LARSON—MATH 511—CLASSROOM WORKSHEET 03
Gilbert Strang Lecture on Sec 1.1.

More on Strang's Lecture

1. What is the **column space** of a matrix?

2. Let $A = \begin{bmatrix} 2 & 1 & 3 \\ 3 & 1 & 4 \\ 5 & 7 & 12 \end{bmatrix}$
   What is the column space of A?

3. What is the (column) **rank** of A? How can we find it?

4. Let C be a matrix of the linearly independent columns of A, chosen iteratively from left to right (include the column if it is not a linear combination of the previous columns. What do you get?

5. Strang claims A can always be written as CR for some matrix R. How can we find R?

6. Strang mentions the theorem that the row rank of any matrix equals its column rank. Is it true for A?

7. Let $\hat{u} = \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix}$ and $\hat{v} = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$.

8. Find $\hat{u} \cdot \hat{v}$.

9. Find $\hat{u} \cdot \hat{v}^T$.

10. What is the rank of $\hat{u} \cdot \hat{v}^T$?

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 **c03**.

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

    How can we enter A in SAGE?

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

13. How can we find the rank of A?

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

15. Find $\hat{u} \cdot \hat{v}$.

16. Find $\hat{u} \cdot \hat{v}^T$.

17. If there is any time left we will try some of the commands on the **Sage Linear Algebra Quick Reference** handout.

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—c03 worksheet attached" (so that it will be properly recorded).
3. Remember to attach today's classroom worksheet!