Homework 4

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2. Ch 7 #3:

b.

```
A = [10^-16,1;1,1];
cond(A)
```

```
ans = 2.6180
```

This is pretty well conditioned since the condition number is close to 1 which implies stability and a well conditioned matrix.

c.

```
A = [10^-16,1;1,1];
b = [2,3]';
n = 2;
for j = 1:n-1
    for i = j+1:n
        mult = A(i,j)/A(j,j);
        A(i,j:n) = A(i,j:n) - mult*A(j,j:n);
        b(i) = b(i) - mult*b(j);
    end
end
x = b;
for i = n:-1:1
    x(i) = (b(i) - A(i,i+1:n)*x(i+1:n))/A(i,i);
end
x
```

```
x = 2×1
    4.4409
    2.0000
```

```
A\b
```

```
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =
1.000000e-32.
ans = 2×1
    4.4409
    2.0000
```

```
cond(A)
```

```
ans = 1.0000e+32
```

By hand I got x = [1,2] and in MATLAB I got x = [4.4409,2] when using and not using pivoting. The condition number of A is very very large which explains the instability of the solution from MATLAB. By hand we can just approximate the values, but MATLAB solves it more exactly and rigorously, so when the condition number is large, there are issues.

6.

```
A = [3,1,4,-1;2,-2,-1,2;5,7,14,-8;1,3,2,4];
b = [7,1,20,-4]';
```

Using partial pivoting, I will rearrange the rows of A and name it "Apiv" and then rearrange b as well and name it "bpiv". I will then apply the same code as above with this matrix "Apiv" and vector "bpiv" in order to find x:

```
Apiv = [5,7,14,-8;3,1,4,-1;2,-2,-1,2;1,3,2,4];
bpiv = [20,7,1,-4]';
n = 4;
for j = 1:n-1
    for i = j+1:n
        mult = Apiv(i,j)/Apiv(j,j);
        Apiv(i,j:n) = Apiv(i,j:n) - mult*Apiv(j,j:n)
        bpiv(i) = bpiv(i) - mult*bpiv(j);
    end
end
```

```
Apiv = 4×4
    5.0000    7.0000   14.0000   -8.0000
         0   -3.2000   -4.4000    3.8000
    2.0000   -2.0000   -1.0000    2.0000
    1.0000    3.0000    2.0000    4.0000
Apiv = 4×4
    5.0000    7.0000   14.0000   -8.0000
         0   -3.2000   -4.4000    3.8000
         0   -4.8000   -6.6000    5.2000
    1.0000    3.0000    2.0000    4.0000
Apiv = 4×4
    5.0000    7.0000   14.0000   -8.0000
         0   -3.2000   -4.4000    3.8000
         0   -4.8000   -6.6000    5.2000
         0    1.6000   -0.8000    5.6000
Apiv = 4×4
    5.0000    7.0000   14.0000   -8.0000
         0   -3.2000   -4.4000    3.8000
         0         0    0.0000   -0.5000
         0    1.6000   -0.8000    5.6000
Apiv = 4×4
    5.0000    7.0000   14.0000   -8.0000
         0   -3.2000   -4.4000    3.8000
         0         0    0.0000   -0.5000
         0         0   -3.0000    7.5000
Apiv = 4×4
10^15 ×
    0.0000    0.0000    0.0000   -0.0000
         0   -0.0000   -0.0000    0.0000
         0         0    0.0000   -0.0000
         0         0         0   -1.6888
```

```
x = b;
for i = n:-1:1
    x(i) = (bpiv(i) - Apiv(i,i+1:n)*x(i+1:n))/Apiv(i,i);
end
x
```

```
x = 4×1
    1.0000
   -1.0000
    1.0000
   -1.0000
```

```
A\b
```

```
ans = 4×1
    1.0000
   -1.0000
    1.0000
   -1.0000
```