

MoCap Toolbox

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Nordic SMC winter school, 5
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About MoCap Toolbox

- Developed by Petri Toiviainen @ University of Jyväskylä, Finland.
Released 2008
- Continued development by
Petri Toiviainen and Birgitta Burger
- Now at version 1.5
- Compatible with most versions of Matlab
(and Octave)
- Download from
<https://www.jyu.fi/hytk/fi/laitokset/mutku/en/research/materials/mocaptoolbox>



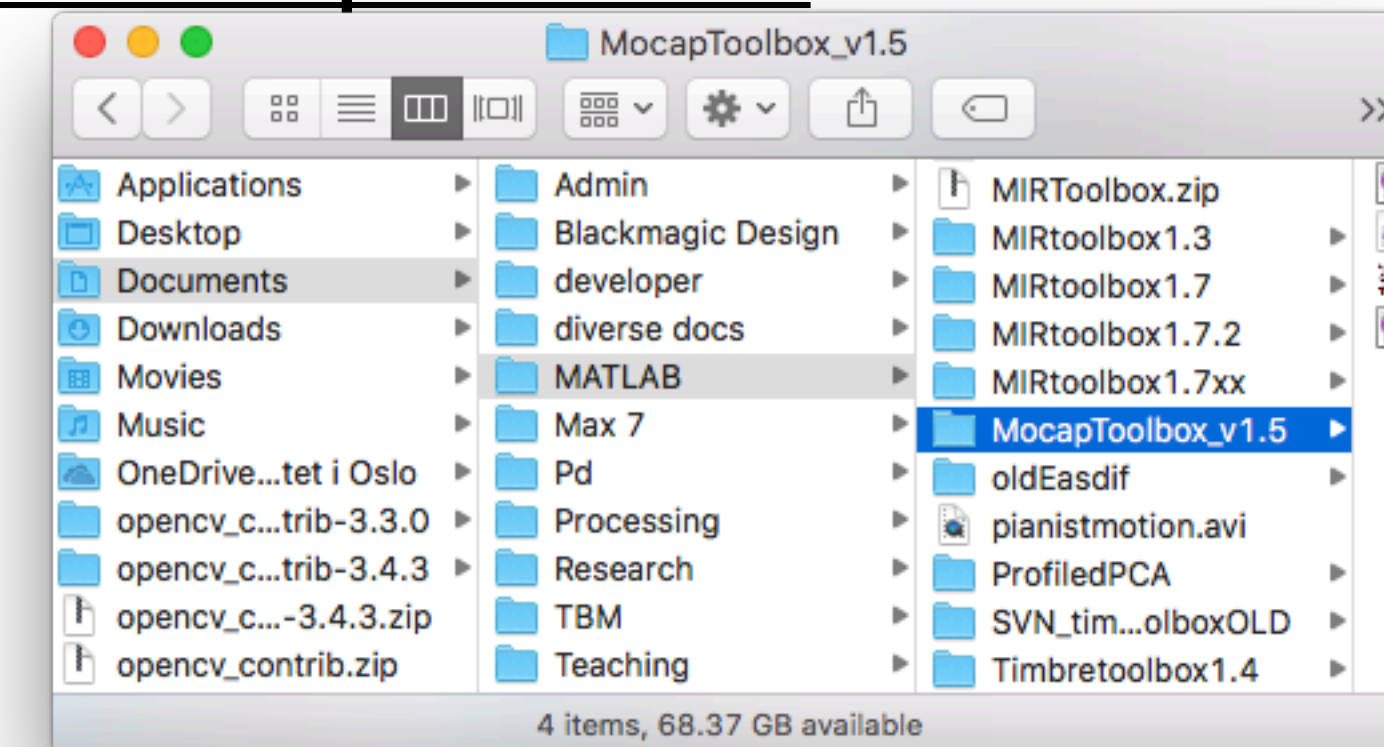
Resources

- MoCap Toolbox manual:
https://www.jyu.fi/hytk/fi/laitokset/mutku/en/research/materials/mocaptoolbox/MCT_manual_v1.5.pdf
also included with the download of the toolbox
- Burger, B. & Toiviainen, P. (2013). MoCap Toolbox – A Matlab toolbox for computational analysis of movement data. In R. Bresin (Ed.), Proceedings of the 10th Sound and Music Computing Conference, (SMC). Stockholm, Sweden: KTH Royal Institute of Technology.
<https://www.jyu.fi/hytk/fi/laitokset/mutku/en/research/materials/mocaptoolbox/MocapToolboxProceeding>



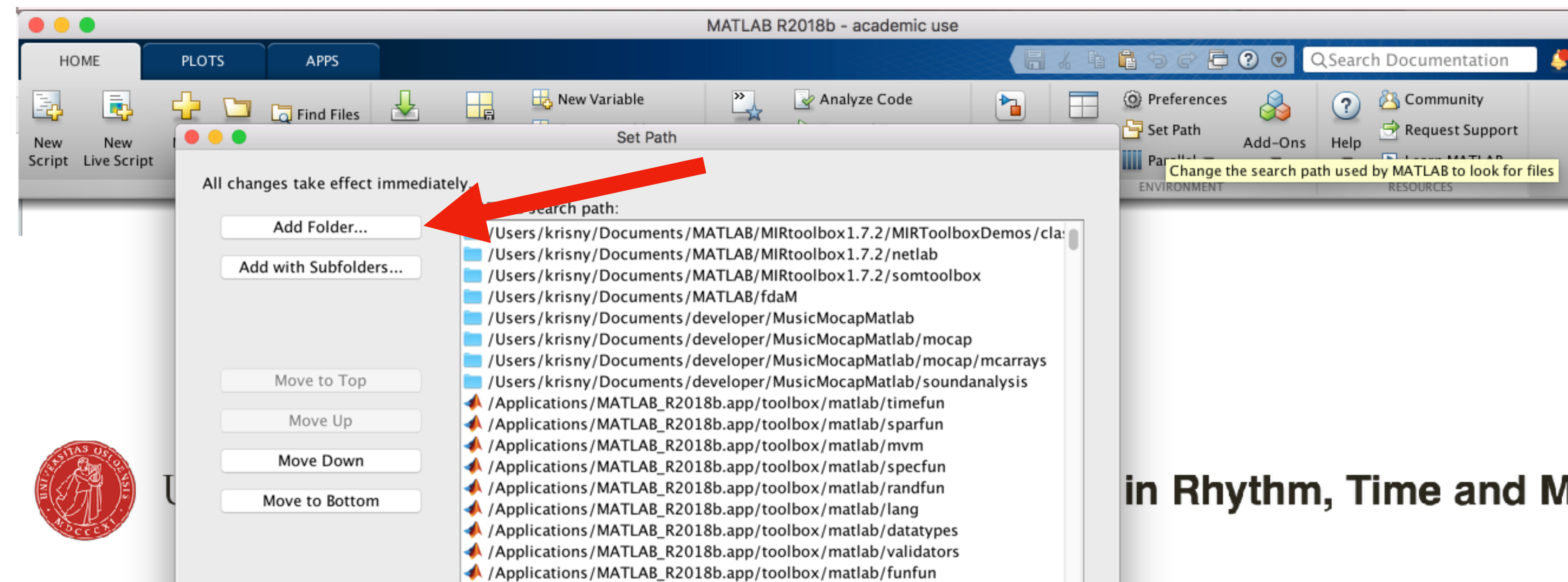
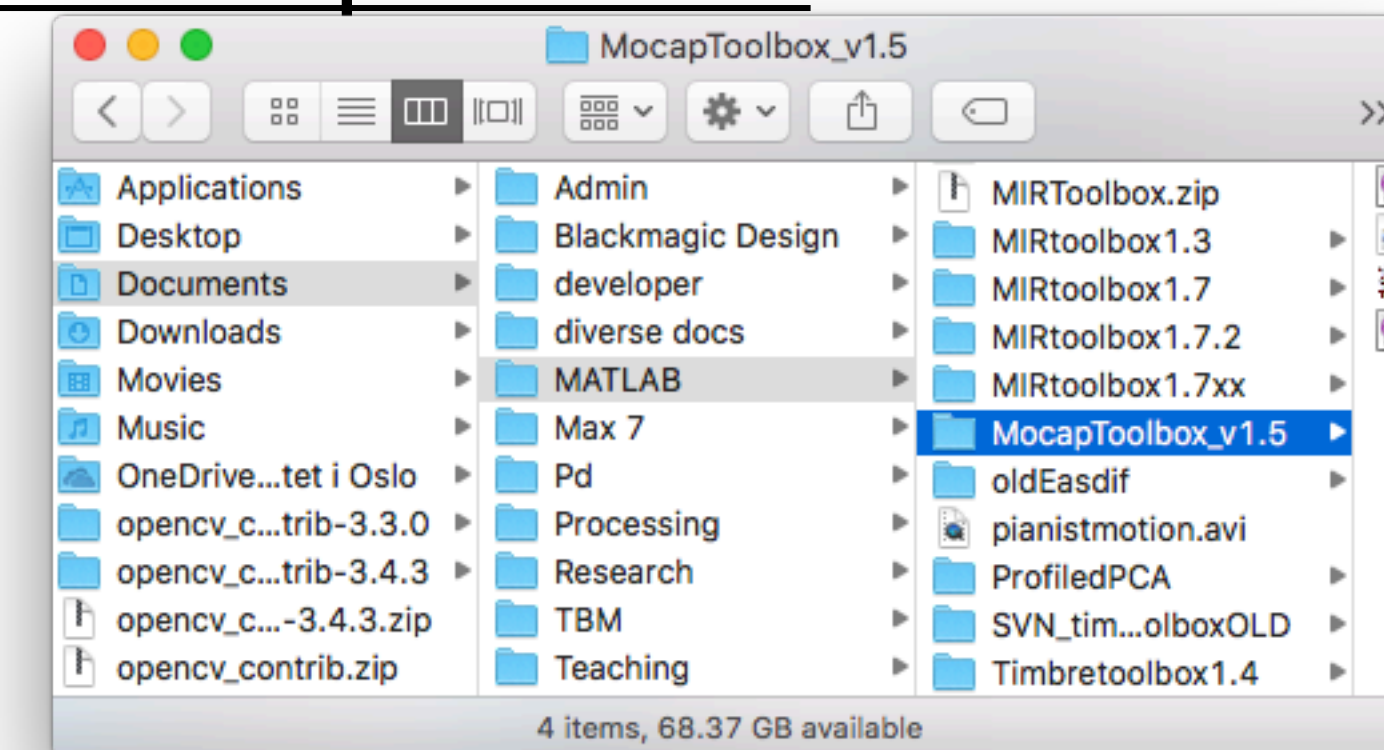
Getting started

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(or web search for “mocap toolbox”)
Suggested download location: ~/Documents/MATLAB
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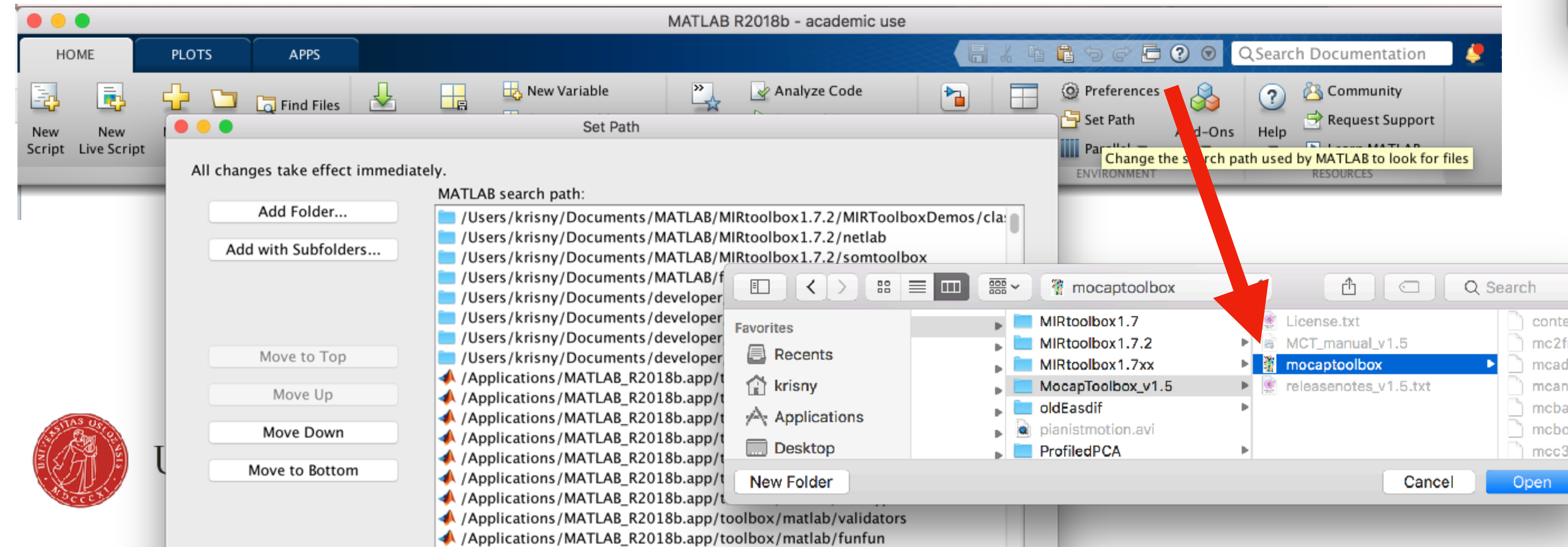
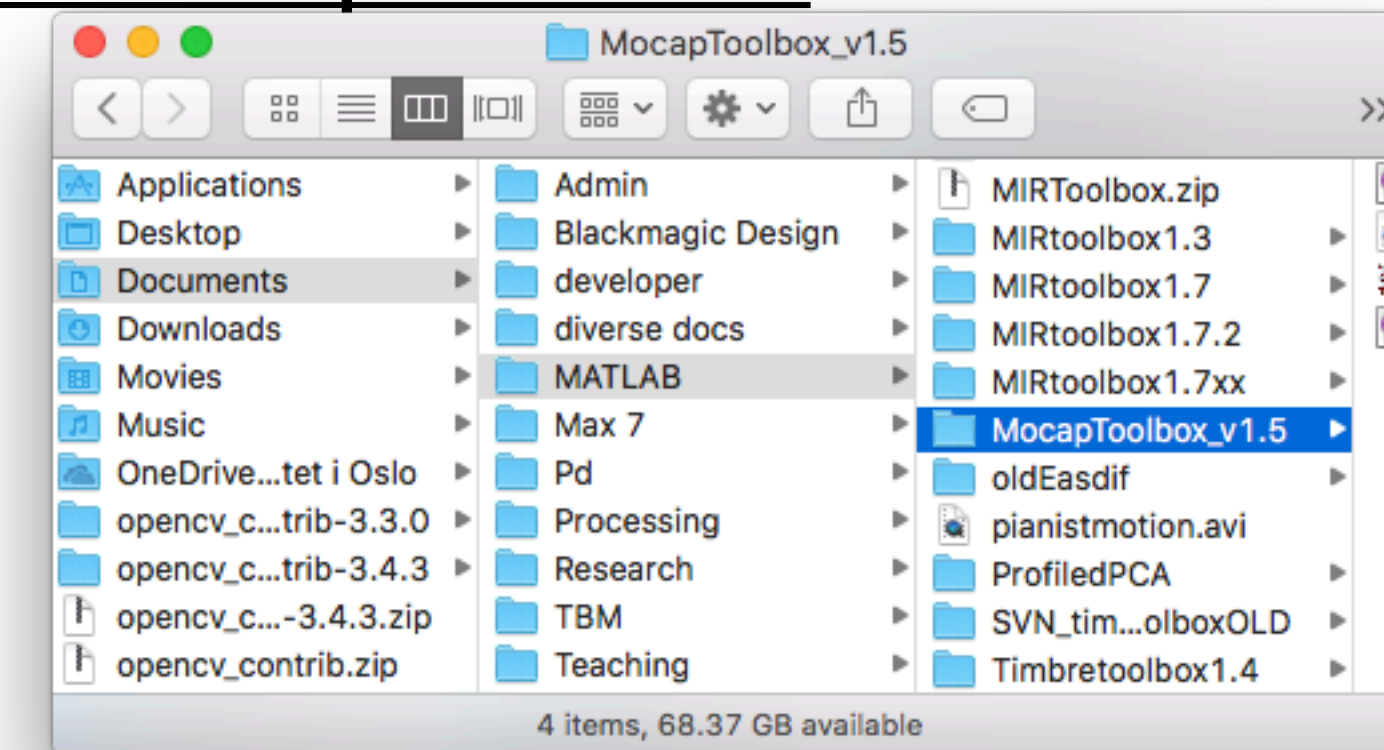


in Rhythm, Time and Motion



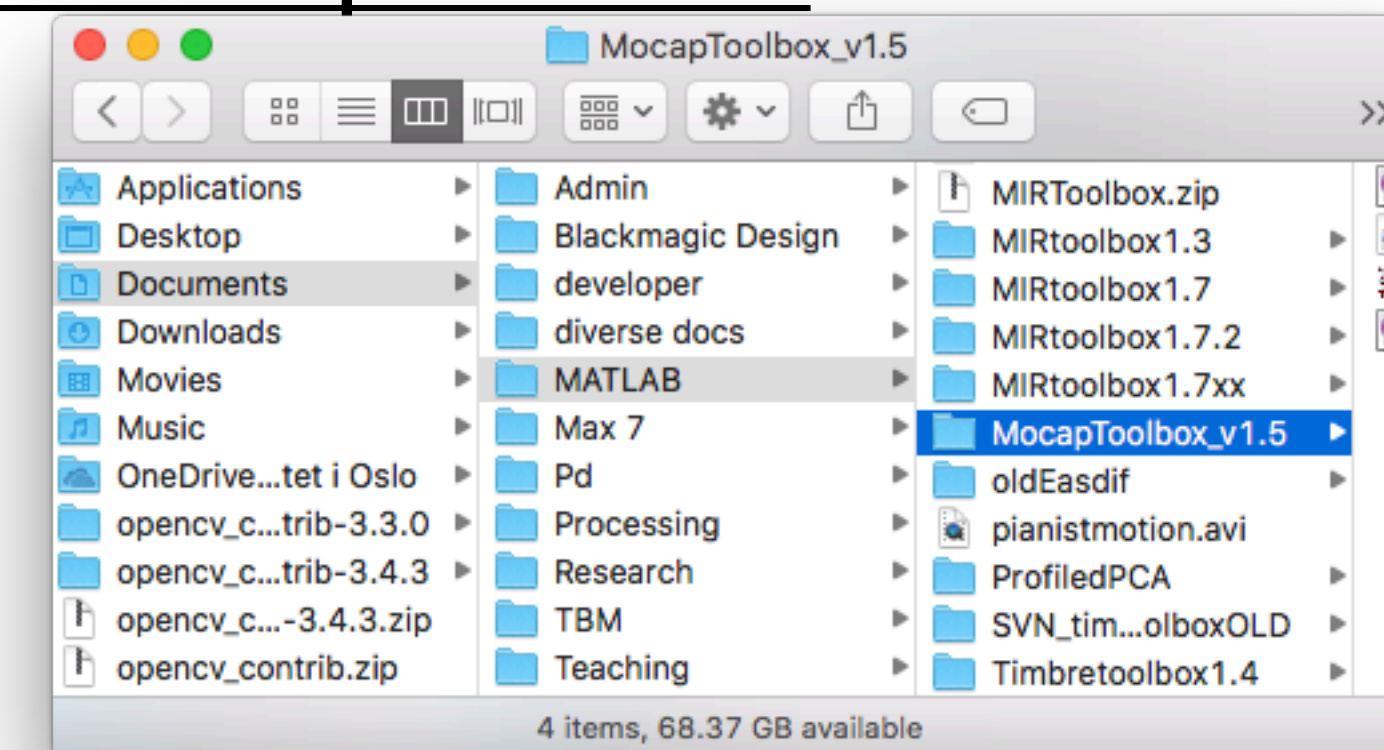
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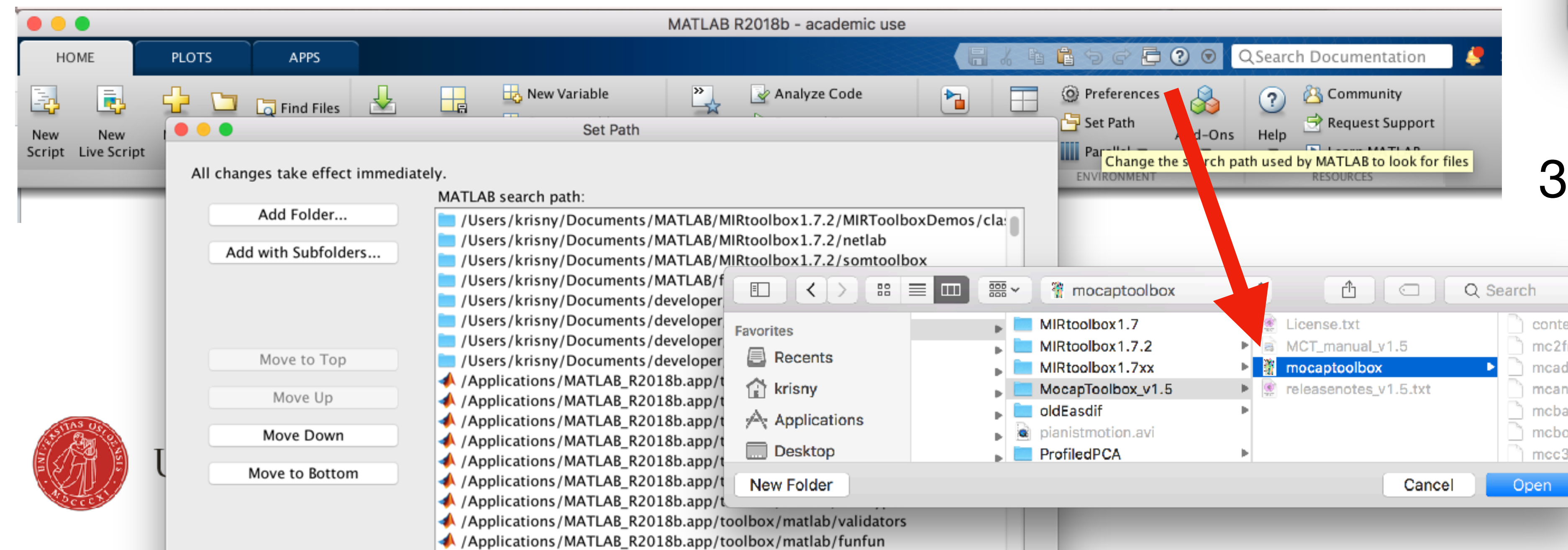


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3. check that it works
by typing
load mcdemodata
in the Matlab
command window

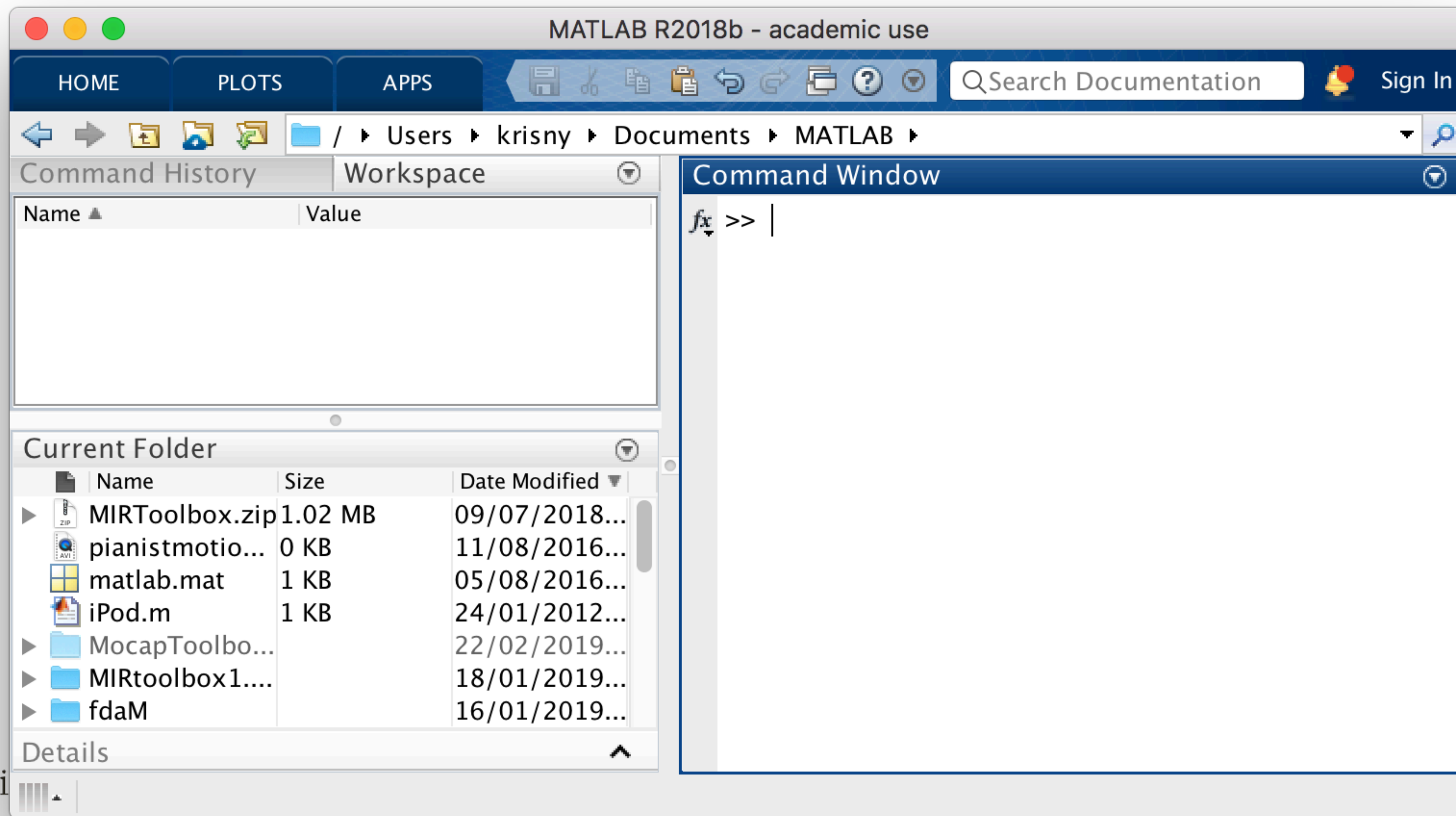


(If you don't have access to Matlab)

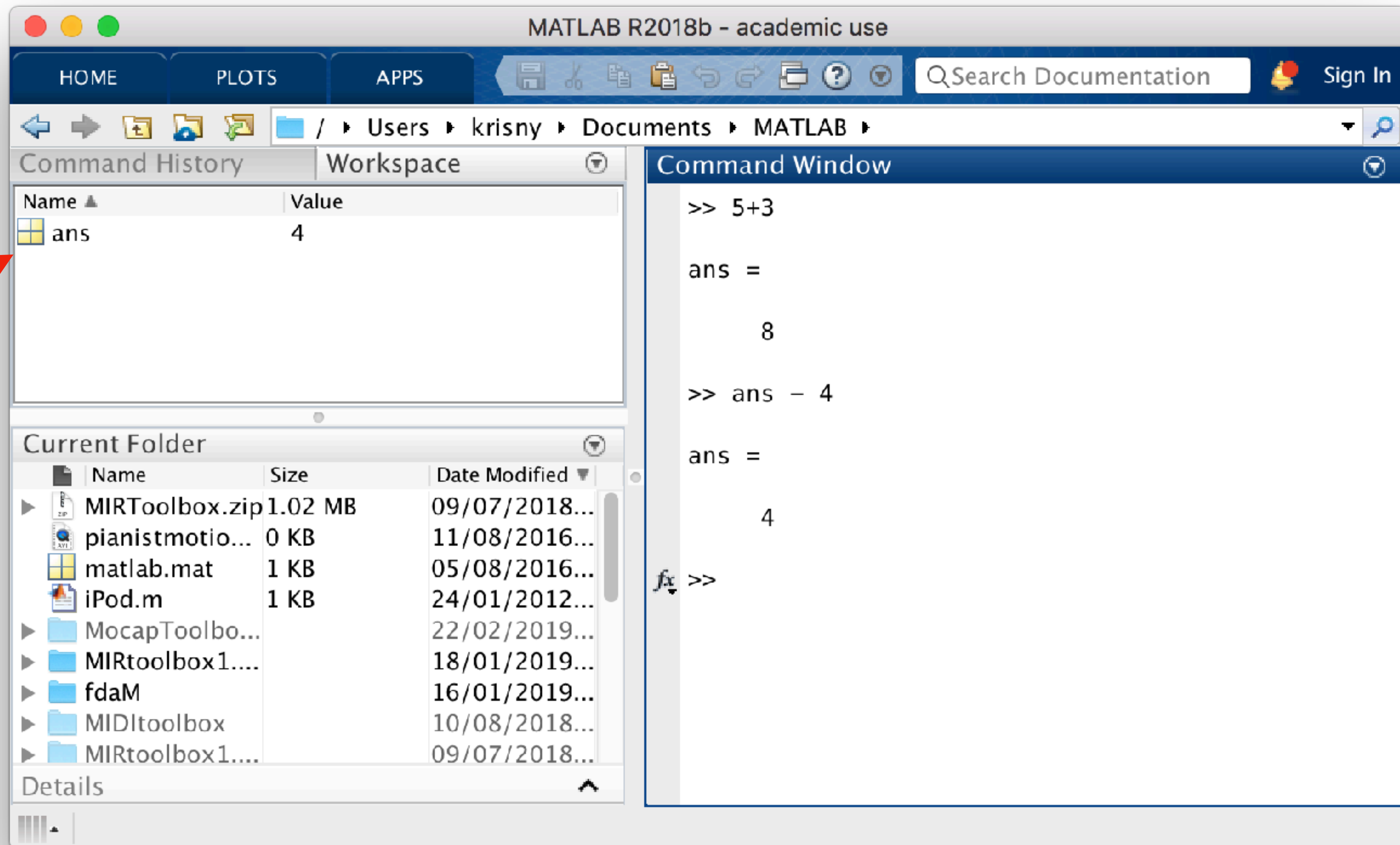
- You may also use Octave, a free alternative to Matlab
- Download from <https://www.gnu.org/software/octave/>
- Or use online: <https://octave-online.net> (must create free account to upload the mocap toolbox)

The screenshot displays the OctaveOnline web interface. On the left, a sidebar contains a 'Files' section with a 'Drop Files Here to Upload' button, a 'Tips and Tricks' section with keyboard shortcuts (Ctrl + Space for auto-completion, Cmd/Ctrl + S for save, Cmd/Ctrl/Win + R for run, and Cmd/Ctrl/Win + E for focus), and a 'Vars' section showing a list of variables. The main area features a file explorer with a 'mocaptoolbox' folder selected, containing various MATLAB files like 'contents.m', 'mc2frontal.m', 'mcaddframes.m', 'mcanimate.m', 'mcbandpass.m', 'mcboundrect.m', 'mcc3d2tsv.m', 'mccenter.m', 'mccomplexity.m', 'mccconcatenate.m', 'mccreateconnmatrix.m', 'mccum.m', 'mcdecompose.m', 'mcdemo1.m', 'mcdemo2.m', 'mcdemo3.m', 'mcdemo4.m', and 'mcdemo5.m'. A black arrow points from the 'Drop Files Here to Upload' button to the 'mocaptoolbox' folder. On the right, a 'Tips and Tricks' section provides instructions on saving files and using keyboard shortcuts. Below this, a 'Vars' section lists variables: {1x9} ans, dance1, dance2, j2spar, japar, m2jpar, mapar, walk1, walk2, and wiidata. At the bottom right, a plot shows a time series of data points, with the x-axis labeled 'seconds' and the y-axis labeled 'Marker 3, dim. 3'. The plot shows a series of peaks and troughs, with the y-axis ranging from approximately 540 to 640. The x-axis ranges from 1 to 5 seconds.

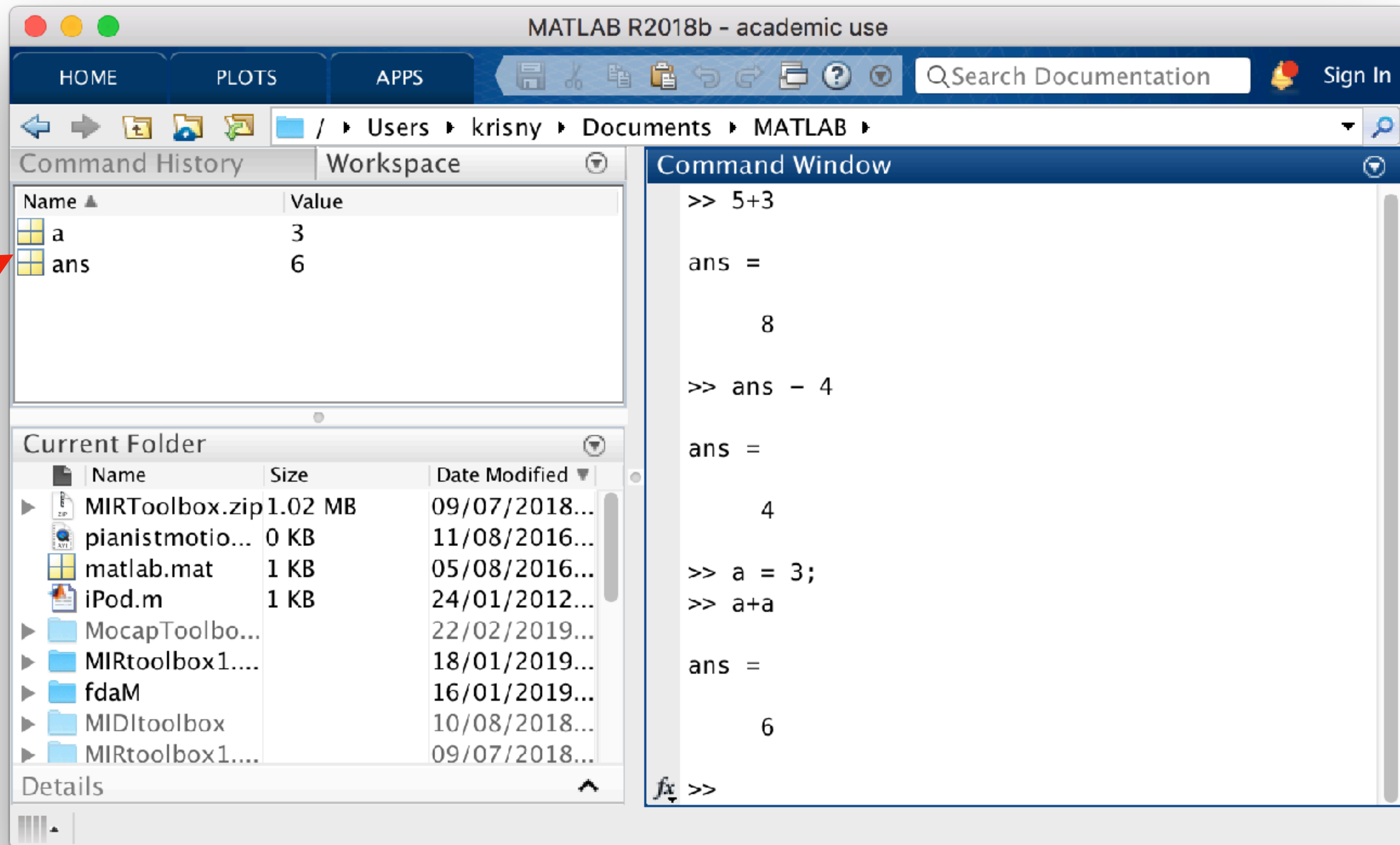
Hello Matlab



The command window



The command window



Most important variable types for working with the MoCap Toolbox

<code>a = 1</code>	single number
<code>a = [1, 2, 3]</code> or <code>a = [1 2 3]</code>	array of numbers
<code>a = 'HELLO'</code>	array of five characters (the same as <code>['H' , 'E' , 'L' , 'L' , 'O']</code>)
<code>a.first = [1 2 3]</code> <code>a.second = 'HELLO'</code>	struct – a group of variables
<code>a = {'HELLO' , 1, 'hello again' , [1 2 3] }</code>	cell array, array which may contain different variable types in the individual cells

Side note for programmers:

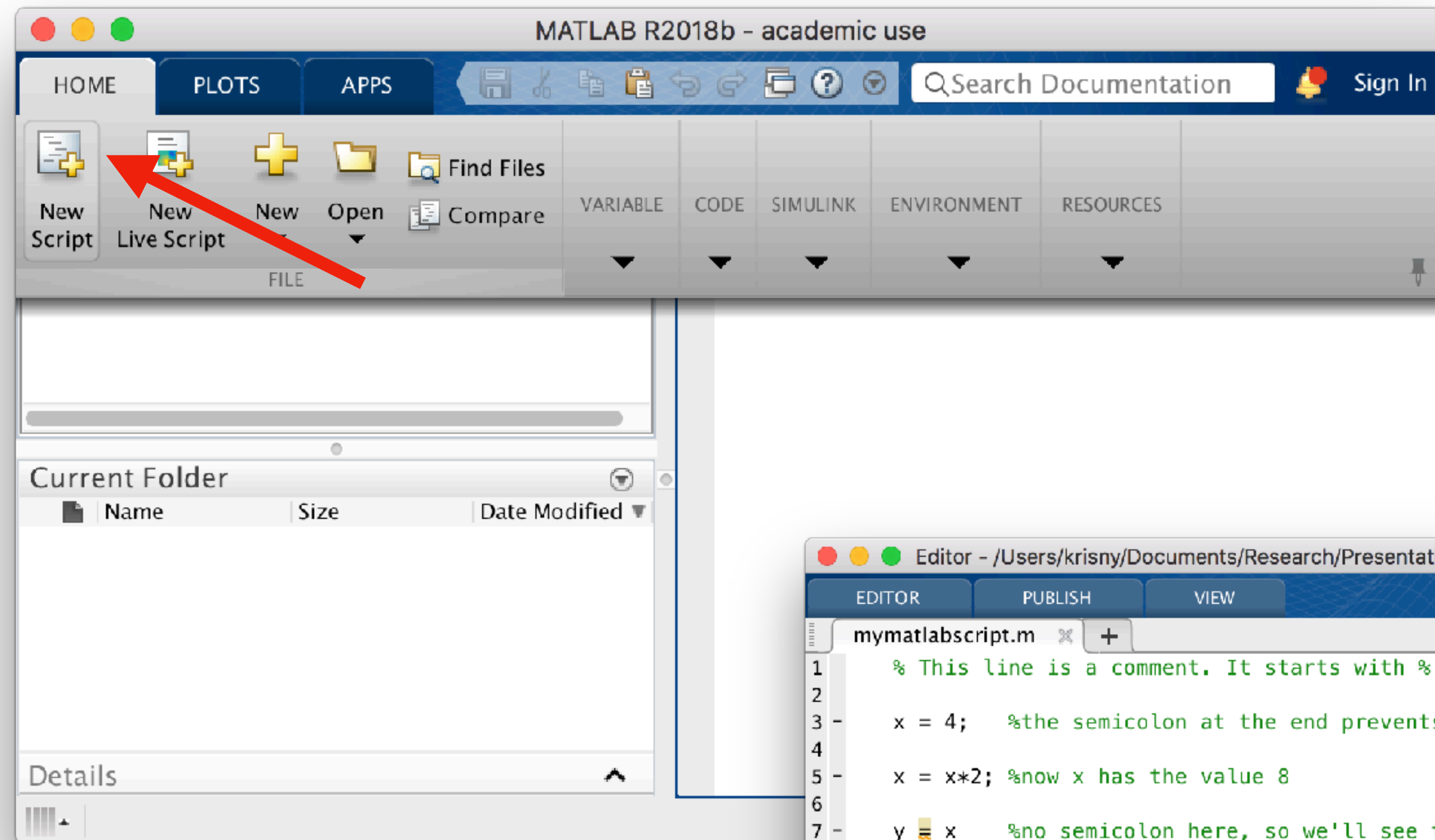
- Matlab allows sloppy coding. It's not strict about use of commas, semicolons, etc. Variable types are inferred.
- Numbers are double precision float by default, but other types may be specified if required, e.g. `a = int32(4)`.
- String type is different from “char array” – declared by “double quotes” rather than ‘single quotes’

Scripts and functions

- A **script** is a collection of Matlab code saved to a file.
 - Instead of typing all your commands in the command window, write the commands in a script file, and run the script. The lines in the script will be run sequentially.
 - The script has access to all the variables in your workspace
 - The script may overwrite the variables in your workspace
- A **function** is also a collection of Matlab code saved to a file, but formatted in a special way that allows it to take an input and produce an output.
 - All the variables to be used by the function must be given as input
 - Creates a temporary memory space for variables and outputs only the variables specified in the function



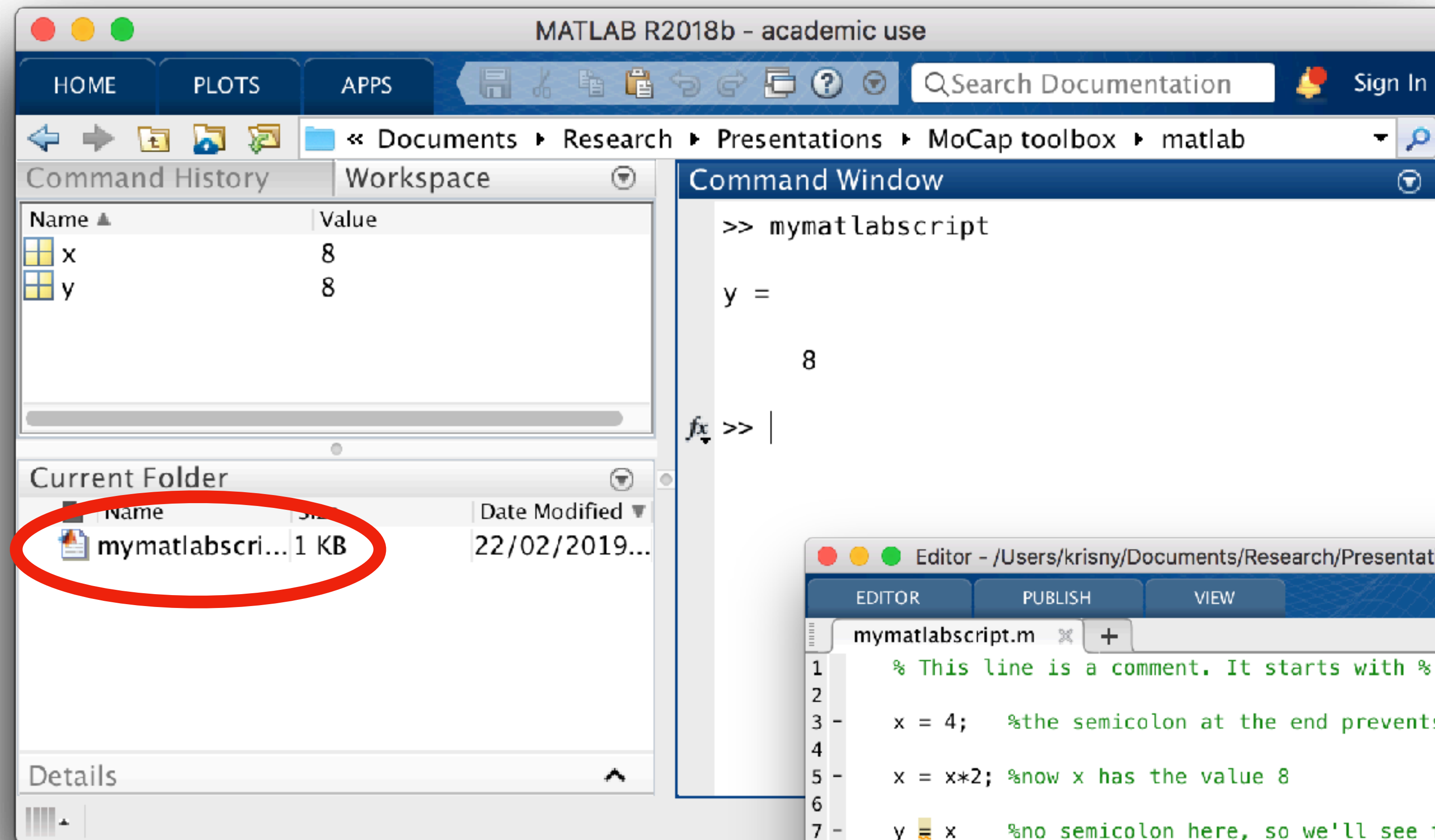
Script example

The image shows a MATLAB Editor window titled 'Editor - /Users/krisny/Documents/Research/Presentations/MoCap toolbox/matlab/mymatlabscript.m'. The window has tabs for EDITOR, PUBLISH, and VIEW. The script content is as follows:

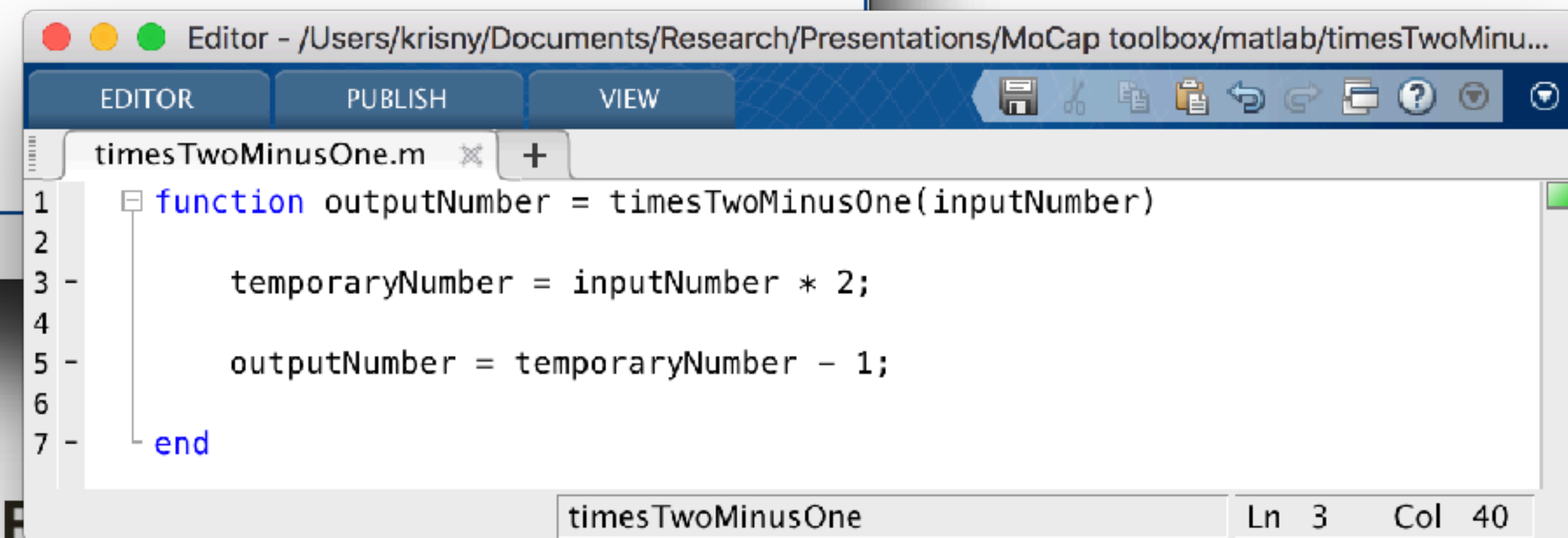
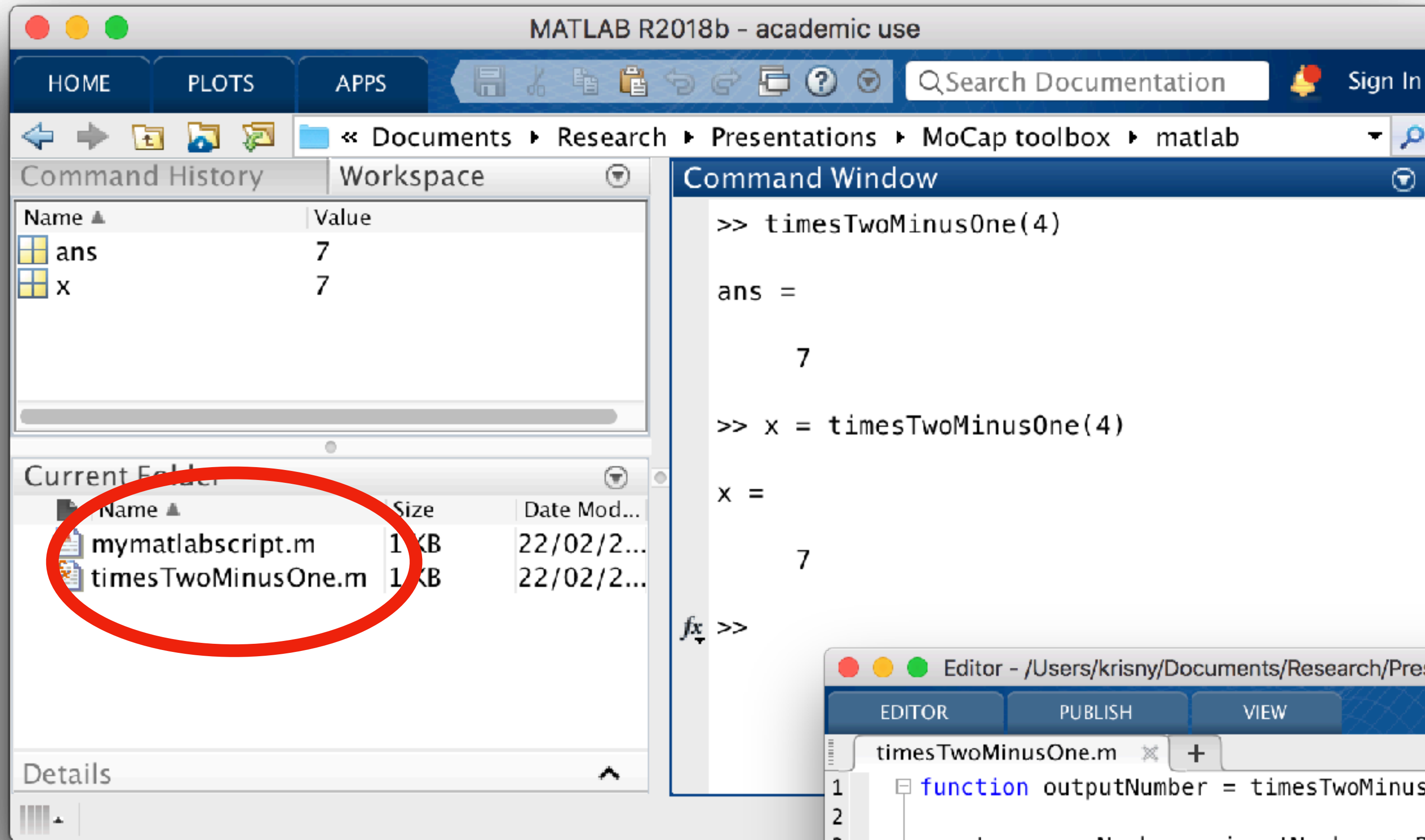
```
1 % This line is a comment. It starts with % and will not be processed by Matlab
2
3 x = 4; %the semicolon at the end prevents output to the command window
4
5 x = x*2; %now x has the value 8
6
7 y = x %no semicolon here, so we'll see this output in the command window
```

The status bar at the bottom right indicates 'Ln 7 Col 76'.

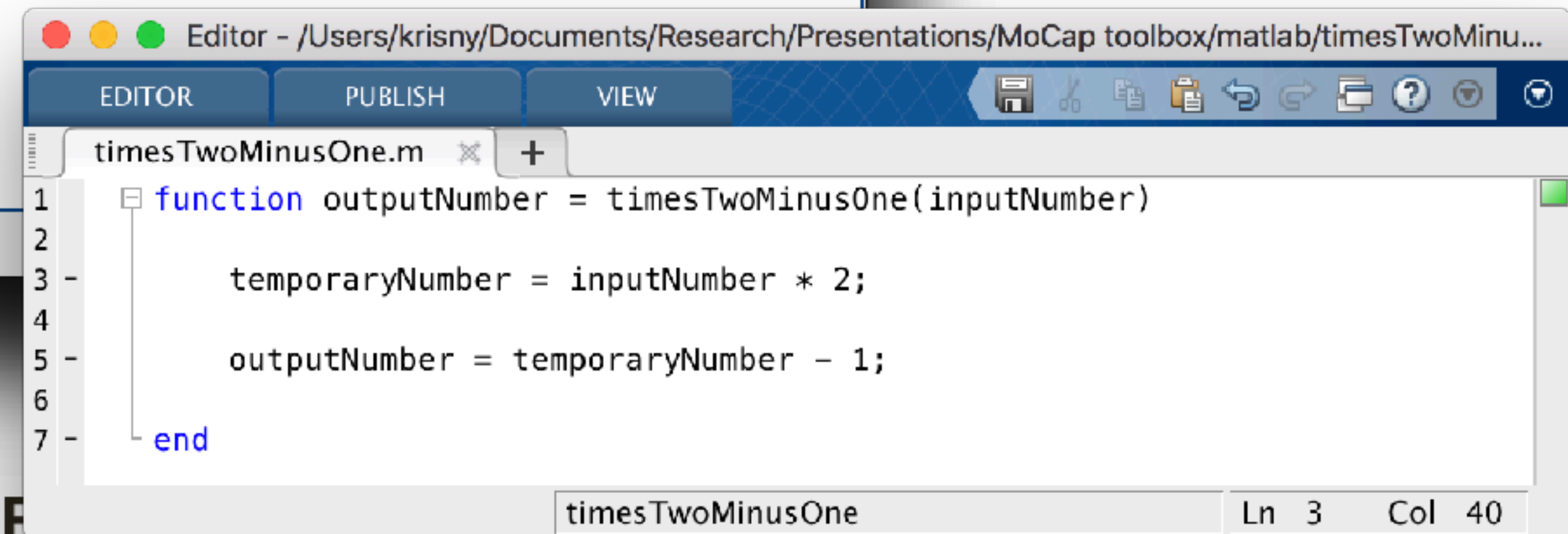
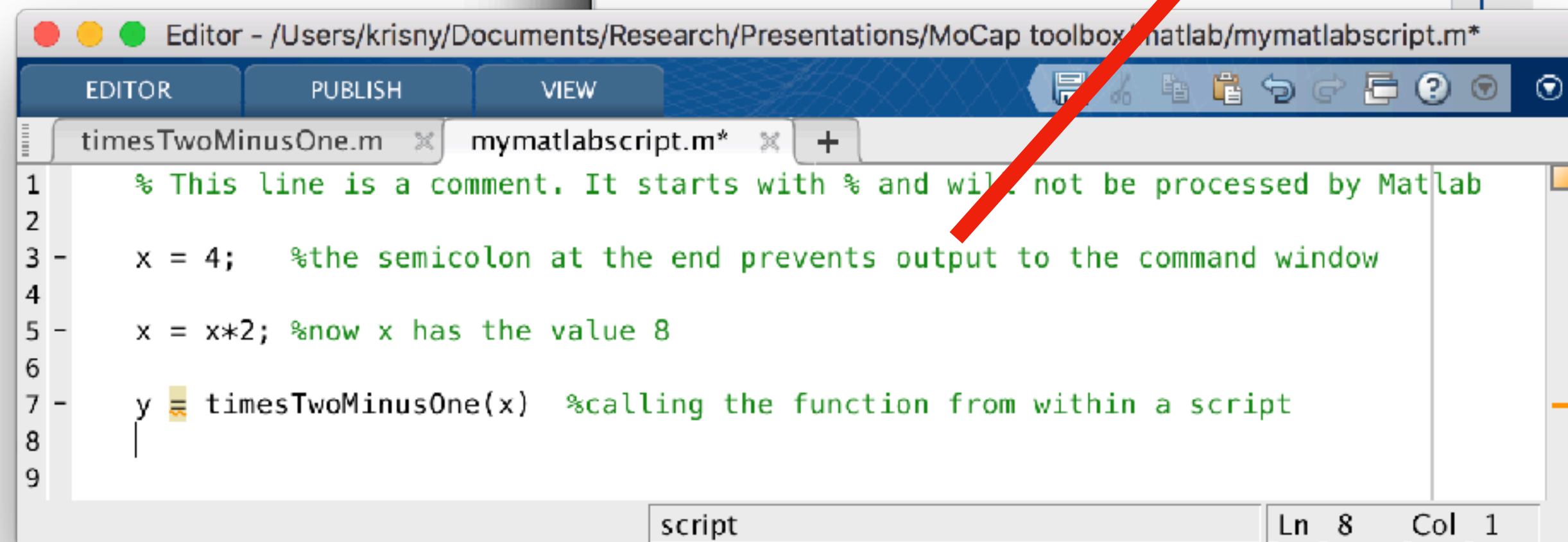
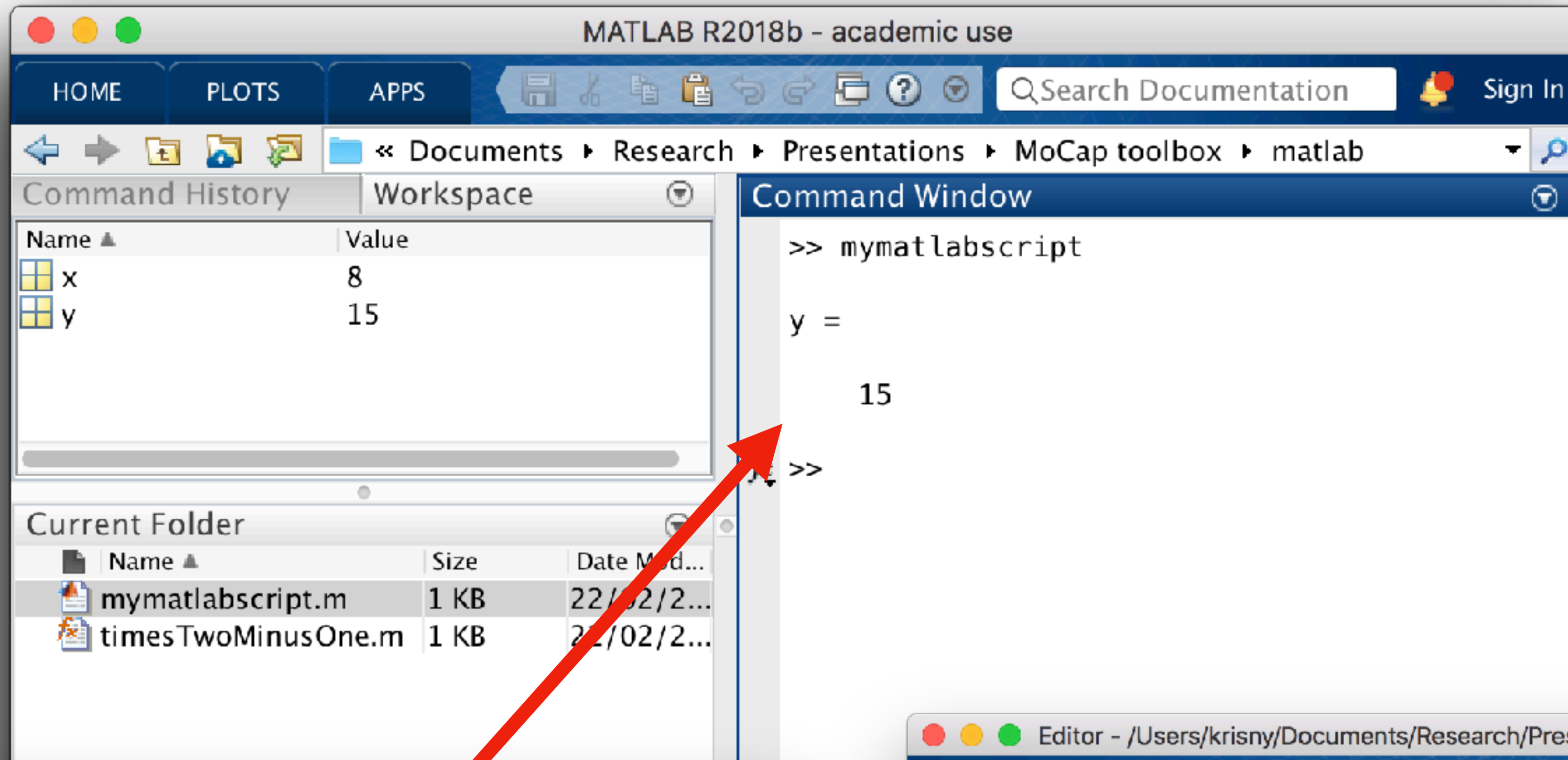
Script example



Function example



Function example



Recap: Matlab basics

- Variables: Memory units that store numbers, text, etc.
- Variable types: numbers, characters, structs, cells, or arrays of these
- Scripts: useful for keeping track of code sequences
 - You can run the same thing again without having to write all the commands to Matlab
 - Keep your scripts as documentation of your work (it'll come in handy when you write your report/paper/thesis)
- Functions: Various operations that can be done on data.
 - MoCap Toolbox is a collection of functions specifically designed for motion capture data



MoCap Toolbox demo

- Importing data
- Data representations
- Preprocessing
- Visualisation
- Kinematic analysis
- Kinetic analysis
- Periodicity / Frequency analysis
- Relational features
- Extensions
 - 3D plotting / animation
 - Relational binary features

Most of this is covered in:

Burger, B. & Toiviainen, P. (2013).
MoCap Toolbox – A Matlab toolbox for
computational analysis of movement data.

and by the function “mcdemo”



Importing data

- File formats:
 - .c3d – generic motion capture data format
 - .tsv – tab-separated values. Provided by Qualisys Track Manager
 - .mat – matlab format as exported by Qualisys Track Manager
 - .wii – for use with data from wiimote controllers, recorded with the WiiDataCapture application available at:

<https://www.jyu.fi/hytk/fi/laitokset/mutku/en/research/materials/mocaptoolbox/WiiDataCaptureDownload2.1>

- `variablename = mcread(filename)`
- `a = mcread('mocapfile.c3d')`



Data structures

- **3D marker data:**
 - 'MoCap data'
 - XYZ position, velocity, acceleration, ...
- **1D data:**
 - 'norm data'
 - Velocity magnitude, other features,...
- **Segment data:**
 - 'segm data'
 - kinematic chain, translations / rotations

Support structures

- **Animation parameters:**
 - 'animpar'
 - Bones/lines between markers, Camera position, Colors, +++
- **Marker-to-joint parameters:**
 - 'm2jpar'
 - Collapse groups of markers to joints, e.g. two mocap markers on the outside and inside of the knee is collapsed to a single "knee" marker in the center of the knee joint.
- **Joint-to-segment parameters:**
 - 'j2spar'

