SI100B Tutorial: Introduction to MATLAB

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2022.11.8

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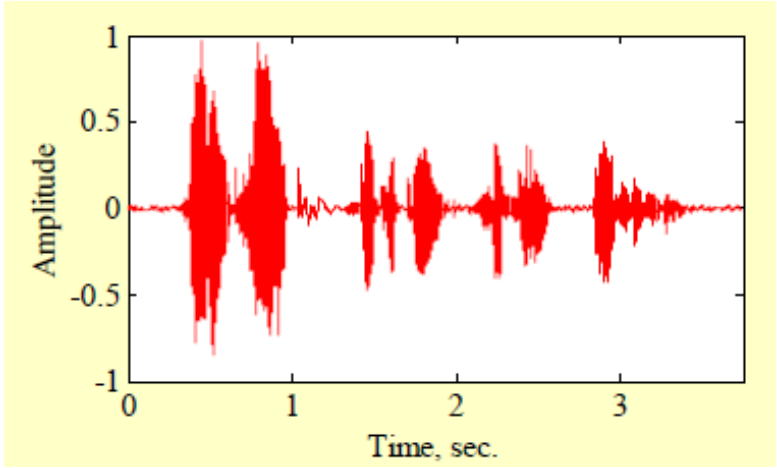
Outline

- Introduction to signal processing
- ~~brief history of MATLAB~~
- Introduction to MATLAB
- Installation
- Learn & try (How to learn)

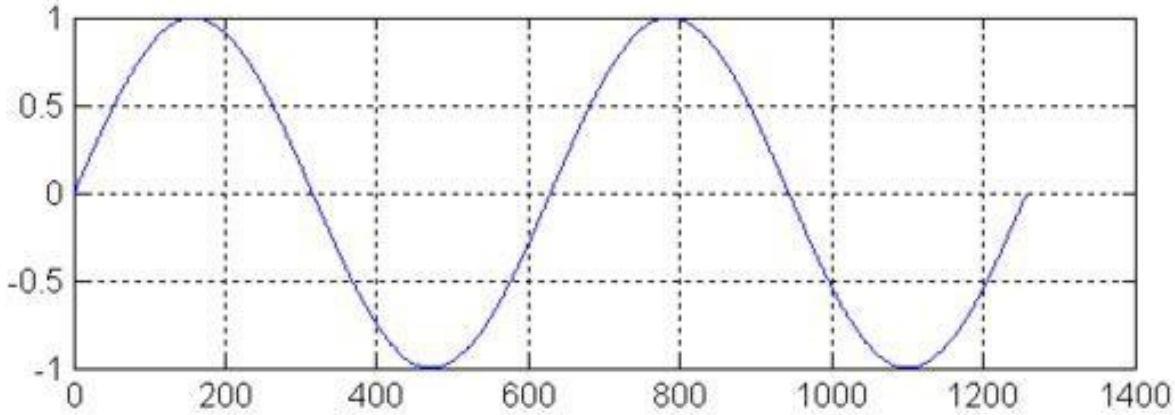
Signal

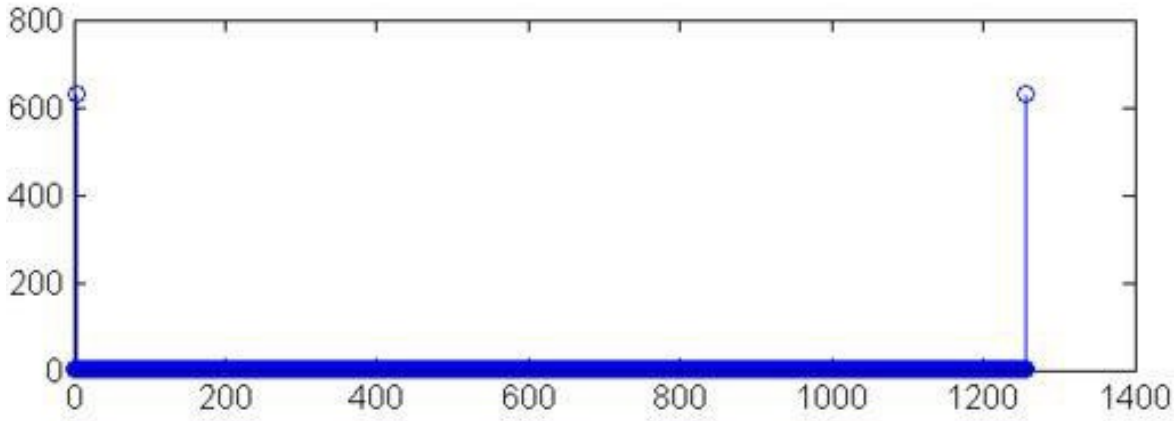
- A signal is a function of independent variables such as time, distance, position, temperature, and pressure
- Example of typical signals
  - Sound
  - Image
  - Video



$f(x,y)$

Signal Analysis





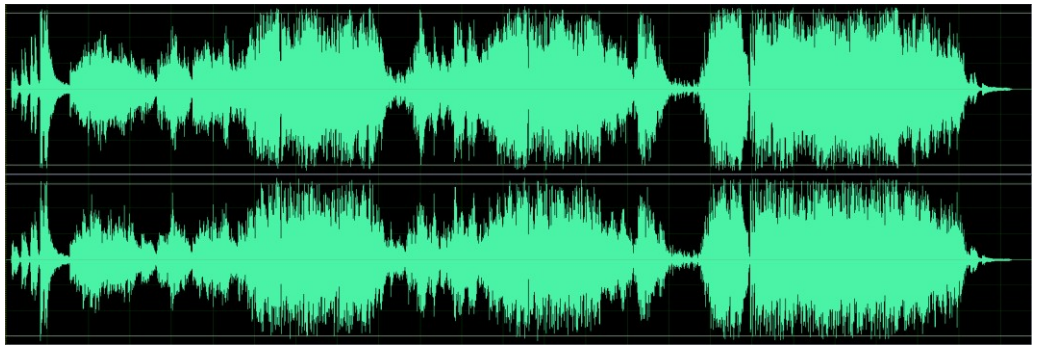
What signal processing can do?(Filtering)

Case1：图像处理（高斯模糊、直方图均衡化）
Case2：降噪耳机

- This task deals with the transformation of signals. The systems that perform this task are called filters
  - Removal of unwanted background noise
  - Separation of frequency bands
  - Removal of interference
  - Shaping of the signal spectrum

the form of sound

my world



computer

命令行窗口

```
>> clear;clf;
[y,Fs] = audioread('magnet.mp3');
>>
```

工作区

名称	值	大小	类
Fs	44100	1x1	double
y	*10907760x2 double*	10907760x2	double

Introduction to MATLAB

- MATLAB is a programming and numeric computing platform used by millions of engineers and scientists to analyze data, develop algorithms, and create models.
- Designed for the way you think and the work you do.

Why MATLAB?

- MATLAB vs. Python
- Computing Environment + MATLAB language vs. A general-purpose programming language
- Toolboxes vs. Packages
- Everything about MATLAB is designed specifically for engineers and scientists.

  Function names and signatures are familiar and memorable. The matrix-based MATLAB language lets you express math directly. Documentation is written for engineers and scientists, not computer scientists.
- Paid vs. Free

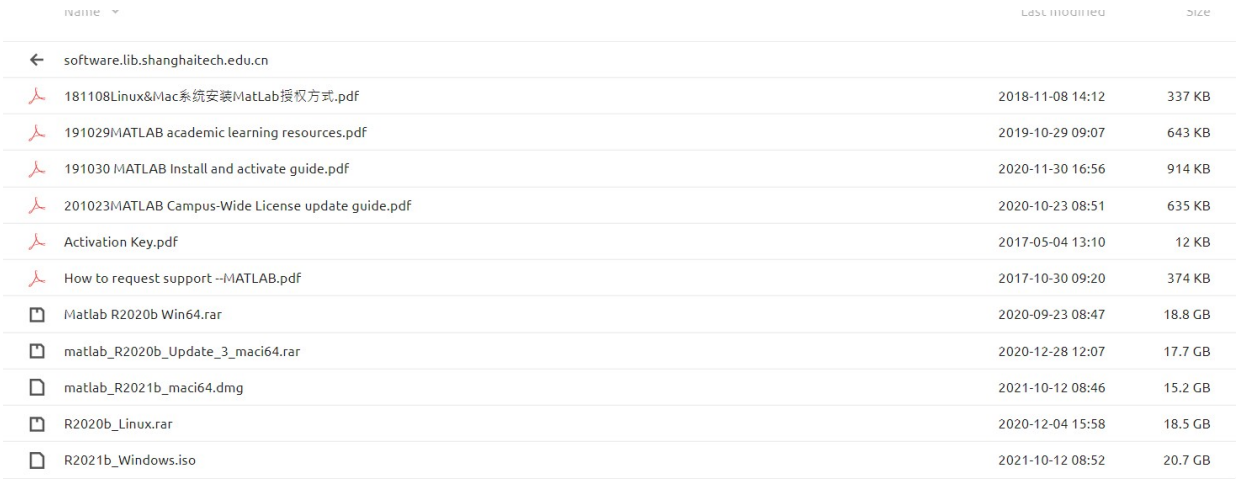
MATLAB in signal processing

MATLAB is a suitable tool in the field of signal processing. WHY?

Installation

Download (Campus only)

- https://library.shanghaitech.edu.cn/3980/list.htm
- http://software.lib.shanghaitech.edu.cn/MatLab/
- You should register an account with XXX@shanghaitech.edu.cn.



Name	Last modified	Size
software.lib.shanghaitech.edu.cn		
181108Linux&Mac系统安装MatLab授权方式.pdf	2018-11-08 14:12	337 KB
191029MATLAB academic learning resources.pdf	2019-10-29 09:07	643 KB
191030 MATLAB Install and activate guide.pdf	2020-11-30 16:56	914 KB
201023MATLAB Campus-Wide License update guide.pdf	2020-10-23 08:51	635 KB
Activation Key.pdf	2017-05-04 13:10	12 KB
How to request support --MATLAB.pdf	2017-10-30 09:20	374 KB
Matlab R2020b Win64.rar	2020-09-23 08:47	18.8 GB
matlab_R2020b_Update_3_maci64.rar	2020-12-28 12:07	17.7 GB
matlab_R2021b_maci64.dmg	2021-10-12 08:46	15.2 GB
R2020b_Linux.rar	2020-12-04 15:58	18.5 GB
R2021b_Windows.iso	2021-10-12 08:52	20.7 GB

Installation

MatLab

下载地址：http://software.lib.shanghaitech.edu.cn/MatLab/ (仅校内网用户可访问)

下载及安装说明：

1. 安装在个人计算机上，请选择您的操作系统（Windows 64bit, Windows 32bit，Mac或Linux）相应的安装包下载至本地。
2. 打开文件夹， Windows下运行Setup.exe文件，MAC下运行InstallForMacOSX进行安装，linux执行Install命令。
3. 后续安装步骤请在校园内网查看“MatLab安装指南（内网）”，更多操作指南可参考MathWorks网站文档中心。
4. 为保证下载速度，敬请错峰下载。
5. MatLab安装系统要求，请访问http://cn.mathworks.com/support/sysreq/current_release/。
6. 若需在电教室或机房安装软件，请联系图书信息中心江丽萍（jianglp@shanghaitech.edu.cn）获取Concurrent License Key 。

辅导资料：

1. MatLab和Simulink教程Learn with matlab tutorials。
2. MATLAB Academy — 通过2小时互动式的课程自学MATLAB。
3. MATLAB Online — 通过Web 浏览器使用网页版MATLAB。
4. 录制的在线研讨会和视频 — 通过视频学习MATLAB & SimuLink在不同应用领域的产品功能。
5. MATLAB示例— 包含丰富的示例供教学和研究使用。
6. 更多的用户交流分享互动可登录这里。
7. 图书馆与MatLab相关的文献资源，欢迎您通过文献资源集成发现系统查找您所需要的学习资源。
8. MatLab相关培训活动，请关注图书馆网站动态通知。

Installation of MATLAB

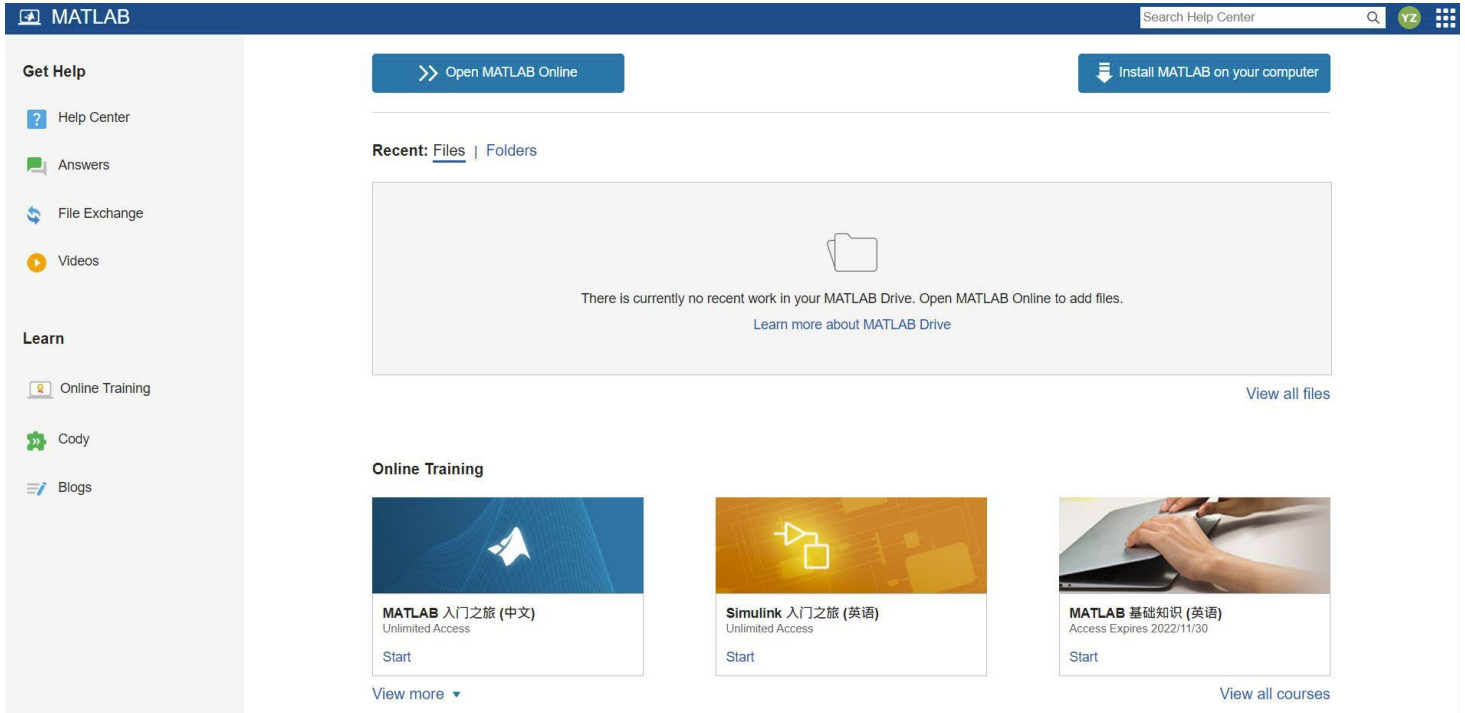
- Install

Toolboxes to be installed

MATLAB Audio Toolbox
Communications Toolbox
Control System Toolbox
DSP System Toolbox
Image Processing Toolbox
Signal Processing Toolbox
Statistics and Machine Learning Toolbox
Symbolic Math Toolbox

Installation

- Online (not recommended)



Learn & Try

- Simple Operation Learning

MATLAB-onramp course

Learning Resources(Campus only）

Guide

Signal Processing

Exercise_Signal_Tutorial_1.mlx

MATLAB Help

Google

Operations

- Variables
- Variable names must begin with a letter.
- Names can include any combinations of letters, numbers and underscores.
- Maximum length for a variable name is 63 characters.
- MATLAB is case sensitive. That is the variable name *A* is different than the variable name *a*.
- Avoid the following names: pi (π), and all built-in MATLAB function names such as length, char, size, plot, break, cos, log, …
- Use 1i or 1j instead of single i or j to represent $\sqrt{-1}$.
- It is good programming practice to name your variables to reflect their function in a program rather than using generic x, y, z variables.

Operations

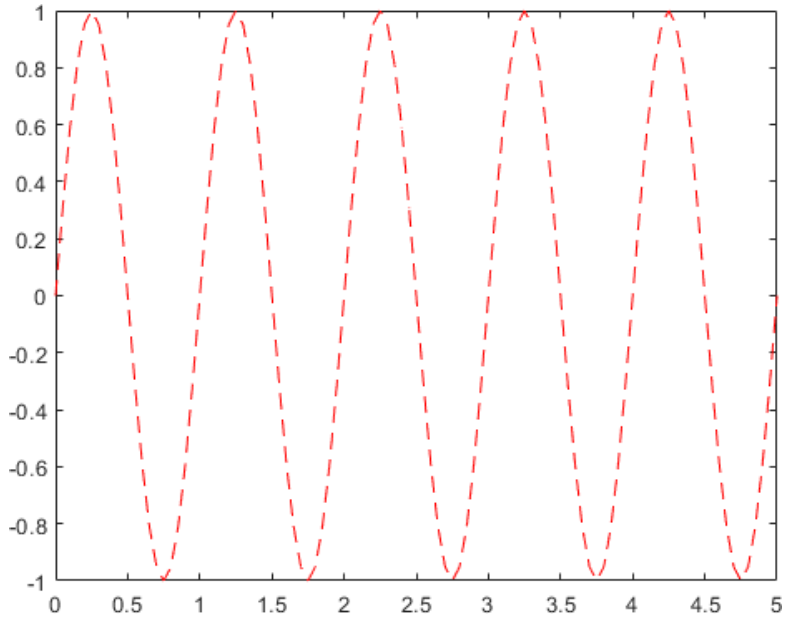
- **Array vs. Matrix Operations**
  - Execute element by element +, - ,.*, ./, .\
- Array vs. Matrix Operations
  - Follow the rules of linear algebra *, /, \, ^, ‘

Operations

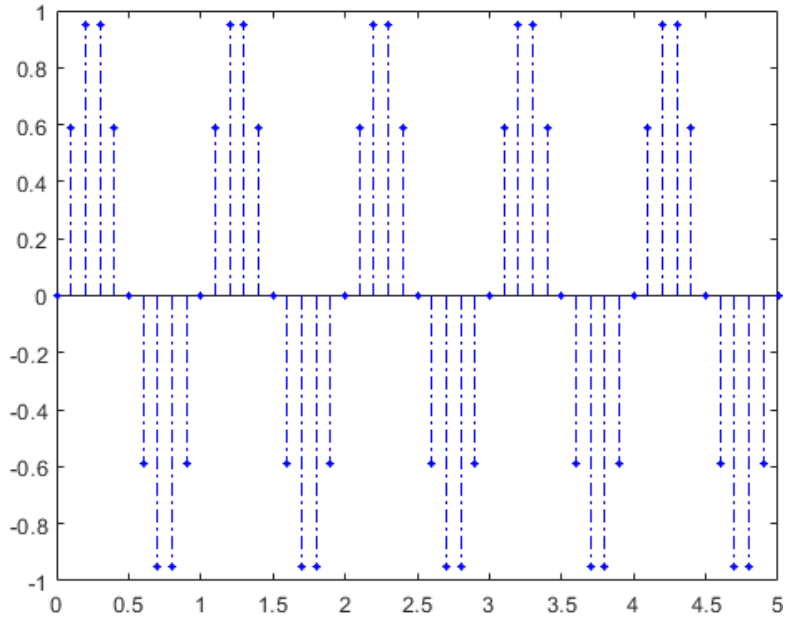
- Something for Signal Processing
- Signals
  - sin
  - cos
  - exp
  - ones
  - zeros
- Interactive
  - input
  - disp
- Symbol
  - ;
  - :
  - ,
- Others
  - clear
  - clf
  - help

Operations

- Draw a picture
  - plot



  - stem



xlabel, ylabel, title, axis, hold on/off, subplot

Operations

- Structure
  - Sequential

```
a = 5;
b = 10;
c = a+b;
```

  - Loop

```
for index = values
    statements
end
```

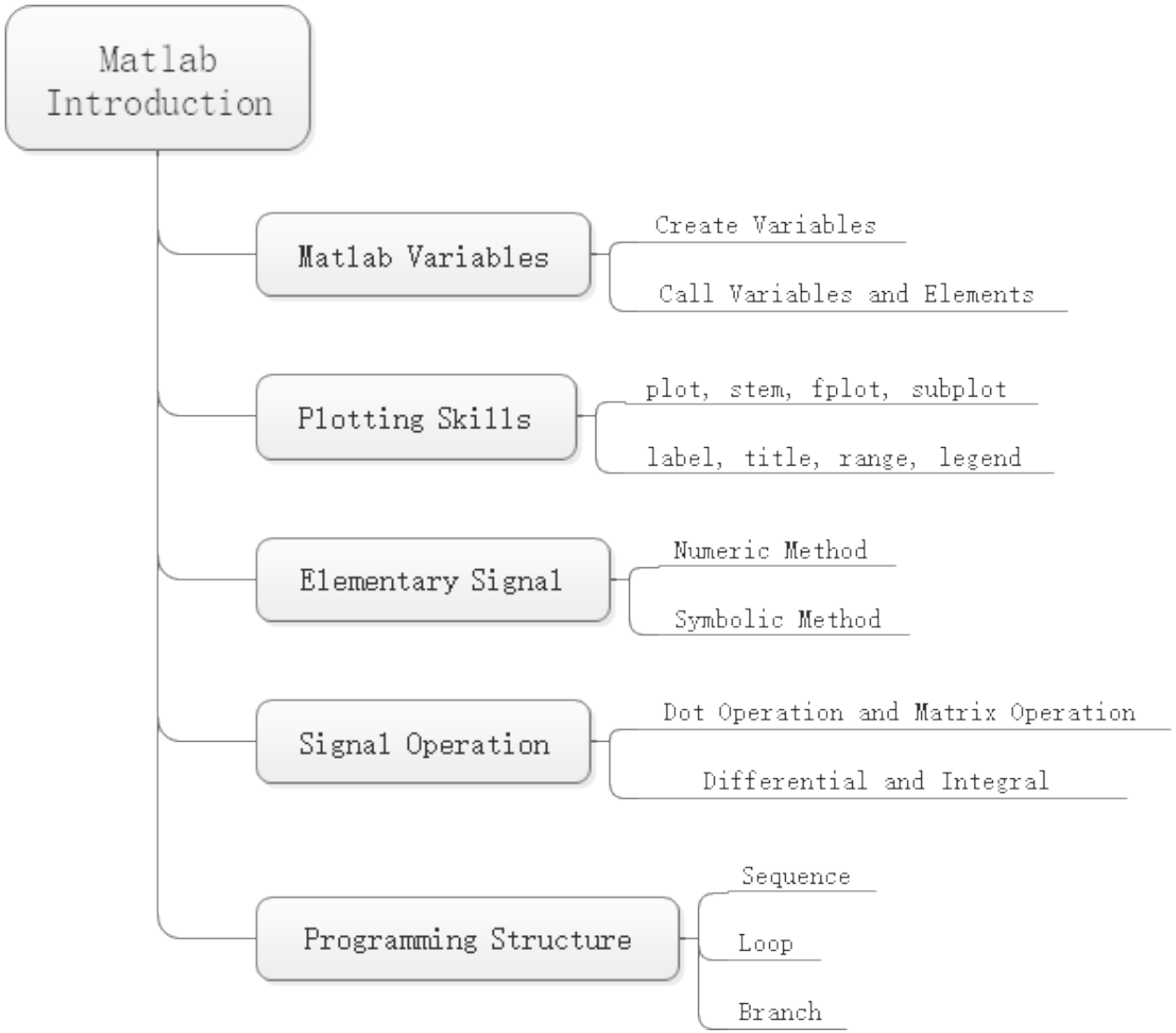
```
while expression
    statements
end
```

  - Branch

```
if expression-1
    statements-1
elseif expression-2
    statement-2
...
else
    statement-n
end
```

```
switch expression
    case value-1
        statement-1
    case value-2
        statement-2
    ...
    otherwise
        statement-n
end
```

Exercise_Signal_Tutorial_1.mlx



Homework1

- 学术诚信

Homework1

- Generate pdf file and upload it to gradescope.(实时编辑器-保存-导出为pdf)
- Need to display both code and results.
- Check if the code is complete.

Encourage discussion in the office hour, if there are code and theoretical questions.

Everyone will have different problems during installation, you should learn to use the Internet and cooperate with each other.

Exercises_1 .mlx Submission:

Before Nov. 22, 0:00