Computer **A**ided **D**esign

MATLAB Introduction for Civil Engineers 1

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Content

- Introduction
- Memory and variables
- Operators, scripts and functions
- Matrices calculator
- Logic operators and decisions
- Loops
- Figures

Example

Solve by end of this lecture?

- حساب كلفة فاتورة الكهرباء
- اختيار التعرفة الأفضل حسب الاستهلاك
  - سعر ثابت 25 ليرة للكيلو الواط الساعي
  - تعرفة متغيرة حسب الاستهلاك

التعـرفـــة:

من ١ إلى ٦٠٠ بسعر ٢ ل.س، من ٦٠١ إلى ١٠٠٠ بسعر ٦ ل.س، من ١٠٠١ إلى ١٥٠٠ بسعر ٢٠ ل.س، من ١٥٠١ إلى ٢٥٠٠ بسعر ٩٠ ل.س، من ٢٥٠١ فما فوق بسعر ١٥٠ ل.س لكل ك.وس

عزيزي المشترك:

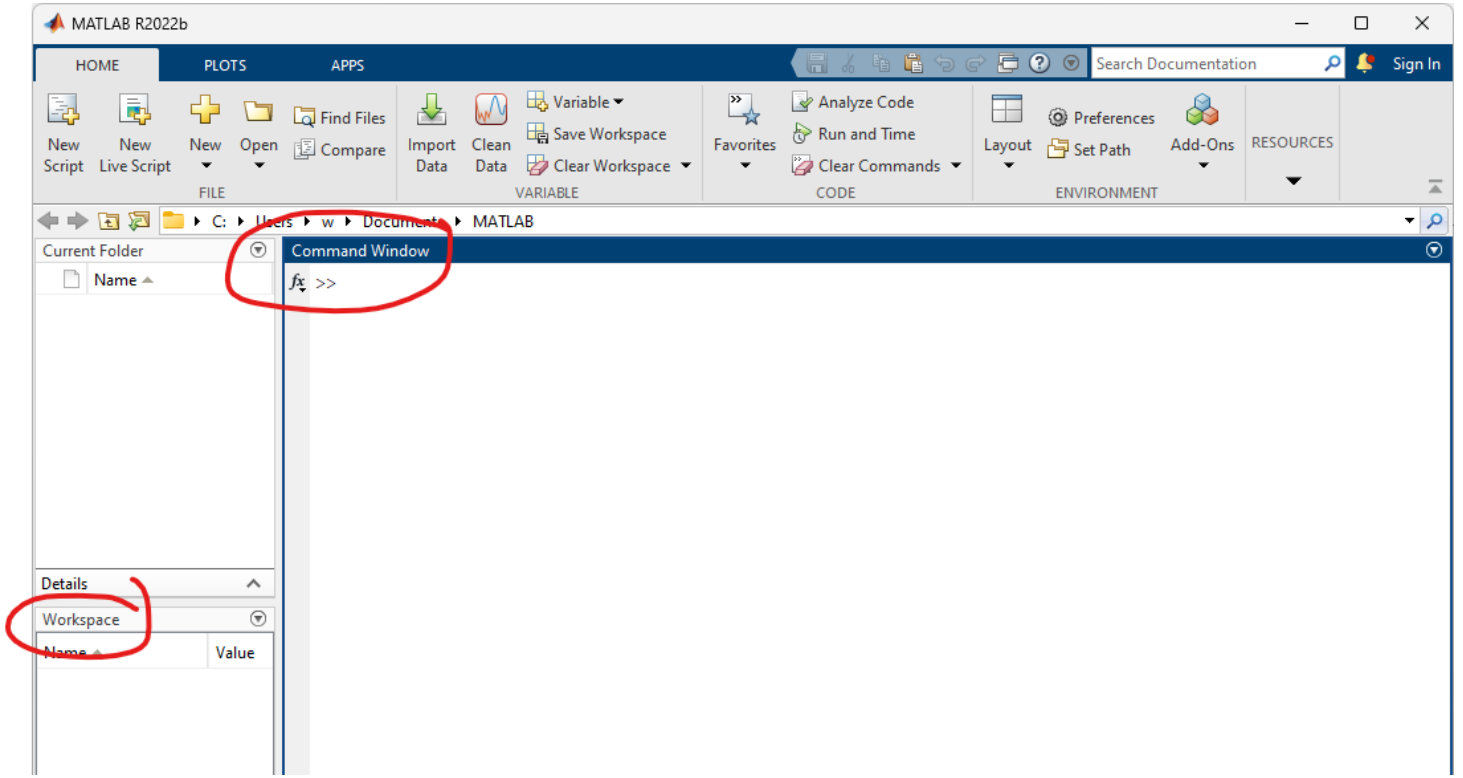
عزيزي المشترك يرجى عدم احضار اي مبلغ فوق المليون ليرة سورية وتسديد قيمة الفاتورة عن طريق(نافذة الدفع الالكتروني--او عن طرق شيك من اي مصرف مصدق اصولا او عن طريق المصرف التجاري في حساب الشركة العامة لكهرباء محافظة دمشق رقم الحساب/ ١٠٥١٠١٤٣٩٠٠١ / ومراجعتنا بعد التسديد للحصول على الفاتورة مباشرة
نرجو المبادرة الى تسديد الفواتير المترتبة عليكم تجنبا من سحب العداد في حال التاخر لمدة اربعة اشهر تطبيقا لنظام الاستثمار الجديد .

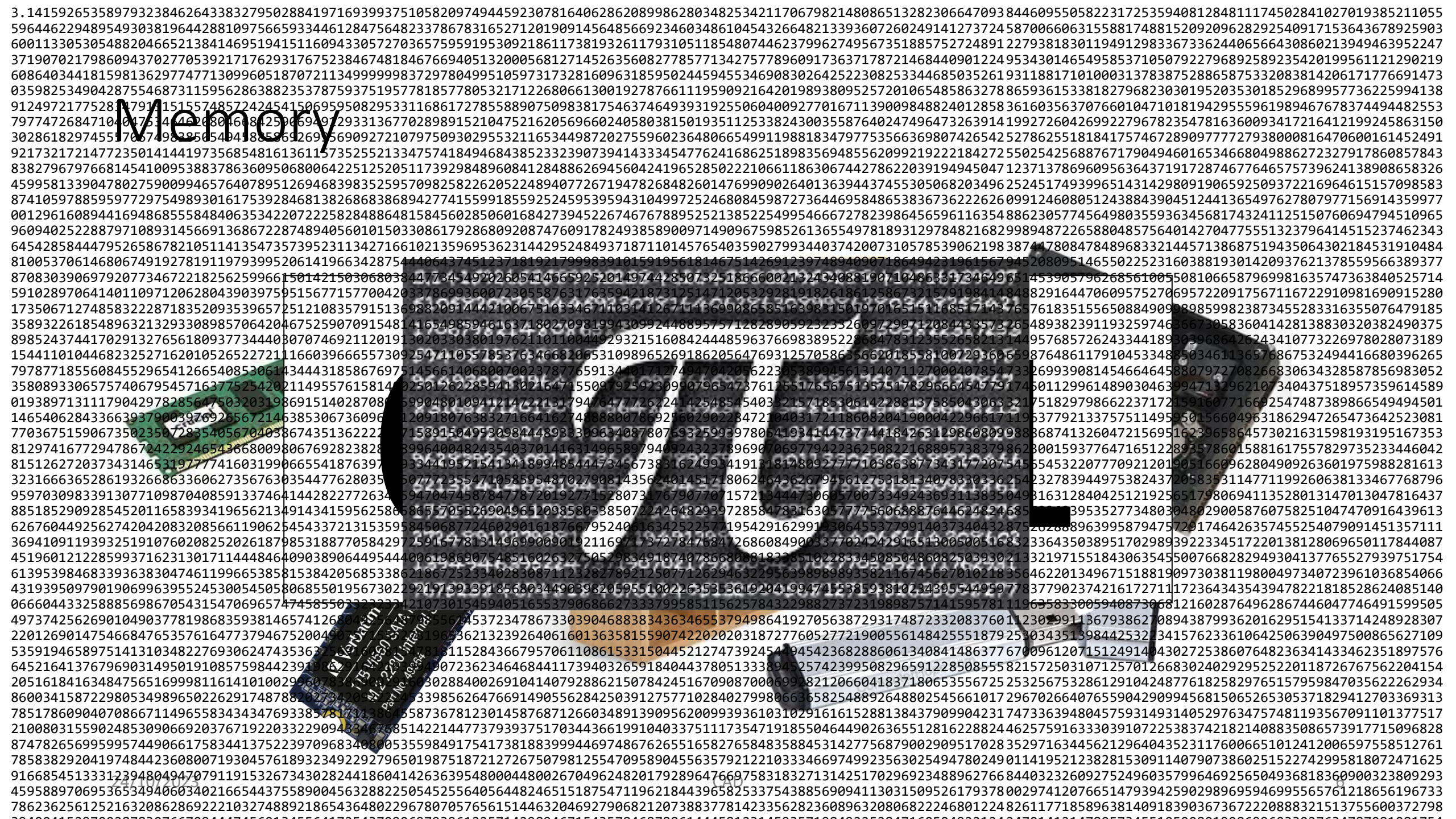
Programming Languages

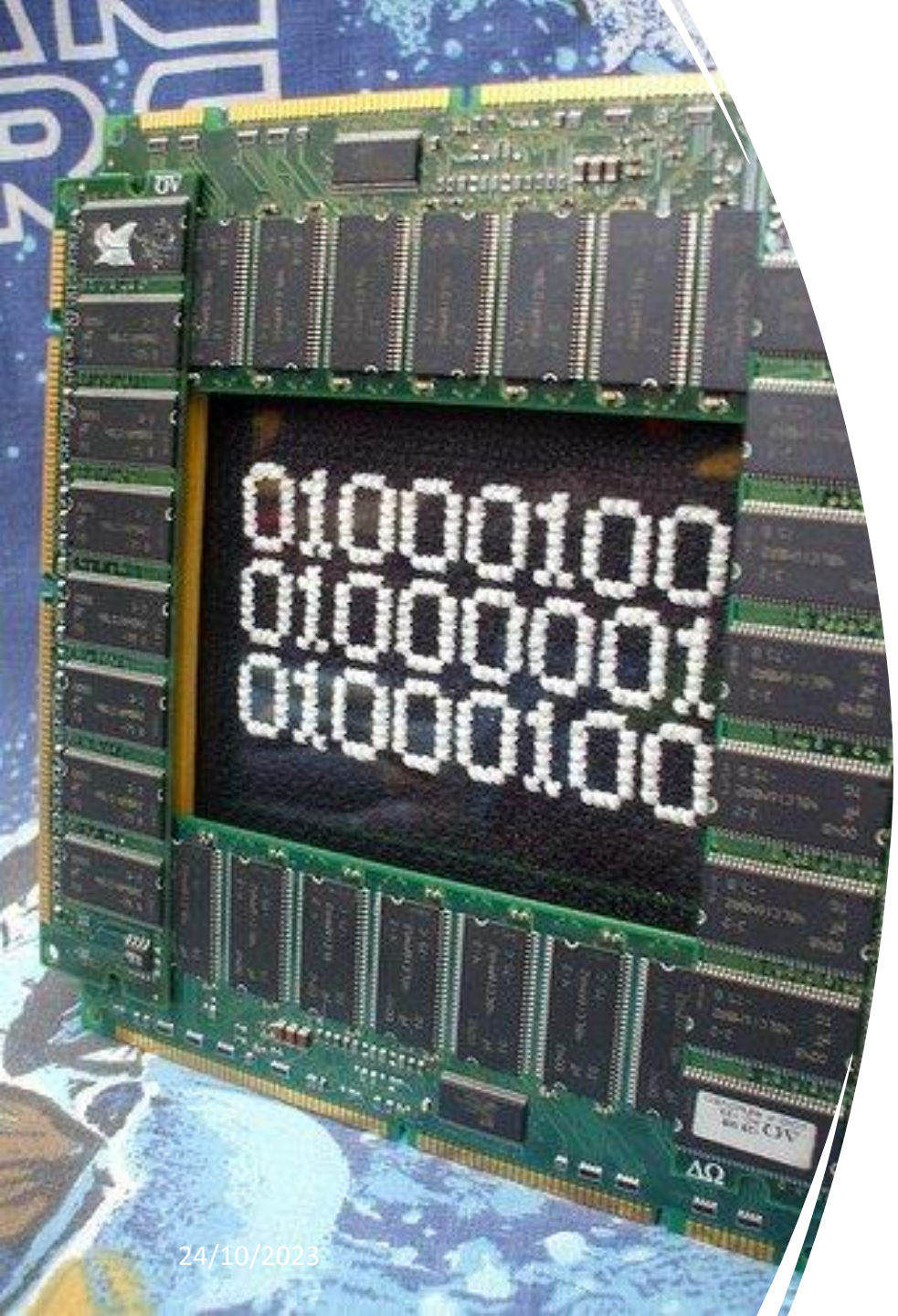
- Fortran — Formula Translation, 1957
- BASIC — Beginner's All-purpose Symbolic Instruction Code, 1964
- C/C++ — 1972/1985
- MS Visual Basic — 1991
- Python — 1991
- Java — 1995

MATLAB

- Matrix Laboratory, 1970s
- Developed by MathWorks
- Matrix manipulations
- Algorithms
- Graph plotting
- Script (could compile)
- Numerical and symbolic engine




Memory



Bit vs Byte

- Bit or binary digit 0/1
- 2 Bit 0/1 0/1
- 3 Bit 0/1 0/1 0/1

2^3 values = 8

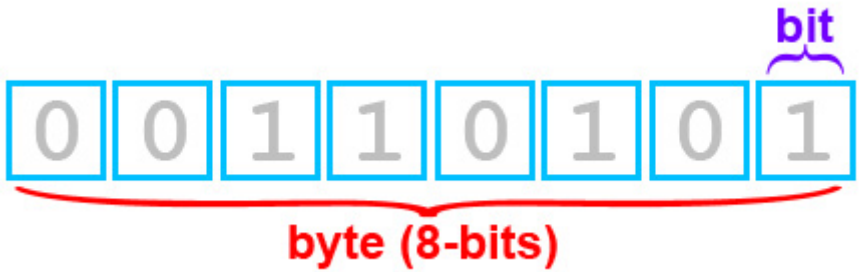
0:	**0**	**0**	**0**
1:	**0**	**0**	**1**
2:	**0**	**1**	**0**
3:	**0**	**1**	**1**
4:	**1**	**0**	**0**
5:	**1**	**0**	**1**
6:	**1**	**1**	**0**
7:	**1**	**1**	**1**

Memory

- Input ‘Hello’ to memory
- Hello = H + e + l + l + o

ASCII

- The **A**merican **S**tandard **C**ode for **I**nformation **I**nterchange
- $2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256$
- 255 character

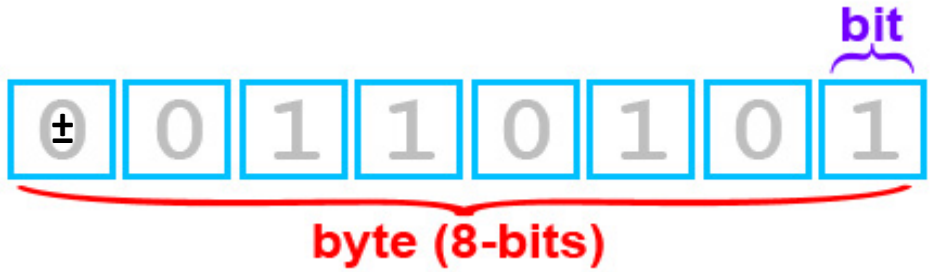


DEC	Symbol	DEC	Symbol	DEC	Symbol	DEC	Symbol	DEC	Symbol	DEC	Symbol	DEC	Symbol	DEC	Symbol
0	NUL	32		64	@	96	`	128	€	160		192	À	224	à
1	SOH	33	!	65	A	97	a	129		161	¡	193	Á	225	á
2	STX	34	"	66	B	98	b	130	‚	162	¢	194	Â	226	â
3	ETX	35	#	67	C	99	c	131	ƒ	163	£	195	Ã	227	ã
4	EOT	36	$	68	D	100	d	132	„	164	¤	196	Ä	228	ä
5	ENQ	37	%	69	E	101	e	133	…	165	¥	197	Å	229	å
6	ACK	38	&	70	F	102	f	134	†	166	¦	198	Æ	230	æ
7	BEL	39	'	71	G	103	g	135	‡	167	§	199	Ç	231	ç
8	BS	40	(	72	H	104	h	136	ˆ	168	¨	200	È	232	è
9	HT	41	)	73	I	105	i	137	‰	169	©	201	É	233	é
10	LF	42	*	74	J	106	j	138	Š	170	ª	202	Ê	234	ê
11	VT	43	+	75	K	107	k	139	‹	171	«	203	Ë	235	ë
12	FF	44	,	76	L	108	l	140	Œ	172	¬	204	Ì	236	ì
13	CR	45	-	77	M	109	m	141		173	-	205	Í	237	í
14	SO	46	.	78	N	110	n	142	Ž	174	®	206	Î	238	î
15	SI	47	/	79	O	111	o	143		175	¯	207	Ï	239	ï
16	DLE	48	0	80	P	112	p	144		176	°	208	Ð	240	ð
17	DC1	49	1	81	Q	113	q	145	‘	177	±	209	Ñ	241	ñ
18	DC2	50	2	82	R	114	r	146	’	178	²	210	Ò	242	ò
19	DC3	51	3	83	S	115	s	147	“	179	³	211	Ó	243	ó
20	DC4	52	4	84	T	116	t	148	”	180	´	212	Ô	244	ô
21	NAK	53	5	85	U	117	u	149	•	181	µ	213	Õ	245	õ
22	SYN	54	6	86	V	118	v	150	–	182	¶	214	Ö	246	ö
23	ETB	55	7	87	W	119	w	151	—	183	·	215	×	247	÷
24	CAN	56	8	88	X	120	x	152	˜	184	¸	216	Ø	248	ø
25	EM	57	9	89	Y	121	y	153	™	185	¹	217	Ù	249	ù
26	SUB	58	:	90	Z	122	z	154	š	186	º	218	Ú	250	ú
27	ESC	59	;	91	[	123	{	155	›	187	»	219	Û	251	û
28	FS	60	<	92	\	124	|	156	œ	188	¼	220	Ü	252	ü
29	GS	61	=	93	]	125	}	157		189	½	221	Ý	253	ý
30	RS	62	>	94	^	126	~	158	ž	190	¾	222	Þ	254	þ
31	US	63	?	95	_	127		159	Ÿ	191	¿	223	ß	255	ÿ

Memory

- Input ‘Hello’ to memory
- Hello = H + e + l + l + o
- 01001000 01100101 01101100 01101100 01101111

Numbers in Memory



- 1 Byte variable
  - Unsigned Integer 0 ~ 255 (2^8=256)

    1111 1111 Bin = 255 Dec
  - Signed integer -128 ~ 127 (2^7=128)

    111 1111 Bin = 127 Dec

Numbers in Memory

- 2 Byte integer (short)
  - Unsigned Integer 0 ~ 65535 (2^{16}=65536)
  - Signed Integer –32768 ~ 32767 (2^{15}=32768)

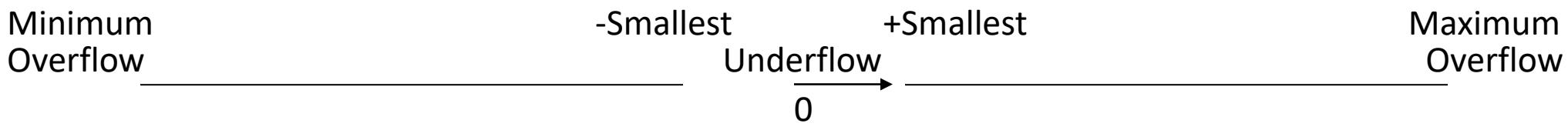
Numbers in Memory

8 Byte double (default in MATLAB)

- Accuracy 16 digits:

```
A = 1.123456789012345
B = 0.0000000000000001  (1E-16)
C = A + B
D = C - A
D = ?
```

- Maximum/Minimum ±1.8 E+308
- Smallest ±2.2 E−308

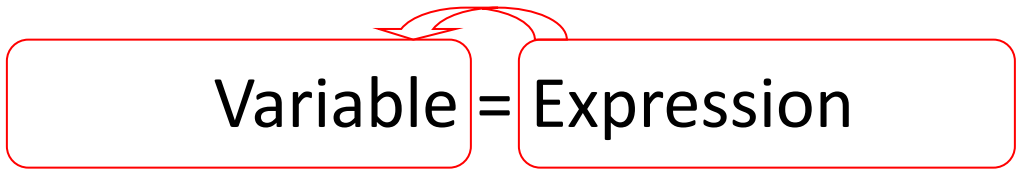


Variables

- Reserved locations in memory
- Names:
  - Including a-z, A-z, 0-9, _ (underscore)
  - Starting a-z, A-z
  - No space `section_radius`
  - Case sensitive
  - CamelCase: `SectionRadius`

Operators

- Assignments operator =
- `MyVariable = 123`



- `MyVariable = MyVariable + 1`
- `MyVariable + 1 = 2`
- Assignments vs. Equal

Arithmetic Operators

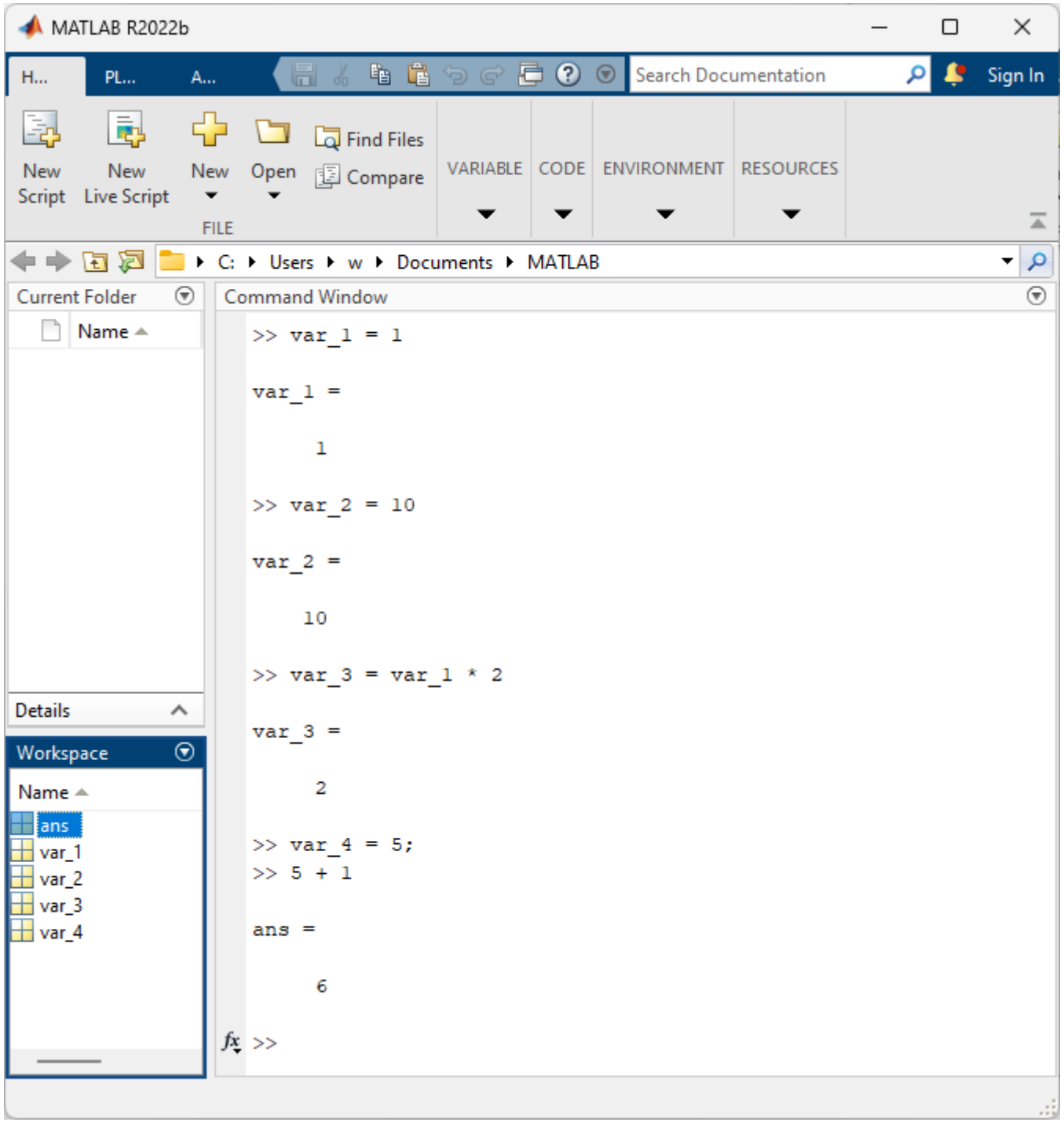
- + − × / ^
- Right division (forward slash, slash /)
- Left division (backward slash, backslash \)
  - a . x = b
  - x = a \ b
  - b / a = b . a^{-1}
  - a \ b = a^{-1}. b

Advanced calculator

- Simple calculations
- `sqrt, exp, log, log10`
- String
- Complex
- Comma
- Semicolon
- Save mat

Special variables

- `ans`
- `pi`
- `inf`
- `NaN`
- `i (or j)`
- `realmin = 2.2251e-308`
- `Realmax = 1.7977e+308`
- `intmax = 2147483647`



Built-in functions

• `abs(x)`	Absolute value
• `sqrt(x)`	Square root
• `round(x)`	Rounds towards nearest decimal or integer
• `fix(x)`	Truncates toward 0
• `floor(x)`	Rounds towards minus infinity
• `ceil(x)`	Rounds towards plus infinity
• `sign(x)`	Signum function
• `rem(x,y)`	Remainder after division
• `exp(x)`	Exponential
• `log(x)`	Natural logarithm
• `log10(x)`	Common (base 10) logarithm
• `log2(x)`	Base 2 logarithm

Trigonometry

- `sin, cos, tan, asin…` input angles in radians
- 1 degree = pi/180 radians
- `angle_radians = angle_degrees * (pi/180)`
- `angle_degrees = angle_radians * (180/pi)`
- `rad2deg, deg2rad`
- `sind, cosd`

Numerical precision

- `sin (0)`
- `sin (pi)`
- `sin (2 * pi)`

MATLAB

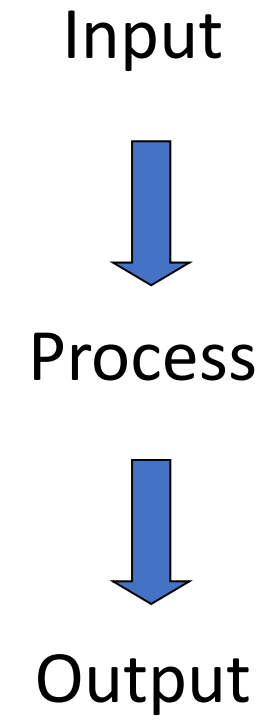
- `who` List current variables
- `whos` List current variables, long form
- `clear` Clear variables and functions from memory
- `clc` Clear command window
- `help` Help for functions in Command Window
- `doc` Reference page in Help browser
- `lookfor` Search for keyword

Scripts

- M file
- Comments
- Display
- Input

Functions

- Set of steps
- Input argument(s) (optional)
- [Output argument(s)] (optional)



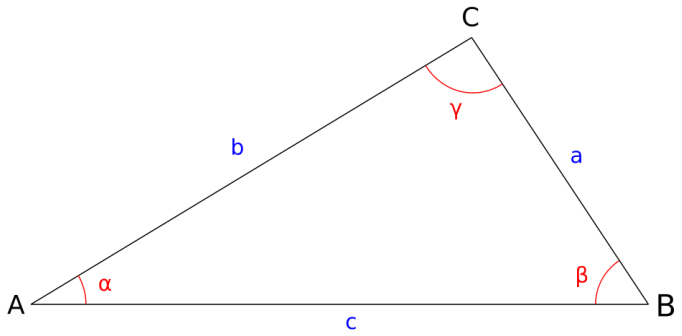
Function syntax

```
function [output1 output2] = func(input1, input2)
% Comment
code
```

- Function name, same as .m file name.
- Current directory
- Comments for help

Function example

$$c^2 = a^2 + b^2 - 2 \times a \times b \times \cos(\gamma)$$



- Define inputs
- Calculate output