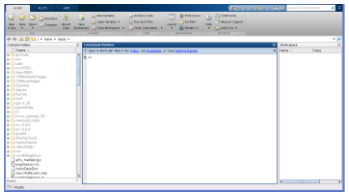
CISC 3250
Systems Neuroscience

Matlab



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Commands

Symbols and keywords cause actions

- `b=2` *creates variable b with value 2*
- `d=b+5` *creates variable d with value computed by adding 5 to value of b*
- `exit` *closes program*

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= operation

= assigns value on right to variable on left

- `b=5` **valid**
- `5 = b` **invalid**

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Variable names

- A variable name is any valid identifier
  - Starts with a letter, contains letters, digits, and underscores (_) only
  - Cannot begin with a digit
  - Case sensitive: `username≠userName≠UserName`

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Standard arithmetic

Operators

- Addition: `5 + 2` evaluates to `7`
- Subtraction: `5 - 2` evaluates to `3`
- Multiplication: `5 * 2` evaluates to `10`
- Division: `4 / 2` evaluates to `2`
- Exponent: `5 ^ 2` evaluates to `25`

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Be careful with variable names

- `NumSpikes=10`

Variables are case-sensitive

- `numspikes-5` **error, did not capitalize N and S**
- `NumSpike-5` **error, forgot letter s at end**

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Logic

Conditional behavior based on variable value

```
if x > 5
  y=2;
else
  y=5;
end;
```

Basic syntax

```
if condition
  actions-if-true
else
  actions-if-false
end
```

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Logic

Conditional behavior based on variable value

```
if x > 5
  y=2;
else
  y=5;
end;
```

Comparisons

- `d<2, d>2` strict inequality
- `d<=2, d>=2` semi-inequality
- `d==2` equality

Logic combinations

- `d>5 & d<8` the AND operation
- `d<5 | d>8` the OR operation

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Loop

Repeating similar action

```
for i = 1:4
  disp(i);
end;
```

Output

```
1
2
3
4
```

Basic syntax

```
for var = VarValues
  actions-to-repeat
end
```

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Defining a vector

Vector is a list of numbers

- `b=[42,35,68,-3]`
- `c=[-18 12 14]`

Vector denoted by [ ] braces

Elements separated by commas , or blank spaces

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Counting in Matlab

`a:b` creates a vector `[a a+1 … b-1 b]`

- `3:6 -> [3 4 5 6]`

`a:k:b` creates a vector `[a a+k a+2k … b]`

- `3:4:15 -> [3 7 11 15]`

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Accessing vector elements

```
a=[2.2 1.4 -5 3.5 -7.8];
```

- `name(index)` accesses single element

`a(4)` *returns* `3.5`

- `name(index1:index2)` accesses set of elements

`a(2:4)` *returns* `[1.4 -5 3.5]`

- `name(end)` accesses final element

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Matrix indexing

Assume we have a 10x500 matrix of spike patterns for 10 neurons `spikeMat`

- `spikeMat(1,:)` contains spikes for neuron 1
- `spikeMat(4,:)` contains spikes for neuron 4

In general:

- `name(:,col)` accesses all elements in column

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Data

Data can be read from files

- `load('classExample.mat');`
- `save('classExample2.mat','c','d');`

List the loaded variables

- `who`
- `whos`

Study the variable

- `size(spike_record)`
- `plot(spike_record)`

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Vector indexing

Assume we have a recording of spike rates for 100 seconds, recorded over non-overlapping 100 ms windows : vector `SpikeRate`

- `SpikeRate(1)` contains rate from 1-100ms
- `SpikeRate(2)` contains rate from 101-200ms

How do we see rates for 4-6s (4001-6000ms)

`SpikeRate(41:60)`

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Semi-colons

; suppresses output of computation result to screen

```
a=10-8
    a = 2
```

Printed to screen

```
b=10-8;
```

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Functions

```
c=[0 3 -2 4];
```

Data are analyzed through functions

`function_name(input_variable)`

- `sum(c) -> 5`
- `min(c) -> -2`
- `max(c) -> 4`

- `plot(spike_record)`

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spikeExample

- From our course website
- Contains variable `spikes` – 10 neurons, 500 ms
- 0 if no spike, 1 if spike

- Compute rates for each 100ms window:

```
rate(1)=sum(spikes(6,1:100));
rate(2)=sum(spikes(6,101:200));
rate(3)=sum(spikes(6,201:300));
rate(4)=sum(spikes(6,301:400));
rate(5)=sum(spikes(6,401:500));
```

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spikeExample – rate loop

- Compute rates for each 100ms window:

```
rate(1)=sum(spikes(6,1:100));
rate(2)=sum(spikes(6,101:200));
rate(3)=sum(spikes(6,201:300));
rate(4)=sum(spikes(6,301:400));
rate(5)=sum(spikes(6,401:500));
```

- Compute with for loop:

```
for i=1:5
  rate(i)=sum(spikes(6,100*(i-1)+(1:100)));
end;
```

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Plotting data

```
plot([4,5,-2,8])
```

- From course site:

```
spikePlot(spikes)
```

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Matrices: rows and columns

```
B=[2.2 1.4; -5 3.5; -7.8 4.3];
```

$$\begin{bmatrix} 2.2 & 1.4 \\ -5 & 3.5 \\ -7.8 & 4.3 \end{bmatrix}$$

- Spaces/commas separate columns
- Semi-colons (;) separate rows
- `name(row,col)` accesses single element

`B(2,1)` *returns -5*

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