CS101 Lecture #24
Homework #12 is due Friday, Jan. 13.
No lab next week.
Final examination will be held Jan. 20, Friday 8am-11am in A-0414.
MATLAB supports many varieties of RNG:
- `rand`, uniform distribution \([0, 1)\)
- `randn`, normal distribution
- `randi`, random integers \([0, n)\)
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);
% Right-array division (. /)
clf %Clear current figure window
plot(x,y,'.' );
Many operations are available:

- mean (average), median, std
- max, min, range
- iqr (interquartile range), corrcoef (the correlation coefficient of two random variables is a measure of their linear dependence) (not yet supported in Octave)
- sort
- boxplot, hist
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```matlab
x = randn( 6,1 );
y = randn( 6,1 );
A = [x y 2*y+3 ];
R = iqr ( A )
```
Equation solving
A classical linear algebra problem:

\[ \begin{pmatrix} 2 & 3 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \]

\( A = \begin{bmatrix} 2 & 3 \\ 3 & 2 \end{bmatrix} \)

\( b = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \)';

\( x = A \backslash b; \; \% \text{ easy solution!} \)

This is called ‘left division’.
Consider a truss problem solved by the method of joints.

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

\[
\begin{pmatrix}
0.5 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0.866 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-0.5 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 \\
0.866 & 0 & 0.866 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & -0.5 & 0 & 0.5 & 1 & 0 & 0 & 0 \\
0 & 0 & 0.866 & 0 & 0.866 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -1 & -0.5 & 0 & 0.5 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{pmatrix}
\begin{pmatrix}
1000 \\
-1433 \\
-1000 \\
0 \\
0 \\
2000 \\
0
\end{pmatrix}
= f
\]
Solution finding

- An effective way to solve equations is to set the left- and right-hand sides to equal each other.

\[ \exp(-\sin^2 bx) = 2 - x^2 \]

- OR, subtract so they go to zero:

\[ \exp(-\sin^2 bx) - 2 + x^2 = 0 \]

```matlab
function [ rhs ] = lhs( x )
    b = 1.0;
    rhs = exp(-sin(b.*x).^2) - 2 + x.^2;
end
fplot( @lhs, [ -10 10 ] );
fzero( @lhs, 0 );
```
Polynomial roots are also easy to find:

\[ 2x^3 + 3x^2 - 4x - 5 = 0 \]

\text{roots(} \begin{bmatrix} 2 & 3 & -4 & -5 \end{bmatrix} \text{)}
Question

\[ A = \begin{bmatrix} 5 & 4 & 1-2 & 2 \\ 5 & 4 & 1 & -2 & 2 \end{bmatrix}; \]
\[ B = \begin{bmatrix} 5 & 4 & 1 & -2 & 2 \end{bmatrix}; \]

Are \( A \) and \( B \) equal in value?

A Yes
B No
\[
\begin{align*}
A &= \begin{bmatrix} 5 & 4 & 1 & -2 & 2 \\ 1 & 2 & 2 \end{bmatrix} \\
B &= \begin{bmatrix} 5 & 4 & 1 & -2 & 2 \\ 1 & 2 & 2 \end{bmatrix}
\end{align*}
\]

Are \( A \) and \( B \) equal in value?

A  Yes
B  No