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Flow Control and Loops with MATLAB

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Flow Control and Loops in MATLAB

Flow Control:

- if-elseif-else statement
- switch-case-otherwise statement

Loops:

- for Loop
- while Loop

The behavior is the same as in other programming languages. It is assumed you know about For Loops, While Loops, If-Else and Switch statements from other programming languages, so we will briefly show the syntax used in MATLAB and go through some simple examples.

If-else Statements

Given the second order algebraic equation:

$$ax^2 + bx + c = 0$$

The solution (roots) is as follows:

$$x = \begin{cases} \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}, & a \neq 0 \\ -\dfrac{c}{b}, & a = 0, b \neq 0 \\ \emptyset, & a = 0, b = 0, c \neq 0 \\ \mathbb{C}, & a = 0, b = 0, c = 0 \end{cases}$$

where $\emptyset$ - there is no solution, $\mathbb{C}$ - any complex number is a solution

If-else Statements

Create a function that finds the solution for x based on different input values for a, b and c, e.g.,

```
function x = solveeq(a,b,c)
```

We will do the following:

- Use if-else statements to solve the problem
- Test the function from the Command window to make sure it works as expected, e.g.,

```
>> a=0, b=2,c=1
>> solveeq(a,b,c)
```

You may define the function like this:

```
function x = solveeq(a,b,c)
if a~=0
    x = zeros(2,1);
    x(1,1)=(-b+sqrt(b^2-
4*a*c))/(2*a);
    x(2,1)=(-b-sqrt(b^2-
4*a*c))/(2*a);
elseif b~=0
        x=-c/b;
elseif c~=0
    disp('No solution')
else
   disp('Any complex number is a
solution')
end
```

We test the function:

1

```
>> a=0, b=2,c=1
a =
     0
b =
     2
c =
     1
>> solveeq(a,b,c)
ans =
   -0.5000
```

```
>> a=1;, b=2;,c=1;
>> solveeq(a,b,c)
ans =
    -1
     0
```

```
>> a=1;, b=1;, c=2;>> solveeq(a,b,c)

ans =        -0.5000 + 1.3229i
             -0.5000 - 1.3229i
```

2

```
>> a=0;, b=0;,c=1;
>> solveeq(a,b,c)
No solution
```

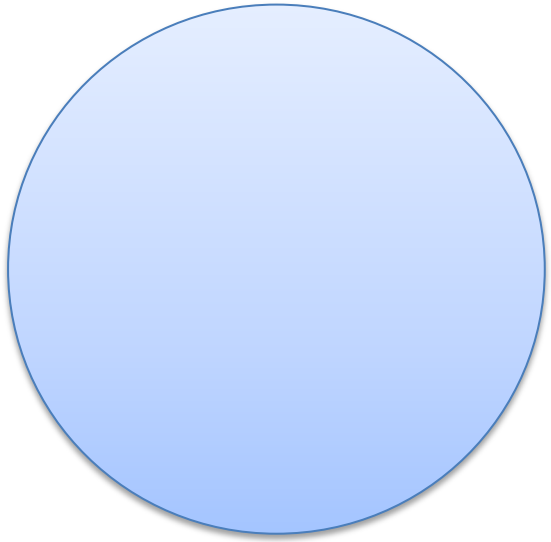
3

```
>> a=0;, b=0;,c=0;
>> solveeq(a,b,c)
Any complex number is a solution
```

Switch-Case Statements

- Create a function that finds either the Area or the circumference of a circle using a Switch-Case statement

$$A = \pi r^2$$
$$O = 2\pi r$$



- You can, e.g., call the function like this:

```
>> r=2;
>> calc_circle(r,1) % 1 means area
>> calc_circle(r,2) % 2 means circumference
```

We can define the function like this:

```
function result = calc_circle(r,x)

switch x
    case 1
        result=pi*r*r;
    case 2
        result=2*pi*r;
    otherwise
        disp('only 1 or 2 is legal values for x')
end
```

Testing the function:

```
>> r=5;, calc_circle(r,1)
ans =
   78.5398
>> r=5;, calc_circle(r,2)
ans =
   31.4159
```

Using an illegal value gives:

```
>> r=5;, calc_circle(r,3)
only 1 or 2 is legal values for x
```

Fibonacci Numbers

- In mathematics, Fibonacci numbers are the numbers in the following sequence:

  0, 1, 1, 2 ,3, 5, 8, 13, 21, 34, 55, 89, 144, …

- By definition, the first two Fibonacci numbers are 0 and 1, and each subsequent number is the sum of the previous two. Some sources omit the initial 0, instead beginning the sequence with two 1s.
- In mathematical terms, the sequence f_n of Fibonacci numbers is defined by the relation:

$$f_n = f_{n-1} + f_{n-2}$$

- with seed values:

$$f_0 = 0, f_1 = 1$$

For Loops

Fibonacci Numbers

We will write a function in MATLAB that calculates the N first Fibonacci numbers, e.g.,

```
>> fibonacci(N)
ans =
     0
     1
     1
     2
     3
     5
     8
    13
    21
    34
```

We will se a For loop to solve the problem.

We define the Function:

```
function f = fibonacci(N)

f=zeros(N,1);
f(1)=0;
f(2)=1;

for k=3:N
    f(k)=f(k-1)+f(k-2);
end
```

We execute the function:

```
>> fibonacci(N)
ans =
     0
     1
     1
     2
     3
     5
     8
    13
    21
    34
```

While Loops

- Create a Script or Function that creates Fibonacci Numbers up to a given number, e.g.,

```
>> maxnumber = 2000;
>> fibonacci(maxnumber)
```

The function can be written like this:

```
function f = fibonacci2(max)
f(1)=0;
f(2)=1;

k=3;
while f < max

    f(k)=f(k-1)+f(k-2);
    k=k+1;
end
```

Testing the function gives:

```
>> maxnumber=200;
fibonacci2(maxnumber)

ans =
     0     1     1     2     3     5     8
13    21    34    55    89   144   233
```

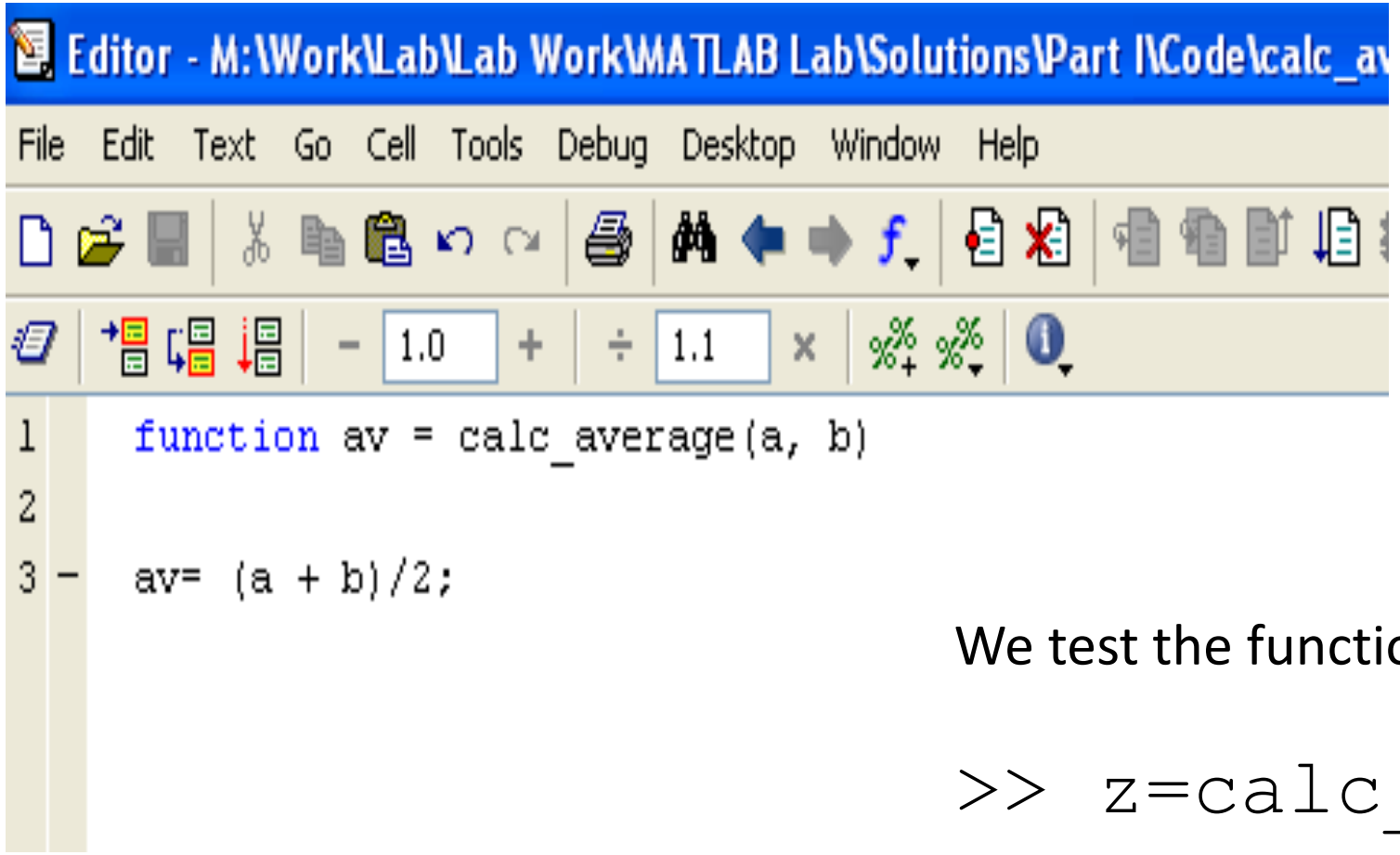
For Loops

- Extend your **calc_average** function from a previous example so it can calculate the average of a vector with random elements. Use a For loop to iterate through the values in the vector and find sum in each iteration:

```
mysum = mysum + x(i);
```

- Test the function in the Command window

Previous Version of calc_average function:



We test the function in the Command window

```
>> z=calc_average(x,y)
z =
     3
```

The function can be written like this:

```
function av = calc_average2(x)

mysum=0;
N=length(x);

for k=1:N
    mysum = mysum + x(k);
end

av = mysum/N;
```

Testing the function gives:

```
>> x=1:5
x =
     1     2     3     4     5
>> calc_average2(x)
ans =
     3
```

If-else Statement

Create a function where you use the "**if-else**" statement to find elements larger then a specific value in the task above. If this is the case, discard these values from the calculated average.

Example discarding numbers larger than 10 gives:

```
x =
     4     6    12

>> calc_average3(x)
ans =
     5
```

The function can be written like this:

```
function av = calc_average2(x)

mysum=0;
total=0;
N=length(x);

for k=1:N

    if x(k) < 10
        mysum = mysum + x(k);
        total=total+1;
    end

end

av = mysum/total;
```

Testing the function gives:

```
x =
     4     6    12

>> calc_average3(x)
ans =
     5
```

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