

Computing Fundamentals

Salvatore Filippone

`salvatore.filippone@uniroma2.it`

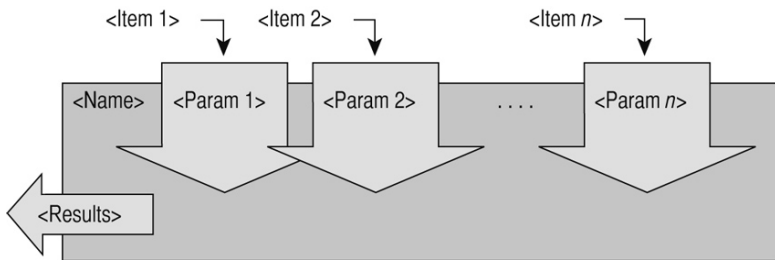
2012–2013

Functions are an essential ingredient of programming. They do:

- 1 Encapsulate a set of instructions for easy reuse;
- 2 Separate interface from implementation;
- 3 Separate variable spaces.

The black box view of functions:

A function only communicates with the rest of the world via its input arguments and its result(s)





```
function < results > = <function name > (<arguments>)  
  <documentation>  
  
  <code body >  
end
```

The final `end` is optional.



Example 1

```
function    mx=amax(v)
    % Return the max absval of a vector
    mx=0;

    for i=1:length(v)
        if (abs(v(i)) >= mx)
            mx = v(i);
        end
    end
```



Example 2

```
function [mx,ix]=iamax(v)
    % Return the max (abs) val of a vector
    % and its position
    mx=0;
    ix=0;

    for i=1:length(v)
        if (abs(v(i)) >= mx)
            mx = v(i);
            ix = i;
        end
    end
```



What happens when you invoke a function?

- 1 You (the user) type the name of the function, and specify constants and/or variables (*actual parameters*)
- 2 The system establishes a correspondence between the entities in the caller's workspace and the *formal arguments* in the function's workspace;
- 3 The function does its computations, and assigns values to the results;
- 4 The results are associated with the variables specified by the user.

The correspondence on entry/exit is established by *copying* the value; this is the *call by value* mechanism.



What happens when you invoke a function?

```
function volume = cylinder1(height, radius)
% function to compute the volume of a cylinder
% volume = cylinder(height, radius)
    base = pi * radius^2;
    volume = base * height;
```

```
h=10;
```

```
r=2;
```

```
vol=cylinder1(h, r);
```


Fine points:

- The work space of the function is separated from the outer workspace; (try `whos`)
- The copy semantics means that the function is normally free to alter the input arguments;
- But copy semantics also means there is an overhead that can be quite substantial;
- It is possible to declare a `global` variable (must be done in both caller and function), but use with great care!
- A function may invoke other functions;
- Always test functions;

Fine points:

- The Matlab/Octave language is peculiar in making it easy to return multiple variables;
- The input arguments may be specified only in part: `nargin`, `nargout`;
- A function is stored in a file with the same name and an `.m` extension;
- How does Octave/Matlab search for a function?

Style points:

- Never trust the user (not even yourself!)
- Never do input/output inside a function;
- Always debug in isolation;
- Consider carefully what a function should do, and whether to partition its work.

Examples:

- Find the roots of a quadratic polynomial;
- Evaluate a polynomial;
- Compute the GCD of two numbers;
- Book exercises;