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% MAT 343 MATLAB Assignment #1

%Question 1

```
A = [-3 1 -2
-1 1 3
2 5 -4];

B = [.7 .9 .7
.7 3.9 3.6
3.1 2.0 3.5];

C = [3 0
4 6
3 0]
```

% (i)

```
A + C
```

{Matrix dimensions must agree.}

% (ii)

```
C*A
```

{Error using *
Incorrect dimensions for matrix multiplication. Check that the number of columns in the first matrix matches the number of rows in
the second matrix. To perform elementwise multiplication, use '.*'.}

% (iii)

```
A + B
ans =
   -2.3000    1.9000   -1.3000
   -0.3000    4.9000    6.6000
    5.1000    7.0000   -0.5000
```

% (iv)

```
B + A
ans =
   -2.3000    1.9000   -1.3000
   -0.3000    4.9000    6.6000
    5.1000    7.0000   -0.5000
```

% (v)

```
A*B
ans =
   -7.6000   -2.8000   -5.5000
    9.3000    9.0000   13.4
```

% (vi)

```
B*A
ans =
   -1.6000    5.1000   -1.5000
    1.2000   22.6000   -4.1000
   -4.3000   22.6000  -14.2000
```

% (vii)

```
4 + C
ans =
     7     4
     8    10
     7     4
```

% (viii)

```
A*C
ans =
   -11     6
    10     6
    14    30
```

% (ix)

```
4 * (A + B)
ans =
   -9.2000    7.6000   -5.2000
   -1.2000   19.6000   26.4000
   20.4000   28.0000   -2.0000
```

% (x)

```
4*A + 4*B
ans =
   -9.2000    7.6000   -5.2000
   -1.2000   19.6000   26.4000
   20.4000   28.0000   -2.0000
```

% (a): both i and ii failed; for addition, in (i), the dimensions must be exactly the same but were 3x
% (a): both i and ii failed; for addition, in (i), the dimensions must be exactly the same but were 3x3 and 3x2; for (ii),
% the INNER dimensions must match; CA is 3x2 * 3x3 which doesn't work.

% (b): yes, those are equivalent.

% (c): yes

% (d): 4+C adds the scalar 4 to every element within the matrix.

% (e): In general, no, AB =/= BA

%Question 2 - Check some linear algebra rules:

```
A = [6 9; -4 -6];
B = [-3 9; -2 6];
C = [3 6; 1 2];
```

% (i) - this rule is false

```
(A*B)^2 == (A^2) * (B^2)
ans =
  2x2
   0   0
   0   0
```

% (ii) - this is untrue because A(B+C) must be LEFT multiplied, not right multiplied as in this case

```
A * (B+C) == ((B*A) + (C*A))
ans =
  2×2
   0   0
   0   0
```

% (iii) this is false when considering the below; true in algebra but not in matrix algebra

```
A^2 == zeros(2,2)
ans =
  2×2
   1   1
   1   1
A == zeros(2,2)
```

ans =
  2×2
   0   0
   0   0

 % (iv) This is NOT true. The correct expansion would be A^2 + AB + BA + B^2; AB and BA cannot be combined into 2AB as they
% would be in regular algebra

(A+B)^2 == A^2 + 2*A*B + B^2
ans =
  2×2 logical array
   0   0
   0   0
% However:
(A+B)^2 == A^2 + A*B + B*A + B^2
ans =
  2×2 logical array
   1   1
   1   1

% (v) - this is false when comparing the below results
B * C == zeros(2,2)
ans =
  2×2
   1   1
   1   1

% (vi) - this will be true since they A is left multiplied
A * (B + C) == A*B + A*C
ans =
  2×2
   1   1
   1   1

%(vii) - this is false in a way similar to (iv); the expansion works in regular algebra but here should be A^2 + AB - BA -B^2
% since AB - BA does not equal zero
(A-B) * (A + B) == A^2 - B^2
ans =
  2×2
   0   0

```
   0   0
```

%Question 3 - The transpose of a matrix

```
A = [-5 6; 5 6];
B = [2 -5; -5 4];
C = [-6 -5 4; 3 2 1];
```

% (i)

```
B' * A'
ans =
   -40   -20
    49    -1
```

% (ii)

```
C' * A
ans =
    45   -18
    35   -
```

% (iii)

```
(A')'
ans =
    -5     6
     5     6
```

% (iv)

```
B'
ans =
     2    -5
    -5     4
```

% (v)

```
A' * B'
ans =
   -35    45
   -18    -6
```

% (vi)

```
(A * B)'
ans =
   -40   -20
```

```
   49    -1
```

% (vii)

```
A * C'
{Error using <a href="matlab:matlab.internal.language.introspective.errorDocCallback('mtimes')"
style="font-weight:bold"> * </a>
Incorrect dimensions for matrix multiplication. Check that the number of columns in the first
matrix matches the number of rows in
the second matrix. To perform elementwise multiplication, use '.*'.}
```

% 3a) the only problem that didn't work is (vii) because the resultant dimensions of C' do not work. This is trying to do
% 2x2 * 3x2 which does not work.

% 3b) b is symmetric; in (iv) we see that it's transpose is the same as it's normal matrix

% 3c) (A')' is just the same thing as A, so they are equal. It's just undoing the transposition.

% 3d) (AB)' =/= A'B' while (AB)' DOES equal B'A' by the property of tranposes.

% Question 4 - Matrix multiplication

```
R = round(10*rand(3));
S = round(10*rand(3));
```

% (i)

```
[R*S(:,1), R*S(:,2), R*S(:,3)]
ans =
   191   141    79
    65    39    58
   170   124    78
```

% (ii)

```
[R(1,:)*S; R(2,:)*S; R(3,:)*S ]
ans =
   191   141    79
    65    39    58
   1
```

% (iii) - below is identical to (i) and (ii)

```
R*S
ans =
```

```
  191   141    79
```

% (iv)
% (i) and (ii) above are simply constructing a new matrix by slicing to "manually" calculate each row by each column.
% (i) is creating the new matrix by iterating through the columns of S, and (ii) is iterating through the rows of S.

% Question 5 - Creating matrices with eye, ones, diag, and triu

```
v = [9 10 11];
M = diag(v)
M =
    9     0     0
    0    10     0
    0     0    11

sevens = ones(3)  * 7;
N = triu(sevens)
N =
    7     7     7
    0     7     7
    0     0     7

P = eye(3,3) * 2
P =
    2     0     0
    0     2     0
    0     0     2


Q = ones(3,2)*8
Q =
    8     8
    8     8
    8     8
```

% Question 6 - create a big matrix with submatrices

% (i)
```
G = [[B; eye(2,2)], [eye(2,2); A], [C; zeros(2,3)]]

G =
```

```
 2   -5    1    0   -6   -5    4
-5   -4    0    1    3    2    1
 1    0   -5    6    0    0    0
 0    1    5    6    0    0    0
```

% Question 7 - manipulate a matrix

% 7a)

```
H = G(1:3,2:4)

H =

   -5    1    0
   -4    0    1
    0   -5    6
```

% 7b)

```
E = H;
E(1,3) = 5

E =

   -5    1    5
   -4    0    1
    0   -5    6
```

% 7c)

```
 F = H(:,2:3)

F =

    1    0
    0    1
   -5    6
```

% 7d) - typing G(:,:) just returns G because it is slicing all rows and all columns
% G(:), interestingly, returns the entire matrix as a column vector. Sort of a transpose + append of every single row.

% 7e) - G(5,1) WOULD return the number at the 5th row and 1st column
% but because that is out of range, it will give an error. G is 4x7
G(5,1)

% 7f) - max(G) is giving the maximum value of each column; ssum(G)

ans =

```
   -2     0     1    13    -3    -3     5
```

% 7g) I think G(G>3) will mask G and return elements greater than 3 within G
% G(G>3) = 500 is assigning the value 500 to each entry in G that is > 3. This is using a technique called masking.

G(G>3)

ans =

```
    4
    5
    6
    6
    4
```

G(G>3) = 500

G =

```
    2    -5     1     0    -6    -5   500
   -5   500
```

% Question 8 - Perform row operations

A = [7 2 5; -21 -7 -11; 28 4 41];

A = [7 2 5; -21 -7 -11; 28 4 41];
A([1,3],:) = A([3,1],:)

A =

```
     28           4          41
    -21          -7         -11
```

```
     7          2          5
```

A(2,:) = A(2,:) + (3/4) * A(1,:)

A =

```
    28          4         41
     0         -4         79/4
     7          2          5
```

A(3,:) = A(3,:) - (1/4)*A(1,:)

A =

```
    28          4         41
     0         -4         79/4
     0          1        -21/4
```

A(3,:) = A(3,:) + (1/4) * A(2,:)

A =

```
    28          4         41
     0         -4         79/4
     0          0         -5/16
```