Question **1**

Not complete

Points out of 1.00

In order to write the eigenvector decomposition, we need the eigenvectors to span the space we are working in so that any initial condition can be expressed in terms of them. If the Eigenvectors command of a matrix outputs in Maple as $\begin{bmatrix} \frac{9}{10} \\ \frac{7}{10} \end{bmatrix}$ $\begin{bmatrix} 1 & 2 \\ 1 & 1 \end{bmatrix}$, then examine the following arguments for their validity:

Argument 1: The determinant of the matrix of eigenvectors is $ad - bc = 1 \cdot 1 - 2 \cdot 1 = -1$, which is not zero, so by the what makes a matrix invertible theorem the columns of the matrix span all of $\mathbb{R}^2$

Argument 2: The definition of span is the set of all linear combinations so we set up a generic vector $\begin{bmatrix} b_1 \\ b_2 \end{bmatrix} = c_1 \begin{bmatrix} 1 \\ 1 \end{bmatrix} + c_2 \begin{bmatrix} 2 \\ 1 \end{bmatrix}$. The corresponding augmented matrix for the system is $\begin{bmatrix} 1 & 2 & b_1 \\ 1 & 1 & b_2 \end{bmatrix}$. Reducing using Gaussian, we see we have full row pivots: $\xrightarrow{r_2' = -r_1 + r_2}$ $\begin{bmatrix} 1 & 2 & b_1 \\ 0 & -1 & -b_1 + b_2 \end{bmatrix}$. Thus we are never inconsistent and so every $\begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$ vector in $\mathbb{R}^2$ is in the span of the eigenvectors.

Argument 3: The span is -1 which is not 0 so we span all of $\mathbb{R}^2$

Which is true:

- ○only Argument 1 is valid
- ○only Argument 2 is valid
- ○only Argument 3 is valid
- ○Argument 1 and Argument 2 are valid
- ○Argument 1 and Argument 3 are valid
- ○Argument 2 and Argument 3 are valid
- ○all three arguments are valid

Is "The vectors are linearly independent" sufficient to explain why eigenvector representatives span an entire space?

- ○yes
- ○no

Check

Question **2**

Not complete

Points out of 7.00

One reason Calculus II with analytic geometry is a prerequisite for linear algebra is that in that class we apply limits to diverse objects including improper integrals and partial sums of series. The key in this section is applying limits limits to numbers that are coefficients within a linear combination of vectors. In linear algebra, our time steps are discrete rather than continuous (like once a day or year).

What is $\lim_{k\to\infty}(\frac{2}{3})^k$

- 0
- $\frac{2}{3}$
- ∞
- DNE
- other

What happens in the longterm as *k* grows large to $a_1(\frac{2}{3})^k \begin{bmatrix} 1 \\ 5 \end{bmatrix}$? What does this tend to?

- 0
- $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$
- $\frac{2}{15}$
- $\begin{bmatrix} a_1\frac{2}{3} \\ a_1\frac{10}{3} \end{bmatrix}$
- ∞
- $\begin{bmatrix} \infty \\ \infty \end{bmatrix}$
- DNE
- other

What is $\lim_{k\to\infty}(\frac{3}{2})^k$

- 0
- $\frac{3}{2}$
- ∞
- DNE
- other

What happens in the longterm as *k* grows large to $a_2(\frac{3}{2})^k \begin{bmatrix} 5 \\ 6 \end{bmatrix}$? What does this tend to?

- 0
- $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$
- $\frac{15}{12}$

○$\begin{bmatrix} a_2\frac{15}{2} \\ a_2 9 \end{bmatrix}$

○∞

○$\begin{bmatrix} \infty \\ \infty \end{bmatrix}$

○DNE

○other

What is $\lim_{k\to\infty} 1^k$

○0

○1

○∞

○DNE

○other

What happens in the longterm as *k* grows large to $a_3 1^k \begin{bmatrix} 5 \\ 6 \end{bmatrix}$? What does this tend to?

○0

○$\begin{bmatrix} 0 \\ 0 \end{bmatrix}$

○$\frac{5}{6}$

○$\begin{bmatrix} 5a_3 \\ 6a_3 \end{bmatrix}$

○∞

○$\begin{bmatrix} \infty \\ \infty \end{bmatrix}$

○DNE

○other

In the cases of growth and die off, the slope of the vector tells us how we die off or grow and what line we are asymptotic to. What is the line we are asymptotic to in $a_2(\frac{3}{2})^k \begin{bmatrix} 5 \\ 6 \end{bmatrix}$?

○$y = \frac{5}{6}x$

○$y = \frac{6}{5}x$

In dynamical systems where we have sums like $a_1(\frac{2}{3})^k \begin{bmatrix} 1 \\ 5 \end{bmatrix} + a_2(\frac{3}{2})^k \begin{bmatrix} 5 \\ 6 \end{bmatrix}$, the dominant piece in the limit determines longterm behavior, i.e. whichever power of *k* is largest magnitude (i.e. largest absolute value)!

Check

Question **3**

Not complete

Points out of 6.00

Open

https://www.geogebra.org/m/xtvtxz6u

The system shown has eigenvectors on the x-axis as well as the y-axis and no other eigenvectors.

Drag the a and b sliders, which are the coordinates of the initial condition in the first quadrant, in order to see how the trajectory changes as k gets large, up to $k=50$ here.

What happens in the long run for most starting positions as you move the sliders?

- ○ die off to the origin: the dominant eigenvalue has absolute value less than 1
- ○ going to stability towards a fixed vector, one that is away from the origin: the dominant eigenvalue is 1
- ○ infinite growth: the dominant eigenvalue has absolute greater than 1

What axis does the trajectory go asymptotic to (for die off or growth) or go towards (for stability) in the long run for most starting positions as you move the sliders?

- ○ x-axis
- ○ y-axis

Next, open the second trajectory

https://www.geogebra.org/m/ynx9eaw8

The system shown also has eigenvectors on the x-axis as well as the y-axis and no other eigenvectors.

Drag the a and b sliders. What happens in the long run in the second trajectory for most starting positions as you move the sliders?

- ○ die off to the origin: the dominant eigenvalue has absolute value less than 1
- ○ going to stability towards a fixed vector, one that is away from the origin: the dominant eigenvalue is 1
- ○ infinite growth: the dominant eigenvalue has absolute greater than 1

What axis does the trajectory go asymptotic to (for die off or growth) or go towards (for stability) in the long run for most starting positions in trajectory 2 as you move the sliders?

- ○ x-axis
- ○ y-axis

Finally, open

https://www.geogebra.org/m/ayvfsqyx

The system shown also has eigenvectors on the x-axis as well as the y-axis and no other eigenvectors.

Drag the a and b sliders. What happens in the long run in the third trajectory for most starting positions as you move the sliders?

- ○ die off to the origin: the dominant eigenvalue has absolute value less than 1
- ○ going to stability towards a fixed vector, one that is away from the origin: the dominant eigenvalue is 1
- ○ infinite growth: the dominant eigenvalue has absolute greater than 1

What axis does the trajectory go asymptotic to (for die off or growth) or go towards (for stability) in the long run for most starting positions as you move the sliders?

- ○ x-axis
- ○ y-axis

Check

Question **4**

Not complete

Points out of 2.00

Examine the following 3 trajectory diagrams, which show the animated trajectory of the path of an initial condition that begins in quadrant 1 but doesn't start on either eigenvector. In your notes, roughly sketch these and label them from among growth, die off, stability (which is which). The animated red +'s show the trajectory progressing and in the long run.

Image 1:

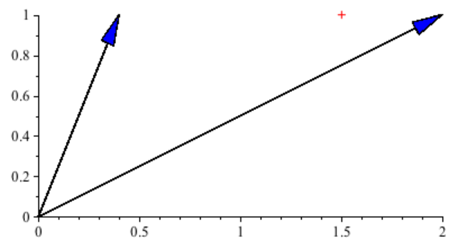


Image 2:

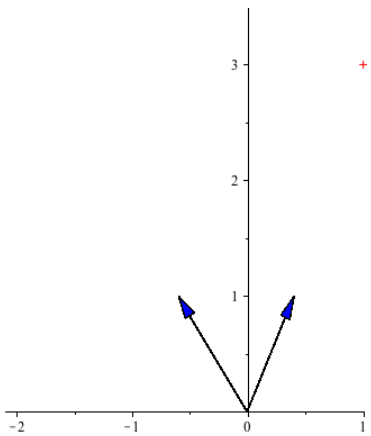
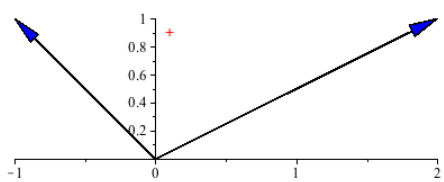


Image 3:



Which image corresponds to the situation where the dominant eigenvalue $|\lambda| < 1$?

○Image 1

○Image 2

○Image 3

○none of the above

Which image corresponds to the situation where the dominant eigenvalue $\lambda = 1$

○Image 1

○Image 2

○Image 3

○none of the above

Which image corresponds to the situation where the dominant eigenvalue $|\lambda| > 1$

○Image 1

○Image 2

○Image 3

○none of the above

For a linear system with real eigenvalues, in the long run can one population grow along one eigenvector while the other dies off along another?

○yes, that is possible

○that's impossible in the long run as the dominant eigenvalue controls the behavior of the system in the long run and forces it to tend to the corresponding eigenvector in the long run, with the eigenvalue telling us whether the multiple populations die off, grow, or stabilize asymptotic to or towards that eigenvector

Check

Question **5**

Not complete

Points out of 7.00

Let A be a 2x2 matrix with eigenvalues

$\lambda_1 = 3$ corresponding to the eigenvector $\vec{v}_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, and

$\lambda_2 = 1/3$ corresponding to the eigenvector $\vec{v}_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$.

Let a_i be the basis coefficient of $\vec{v}_i$ that represents the initial condition.

Write the eigenvector decomposition for the system $\vec{x}_k$:

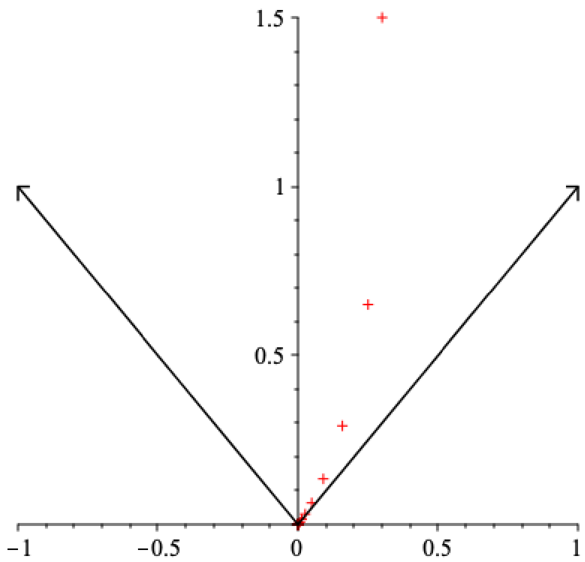
		k			k
a_1	[ ]	[ ]	$+a_2$	[ ]	[ ]
		[ ]			[ ]

What is the mathematical longterm behavior for most initial conditions?

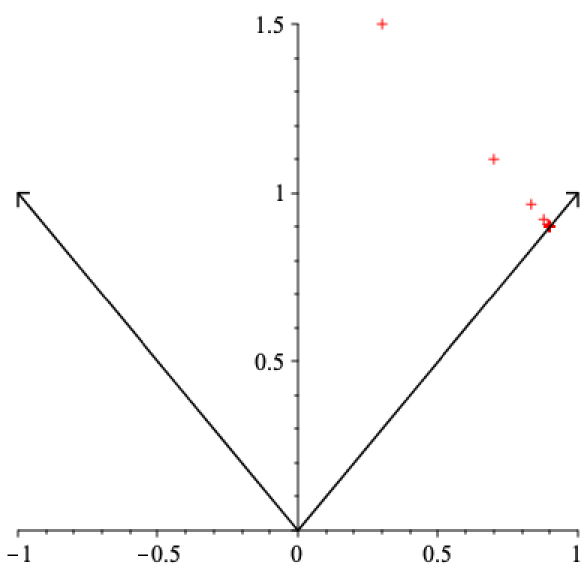
- ○ dies out along $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
- ○ stabilizes along $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
- ○ grows along $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
- ○ dies out along $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$
- ○ stabilizes along $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$
- ○ grows along $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$
- ○ other

Which trajectory graph could represent this system based on the above decomposition?

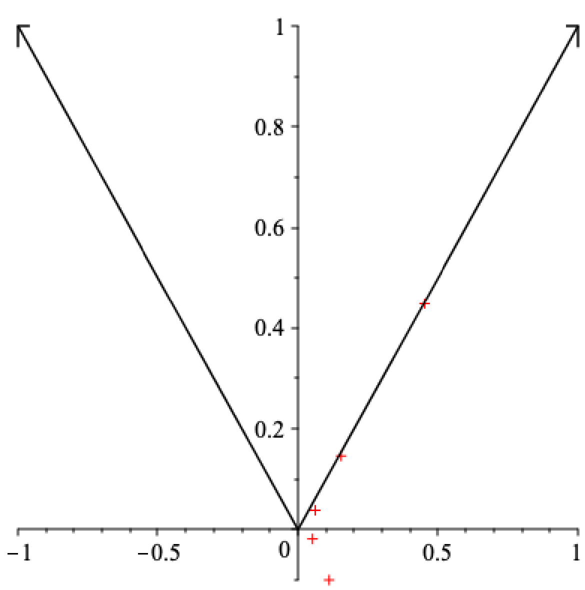
graph 1



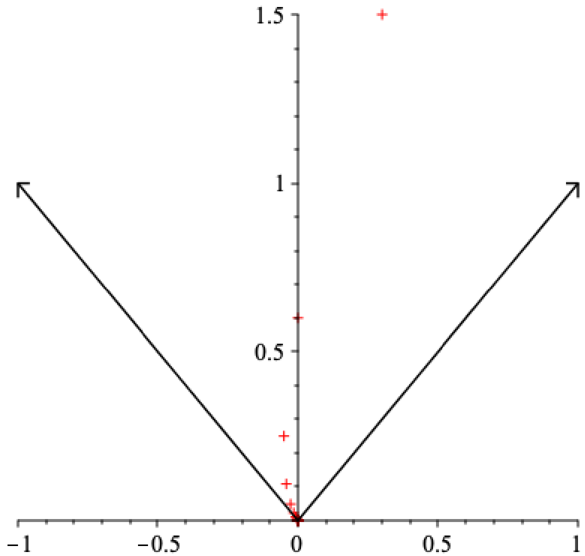
graph 2



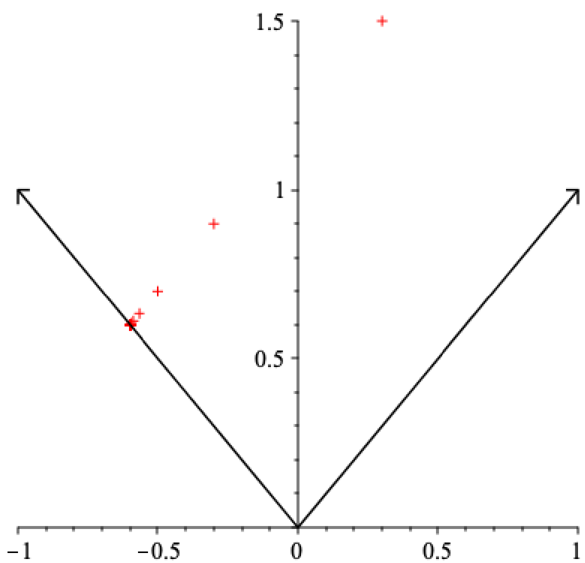
graph 3



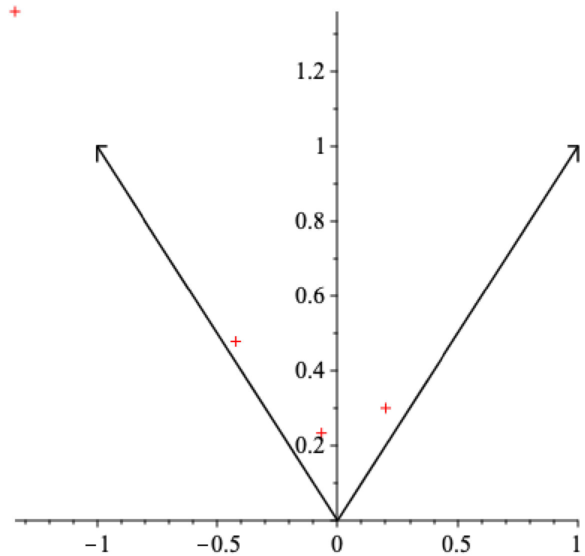
graph 4



graph 5



graph 6



- graph 1
- graph 2
- graph 3
- graph 4
- graph 5
- graph 6
- other

If we had an eigenvalue of 1, then we have a decomposition like

$a_1 1^k \begin{bmatrix} a_2 \\ a_3 \end{bmatrix} + b_1 \lambda^k \begin{bmatrix} b_2 \\ b_3 \end{bmatrix}$ where $|\lambda|$<1, as it is the weaker eigenvalue.

In this case, because $1^k = 1$, we can reduce and combine the constants into the eigenvectors so that it looks like

$\begin{bmatrix} a_1 a_2 \\ a_1 a_3 \end{bmatrix} + \lambda^k \begin{bmatrix} b_1 b_2 \\ b_1 b_3 \end{bmatrix}$

which is a constant vector + t another constant vector.

This should look familiar from chapter 1 work we did on objects like $\vec{u} + t\vec{v}$.

Which graphs have an eigenvalue of 1?

- graphs 1 and 4
- graphs 2 and 5
- graphs 3 and 6

Check

Question **6**

Not complete

Points out of 1.00

Let A be a 2x2 matrix with eigenvalues

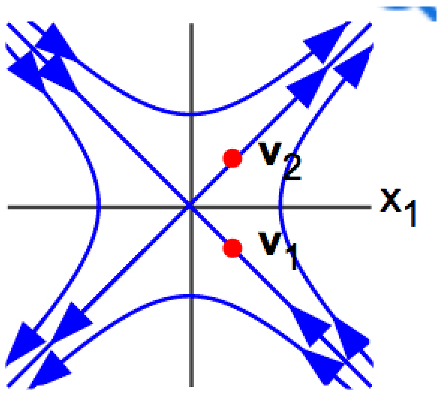
$\lambda_1 = 1/3$ corresponding to the eigenvector $\vec{v}_1 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$ and

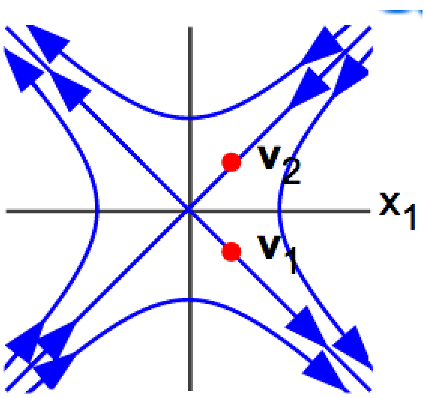
$\lambda_2 = 3$ corresponding to the eigenvector $\vec{v}_2 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

Sketch a trajectory diagram for the longterm behavior of the system, by graphing the two eigenvectors and picking a starting point in the first quadrant to sketch what happens over time.

While the trajectory diagram will look different than the visualizations below, since yours will just show 1 trajectory within the first quadrant, compare your trajectory diagram with the diagrams below. Below they show what happens if we start on either of the lines corresponding to the eigenvectors, as well as what happens in each quadrant off the eigenvector lines over time. Which diagram represents the system's long-term behavior?

Select one:

○ 

○ 

○ other

Check

Question **7**

Not complete

Points out of 13.00

Let *A* be a 3x3 matrix with eigenvalues $\lambda_1 = 4$ corresponding to the eigenvector $\vec{v}_1 = \begin{bmatrix} 1 \\ 0 \\ -2 \end{bmatrix}$,

$\lambda_2 = 3/4$ corresponding to the eigenvector $\vec{v}_2 = \begin{bmatrix} 4 \\ 1 \\ -4 \end{bmatrix}$, and

$\lambda_3 = 1/4$ corresponding to the eigenvector $\vec{v}_3 = \begin{bmatrix} -2 \\ -4 \\ 8 \end{bmatrix}$

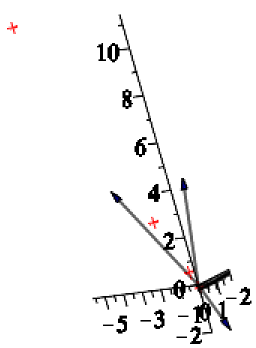
Let a_i be the basis coefficient of $\vec{v}_i$ that represents the initial condition.

Write the eigenvector decomposition for the system $\vec{x}_k$ using the ordering from above:

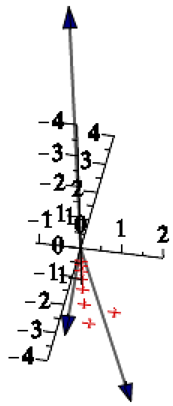
		k	[ ]		k	[ ]	k	[ ]
a_1	[ ]		[ ]	$+a_2$	[ ]	[ ]	$+a_2$	[ ]	[ ]
			[ ]			[ ]		[ ]

Consider the following three graphs in 3-space

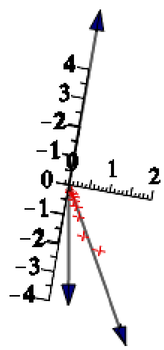
graph 1 shows growth in the longterm asymptotic to $\begin{bmatrix} 1 \\ 0 \\ -2 \end{bmatrix}$



graph 2 shows die off in the longterm asymptotic to $\begin{bmatrix} 4 \\ 1 \\ -4 \end{bmatrix}$



graph 3 shows die off in the longterm asymptotic to $\begin{bmatrix} -2 \\ -4 \\ 8 \end{bmatrix}$



What happens to the system as k gets large for most initial conditions?

- ○ grows along $\begin{bmatrix} 1 \\ 0 \\ -2 \end{bmatrix}$ like in graph 1
- ○ dies off along $\begin{bmatrix} 4 \\ 1 \\ -4 \end{bmatrix}$ like in graph 2
- ○ dies off along $\begin{bmatrix} -2 \\ -4 \\ 8 \end{bmatrix}$ like in graph 3
- ○ other

Check

Question **8**

Not complete

Points out of 5.00

Say we have a system of Foxes (*x*) and Rabbits (*y*), where the matrix *A* represents the change in populations from year to year, and the largest magnitude eigenvalue for *A* is 1.1 and the corresponding eigenvector is $\begin{bmatrix} 2 \\ 100 \end{bmatrix}$

Part a) The foxes grow in the long run by

% each year, for most starting positions. In other words, what is the rate of change, since that is the growth rate.

Part b) Do the rabbits and foxes change at the same rate (as each other) in the long run?

○yes ○no

Part c) What ratio do the populations tend to in the longterm, for most starting positions? (Do NOT simplify).

foxes to

rabbits

Part d) What is the equation of the line the populations tend to in the longterm, for most starting positions?

y =

x

Check

Question **9**

Not complete

Points out of 5.00

Let A be a matrix with eigenvector decomposition $\vec{x}_k = a_1 \lambda_1^k \begin{bmatrix} a \\ b \end{bmatrix} + a_2 \lambda_2^k \begin{bmatrix} c \\ d \end{bmatrix}$.

Fill in the following to see the matrix algebra for $\vec{x}_{k+1}$

$\vec{x}_{k+1} =$

[ ]

$\vec{x}_k$.

Substitute for $\vec{x}_k$ and write out the steps to show that this equals $a_1 \lambda_1^{k+1} \begin{bmatrix} a \\ b \end{bmatrix} + a_2 \lambda_2^{k+1} \begin{bmatrix} c \\ d \end{bmatrix}$?

Which algebraic properties are needed?

Should we apply the inverse?

○ yes ○ no

Should we use left distributivity?

○ yes ○ no

Should we pull scalars through a matrix?

○ yes ○ no

Should we use the definition of eigenvector?

○ yes ○ no

Check

Question **10**

Not complete

Points out of 2.00

A basketball team has a 60% probability of winning their next game if they have won their previous game but only a 30% probability of wining their next game if they have lost their previous game. Let x be % chance of winning game k and y be the % chance of losing that game.

What is the probability of winning the next game?

○ $.6x + .3y$

○ $.4x + .7y$

If the eigenvector decomposition for the system is

$$\left(\frac{1}{7}\right)\left(1^k\right)\begin{bmatrix}3\\4\end{bmatrix} + \left(\frac{-4}{7}\right)\left(0.3^k\right)\begin{bmatrix}-1\\1\end{bmatrix}$$

then because $1^k = 1$, we can reduce as follows:

$$= \left(\frac{1}{7}\right)\begin{bmatrix}3\\4\end{bmatrix} + \left(\frac{-4}{7}\right)\left(0.3^k\right)\begin{bmatrix}-1\\1\end{bmatrix}$$

$$= \begin{bmatrix}\frac{3}{7}\\\frac{4}{7}\end{bmatrix} + \left(\frac{-4}{7}\right)\left(0.3^k\right)\begin{bmatrix}-1\\1\end{bmatrix}$$

Notice that the basis coefficients are specific numbers here, for a specific initial condition. What happens to the system in the long run?

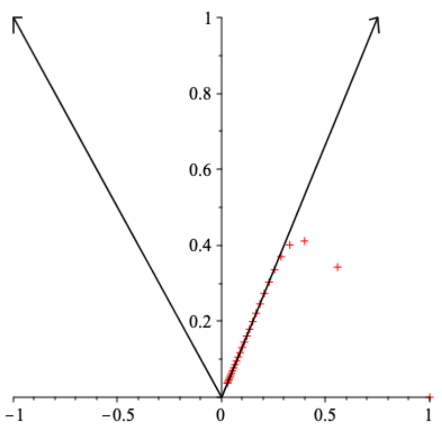
○ The system tends to $\begin{bmatrix}0\\0\end{bmatrix}$ in the long run

○ The system stabilizes to $\begin{bmatrix}\frac{3}{7}\\\frac{4}{7}\end{bmatrix}$ in the long run

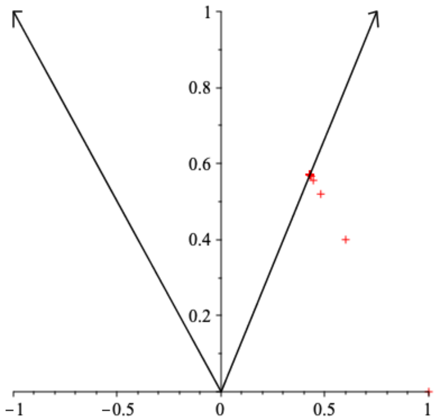
○ The systems keeps growing in the long run

Which trajectory graph represents the system? They all begin at (1,0) on the x-axis:

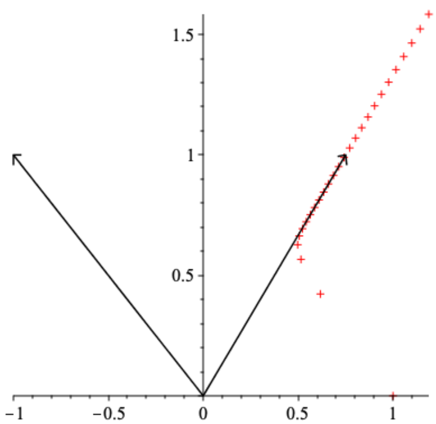
graph 1



graph 2



graph 3



○graph 1

○graph 2

○graph 3

Check

Question **11**

Not complete

Points out of 1.00

To solidify and prepare for upcoming work, review and contemplate your knowledge and any questions that remain as related to definitions, concepts, computations, and examples from 5.6, including

- eigenvector decomposition
- longterm behavior or steady state
- geometry of solutions and a trajectory of the dynamical system
- relationship of the magnitude (absolute value) of the eigenvalues and the longterm behavior, including the direction of greatest attraction or repulsion and which term is dominant in the longterm and what that means for trajectories

and consider 5.1 and 5.2, including

- eigenvector, eigenvalue, and eigenspace
- eigenvectors and difference equations on p. 279
- nonzero eigenvalues and what makes a matrix invertible
- characteristic equation
- similar matrices via a similarity transformation (compare with what we did in 2.7 and computer graphics to rotate about a point other than the origin)
- application to dynamical systems

and 3.1, 3.2, 3.3, including

- determinant computations: diagonal method or cofactor expansion method (Laplace expansion)
- determinant of a triangular matrix or a transpose of a matrix
- impact of row operations on determinants
- connection of determinants to invertibility and what makes a matrix invertible
- determinants as area of parallelogram or volume of parallelepiped and the impact of row operations

Since the material builds on itself, consider whether there is any material from before this module that you want to brush up on:

1.1

- algebra of linear equations: coefficients and variables
- geometry of linear equations in 2D and 3D: lines and planes
- solution set: inconsistent: 0 solutions; consistent: 1 unique solution or infinite solutions
- matrix of a linear system: coefficient matrix, augmented matrix, triangular form
- row equivalent systems
- algorithm for solving a linear system using elementary row operations of replacement, interchange, and scaling

1.2

- matrix of a linear system: row echelon form (Gaussian), reduced row echelon form (Gauss-Jordan)
- pivots: pivot position of a matrix, pivot column of a matrix
- row reduction algorithm we will most commonly use: elimination by forward phase and back substitution to row echelon form
- solution set: inconsistent: 0 solutions; consistent: 1 unique solution or infinite solutions with free variables and parametric solutions

1.3

- algebra of vectors: coordinates, addition of vectors, scalar multiplication of vectors, properties like associativity under addition (property ii on p. 29), a linear combination with weights, zero vector, span of a set of vectors=all the linear combinations, is a vector in the span?, vector equation $\longrightarrow$ augmented matrix
- geometry of vectors in 2D and 3D: directed segment, parallelogram for addition, on same line for scalar multiplication of vectors, origin=zero vector, a linear combination geometrically in the plane or 3D, span=all the linear combinations geometrically in the plane or 3D, spaces of subsets of R^n spanned by vectors

1.4

- algebra of matrix vector equation $A\vec{x} = \vec{b}$:
  - multiply a matrix and a column vector by linear combinations of the columns of *A* using weights from $\vec{x}$
  - span of the columns of *A* = set of all linear combinations of the columns of *A*
  - matrix vector equation $\longrightarrow$ vector equation $\longrightarrow$ augmented matrix

- equations generic vectors $\vec{b}$ must satisfy to be in the span (Example 3)
  - dot products of rows of *A* with $\vec{x}$,
- geometry of solutions of matrix vector equation $A\vec{x} = \vec{b}$: spaces of subsets of R^3 spanned by the column vectors of A, geometry of such spaces (Figure 1)
- Theorem 4: relationship of consistency of $A\vec{x} = \vec{b}$ to always being a linear combination to spanning the entire R^m, where *m* is the number of rows, to having a pivot position in every row of *A*.
- identity matrix *I*

1.5

- algebra of homogeneous systems: $A\vec{x} = \vec{0}$
- algebraic solutions of homogenous systems always include the trivial solution=$\vec{0}$. nontrivial solutions, if any exist, are parameterized in parametric vector form using free variables to express those as well as the variables with pivots and then decomposed algebraically to showcase the algebra and geometry giving $t\vec{v}$ or $s\vec{u} + t\vec{v}$ or similar, where each free variable is attached to a vector.
- geometry of solutions of homogeneous systems are geometric spaces through the origin like lines, planes, or hyperplanes
- algebra of nonhomogeneous systens: $A\vec{x} = \vec{b}$
- solutions of nonhomogeneous systems in parametric vector form can be decomposed algebraically to showcase the algebra and geometry like $\vec{p} + t\vec{v}$, vectors ending on the line parallel to $\vec{v}$ or $\vec{p} + s\vec{u} + t\vec{v}$, vectors ending on the plane parallel to the one spanned by $\vec{u}$, $\vec{v}$...
- geometry of solutions of nonhomogeneous systems are geometric spaces translated away from the origin via adding $\vec{p}$

1.7

- linearly independent set of vectors and connection to a homogeneous equation having only the trivial solution
- linearly dependent set of vectors and connection to nontrivial solutions existing and providing a dependance relation
- geometry of linearly independent set of 2 vectors: independent directions in space versus along the same line (Figure 1)
- geometry of linearly independent set of 3 or more vectors: no one vector is in the span of the rest, i.e. they are all needed to span the space versus redundancy in the geometric space they span in the sense that they aren't all needed to generate the same space under linear combinations (Figure 2)
- linearly independent columns of a matrix
- redundancy of $\vec{0}$ in a set of vectors $\{\vec{v}_1 = \vec{0}, \vec{v}_2, \ldots \vec{v}_n\}$ (Theorem 9)

1.8 and 1.9

- linear transformation: addition and scalar multiplication
- left multiplication matrix representations
- dilation, projection, reflection, rotation, shear (see Examples 2-5 in 1.8, Examples 2-3 in 1.9, and tables 1-4 in 2.8)
- the algebraic image of the unit axes as a way to find the matrix of the transformation
- range of a linear transformation: the algebraic or geometric images or outputs, e.g. of the unit square as a way to visualize the transformation and understand its effects
- the range, image or output of a sheared sheep

2.1

- matrices: diagonal matrix [and main diagonal], zero matrix
- matrix operations: matrix addition, scalar multiplication of a matrix, matrix multiplication, powers of a matrix, left (or right) multiplication, transpose of a matrix
- matrix multiplication by linear combinations of the columns of A using weights from the corresponding column of B or by the dot products of a row of A with the corresponding column of B.
- algebraic properties that do hold for matrix multiplication: associativity and one-sided distributivity
- algebraic properties that don't hold for matrix multiplication: commutativity

2.2

- matrices: invertible (nonsingular) matrix, noninvertible (singular) matrix, elementary matrix
- determinant and inverse of a 2x2 matrix
- connection between invertibility and unique solutions
- inverse of a product of matrices and inverse of a transpose

2.3

- what makes a matrix invertible for a square matrix (Theorem 8 statements aside from f. and i., which we haven't covered)
- condition number (numerical note on p. 123)

2.7

- 2D and 3D computer graphics as columns of a matrix --- connect the dots!
- effects of 2D and 3D linear transformations from 1.8 and 1.9 and 3D transformations on figures--- algebra and matrix representation and geometry and visualization
- homogeneous coordinates
- composite transformations ABC is read right to left like functions, where C is the first action
- rotate about a point other than the origin (Figure 7)

2.8

- subspace properties: closed under addition and scalar multiplication
- spaces associated to a matrix: column space and null space
- basis: linearly independent spanning set
- basis for column space as the pivot columns
- basis for null space as the vectors attached to free variables in parametric solutions of the homogeneous system $A\vec{x} = \vec{0}$

2.9

- dimension of a space
- rank of a matrix (dimension of column space)
- nullity of a matrix (dimension of null space)
- rank nullity theorem (Theorem 14)
- what makes a matrix invertible continued: adding rank and nullity to Theorem 8 when the matrix is square

6.1

- inner product of $\vec{u}$ and $\vec{v}$ and connection to the dot product
- length or norm of a vector
- orthogonal vectors

When you have finished reviewing and reflecting, select one of the following (both receive full credit)

○I currently have no questions

○I will continue solidifying and understand that help is available in Dr. Sarah's more extensive feedback that follows below each question after I finish and open back up an entire practice quiz (this is more extensive than the hints that I can access during the open quiz), in Dr. Sarah's glossary/Wiki which is embedded into ASULearn from the linked terms, in Dr. Sarah's office hours and forum, and in Math Lab and Tutoring

Check

◄ 5.6 interactive video

Jump to...

second chance 5.6 practice quiz ►