

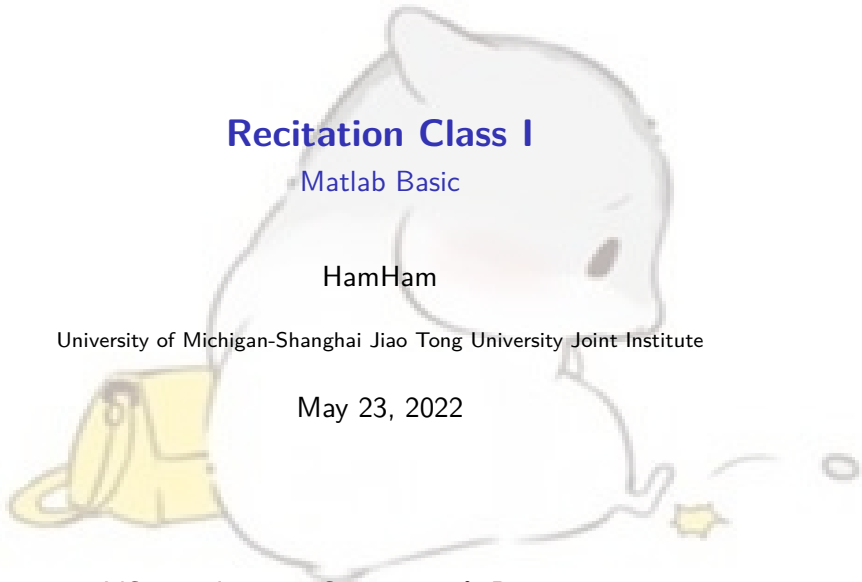
# Recitation Class I

Matlab Basic

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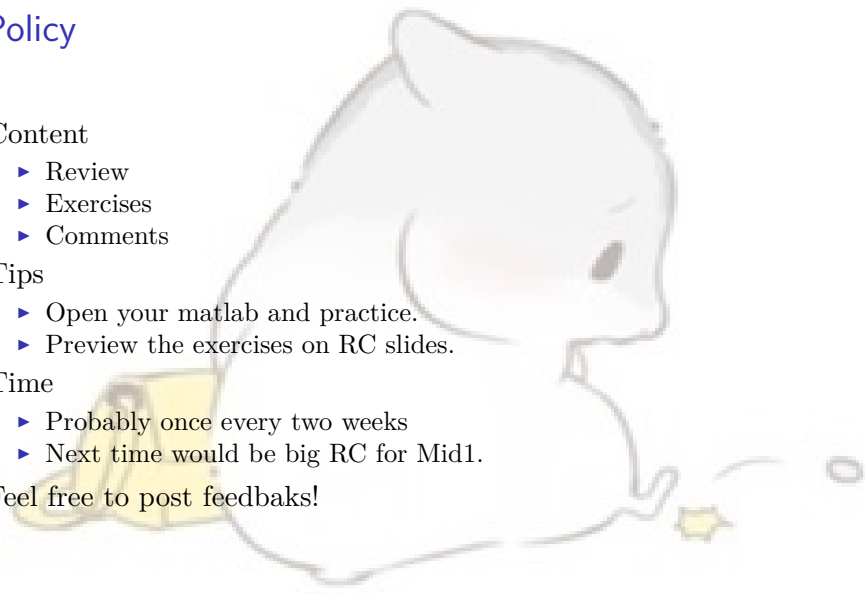
May 23, 2022



VG101 - Intro to Computers & Programming

# RC Policy

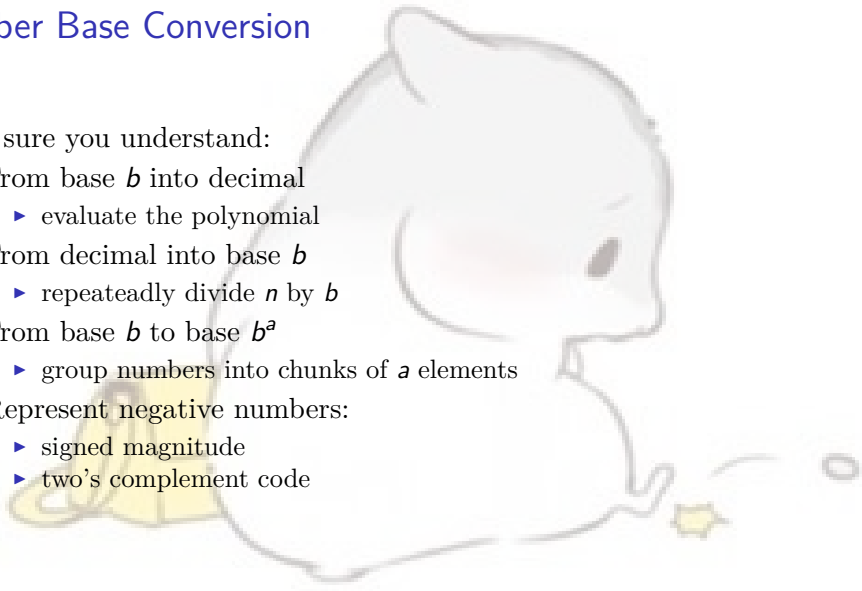
- Content
  - ▶ Review
  - ▶ Exercises
  - ▶ Comments
- Tips
  - ▶ Open your matlab and practice.
  - ▶ Preview the exercises on RC slides.
- Time
  - ▶ Probably once every two weeks
  - ▶ Next time would be big RC for Mid1.
- Feel free to post feedbacks!



# Number Base Conversion

Make sure you understand:

- From base  $b$  into decimal
  - ▶ evaluate the polynomial
- From decimal into base  $b$ 
  - ▶ repeatedly divide  $n$  by  $b$
- From base  $b$  to base  $b^a$ 
  - ▶ group numbers into chunks of  $a$  elements
- Represent negative numbers:
  - ▶ signed magnitude
  - ▶ two's complement code



## ASCII code

- Here is the introduction for [ASCII](#) on wikipedia.
- 7bits, 128 characters
- Idea: encoding

Characters	ASCII code	Hexadecimal
space	32	20
0	48	30
A	65	41
a	97	61

[Table](#): ASCII for common characters

# Algorithm

## Properties

- **Output.**
- **Definiteness.** The steps of the algorithm are defined precisely.
- **Correctness.** For each input, the algorithm produces the correct output values.
- **Finiteness.** The algorithm must end at some point.
- **Effectiveness.**
- **Generality.**

## Question

Is there any algorithm without input? without output?

## Matlab Syntax Tips

;  
: suppress the output of this line.

%  
: annotation.

,  
: two statements at the same line.

...  
: one statement in more than one lines

### Notice

A valid ... is shown in blue color, otherwise you may need to add a whitespace to separate the code and ...

## Datatype and Operations

- Numeric: 0, 0.132, 1e-10, pi
  - ▶ Pay attention to the priority.
  - ▶ + - \* / \ ^ mod(x,y)
  - ▶ Default type: double
- Numeric Matrix: [0,1,2]
  - ▶ + - \* .\* / ./ ^ .^
  - ▶ combine, indexing
- Char: 'a'
  - ▶ ischar()
- Char array: 'abcdefg'  
*(Chars exist individually and form a group.)*
  - ▶ indexing
  - ▶ combine: [a,b]
- String: "abcdefg"  
*(Chars as a whole)*

# Variable

## Naming

- start with a letter.
- underline is allowed, no other special characters.
- case sensitive.
- no more than 31 characters.

## Recommendation:

- Hungarian Notation
  - ▶ `m_count`, `lnum`
- Lower Camel Case: variable name
  - ▶ `ballRadius`, `intervalLength`
- Upper Camel Case: class name, function name
  - ▶ `Rectangle`, `GetColor`



## Assignment Operator

- Assignment Operator '='

- calculate the right hand side.
- let the left hand side equals to right hand side.

```
1 a =1; a = a+1;
```

- Logical Operator '=='

- Compare whether two value are equal

```
1 if a == 1  
2     disp('Yes');  
3 end
```

## Exercise 1 - Swap two Variables

The user inputs the value of  $x$  and  $y$ , please write a program to exchange this two variables.

Sample input

12

34

Sample output

34

12

## Array Creation

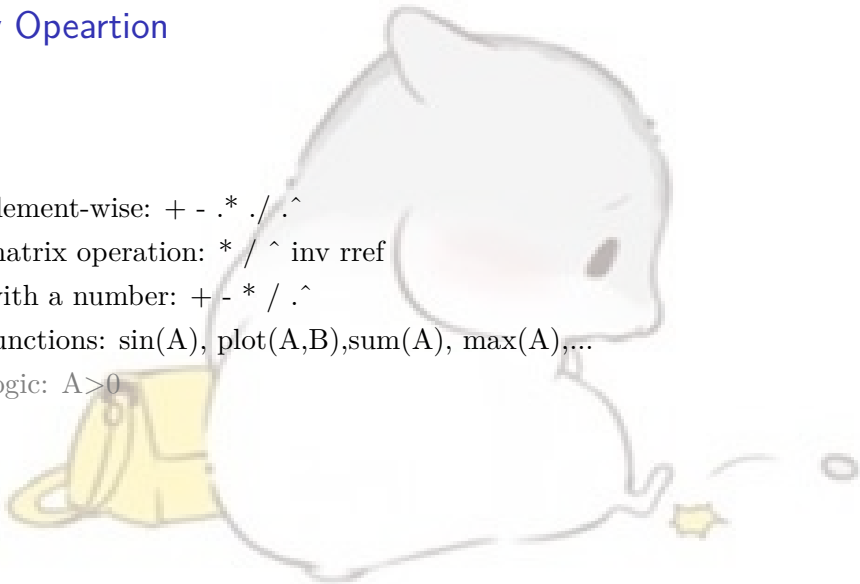
- write by hand.
- start:step:end
- linspace(start,end,numInTotal) (linear)
- logspace(start,end,numInTotal) (log)
- zeros(rowNum,columnNum)
- ones(rowNum,columnNum)
- rand(rowNum,columnNum)
- magic(size)
- eye(size)

### Question

How to create a 3\*3 matrix, all the elements are 2?

# Array Operation

- element-wise:  $+$   $-$   $.$  $*$   $.$  $/$   $.$  $^$
- matrix operation:  $*$   $/$   $^$  inv rref
- with a number:  $+$   $-$   $*$   $/$   $.$  $^$
- functions:  $\sin(A)$ ,  $\text{plot}(A,B)$ ,  $\text{sum}(A)$ ,  $\text{max}(A)$ ,...
- logic:  $A > 0$



# Array Concatenation

- left-right connection:  $[A,B]$  or  $[A \ B]$
- upper-lower connection:  $[A;B]$

## Notice

Pay attention to the size (in other words,  $n \times m$ ) of the input matrix

## Array Access

- $A(1)$ : **column-major** label each elements
- $A(1,2)$ : (row,column)
- $A(B,C)$ 
  - ▶ the range of row is the elements(column-major) in B;
  - ▶ the range of column is the elements(column-major) in C.
  - ▶ combine all the elements we get.
  - ▶ Example:  $A([2,1],[1,3])$ ;
- $A(B,:)$ ,  $A(:,B)$ 
  - ▶ similar to previews one, ‘:’ represents ‘all’
  - ▶ example:  $A([2,1],:)$
- $A(\text{LOGIC})$ 
  - ▶ LOGIC is a logical matrix
  - ▶ extract the component where LOGIC is 1

# Array Assign

Two steps

- find the elements that you want to assign
  - ▶ use Array Access technique
- assign the value
  - ▶ Assign a matrix
  - ▶ Assign a number



## Exercise 2 - Binary to Decimal

The user inputs a matrix, which represents a binary number. For example,  $[1,0,1,1,1]$  represents  $(10111)_2$ . Please convert it to decimal and print the result.

Sample input

```
[1 0 1 1 1]
```

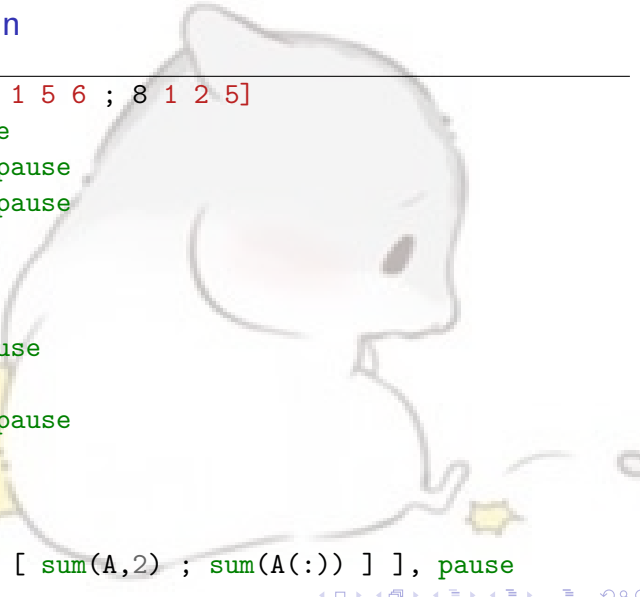
Sample output

```
23
```



## Exercise 3 - Explain

```
1 A = [2 7 9 7 ; 3 1 5 6 ; 8 1 2 5]
2 A(:, [1 4]), pause
3 A([2 3], [3 1]), pause
4 reshape(A, 2, 6), pause
5 A(:), pause
6 flipud(A), pause
7 fliplr(A), pause
8 [A A(:, end)], pause
9 A(1:3, :), pause
10 [A ; A(1:2, :)], pause
11 sum(A), pause
12 sum(A'), pause
13 sum(A, 2), pause
14 [ [ A ; sum(A) ] [ sum(A, 2) ; sum(A(:)) ] ], pause
15 A.'
```



# If & Switch Statement

Syntax:

```
1  if (condition1)
2      statement1
3  elseif (condition2)
4      statement2
5  else
6      statement3
7  end
```

Syntax:

```
1  switch (expression)
2      case value1
3          statement1
4      case value2
5          statement2
6      otherwise
7          statement3
8  end
```

## Usage

**if:** Deal with special cases or boundary conditions.

**switch:** Classify objects to large number of categories.

## Exercise 4 - Leap Year

Judge whether a year inputed by the user is a leap year or not.  
Output “Yes” or “No”.

Sample input

Sample output

# For & While Statement

Syntax:

```
1 for variable = list
2   statement
3 end
```

Syntax:

```
1 while (condition)
2   statement
3 end
```

## Usage

**for:** Do the work for a given times, get the final result step by step.

**while:** Keep doing some work until some condition is reached.

# Loop Control

## break

break can jump out of **one layer** of the loop

## continue

continue will skip the sentence behind it and start a new round of loop. Sometimes it works like an else branch.

## Exercise 5 - Binary to Decimal (Revisited)

The user inputs a matrix, which represents a binary number. For example,  $[1,0,1,1,1]$  represents  $(10111)_2$ . Please convert it to decimal and print the result. Now, use a for loop instead.

### Question

Which one is faster? For loop or matrix operations?

## Let's do an experiment!

```
1 a=zeros(1,100000000); i=1;
2 tic; while i<=100000000; a(i)=2*(i-1); i=i+1; end; toc;
3 a=zeros(1,100000000);
4 tic; for i=1:100000000; a(i)=2*(i-1); end; toc;
5 tic; [0:2:199999999]; toc;
```

Use **vectorization** if possible!

- Recommended open course: CS229

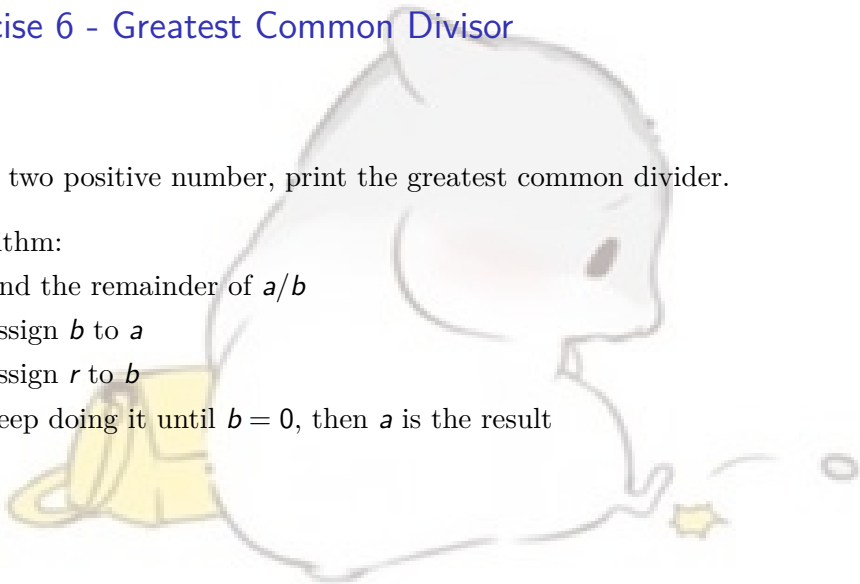
<https://www.bilibili.com/video/BV164411b7dx?p=82>

## Exercise 6 - Greatest Common Divisor

Given two positive number, print the greatest common divider.

Algorithm:

- find the remainder of  $a/b$
- assign  $b$  to  $a$
- assign  $r$  to  $b$
- keep doing it until  $b = 0$ , then  $a$  is the result





## Reference

- Charlemagne, Manuel. VG101-2020FA Lecture Slides.
- Zhu, Yifei. VG101-2022SU Lecture Slides.
- Zhu, Kan. VG101-2021SU-RC1 Slides
- Zhu, Kan. VG101-2021SU-RC2 Slides
- Zhou, Shuyi. VG101-2020FA-RC2 Slides.



End

