

Math 323  
Linear Algebra and Matrix Theory I  
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## Key Homework 2

### Strang Page 30 no: 9

a)

$A = \begin{bmatrix} 1 & 2 & 4 \\ -2 & 3 & 1 \\ -4 & 1 & 2 \end{bmatrix}$ ,  $x = \begin{bmatrix} 2 \\ 2 \\ 3 \end{bmatrix}$ ,  $Ax_1 = A(1, :)*x$ ,  $Ax_2 = A(2, :)*x$ ,  
 $Ax_3 = A(3, :)*x$ ,  $Ax = [Ax_1; Ax_2; Ax_3]$

$A =$

```
1      2      4
-2     3      1
-4     1      2
```

$x =$

```
2
2
3
```

$Ax_1 =$   
18

$Ax_2 =$   
5

$Ax_3 =$   
0

$Ax =$   
18  
5  
0

### Strang Page 30 no: 10

$Ax = x(1)*A(:, 1) + x(2)*A(:, 2) + x(3)*A(:, 3)$

$Ax =$   
18  
5  
0

Nine separate multiplications are required to obtain this result.

### Strang Page 30 no: 11

$A = \begin{bmatrix} 2 & 3 \\ 5 & 1 \end{bmatrix}$ ,  $x = \begin{bmatrix} 4 \\ 2 \end{bmatrix}$ ,  $Ax = A*x$

$$A = \begin{bmatrix} 2 & 3 \\ 5 & 1 \end{bmatrix}$$

$$x = \begin{bmatrix} 4 \\ 2 \end{bmatrix}$$

$$Ax = \begin{bmatrix} 14 \\ 22 \end{bmatrix}$$

$$A=[3 \ 6; \ 6 \ 12], \ x=[2; \ -1], \ Ax=A*x$$

$$A = \begin{bmatrix} 3 & 6 \\ 6 & 12 \end{bmatrix}$$

$$x = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$$

$$Ax = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$A=[1 \ 2 \ 4; \ 2 \ 0 \ 1], \ x=[3; \ 1; \ 1], \ Ax=A*x$$

$$A = \begin{bmatrix} 1 & 2 & 4 \\ 2 & 0 & 1 \end{bmatrix}$$

$$x = \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}$$

$$Ax = \begin{bmatrix} 9 \\ 7 \end{bmatrix}$$

### **Strang Page 30 no: 13**

- ... a vector with  $n$  components to produce a vector with  $m$  components.
- ... are in  $n$  dimensional space. The combination of the columns of  $A$  is in  $m$  dimensional space.

### **Strang Page 30 no: 14**

- A linear equation in three unknowns  $x, y$  and  $z$  is given by  $ax + by + cz = d$ .
- ... provided  $c + d = 1$ .
- ... when the right side is zero.

### **Strang Page 30 no: 15**

- $I_2 = \text{eye}(2)$

$$I_2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

b)

$$J_2 = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

$$J_2 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

### Strang Page 30 no: 20

a)

$$P_1 = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}, P_2 = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}, v = \begin{bmatrix} 5 \\ 7 \end{bmatrix}, P_1 v = P_1 * v, P_2 P_1 v = P_2 * P_1 * v$$

$$P_1 = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}$$

$$P_2 = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}$$

$$v = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$$

$$P_1 v = \begin{pmatrix} 5 \\ 0 \end{pmatrix}$$

$$P_2 P_1 v = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

### Strang Page 30 no: 29

a)

$$A = \begin{bmatrix} 0.8 & 0.3 \\ 0.2 & 0.7 \end{bmatrix}, u_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, u_1 = A * u_0, u_2 = A * u_1, u_3 = A * u_2$$

$$A = \begin{pmatrix} 0.8000 & 0.3000 \\ 0.2000 & 0.7000 \end{pmatrix}$$

$$u_0 = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

$$u_1 = \begin{pmatrix} 0.8000 \\ 0.2000 \end{pmatrix}$$

$$u_2 = \begin{pmatrix} 0.7000 \\ 0.3000 \end{pmatrix}$$

$$u_3 = \begin{pmatrix} 0.6500 \\ 0.3500 \end{pmatrix}$$

Each of the vectors has the property that the sum of its components equals 1.