



# **Recitation Class 02 for VG101**

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# Interface

- Please follow the TA's demonstration, if you bring a laptop with you to the class!
- Desktop / Desktop Layout / Default
- Command Window
- Workspace
- Command History
- Current Folder

# Editor

- Create a new script
- Type the code in it
- Save and run
- Debug (maybe covered in the future)
- The rules of naming in VG101
  - s5123709xxx\_hwk1.m
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- ~~s5123709xxx\_hwk1.m.m~~

# Variables

- Scalar
  - E.g. `a = 3;`    `b = 1.2345;`
- Vector
  - E.g. `v = [1,2,3,4];`    `v = [1 2 3 4];`  
          `v = 1:1:4;`        `v = 1:4;`
- Matrix
  - E.g. `c = [1,2,3;4,5,6];`    `c = [1 2 3;4 5 6];`

# Operators

- Plus: +
- Minus: -
- Multiply: \*
- Divide: /
- Power: ^
- Assign: =
- Brackets: ()

# Operators

- Interesting usage of “.”
  - For “\*”: #(column of left matrix) = #(row of right matrix)
  - For “.\*”: the same size for both matrix
- The same rule for “./” and “.^”
- Comparison of their usage:
    - E.g. find the value of  $a_i = \frac{\sin(i)}{i}$  for all  $0 < i \leq 100, i \in \mathbb{N}$
    - E.g. Information Search Online (Beyond this course)



# Operators

- Suppose you have a database including the name of the following books:
  - *Introduction to Computer*
  - *Introduction to Programming*
  - *Computer Programming*
  - *Introduction to MATLAB Programming*
  - *MATLAB and Programming*
  - *Mathematics and Programming*
  - *Mathematics and MATLAB Programming*
- You search “MATLAB programming”
- Larry Page and Google PageRank algorithm



## Some other points

- Comments: %
- Separate the commands: ,
- Suppress the output: ;
- Have a try:
  - `a = 3, b = 5;`
  - `a = 3, b = 5`
  - `a = 3; b = 5;`
  - `a = 3; b = 5`

# Constants in MATLAB

- Never name your variables as:
- $\pi = 3.14159265358\dots$
- $i = \sqrt{-1}$
- Inf = Infinity
- NaN = Not a number
- ...e... = 10 to the power of ...
  - E.g. format long;  
123 \* pi

# Built-in Functions in MATLAB

- `help`
  - E.g. `help format`;
  - `format longeng`;  
`pi * 123`  
`format longe`;  
`pi * 123`  
`format`;  
`pi * 123`
- `clc`
- `clear`
  - If you want to find more, try “`help clear`”.



# Built-in Functions in MATLAB

- `round`                      `a = [round(-5.556) round(-5.446)]`
  - Compare it with “`a = [fix(-5.556) fix(-5.446)]`”
  - Compare it with “`a = [floor(-5.556) ceil(-5.446)]`”
  - Compare it with “`a = [ceil(-5.556) floor(-5.446)]`”
- `log`                          `a = log(exp(5))`
  - Compare it with “`a = log10(10 ^ 5)`”
- `mod`                         `a = mod(-3,2)`
  - Compare it with “`a = rem(-3,2)`”
- `sin`                          `a = sin(pi / 4)`
  - Compare it with “`a = sind(45)`”
- `linspace`                    `a = linspace(1,20,4)`
  - Compare it with “`a = 1:(20 - 1) / 3:20`”

# Built-in Functions in MATLAB

- `sqrt`                      `a = sqrt(81)`
- `abs`                        `a = abs(-81)`
- `sum`                        `sum([8 2 5 4])`
  - How to express “dot product” with the function?
- `size`                        `a = size([8 2 5 5; 6 3 9 2; 7 1 1 4])`
  - Have a try: `a = size(size([8 2 5 5; 6 3 9 2; 7 1 1 4]))`
  - Do you know the reason?
- `zeros`                      `a = zeros(3)`
  - Compare it with “`a = ones(3)`”
- `min`                        `a = min([8 2 5; 6 3 9; 7 1 4])`
  - Have a try: `a = max(min ([8 2 5; 6 3 9; 7 1 4]))`
  - Do you know the reason?

# Plot

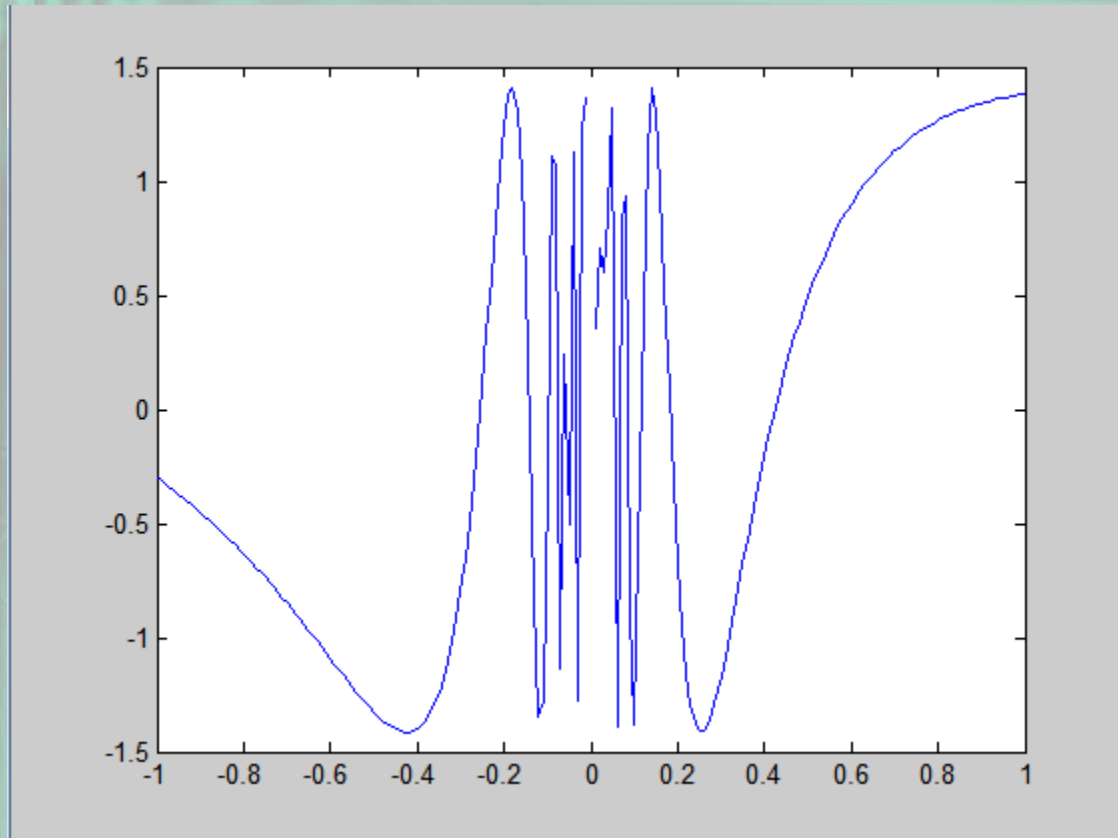
- More details will be covered in the future!
- Make use of vector.
  - E.g. plot of  $y = \sin\left(\frac{1}{x}\right) + \cos\left(\frac{1}{x}\right)$
  - How to make it?
  - What will happen on the point where  $x$  is equal to 0?



# Plot

- More details will be covered in the future!
- Make use of vector.
  - E.g. plot of  $y = \sin\left(\frac{1}{x}\right) + \cos\left(\frac{1}{x}\right)$
  - `x = -1:0.01:1;`  
`y = sin(1./x) + cos(1./x);`  
`plot(x,y);`
  - What will happen on the point where x is equal to 0?

# Plot



# Plot

- A problem from *Calculus (5<sup>th</sup> ed.)* by James Stewart.
- The population of a certain species in a limited environment with initial population of 100 and carrying capacity 1000 is:

$$P(t) = \frac{100000}{100+900e^{-t}} \quad t \text{ is measured in years}$$

- Graph this function and estimate how long it takes for the population to reach 900



# Plot

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- The population of a certain species in a limited environment with initial population of 100 and carrying capacity 1000 is:

$$P(t) = \frac{100000}{100+900e^{-t}} \quad t \text{ is measured in years}$$

- Graph this function and estimate how long it takes for the population to reach 900
- Answer: 4.394

## Loop Structure (*for* loop)

- for <scalar\_1> = <vector>  
    expression  
end
- It can also be nested.
- for <scalar\_1> = <vector>  
    for <scalar\_2> = <vector>  
        expression  
    end % the end of “for <scalar\_2> = <vector>”  
end % the end of “for <scalar\_1> = <vector>”

## Loop Structure (*for* loop)

- Easy problem:
- What will be the value of [a b c d] at last?

```
• c = 0; d = 0;  
  for a = 1:1:10  
    d = d + 1;  
    for b = 1:2:10  
      c = c + 1;  
    end  
  end  
end
```



## Loop Structure (*for* loop)

- Challenging problem:
- Catalan numbers are named after Eugene Charles Catalan. They are a sequence of numbers, which are very important in counting problem. So example, the Catalan number  $C_n$  can be viewed as the number of different methods to dissect a regular polygon with  $n$  sides. We can conclude that:

$$C_n = \frac{1}{n-1} \binom{2n-4}{n-2} \quad (n \geq 2, n \in \mathbb{N})$$

Calculate  $C_n$  for a certain  $n$

## Loop Structure (*for* loop)

- Hint:
- How to use a nested *for* loop to calculate  $\binom{2n-4}{n-2}$  ?
- How to use “/” during the division here? How to use “./” during the division here?