<u>Linear Algebra MAT313 Fall 2022</u> <u>Professor Sormani</u> <u>Lesson 5 Homogeneous Linear Systems</u>

Please be sure to mark down the date and time that you start this lesson. Carefully take notes on pencil and paper while watching the lesson videos. Pause the lesson to try classwork before watching the video going over that classwork. If you work with any classmates, be sure to write their names on the problems you completed together. Please wear masks when meeting with classmates even if you meet off campus.

You will cut and paste the photos of your notes and completed classwork and a selfie taken holding up the first page of your work in a googledoc entitled:

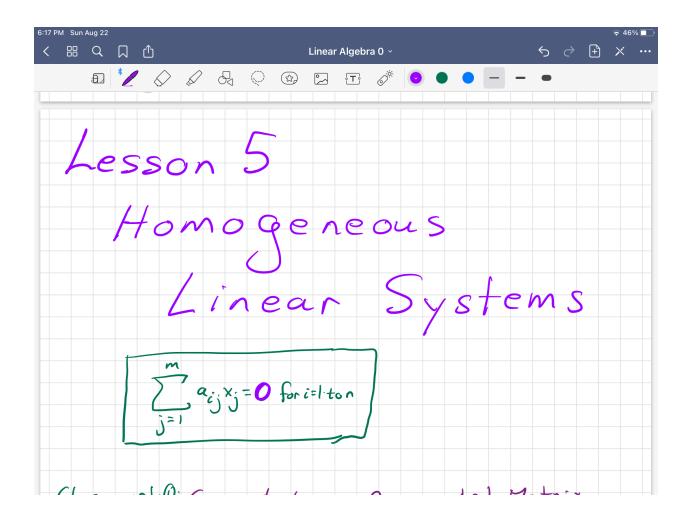
MAT313F22-lesson5-lastname-firstname

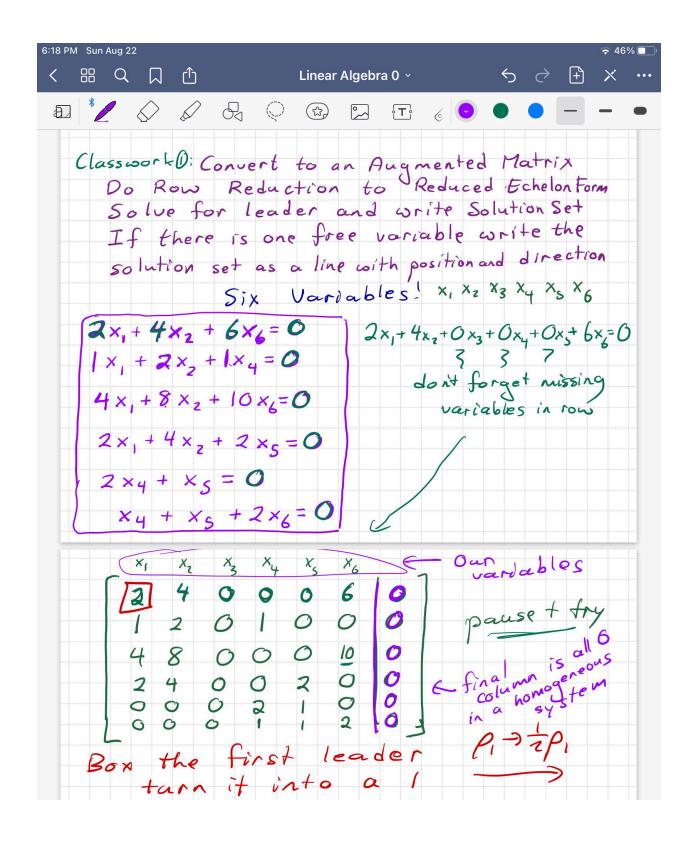
and share editing of that document with me <u>sormanic@gmail.com</u>. You will also include your homework and any corrections to your homework in this doc.

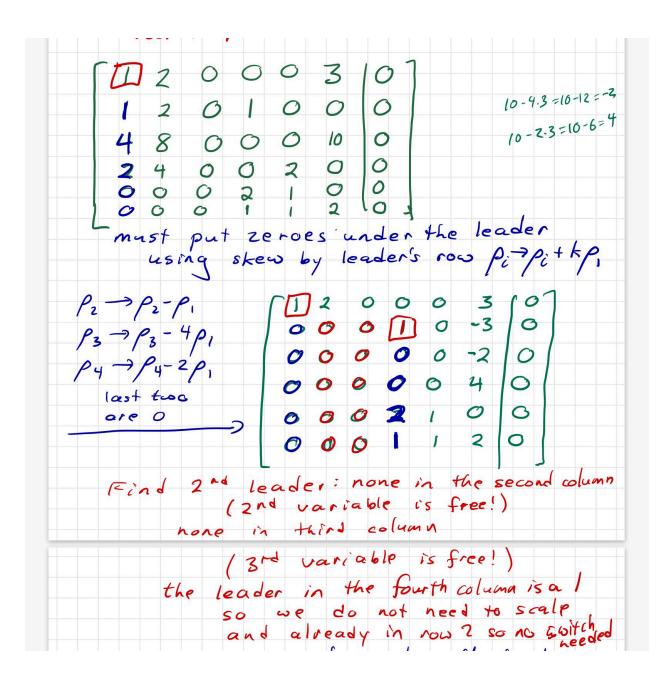
If you have a question, type **QUESTION** in your googledoc next to the point in your notes that has a question and email me with the subject MAT313 QUESTION. I will answer your question by inserting a photo into your googledoc or making an extra video.

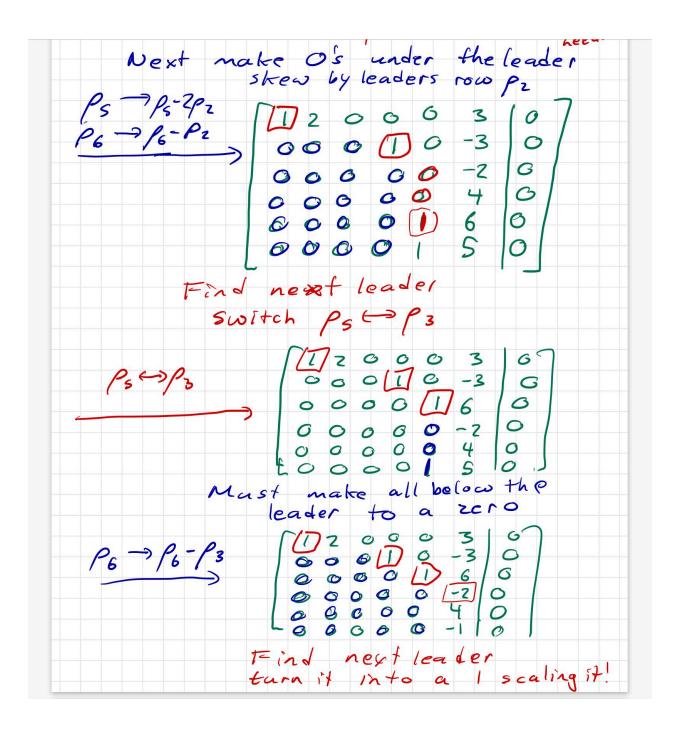
Watch the Playlist 313F21-5-1to9

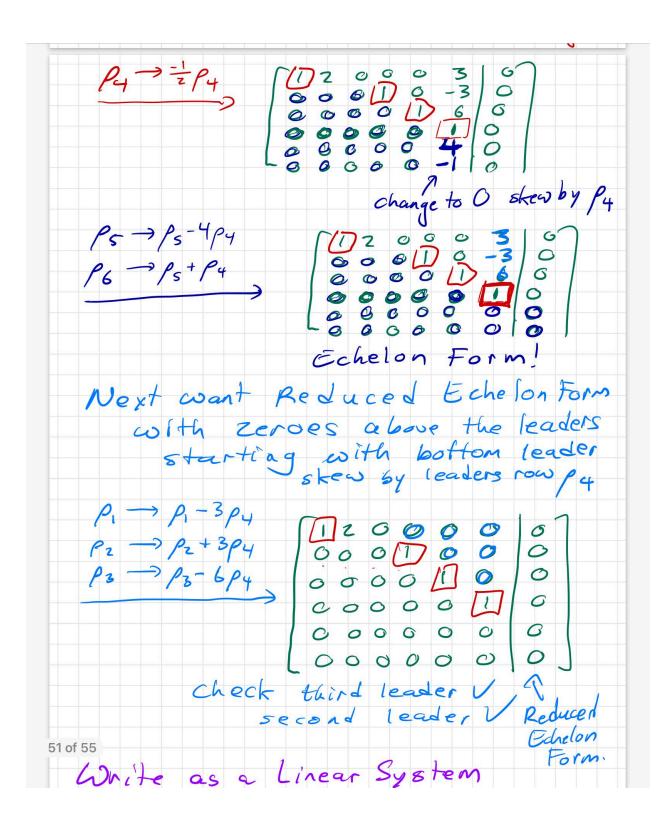
Once you have completed and submitted the work for this lesson, email Professor Sormani requesting a sample for Exam 1.



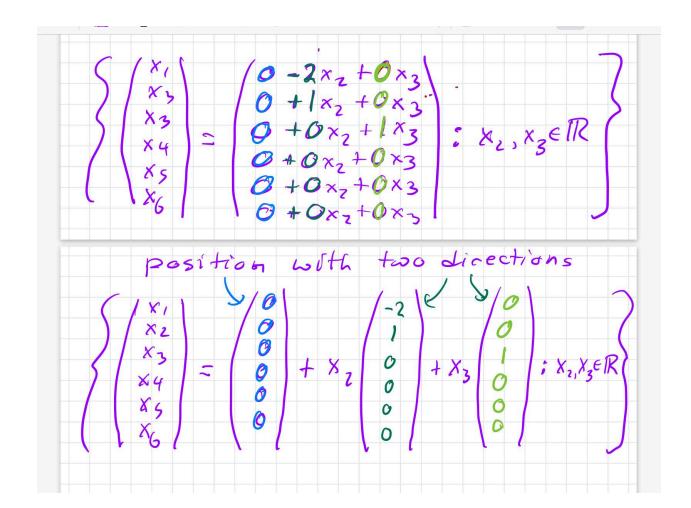


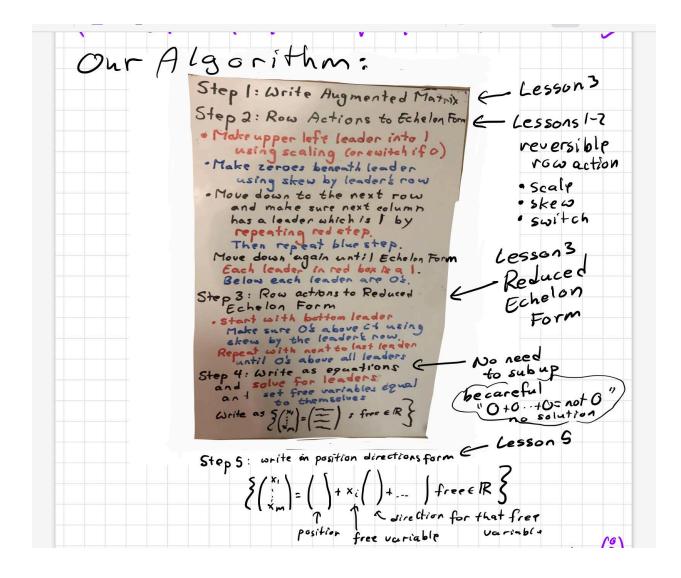






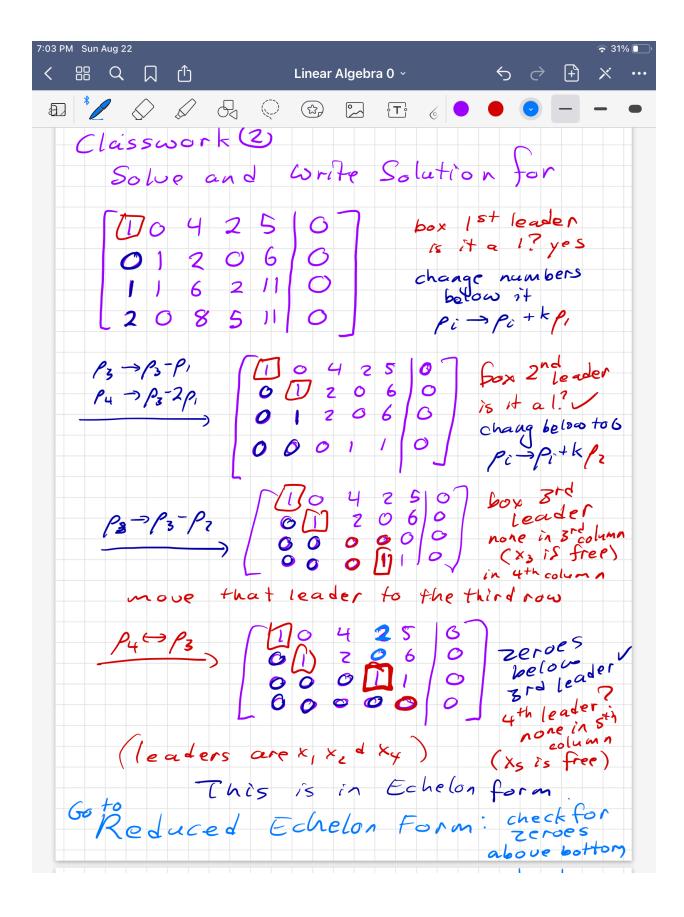
 $X_1 = -2x_7$ $1 \times_1 + 2 \times_2 = 0$ solve for leaders xy = 0X5 = 0 X6 = 0 $x_2 = X_2$ free variables X3=X3 -2×2 ×2 ×3 6 0 $x_2, x_3 \in \mathbb{R}$ two free ! cannot write in line form!

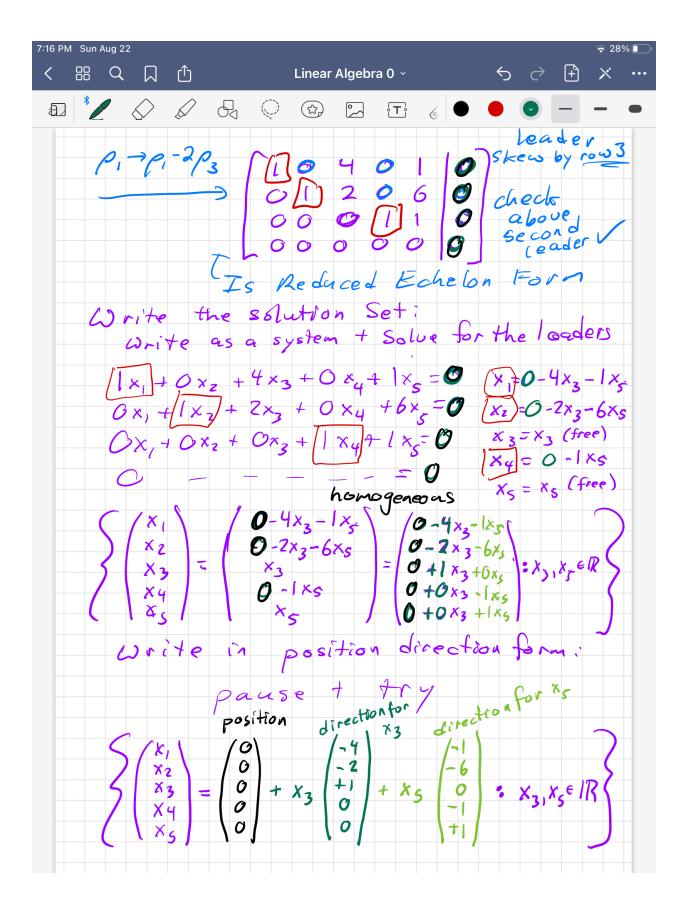




free variable When the system is homogeneous the position water id If a homogeneous system has ∑X=O+ta | t∈R3 a line the origin. If it has two free variables, s,t { x = 0 + t a + s b | s, t e R}

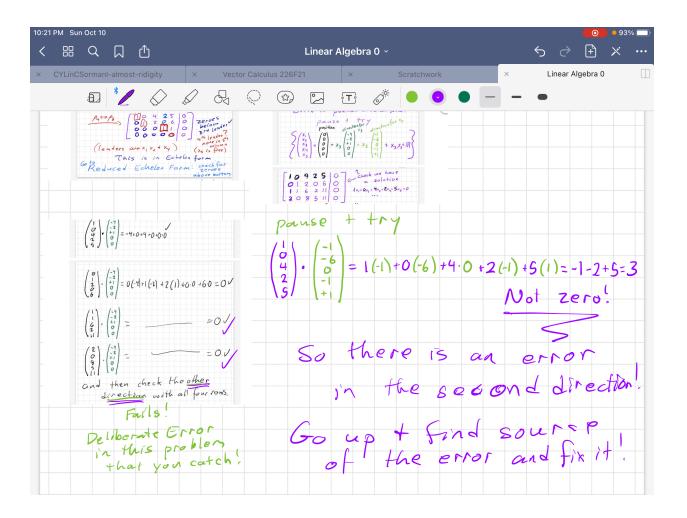
direction
direction
direction
direction notice that when s,t=0then x=0So x,=0 x2=0 -- xm=0 to system. If there are no free variables the only solution is $\frac{2}{3}$ is never an 0.

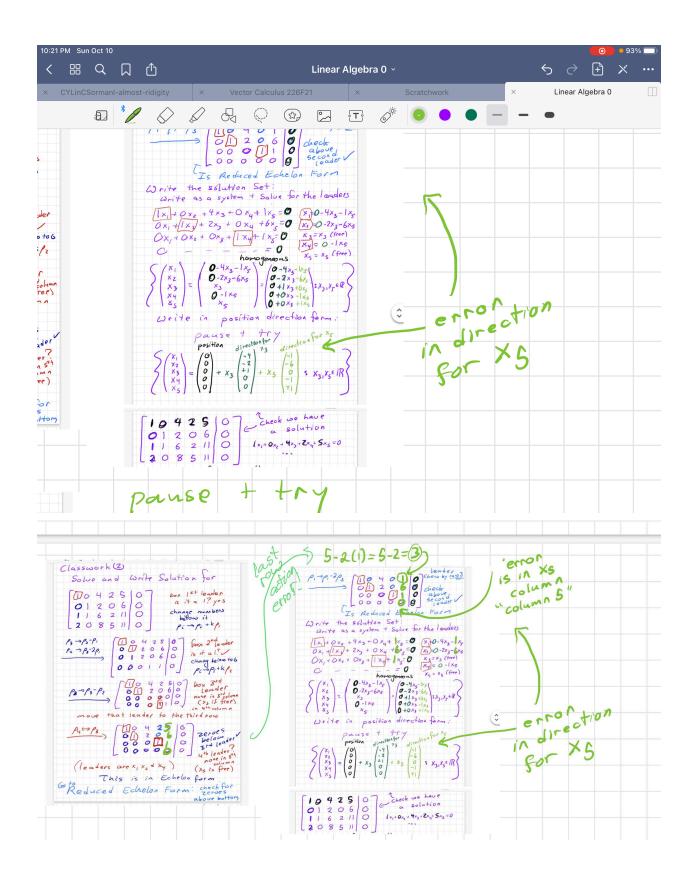




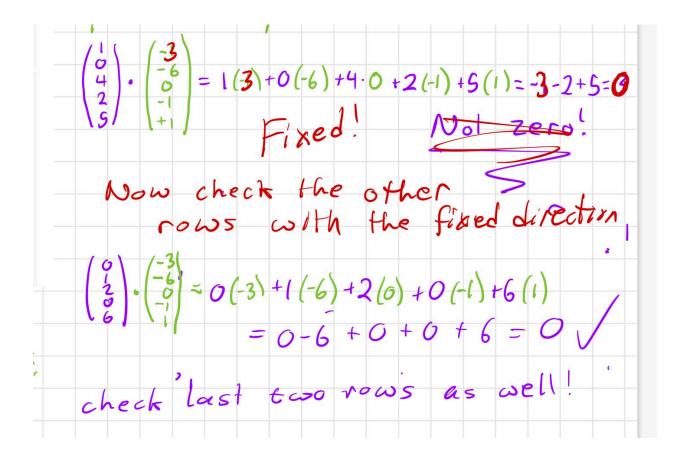
10425 0 Echeck we have check we have solution
012060
1162110 | 1x1+0x2+4x3+2x4+5x5=0
2085110 when the free variables are zero the position is a solution so plugging it into the rows should give = di in nomogoneous case 0+0+0...+0=01 In fact the from of the augmented matrix dot product with position Check your position asing dot products. direction is a solution to the homogeneous system habing its free variable=1 cent other free variables=0. each Take a dot product row: · direction = 0 $\begin{pmatrix} 1 \\ 0 \\ 4 \\ 2 \end{pmatrix} \cdot \begin{pmatrix} -4 \\ -2 \\ +1 \\ 0 \end{pmatrix} = -4 + 0 + 4 + 0 + 0 = 0$

When you do this check, you will discover it is not zero!!!! There is an error in the row reduction! Below we show how to trace back and discover the error in the last row action! See Video 313F21-5-8b.





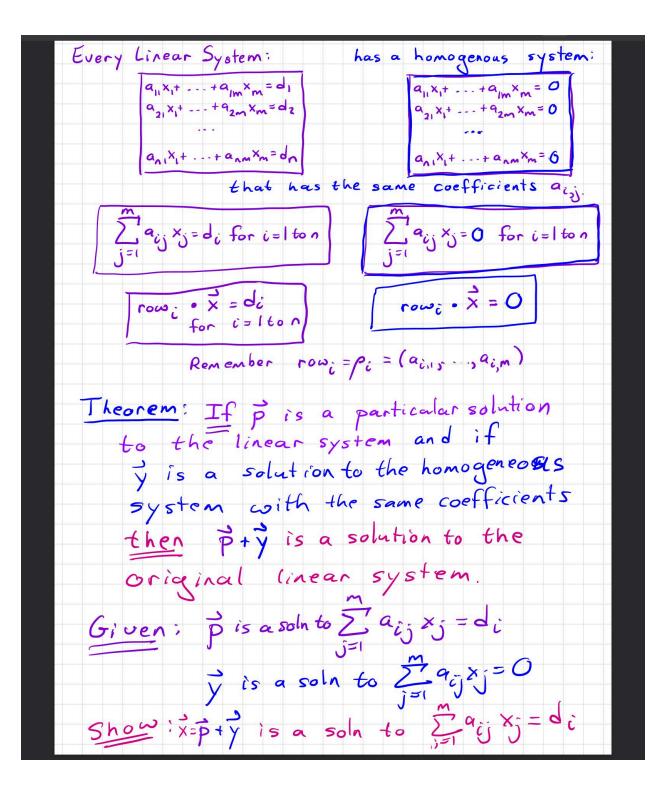
5-2(1)=5-2=3314

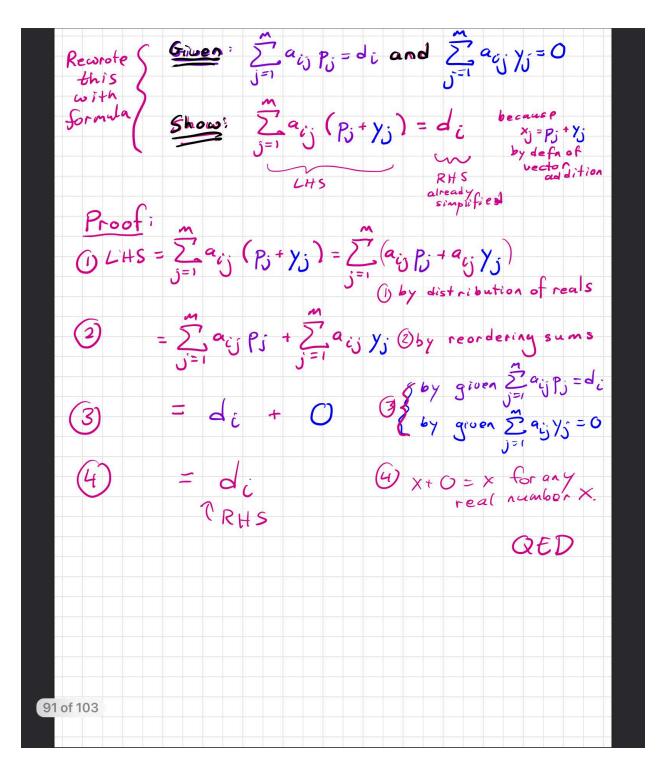


The following notes are explained in 313F21-5-9a 313F21-5-9b 313F21-5-9c at the end of the <u>Playlist 313F21-5-1to9</u>.

313F21-5-9a

Every Linear System:	has a homogenous system:
$a_{11}x_1 + + a_{1m}x_m = d_1$ $a_{21}x_1 + + a_{2m}x_m = d_2$	$a_{11}x_1 + \dots + a_{1m}x_m = 0$ $a_{21}x_1 + \dots + a_{2m}x_m = 0$
1 21 X1 1 2m 2m 2 2	2, X, + + 4 _{2m} X _m = 0
anix,+ + anm xm = dn	anix,++anmxm=0
that has the same coefficients aizi.	
When we solve them \[\begin{align*} \begin{align*} \alpha_{11} & \div & \alpha_{11} & \div & \alpha_{11} & \div	
Lan anz and dn	ani ani - · · · anm O
Same row actions are determined by the coefficients Echelon Form [E] [E] So when we solve for leaders	
leader = position + (free)(direction) + + (free)(dir) (for the homogeneous system the position is zero same free variables + directions Sometimes the original system has no solution due to a row 0 0 0 0 1 to monzero here entry here but the homogeneous system always 0 0 0 0 10 has a solution	





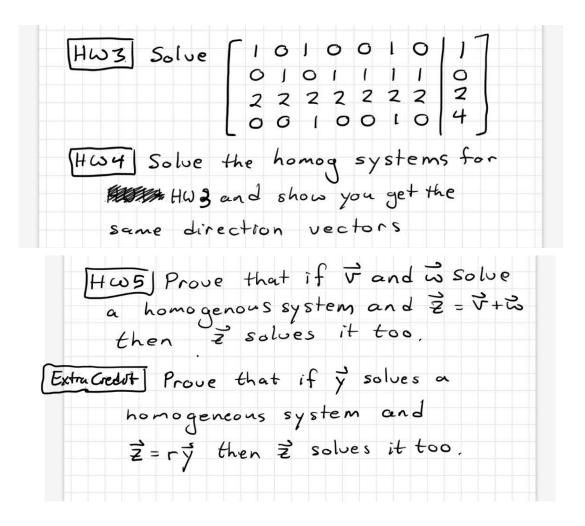
Complete HW-HW4 below checking your answers using the dot products as explained above. HW5 is almost the same as the last classwork.

HWI Solve X, + x8 = 2

HW2 | Solve using work from $X_3 + X_5 = 0$ and show it has $X_2 + X_7 = 0$ the same direction vectors as HUI.

$$x_1 + x_8 = 0.$$

 $x_3 + x_5 = 0.$
 $x_2 + x_7 = 0.$
 $x_4 + x_6 = 0.$



There is a proof on Exam 1. Students who want more practice with proofs may try the proofs in the following Vector Calc videos, pausing and trying each step yourself: <u>226F21-1-7</u>, <u>226F21-1-9</u>, and <u>226F21-2-3</u>.

Once you have completed the classwork and homework for this lesson, submit it and email me to request access to the <u>Sample for Exam 1</u> and to schedule your exam (please tell me all times you are available):

Th Sept 22 3-4:30 pm Mon Sept 26 8-9:30 pm Wed Sept 28 8-9:30 pm