Systems Neuroscience
Matlab, 3+ dimensional data

Professor Daniel Leeds
dleeds@fordham.edu
JMH 332

Matrices in $n$ dimensions

\[
x = \begin{bmatrix} 1 & 2 & 3; 4 & 5 & 6 \end{bmatrix}
\]

\[
y(:,:,1)=\begin{bmatrix} 1 & 2; 3 & 4 \end{bmatrix}
\]

\[
y(:,:,2)=\begin{bmatrix} 5 & 6; 7 & 8 \end{bmatrix}
\]

\[
y(:,:,3)=\begin{bmatrix} 9 & 10; 11 & 12 \end{bmatrix}
\]

size(y) -> [2 2 3]

Typical brain data : location of neuron ($x,y,z$) + time

Heat-maps

\text{imagesc(Data)} \text{ – view 2D matrix of scaled data as image}
• Red is highest value, blue is lowest value

Visualize a 2D slice of brain data (size(brainData) -> 128x128x88)
\[
slice = \text{squeeze(brainData(:, :, 20))} \rightarrow \text{slice 20 of brain}
\]

\text{imagesc(slice)}

Scaling vs. not-scaling

\text{imagesc(Data)} \text{ – view 2D matrix of scaled data as image}
• Red (or yellow) is highest value, blue is lowest value

\text{image(Data)} \text{ – view 2D matrix of data as image}
• Red (or yellow) is 64 or higher, blue is 0 or lower

\[
slice = \text{squeeze(brainData(:, :, 10))};
\]

\text{figure; imagesc(slice);} vs
\text{figure; image(slice)}
Code for multi-slice plot

```matlab
for i=1:12
    slice=squeeze(S1brain(i*10,:,:));
    subplot(3,4,i), imagesc(slice);
end;
```

Finding desired values

```matlab
find(vector<number>)
```
Return indices in vector that are less than number

Example:
```matlab
vector=[5, -1, 0, 12];
smallLocations=find(vector<2);
smallLocations contains [2 3]
```

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

Data summaries

Mat(:) – converts matrix to single dimension vector

Say MatVariable is a 5x5x10 matrix
- MatVariable(:) – converts data to single 250x1 vector

Summaries
- `mean(MatVariable(:))` – average value across all entries
- `sort(MatVariable(:))` – sort values from low to high
- `hist(MatVariable(:))` – histogram of values across all entries

Combining searches

Logic combinations
- `d>5 & d<8` the AND operation – all conditions must be true
- `d<5 | d>8` the OR operation – one or more conditions true

Example:
```matlab
find(vector<2 & vector>-2)
```

Can combine results from multiple matrices:
```matlab
vecB=[12 3 8 0];
find(vector<2 | vecB>4)
```