LARSON—MATH 511—CLASSROOM WORKSHEET 04
Gilbert Strang Lectures 1 & 2.

More on Strang's Lecture

1. Let $A = \begin{bmatrix} 2 & 1 & 3 \\ 3 & 1 & 4 \\ 5 & 7 & 12 \end{bmatrix}$
2. Strang claims A can always be written as CR for some matrix R. How can we find R?
3. Strang mentions the theorem that the row rank of any matrix equals its column rank. Is it true for A?
4. Let $\hat{u} = \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix}$ and $\hat{v} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$.
5. Find $\hat{u}\hat{v}^T$.
6. What is the rank of $\hat{u} \cdot \hat{v}^T$?
7. Let $A = \begin{bmatrix} 2 & 4 \\ 5 & 3 \end{bmatrix}$
8. What is the rank of A?
9. Can we find vectors $\hat{l}_1$, $\hat{u}_1$, $\hat{l}_2$, $\hat{u}_2$ so that $A = \hat{l}_1\hat{u}_1^T + \hat{l}_2\hat{u}_2^T$?
10. What are the 4 fundamental subspaces of a matrix A?
11. What are the 4 fundamental subspaces of $A = \begin{bmatrix} 2 & 4 \\ 5 & 3 \end{bmatrix}$?
12. Find the dimensions of those subspaces. What do you notice?

Sage/CoCalc

(a) Start the Chrome browser.
(b) Go to `http://cocalc.com`
(c) Login (likely using **your VCU email address**).
(d) You should see an existing Project for our class. Click on that.
(e) Click "New", then "Sage Worksheet", then call it **c04**.

13. Let $A = \begin{bmatrix} 2 & 1 & 3 \\ 3 & 1 & 4 \\ 5 & 7 & 12 \end{bmatrix}$

    How can we enter A in SAGE?

14. How can we find the column space of A in SAGE?

15. How can we find the rank of A?

16. How can we input the vectors $\hat{u} = \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix}$ and $\hat{v} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$.

17. Find $\hat{u}\hat{v}^T$.

18. Let $A = \begin{bmatrix} 2 & 4 \\ 5 & 3 \end{bmatrix}$

    How can we enter A in SAGE?

19. How can we find the column space of A in SAGE?

20. How can we find the row space of A?

21. How can we find the null space of A?

22. How can we find the null space of A^T?

23. Check that the basis vectors of the column space of A are orthogonal with the basis vectors of the null space of A.

Getting your classwork recorded

When you are done, before you leave class...

1. Click the "Make pdf" (Adobe symbol) icon and make a pdf of this worksheet. (If CoCalc hangs, click the printer icon, then "Open", then print or make a pdf using your browser).
2. Send me an email with an informative header like "Math 511—c04 worksheet attached" (so that it will be properly recorded).
3. Remember to attach today's classroom worksheet!