MATLAB SESSION

CS 231A

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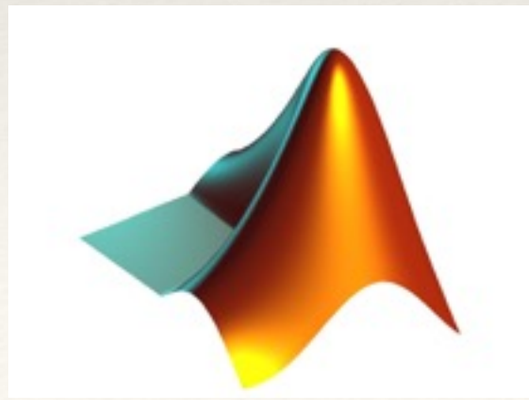
Roadmap

- What is MATLAB?
- Setup and IDE
- Syntax
  - Variables, Matrix/Vectors
  - Datatypes and Operators
  - Control Flow
  - Plots and Images
- Tips and Tricks

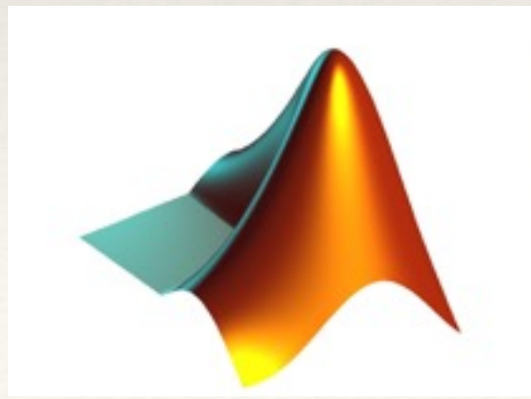
What is MATLAB?

- **MATLAB(Matrix Laboratory)**
  - Programming Language optimized for matrix operations
  - Editor + IDE
  - Libraries (toolboxes)
    - Computer Vision, Statistics and ML, Finance…



What is MATLAB?

- **GOOD FOR..**
  - Linear algebra programming (matrix multiplication, decomposition..)
  - Scientific computations (numerical, data analysis..)
  - Quick Prototyping (toolboxes)



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Access to MATLAB

- **Requires a License**
  - Buy through Stanford web store ($70/year)
  - Use Stanford corn cluster (Free)
    - May ask for authentication (passcode)

```
>> ssh <suid>@corn.stanford.edu
>> module load matlab
>> matlab &
```

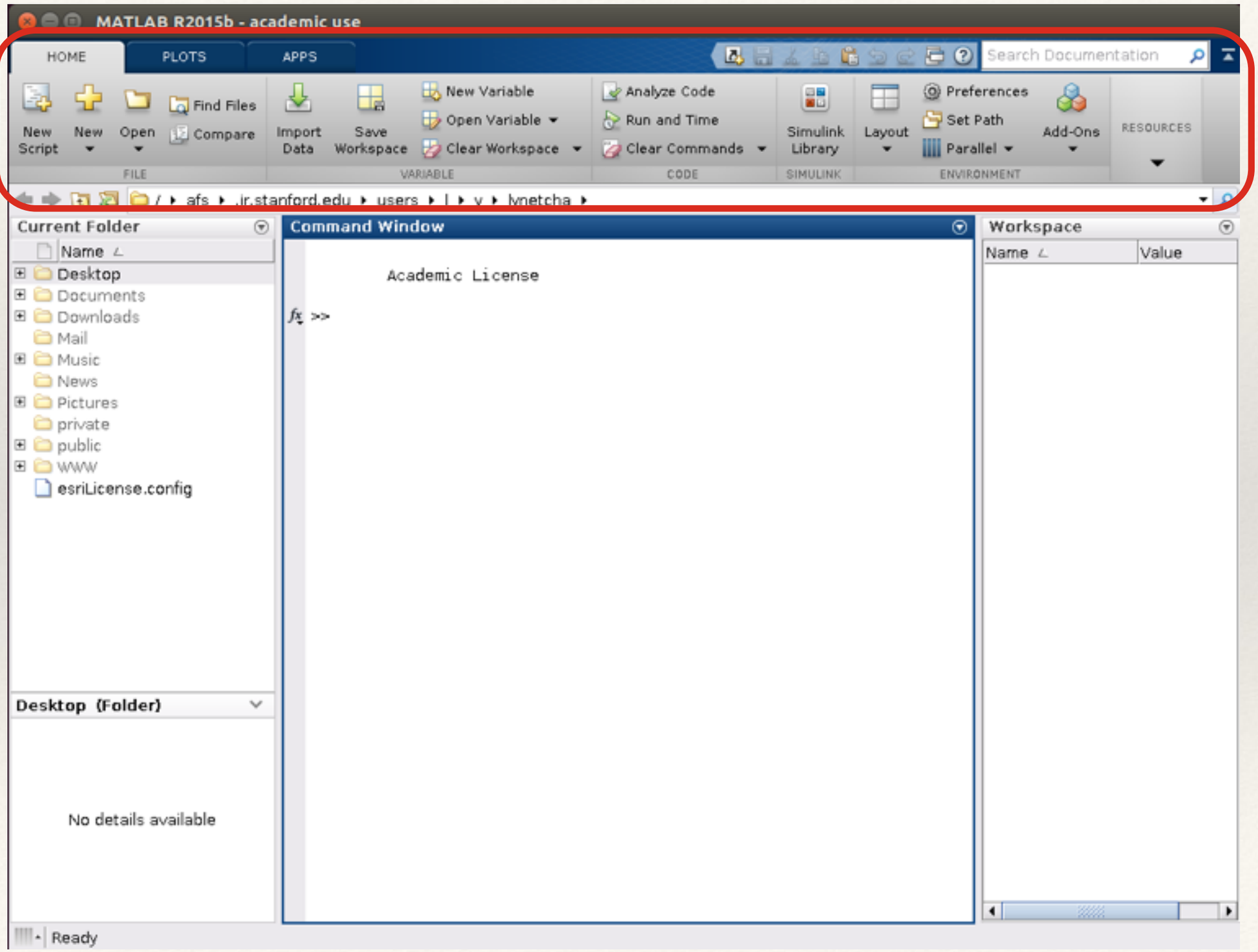
OR

```
>> matlab -nodesktop
```

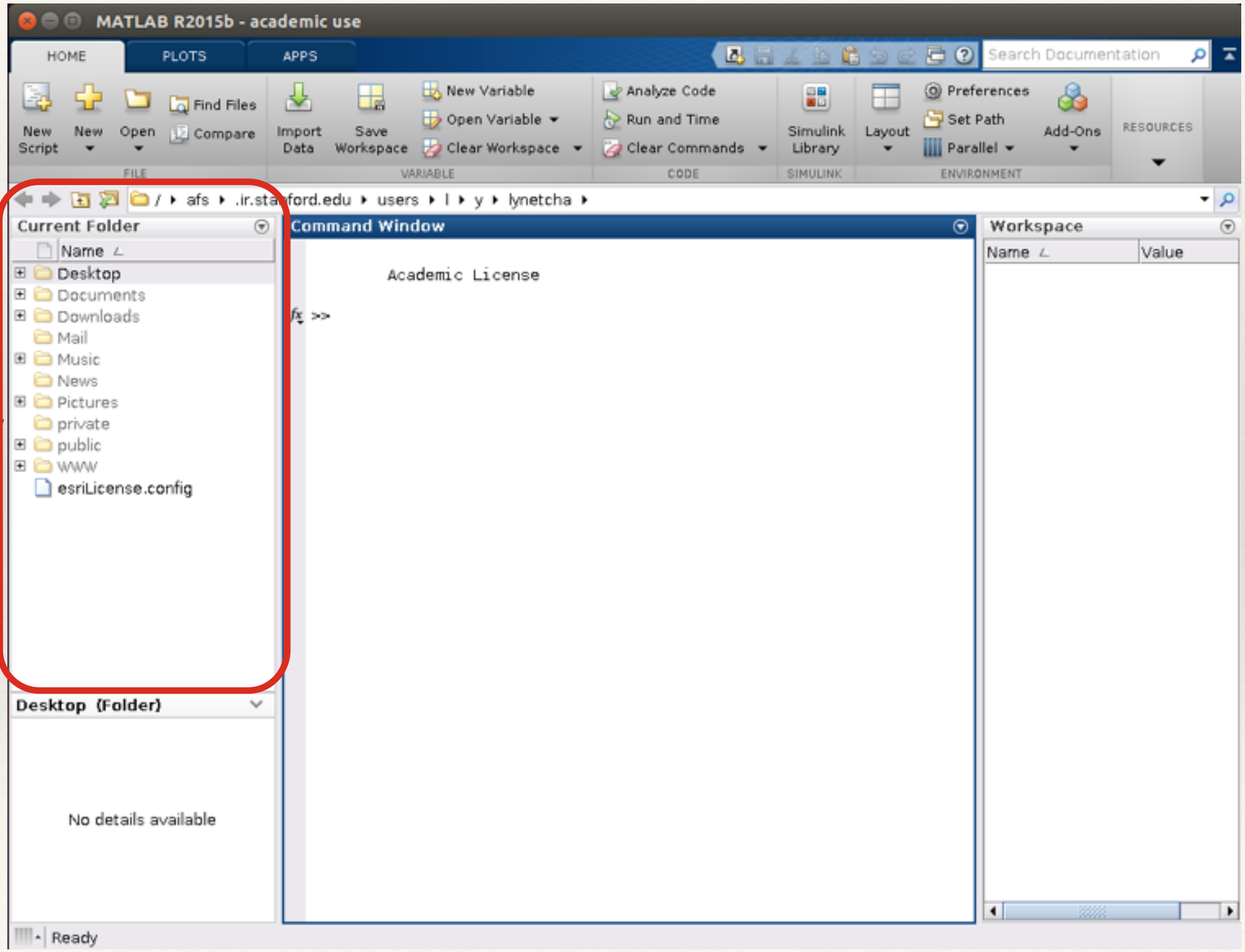
(Shell/Command Window only -faster but no GUI)

MATLAB IDE

MENU

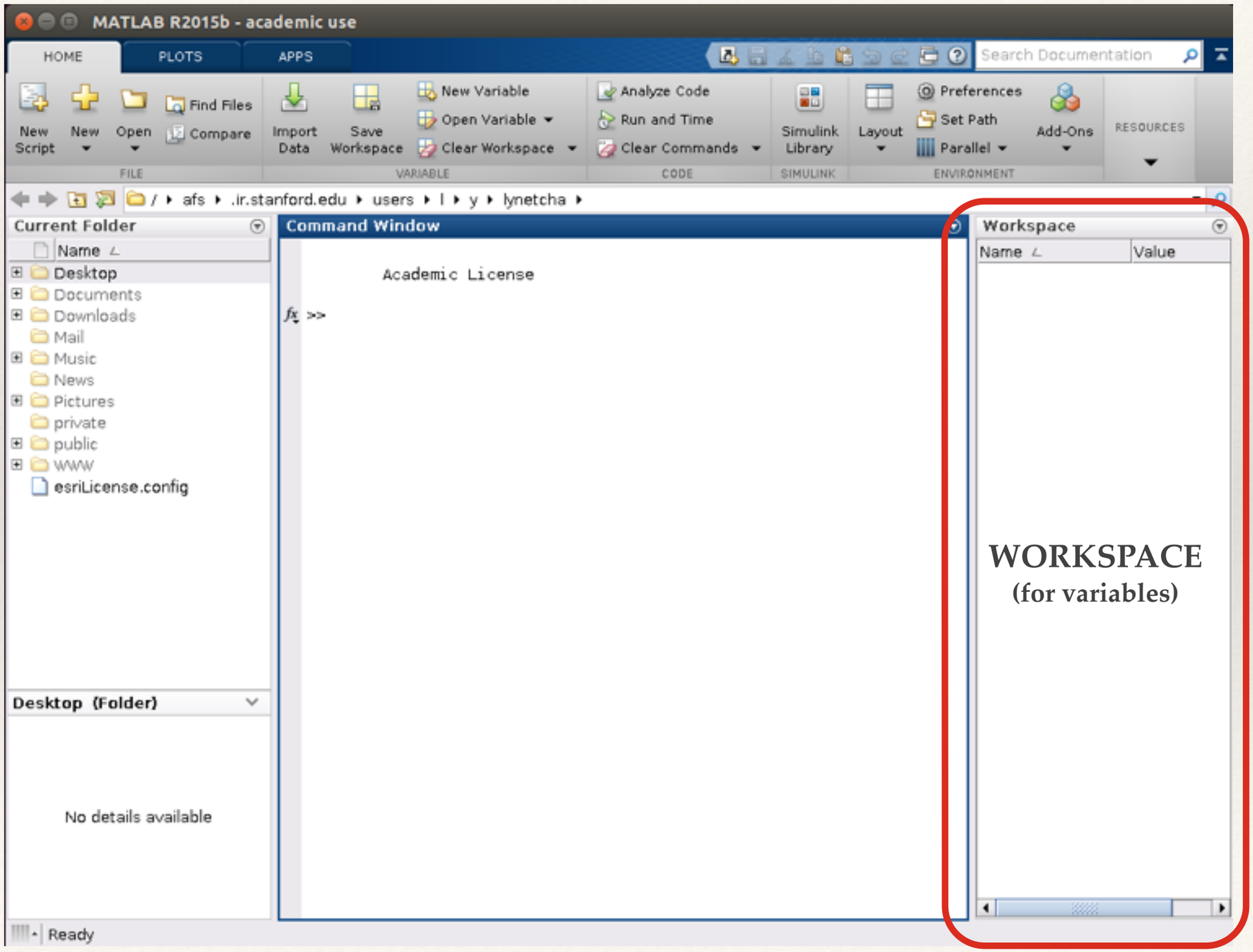


MATLAB IDE



FOLDERS
&
FILES

MATLAB IDE


MATLAB R2015b - academic use
HOME
PLOTS
APPS
Search Documentation
New Script
New
Open
Find Files
Compare
Import Data
Save Workspace
New Variable
Open Variable
Clear Workspace
Analyze Code
Run and Time
Clear Commands
Simulink Library
Layout
Preferences
Set Path
Parallel
Add-Ons
RESOURCES
FILE
VARIABLE
CODE
SIMULINK
ENVIRONMENT
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Academic License
>>
Workspace
Name
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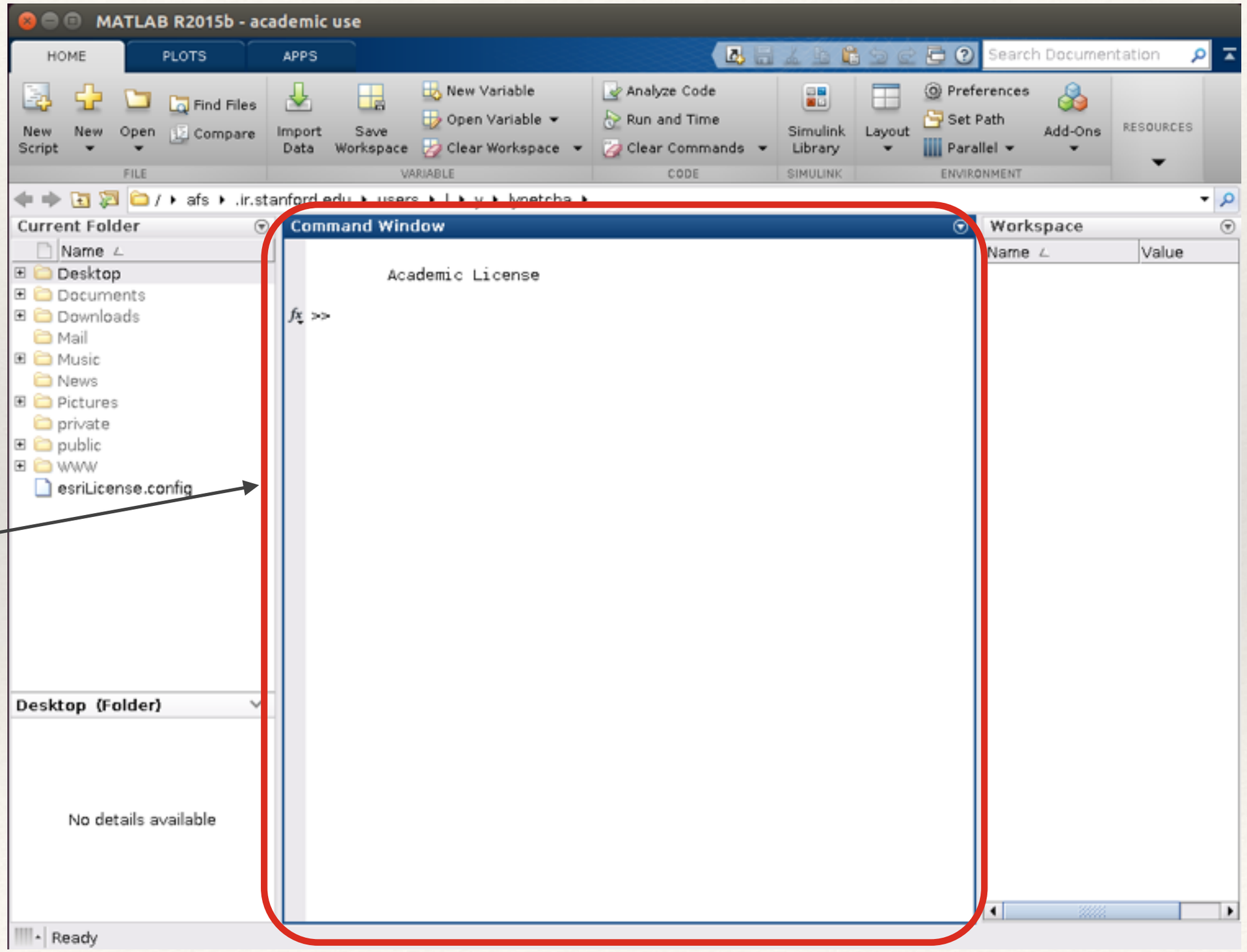
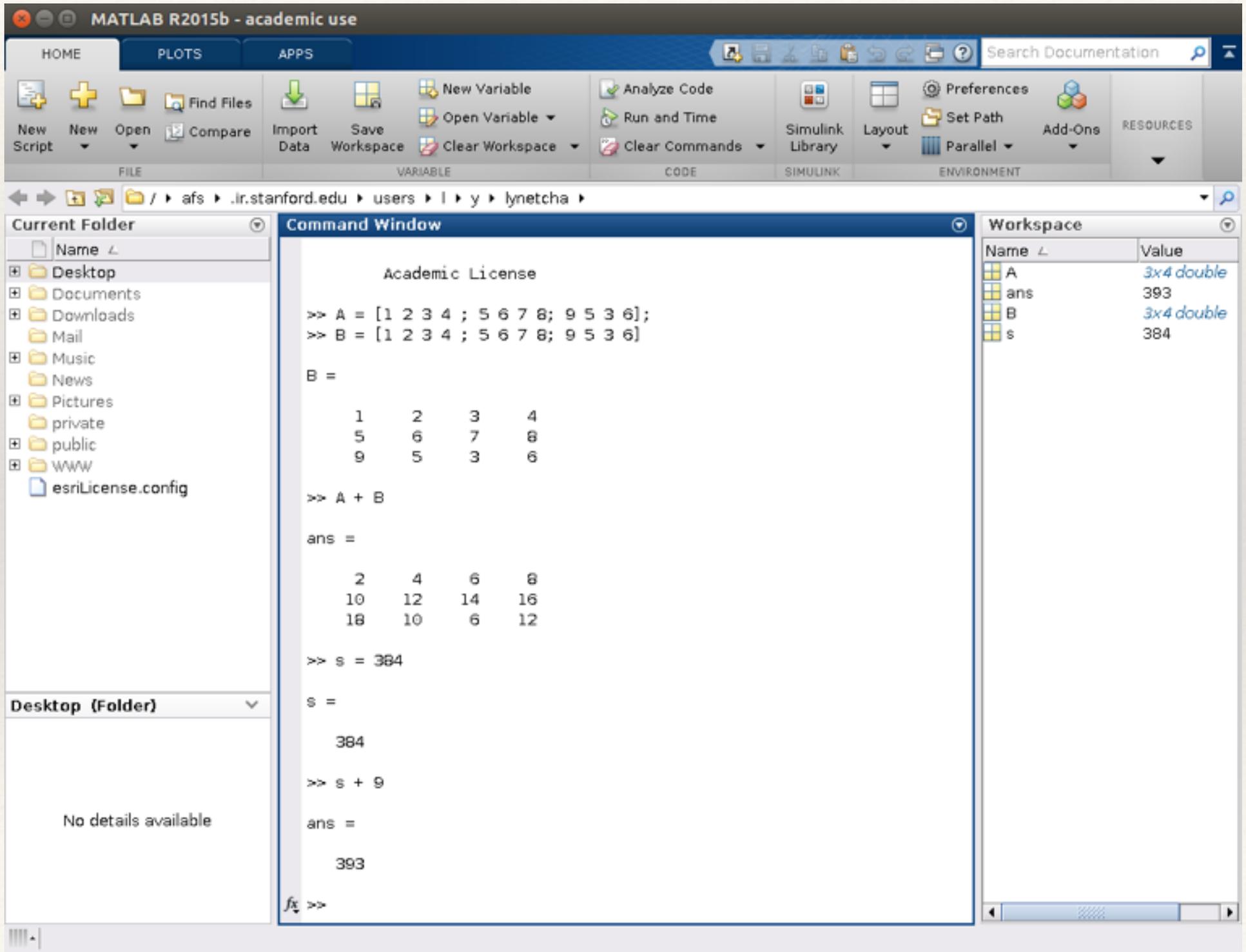
WORKSPACE
(for variables)
Ready

MATLAB IDE

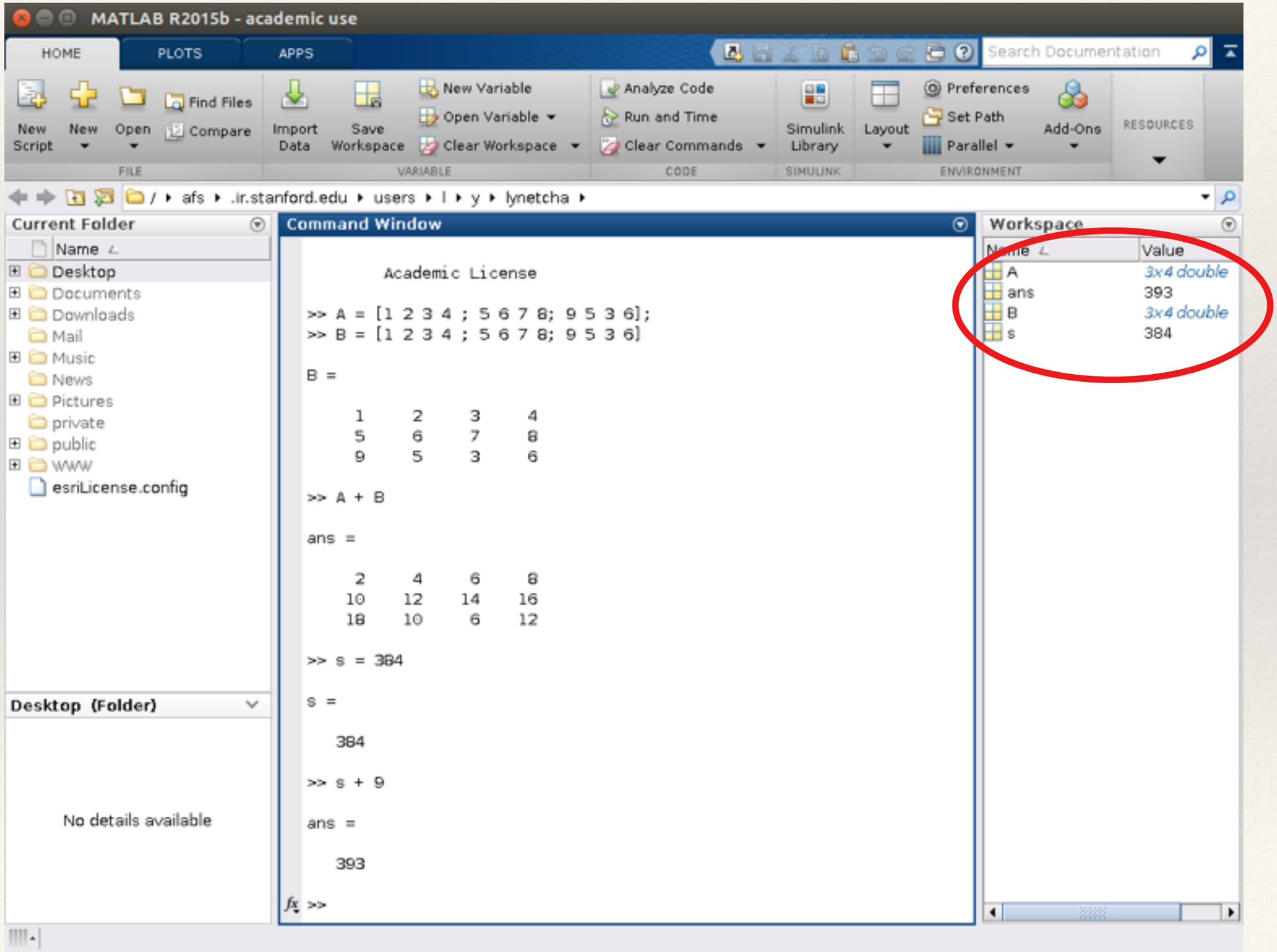


COMMAND WINDOW

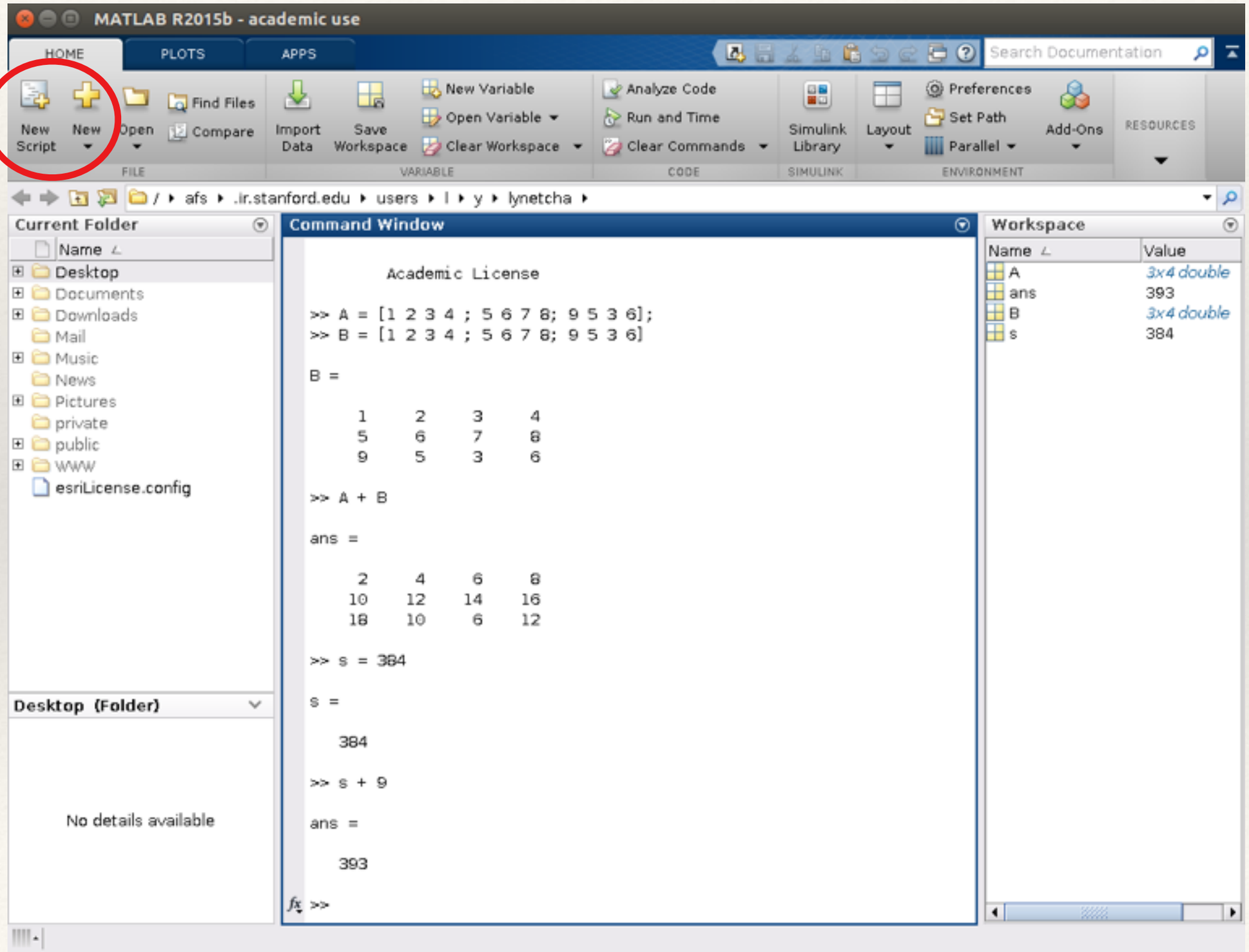
Command Window



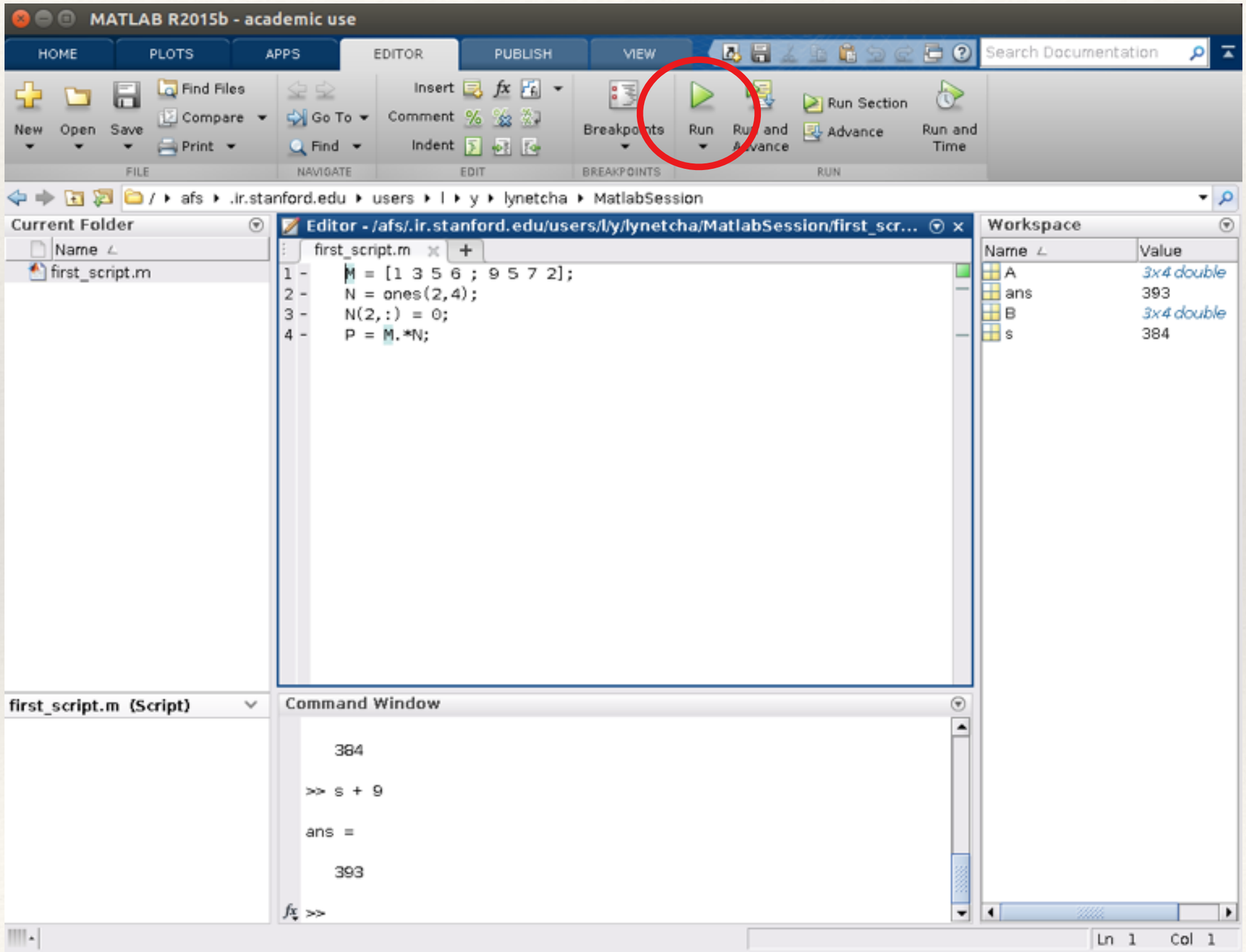
Command Window



First Script



First script(.m file)



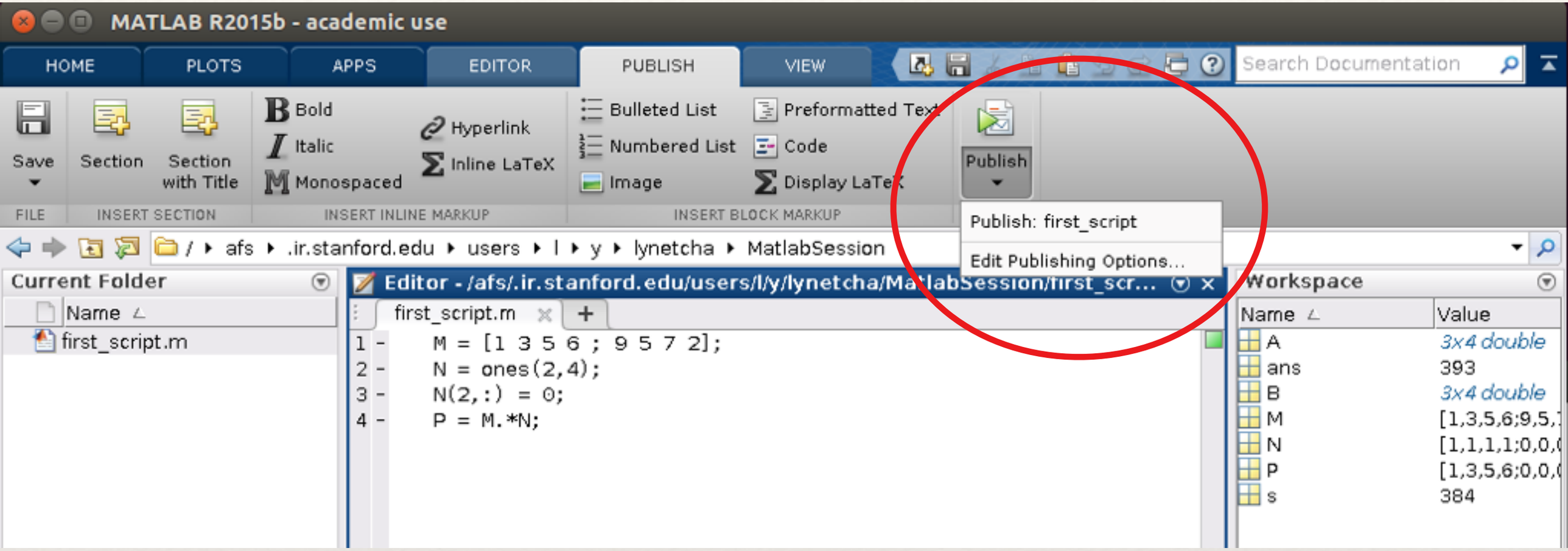
First function(function.m file)

Editor - /afs/.ir.stanford.edu/users/l/y/lynetcha/MatlabSession/sumMat...

first_script.m | sumMatrix.m | +

```
1     function S = sumMatrix(A,B)
2 -       S = A+B;
3 -   end
```

Publishing


MATLAB R2015b - academic use
HOME
PLOTS
APPS
EDITOR
PUBLISH
VIEW
Search Documentation
Save
Section
Section with Title
Bold
Italic
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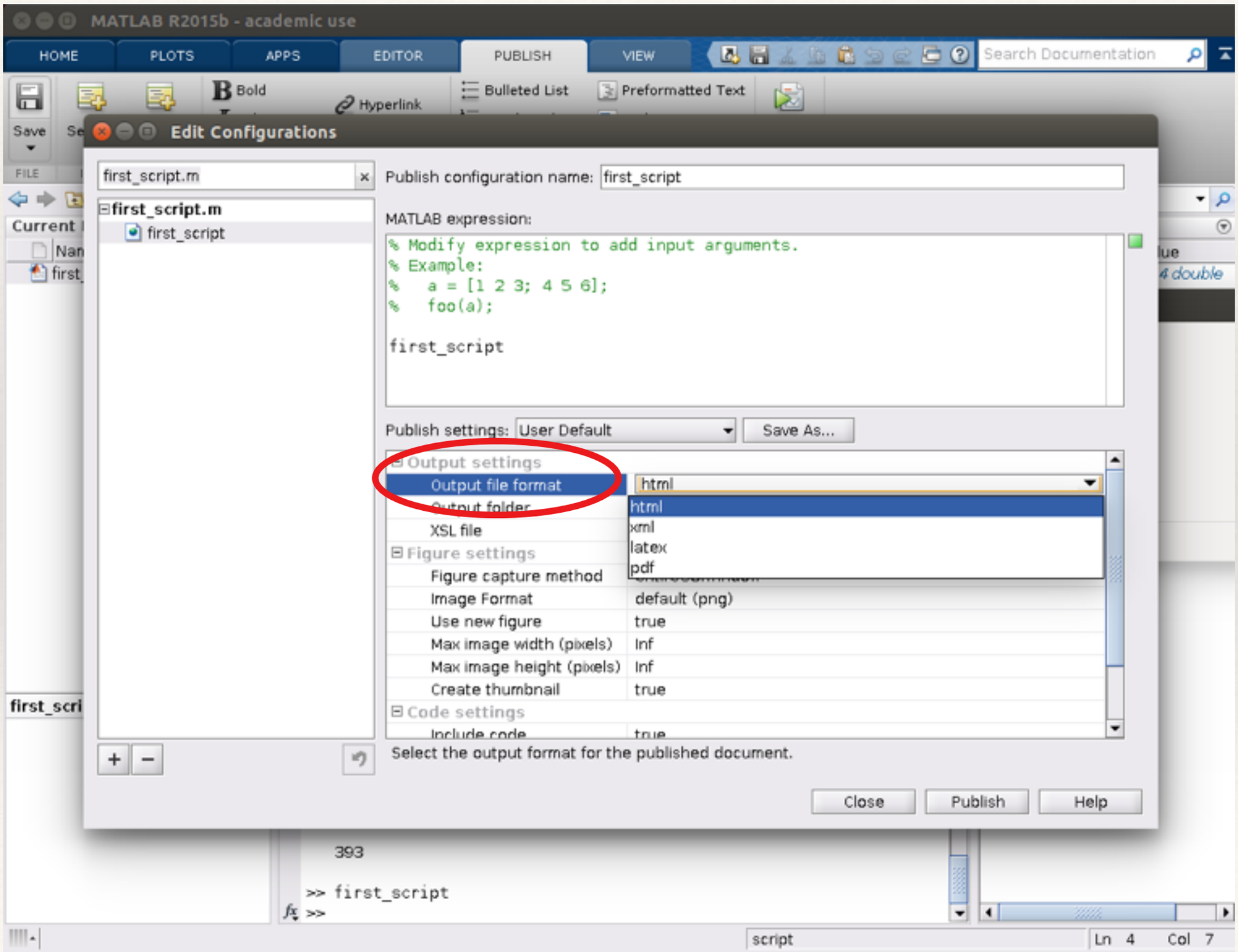
Hyperlink
Inline LaTeX
Bulleted List
Numbered List
Image
Preformatted Text
Code
Display LaTeX
Publish
FILE
INSERT SECTION
INSERT INLINE MARKUP
INSERT BLOCK MARKUP
Publish: first_script
Edit Publishing Options...
/ ▸ afs ▸ .ir.stanford.edu ▸ users ▸ l ▸ y ▸ lynetcha ▸ MatlabSession
Current Folder
Name
first_script.m
Editor - /afs/.ir.stanford.edu/users/l/y/lynetcha/MatlabSession/first_scr...
first_script.m
1 - M = [1 3 5 6 ; 9 5 7 2];
2 - N = ones(2,4);
3 - N(2,:) = 0;
4 - P = M.*N;
Workspace
Name
Value
A
3x4 double
ans
393
B
3x4 double
M
[1,3,5,6;9,5,
N
[1,1,1,1;0,0,
P
[1,3,5,6;0,0,
s
384

Publishing


MATLAB R2015b - academic use
HOME
PLOTS
APPS
EDITOR
PUBLISH
VIEW
Search Documentation
Bold
Hyperlink
Bulleted List
Preformatted Text
Save
Edit Configurations
first_script.m
first_script.m
first_script
Publish configuration name: first_script
MATLAB expression:
% Modify expression to add input arguments.
% Example:
%   a = [1 2 3; 4 5 6];
%   foo(a);
first_script
Publish settings: User Default
Save As...
Output settings
Output file format
html
XSL file
Figure settings
Figure capture method
Image Format
default (png)
Use new figure
true
Max image width (pixels)
Inf
Max image height (pixels)
Inf
Create thumbnail
true
Code settings
Include code
true
html
xml
latex
pdf
Select the output format for the published document.
Close
Publish
Help
393
>> first_script
>>
script
Ln 4
Col 7

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Variables, Matrix/Vector

- Variables

```
a = 4;    s = 'apple';
```

- Row Vectors

```
row1 = [1 2 3];    row1 = [1,2,3];   row1 = 1:3;
row2 = [2 4 6];    row2 = [2,4,6];   row2 = 2:2:6;
row3 = [9 7 5];    row3 = [9,7,5];   row3 = 9:-2:5
```

Variable, Matrix/Vector

- Column vectors

```
col = [1; 2; 3];     col = row';
```

- Matrices

```
mat = [1 2 3 ;          mat = [1,2,3 ;
       4 5 6];                 4,5,6];
```

Special Matrices and Matrix Operation

- Special Matrices

```
Z = zeros(3,5);    O = ones(4,6);    E = eye(5); E = eye(5,5);
```

- Indexing

```
A(4); A(1:end);   A([4 7 3]);  A(5:end);   A(2,4);
```

Special Matrices and Matrix Operation

- Dot Product/Matrix Product

```
C=A*B;        C=dot(A,B)
```

- Transpose

```
A_t = A';
```

- Inverse

```
 Y = inv(X);
```

Useful Matrix Functions

- size(A);
- diag(v); diag(A); …
- rand(n); randi(m,n); randn(m,n);
- max(A); min(A,[],dim); sum(A,[],dim);
- svd, eig
- …

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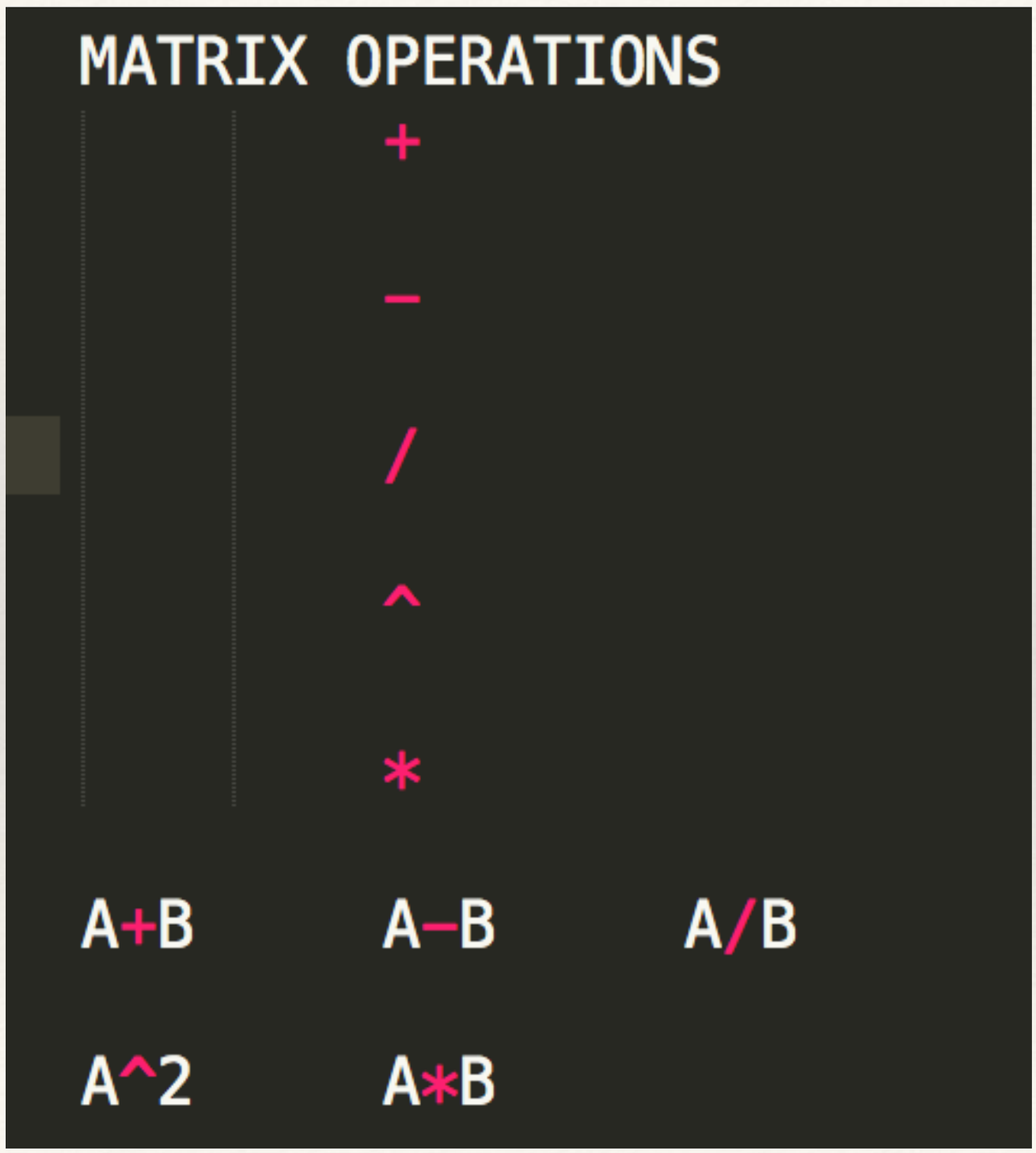
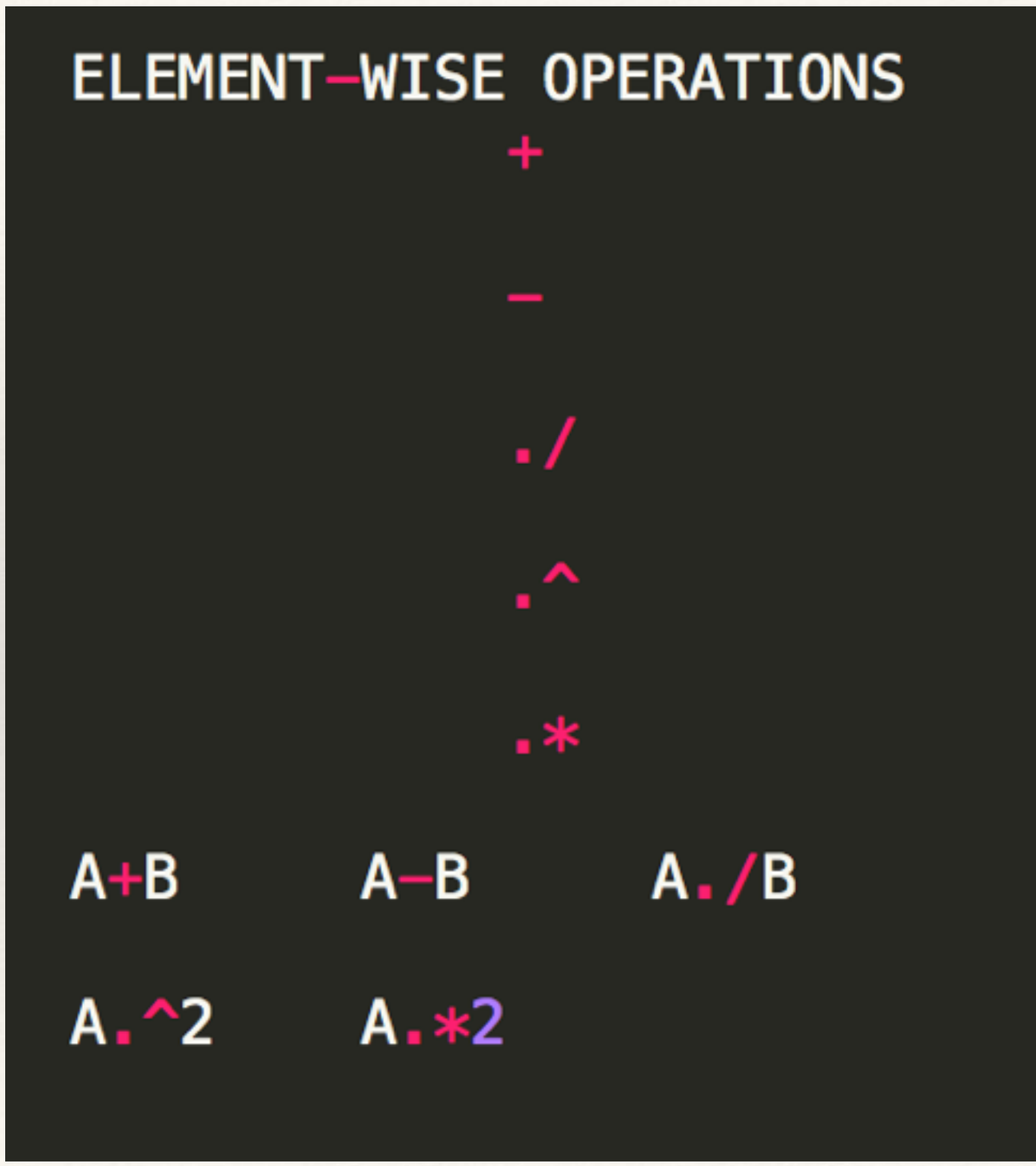
Data Types

- int
- double
- char
- uint8
- ….

- struct
  - s = struct('f1','a','f2',[])
- cells
  - C = {‘firstname’,8, [45 6 7]};

Matrix vs Element-wise operations





Relational Operators

- Element-wise
- Output binary (1,0)

```
A<B

A<=B

A>B

A>=B

A==B

A~=B
```

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Control Flow (if statements)

```
yourNumber = input('Enter a number: ');

if yourNumber < 0
    disp('Negative')
elseif yourNumber > 0
    disp('Positive')
else
    disp('Zero')
end
```

Control Flow(for statements)

```
A = zeros(5,100);
for m = 1:5
    for n = 1:100
        A(m, n) = 1/(m + n - 1);
    end
end
```

While Statements

```
n = 1;
nFactorial = 1;
while nFactorial < 1e100
    n = n + 1;
    nFactorial = nFactorial * n;
end
```

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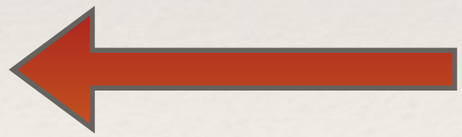
  - Plots and Images 
- Tips and Tricks

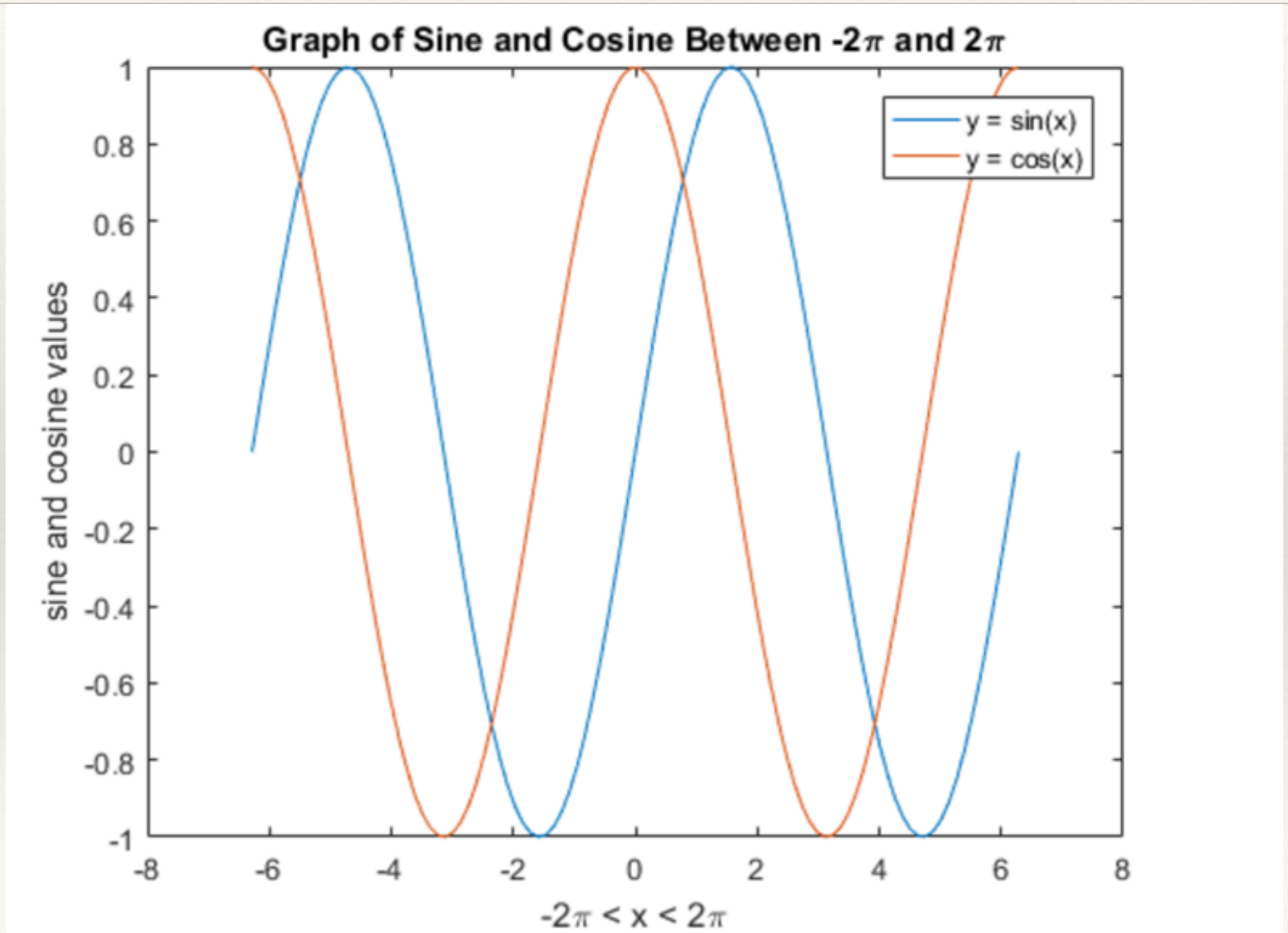
Plotting

- figure
  - Holds individual plot/ image. Call figure() for each distinct plot/image when **publishing**.
- hold / hold all
  - draw several plots on the same image
- title(str)
- xlabel(str)
- ylabel(str)
- legend(strs)

Plotting

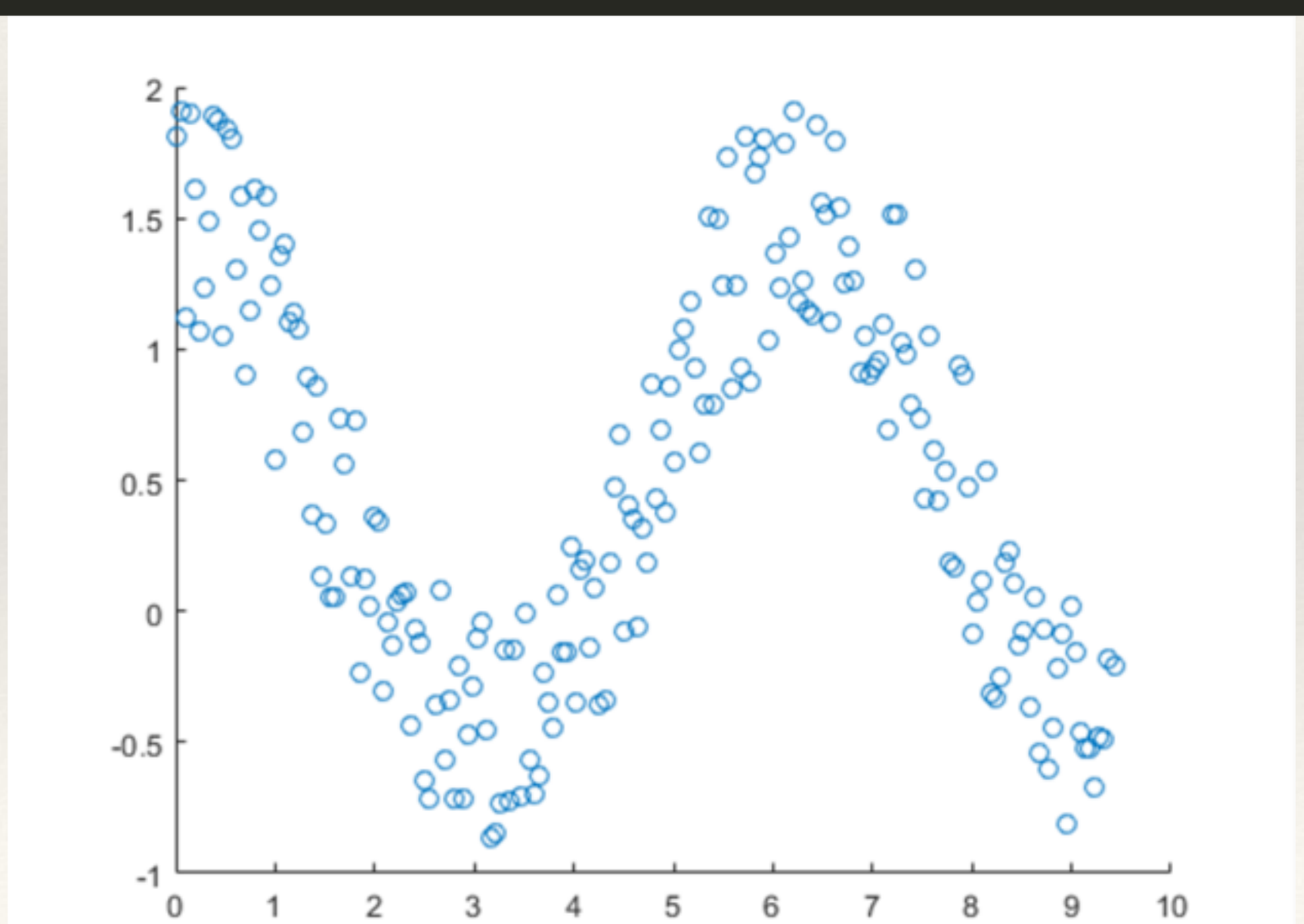
```
x = linspace(-2*pi,2*pi,100);
y1 = sin(x);
y2 = cos(x);

figure
plot(x,y1,x,y2)

title('Graph of Sine and Cosine Between -2\pi and 2\pi')
xlabel('-2\pi < x < 2\pi') % x-axis label
ylabel('sine and cosine values') % y-axis label
legend('y = sin(x)','y = cos(x)')
```

Plotting


Graph of Sine and Cosine Between -2π and 2π
y = sin(x)
y = cos(x)
sine and cosine values
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-8
-6
-4
-2
0
2
4
6
8
-2π < x < 2π

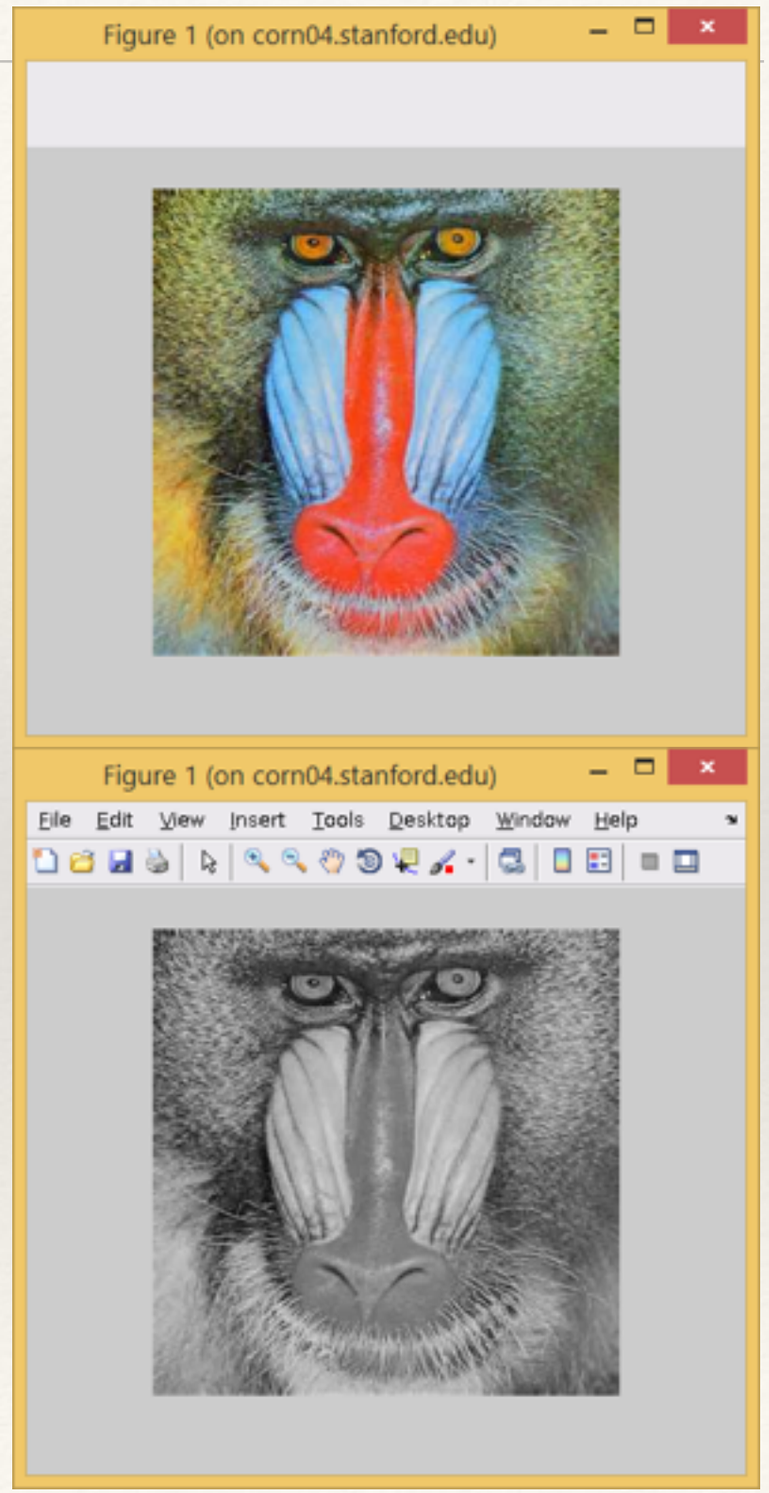
Scatter plot

```
x = linspace(0,3*pi,200);
y = cos(x) + rand(1,200);
scatter(x,y)
```



Images

- **imread(str)**
  - Reads image as RGB (m x n x 3 matrix)
- **rgb2gray(I);**
- **imshow(I)**
  - Displays matrix/image
  - double,single…: 0=black, 1=white
  - uint8: 0=black, 255=white



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Tips and Tricks

- **Use the publish command to submit your work!**
- Use comments for legible submissions
  - **%% Problem 1**
- Check Matrix dimensions
- Element-wise vs matrix operators mistakes
- Use **matrix operations** instead of **for loops** (That's what's MATLAB is for)
- Use functions when necessary (For your project for example)

QUESTIONS?