BME1901 – Introductory Computer Sciences
Laboratory Handout – 5

OBJECTIVES

Learn about,

- for and while loops
- fprintf() function
- Solving various questions

TOOLS

for loops[1]

"for" loops executes a group of given statements for a specified number of times. Index values for the "for" loops may be given in the following forms;

- initVal:endVal — Increment the index variable from initVal to endVal by 1, and repeat execution of statements until index is greater than endVal.
- initVal:step:endVal — Increment index by the value step on each iteration, or decrements index when step is negative.
- valArray — Create a column vector, index, from subsequent columns of array valArray on each iteration. The input valArray can be of any MATLAB® data type.

"end" is needed to mark end of statements realted to a for loop.

```
for (index = values)

    statements

end
```

Example: Write a code that gives the even indexed values in array B from the input array A.

```
A = input('Give a number array: ');

for i = 2:2:length(A)

    B(i/2) = A(i);

end

disp(B);
```

[1] https://www.mathworks.com/help/matlab/ref/for.html

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while loops[2]

"while" loops repeats the execution of a group of statements while the expression is true. An expression is true when its result is nonempty and contains only nonzero elements (logical or real numeric). Otherwise, the expression is false. "end" is needed to mark end of statements realted to a while loop.

```
while (expression)

    statements

end
```

Example: Write a code that calculates the factorial of the input.

```
N = input('Give a number for calculation of its factorial: ');

F = N;

while N > 1

    N = N - 1;

    F = F * N;

end

disp(F);
```

ASCII character list[3]

The ASCII printable characters with their associated **decimal** code

Code	Char	Code	Char	Code	Char	Code	Char	Code	Char	Code	Char
32		48	0	64	@	80	P	96	`	112	p
33	!	49	1	65	A	81	Q	97	a	113	q
34	"	50	2	66	B	82	R	98	b	114	r
35	#	51	3	67	C	83	S	99	c	115	s
36	$	52	4	68	D	84	T	100	d	116	t
37	%	53	5	69	E	85	U	101	e	117	u
38	&	54	6	70	F	86	V	102	f	118	v
39	'	55	7	71	G	87	W	103	g	119	w
40	(	56	8	72	H	88	X	104	h	120	x
41	)	57	9	73	I	89	Y	105	i	121	y
42	*	58	:	74	J	90	Z	106	j	122	z
43	+	59	;	75	K	91	[	107	k	123	{
44	,	60	<	76	L	92	\	108	l	124	|
45	-	61	=	77	M	93	]	109	m	125	}
46	.	62	>	78	N	94	^	110	n	126	~
47	/	63	?	79	O	95	_	111	o		

[2] https://www.mathworks.com/help/matlab/ref/while.html
[3] https://i.redd.it/coajef4g08d21.png

fprintf() function[4]

fprintf(format, A1, A2, …, An) function displays the results on the screen from data given in "A1, A2, …, An" as described in "format". fprintf() function uses special characters in "format" section as placeholder for data given in data "A1, A2, …, An", these placeholder characters also specifies type of data. Additional caracters may also be used in "format" to shape the output. Some characters and their description are given in Table 1.

Table 1 – fprintf() function special characters

Character	Description
%d or %i	Base 10 signed integer
%u	Base 10 unsigned integer
%f or %X.Yf	Fixed-point notation (for numbers with a decimal point). In fixed-point notation precision operators of X (field width) and Y (precision) may be used.
%c	Single character
%s	String array
\n	New line

```
>> a = 10;

>> fprintf('a is equal to %d', a)

    a is equal to 10
```

```
>> b = -4;

>> fprintf('b is equal to %d', b)

    a is equal to -4
```

```
>> c = pi;

>> fprintf('c is equal to %f', c)

    c is equal to 3.141593
```

```
>> d = pi;

>> fprintf('d is equal to %3.2f', d)

    d is equal to 3.14
```

```
>> e = 'AB';

>> fprintf('character %c', e)

    character Acharacter B
```

```
>> f = 'AB';

>> fprintf('string %s', f)

    string AB
```

```
>> fprintf('Without new line.'); fprintf('Both texts on same line.')

    Without new line.Both texts on same line.
```

```
>> fprintf('With new line character.\n'); fprintf('Texts on different lines.')

    With new line character.
    Texts on different lines.
```

[4] https://www.mathworks.com/help/matlab/ref/fprintf.html

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PROBLEMS

1. Write a script (m-file) called "diamond.m" that requests number of stars on one edge of a diamond shape as an input from the user then then displays a dimond shape using star (*) and space characters.

2. Let's assume you and your friend want to send secret messages to each other. Therefore you come up with an encryption/decryprition method of swapping each letter of the English alphabet (26 letters) from their beginning position to their position from the end for uppercase and lowercase letters seperately (e.g.: "a" becomes "z", "b" becomes "y", "C" becomes "X", "W" becomes "D", …) while keeping all other characters unchanged. Write a script (m-file) called "encrypt_decrypt.m" that request a character array input from the user to accomplish this encryption/decrption. First give the program a character array to encrypt the message. Then take the output from part a and give it to the program to decrypt the message.

3. Write a script (m-file) called "fibonacci_rabbits.m" that would simulate the reproduction cycle of an alien rabbit spicies that come to Earth. This alien rabbit spicies does not require a mate to reproduce (so a single rabbit can create more rabbits alone one at a time) and they are immortal (they never die). Only condition for a rabbit from this alien spicies to reproduce is to grow up. When a baby alien rabbit is born it takes one month to grow up and after that it may reproduce. A baby alien rabbit comes to Earth on an asteroid. When the population of the alien rabbits surpass the human population on Earth they will invade the whole Earth. How long would it take for them to accomplish this goal and what would their population be at that time? You may assume human population on Earth around 8 billion.

4. There's a famous legend about the origin of chess that goes like this. When the inventor of the game showed it to the emperor of India, the emperor was so impressed by the new game, that he said to the man *"Name your reward!"*. The man responded, *"Oh emperor, my wishes are simple. I only wish for this. Give me one grain of rice for the first square of the chessboard, two grains for the next square, four for the next, eight for the next and so on for all 64 squares, with each square having double the number of grains as the square before."* The emperor agreed, amazed that the man had asked for such a small reward - or so he thought. After a week, his treasurer came back and informed him that the reward would add up to an astronomical sum, far greater than all the rice that could conceivably be produced in many many centuries![5] Write a script (m-file) called "story_of_chess.m" that would calculate how many rice grains should be on each square on a 8 by 8 chess board. Then calculate the total number of rice grains. Taking the average weight of a rice grain as 0.029 grams find the total weight of all rice grains. Assuming 1 billion tonnes of rice being produced globally per year how long would it take to whole world today to pay the inventor of chess.

[5] http://www.dr-mikes-math-games-for-kids.com/rice-and-chessboard.html