Matlab Programming

Linear Algebra

Matlab arrays are designed to act just like matrices and tensors from linear algebra.

```
>> a = [2 3; 4 5];
>> b = [1 2;1 2];
```

Matlab arrays are designed to act just like matrices and tensors from linear algebra.

```
>> a = [2 3; 4 5];
>> b = [1 2;1 2];
>> a * b
   5   10
   9   18
```

Lots of useful utilities

```
>>> sum(a)
```
6   8

```
>>> sum(a, 2)
```
5

9

```
        2  →
      ┌────┬────┐
1     │ 2  │ 3  │  5
      ├────┼────┤
↓     │ 4  │ 5  │  9
      └────┴────┘
        6    8
```

Why is one a row and one a column?

Example: disease statistics

. One row per patient

. Columns are hourly responsive T cell counts

```
>>> data(:, 1) # t₁ count for all
patients
```

$1 \quad 0 \quad 0 \quad 2 \quad 1$

```
>>> data(1, :) # all samples for
patient 1
```

$1 \quad 3 \quad 3 \quad 5 \quad 12 \quad 10 \quad 9$

```
>>> mean(data)    # over time
0.8   2.6   4.4   6.4   10.8   11.   12.2

>>> mean(data, 2)    # per patient
6.14   4.28   16.57   2.14   5.29
```

mean(data,1) is the same as mean(data).

Select the data for people who started with
a responsive T cell count of 0

```
>>> data(:, 1)
  1 0 0 2 1
>>> data(:, 1) == 0
  0 1 1 0 0
>>> data( data(:, 1) == 0 )
  0  1  2  4  8  7  8
  0  4 11 15 21 28 37
```

Find the mean T cell count over time for people who started with a count of 0

```
>>>               data(:, 1)
```

Column 1

Find the mean T cell count over time for people who started with a count of 0

```
>>>                data(:, 1) == 0
```

Column 1 is 0

Find the mean T cell count over time for people
who started with a count of 0

```
>>>          data( data(:, 1) == 0 )
```

Rows where column 1 is 0

Find the mean T cell count over time for people who started with a count of 0

```
>>> mean(data( data(:, 1) == 0 ))
```

Mean along axis 1 of
rows where column 1 is 0

Find the mean T cell count over time for people who started with a count of 0

```
>>> mean(data( data(:, 1) == 0 ))
```

0   2.5   6.5   9.5   14.5   17.5   22.5

Find the mean T cell count over time for people
who started with a count of 0

```
>>> mean(data( data(:, 1) == 0 ))
```

0   2.5   6.5   9.5   14.5   17.5   22.5

Key to good array programming: no loops!

There are thousands of built-in functions in Matlab. The are fastõ

õ and someone else has debugged them.

```
conj                hist
   conv                lsqr
     corr                   eig
        diag                      roots
          fft                          solve
             gradient              ode15s
```

Matlab documentation: examples and a brief summary of the algorithm they implement.

```
>> help solve

SOLVE   Symbolic solution of algebraic
    equations.

    SOLVE('eqn1','eqn2',...,'eqnN')


    SOLVE('eqn1','eqn2',...,'eqnN','var1,var
    2,...,varN') …
```

Type =helpq at the command line to bring up a list of all available functions.

If Matlab doesnq have the exact function you are looking for, you can:

1) Check Matlab Centralq file exchange, where youql find many cutting edge packages, or

2) Build the function yourself using the information in the next lecture.

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