Modeling Human Perceptual Inference by Drift Diffusion Model and Neural Network

Group B - (Dataset 3)

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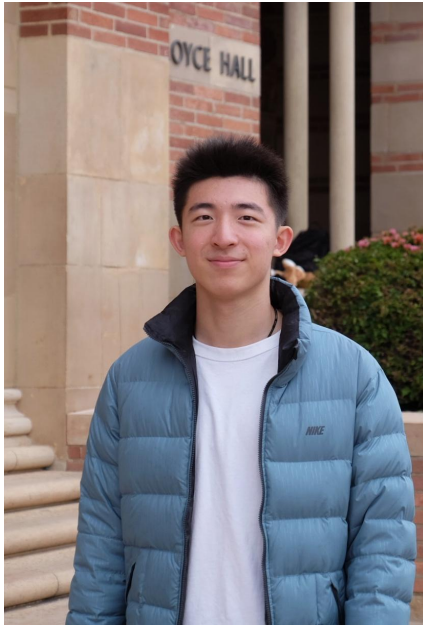
TAs: Alaz Aydin, Shashwati Tripathi
Mentor: Jeff Erlich

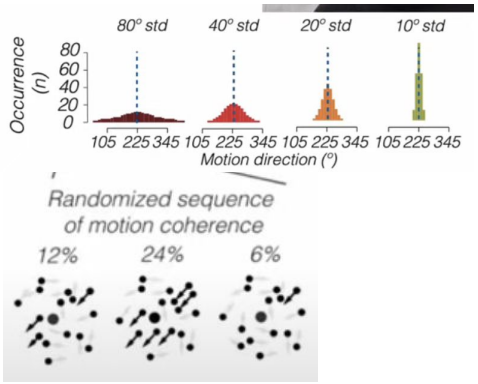
Leou Ying

Neuroscience Undergraduate Student

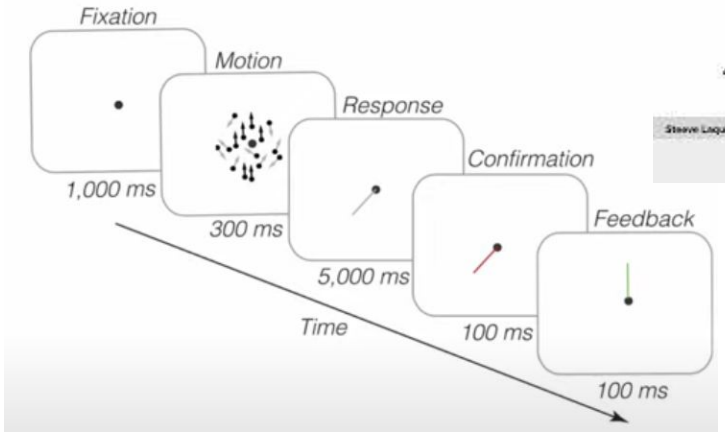


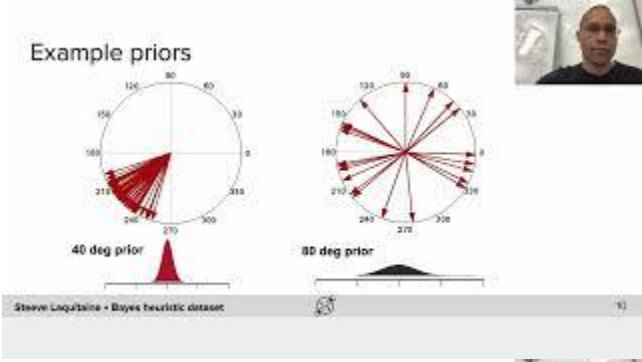
The Switching Observer

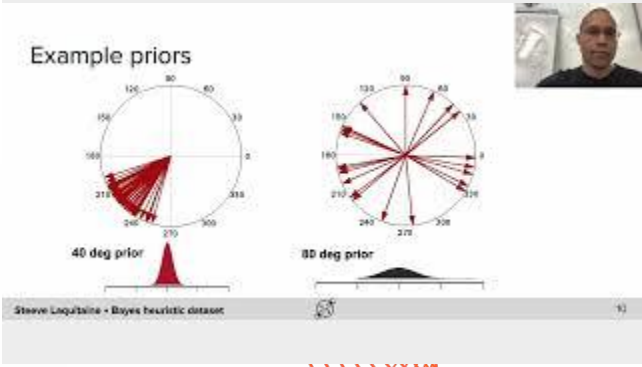
Laquitaine & Gardner found evidence for the “Switching Observer” (dataset 3).



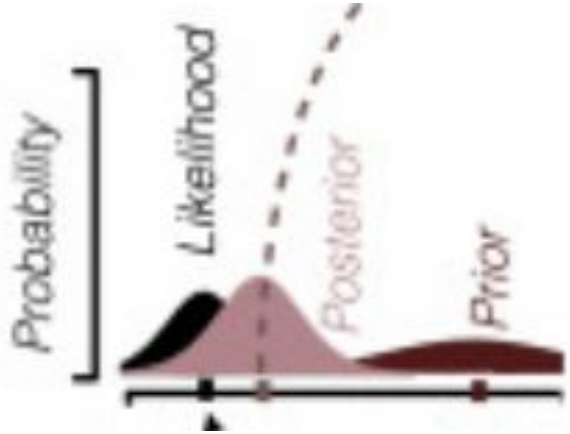
Laquitaine & Gardner 2017



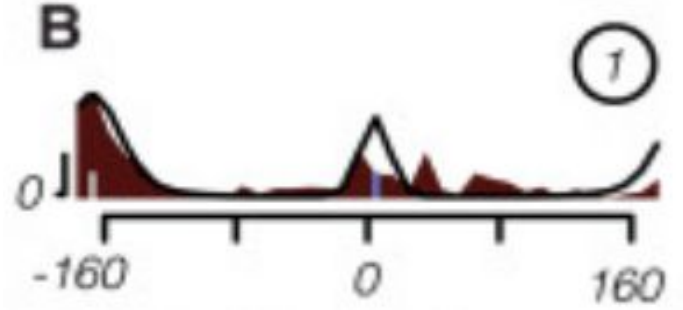




Bayesian Observer



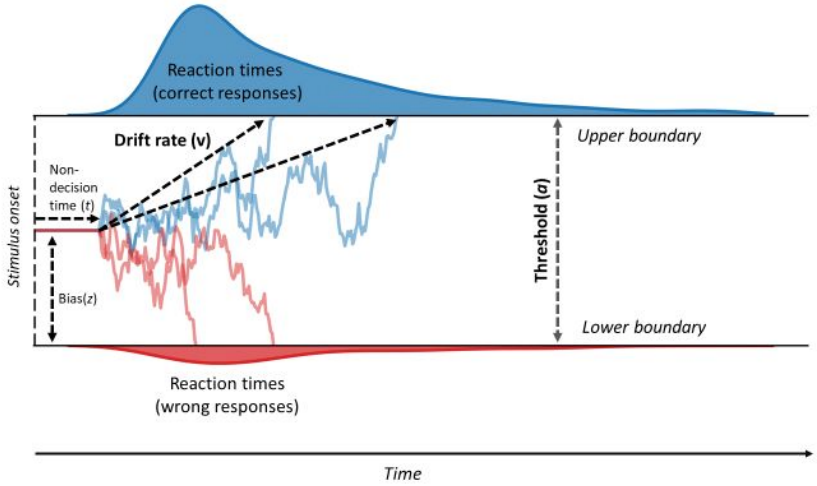
Switching Observer



We were wondering why this switch exists. One limitation the paper had is that it doesn't examine reaction time.

The Switching Observer

We hypothesized that this switch process could be modelled by a ***Drift-Diffusion model,*** which may tell us about a relationship between this switch and the reaction time.

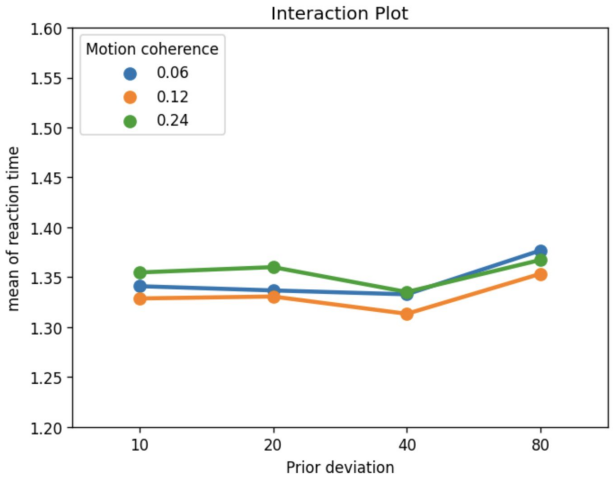


(Mikkel C Vinding et al.)

Reaction Time in the dataset

In the data, we examined:

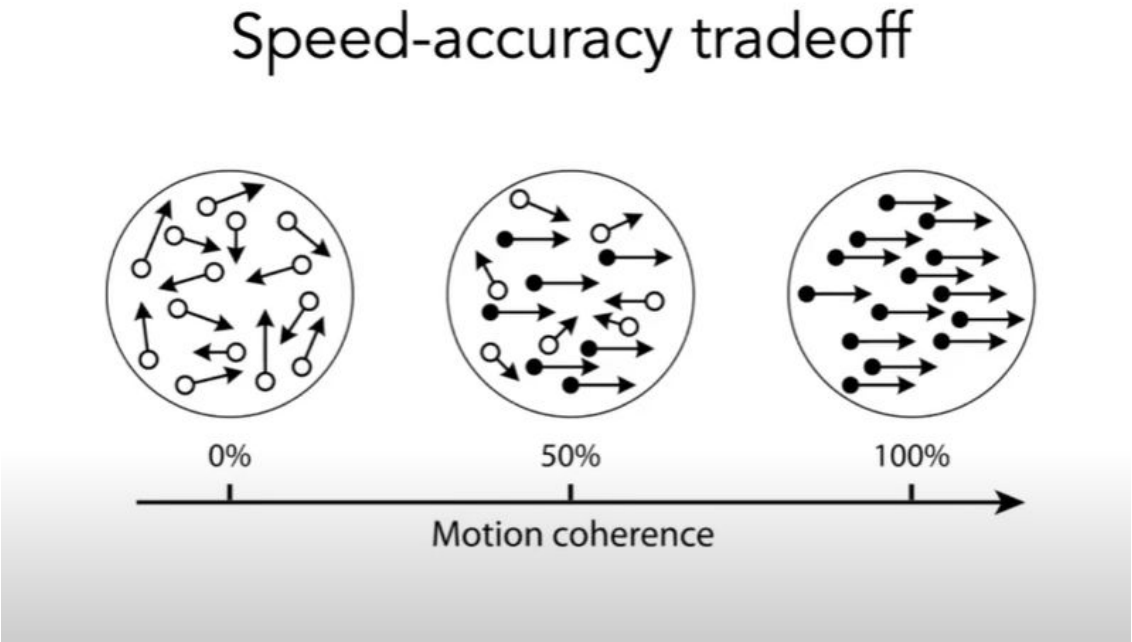
- Reaction Time v.s. Motion Coherence
- Reaction Time v.s Standard deviation
- Reaction time wrt prior-likelihood proximity to estimation
- Reaction time wrt start-angle proximity to estimation
- Reaction time wrt start-angle proximity to prior/likelihood



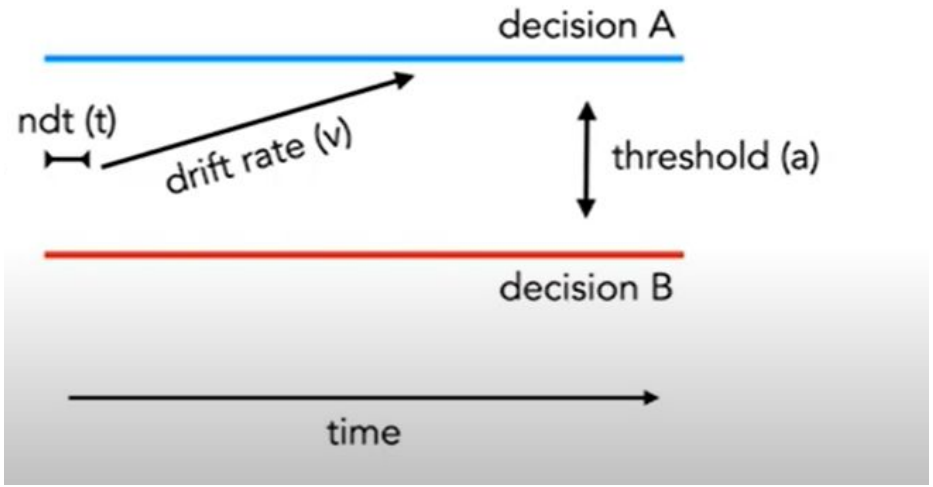
Faezeh Sarlakifar

Computer Engineering Undergraduate Student

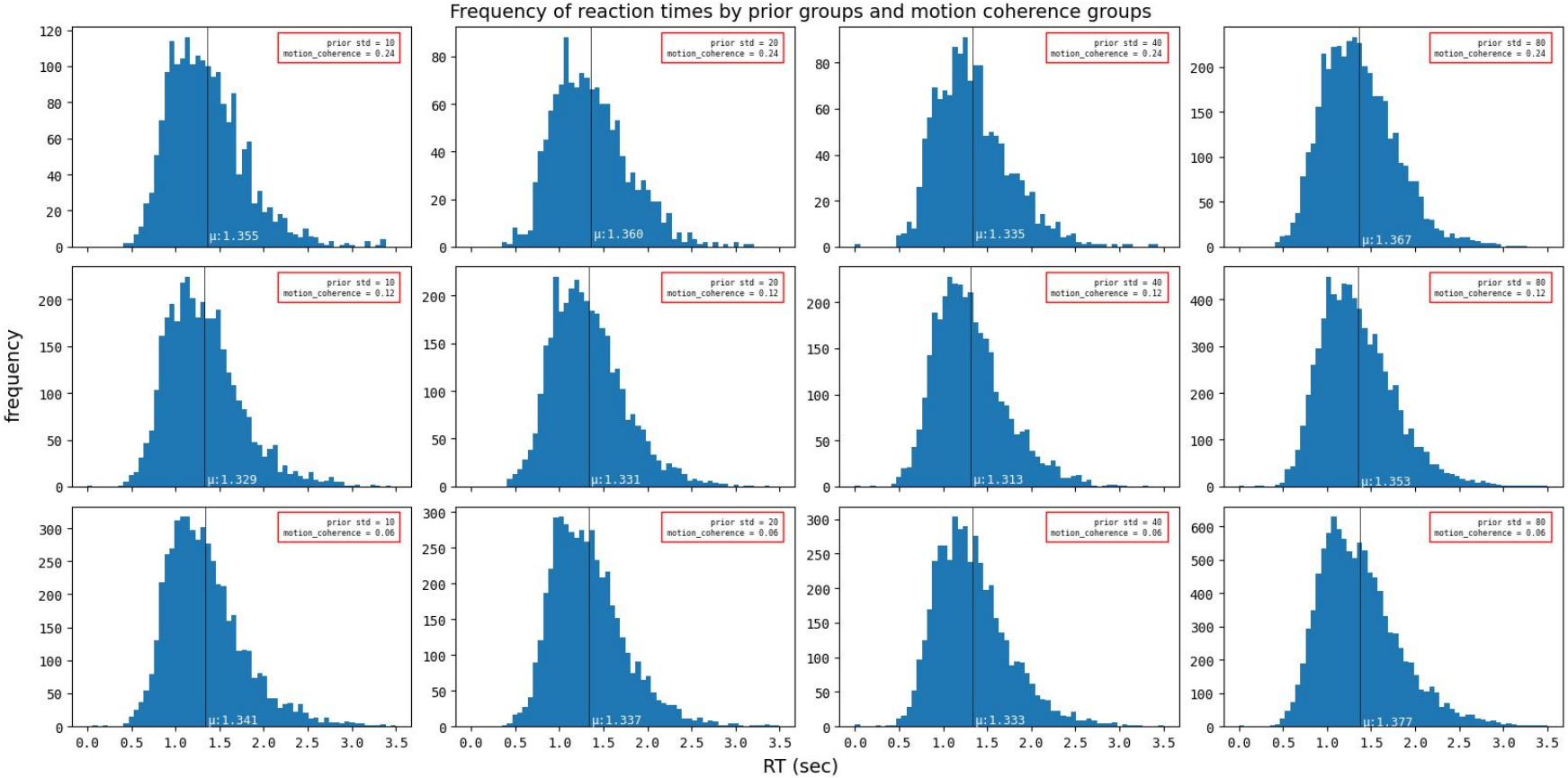
The Drift Diffusion Model (DDM)

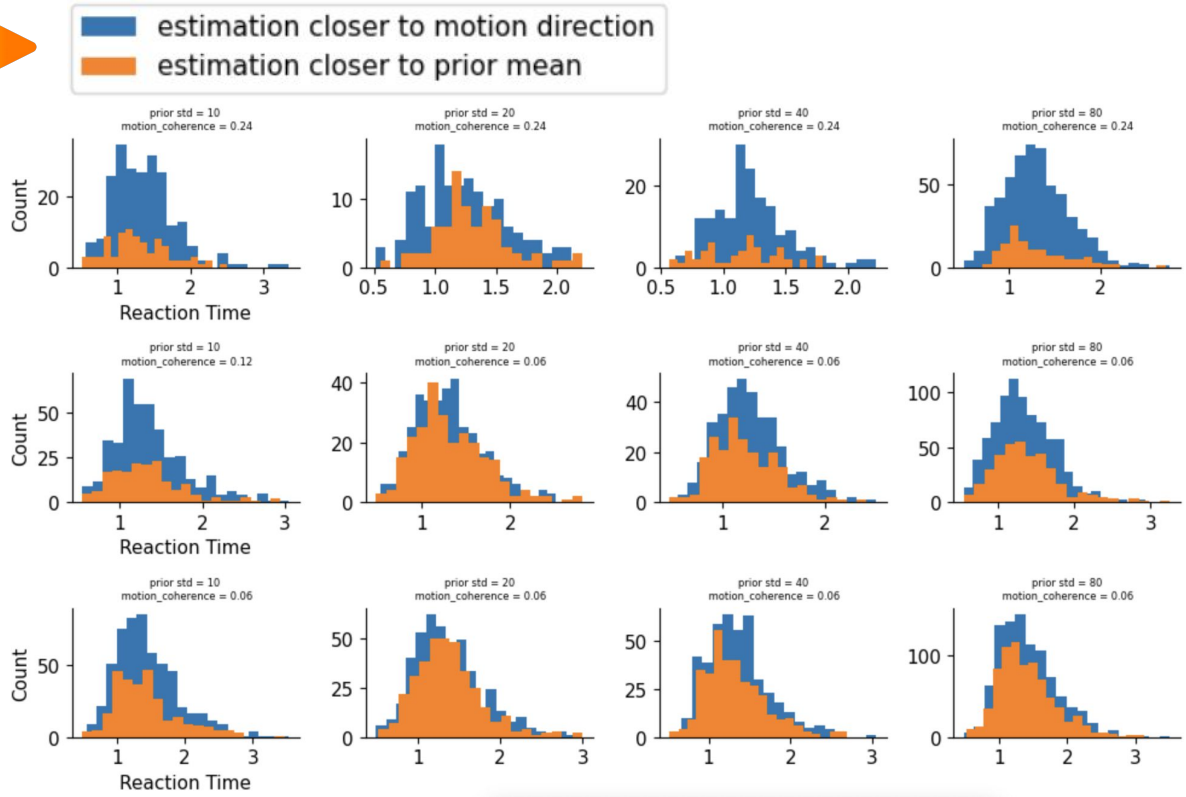


The Drift Diffusion Model (DDM)



Reaction Time




estimation closer to motion direction
estimation closer to prior mean
prior std = 10
motion_coherence = 0.24
prior std = 20
motion_coherence = 0.24
prior std = 40
motion_coherence = 0.24
prior std = 80
motion_coherence = 0.24
prior std = 10
motion_coherence = 0.12
prior std = 20
motion_coherence = 0.06
prior std = 40
motion_coherence = 0.06
prior std = 80
motion_coherence = 0.06
prior std = 10
motion_coherence = 0.06
prior std = 20
motion_coherence = 0.06
prior std = 40
motion_coherence = 0.06
prior std = 80
motion_coherence = 0.06
Count
Reaction Time

Sajjad Rezvani Khaledi

Electrical Engineering student

Modeling to find correlation

- Logistic Regression
- Neural Network

	trial_index	prior_mean	estimate_degree	motion_direction	sensory_bias	prior_bias	reaction_time	prior_std	motion_coherence	distance	binarized_estimate_degree
0	1	225	225.583113	225	0.583113	0.583113	NaN	10	0.12	0	0
1	2	225	223.291282	225	-1.708718	-1.708718	NaN	10	0.12	0	0
2	3	225	231.312691	235	-3.687309	6.312691	NaN	10	0.06	10	0
3	4	225	230.166776	225	5.166776	5.166776	NaN	10	0.06	0	0
4	5	225	229.020860	215	14.020860	4.020860	NaN	10	0.24	10	1
...	...	...	...	...	...	...	...	...	...	...	...
83208	198	225	249.013514	205	44.013514	24.013514	1.298565	40	0.06	20	1
83209	199	225	219.997721	265	-45.002279	-5.002279	1.175129	40	0.12	40	1
83210	200	225	268.246734	245	23.246734	43.246734	0.793728	40	0.06	20	0
83211	201	225	274.075461	185	89.075461	49.075461	1.363531	40	0.12	40	1
83212	202	225	232.904188	185	47.904188	7.904188	1.553555	40	0.06	40	1

83213 rows × 11 columns

Model Predictions

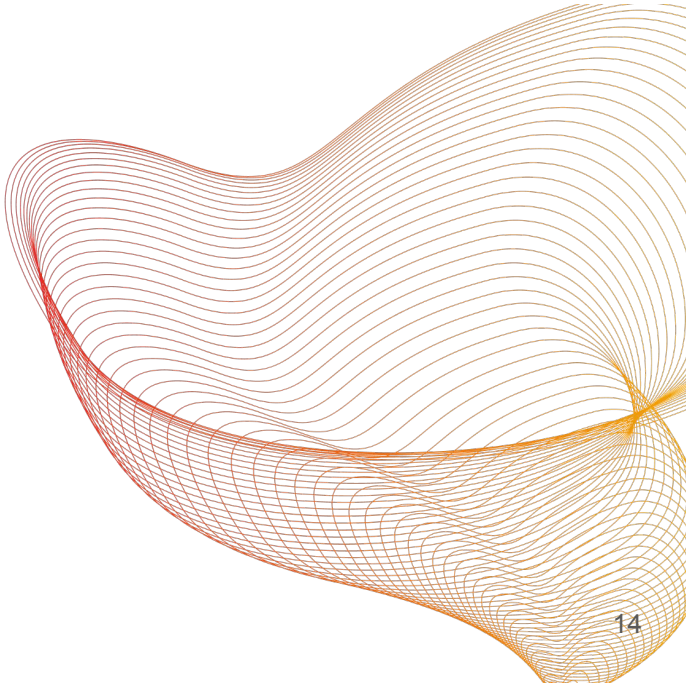
- Binerianzing label
- Normalize data
- Reform degrees
- balance classes

```
       [reaction_time prior_std motion_coherence distance]
Coef:  [[ 0.05892034 -0.19810343 -0.63563224 -0.15510144]]

>>>train: 0.6414602346805737
>>>test: 0.6223958333333334
```

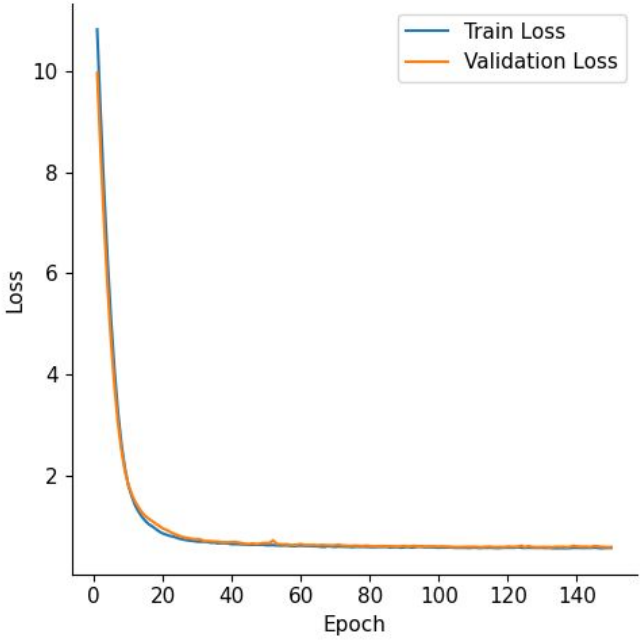
	precision	recall	f1-score	support
0	0.71	0.51	0.60	208
1	0.57	0.75	0.65	176
accuracy			0.62	384
macro avg	0.64	0.63	0.62	384
weighted avg	0.64	0.62	0.62	384

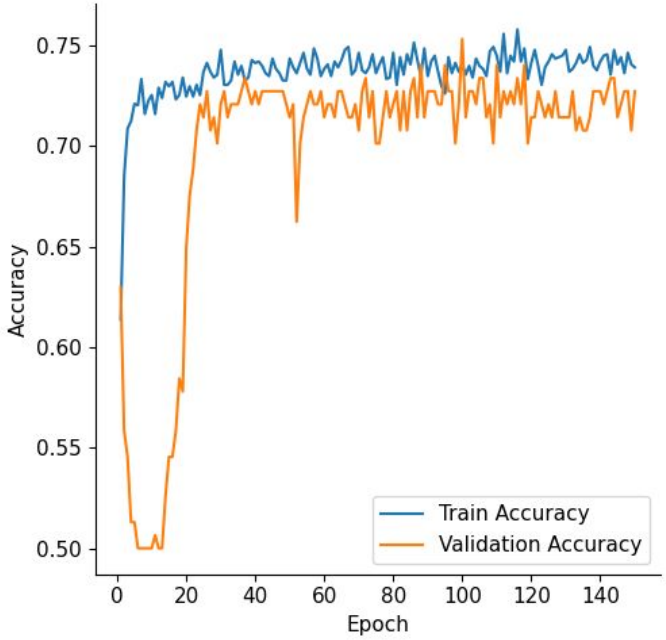
```
[[132  44]
 [101 107]]
```

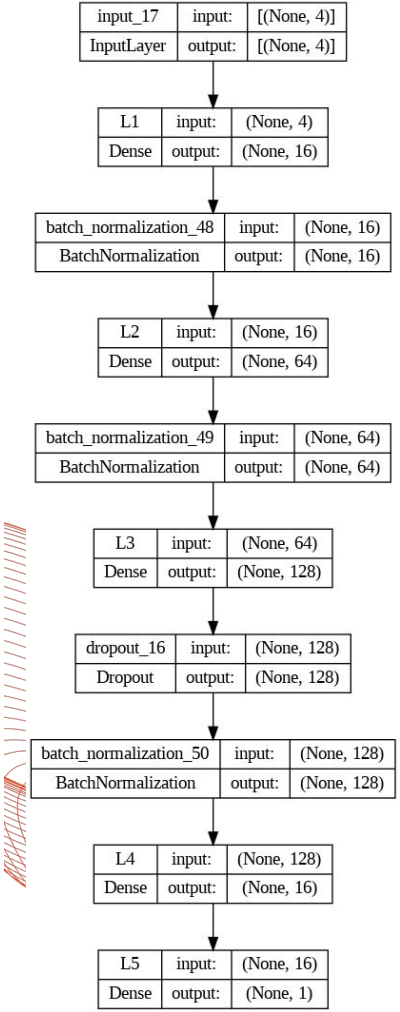


Neural Network

```
Epoch 150/150 22/22 [==============================] - 0s 7ms/step
- loss: 0.5628 - accuracy: 0.7391 - val_loss: 0.5817 -
val_accuracy: 0.7273 Test Loss: 0.5301, Test Accuracy: 76.30%
```







Thank you. Please feel free to ask any questions. 😄