

Lab 0

Mathematica is the main product of the Wolfram Research company, which was founded by Stephen Wolfram in 1987. Today, it is one of the most powerful and widely used mathematical software in research and education. You don't need prior programming experience to use Mathematica, although such experience will be helpful. In this lab, you will learn how to

- get access to Mathematica,
- do basic arithmetics on Mathematica,
- define functions and graph them.

1 Access Mathematica

The first step is to create a Wolfram account. Go to

<https://account.wolfram.com/login/oauth2/sign-in>

and click on “Create one”. Make sure that you use your BYUH email (either @go.byuh.edu or @byuh.edu), not your personal email account. After this step, there are three methods to get access to Mathematica. I recommend the first or second method. If you are technically proficient, you can try the third method.

- Method 1: Use the cloud-based version of Mathematica at

<https://www.wolframcloud.com>

This is the simplest option because no installation is needed. However, you are limited to about 8 minutes of computing time per month (which is sufficient for the purpose of this class). Files stored on the cloud will be deleted after 60 days. Make sure to download your files from the cloud occasionally so that you won't lose them.

- Method 2: As a BYUH student, you can request a Mathematica license for your personal computer by going to

<https://www.wolfram.com/siteinfo>

Enter your WolframID (your BYUH email address), and the password of your Wolfram account. Then proceed as directed. You will receive an email from Wolfram Customer Support saying that you have been assigned a license. Then go to

<https://user.wolfram.com/portal/myProducts.html>

and click on “Mathematica for Sites” to download Mathematica installer to your computer.

- Method 3: The Wolfram Research company releases the Mathematica kernel (but not the interface) for free for the purpose of software development. You can install this kernel on your computer together with JupyterLab (also free) acting as a user interface. This option requires quite a bit of work, but will allow you use Mathematica regardless of your student status. The instruction is here:

<https://web.engr.oregonstate.edu/~phamt3/Resource/Wolfram-Mathematica-with-JupyterLab.pdf>

2 Basic arithmetics

- (1) Type $(1+2)^2-3*a$, then **Shift+Enter**.
- (2) Type $a=5$, then **Enter**. Then type $(1+2)^2-3*a$ and **Shift+Enter**.
- (3) Type $35/6$, then **Shift+Enter**.
- (4) Type $[1+2]^2$, then **Shift+Enter**.
- (5) Type $(1+2)^2$, then **Shift+Enter**. What difference do you notice between (4) and (5)?
- (6) Type $N[35/6]$ (notice the square brackets), then **Shift+Enter**.
- (7) Type $Sqrt[2]$ (notice the capitalized S), then **Shift+Enter**.
- (8) Type $N[%]$, then **Shift+Enter**.
- (9) Type $Sin[Pi]$, then **Shift+Enter**. Next, try the same command but with lowercase S and/or P. Is Mathematica case sensitive?
- (10) Type 34^{100} ; (with the semicolon), then **Shift+Enter**.
- (11) Type 34^{100} (without semicolon), then **Shift+Enter**.

The semicolon is to hold the output. One uses it when output is too long or not of interest. You may have noticed that the function N is to evaluate a numerical value of an expression. Each function's name is capitalized and used with square brackets (not with parentheses as we usually write on paper). For example, the function $\sin(x)$, $\cos(x)$, $\exp(x)$, $\ln(x)$ are written as $Sin[x]$, $Cos[x]$, $Exp[x]$, $Log[x]$, respectively.

- (12) $Exp[1]$, then **Shift+Enter**.
- (13) $Log[2]$, then **Shift+Enter**.
- (14) Find a numerical value of $e^{2\cos(\sqrt{2})} + \ln 2$. Pay attention when to use square bracket and when to use parentheses.

3 Define and graph functions

- (15) $f[x_] := Sin[x]+Cos[x]$ (notice the underscore after x), then **Shift+Enter**.
- (16) $f[Pi]+f[Pi/4]$, then **Shift+Enter**.
- (17) $Clear[f]$, then **Shift+Enter**.
- (18) $f[Pi]+f[Pi/4]$, then **Shift+Enter**.

Command (15) is to define a function. An underscore is required when defining the function f . It is not needed when using the function. The function $Clear$ is to remove a defined variable from the memory.

Next, let us plot functions of one variable, for example the sine function. Try the following commands:

- (19) $Plot[Sin[x], \{x,0,2*Pi\}]$, then **Shift+Enter**.
- (20) For decoration, try

```
Plot[Sin[x], {x,0,2*Pi}, PlotStyle -> {Red, Dashed}]
```

Then **Shift+Enter**. Note that the arrow is typed as `->`.

(21) You can also give the function a name before plotting it. For example,

```
f[x_] := Sin[x];  
Plot[f[x], {x,0,2*Pi}, Filling->Axis]
```

Then **Shift+Enter**. Note that the dash following x within the brackets is no longer used because f was already defined.

4 To turn in

Submit your implementation of Exercises (1) - (21) as a single pdf file.