CISC 3250
Systems Neuroscience

Matlab, part 4: Projection/Correlation Analyses

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Matrix math

$$\begin{bmatrix} | & | & | \\ v_1 & v_2 & v_3 \\ | & | & | \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = xv_1 + yv_2 + zv_3$$

Assuming right matrix is a single column

In general, # of left matrix columns must equal # of right matrix rows

Matrices in matlab

```
A= [1 2; 3 4];
b= [4; 5];
```

What is `A*b`?

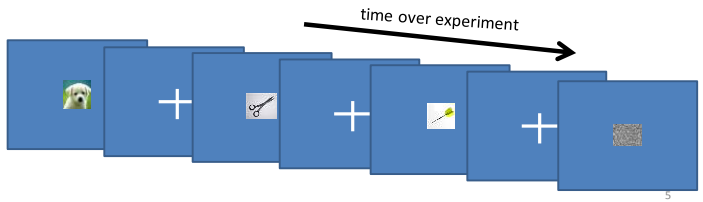
Transpose: `[4; 5]` == `[4 5]'`

`a'` flips rows and columns

LOC localizer: experimental design

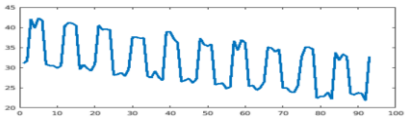
Each second:

- new object OR
- new noise OR
- "blank screen" (fixation)



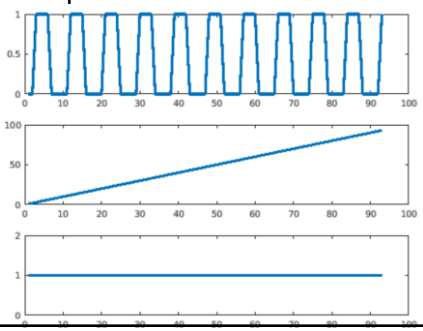
Building the voxel response

Voxel response
`neuroData`
at each second neural response to stimuli



`timesObjs`,
at each second:

- 0 for no-object, 1 for yes-object
- Drift and offset



Building the voxel response
General Linear Model

Design matrix M

- On/off information O
- Constant offset C
- Linear drift L

Measured voxel output v [$v_{t=1}$ $v_{t=2}$ … $v_{t=93}$]^T

$$M = \begin{bmatrix} | & | & | \\ O & C & L \\ | & | & | \end{bmatrix} \qquad M \begin{bmatrix} \beta_o \\ \beta_c \\ \beta_L \end{bmatrix} = v \qquad B = M^{-1}v$$

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Matlab code

```
% Want: k1*O+k2*C+k3*L=sigOut1;
% I.e.: M*kVec = sigOut1;
% Define M "design matrix"
M= [ blockPatt; driftL; driftC];
% M is 3 x 93, we want 93 x 3 matrix
Mtrans=M';
x=pinv(Mtrans)*sigOut1;
% inv only works on square mat –
%     num rows=num cols,
% pinv on any matrix
```

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More Matlab code

```
% Find patterns in sigOut1
M= [ blockPatt; driftL; driftC];
Mtrans=M';
x=pinv(Mtrans)*sigOut1
```

9.9896 Block1
-0.1007 linDrift
30.4889 offset

```
% Patt-correct time blocks,
% Patt2-unrelated time blocks
M=[blockPatt;driftL;driftC; blockPatt2];
Mtrans=M';
x4=pinv(Mtrans)*sigOut1;
```

9.9773 Block1
-0.1006 linDrift
30.5045 offset
-0.0217 block2

Comparing vectors

Can compare 2 vectors

- by correlating `corr(a,b)`
  - between -1 and 1
  - high |correlation| = high connection between vectors
- by multiplying `a*b'`
  - high product = high similarity

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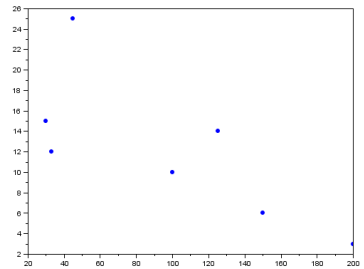
Scatter-plots

Visualizing how two variables vary together

Reaction time	Cortical response
100	10
45	25
150	6
30	15
125	14
33	12
200	3



```
plot(var1,var2,'.')
scatter(var1,var2)
```

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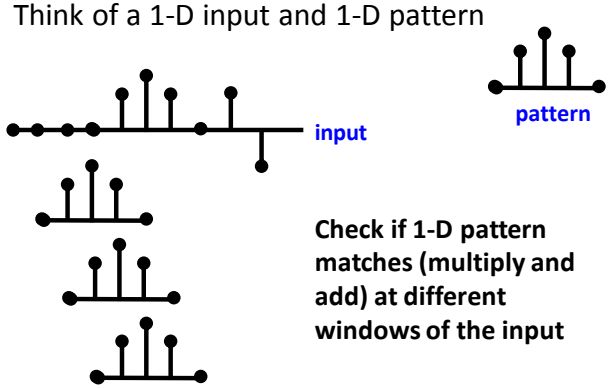
Convolution in Matlab

Think of a 1-D input and 1-D pattern



Check if 1-D pattern matches (multiply and add) at different windows of the input

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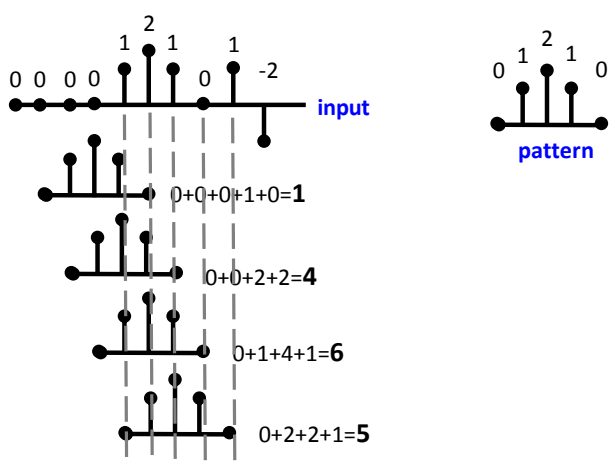
Convolution in Matlab



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