Matlab programming

Discretization Methods in Engineering

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Introduction

Motivation:

- Goal #4: program algorithms
- We need a "simple" programming language to express and test algorithms.

What is `Matlab`?

- Stands for `Matrix Laboratory`.
- Developed and sold by Mathworks (`http://www.mathworks.com`)
- An interpreted programming language.
- Versions for windows, mac, linux, ...
- Student version 50€
- Not the fastest running code, but very easy fast to develop, test
- It has a huge users base, sharing tools and libraries.

Octave

What is `octave`?

- A free `Matlab` clone
- Available from `http://www.gnu.org/software/octave/`
- Not 100% compatible with `Matlab`, but enough for the course

How are we using Matlab

- You definitely need to know to program in `Matlab`, for this and other courses in the Master's.
- Mathworks web page has manual, "webinars", tutorials,
- There are hundreds of documents on the web. For example: `http://mat21.etsii.upm.es/ayudainf/aprendainf/Matlab70/matlab70`
- You will have to program numerical methods
- You will modify an existing finite element code.

Programming style

Almost anybody can program. But you need to program well. For this class, we have some rules:

1. You have to include comments in your code.
2. Your code must be properly indented
3. Variables and functions must have meaningful names
4. You must structure your algorithms with functions

Comments in your code

Provide explanations either in Spanish or English of what you do, when it is not obvious

Example (Bad coding)

```
function a = xp43(j)
r = 2.0*pi; % set r equal to 2 pi
a = r*j;
end
```

Example (Better coding)

```
% circlelength
% computes the length of a circle from its radius
% usage   l = circlelength(r)
% input   r : the radius
% output  l : the length
% author: ir, date: sep 2013
function l = circlelength(r)
    l = 2.0*pi*r;
end
```

Indent your code

Properly indented code reads much better

Example (Bad coding)

```
function m = mm12k(j)
m = 0.0;
for i=1 :length(j),
if (mod(j(i),2) == 0)
m = max(m,j(i));
end
end
end
```

Example (Better coding)

```
% maxeven
% computes the maximum even number of a vector of nonn
% returns 0 if all numbers are odd, or 0 is the only e
% usage  me = maxeven(v)
% input  v : a vector of nonnegative integers
% output me : the maximum even number
% author: ir, date: sep 2013
function me = maxeven(v)
  m = 0.0;
  for i = 1 : length(v),
     % check the parity of v(i)
     if (mod(v(i),2) == 0)
        m = max(m,v(i));
     end
  end
end
```

Given meaningful names to variables and functions

Example (Bad coding)

```
function x = xx(yy)
g = yy(1,:);
p = yy(2,:);
w = yy(3,:);
c = norm(g-p);
f = norm(p-w);
s = norm(w-g);
b = min(c,f);
x = min(b,s);
end
```

Example (Better coding)

```
% shortedge
% computes the length of the shortest edge of a triang
% usage   l = shortedge(t);
% input   t : a (3x2) matrix. Each row holds the (x,y)
% output l : the length of the shortest edge in the tr
% author: ir, date: sep 2013
function l = shortedge(t)
   edge(1) = norm( t(1,:) - t(2,:) );
   edge(2) = norm( t(2,:) - t(3,:) );
   edge(3) = norm( t(3,:) - t(1,:) );
   l       = min(edge):
end
```

Structure your code with functions and subroutines

Some guidelines:

- Functions should be short(?) units of code with well defined input, output and purpose.
- When a piece of code is often used, make it an independent function.
- When a function gets too long or complex, see if you can split it into simpler tasks.

And last...

- `Matlab` is a high level programming language, meaning there are hundreds of pre-defined commands, doing all kinds of useful operations on data.
- In particular, matrix and vector operations are defined in the language.

Example

Don't do:

```
a = 0;
for i = 1:10,
    a = a + v(i)*v(i);
end
a = sqrt(a);
```

Instead do:

```
a = norm(v);
```

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