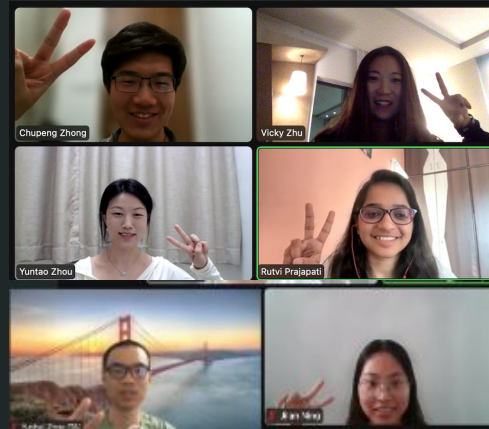


# Decoding Stimulus Category from Single-trial Neural Activity

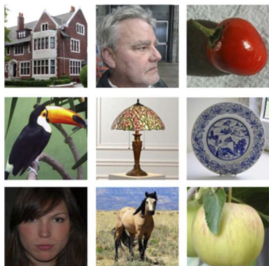
Team members: Yuntao Zhou, Jilan Ning,  
Vicky Zhu, Chupeng Zhong

Dumpling Group 2/ Face Project

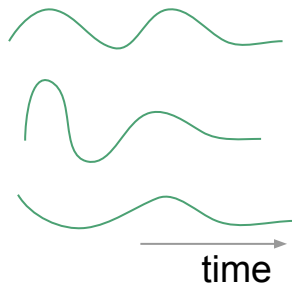
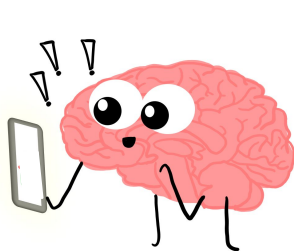


# Background

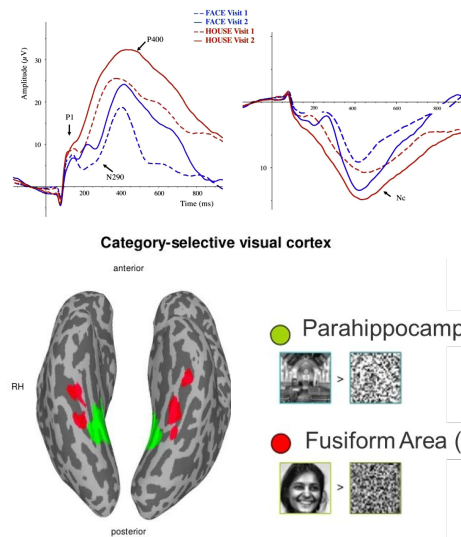
**Question:** whether category decoding works on single-trial neural activities?



(Heering and Rossion, 2015)



Averaged  
signals



[https://benedikteheering.de/glm2018/images/fmri\\_ffa\\_ppa.jpg](https://benedikteheering.de/glm2018/images/fmri_ffa_ppa.jpg)

(e.g., Hasson et al., 2003; Li et al., 2022; Lorenzo et al., 2020)

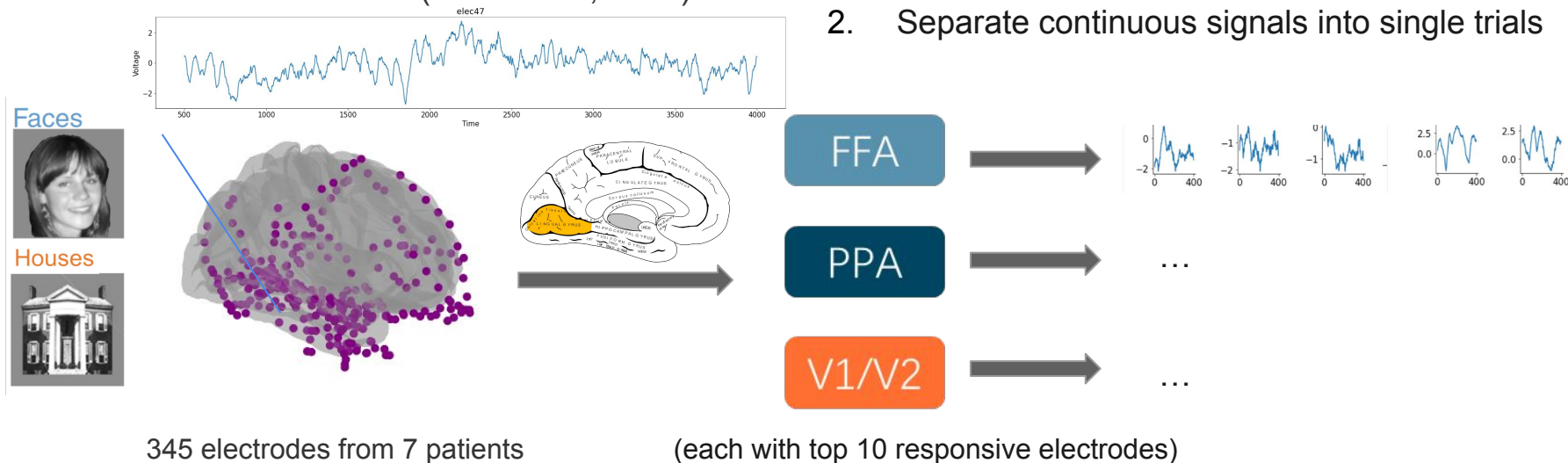
# Method: ROI-wise models to decode category information

## Dataset:

Faces/Houses ECoG dataset (Miller et al., 2017)

## Pre-processing:

1. Generate three sub-datasets
2. Separate continuous signals into single trials

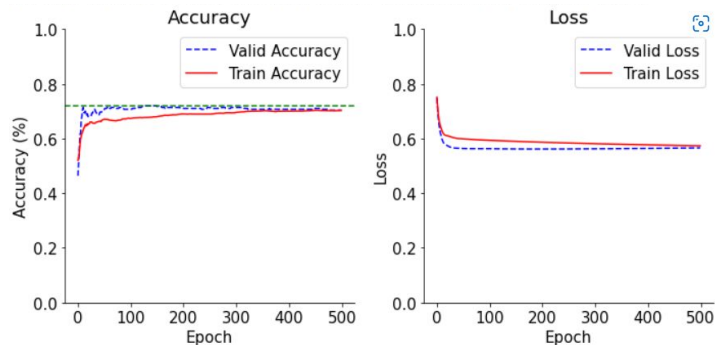


## Hypothesis:

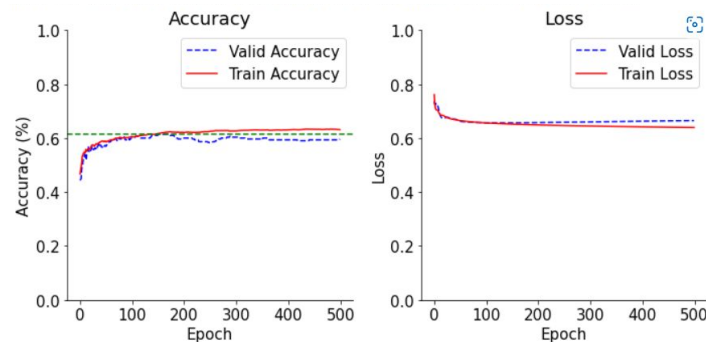
the single-trial signals from FFA and PPA show higher prediction accuracy than those from V1/V2.

# Logistic Model:

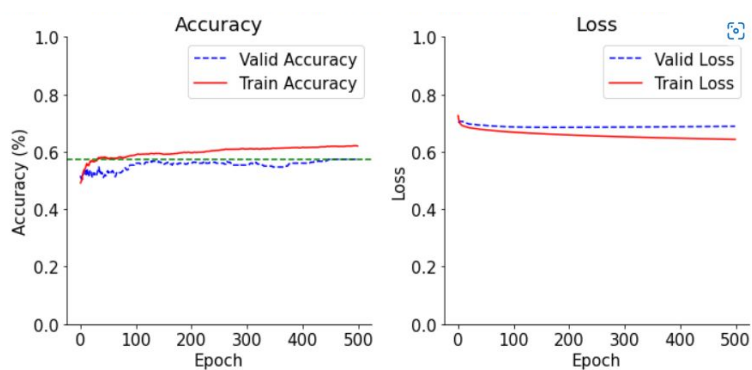
FFA



V1V2



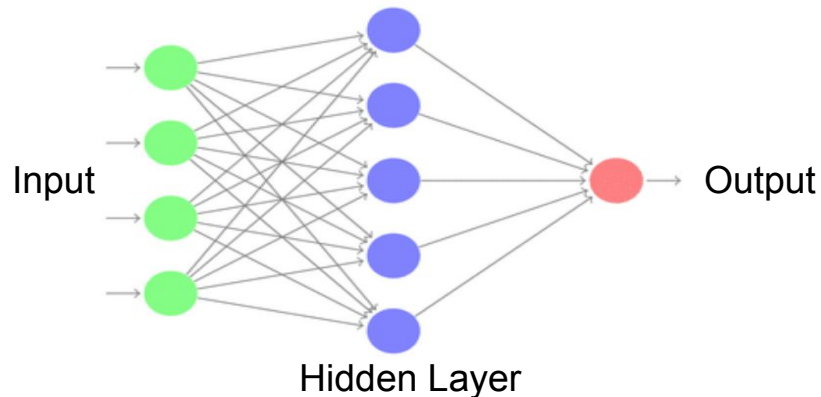
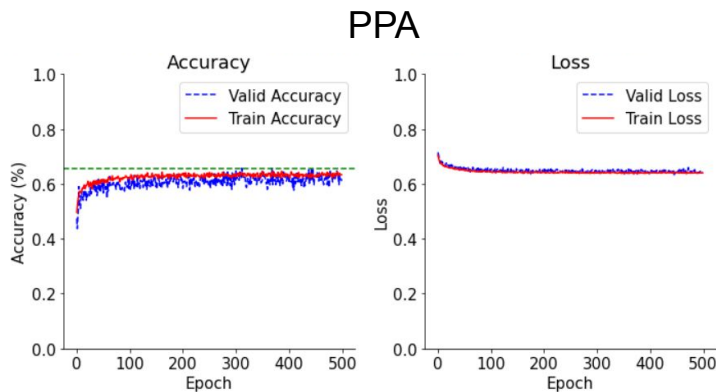
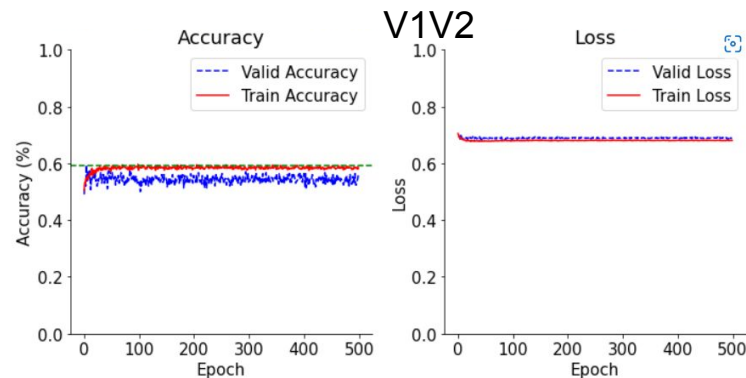
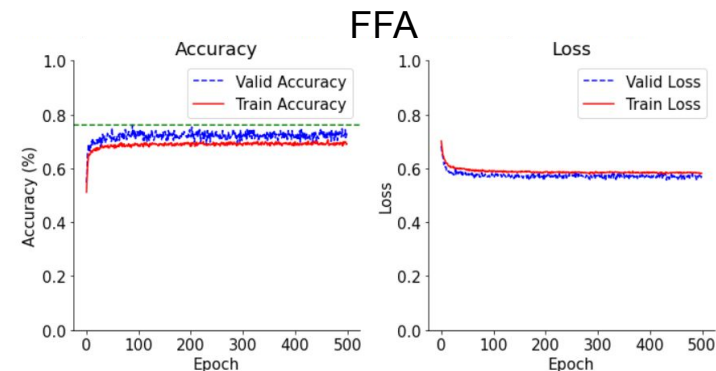
PPA



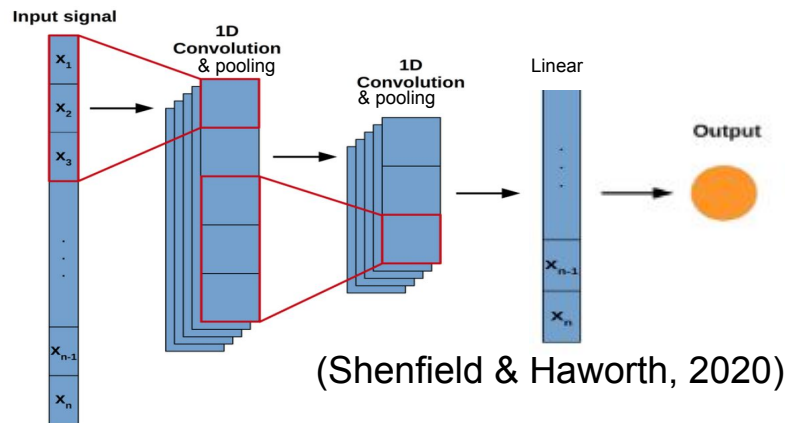
	FFA	PPA	V1/V2
Hyperparameters	hidden_dim=[ ];p=0;epoch=500; lr=0.001;weight_decay=0		
Acc (train)	0.70250	0.61958	0.63125
Acc (valid)	0.70333	0.57333	0.59667
Loss (train)	0.57305	0.64277	0.63921
Loss (valid)	0.56556	0.68822	0.66477

# Multilayer Perceptron (MLP):

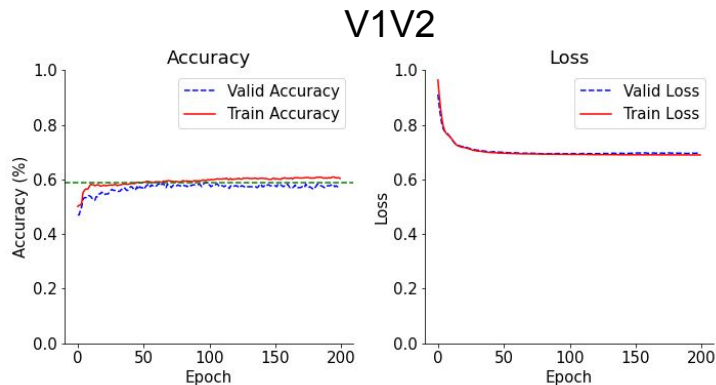
hidden\_dim=[50];p=0.1 ;epoch=500; lr=0.001;weight\_decay=0.1



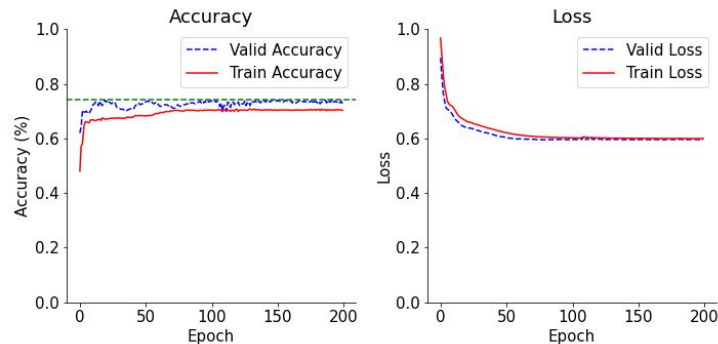
# Convolutional Neural Network Model (CNN) : 1D sliding and pooling



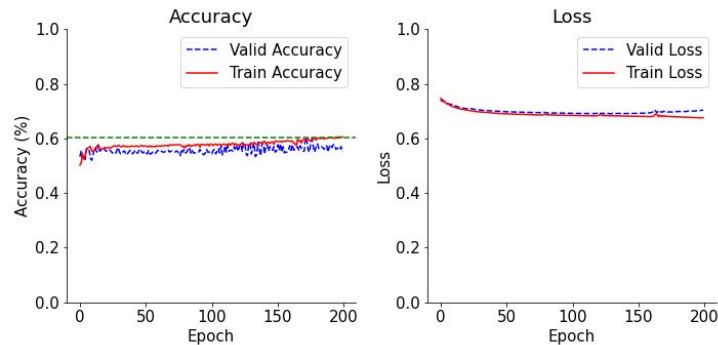
(Shenfield & Haworth, 2020)



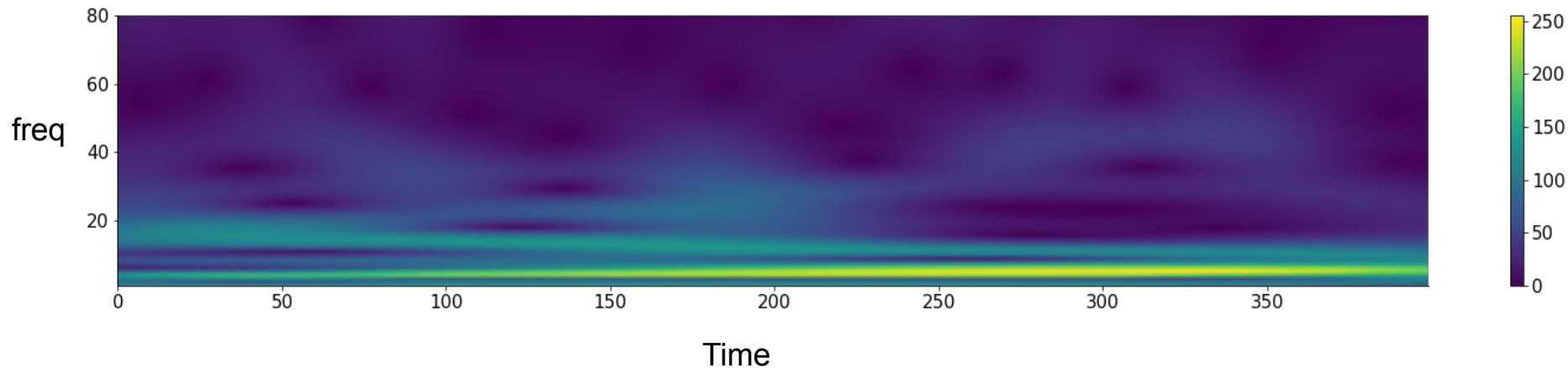
FFA



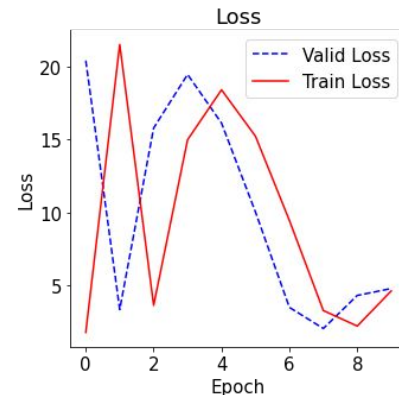
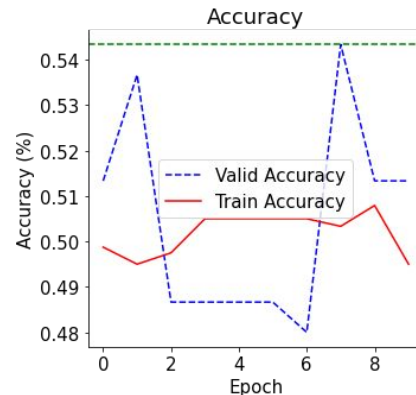
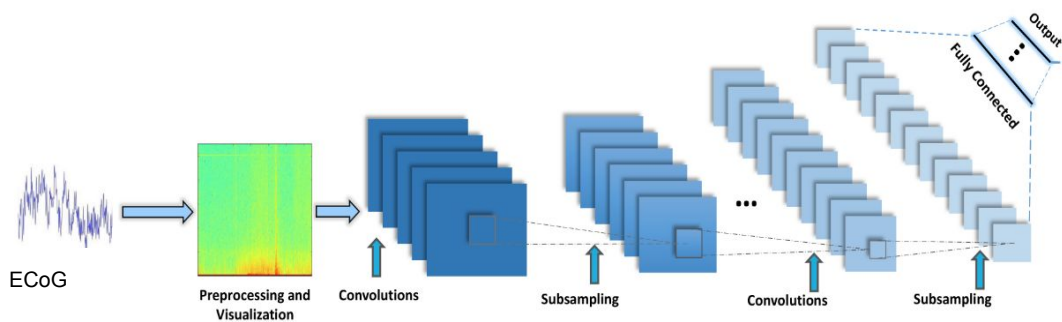
PPA



# CNN: 2D sliding and pooling



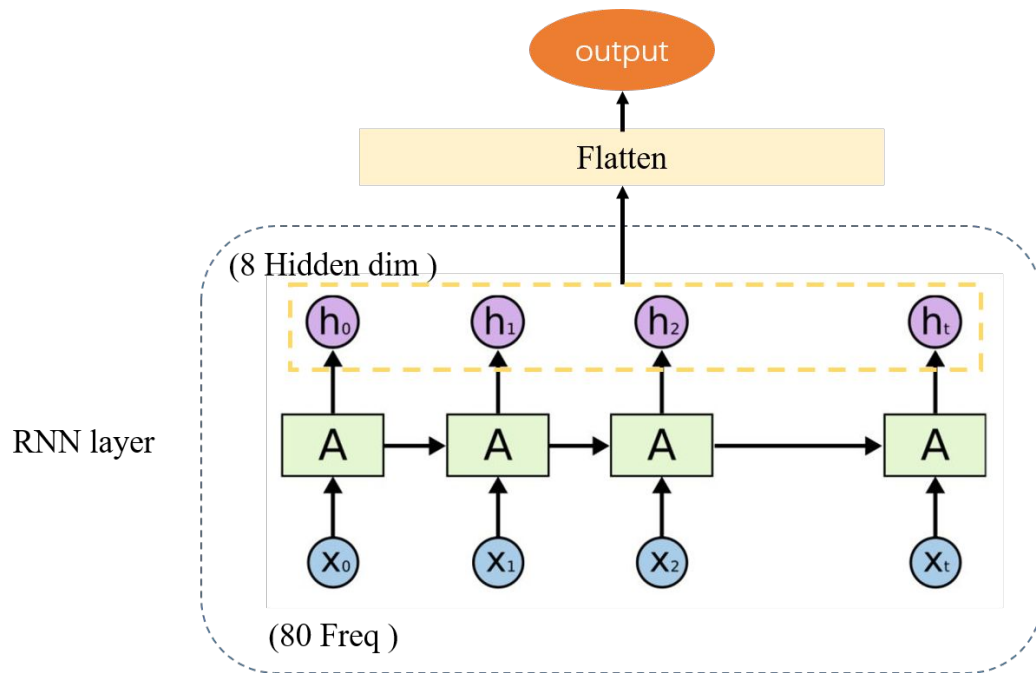
<https://www.arxiv-vanity.com/papers/2007.01276/>



Bad performance for any region :(

# Recurrent Neural Network:

RNN (hidden state dim = 8) -> output layer (# of parameters: 3921)

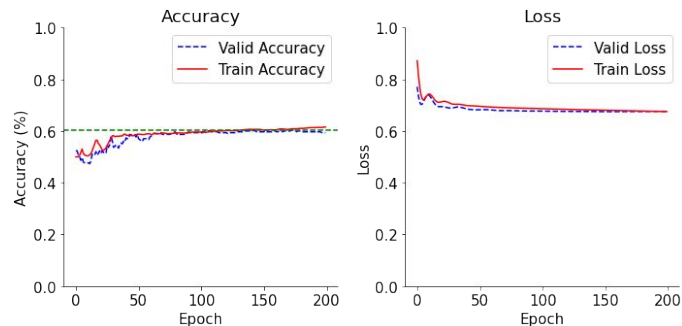


<https://zhuanlan.zhihu.com/p/44145288>

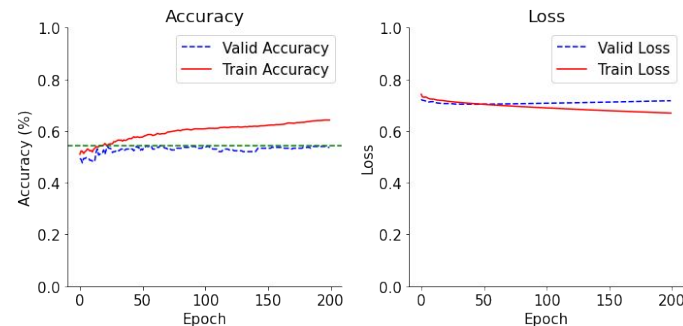


# Recurrent Neural Network:

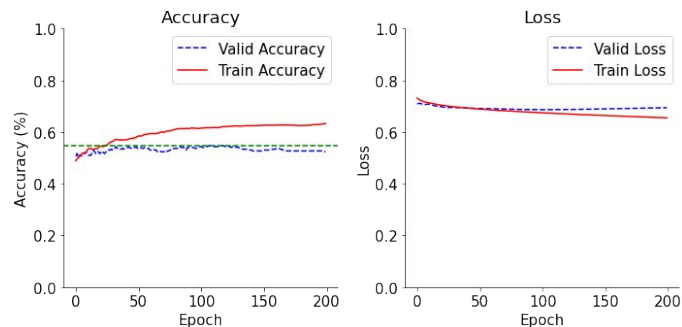
## FFA



## V1/V2



## PPA



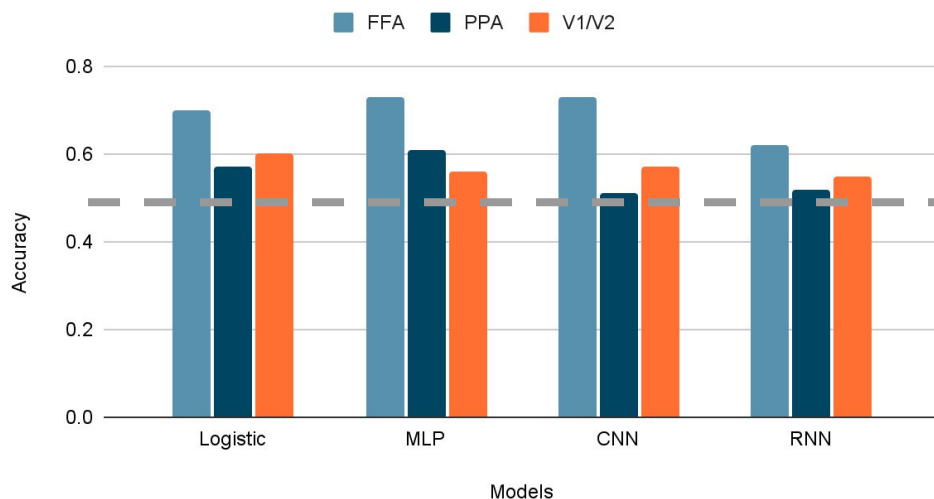
	FFA	PPA	V1/V2
Acc (train)	0.6383	0.6325	0.6354
Acc (valid)	0.6200	0.5233	0.5500
Loss (train)	0.6560	0.6545	0.6732
Loss (valid)	0.6665	0.6937	0.7048



# Summary

	Logistic	MLP	CNN_1D	RNN
# of param	401	20101	1331	3921

## Validation Accuracy



To answer our questions:

- Which region? FFA
- Which model? CNN
- Problem: overfitting, small sample, low accuracy



# Thank you!

We want to thank NMA giving us a platform to know each other!



Thank our tutorial TA, Yunhui Zhou, who gave us tremendous supports on the knowledge and technical trainings!



Thank our mentor, Shahriar Faghani, who gave us some very insightful guidance through our project line.



Thank our project TA, Rutvi Prajapati, who checked in with us weekly for the process and provide valuable advice.

# Appendix

