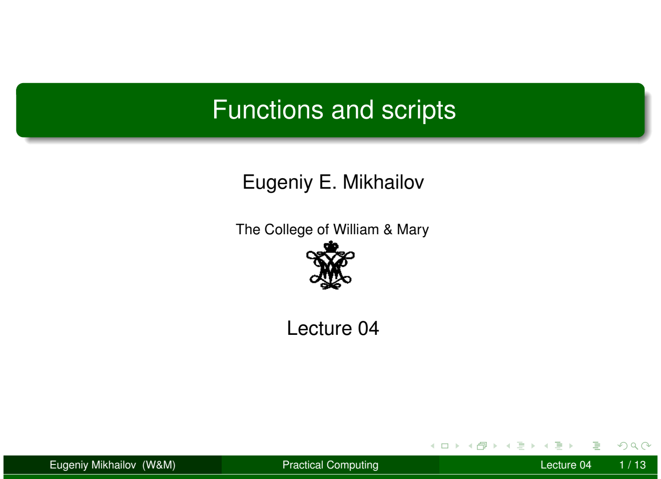

Functions and scripts

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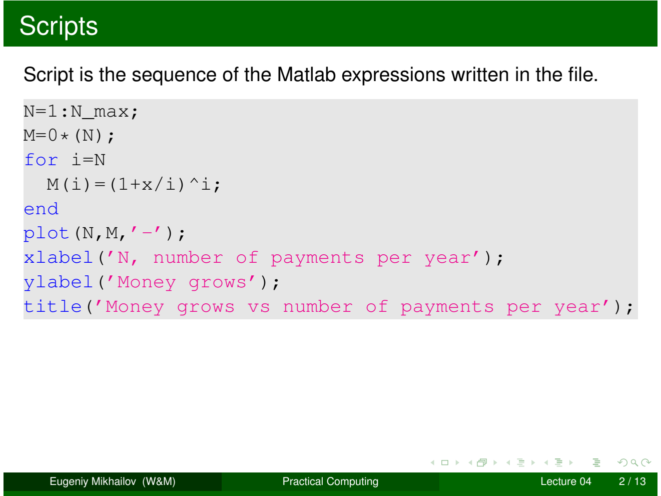
The College of William & Mary

Lecture 04

Notes

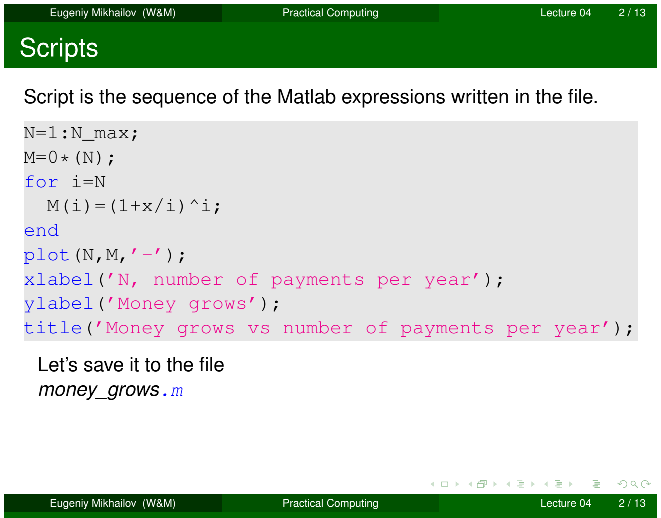


Scripts

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');
```

Notes



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Let's save it to the file *money_grows*.m

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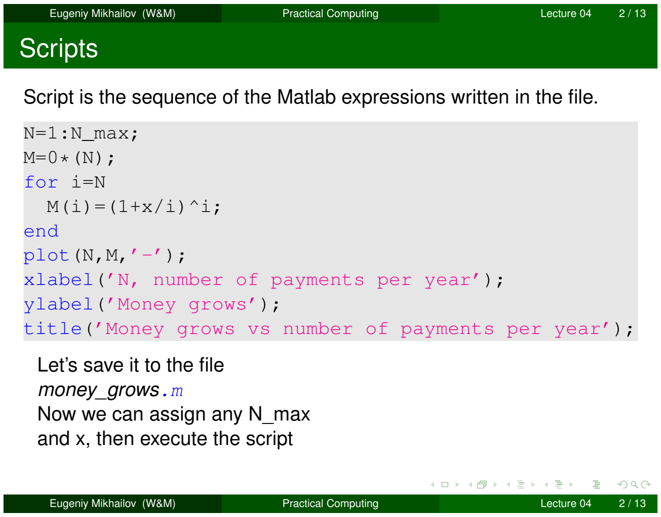

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Let’s save it to the file *money_grows*.m
Now we can assign any N_max and x, then execute the script

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

Notes

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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N=1:N_max;
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```

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

```
M =
1.5000    1.5625
```

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

Notes

Matlab functions

Used for separation of a meaningful chunk of code

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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```
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);
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```

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
```

Notes

Function self documentation

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```
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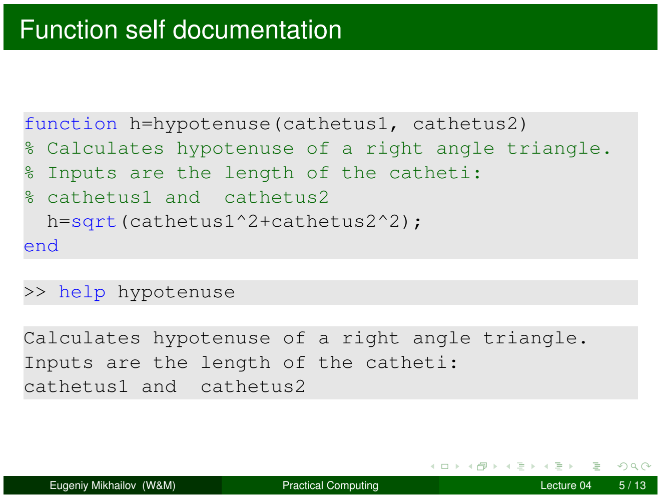
Notes



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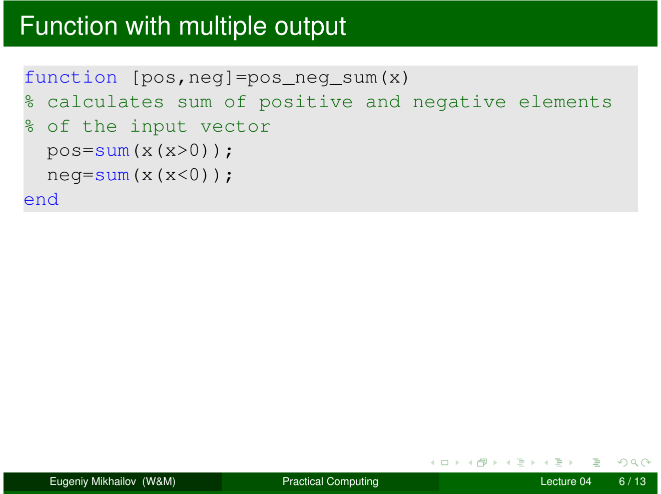

Function with multiple output

```
function [pos,neg]=pos_neg_sum(x)
% calculates sum of positive and negative elements
% of the input vector
  pos=sum(x(x>0));
  neg=sum(x(x<0));
end
```

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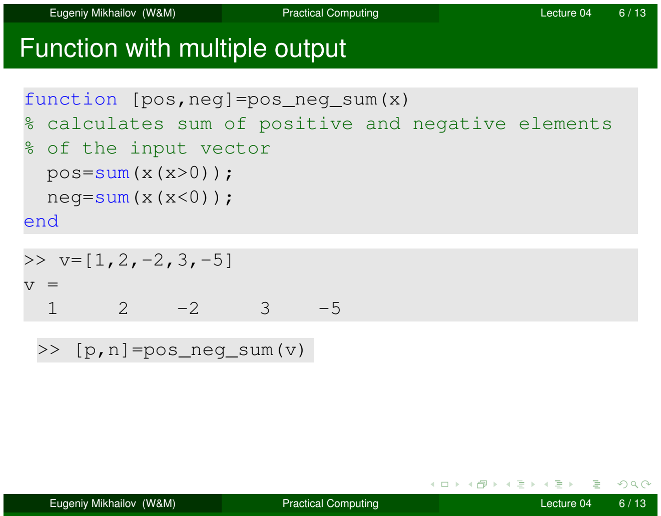

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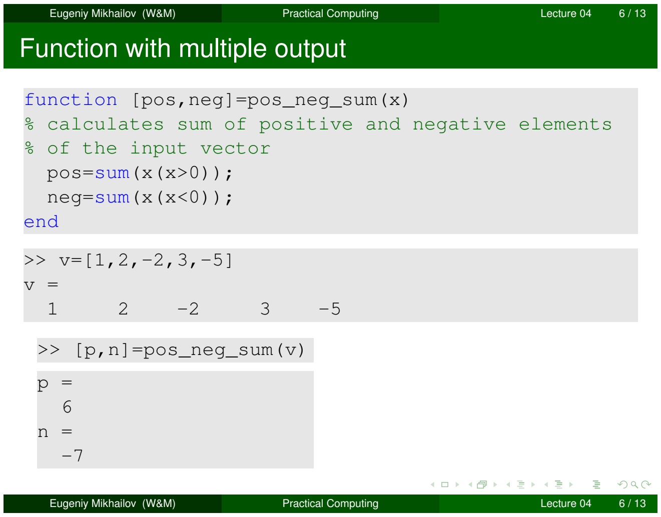
```
>> v=[1,2,-2,3,-5]
v =
  1     2    -2     3    -5
```

```
>> [p,n]=pos_neg_sum(v)
```

Notes



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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];

[p,n]=pos_neg_sum(v)
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   6
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   -7
```

```
>> pos
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    23
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```

```
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   6
n =
   -7
```

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

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

Notes

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 $0! = 1$

Notes

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
```

Notes

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.

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  `save ’filename.mat’`
- functional form
  `save(’filename.mat’)`
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- command form
  `save 'filename.mat'`
- functional form
  `save('filename.mat')`
  - saves all workspace variables to the file 'filename.mat'

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.

Notes

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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Now you want your results back to the workspace

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To load only var1, var2, and var3

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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.

Notes

Data Import

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.

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