

Functions and scripts

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Lecture 04

Scripts

Script is the sequence of the Matlab expressions written in the file.

```
N=1:N_max;
M=0*(N);
for i=N
    M(i)=(1+x/i)^i;
end
plot(N,M,'-');
xlabel('N, number of payments per year');
ylabel('Money grows');
title('Money grows vs number of payments per year');
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Now we can assign any N_{max}
and x , then execute the script

```
>> N_max=4; x=.5;  
>> money_grows;  
>> M  
M =  
1.50    1.56    1.58    1.60
```

Scripts variable space

Unlike functions **scripts modify Workspace variables**

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>> M=123; x=.5;  
>> N_Max=2; money_grows;  
>> M
```

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```
>> M=123; x=.5;  
>> N_Max=2; money_grows;  
>> M
```

```
M =  
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```

Think about script as it is a keyboard macro. Calling script is equivalent to typing the scripts statements from the keyboard.

Matlab functions

Used for separation of a meaningful chunk of code

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function [out1, out2, ..., outN] = func_name (arg1, arg2, ..., argN)  
    % optional but strongly recommended function description  
    set of expressions of the function body  
  
end
```


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end
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```
function h=hypotenuse(cathetus1, cathetus2)  
% Calculates hypotenuse of a right angle triangle.  
% Inputs are the length of the catheti:  
% cathetus1 and cathetus2  
    h=sqrt(cathetus1^2+cathetus2^2);  
end
```

Function must be saved into separate name with filename matching function name and extension `m`. In our case it is `hypotenuse.m`

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```
>> c=hypotenuse(3,4)  
c =  
    5
```

Function self documentation

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Function with multiple output

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function [pos,neg]=pos_neg_sum(x)
% calculates sum of positive and negative elements
% of the input vector
    pos=sum(x(x>0));
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```
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If you ask for less it will return the first in the list value i.e. `pos`

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Local space of variables in functions

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>> pos=23;
>> x=[1,-1,-1];
>> v=[1,2,-2,3,-5];

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```

```
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n =
   -7
```

```
>> pos
pos =
    23
```

```
>> x
x =
    1   -1   -1
```

Recursion: function calls itself

Canonical example: factorial

$$N! = N \times (N - 1) \times (N - 2) \cdots 3 \times 2 \times 1$$

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We can rewrite it as

$$N! = N \times (N - 1)!$$

Notice that $0! = 1$

Recursion for factorial

```
function f=myfactorial(N)
% Calculates factorial of the input. N!=N*(N-1)!
% Input must be an integer larger or equal to zero.

if ( N < 0 ) % ALWAYS sanitize the input !!!
    error('wrong input, input must be >= 0');
end
if ( N ~= floor(N) )
    error('input is not an integer number');
end
% Once input is good we can calculate the factorial
if ( N==0 )
    f=1; return; % return stops the evaluation
end
f=N*myfactorial(N-1);
end
```

Saving your results

Let's say you have calculated some intermediate results and want to save them.

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Not surprisingly it is done with `save` command. It can be called in several different ways.

- command form

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- functional form

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save('filename.mat')
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- saves all workspace variables to the file 'filename.mat'

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To save only `var1`, `var2`, and `var3`

- `save 'filename.mat' var1 var2 var3`

- `save('filename.mat', 'var1', 'var2', 'var3');`

- `fname='saved_variables.mat'; save(fname, 'var1', 'var2', 'var3');`

notice the use of apostrophes

i.e. `save` as a function expect strings for the arguments.

Saving: couple words of wisdom

By default Matlab saves into a binary format specific to Matlab. If you work with Matlab only it is fine.

But I personally do not like formats which are not human readable at least if they generate reasonably small sized files.

To generate human readable format you can use `-ascii` switch when saving but such notation **drops the variable name** from the file.

So do not use `-ascii` to save multiple variables, **save only one variable per file**

- `save -ascii 'filename.mat' var1`
- `save('filename.mat', '-ascii', 'var1');`
- `fname='saved_variables.mat'; save(fname, '-ascii', 'var1');`

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It is done with `load` command. It can be called in several different ways.

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- loads all variables from the file 'filename.mat'

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- `load('filename.mat', 'var1', 'var2', 'var3');`

- `fname='variables.mat'; load(fname, 'var1', 'var2', 'var3');`

- loads only variables `var1`, `var2`, and `var3`

notice the use of apostrophes, `load` as a function expect strings for its arguments.

Often you need to import data from other sources.

- `load` is often smart enough
- Otherwise right click on a data file in the `Current Folder` tab and chose `Import Data`.
 - Notice handy check mark `Generate Matlab code` for the case where you have many similarly structured files to be imported.