

CS 486/686 – Matlab Tutorial

Introduction to Matlab with
a focus on Assignment 3

David L. Yeung
(for Prof. Pascal Poupart)
June 29, 2005

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.