

CS 486/686 – Matlab Tutorial

Introduction to Matlab with
a focus on Assignment 3

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What is Matlab?

- “Matlab” comes from the words **Matrix Laboratory**:
 - It’s an environment for scientific computing based on *matrix manipulation*.
 - It has an interactive environment, a function library, and a programming language.

Starting and Exiting Matlab

- To start Matlab:
 - Type “`matlab`” at the Unix prompt.
 - Options: “`matlab -nojvm -nosplash`”
- To exit Matlab:
 - Type “`exit`” or “`quit`” at the Matlab prompt.

Getting HELP

- The most important command:
 - Type “`help`” at the Matlab prompt.
 - Type “`help command`” for help on a command.
- Other useful help commands:
 - “`lookfor`” – search for a command.
 - “`helpdesk`” or “`helpwin`” – help window.

Matrices

- (Almost) everything is a matrix:
 - `> A = [1 2; 3 4]`
A =
1 2
3 4
 - `> A(2,1)`
ans =
3
- Can also have higher dimensions:
 - `> T = zeros(17,17,4);` (note semicolon)
 - `> size(T)`
ans =
17 17 4

Matrices (cont'd)

- Initialization:
 - zeros, ones, eye, cat
 - `> Uprime = zeros(17,1);`
- Submatrices:
 - `> A(2,:)`
ans =
3 4
 - `> A(:,1)`
ans =
1
3

Matrix manipulation

- Operate on entire matrices:
 - Add, subtract, multiply, divide.
 - `> C = A + B;`
- Operate on each element:
 - `> C = A .* B;`
 - See "help times", "help mtimes".

Helpful functions

- For Assignment 3, you might want to take a look at the "help" for:

- `max (min), abs, sum`
 - `delta = max(delta, abs(Uprime(s) - U(s)));`

- Suppose we want (for a fixed s):

$$\max_a \sum_{s'} T(s, s', a) U(s')$$

Helpful functions - Example

- First, we look at:
 $T(s, s', a)U(s')$
- Recall that the *size* of T is (17,17,4):
 - Thus, the *size* of $T(s, :, :)$ is (1,17,4).
 - But the *size* of U is (17,1).
- To multiply T and U on index s' , first:
 - `U4 = repmat(U,1,4) % same as [U U U U]`
 - which now has a *size* of (17,4).

Helpful functions - Example

- We want:
 $T(s, s', a)U(s')$
- We define:
 - `TU = squeeze(T(s, :, :)) .* U4;`
 - See "help squeeze".
- Then: $\max_a \sum_{s'} T(s, s', a)U(s')$
is just: `max(sum(TU))`;

Loops

- Matlab has both "for" and "while":

```
i = 1;
for t = 0:pi/20:pi,
    y(i) = sin(t);
    i = i+1;
end
```
- "For" loops can often be replaced:

```
t = 0: pi/20 : pi;
y = sin(t)
```
- See help for "for", "while", "break".

Scripts and Functions

- Matlab can execute ".m" files:
 - Can either be scripts or functions.
- Function definitions:
 - Result, function name, input args.
 - `function [T, R] = gridWorld`
 - `function utility = valueIteration(T, R, gamma, epsilon)`
 - `function showGrid(U)`
- Try changing to:
 - `function [T,R] = gridWorld(a,b)`

Other useful commands

- Workspace:
 - `whos`, `size`
- Matrix manipulation:
 - `find`, `relop`, `logical`
- Display:
 - `disp`, `sprintf`, `(;)`
- Diary:
 - `diary on`, `diary off`, `diary('file')`

Value Iteration

```
function U = valueIteration(T, R, gamma, epsilon)
    Uprime = ...
    while true, % repeat
        U = Uprime; delta = 0;

        for s = 1:17, % for each state s in S do
            Uprime(s) = ... % recall TU from earlier

            delta = ... % update delta
        end % for

        if delta ... % do until condition
            break;
        end % if
    end % while
```

For additional information

- The MathWorks website:
 - <http://www.mathworks.com>
- Also check the course newsgroup.