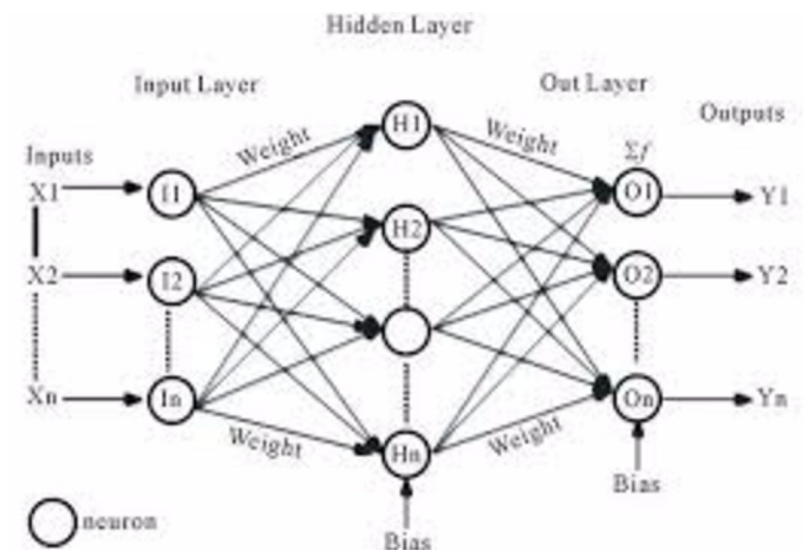

GPU-Accelerated Deep Convolutional Neural Network for Object Recognition

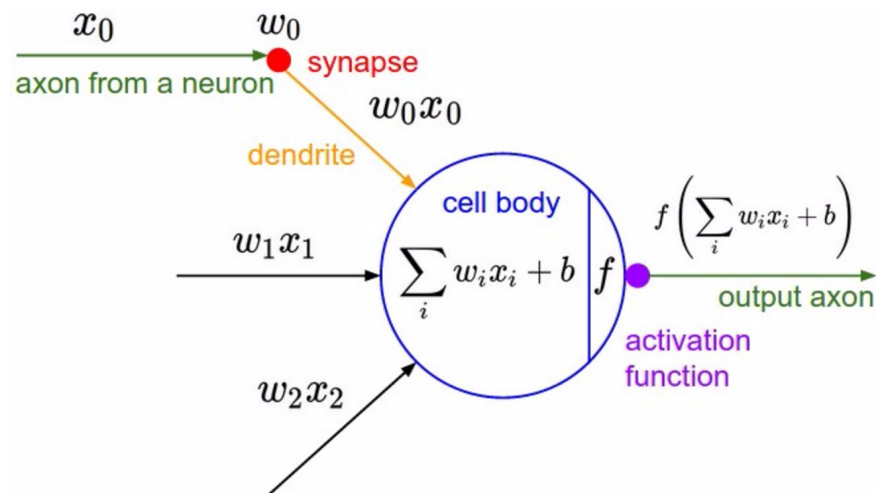
— Guan Sun —

Milestone 2

Implement the computation for Inner product layer, Rectified linear unit layer and Softmax layer



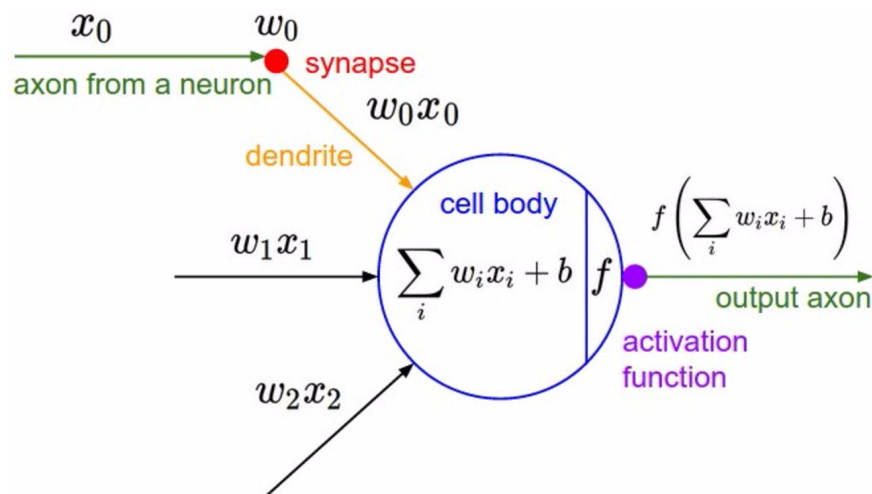
Inner Product Layer



$$\sum_i w_i x_i + b$$

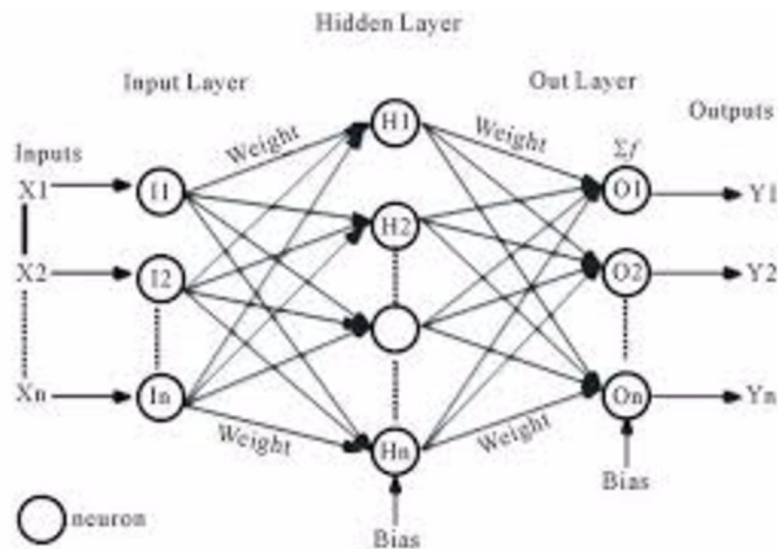
Matrix Multiplication!

Rectified Linear Unit Layer



$$f(x) = \max(x, 0)$$

Softmax Layer



$$P(y = j|\mathbf{x}) = \frac{e^{\mathbf{x}^T \mathbf{w}_j}}{\sum_{k=1}^K e^{\mathbf{x}^T \mathbf{w}_k}}$$

Test Results

```
[ RUN ] InnerProductLayerTest/0.TestSetUp
[ OK ] InnerProductLayerTest/0.TestSetUp (190 ms)
[ RUN ] InnerProductLayerTest/0.TestForward
[ OK ] InnerProductLayerTest/0.TestForward (0 ms)
[ RUN ] InnerProductLayerTest/0.TestForwardNoBatch
[ OK ] InnerProductLayerTest/0.TestForwardNoBatch (0 ms)
[ RUN ] InnerProductLayerTest/0.TestGradient
[ OK ] InnerProductLayerTest/0.TestGradient (109 ms)
[-----] 4 tests from InnerProductLayerTest/0 (299 ms total)

[-----] 4 tests from InnerProductLayerTest/1, where TypeParam = NScaffe9CPUDeviceIdEE
[ RUN ] InnerProductLayerTest/1.TestSetUp
[ OK ] InnerProductLayerTest/1.TestSetUp (0 ms)
[ RUN ] InnerProductLayerTest/1.TestForward
[ OK ] InnerProductLayerTest/1.TestForward (1 ms)
[ RUN ] InnerProductLayerTest/1.TestForwardNoBatch
[ OK ] InnerProductLayerTest/1.TestForwardNoBatch (0 ms)
[ RUN ] InnerProductLayerTest/1.TestGradient
[ OK ] InnerProductLayerTest/1.TestGradient (111 ms)
[-----] 4 tests from InnerProductLayerTest/1 (112 ms total)

[-----] 4 tests from InnerProductLayerTest/2, where TypeParam = NScaffe9GPUDeviceIdEE
[ RUN ] InnerProductLayerTest/2.TestSetUp
[ OK ] InnerProductLayerTest/2.TestSetUp (14 ms)
[ RUN ] InnerProductLayerTest/2.TestForward
[ OK ] InnerProductLayerTest/2.TestForward (2 ms)
[ RUN ] InnerProductLayerTest/2.TestForwardNoBatch
[ OK ] InnerProductLayerTest/2.TestForwardNoBatch (1 ms)
[ RUN ] InnerProductLayerTest/2.TestGradient
[ OK ] InnerProductLayerTest/2.TestGradient (2576 ms)
[-----] 4 tests from InnerProductLayerTest/2 (2593 ms total)
```

```
[-----] 11 tests from NeuronLayerTest/1, where TypeParam = NScaffe9CPUDeviceIdEE
[ RUN ] NeuronLayerTest/1.TestReLU
[ OK ] NeuronLayerTest/1.TestReLU (0 ms)
[ RUN ] NeuronLayerTest/1.TestReLUGradient
[ OK ] NeuronLayerTest/1.TestReLUGradient (2 ms)
[ RUN ] NeuronLayerTest/1.TestReLUWithNegativeSlope
[ OK ] NeuronLayerTest/1.TestReLUWithNegativeSlope (0 ms)
[ RUN ] NeuronLayerTest/1.TestReLUGradientWithNegativeSlope
[ OK ] NeuronLayerTest/1.TestReLUGradientWithNegativeSlope (1 ms)
[ RUN ] NeuronLayerTest/1.TestPreLUParam
[ OK ] NeuronLayerTest/1.TestPreLUParam (0 ms)
[ RUN ] NeuronLayerTest/1.TestPreLUForward
[ OK ] NeuronLayerTest/1.TestPreLUForward (0 ms)
[ RUN ] NeuronLayerTest/1.TestPreLUForwardChannelShared
[ OK ] NeuronLayerTest/1.TestPreLUForwardChannelShared (0 ms)
[ RUN ] NeuronLayerTest/1.TestPreLUGradient
[ OK ] NeuronLayerTest/1.TestPreLUGradient (127 ms)
[ RUN ] NeuronLayerTest/1.TestPreLUGradientChannelShared
[ OK ] NeuronLayerTest/1.TestPreLUGradientChannelShared (120 ms)
[ RUN ] NeuronLayerTest/1.TestPreLUConsistencyReLU
[ OK ] NeuronLayerTest/1.TestPreLUConsistencyReLU (1 ms)
[ RUN ] NeuronLayerTest/1.TestPreLUInPlace
[ OK ] NeuronLayerTest/1.TestPreLUInPlace (0 ms)
[-----] 11 tests from NeuronLayerTest/1 (251 ms total)
```

```
[-----] 2 tests from SoftmaxLayerTest/1, where TypeParam = NScaffe9CPUDeviceIdEE
[ RUN ] SoftmaxLayerTest/1.TestForward
[ OK ] SoftmaxLayerTest/1.TestForward (1 ms)
[ RUN ] SoftmaxLayerTest/1.TestGradient
[ OK ] SoftmaxLayerTest/1.TestGradient (165 ms)
[-----] 2 tests from SoftmaxLayerTest/1 (166 ms total)

[-----] 2 tests from SoftmaxLayerTest/2, where TypeParam = NScaffe9GPUDeviceIdEE
[ RUN ] SoftmaxLayerTest/2.TestForward
[ OK ] SoftmaxLayerTest/2.TestForward (15 ms)
[ RUN ] SoftmaxLayerTest/2.TestGradient
[ OK ] SoftmaxLayerTest/2.TestGradient (3031 ms)
[-----] 2 tests from SoftmaxLayerTest/2 (3046 ms total)

[-----] 2 tests from SoftmaxLayerTest/3, where TypeParam = NScaffe9GPUDeviceIdEE
[ RUN ] SoftmaxLayerTest/3.TestForward
[ OK ] SoftmaxLayerTest/3.TestForward (1 ms)
[ RUN ] SoftmaxLayerTest/3.TestGradient
[ OK ] SoftmaxLayerTest/3.TestGradient (3034 ms)
[-----] 2 tests from SoftmaxLayerTest/3 (3035 ms total)
```

Milestone 3

Train a model

Performance Analysis & Optimization

Thanks!