Coursework
hw09 due 4/28
hw10 due 5/3
hw11 due 5/3
Grade check period coming up: May 1–5. All posted Compass grades will be considered final after this. Double-check if the grade says “upcoming”.
x = 1
y = true
~(x ~= y || y < x)

What is the result of this operation?

A true
B false
C 0
D 1
\[ x = 1 \]
\[ y = \text{true} \]
\[ \neg(x \approx y \lor y < x) \]

What is the result of this operation?

A true ★
B false
C 0
D 1 ★
A = [ 1 0 ; 4 5 ];
A( A > 0 )

What is the value of ans?

A [ 1 0 ; 1 1 ]
B [ 1 0 , 1 1 ]
C [ 1 4 5 ]
D 1 (true)
A = \[
\begin{bmatrix}
1 & 0 \\
4 & 5
\end{bmatrix};
\]
A( A > 0 )

What is the value of ans?

A \[
\begin{bmatrix}
1 & 0 \\
1 & 1
\end{bmatrix}
\]
B \[
\begin{bmatrix}
1 & 0 \\
1 & 1
\end{bmatrix}
\]
C \[
\begin{bmatrix}
1 & 4 & 5
\end{bmatrix}
\]
D 1 (true)


x = 10;
if (x / 2) <= 5 | (x == 1)
    x = x + 1;
end
if x ~= 10 & x <= x
    x = x * 2;
end

What is the final value of x?

A 10
B 11
C 20
D 22
x = 10;
if ( x / 2 ) <= 5 | ( x == 1 )
    x = x + 1;
end
if x ~= 10 & x <= x
    x = x * 2;
end

What is the final value of x?
A 10
B 11
C 20
D 22 ✭
Equation solving
Matrix Equations

Most engineering equations have most nonzero values near the diagonal.

This means most of the matrix is zero, and efficient to store and calculate with.
The inverse of a matrix does not have the same properties!
Consider a truss problem solved by the method of joints.

\[
\begin{align*}
0.5 \ T_1 + T_2 &= R_1 = f_1 \\
0.866 \ T_1 &= -R_2 = -0.433 \ f_1 - 0.5 \ f_1 \\
-0.5 \ T_1 + 0.5 \ T_3 + T_4 &= -f_1 \\
0.866 \ T_1 + 0.866 \ T_5 &= 0 \\
-T_2 - 0.5 \ T_3 + 0.5 \ T_5 + T_6 &= 0 \\
0.866 \ T_3 + 0.866 \ T_5 &= f_2 \\
-T_4 - 0.5 \ T_5 + 0.5 \ T_7 &= 0
\end{align*}
\]
Systems of equations

\[
\begin{pmatrix}
0.5 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0.866 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-0.5 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 \\
0.866 & 0 & 0.866 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & -0.5 & 0 & 0.5 & 1 & 0 & 0 \\
0 & 0 & 0.866 & 0 & 0.866 & 0 & 0 & 0 \\
0 & 0 & 0 & -1 & -0.5 & 0 & 0 & 0.5
\end{pmatrix}
\times
\begin{pmatrix}
1000 \\
-1433 \\
-1000 \\
0 \\
0 \\
2000 \\
0
\end{pmatrix}
\]

\[\mathbf{T}_\mathbf{x} = \mathbf{f}\]

- Use the New Variable... interface to define this.
- Also check inv of this matrix.
Statistics
MATLAB supports many varieties of RNG:

- `rand`, uniform distribution \([0, 1)\)
- `randn`, normal distribution
- `randi`, random integers \([0, n)\)

Note that the interfaces for these are quite different from Python!
rand(5); % generate 5x5 matrix
rand(5,1); % generate 5x1 row vector
10 * rand(3); % 3x3 matrix from [0,10)
randi(5); % generate number from [0,5]
randi(5,2); % generate 2x2 matrix
randi([-5,5],10,1); % from [-5,5] in 10x1
randn(); % single normal number
randn(5);  % generate 5x5 matrix
randn(5,2); % generate 5x2 matrix
randn( 'seed',1 );
x = linspace( 0,2*pi,101 );
y = sin( x/50 ) ./ x + .002 * randn( 101,1 );
clf
plot( x,y,’.’ );
Many operations are available:

- mean, median, std
- max, min, range
- iqr, corrcoef (the correlation coefficient of two random variables is a measure of their linear dependence) (don’t worry about these)
- sort, sum, cumsum, prod, cumprod
- boxplot, hist
Many operations are available:

- mean, median, std
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- boxplot, hist

```matlab
x = randn( 6,1 );
y = randn( 6,1 );
A = [x y 2*y+3 ];
R = corrcoef( A )
```
\[
\begin{align*}
x &= [1 \ 2 \ 3 \ 4 \ 5]; \\
A &= \begin{bmatrix}
-5 & 0 & 10 \\
-4 & 1 & 9 \\
-3 & 2 & 8 \\
-2 & 3 & 7 \\
-1 & 4 & 6 
\end{bmatrix}
\end{align*}
\]

\begin{verbatim}
sort( x )
sort( x,'descend' )
sort( A )
sortrows( A )
sortrows( A,3 )
cumsum( x )
\end{verbatim}

\begin{verbatim}
y = rand( 1000,1 );
boxplot( y )
\end{verbatim}
Example: Brexit polling

poll = importdata('brexit.csv');
plot( poll.data(:,2) );
plot( poll.data(:,3) );
% oh no! our plotted data disappeared!
Example: Brexit polling

```matlab
poll = importdata('brexit.csv');
hold on;  % make plots persistent until closed
plot( poll.data(:,2) );
plot( poll.data(:,3) );
plot( poll.data(:,4) );
```
Example: Brexit polling

```matlab
n = numel(poll.data(:,2));

mean_r = mean( poll.data(:,2) ) * ones( n+1,1 );
stdev_r = std( poll.data(:,2) );
std_rp = mean_r+stdev_r;
std_rm = mean_r-stdev_r;
hold on
plot( poll.data(:,2), 'ro' );
plot( 0:n,mean_r, 'r-' );
plot( 0:n,std_rp, 'r--' );
plot( 0:n,std_rm, 'r--' );
```
n = numel(poll.data(:,2));
mean_r = rolling_mean( poll.data(:,2)', 25 );
stdev_r = rolling_std( poll.data(:,2)', 25 );
std_rp = mean_r+stdev_r;
std_rm = mean_r-stdev_r;
hold on
plot( poll.data(:,2), 'ro' );
plot( 0:n-1,mean_r, 'r-' );
plot( 0:n-1,std_rp, 'r--' );
plot( 0:n-1,std_rm, 'r--' );
Example: Hydropower statistics

dams = importdata( 'hydropower.csv' );
disp( dams );
plot( dams.data(:,6),dams.data(:,5),'bo' );
xlim( [ 1900 2000 ] )

What statistics should we try to see here?
Next steps
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