Tutorial I - Modeling metacognition using the hMeta-d toolbox
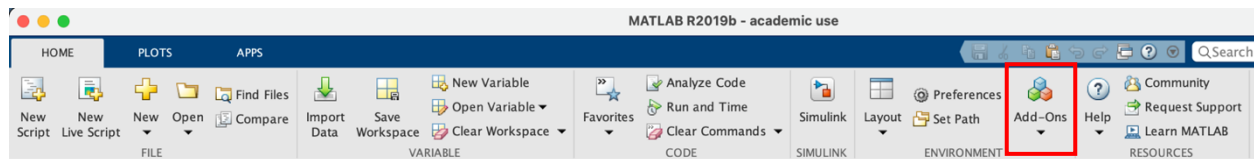
Content

In this tutorial, we will recap the theory underlying the hMeta-d model for quantifying metacognitive efficiency, our ability to monitor and evaluate our own decisions. We will introduce the model in an accessible way, then discuss practical issues when fitting computational models to behavioral data, and go through code examples relevant to computational psychiatry studies using the hMeta-d toolbox (in MATLAB).

Installation guide

1. In the tutorial we will use MATLAB. Please make sure you install MATLAB and that you can open and run it https://www.mathworks.com/products/get-matlab.html

2. Next, you will need to install the following MATLAB Toolboxes:
   - 'Statistics and Machine Learning Toolbox' (https://www.mathworks.com/products/statistics.html)
   - 'Optimization Toolbox' (https://www.mathworks.com/products/optimization.html)

To install these Toolboxes, open MATLAB and open the "Add-Ons" tab

You should now see a new window similar to the following:
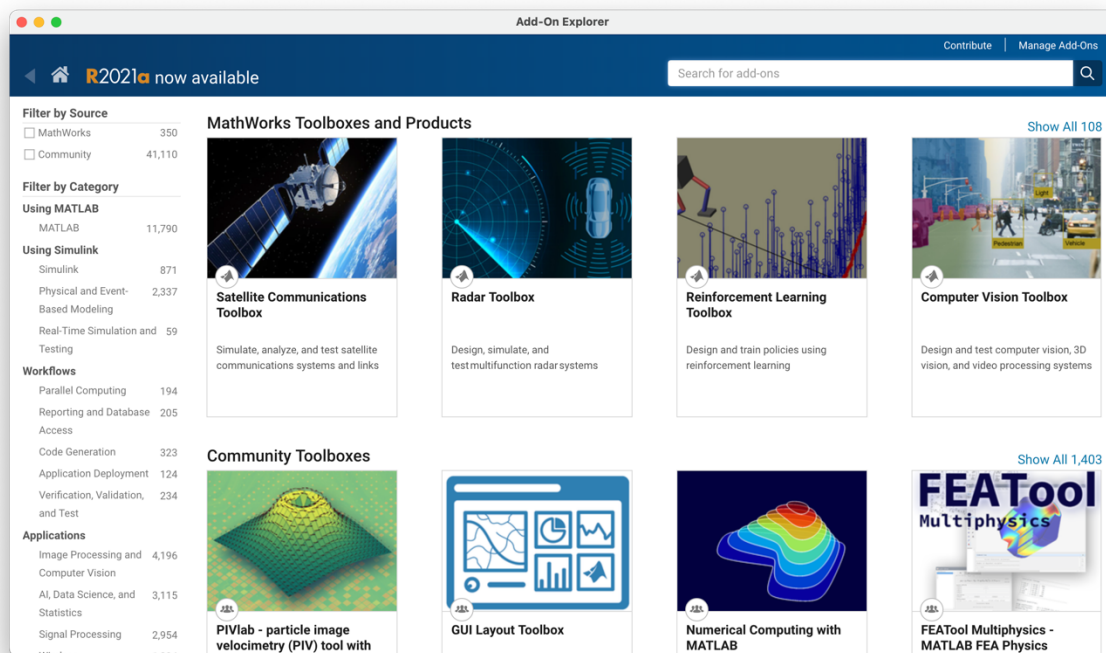
Search the toolboxes you need using the search bar in the upper right corner. You will immediately see whether these are installed. If not, click on the toolbox's name/thumbnail and follow the instructions to install it.

3. Then go to the Github page of the HMeta-d Toolbox and download the 'master' folder (found here: https://github.com/metacoglab/HMeta-d). You will be provided with 2 possibilities to download the toolbox:
   - Downloading the toolbox via .zip File.
   - Cloning the toolbox. This allows you to keep up-to date with future changes in the toolbox. You will however need to install git on your machine.

For the purposes of the tutorial and if you do not have git, we advise you to use the first possibility and only download the .zip File. In that case, unzip the file and put it in a folder/directory which you will use for the practical tutorial (*e.g.,* Desktop/CPC2024/MetacognitionTutorial). **Avoid spaces in the titles of your folders**.

4. Now you need to install JAGS (an MCMC package similar to BUGS) on your machine, which can be found here: http://mcmc-jags.sourceforge.net. **Note that there are compatibility issues between matjags and JAGS 4.X**. To run the MATLAB code, **you will need to install JAGS 3.4.0** rather than the latest version.

   a. macOS
      i. If you follow the above link and click your way through to your operating system, you should land on this page: https://sourceforge.net/projects/mcmc-

jags/files/JAGS/3.x/Mac%20OS%20X/ **Read the READMe carefully**. JAGS-Mavericks-3.4.0.dmg is suitable for OS 10.9 (Mavericks) or later.

ii. Download and open the .dmg file. You will see the following window appear:
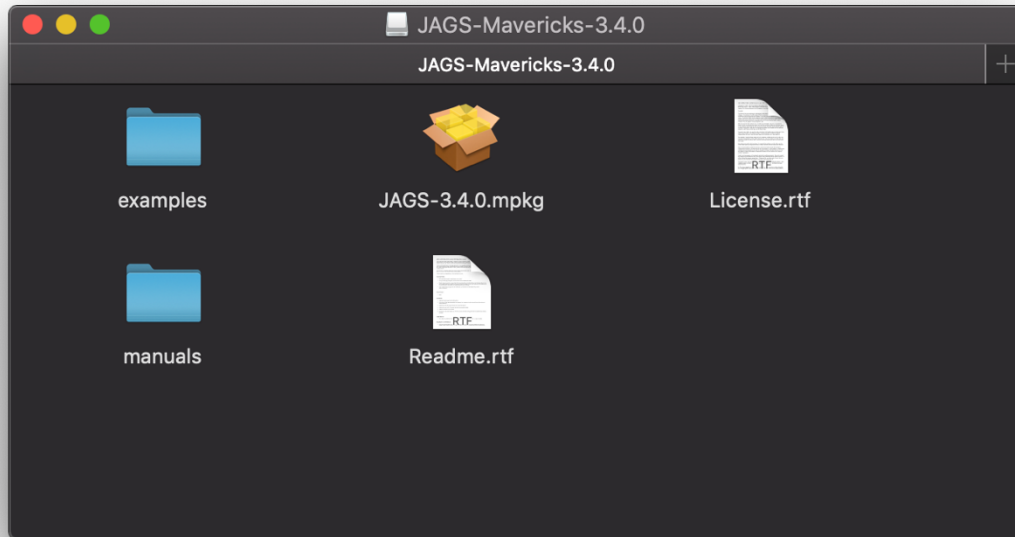
iii. If you get an "unidentified developer" error message, right-click on the .dmg icon→ open → open as in the picture below
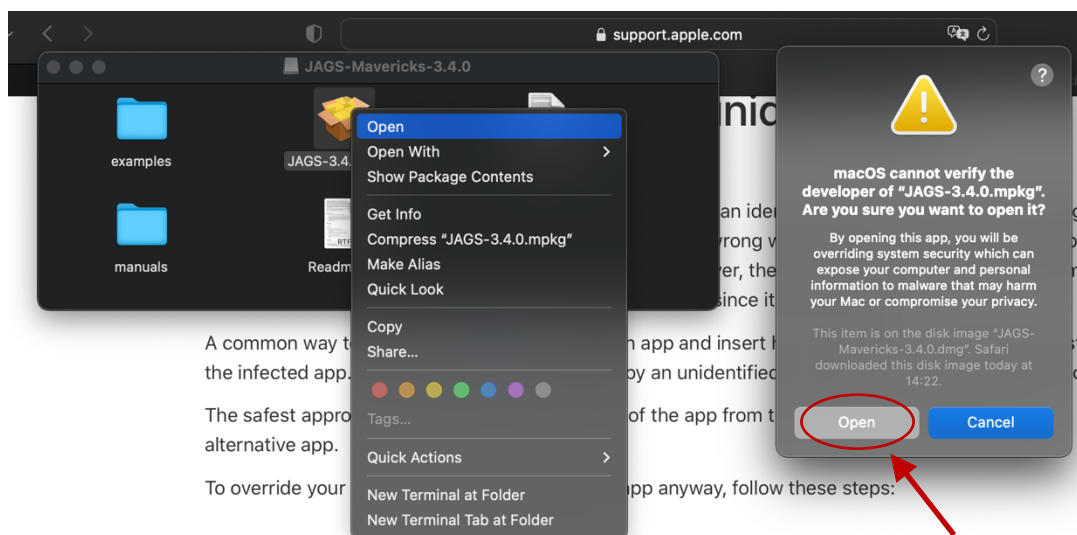

The first thing to do is to click on the Readme.rtf and read it. Please follow the instructions carefully.

b. Windows

   i. Go to: https://sourceforge.net/projects/mcmc-jags/files/JAGS/3.x/Windows/. Try to download the .exe file and open it. An installer will appear and will guide you through the installation. **Note down the destination folder for the installation (default: C:\Program Files\JAGS\JAGS-3.4.0)**.

      If the JAGS installation was successful, you can **advance to step 5** of this installation guide. If you do not manage to run `exampleFit.m` or `exampleFit_group.m`, in step 7 of the installation guide, turn to the instructions below.

   ii. Open MATLAB. Navigate to the JAGS folder (default: C:\Program Files\JAGS\JAGS-3.4.0) and add it to your MATLAB path by right-clicking on the folder. To do this, use the Current Folder pane on the left of the MATLAB GUI.
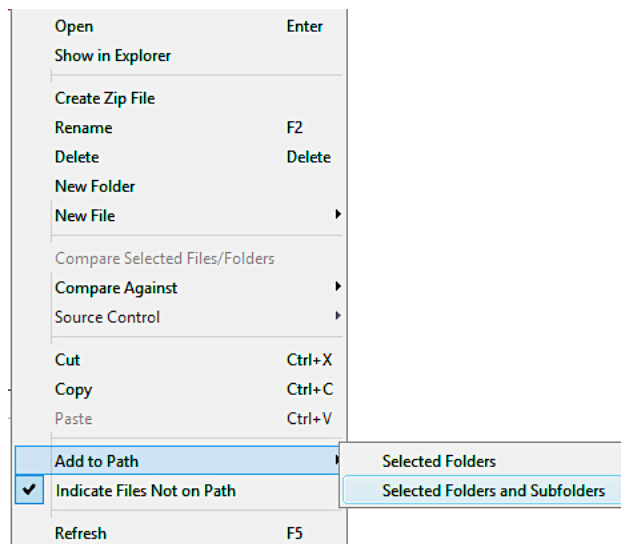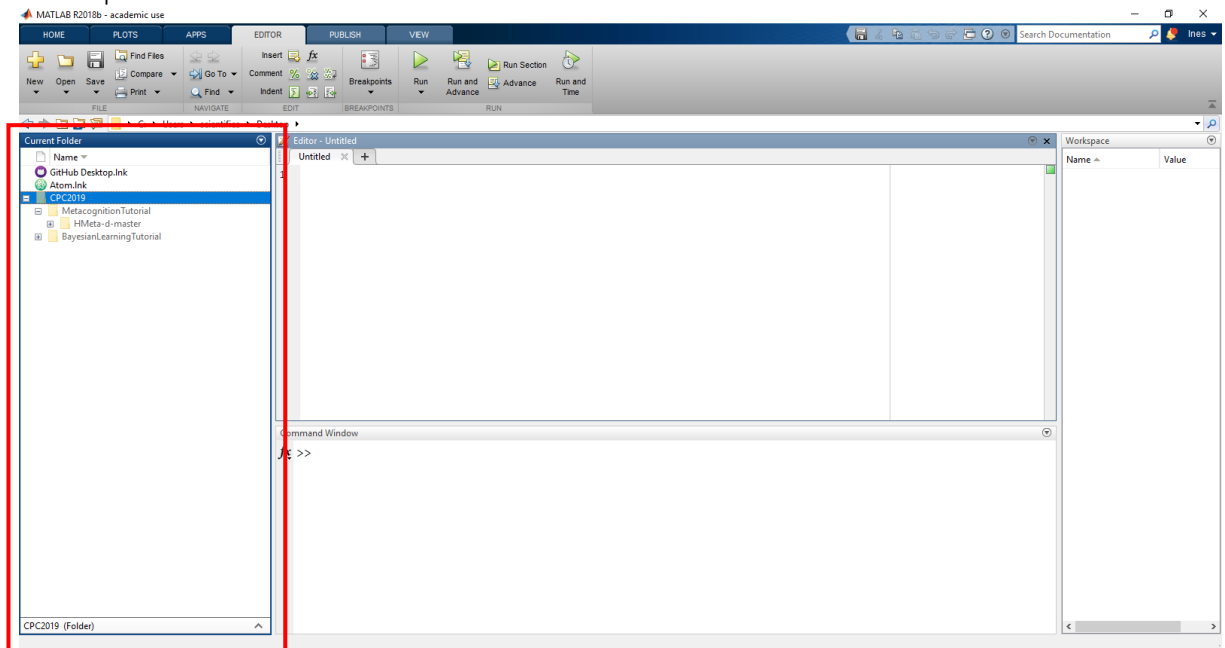
iii. Modify your Windows Path environment variable to include the JAGS bin folder. To do this:

1. Click on the Windows start button and search for "Edit the system environment variables"
2. Select "Environment variables" (above lower right corner of new window)
3. Under System variables (the bottom half of the screen), find the row that says "PATH" under the Variable field.
4. Select the "PATH" row, and click "Edit".
5. Add the path where your JAGS bin folder is installed (default: C:\Program Files\JAGS\JAGS-3.4.0\x64\bin) to the list of PATH variables. **Click OK, and then click OK again in the Environment Variables windows and on the System Properties windows (if you do not click OK on the Environment Variables windows, the changes to the PATH variable will not be saved).**
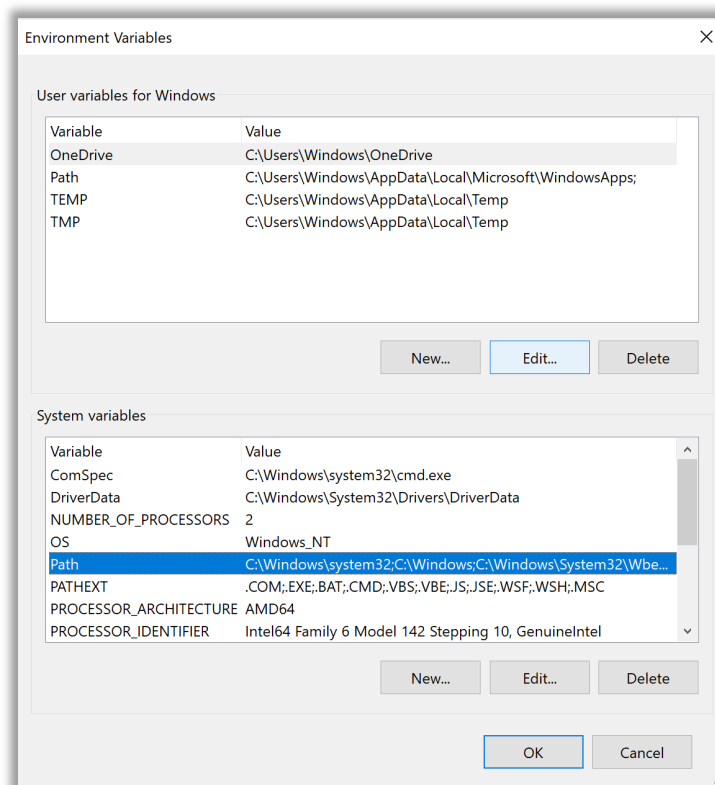
iv. If this still does not solve your problem, go to: https://sourceforge.net/projects/mcmc-jags/files/Manuals/3.x/ and download the installation manual. Go to the section on Windows and **read everything before starting to download anything. This will save you lots of time going back and forth because you did not know what the specific instructions were.** There are known issues with the installation on Windows. If you have trouble installing JAGS, please consult the **#tutorial-helpdesk channel on Discord**.

5. In order to run the code, you will first need to open MATLAB and in MATLAB navigate to the folder/directory you prepared (e.g., "MetacognitionTutorial"). Then right-click on the directory and "Add to Path", "Selected Folders and Subfolders".

6. To get started, try running `exampleFit.m` or `exampleFit_group.m`. If you have **trouble installing JAGS**, do not worry. You will still be able to follow the majority of the tutorial.

Further support

If you have trouble getting to this point before the Practical Tutorial Session, please consult the **#tutorial-helpdesk channel on Discord**. You will be given access to the CPC Slack workspace at the beginning of the course. Check if anyone has had the same issue and has managed to solve it and how. If no one else has encountered the same problem, post your question. We will be monitoring the channel and providing support. In addition, given the volume of attendees this year, we would be really grateful if you could assist us by answering queries on Discord yourself if you come across a problem, you know and have solved.

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