

Building an ML-Powered Game AI Using TensorFlow in Go



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Who am I?



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ML Workflow for Go



Train Model
from Data in
Python

Export Trained Model

Deploy in Go ML
runtime (eg.
Tensorflow)



ML Libraries



- TensorFlow
 - Google's library for ML
 - Expresses calculations as a computation graph
 - GPU/CPU Support
 - Many language bindings
 - Supports/provides pre-trained models



How do we model this?



- Data modelling important
- ML is not magic, and you still need some expertise in how to ask the right questions



Our AI Brain Structure

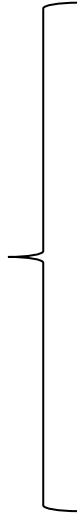
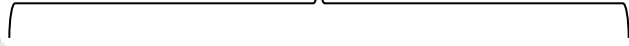


- Our data model:
 - dx, dy, du, dv
- Binary classifier
 - Shoot/Not shoot
- Simple Neural Network





$Dx = \text{Difference in } X$

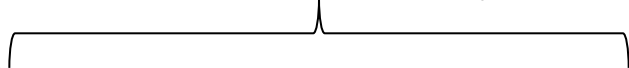


$Dy = \text{Difference in } Y$

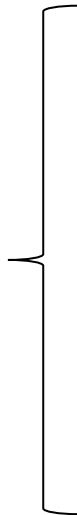




Du = Difference in X velocity



Dv = Difference in Y vel





Hit = 1



Miss = 0

???



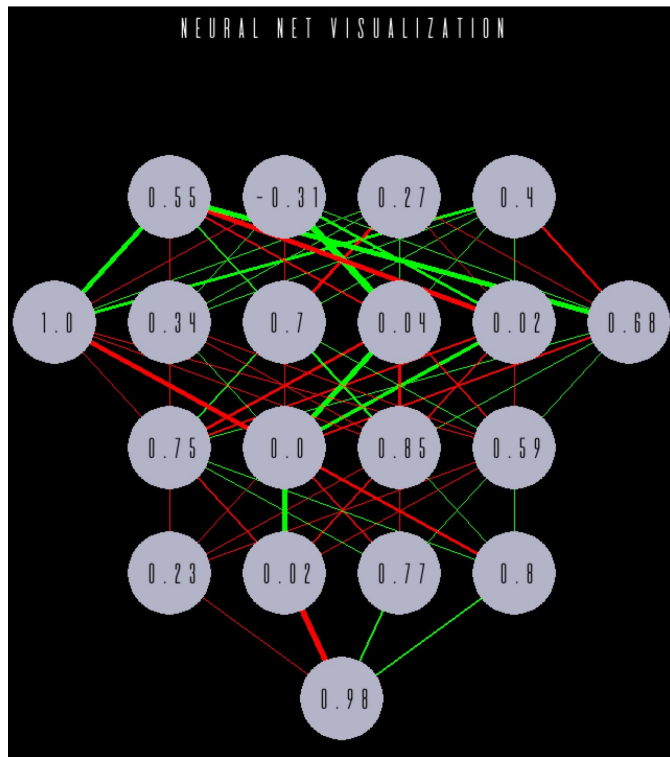
Sample Training Data



- Sample data, raw:
 - Dx: 45 Dy: 200 Du: -6 Dv: -10
- Normalized data:
 - Dx: 0.1 Dy: 0.25 Du: -0.04 Dv: -0.2



Visualizing the Network



Load Model in Go



```
// bundle contains Session + Graph  
bundle, err := tf.LoadSavedModel("exported_brain",  
[]string{"train"}, nil)
```



Uh, now what?



Retrieve Operators



- Need the Operations for the Input/Output Nodes:

```
inputop := bundle.Graph.Operation("dense_1_input")
```

```
outputop := bundle.Graph.Operation("dense_5/Sigmoid")
```



Wait a second. How?



```
Welcome to ROBCO Industries (TM) Termlink
Password Required
Attempts Remaining: ■ ■ ■
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[Tab] EXIT
```

This was totally NOT me looking through a raw protocol buffer in my text editor.



Making it “think”



- Execute TensorFlow graph:

```
var column *tf.Tensor  
    column, err = tf.NewTensor([1][4]float32{dx, dy, du, dv})  
    results, err :=  
bundle.Session.Run(map[tf.Output]*tf.Tensorcolumn}, []tf.Output{outputop.Output(0)}, nil)
```



Acting on the result

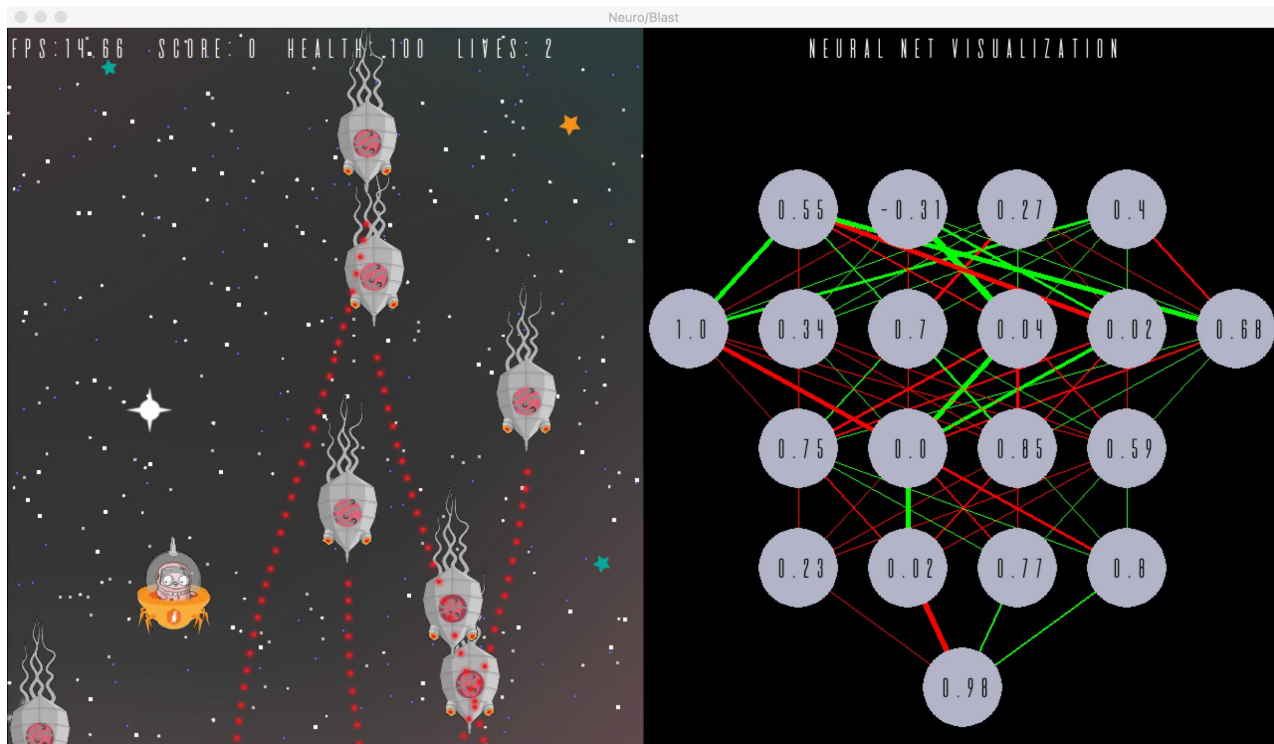


- Parse and execute the action:

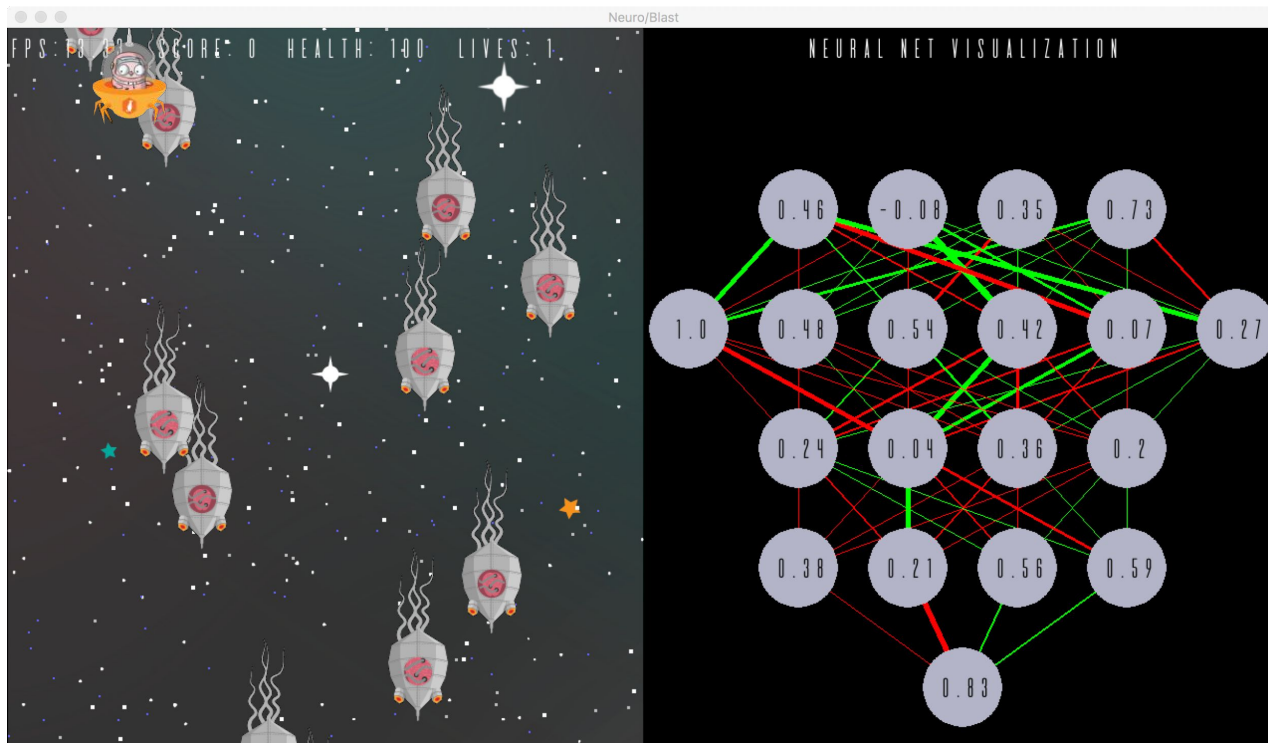
```
for _, result := range results {  
    if result.Value().([][]float32)[0][0] >= 0.5 &&  
enemy.canfire {  
    // FIRE!!  
    }  
}
```



Model - Positive



Model - Negative



Game Libraries



- **Pixel:** github.com/faiface/pixel
- Other libraries:
 - Ebiten: hajimehoshi.github.io/ebiten/
 - Engo: engo.io
 - ...many more to come!



Opp. to Contribute



- Still a lot of both low-level and high-level work to be done for games and ML
- Tools
- TensorFlow bindings could also use love
- Documentation
- Go could use its own Keras



Summary



- Data Science and ML is a growing use case for Go - especially for operationalized ML
- Game community is active but in its infancy, lots of opportunity to help out!
- **YES!** This will all appear on GitHub!
Follow me for updates!



Thank you!



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