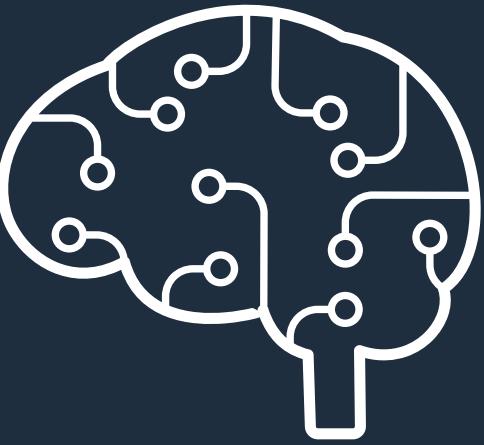
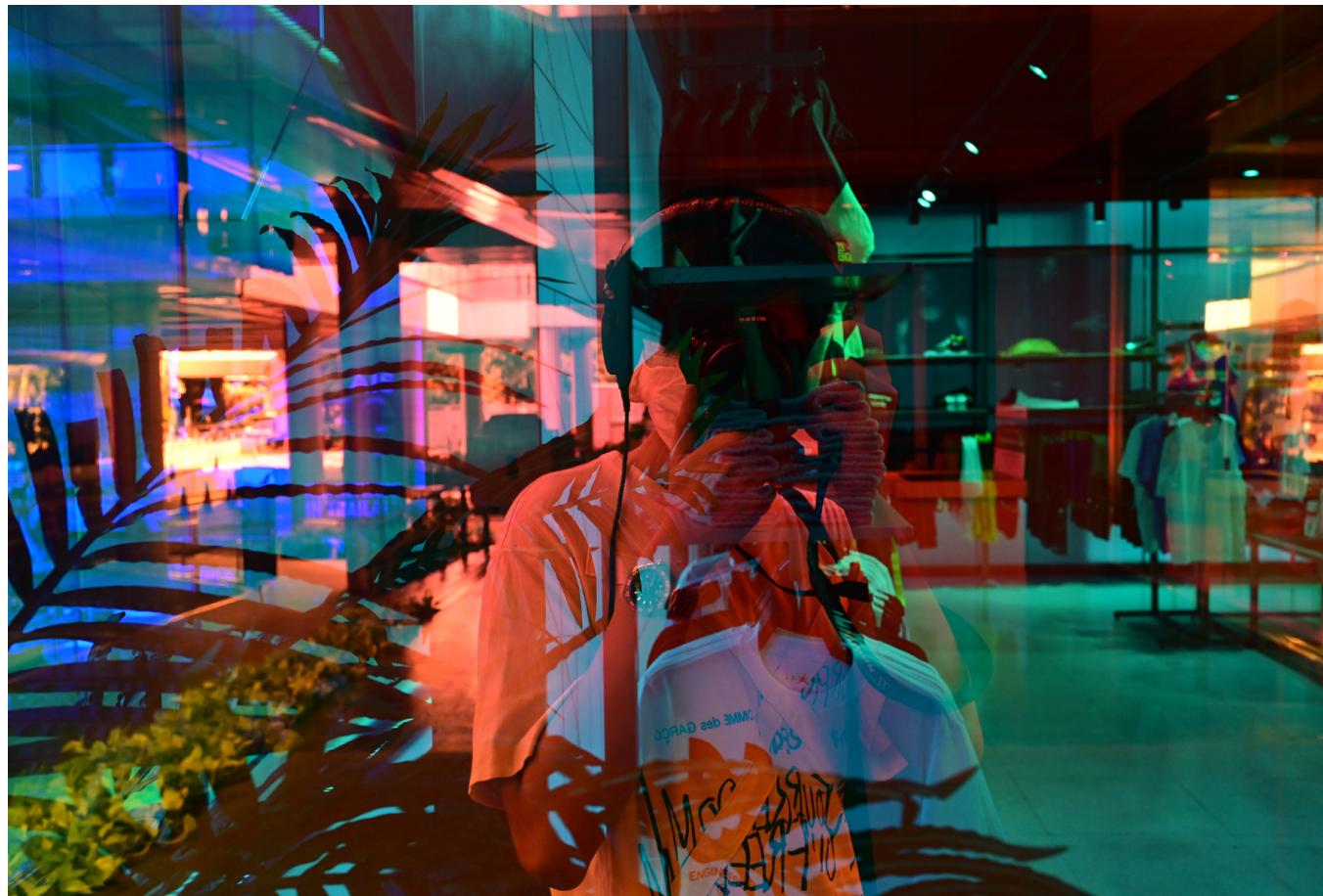


Intro

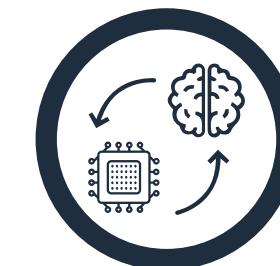


Who am I?

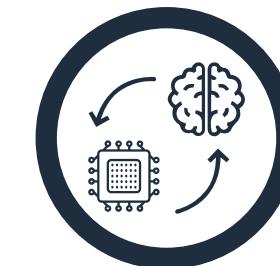


- Chattarin Poungtubtim (Pun)
- 5th year medical students at KCMH, Chulalongkorn Univ.
- Research assistant at CCCN lab

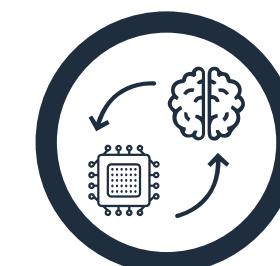
Outline



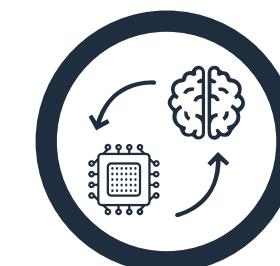
Introduction to the Session



Encoding & Decoding



Brain decoder



Our question

Is mind reading real?

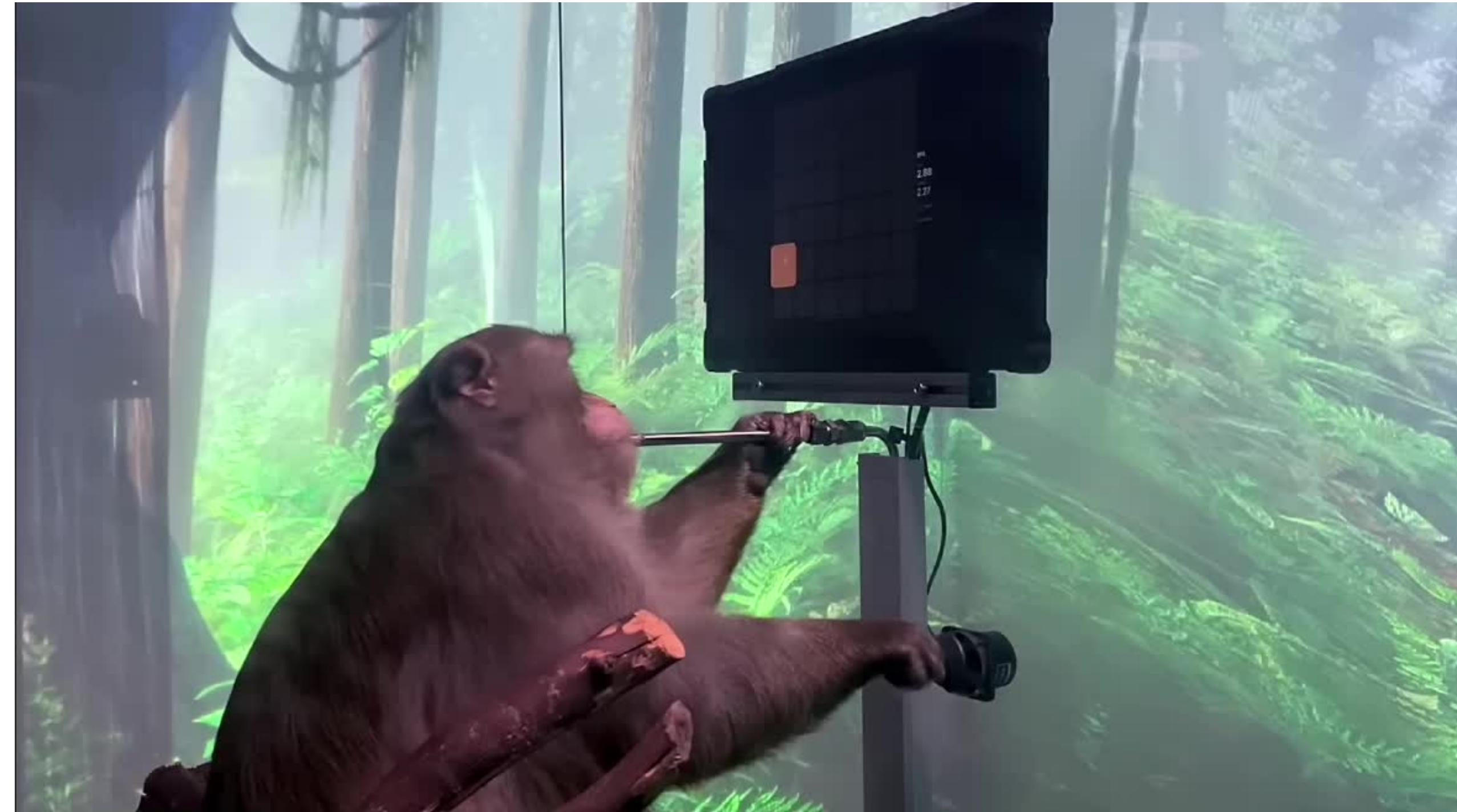


EXPECTATION

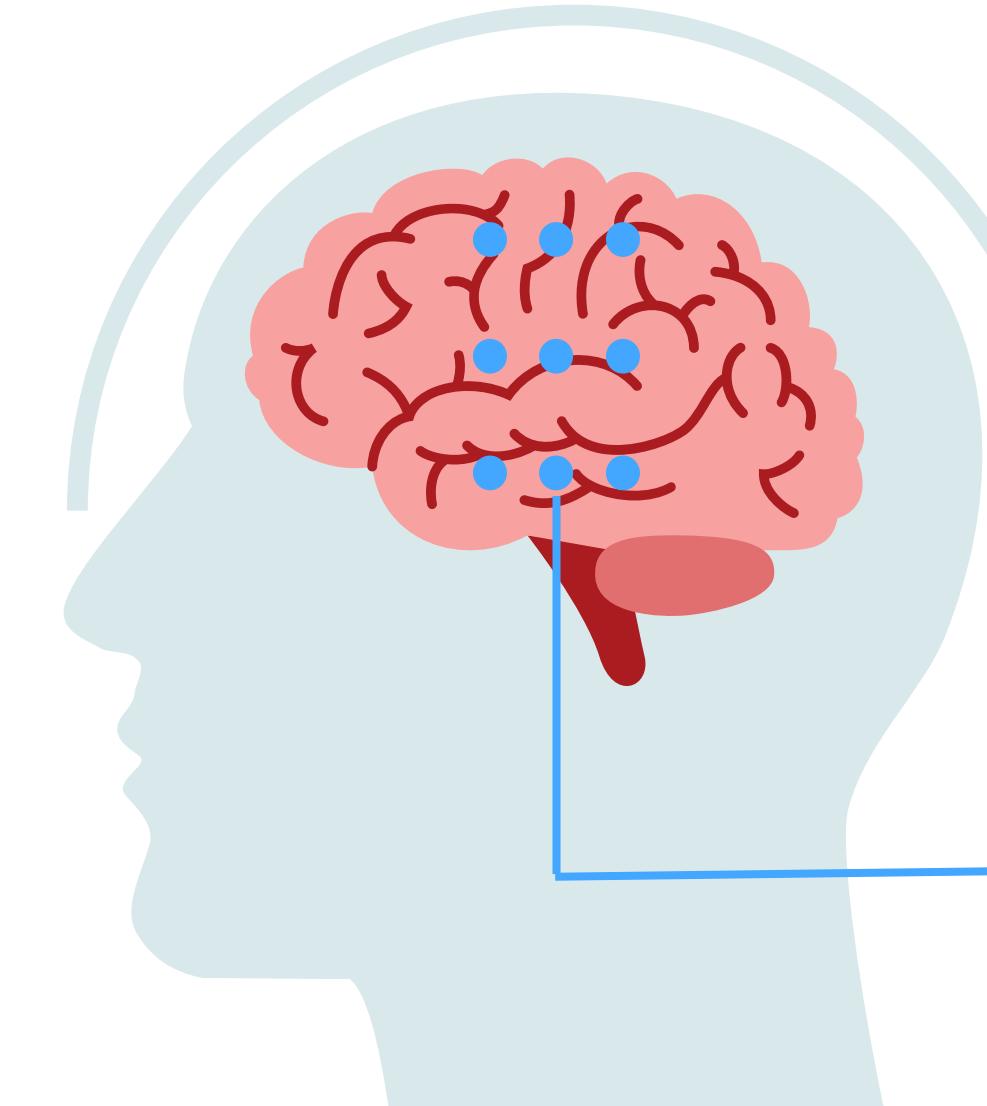
REALITY



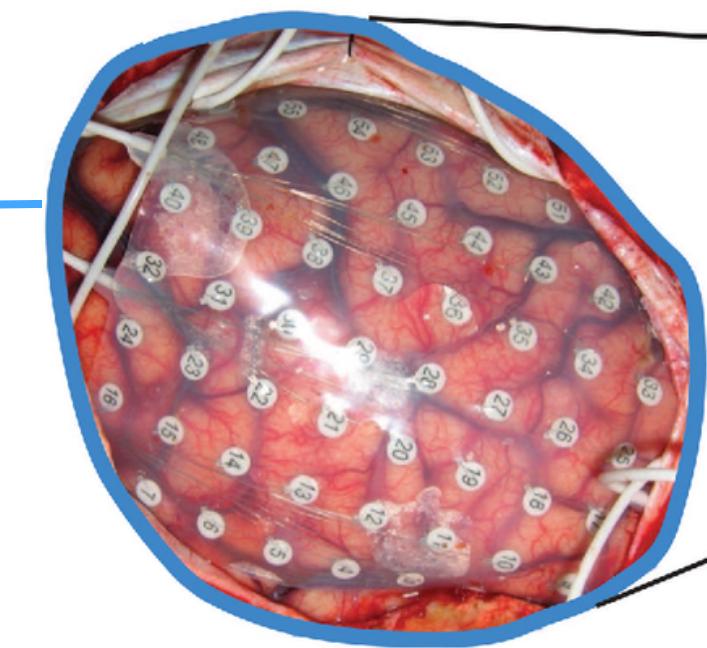
Mind pong



Eavesdrop the brain

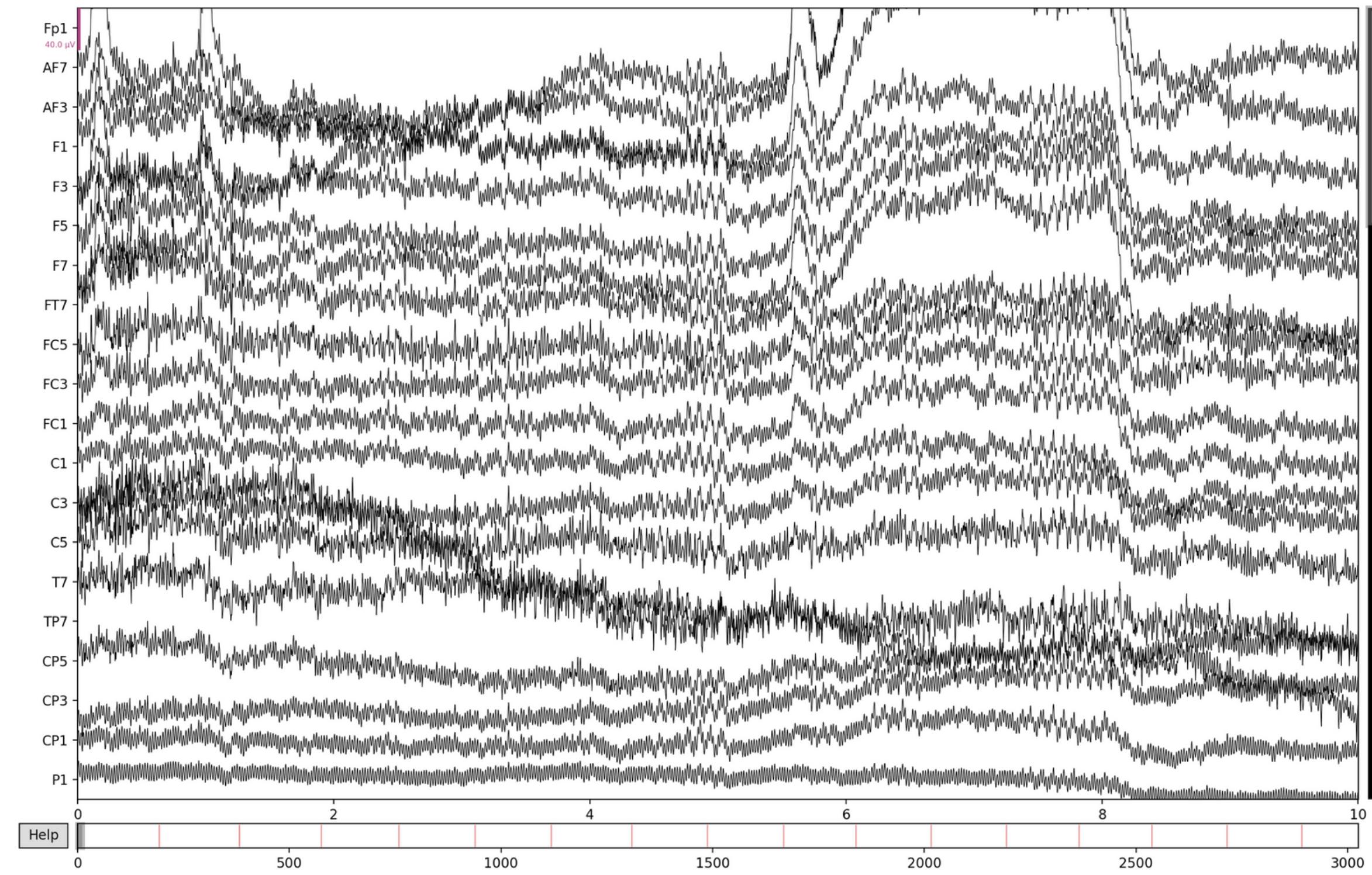


EEG



ECoG

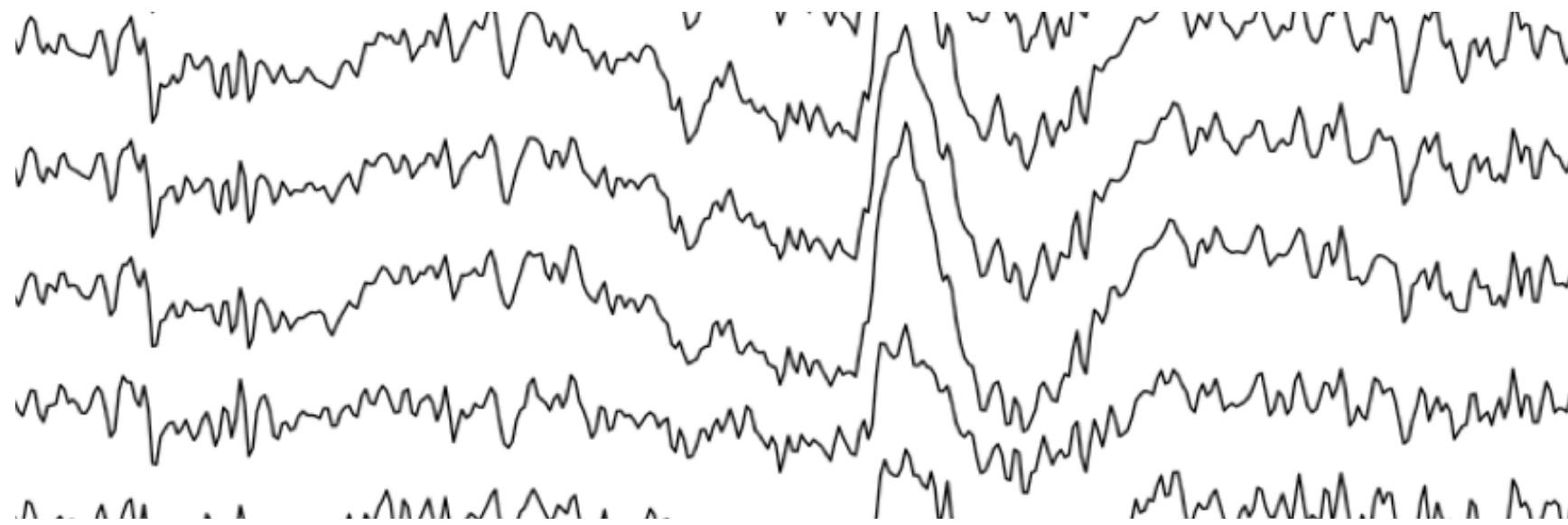
Brain signal is complicated



How do we make sense of EEG data?

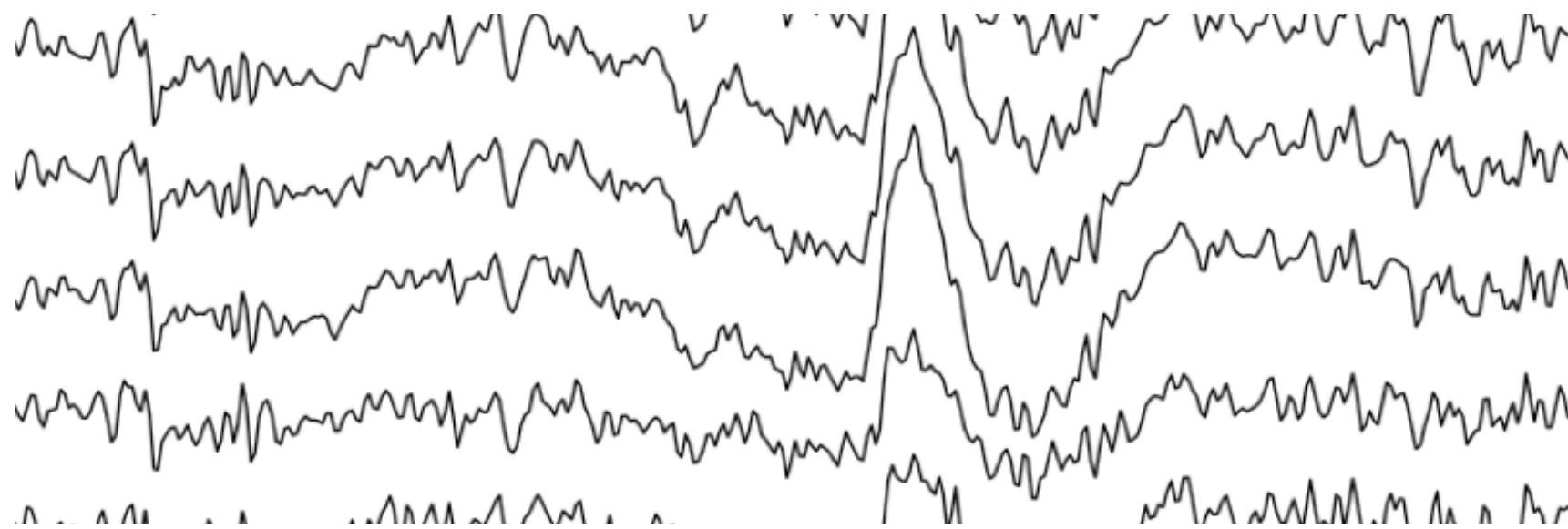
Goal of mind reading

EEG signal



Goal of mind reading

EEG signal

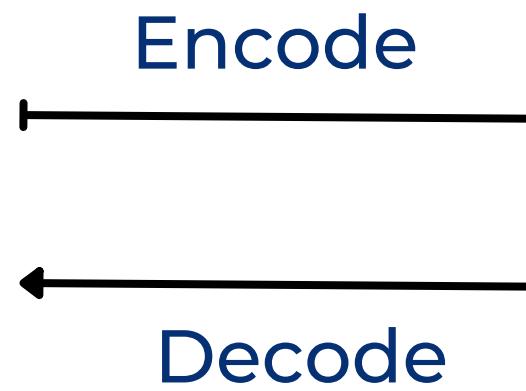


Stimuli

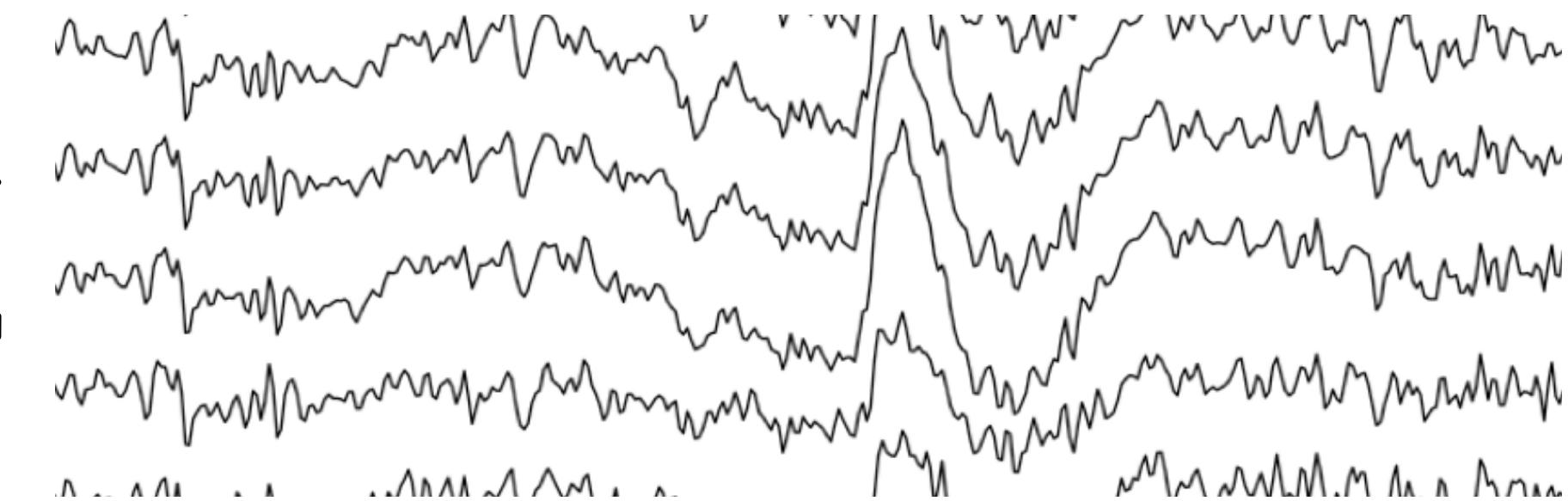


Brain is an enigma

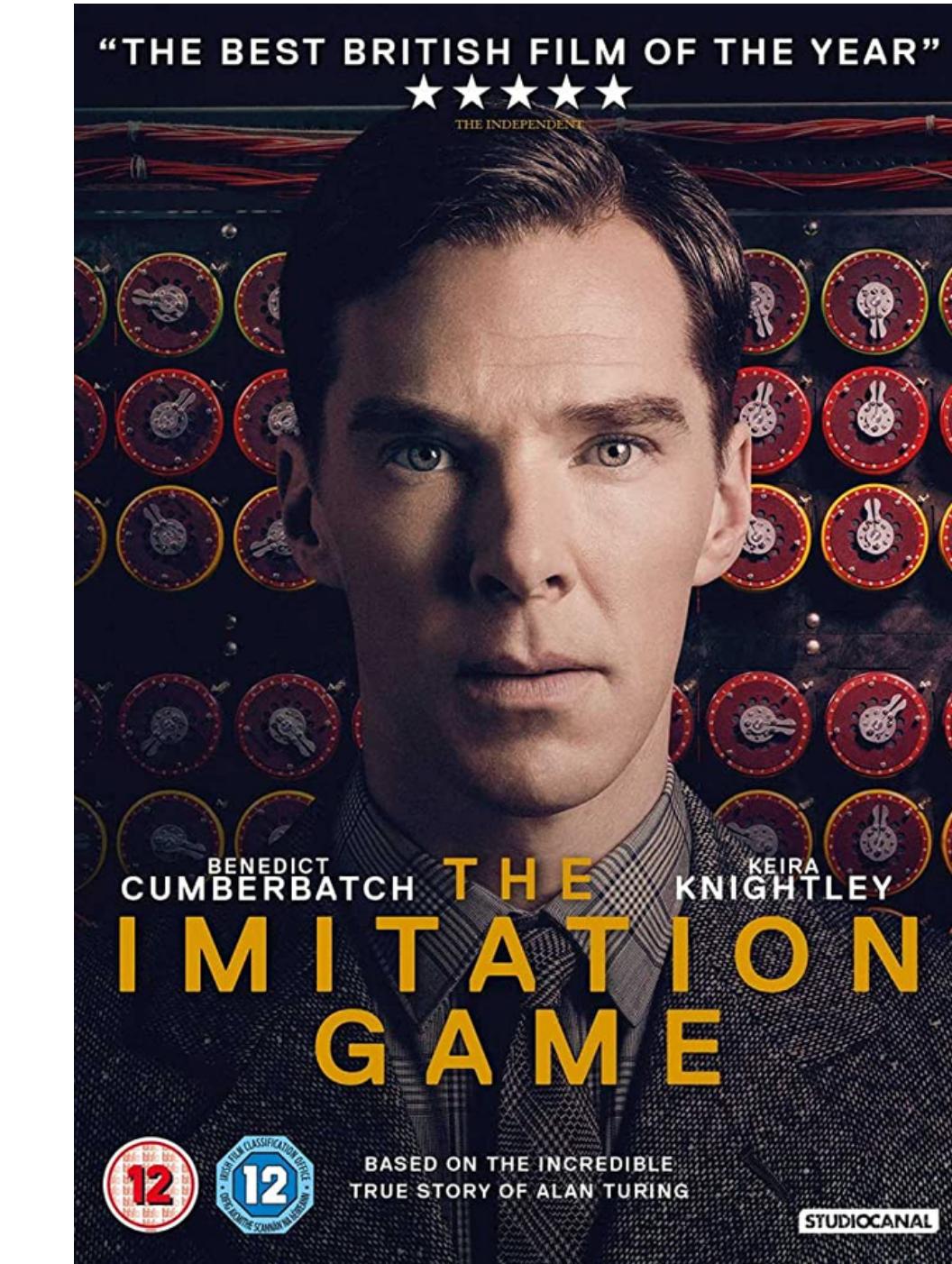
What we see



What brains see



Brain is an enigma



Brain is an enigma

Rule

$A \Rightarrow C$

$B \Rightarrow D$

$C \Rightarrow E$

...

$Y \Rightarrow A$

$Z \Rightarrow B$

Message

Hello

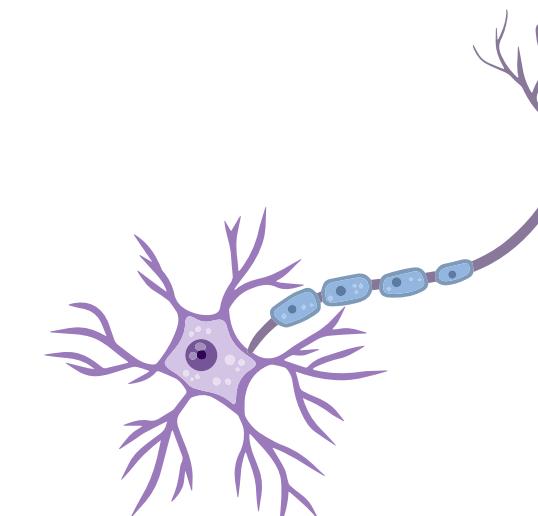
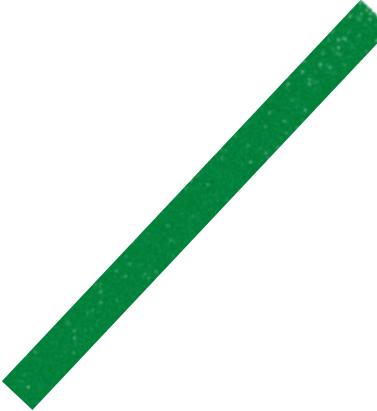
Encode

Decode

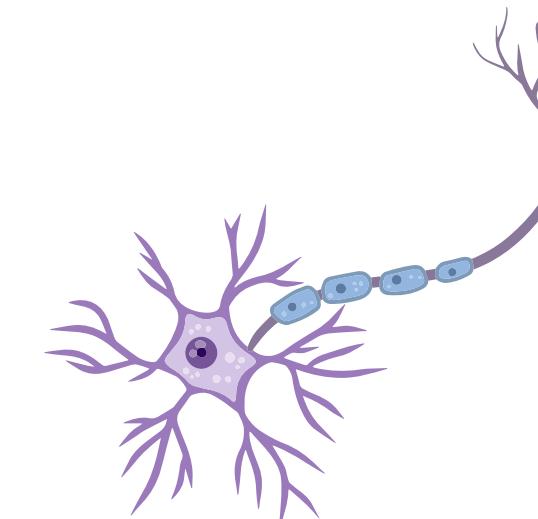
Code

Jgooq

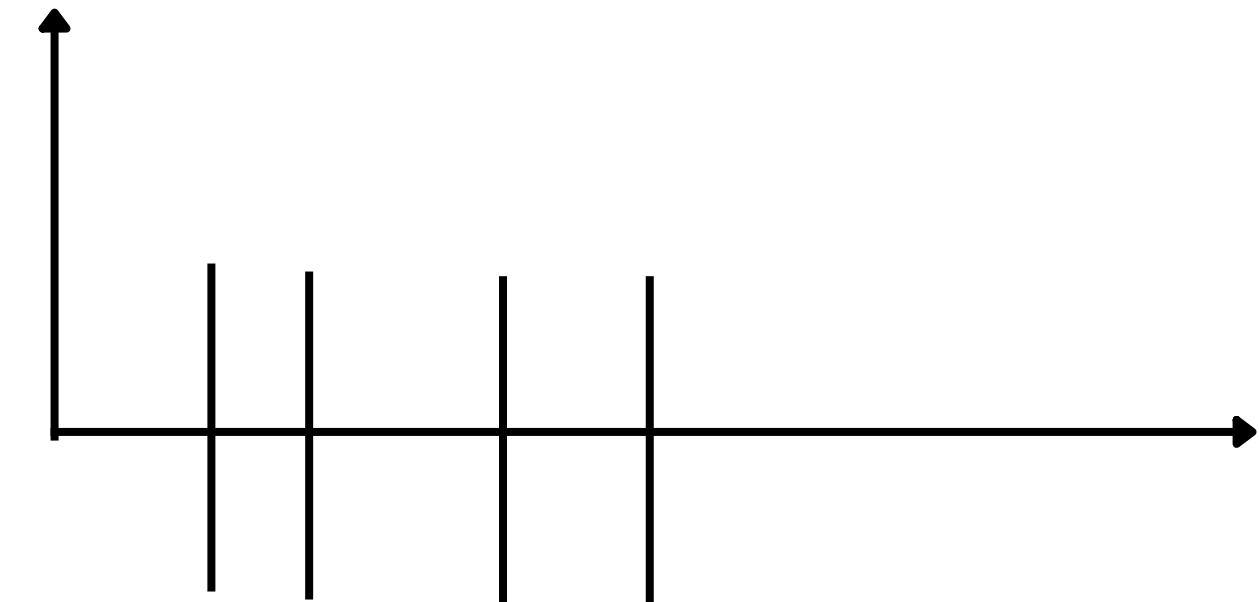
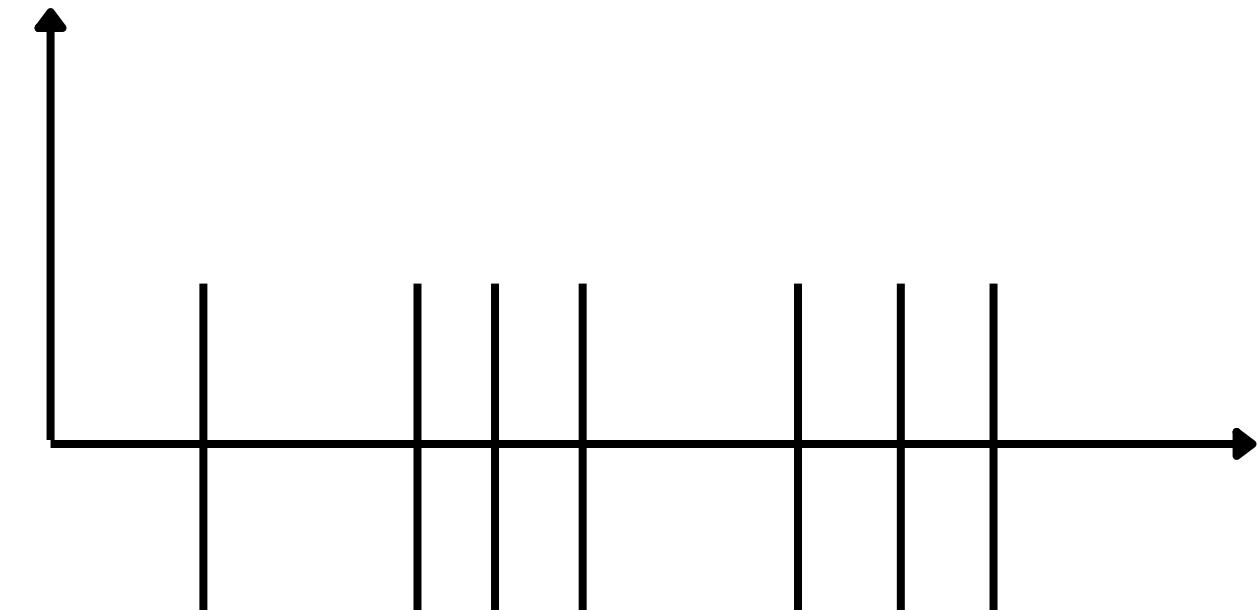
Encoding



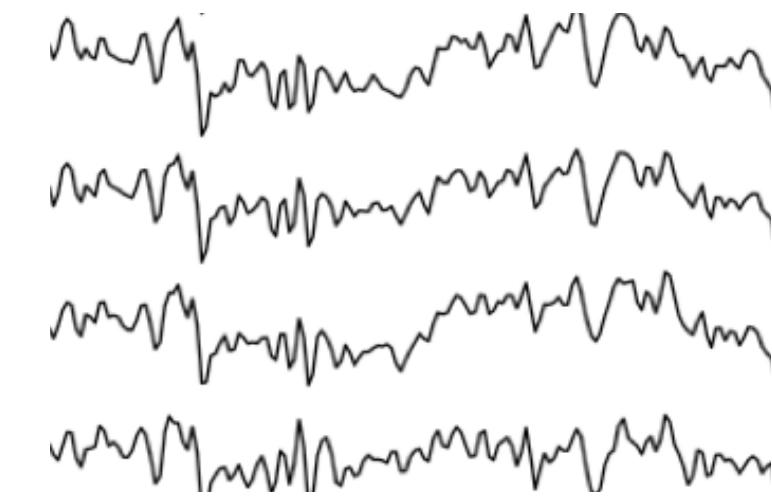
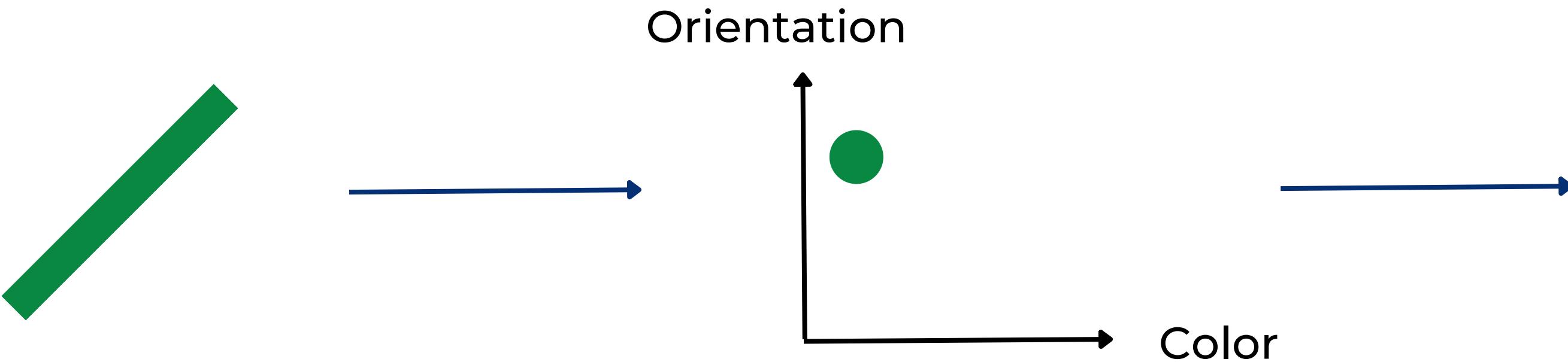
Orientation



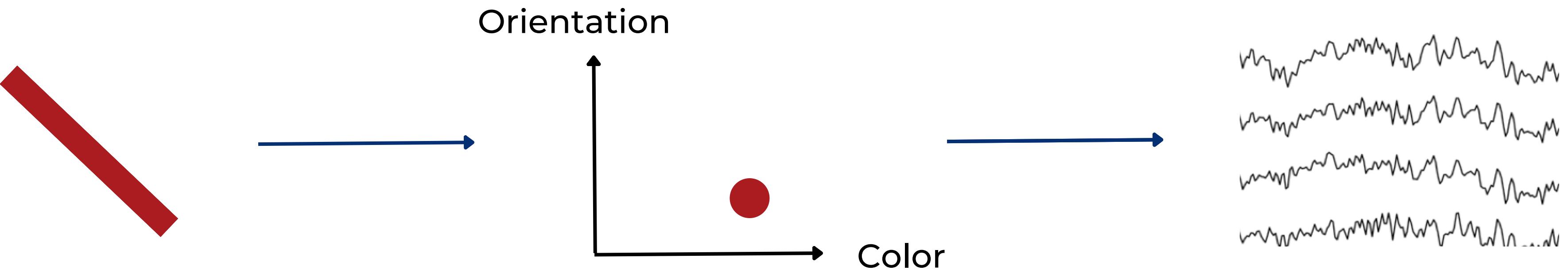
Color



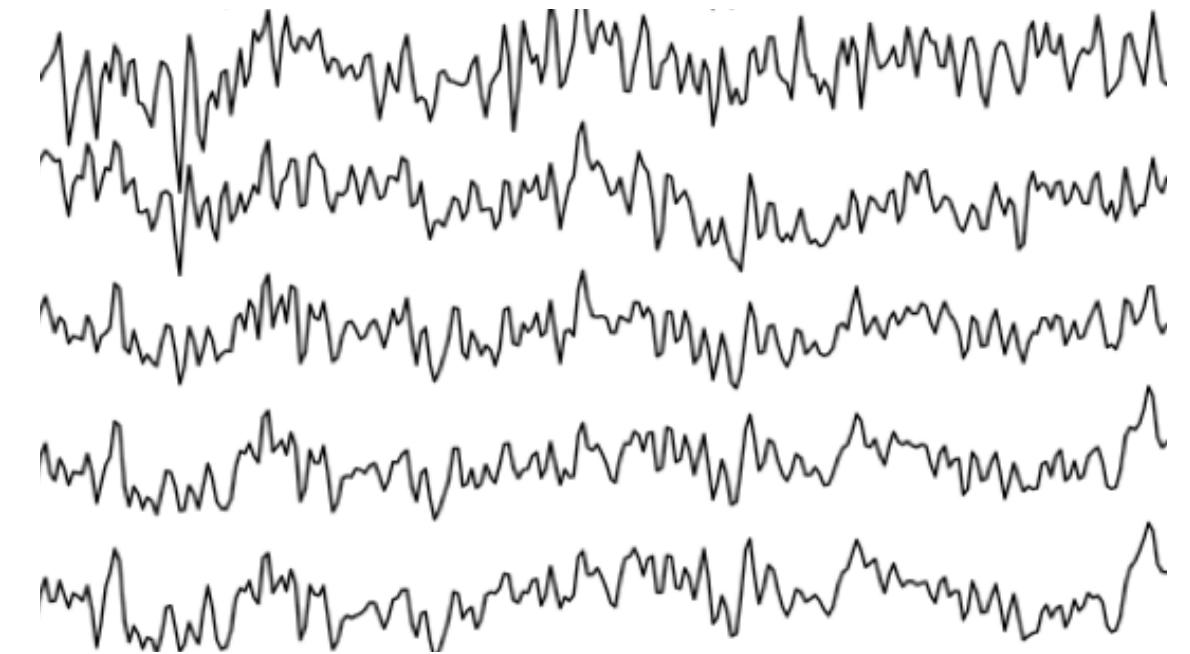
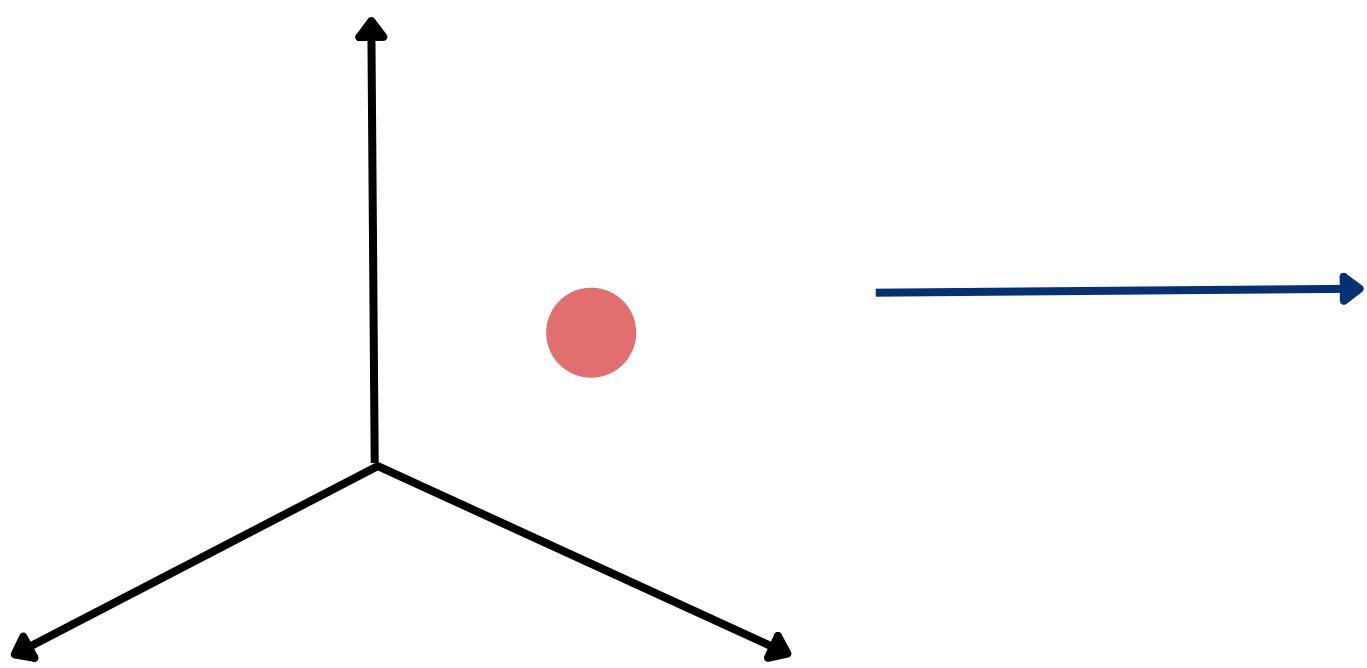
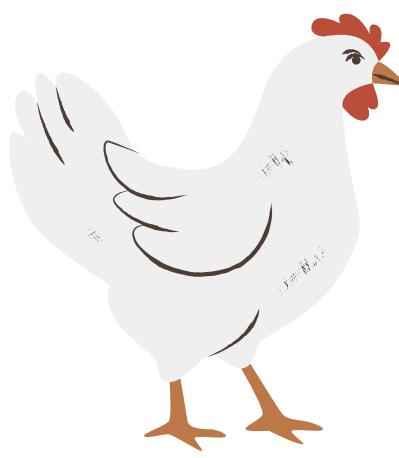
Encoding



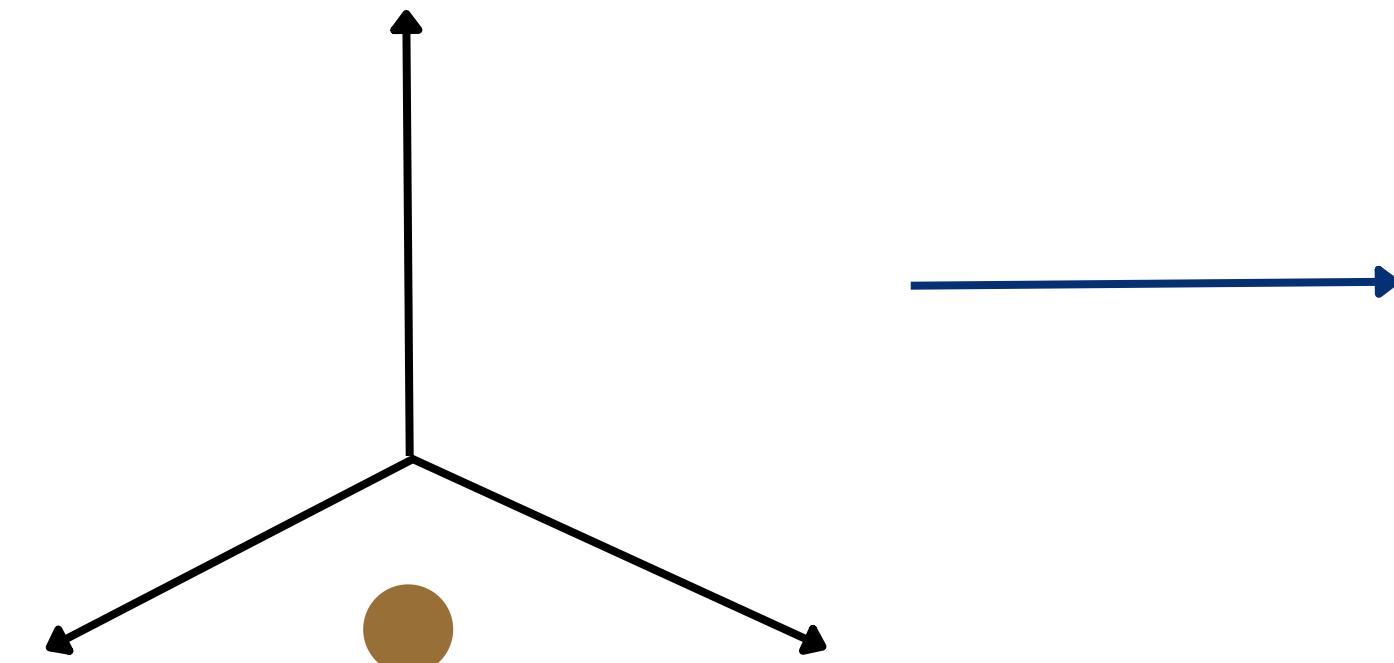
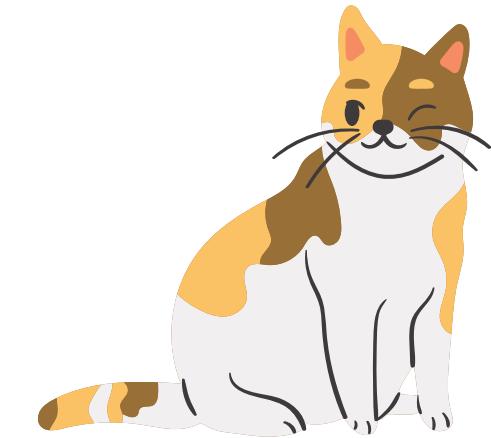
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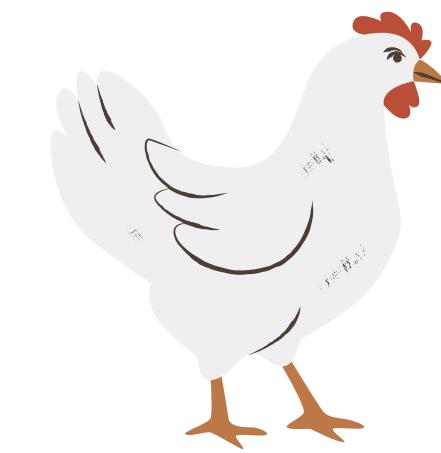
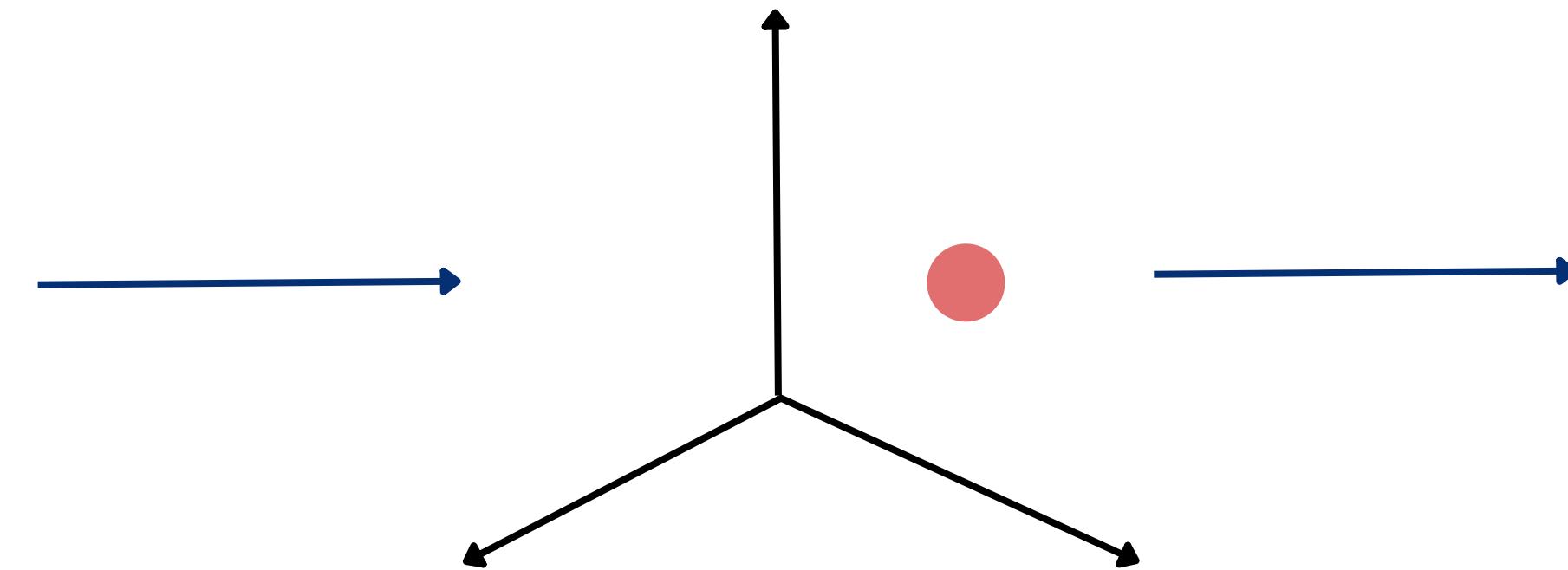
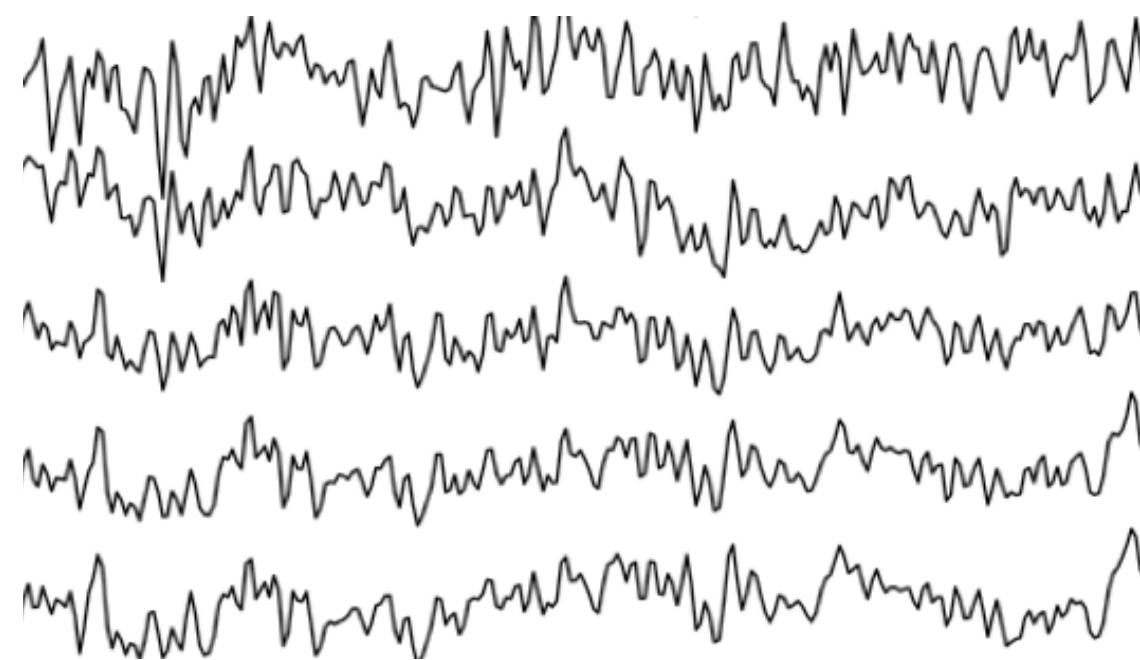
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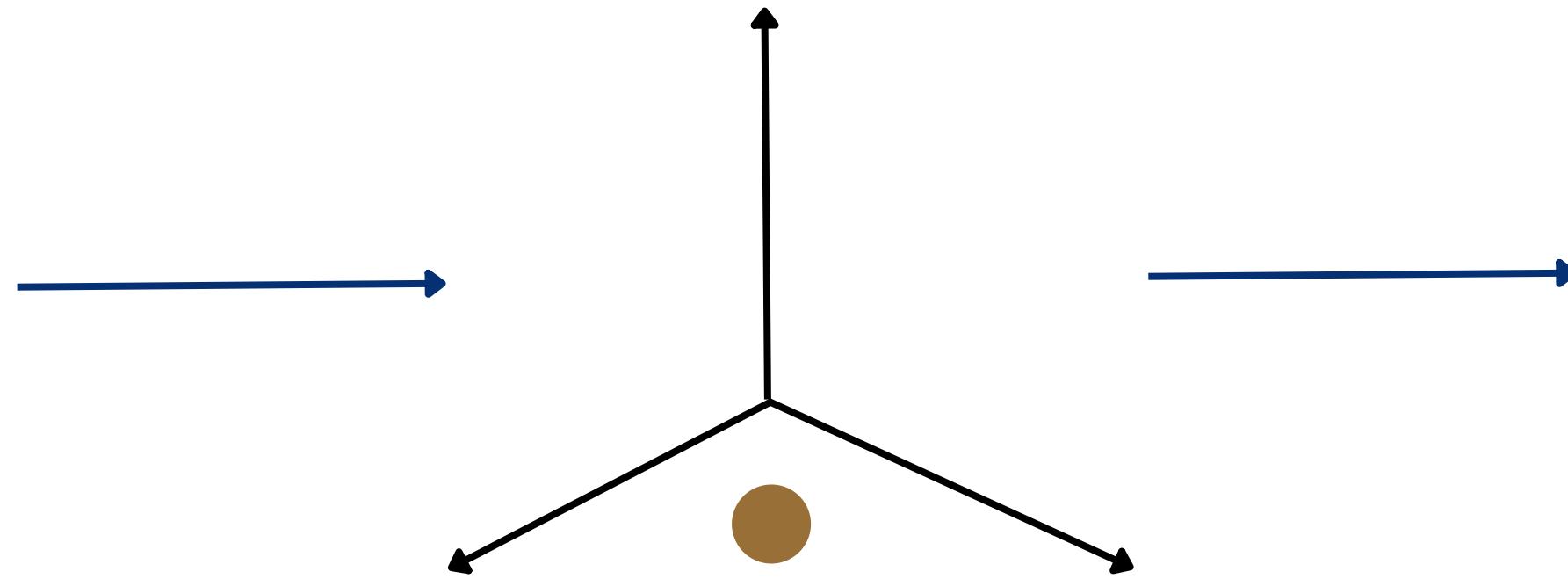
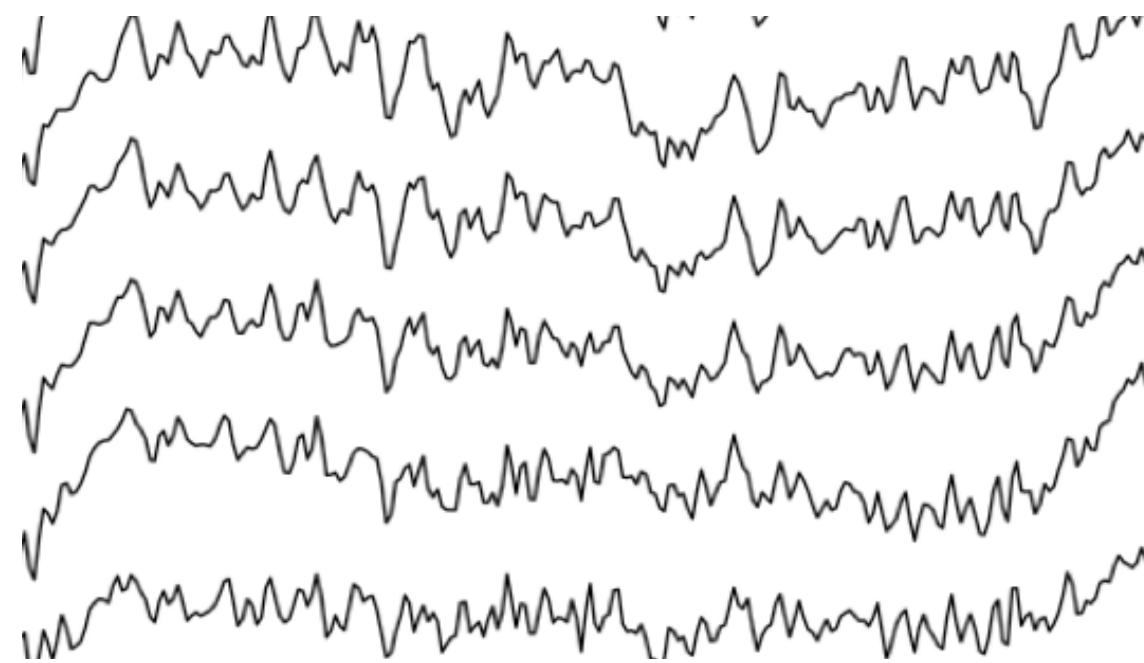
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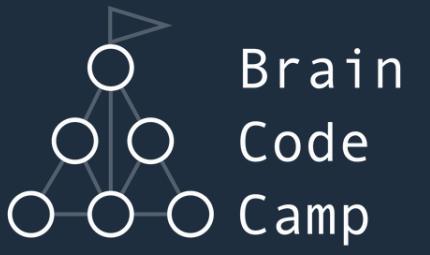


Decoding



Decoding

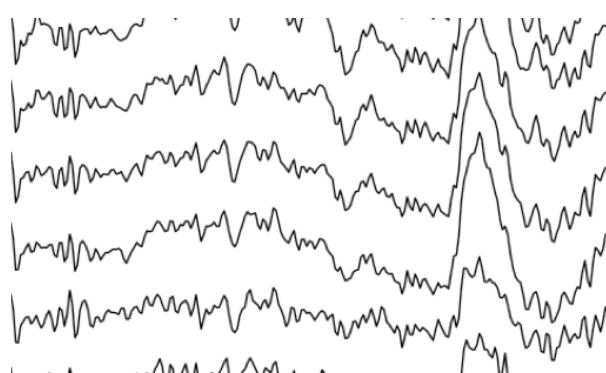
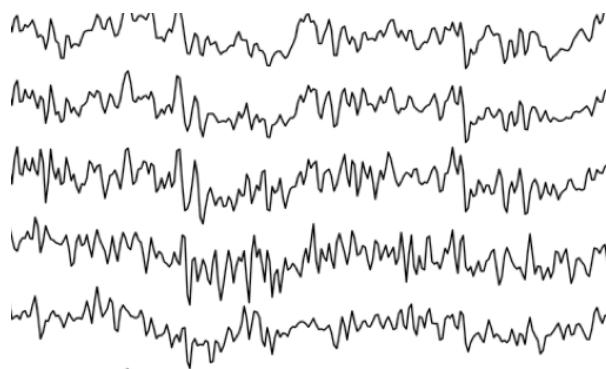
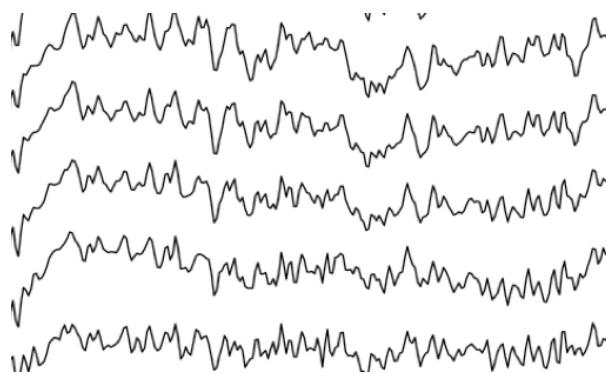




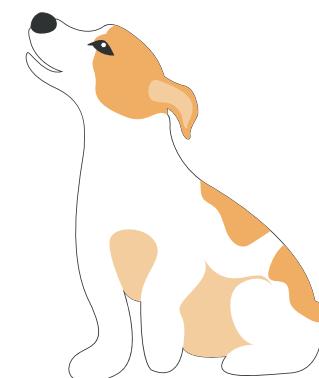
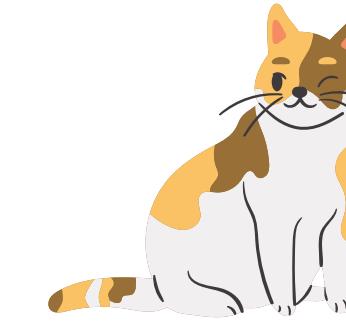
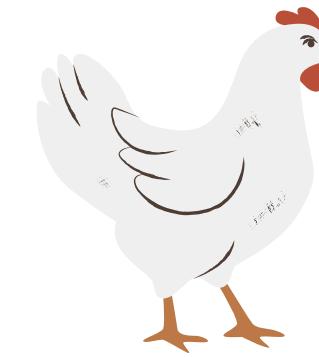
Brain decoder

Step 1: Collect data

EEG data

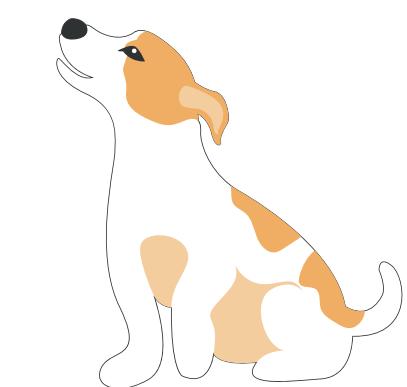
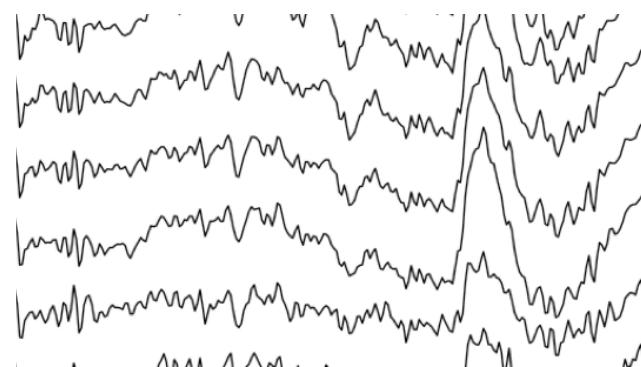
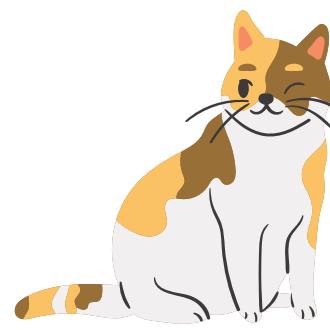
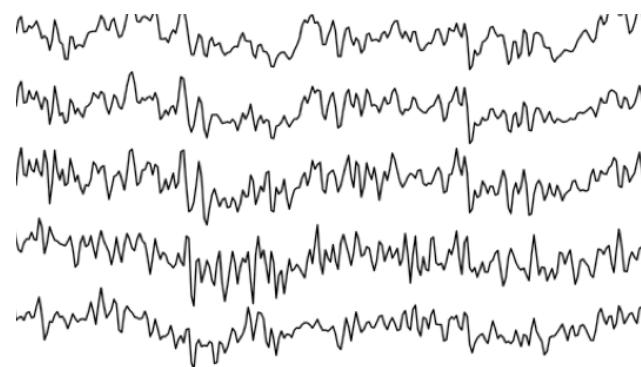
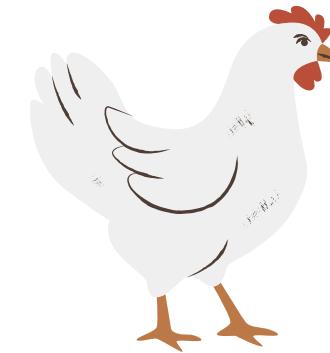
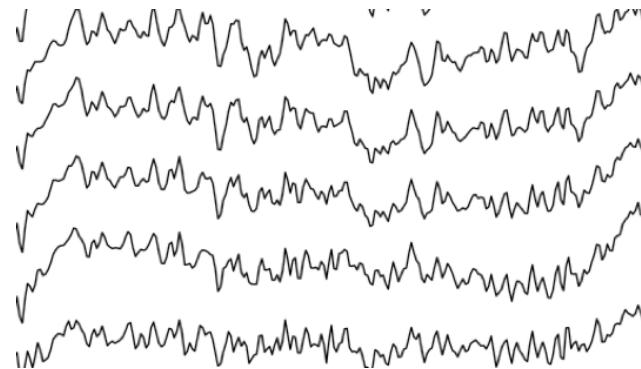


Stimuli

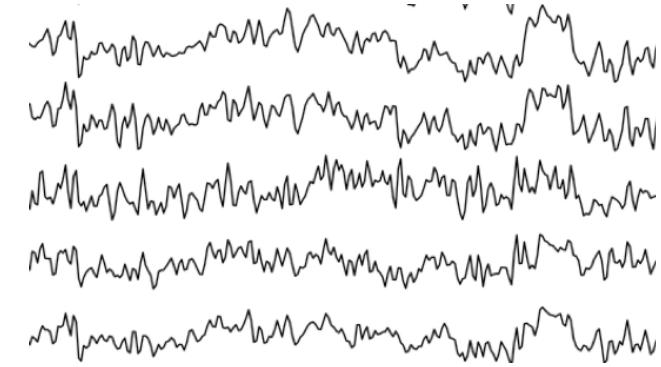
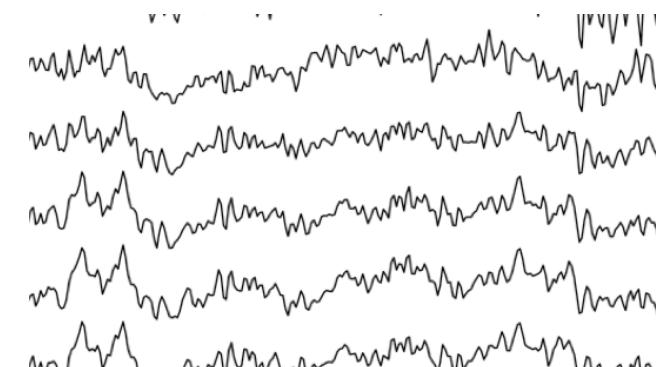
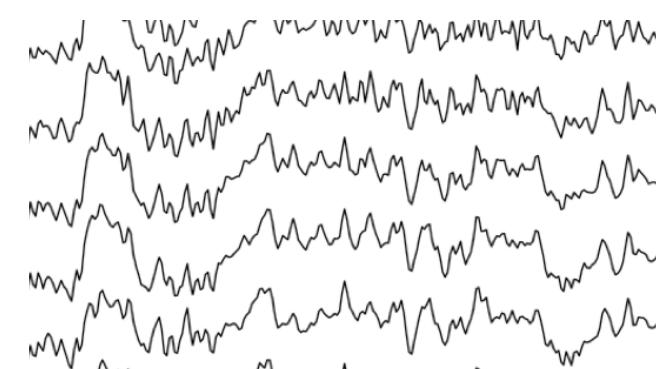


Step 2: Split train-test

Train

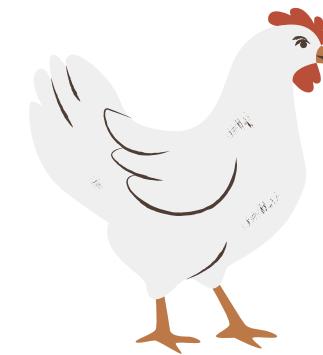
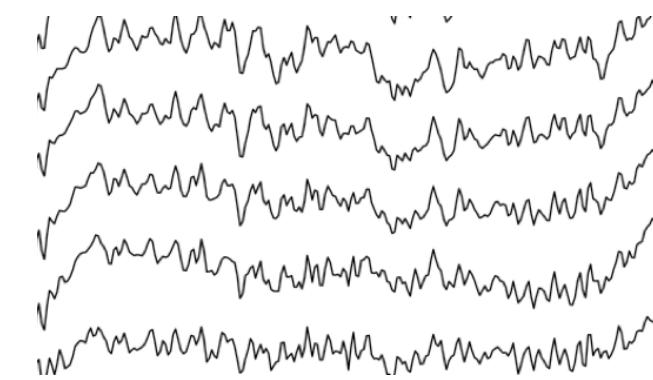


Test

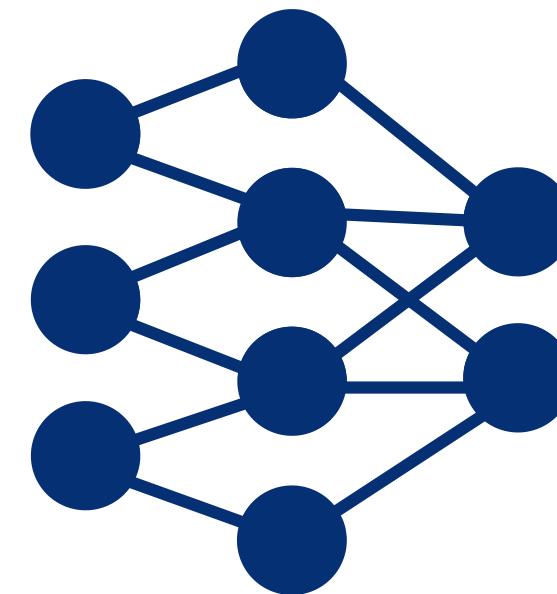


Step 3 : Training

Data

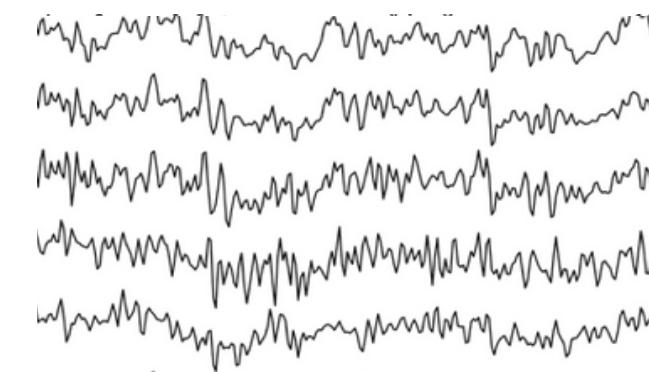


Model

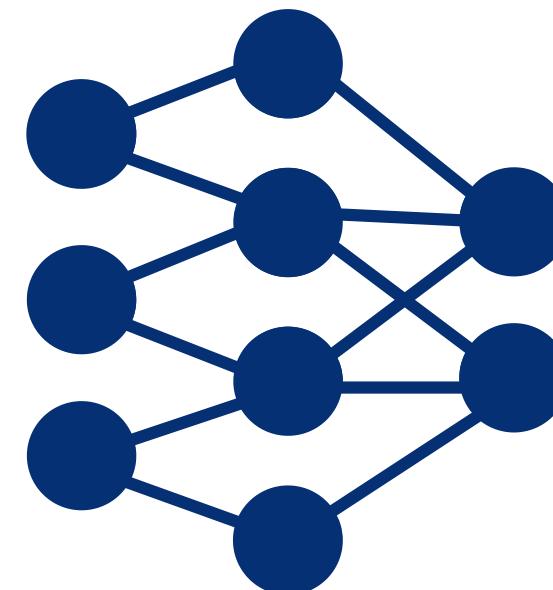


Step 3 : Training

Data

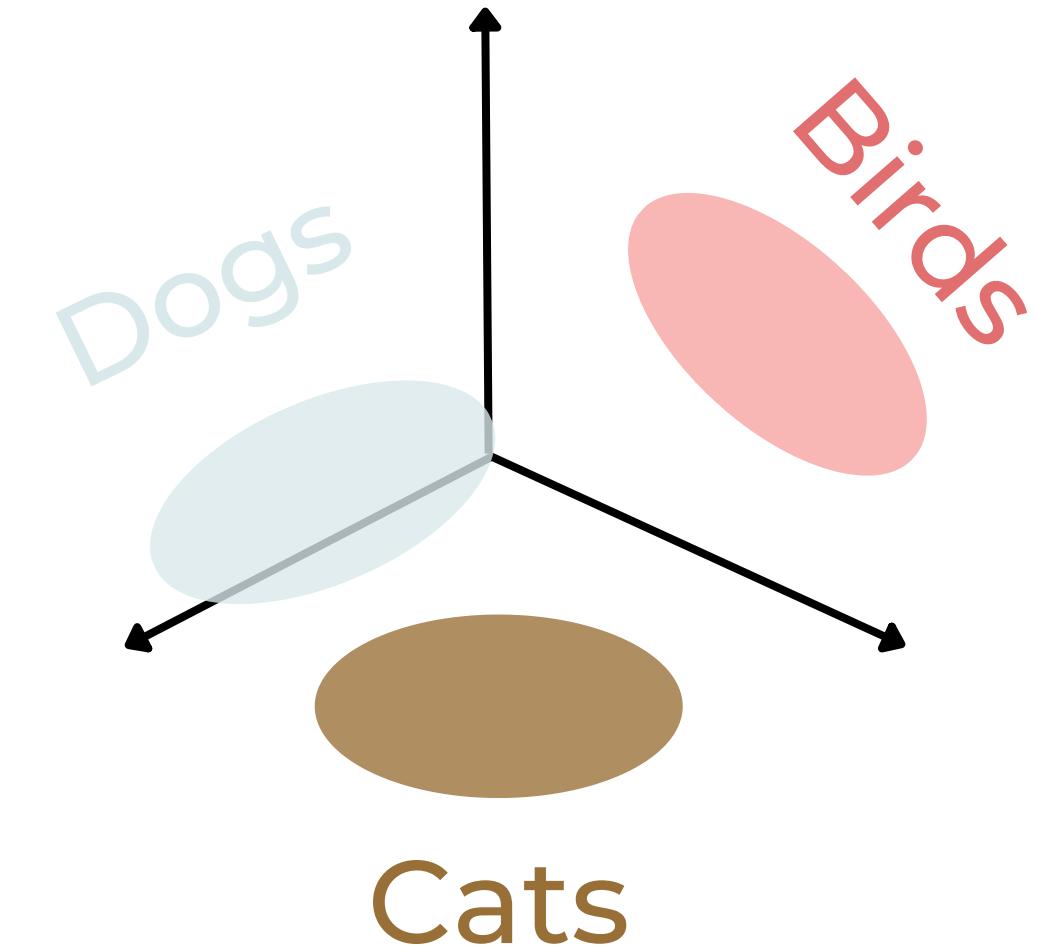
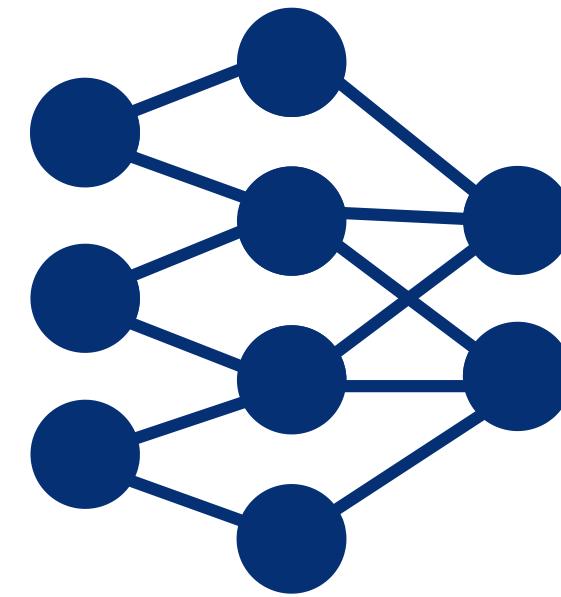


Model



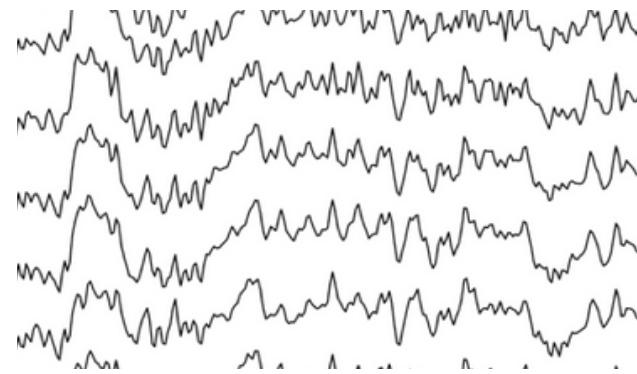
Step 3 : Training

Model

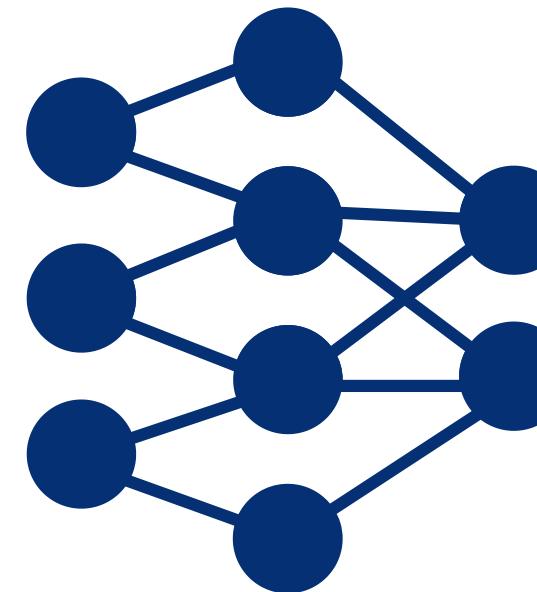


Step 4 : Testing

Data

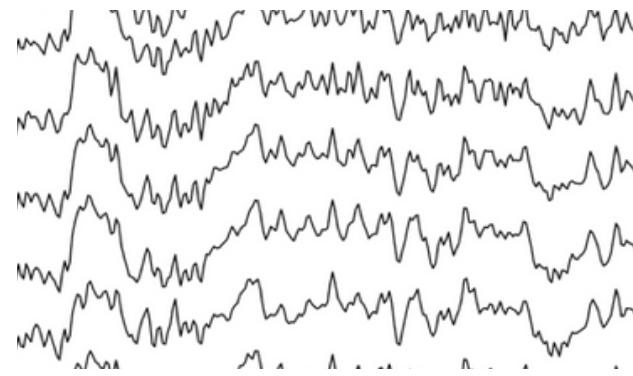


Model

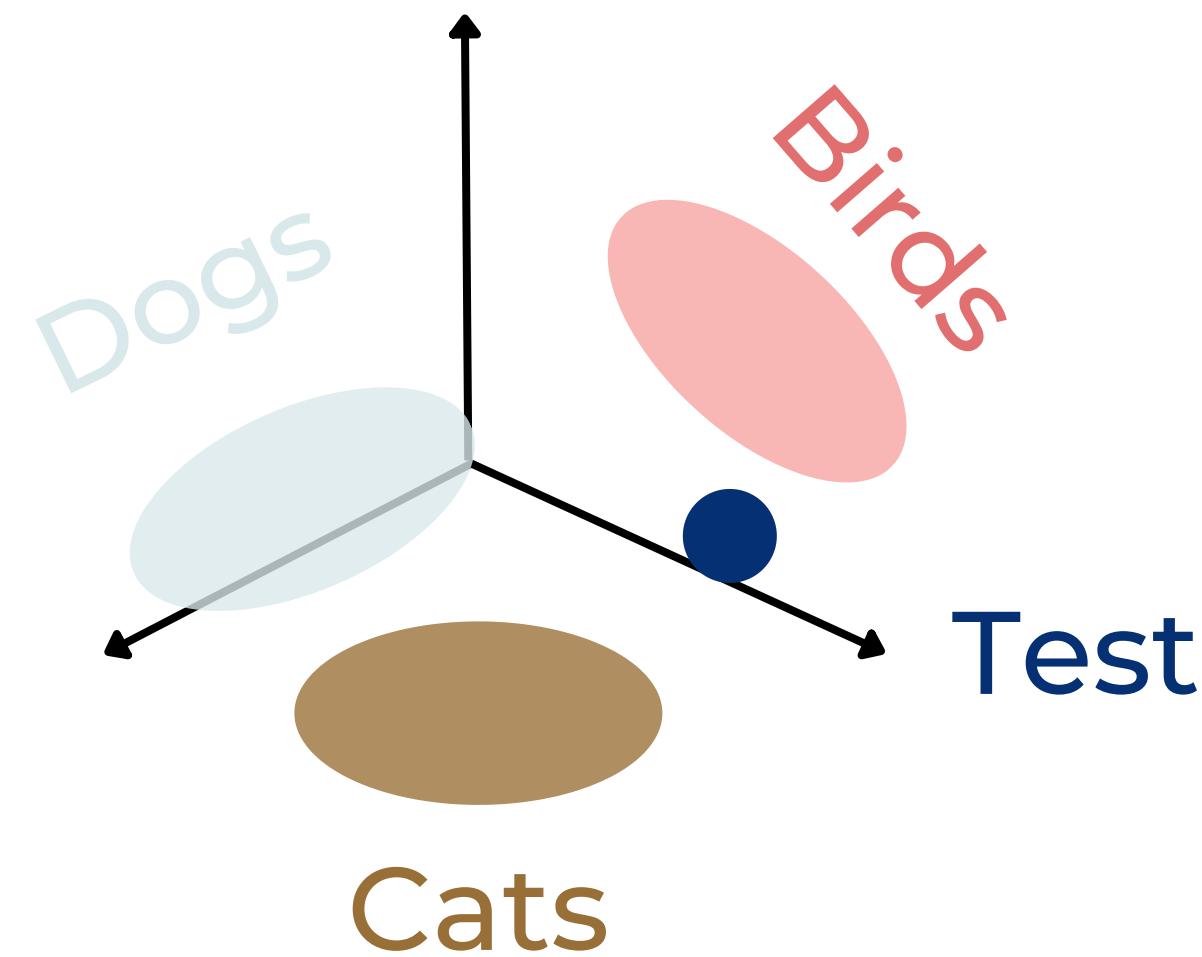


Step 4 : Testing

Data



Model

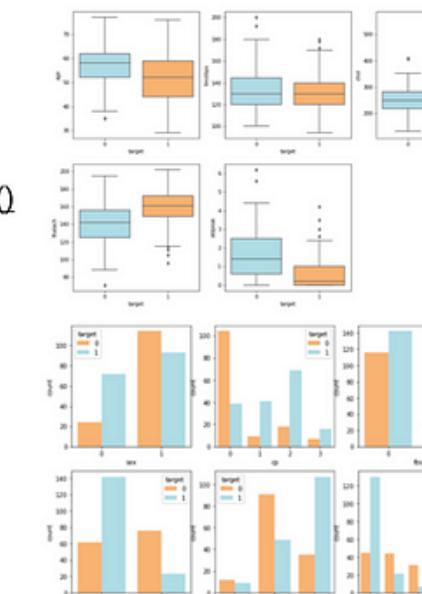
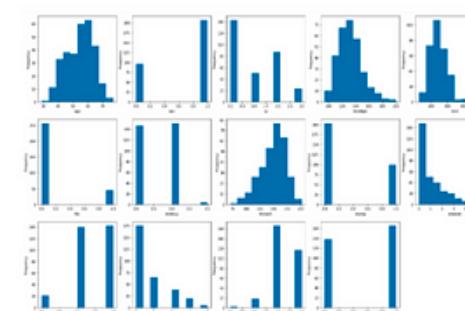


Classification
problem

Machine Learning Algorithms - Classification

Exploratory Data Analysis (EDA)

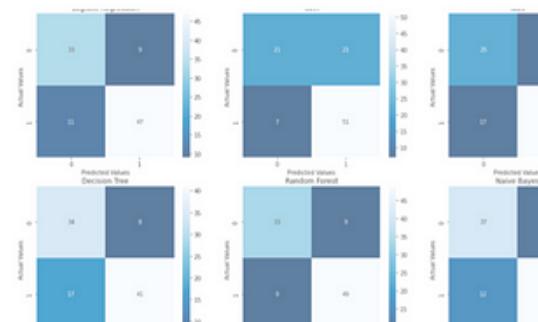
- 1) Histogram: `df.plot(kind = 'hist')`
- 2) Box Plot: `sns.boxplot()`
- 3) Grouped Bar Chart: `sns.countplot()`



Model Evaluation

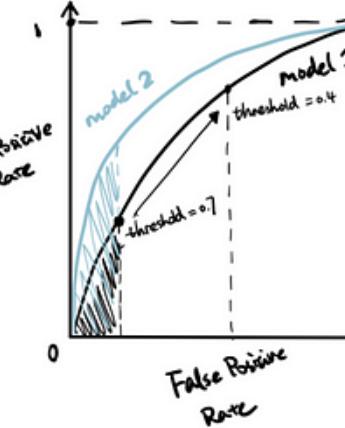
Confusion Matrix

`confusion_matrix(y_test, y_pred)`

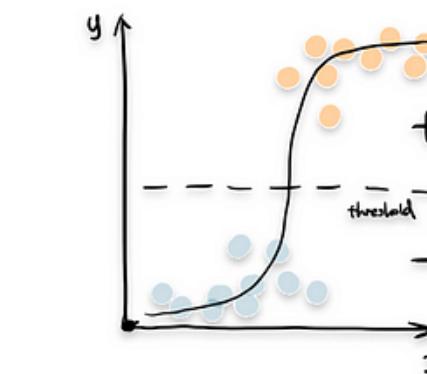


ROC & AUC

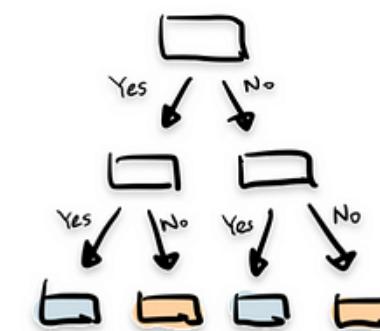
`metrics.auc(fpr, tpr)`



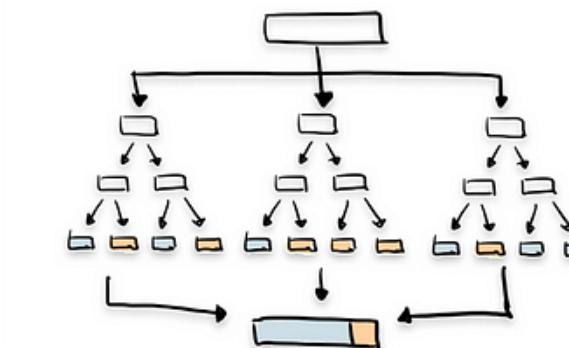
Logistic Regression



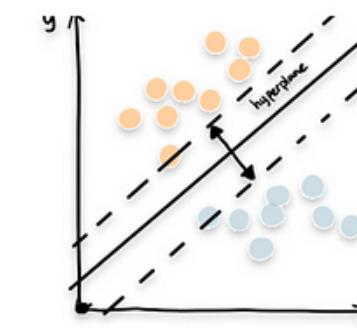
Decision Tree



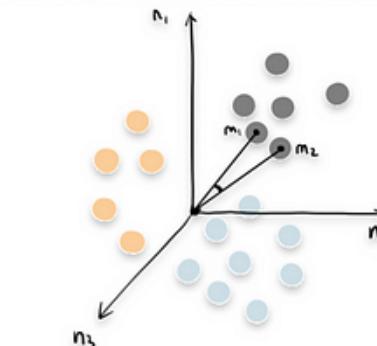
Random Forest



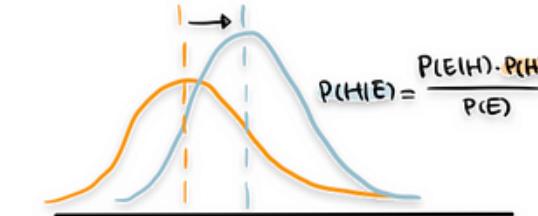
Support Vector Machine



K Nearest Neighbour



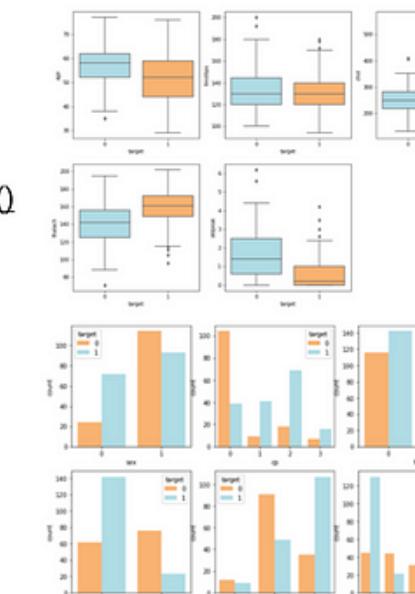
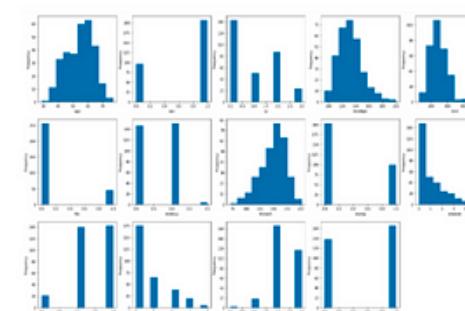
Naive Bayes



Machine Learning Algorithms - Classification

Exploratory Data Analysis (EDA)

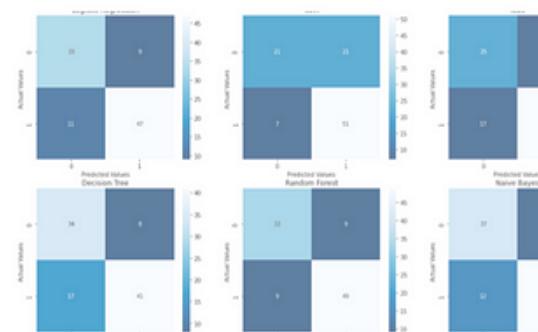
- 1) Histogram: `df.plot(kind = 'hist')`
- 2) Box Plot: `sns.boxplot()`
- 3) Grouped Bar Chart: `sns.countplot()`



Model Evaluation

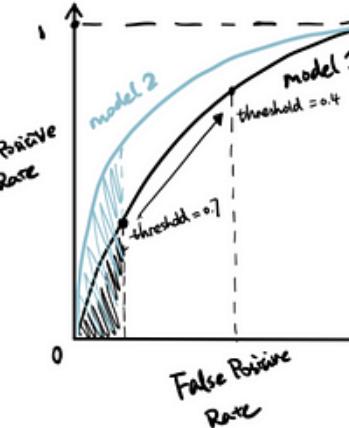
Confusion Matrix

`confusion_matrix(y_test, y_pred)`

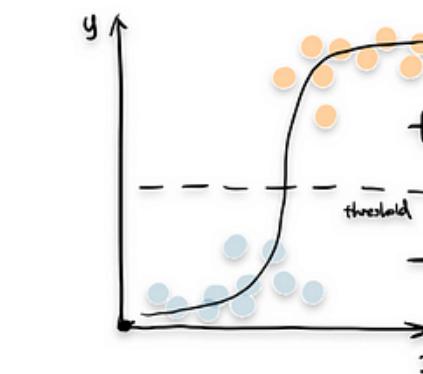


ROC & AUC

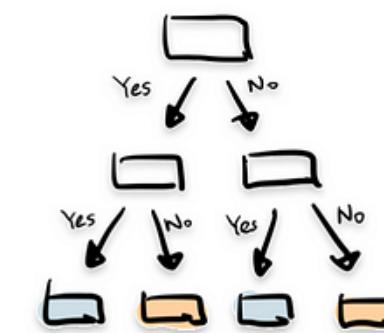
`metrics.auc(fpr, tpr)`



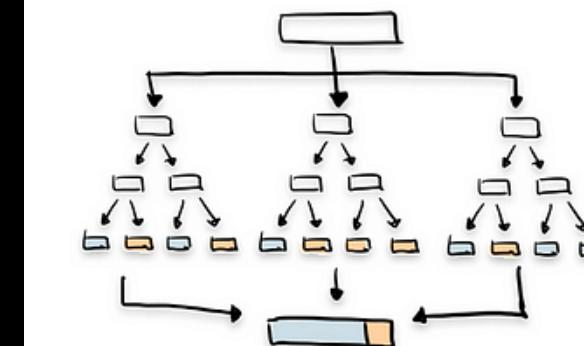
Logistic Regression



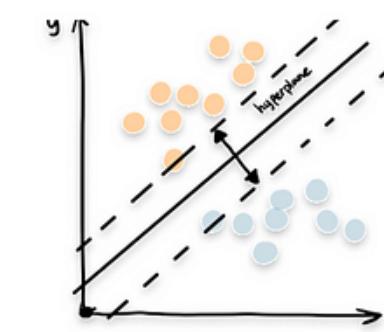
Decision Tree



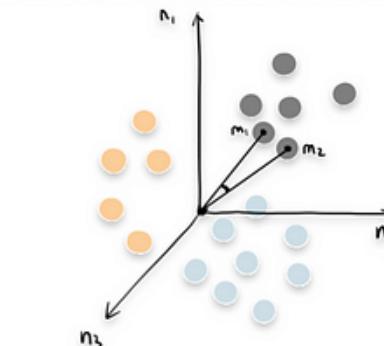
Random Forest



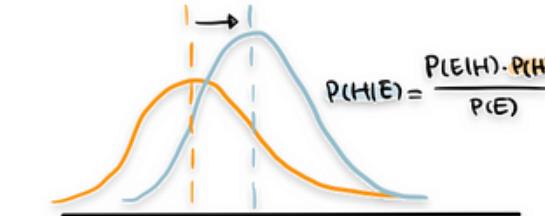
Support Vector Machine



K Nearest Neighbour



Naive Bayes



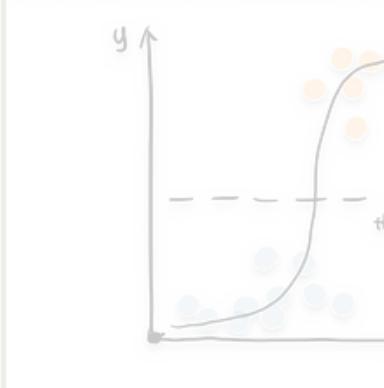
Machine Learning Algorithms - Classification

Exploratory Data Analysis (EDA)

1) Histogram: `df.plot(kind = 'hist')`
 2) Box Plot: `sns.boxplot()`
 3) Grouped Bar Chart: `sns.countplot()`



Logistic Regression



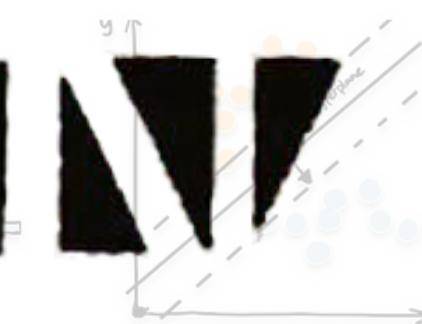
Decision Tree



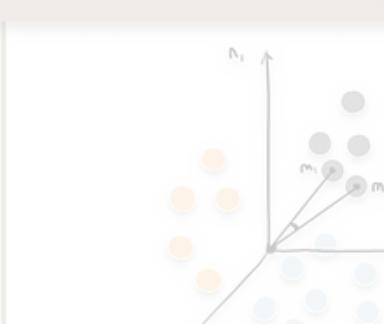
Random Forest



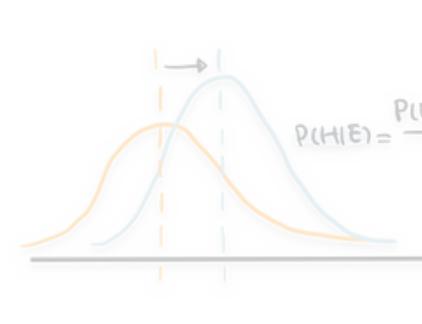
Support Vector Machine



K Nearest Neighbour



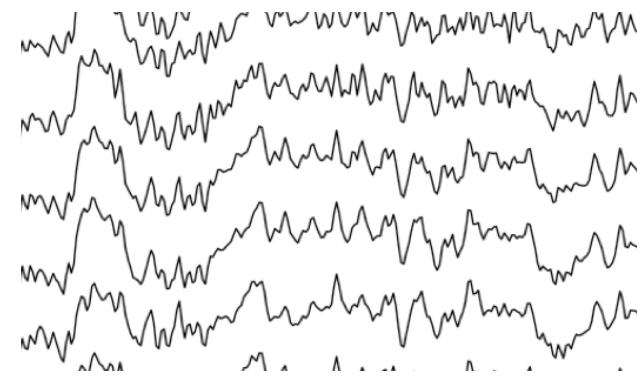
Naive Bayes



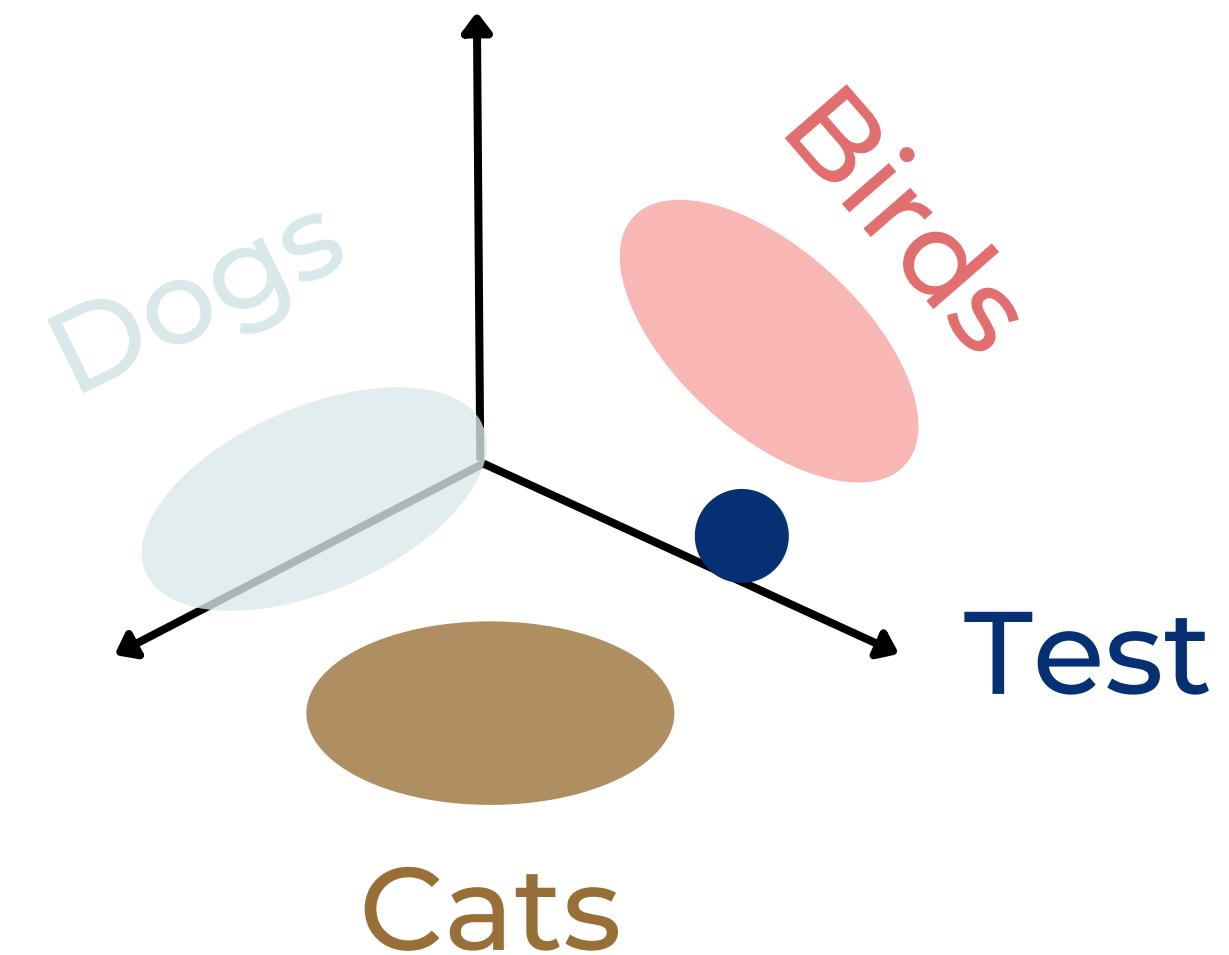
←
 To Be Continued

Step 4 : Testing

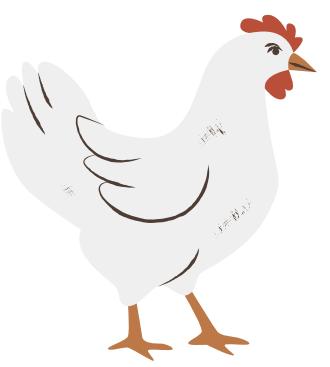
Data



Model



Prediction



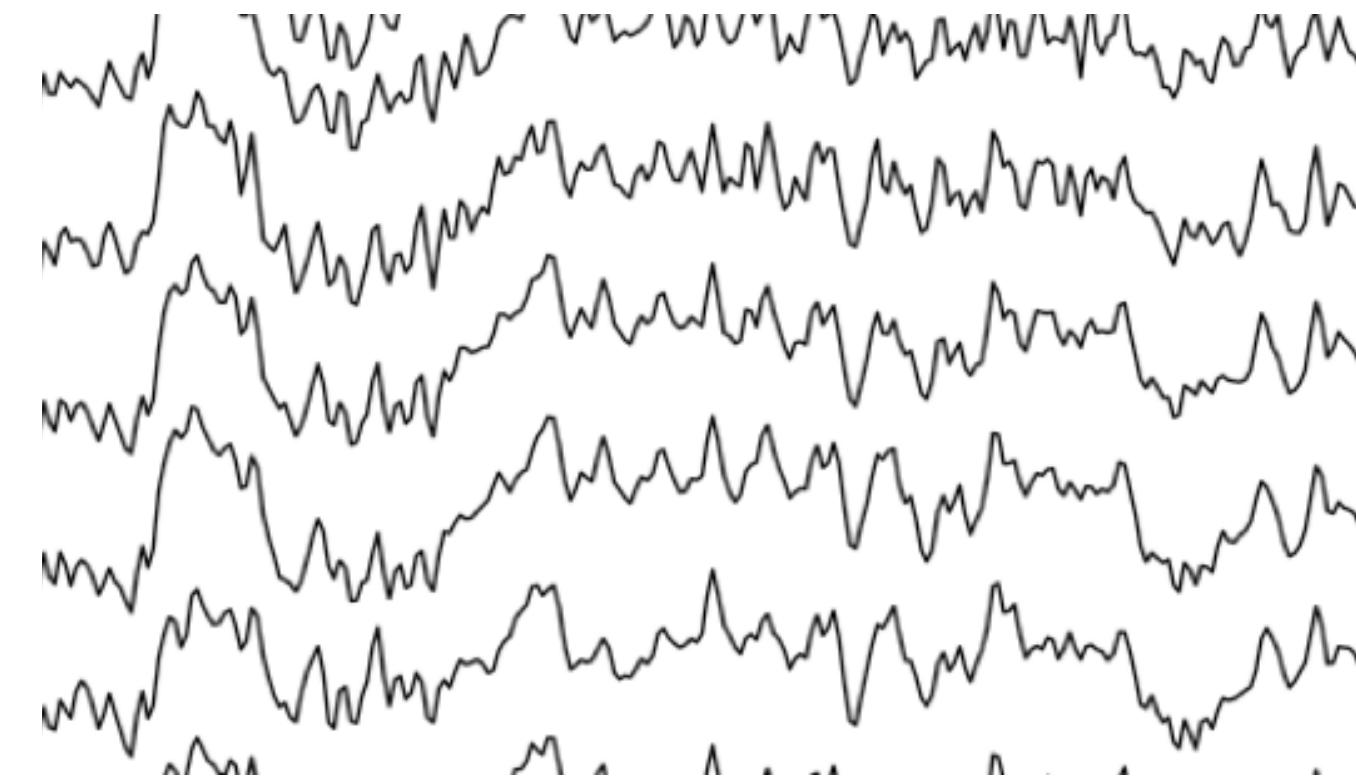
Birds
Ans.



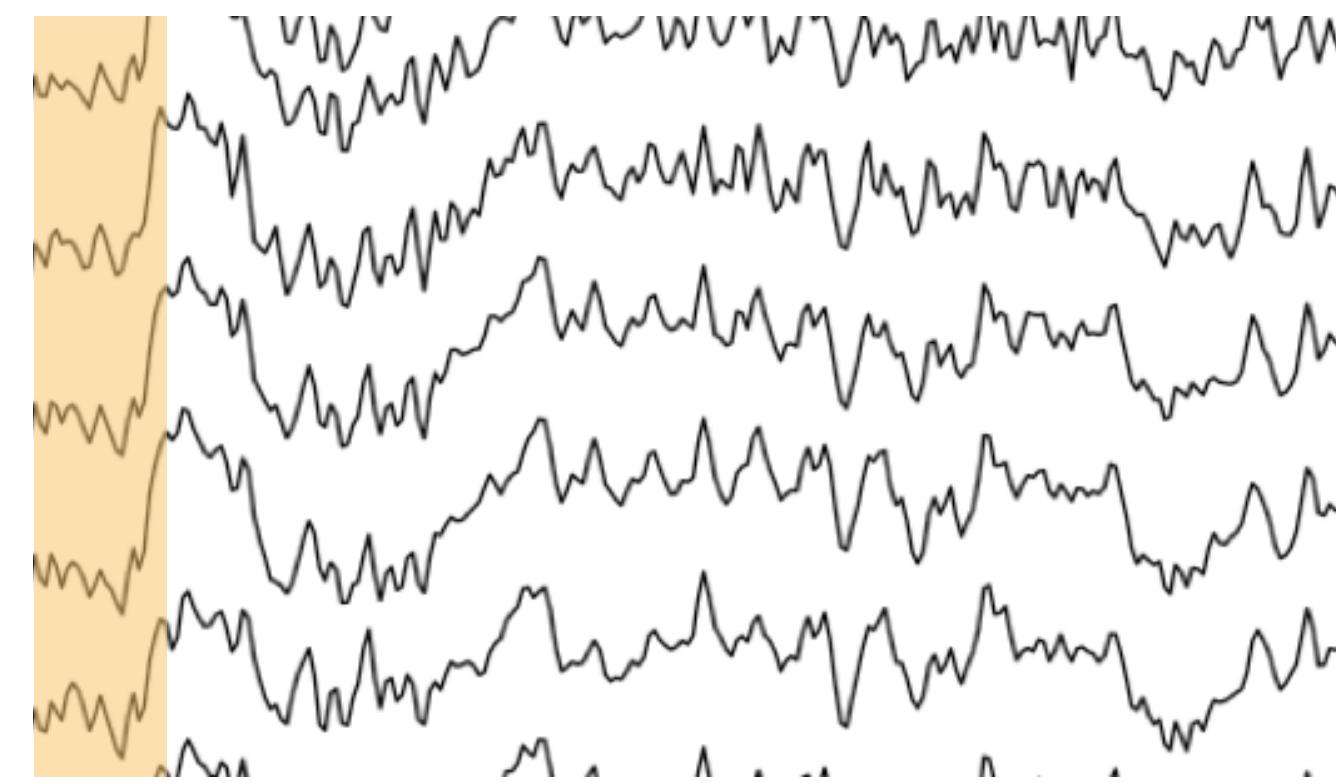
Step 4 : Testing

Trials	Prediction	Answer	Correct
1	Birds	Birds	1
2	Cats	Dogs	0
3	Dogs	Birds	0
4	Cats	Cats	1
5	Dogs	Dogs	1
6	Birds	Birds	1

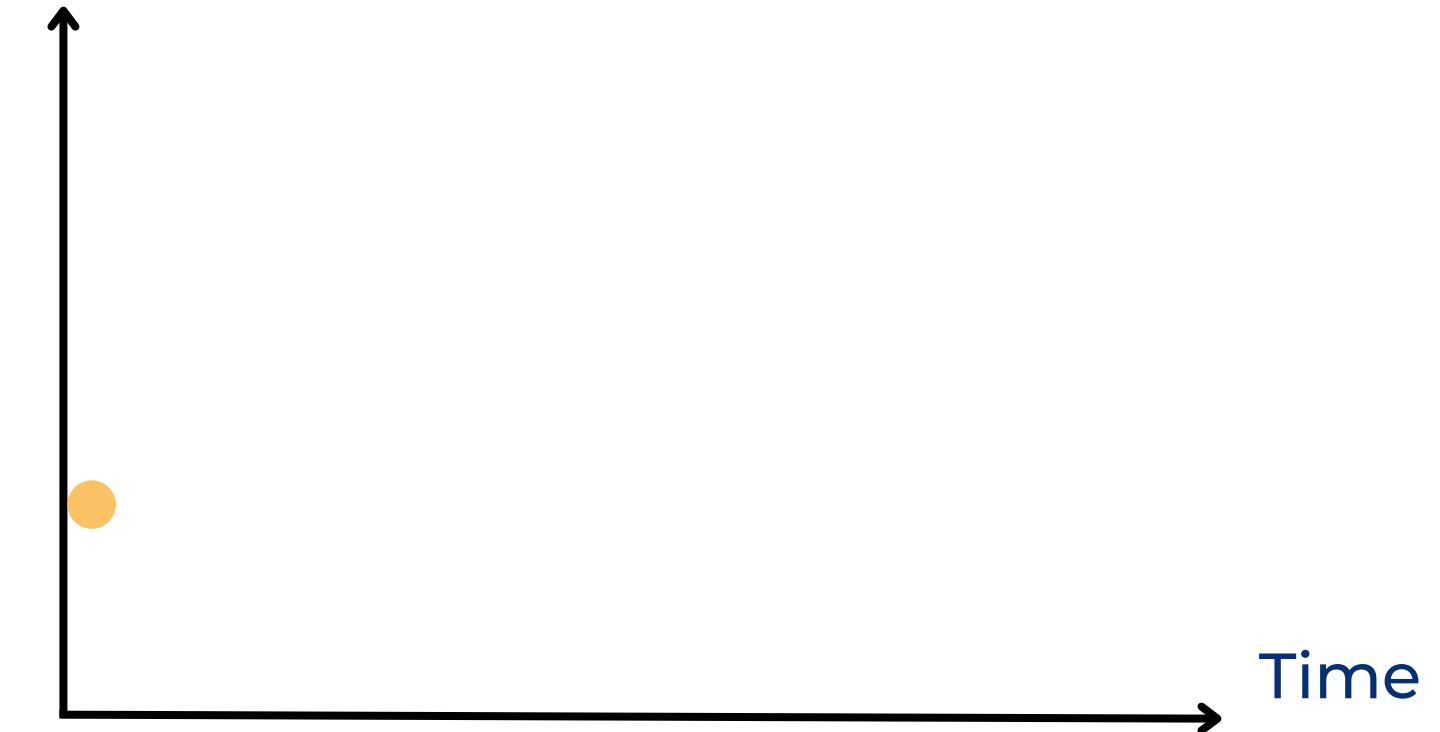
Step 4 : Testing



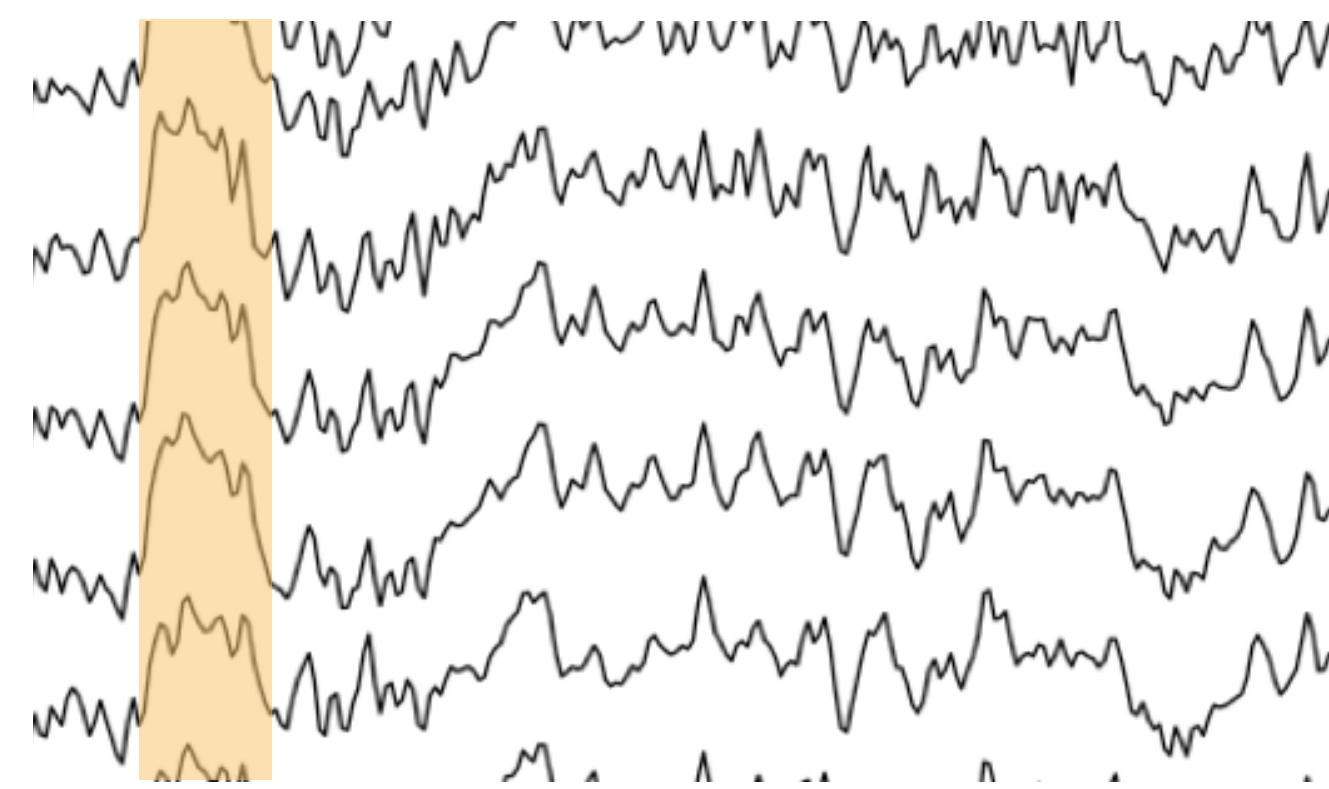
Step 4: Testing



Decoding acc.



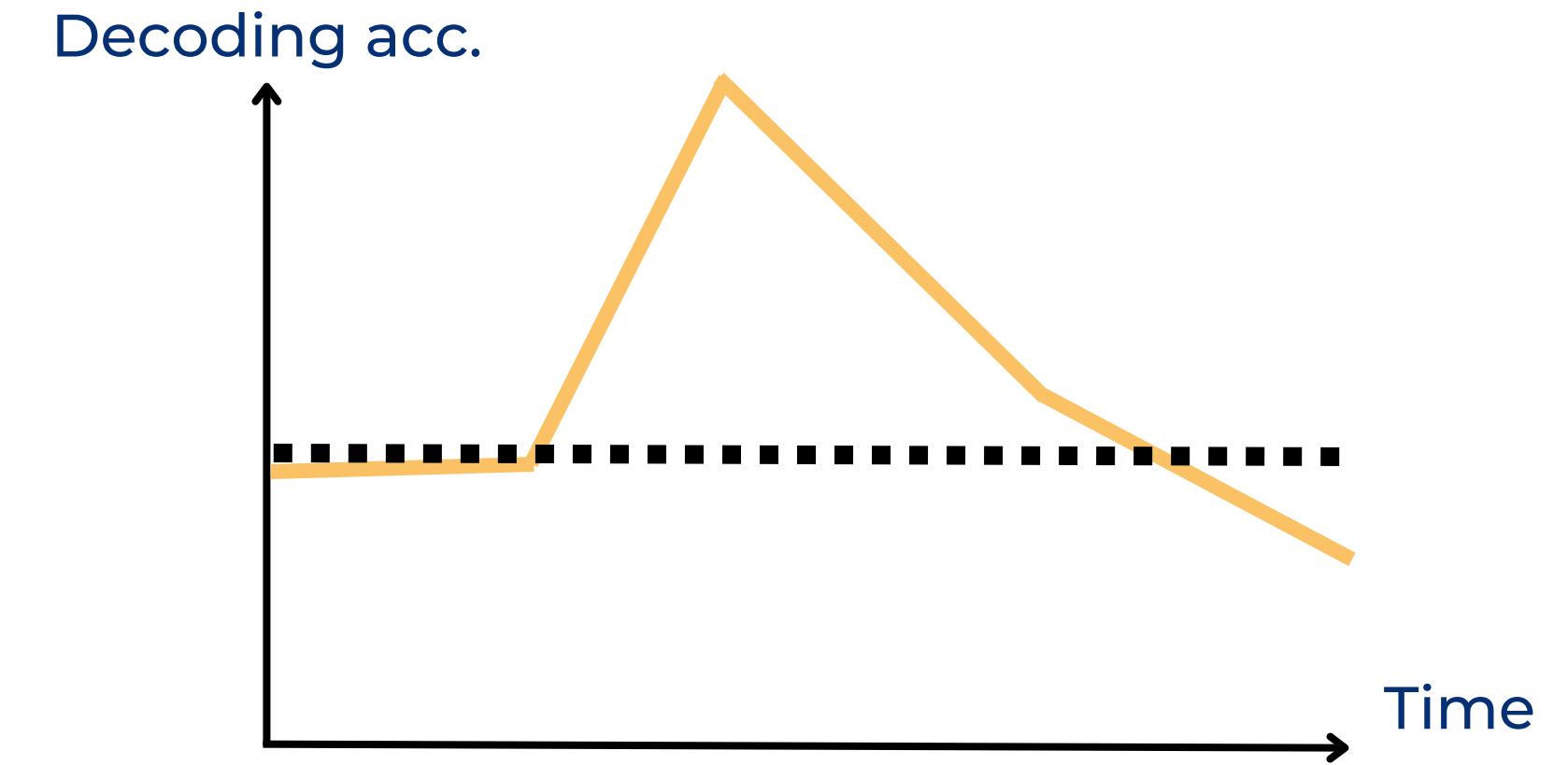
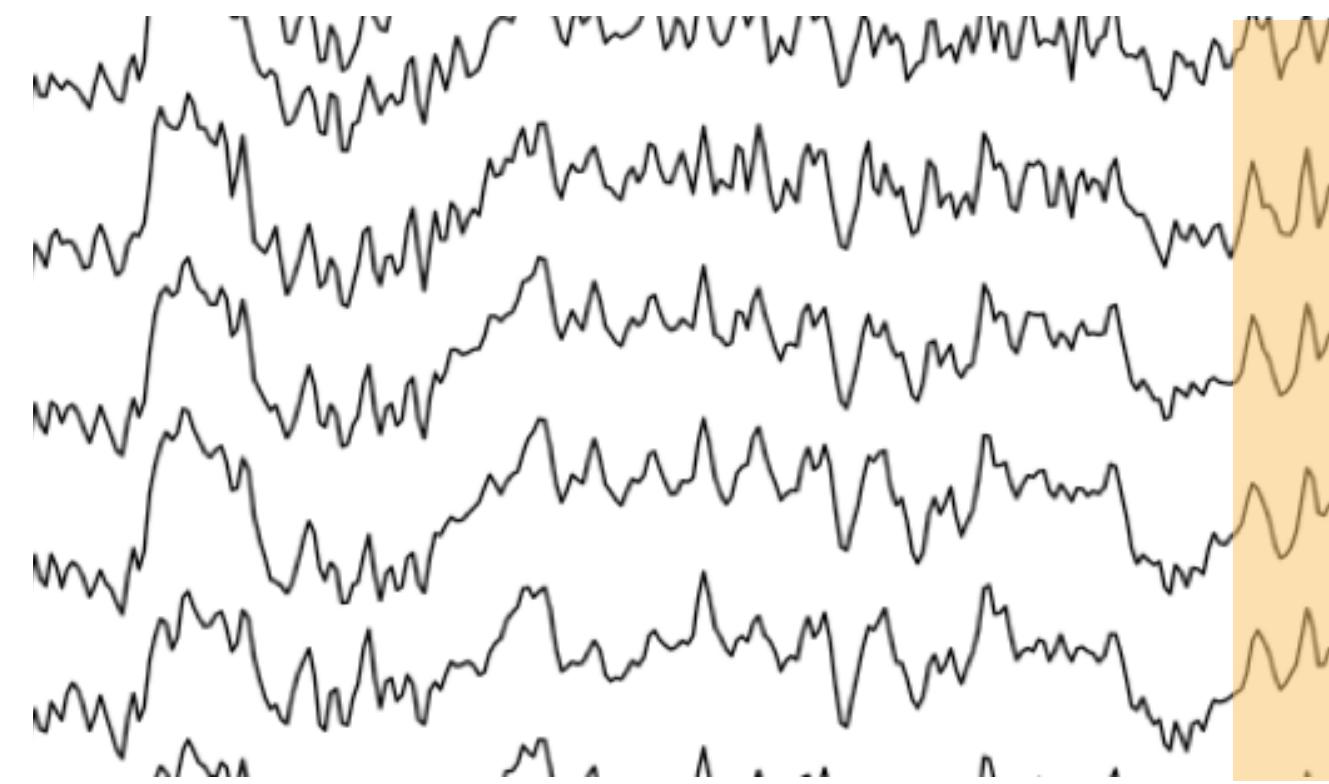
Step 4: Testing

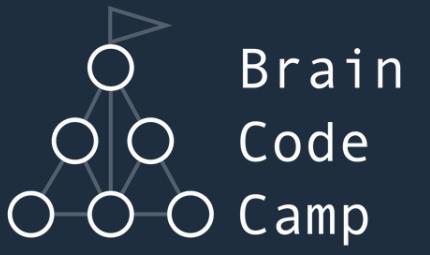


Decoding acc.



Step 4 : Testing

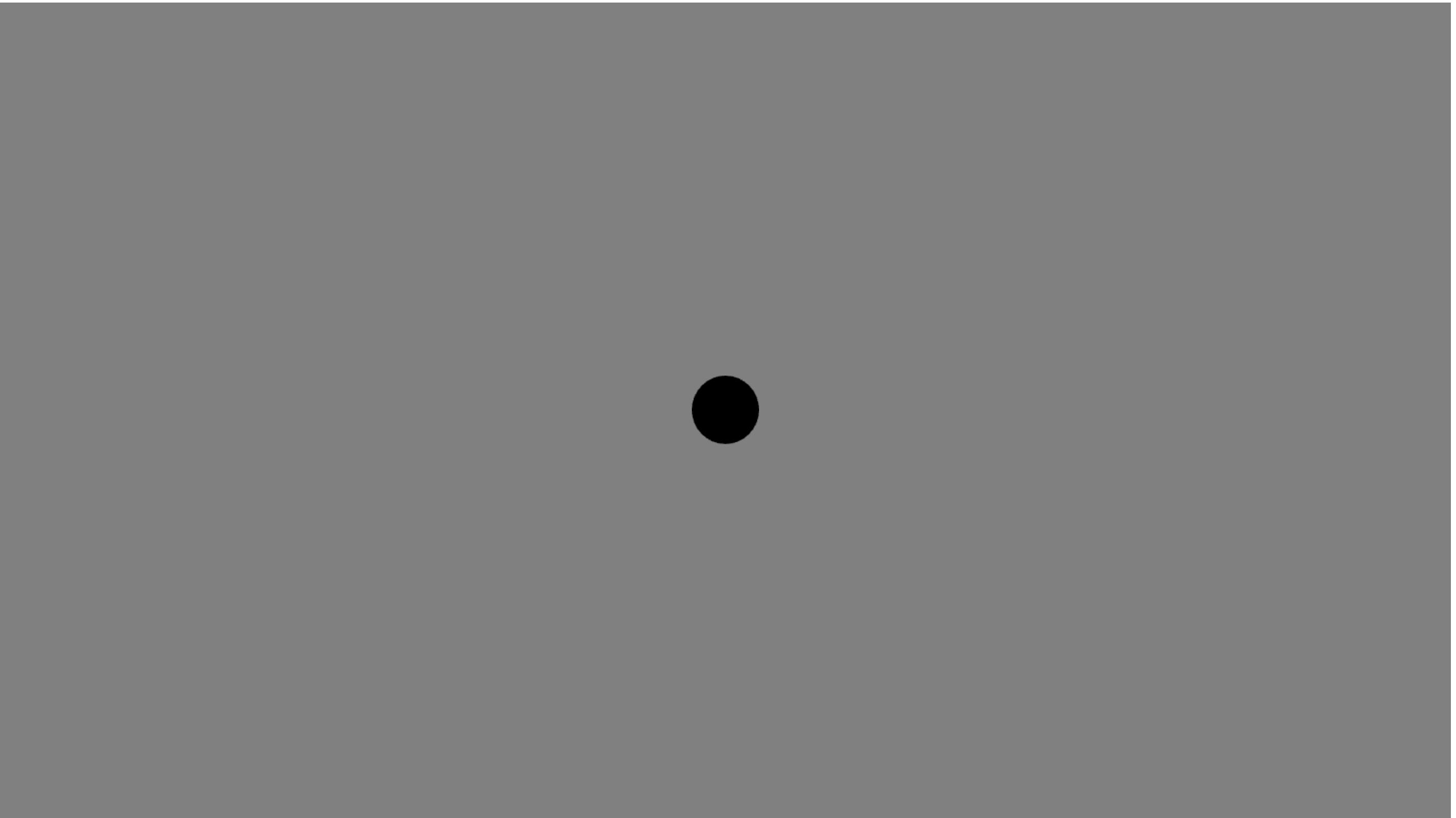
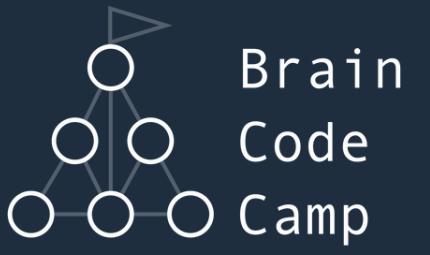


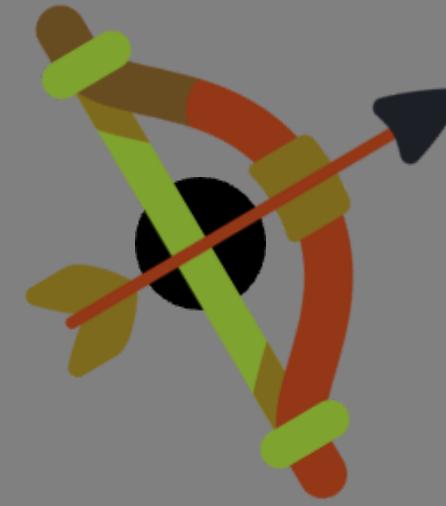
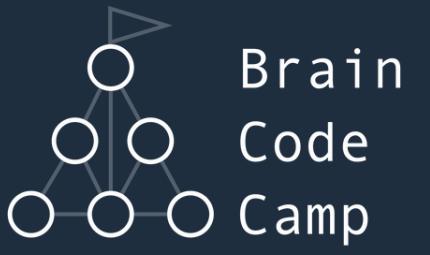


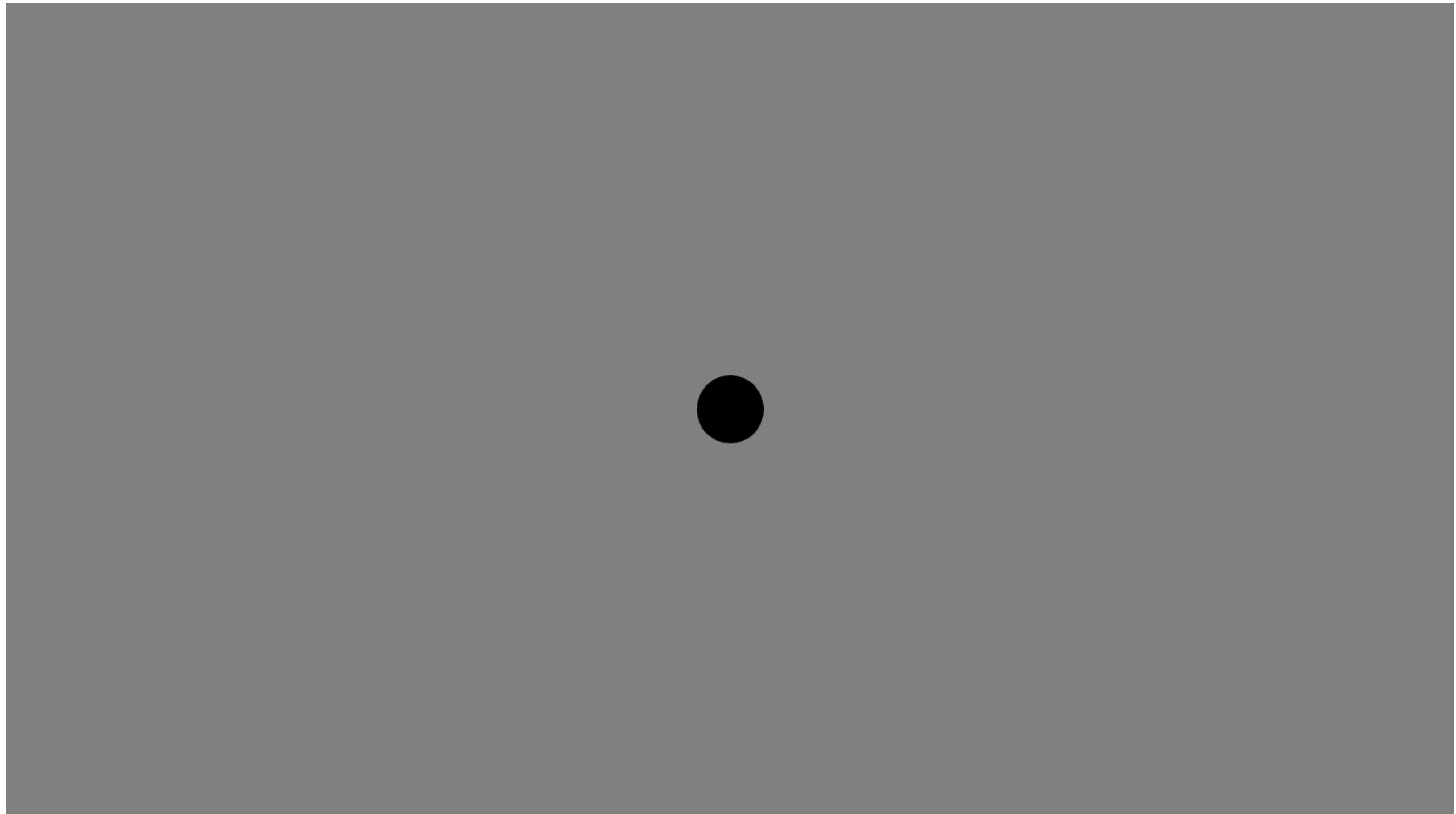
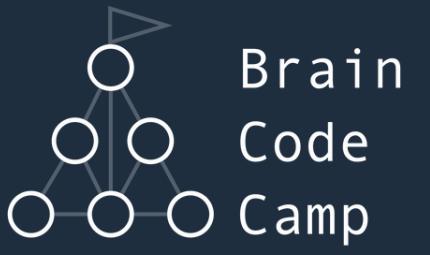
Let's move to our question

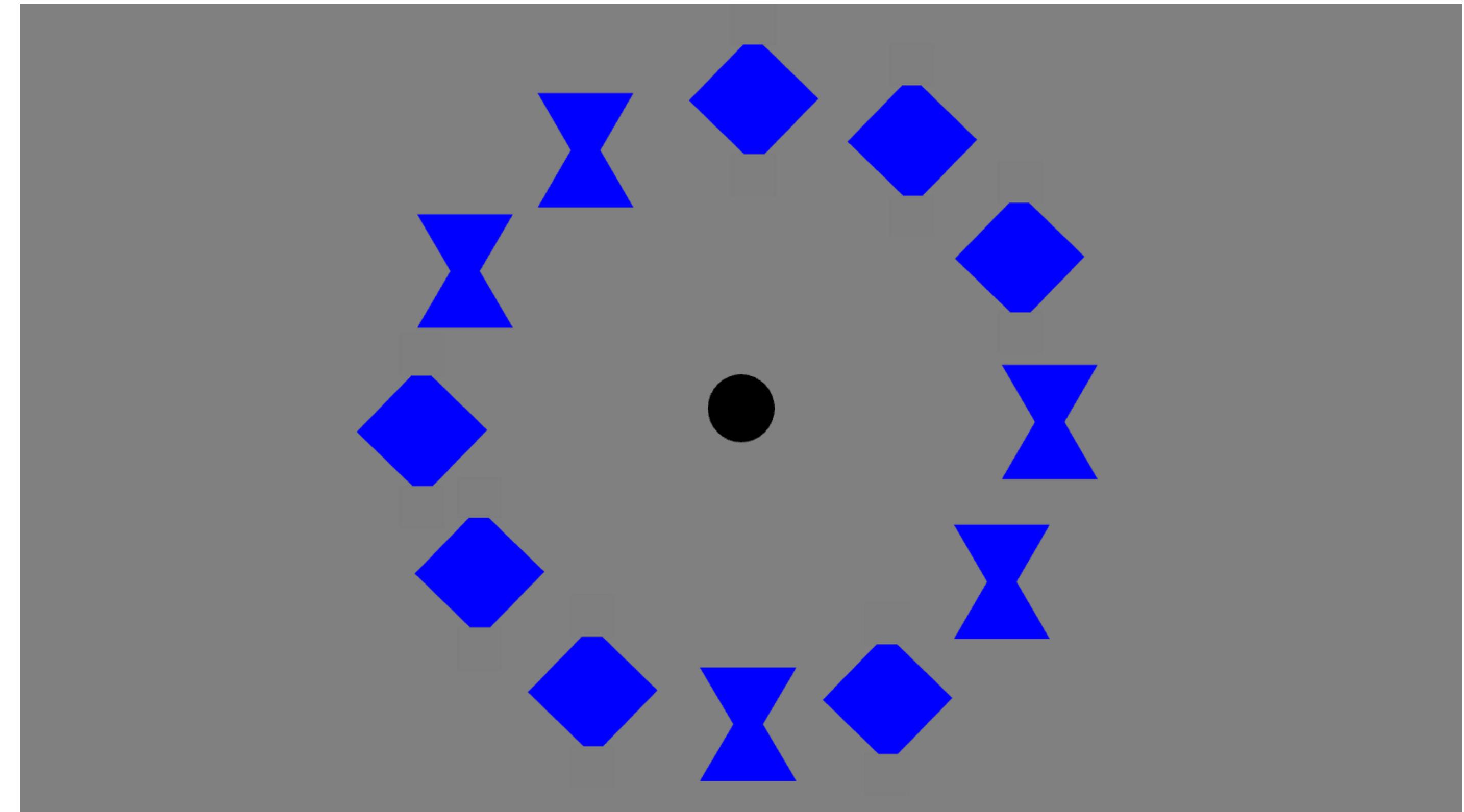


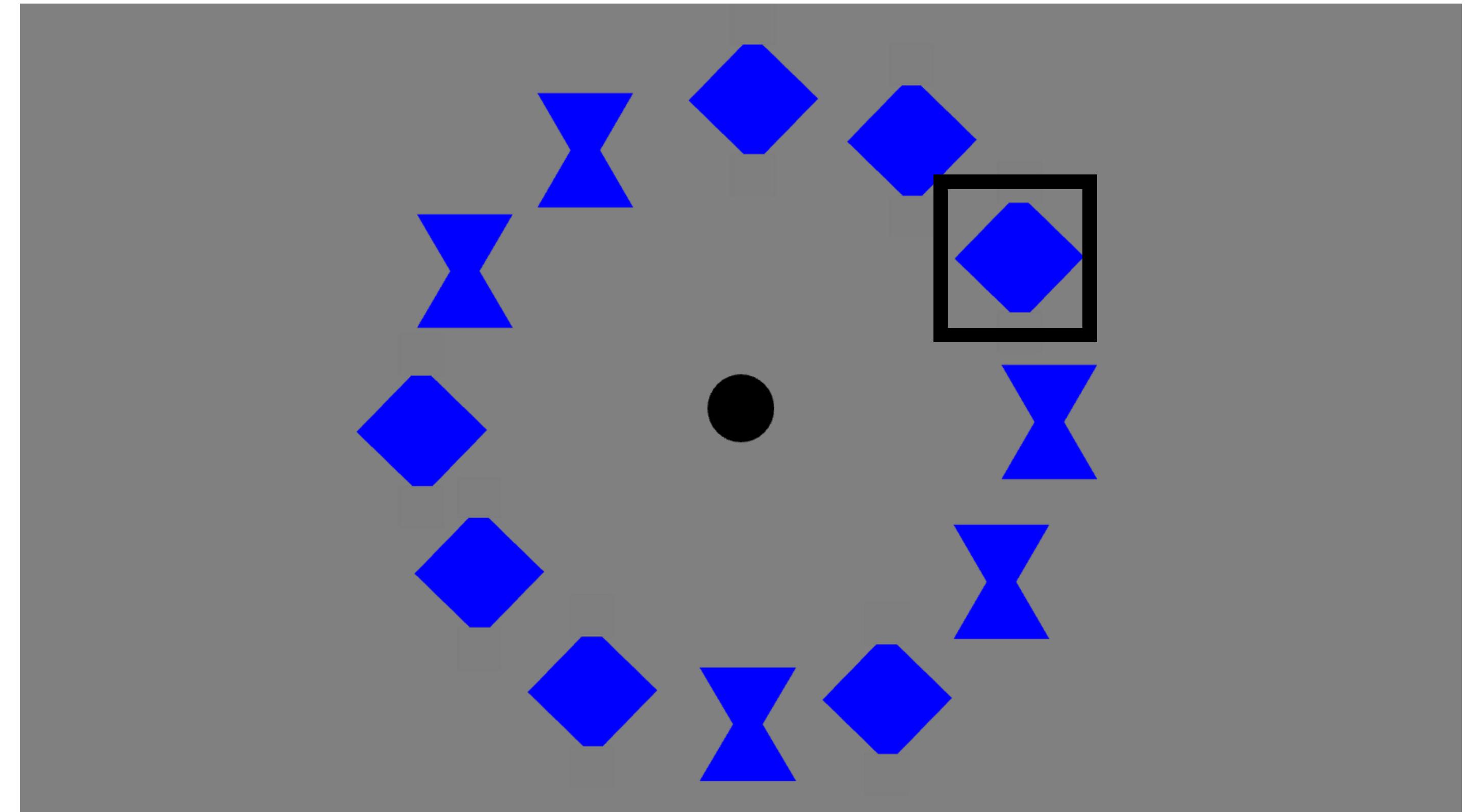


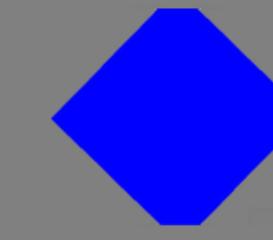
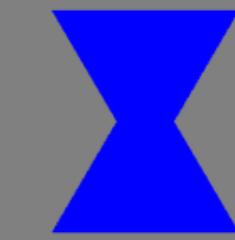
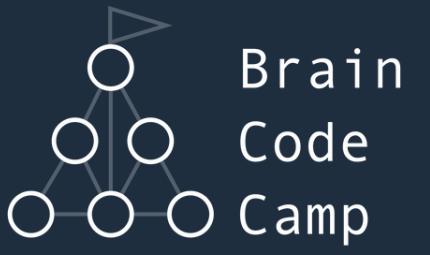


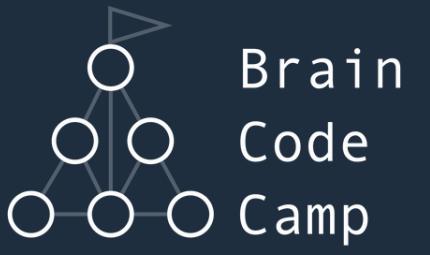


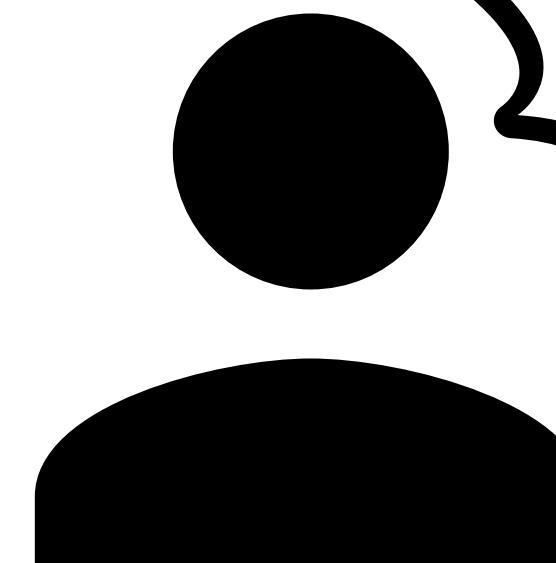
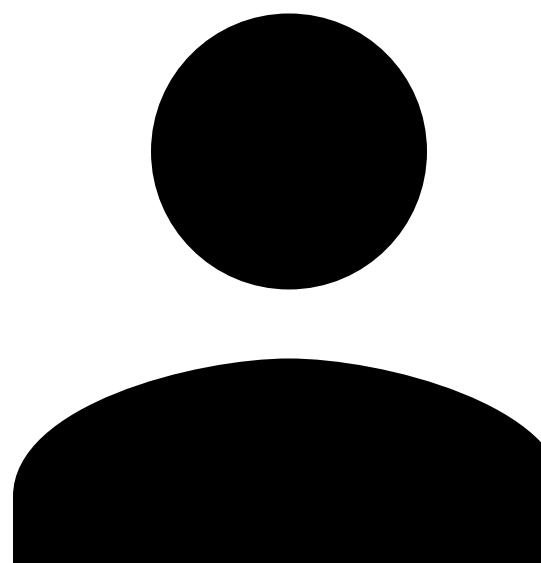
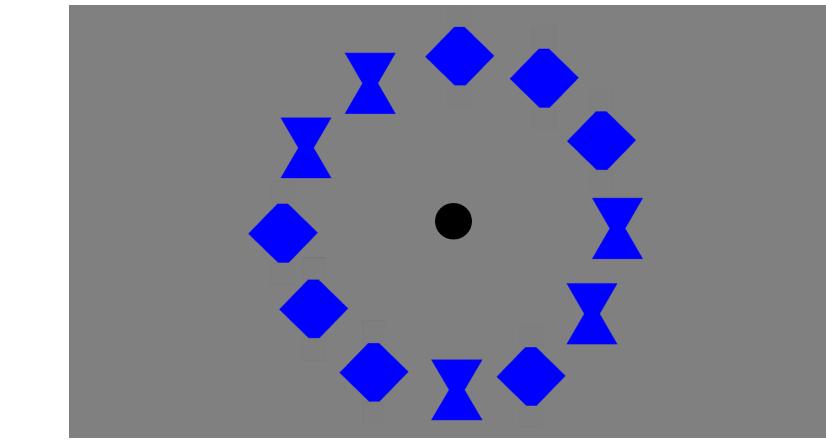
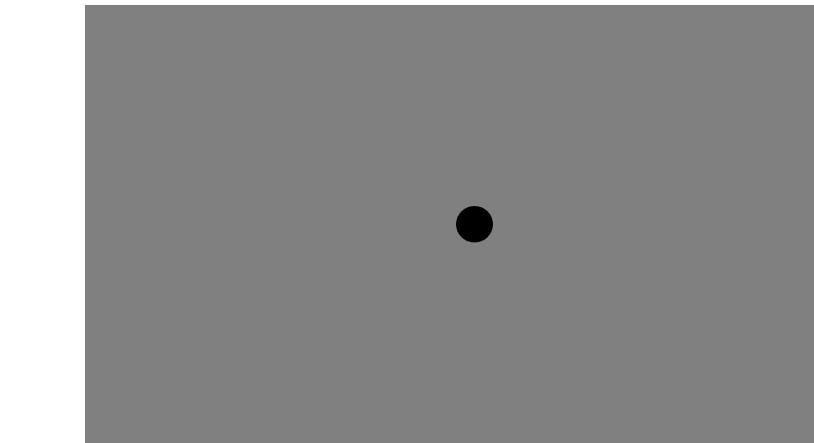
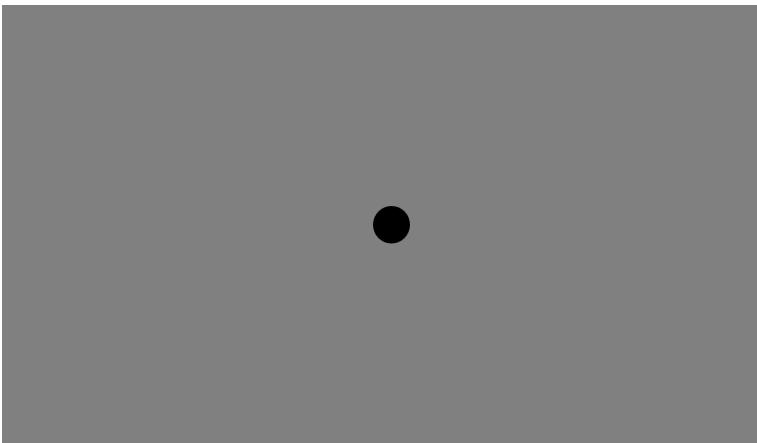
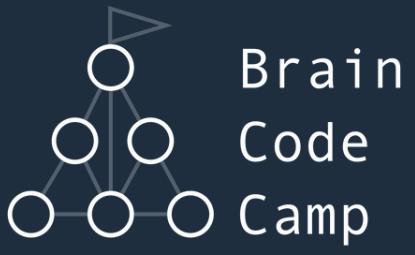






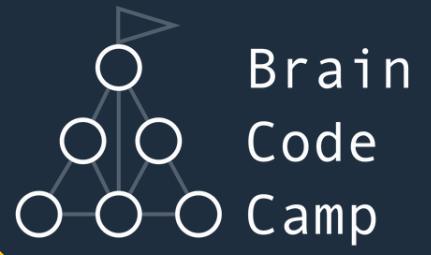






Target will
appear at
2 "

Can we decode target location from EEG signal?



Brain
Code
Camp

To be continued