

## Video Project # 1 Topics

The following are the topics for Video Project # 1. The number you received in the PDF posted for your Discussion section corresponds to the Project you were randomly selected to do.

In addition to the topic itself, we list a few ideas for getting started. Each of these topics relates quite closely to concepts from the course lectures and in most cases your textbook and supplemental videos. You are encouraged to review all course material related to these topics.

Of course, each of these topics are important beyond our specific course! Indeed, most of these topics have excellent Wikipedia articles. You are heavily encouraged to search for additional resources on-line.

Remember, there are no “right answers” we have in mind for your video projects. We encourage you to be creative and have fun!

You can consult with the course Instructors/TAs and your classmates on this video topic. However, each student is responsible for submitting their own video project.

Topic #	Topic Name	Ideas for Getting Started
1	Row Picture vs Column Picture	What do each of these mean? Why are they useful? Why are they useful? Give an example.
2	Linear Combination	How is this defined? What does it mean? How/why is this useful in calculating linear algebra? Give an example.
3	Consistent vs Inconsistent System of Equations	What do these mean? What does it tell you about the system? Give an example.
4	Row Echelon form of a Matrix	What does it mean? How does this come up and why is it useful? Give an example.
5	# of Pivots in Relation to Solutions $A\vec{x} = \vec{b}$	What is a pivot? How does it come up? And what does it tell us? Give an example.
6	Underdetermined system and its relationship to infinitely many solutions	What do these terms mean? Give an example.
7	Elementary Matrices	What are they? When do they come up? Why are they useful? Give an example.
8	Gaussian Elimination	What does this mean? Does it change the solutions of $A\vec{x} = \vec{b}$ ? Give an example.
9	Gauss-Jordan Algorithm	What does this algorithm do? Why does it work? How can it fail? Give an example.
10	LU Factorization	What is this factorization? When does it exist? How is it useful in solving $A\vec{x} = \vec{b}$ ? Given an example.
11	Linear Transformation	What kinds of transformations are linear transformations? Give one example of something that is a linear transformation, and one that is not a linear transformation.
12	Vector Space	What makes a vector space? What conditions must hold? Give an example of something that IS and is NOT a vector space.
13	Subspace	What makes a subset of a vector space a subspace? What conditions must hold? Give an example of something that IS and is NOT a subspace.
14	Four fundamental subspaces	What are they? What properties do they have? Give an example.

Topic #	Topic Name	Ideas for Getting Started
15	Upper/Lower Triangular Matrices	Explain what they are. Are the products of Upper/Lower matrices still the same type? How do these matrices arise in linear algebra. Give an example.
16	Rank of a Matrix	What does it mean? How does it come up? What does it tell us about the solutions to $A\vec{x} = \vec{b}$ ? Give an example.
17	Special Solution to $A\vec{x} = \vec{0}$	What does this mean? How do these solutions come up? How do they relate to $N(A)$ ? Give an example.
18	Column Space of $A$	What does it mean? How do you find it? How does it relate to the solutions to $A\vec{x} = \vec{b}$ ? Give an example.
19	Linear independence	What does this mean? How does it come up? Give an example of a linearly independent set and a set that is linearly dependent.
20	Span of a Set of Vectors	What does this mean? How does it come up? Why is this useful?
21	Basis of a Vector Space	What does this mean? How does it come up? Why is this useful? Give an example of something that is and is NOT a basis.
22	Dimension of a Vector Space	What does this mean? How does it come up? Why is this useful? Give an example of something how you calculate a dimension.
23	Symmetric Matrix	What does it mean for a matrix to be symmetric? What neat things exist about symmetric matrices (i.e., are they preserved under addition/multiplication). Give examples. Where do symmetric matrices come up in this class. Give an example.
24	Full Row Rank	What does it mean for the solutions to $A\vec{x} = \vec{b}$ if $A$ has full row rank? Does this system have an inverse? Give an example.
25	Full Column Rank	What does it mean for the solutions to $A\vec{x} = \vec{b}$ if $A$ has full column rank? Does this system have an inverse? Give an example.
26	Invertible Matrices	When do these exist? How do you find them? How can you tell if a Matrix is invertible. Why are they useful? Give an example.
27	Rank Nullity Theorem	What does this mean? How does this come up? How does this help us understand $A\vec{x} = \vec{b}$ ?
28	Orthogonal	What does it mean for a vector to be orthogonal? Why is this useful and how does it come up? Give an example.
29	Orthogonal Complement	What does this mean? When is it defined? Why is this useful and how does it come up in this class. Give an example.
30	Matrix Projecting a Vector onto a Line	What does it mean to project onto a line? How can you calculate a projection matrix? Give an example.