Matrix Inverse Example

Set up a 3x3 matrix

```
% Define the initial 3x3 matrix
A = [2 1 1;
     4 -6 0;
     -2 7 2]
```

```
A =
      2             1             1
      4            -6             0
     -2             7             2
```

format(rational) for our simplicity

```
format("rational")
```

Use Matlab's "inv(A)" operator

```
B=inv(A)
```

```
B =
      3/4          -5/16         -3/8
      1/2          -3/8          -1/4
     -1             1             1
```

```
C=inv(B)
```

```
C =
      2             1             1
      4            -6             0
     -2             7             2
```

Check that it is the inverse

```
on_right = A*B
```

```
on_right =
      1             0             0
      0             1             0
      0             0             1
```

```


on_left = B*A
```

```
on_left =
      1             0             0
      0             1             0
      0             0             1
```

```

```

Use Gauss-Jordan Elimination

Step 1: Augment A with I_3 (identity matrix)

```
% built-in identity maker
I3 = eye(3);
augmented_matrix = [A, I3]
```

```
augmented_matrix =
      2      1      1      1      0      0
      4     -6      0      0      1      0
     -2      7      2      0      0      1
```

Step 2: Do elimination to get A in upper triangular form

```
% rename for simplicity
M=augmented_matrix;
% get first column right
M(2,:) = M(2,:) -2*M(1,:);
M(3,:) = M(3,:) + M(1,:);
M
```

```
M =
      2      1      1      1      0      0
      0     -8     -2     -2      1      0
      0      8      3      1      0      1
```

```
% get second column right
M(3,:) = M(3,:) + M(2,:)
```

```
M =
      2      1      1      1      0      0
      0     -8     -2     -2      1      0
      0      0      1     -1      1      1
```

```

% AT THIS POINT (Gauss) ELIMINATION IS DONE

% The pivots are .....
% What would this tell us ......
```

Now we get zeros ABOVE the pivots

```
% get column two right
M(1,:) = M(1,:) + (1/8)* M(2,:)
```

```
M =
      2      0    3/4    3/4    1/8      0
      0     -8     -2     -2      1      0
      0      0      1     -1      1      1
```

```
% get column three right
M(1,:) = M(1,:) - (3/4)* M(3,:);
M(2,:) = M(2,:) + 2* M(3,:);
M
```

```
M =
       2             0             0            3/2          -5/8          -3/4
       0            -8             0           -4             3             2
       0             0             1           -1             1             1
```

Make all pivots be 1

```
M(1,:) = (1/2)*M(1,:);
M(2,:) = (-1/8)*M(2,:);
M
```

```
M =
       1             0             0            3/4          -5/16         -3/8
       0             1             0            1/2          -3/8          -1/4
       0             0             1           -1             1             1
```

Grab the right-hand side of augmented matrix

```
test = M(:,4:6)
```

```
test =
       3/4          -5/16         -3/8
       1/2          -3/8          -1/4
      -1             1             1
```

Check to see if it is the same as B

```
equal_check = isequal(test,B)
```

```
equal_check = logical
   1
```

```
equal_check_by_element = (test == B)
```

```
equal_check_by_element = 3×3 logical array
   1   1   1
   1   1   1
   1   1   1
```

"RREF" stands for "Reduce Row-Echelon Form"

```
test_2 = rref(augmented_matrix)
```

```
test_2 =
       1             0             0            3/4          -5/16         -3/8
       0             1             0            1/2          -3/8          -1/4
       0             0             1           -1             1             1
```