

Neural Networks for Feature Analysis

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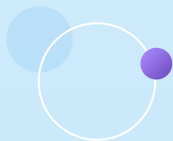
Motivation



- **Animal behavioral studies:** Hypothesize some response to a stimulus and use statistical methods to test the hypothesis
- **Issue:** Someone needs to guess what the behavior will look like in the first place
- **Solution:** we can use machine learning (ML) to analyze features of behavior we wouldn't expect

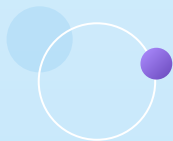
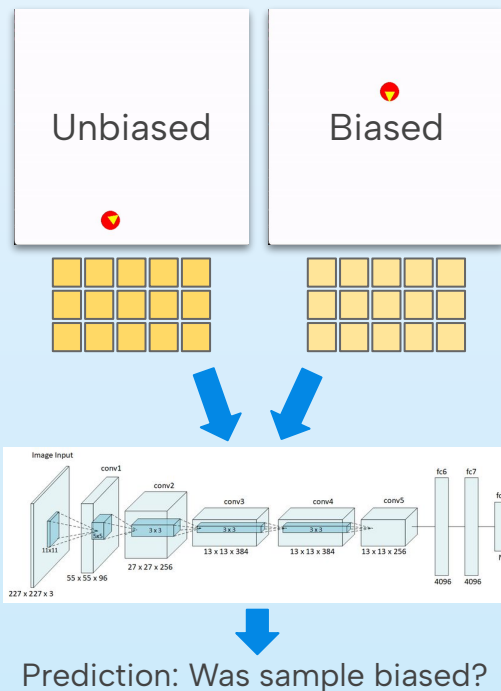
What's our objective :

How well can neural networks analyze behavioral response to stimuli?



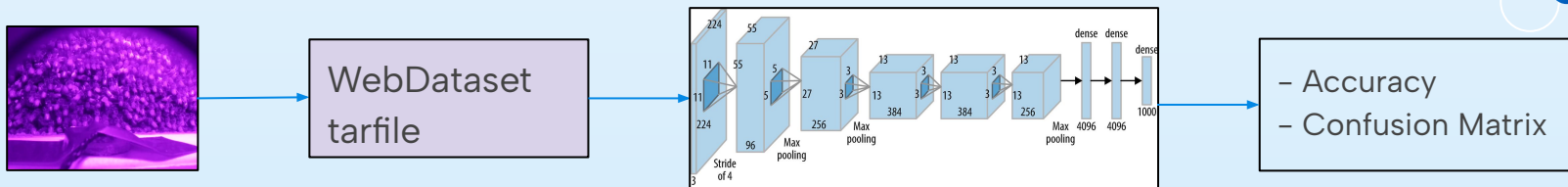
Our approach

- **Dataset:** Generate samples of unbiased or biased behavior (bias indicates stimulus)
- **ML model:** Neural network predicts if a sample was biased or unbiased
- **Report accuracy:** Accuracy indicates the ability of model to learn features



How does the accuracy depend on amount of bias?

Software Stack



dataset.tar

Class: With bias	0.png	1.png
	2.png	3.png
Class: No bias	0.png	1.png
	2.png	3.png

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- **ML stack:** https://github.com/bfirner/bee_analysis
- **Dataset format:** Each dataset is tarfile of samples
 - Each sample contains frames and class information
- **Model:** Modified version of AlexNet
 - Input is series of depth-stacked frames
 - 1st layer Conv2D kernels must fit number of frames (e.g. 4 frames → 12 layered kernel)
 - Output: Either class 1 or class 2

Testing the Stack

- We trained the model using simple test cases
- This was to validate that the software stack works as expected
- Main test cases:

- Black/White Frames



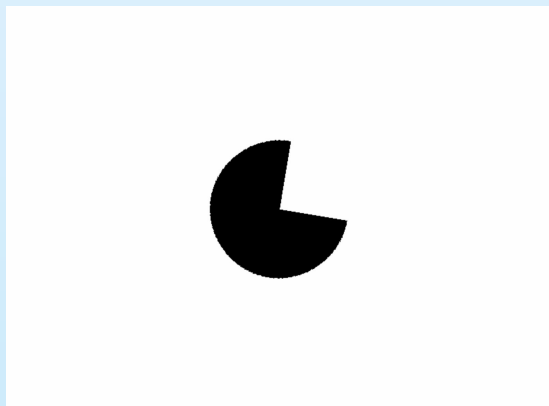
- Left/Right Chequered Pattern



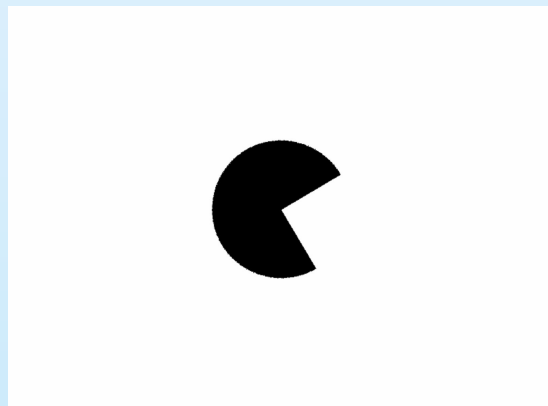
- Clockwise vs Anticlockwise Test

CW vs CCW Test

Testing the model with Patterns – **Time varying features**



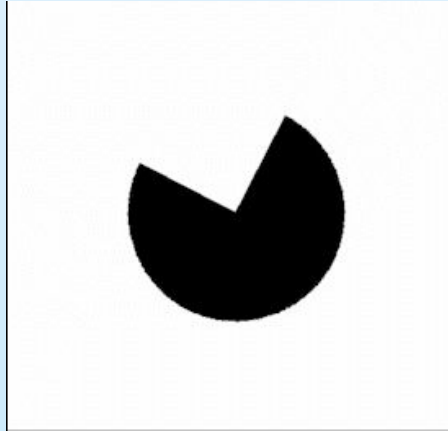
4 frames – 100%



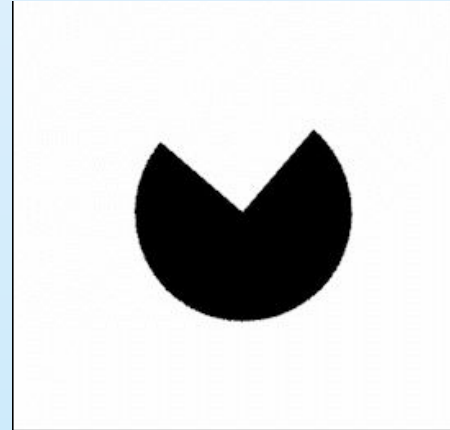
1 frame ~ 50%

Simulation for Feature Recognition

+ -10°



Random

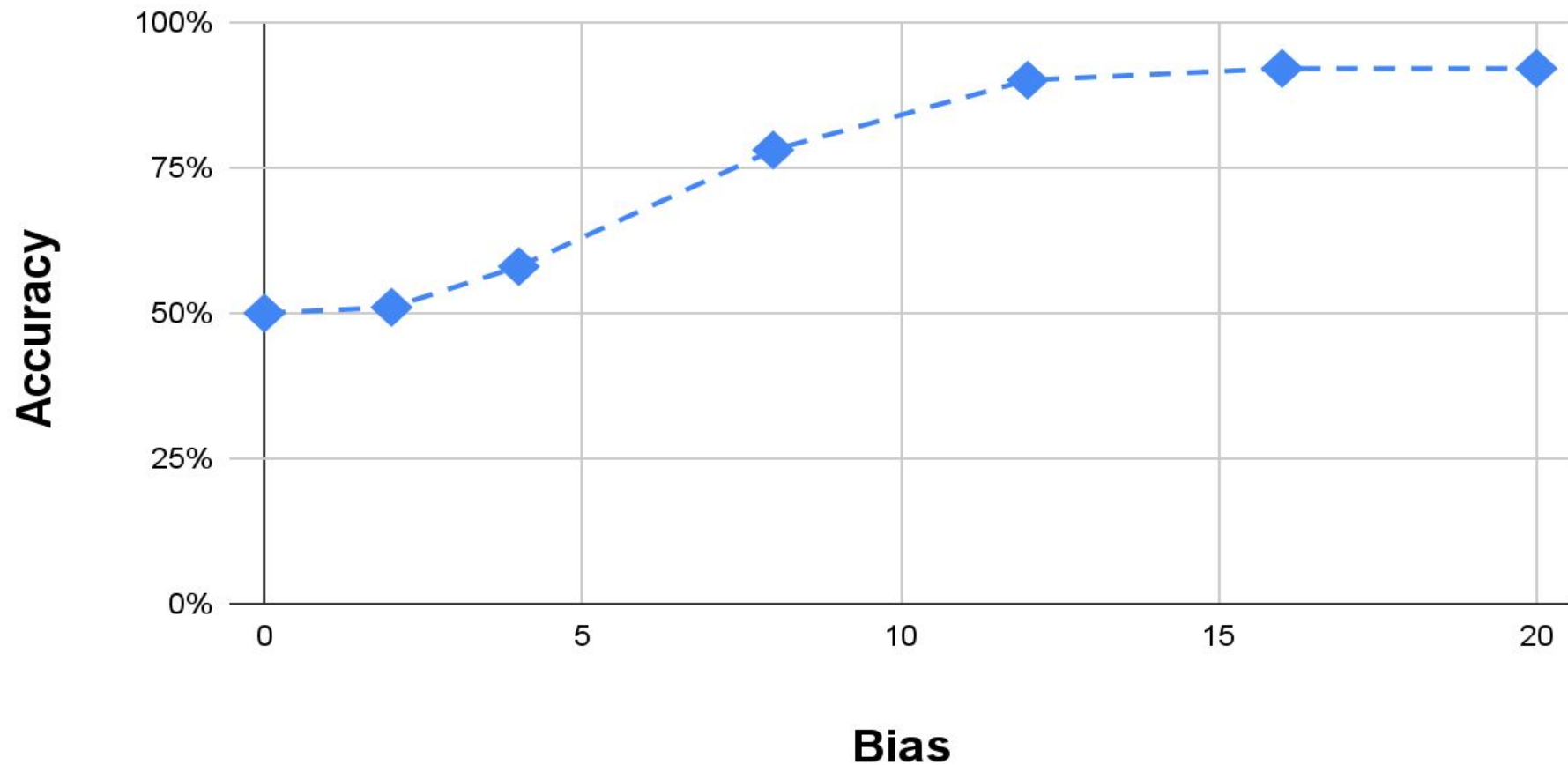


Bias(30° shown)

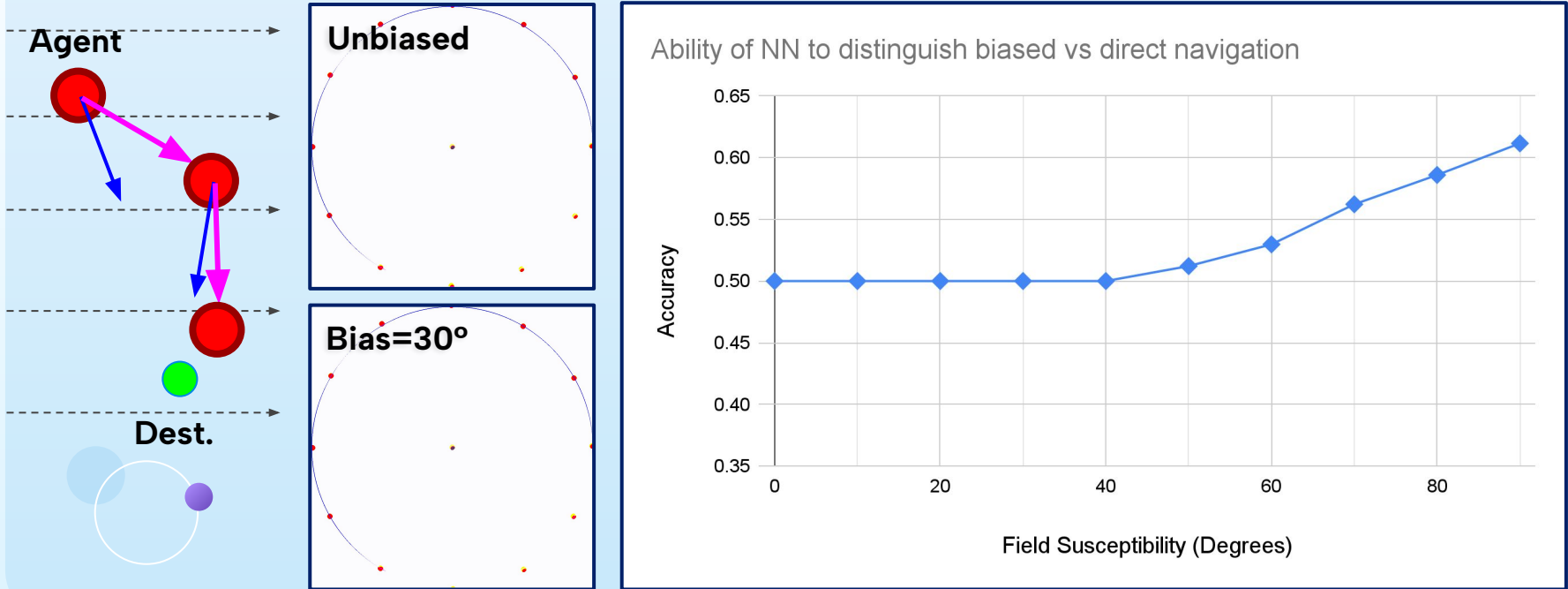
+ -10°

+ 30°
Only
Right

Ability of NN to distinguish 3 transition Pacman



Next Steps—More Complex Behaviors



Next Steps—Under the Hood

- **Saliency graphs**

- Right now, we have no idea what the model learns
- Black box
- Next step is to see what the model is actually picking up

