenda for today

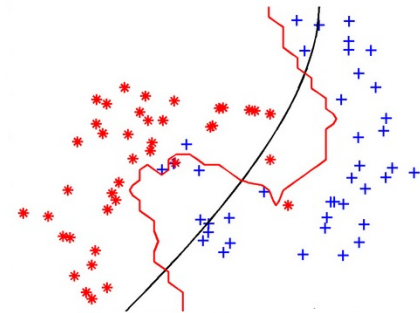
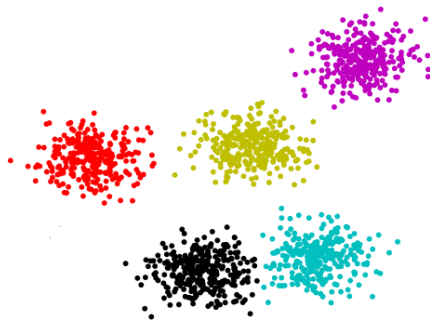
- Introductions
- Course policies
- Assignments from today

## Know your professor

- **Current title:** Associate Professor of Statistics
- **Education:** PhD in Applied Math, University of Minnesota, 2009
- **Employment history:** Visiting faculty at Duke University (2009-2013) and Claremont McKenna College (2013-2014)
- **Teaching experience**
  - SJSU (2014-present): Math 39, 42, 161A, 163, 164, 185, 250, 251, 261A, 261B, 263
  - Prior: college algebra, calculus, differential equations, statistics

## Know your professor - research

I work in several areas of machine learning, such as clustering and classification, with applications to image processing and documents analysis.



## **Know your professor - research (cont'd)**

I have taught/developed several machine learning courses (see my webpage at <http://www.sjsu.edu/faculty/guangliang.chen/>).

This semester I am teaching Math 251 Statistical and Machine Learning Classification (which requires Math 250 ← Math 39).

I have also worked with several undergraduate students on research and even published papers together.

If you want to learn more from me on these topics, come to my office hours to discuss them in further detail.

## Now it's your turn...

You can briefly introduce yourself by saying your

- **name**
- **major**
- **academic year,**
- **why you want to take this course,** and
- **anything else about you** (to help us remember who you are).

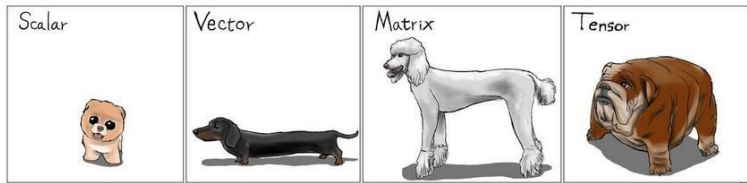
## Overview of Math 39

- **Catalog description:** Matrices, systems of linear equations, vector geometry, matrix transformations, determinants, eigenvectors and eigenvalues, orthogonality, diagonalization, applications, computer exercises. Theory in  $\mathbb{R}^n$  emphasized; general real vector spaces and linear transformations introduced.
- **Prerequisite:** MATH 31 or Math 31X (with a grade of C- or better)
- Students typically come from **math, stats, CS, and engineering.**
- A grade of B or better in this course is required for admission into **MS Statistics** and **MS Data Science** at SJSU.

## What are matrices?

**Vectors** are 1D arrays of numbers (arranged in column form), e.g.,  $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$ .

**Matrices** are 2D arrays of numbers, e.g.,  $\begin{bmatrix} 2 & 0 & 3 & -1 \\ 0 & -2 & 4 & 4 \\ 1 & -1 & 3 & 0 \end{bmatrix}$





*Notation:* Matrices are denoted by boldface uppercase letters (**A**, **B**, etc.), vectors boldface lowercase (**a**, **x**, etc.); scalars plain lowercase ( $x_1, x_2, a, b$ ).

We only study vectors and matrices consisting of real numbers in this course.

We say that a vector **a** with  $n$  entries has size  $n \times 1$  (and length  $n$ ), and denote it as  $\mathbf{a} \in \mathbb{R}^n$ .

We say that a matrix **A** with  $m$  rows and  $n$  columns has size  $m \times n$ , and denote it as  $\mathbf{A} \in \mathbb{R}^{m \times n}$ .

## Why do we want to study matrices?

Matrices are very convenient for representing a lot of objects, such as

- **Linear systems of equations** ← application in this course
- Data sets in Euclidean spaces
- Digital images and their collections
- Text corpus (collections of text documents)
- Graph/network data

## Linear systems as matrices

$$\begin{cases} 2x_1 - x_2 + 5x_3 = 0 \\ x_1 - 2x_2 + 4x_3 = -1 \\ 3x_1 + 6x_2 = 1 \end{cases} \longrightarrow \mathbf{A} = \begin{bmatrix} 2 & -1 & 5 \\ 1 & -2 & 4 \\ 3 & 6 & 0 \end{bmatrix}, \quad \mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}, \quad \mathbf{b} = \begin{bmatrix} 0 \\ -1 \\ 1 \end{bmatrix}$$

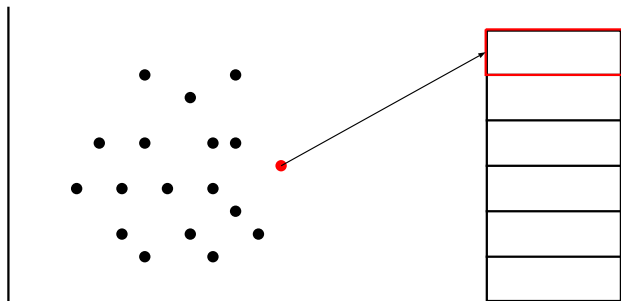
The system of linear equations can be written as  $\mathbf{Ax} = \mathbf{b}$ .

One can also form an augmented matrix by combining  $\mathbf{A}$  and  $\mathbf{b}$  together:

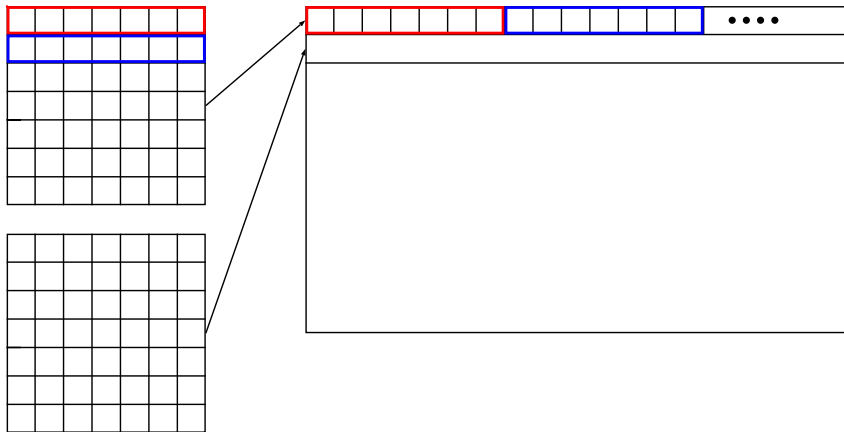
$$[\mathbf{A} \mid \mathbf{b}] = \begin{bmatrix} 2 & -1 & 5 & 0 \\ 1 & -2 & 4 & -1 \\ 3 & 6 & 0 & 1 \end{bmatrix}$$

## Data sets as matrices

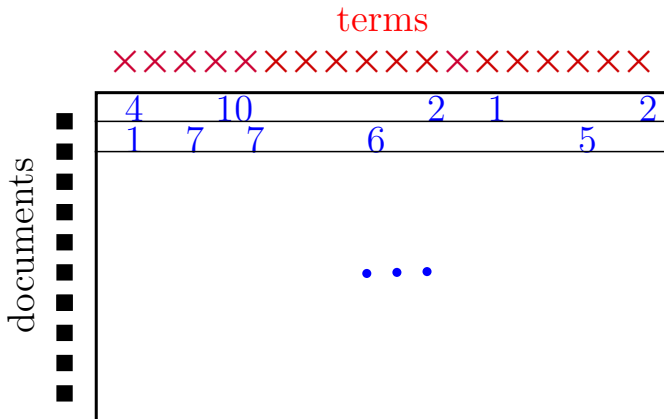
Rows correspond to objects, columns correspond to numerical features.



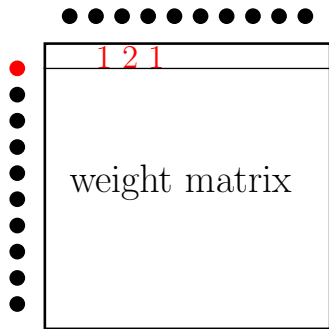
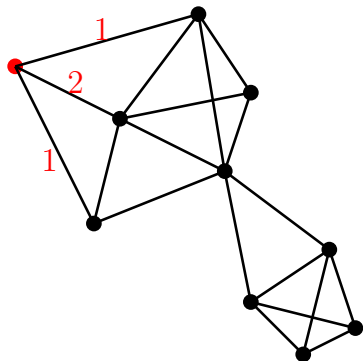
## Digital images as matrices



## Collections of documents as matrices



## Network (graph) data as matrices



## What the course is about

This course covers the following fundamentals:

- **Matrix concepts:** symmetry, rank, trace, determinant, eigenvalues and eigenvectors
- **Matrix algebra:** matrix addition, multiplication, decompositions
- **Geometric interpretations:** vector spaces, row/column/null spaces, eigenspace
- **Applications:** Solving systems of linear equations, least-squares problems

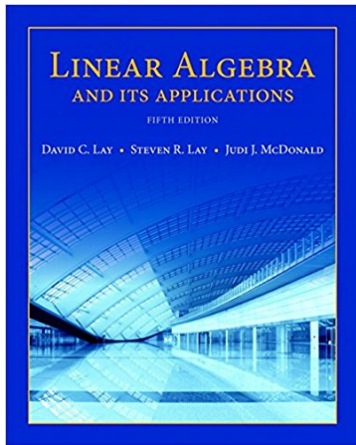


## Required textbook

*Linear Algebra and Its Applications*, 5th edition, by D. Lay, S. Lay and J. McDonald (2015), Pearson. ISBN: 978-0321982384.

We will cover material from the first 7 chapters of the book.

You may use an older edition for reading but you should do the homework assigned based on the 5th ed.



## Teaching methodology

This class is taught in the following format:

- The presentations are **slides-based**:
  - Pros: efficient, informative, and easily accessible
  - Cons: very fast-paced ← Reading the textbook before class can be very helpful. Also, come to office hours with questions
- Accompanied by **worksheets** (containing lecture examples)
- Complemented by **office hours** and **Piazza** to answer any questions

## Learning management system

We will use **Canvas** (accessible via <http://one.sjsu.edu/>) in various ways:

- Post homework assignments
- Record homework and test scores (let me know ASAP if any mistake)
- Make announcements (e.g. reminders, clarifications, deadline changes)

Make sure to check your Canvas settings to receive timely notifications. Also, check if your email address in record is still good.

## Course webpage

I am maintaining a course webpage<sup>1</sup> for posting the following information:

- Syllabus (also available in Canvas).
- Lecture slides and other learning resources

Please visit the webpage before class to download the corresponding slides (try refreshing your browser if you don't see them).

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<sup>1</sup><https://www.sjsu.edu/faculty/guangliang.chen/math39.html>

## Piazza

We will use **Piazza**<sup>2</sup> as the class bulletin board to communicate and discuss course-related questions.

Rather than emailing questions to me, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email [team@piazza.com](mailto:team@piazza.com).

**Advantages:** Responses (from me and/or your peers) are **fast**, **efficient** and have **broad impact**. Also, you get to interact more with your peers!

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<sup>2</sup>Signup link: [piazza.com/sjsu/fall2022/math39](https://piazza.com/sjsu/fall2022/math39)

Sample questions you can post there (anonymously if you want) :

- *What is the new due date for Hw1 (I couldn't go to class yesterday)?*
- *What does Hw2-Q1 want, or I got 0.6 for Q2, is that correct?*
- *Can somebody explain to me in a different way what a matrix rank is?*
- *Can somebody kindly share your notes with me (I was sick and had to miss Tuesday's class)?*
- *I would like to form a small group to study together. Who is interested? Email me at xxx.xxx@sjsu.edu.*

## i-Clicker

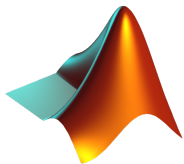
This semester we will use **i-Clicker** to perform some in-class activities (such as polling and quizzing).

- Go to <https://www.iclicker.com/> to create a free account (as students) and add this class (search first for San Jose State University, then my name).
- To participate in class, you will need to have a smart phone or laptop.

On random days, there will be pop quizzes, each consisting of a multiple-choice question, during the first 5 minutes of each class. It is meant to test your understanding of a concept, but counted toward extra credit.

## MATLAB (MATrix LABoratory)

MATLAB is commercial software developed by MathWorks. It is easy to use, and very efficient for performing linear algebra operations.



San Jose State has purchased a campus-wide MATLAB license for everyone to use for free.<sup>3</sup>

You can use Matlab as a **matrix calculator** for homework calculations (however, be sure to show all steps).

Matlab is not allowed for the exams.

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<sup>3</sup><https://www.mathworks.com/academia/tah-portal/san-jose-state-university-31511582.html>



## Course requirements

- **Homework (15%).** Assigned weekly on, and also collected via, Canvas (electronic submission only).
- **Midterm 1 (25%).** October 4, Tuesday, in class
- **Midterm 2 (25%).** November 10, Thursday, in class
- **Final exam (35%).** The University has fixed the date and time to be December 14, Wednesday, 12:15–2:30pm.

## Extra credit (up to 5%)

...may be earned in several ways, such as

- In-class pop quizzes (conducted through i-Clicker during the first 5 minutes on random days)
- Bonus questions on homework and exams
- Extra-credit activities assigned by the instructor

More opportunities may be given during the semester, at the instructor's discretion.

## **Grading policy - homework**

You may collaborate on homework but must write independent solutions.

Copying at any level will result in a zero score for the homework, and will be reported to SJSU Office of Student Conduct.

Please write legibly (unrecognizable work will be given zero points).

Only late homework within 24 hours will be accepted. However, a penalty of 10% of the total number of points will be applied.

Your lowest homework score will be dropped.

## Grading policy - tests

The midterm and final exams are closed book, and conducted in person.

Before each exam, a study guide with some practice problems will be provided to you for testing your understanding of the material. However, it is in your best interest to review all the material thoroughly.

**No make-up exams will be given if you miss a midterm exam.** If you have a legitimate excuse (e.g., illness or other personal emergencies) and can provide some kind of evidence, the weight of the midterm will be combined with the final.

## Important reminders

**Show all important steps** for both homework and tests:

- It is your entire work (in terms of **correctness**, **completeness**, and **clarity**) that is graded.
- **Correct answers with no or poorly written supporting steps will be given very little credit.**

Please **write legibly** (unrecognizable work will receive no credit).

Copying or plagiarism at any level will not be tolerated and, per SJSU policy, will be reported to the Office of Student Conduct & Ethical Development.

## Grade cutoffs

...will be determined based on the following **percentages**:

- A+: 97%, A: 93%, A-: 90%
- B+: 85%, B: 80%, B-: 75%
- C+: 72%, C: 68%, C-: 65%
- D+: 60%, D: 55%, D-: 50%
- F: <50%

and **the actual distribution of the class** at the end of the semester.

### Potential challenges:

- Slides-based lectures tend to move fast
- A lot of material to be covered
- **Matrix concepts** can be initially difficult to grasp
- Ability of **abstract thinking and reasoning** is also important.

## Your responsibilities in learning

My duty as an instructor is to disseminate knowledge while helping you learn. **The ultimate responsibility of learning is upon the student, not the instructor.** Thus, you should

- Attend all classes
- Participate in-class discussions
- Read the textbook before and after class
- Take time to think through the concepts
- Do your homework
- ASK whenever you don't understand something!!!



## Classroom protocols

- The class starts on time, so do not be late.
- Please remember to turn off or mute your cell phone during class.
- Please do not perform irrelevant or distracting activities in class.
- If you miss a class, you are responsible for finding out what's said/done in that class (such as new material, deadline change, etc.) and responding accordingly.
- Academic dishonesty at any level is not tolerated and will be surely reported to the Office of Student Conduct, per SJSU policy.

## Study groups

You are strongly encouraged to form study groups, so that you may learn from each other and collaborate on homework (but you must write independent solutions).

Let me know if you need help with finding a study partner.

## Special accommodations

If you anticipate needing any special accommodation during the semester (e.g., you have a disability registered with SJSU's Accessible Education Center), please let me know as soon as possible.

## Instructor feedback

I strive to teach in the best ways to facilitate your learning. To achieve this goal, it is very helpful for me to receive timely feedback from you.

You can choose to

- talk to me in person, or
- send me an email, or,
- submit your feedback anonymously through <http://goo.gl/forms/f0wUD5aZSK>.

## Contact information

- **Office:** 417 MacQuarrie Hall
- **Phone:** (408) 924-5131
- **Email:** *guangliang.chen@sjsu.edu*. I check my emails frequently, but you should allow a turnaround time of up to 24 hours (on weekdays) or 48 hours (during weekends).
- **Office hours:** TR 12:20-1:20pm (in person), W 4-5pm (on Zoom), and by appointment.

## Assignments from Day 1 (\*extra credit)

1. \*Go to **Piazza**<sup>4</sup> to ask a course-related question to the whole class (2 points) and answer another person's question (1 point).
2. Create an **i-Clicker**<sup>5</sup> student account and add this class.
3. Download **Matlab** to your computer and meanwhile, complete the 2-hour, online **Matlab Onramp** course.<sup>6</sup>

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<sup>4</sup><https://piazza.com/class/l6qziqksahp86>

<sup>5</sup><https://www.iclicker.com>

<sup>6</sup><https://www.mathworks.com/learn/tutorials/matlab-onramp.html>

## Add code policy

You should **write down your name, SJSU id, and email**, and sign on the attendance sheet before you leave.

Departmental policy is that add codes (when available) be given out in the following order: **graduating seniors > first timers > repeaters > Open University students**

If you are not able to receive an add code by next class, you are welcome to continue attending classes until the add/drop deadline (Thursday, 9/15).

**Questions?**