

Lecture 2

Matlab Tutorial: Part 1

L. Olson

Department of Computer Science
University of Illinois at Urbana-Champaign

2005.12.01



What is MATLAB?

- both a computing environment and a language
- initially developed as an easy interface to LAPACK: Linear Algebra Package (FORTRAN libraries)
- **MAT**rix **LAB**oratory
- Written in C. For matrix computations, it calls C/Fortran libraries == Fast
- Matlab + "Toolboxes"
 - ▶ Symbolic Math Toolbox: mathematical manipulation of symbols
 - ▶ Partial Differential Equation Toolbox: tools for solving PDEs in 2-D
 - ▶ Statistics Toolbox: statistical data analysis
 - ▶ Image processing toolbox: visualization and image analysis
 - ▶ Bioinformatics toolbox: computational molecular biology
 - ▶ Compiler: application development
 - ▶ many many more.
- <http://www.mathworks.com>



Why Matlab?

The Good:

- Fast development times
- no compiling, easy debugging
- accessible syntax and language constructs
- in-house graphics capabilities
- tons of basic "libraries" or functions available
- many more complicated "toolboxes" can be added

The Bad:

- small coding mistakes can result in slow code
- loops are extremely computationally intensive
- language is limited: no templates, classes etc.

The Ugly:

- proprietary (but the language format is open)
- expensive
- the open source substitute, Octave, is not fully compatible



How to Matlab?

Luke's 4 **big ideas**:

- 1 Let Matlab help you
- 2 Everything is a matrix
- 3 tri-development: interactive, scripting, functions (next time)
- 4 visualize



Let Matlab Help You

- `>> help`
- `>> doc`
- `>> lookfor`
- Actually **read** the error messages

```
>> a = 3  
a = 3
```

```
>> c = a + b  
??? Undefined function or variable 'b'.
```



Everything is a Matrix

```
a =  
1     2     3     4     5  
  
b =  
some string  
  
>> a = [1 2 3 4 5]  
>> b = 'some string'  
>> whos  
Name      Size      Bytes  Class  
>> a(3)    a         1x5      40    double array  
>> b(3)    b         1x11     22    char array  
>> length(a)  
>> length(b)  
  
ans = 3  
ans = m  
ans = 5  
ans = 11
```



Exercise #1

```
..Matlab
```

Exercise #1

Show $\sum_{n=1}^{\infty} \frac{1}{n^2}$ converges to $\frac{\pi^2}{6}$.

- do not use loops
- consider $n = 100, 1000, 10000$
- can be done in 4 lines:



Exercise #1

```
>> exact = (pi^2)/6
>> n = 1000;
>> a = 1:n;
>> a = a.^2;
>> a = 1./a;
>> approx = sum(a)
>> exact - approx
```



Exercise #2

- Ruffed Grouse: Primary upland game bird of central/northern Wisconsin



- Wisconsin DNR data: `grouse.dat`

1964 1.14

1965 1.02

1966 0.94

·

·

·

- First Column: year
- Second Column: Average number of "drums" per stop (overlap starting at year 1994. Line 34)
- Plot the data. Are there any trends?



Exercise #2

```
>> g = load('grouse.dat')
>> plot(g(1:33,1),g(1:33,2),'r-s')
>> hold on;
>> plot(g(34:44,1),g(34:44,2),'b-o')
>> legend('Early Drum Stations','New Drum Stations')
>> axis([1960 2005 0.0 3.0])
```

Practice!

- go over §2.1 - §2.5
- "matlab tutorial" on the web
- <http://www.cse.uiuc.edu/heath/scicomp/matlab.html>
- HW#1 is on the web
- Next time: Matlab **programming** basics
- Next next time: advanced Matlab + errors
- Project idea: Sparse Storage in Matlab, Mat-Vec multiply (see me)

