RemoveNodeMAB-Different_bandit

March 22, 2017

Compute the performance of MAB methods

```
In [1]: import numpy as np
        import time
        import sys
        from numpy import *
        import matplotlib.pyplot as plt
        from sklearn import metrics
        %matplotlib inline
        #plt.rcParams['figure.figsize'] = (15, 6)
```

0.1 Load BOKEH lib.

```
In [2]: from bokeh.layouts import row, gridplot
        from bokeh.plotting import figure, output_notebook, show
        from bokeh.models import Legend

        ##############################################################################
        TOOLS = 'box_zoom,box_select,crosshair,resize,reset,lasso_select,pan,save,poly_select,ta
        output_notebook()
        ##############################################################################
```

1 Load the data

```
In [3]: X_train = np.load('./glass/X_train.npy')
        y_train = np.load('./glass/y_train.npy')
        X_test = np.load('./glass/X_test.npy')
        y_test = np.load('./glass/y_test.npy')
        X_deploy = np.load('./glass/X_deploy.npy')
        y_deploy = np.load('./glass/y_deploy.npy')

        print('Number of training examples',len(X_train))
        print('Number of validation examples',len(X_test))
        print('Number of testing examples',len(X_deploy))
```

```
Number of training examples 136
Number of validation examples 35
```

```
Number of testing examples 43
```

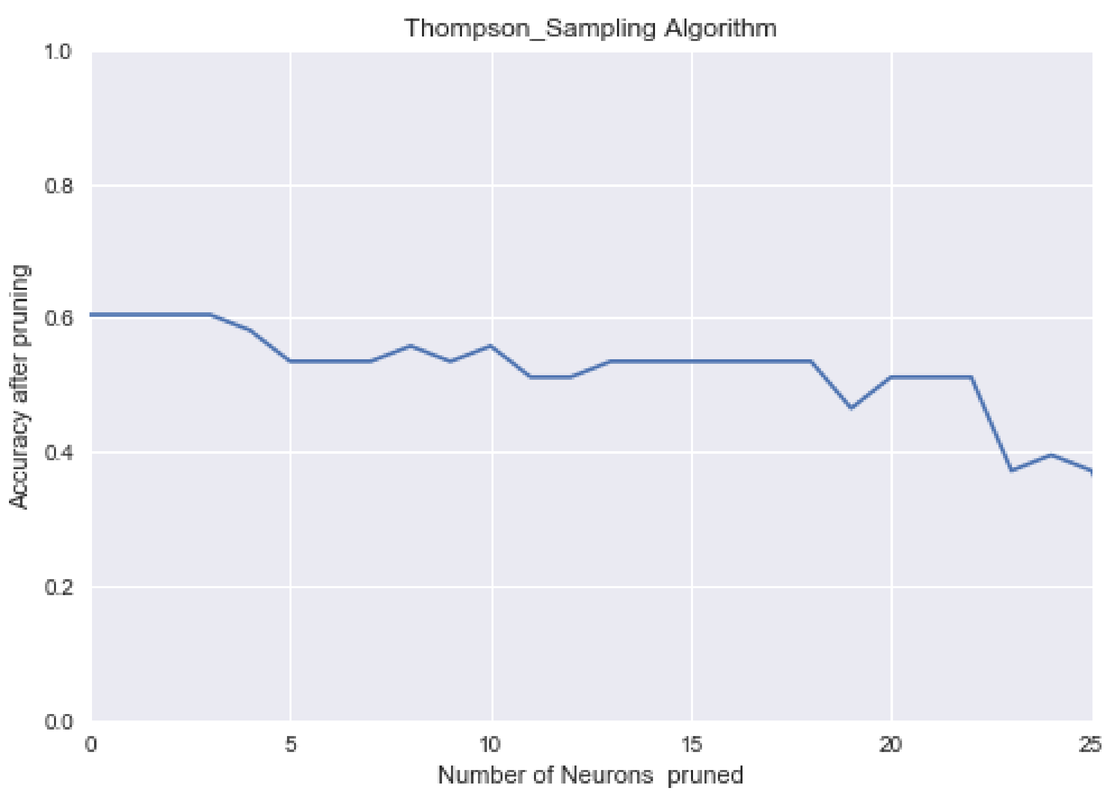
```
In [4]: exec(open("core.py").read())  # pyhton 3x
        #exec(compile(open('core.py', "rb").read(), 'core.py', 'exec'))

        #execfile("./core.py") # python 2.7
```

1.1 Run Thompson Sampling pruning Algorithm

```
In [5]: algo = Thompson_Sampling([], [])
        Alg_name = 'Thompson_Sampling Algorithm'
        path = './Thompson_Sampling/'
        sys.path.append("./Thompson_Sampling")
        exec(open("mnist_cnnFORTESTING.py").read())
```

```
/Library/Frameworks/Python.framework/Versions/3.6/lib/python3.6/site-packages/sklearn/cross_vali
  "This module will be removed in 0.20.", DeprecationWarning)
Using Theano backend.


Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
The time for running this method is 0.09522414207458496 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.56
Test after pruning= 0.53
Test after pruning= 0.56
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.47
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.37
```

```
Test after pruning= 0.40
Test after pruning= 0.37
Test after pruning= 0.23
Test after pruning= 0.28
Test after pruning= 0.35
Test after pruning= 0.35
Test after pruning= 0.47
Test after pruning= 0.53
Test after pruning= 0.44
Test after pruning= 0.44
Test after pruning= 0.44
```

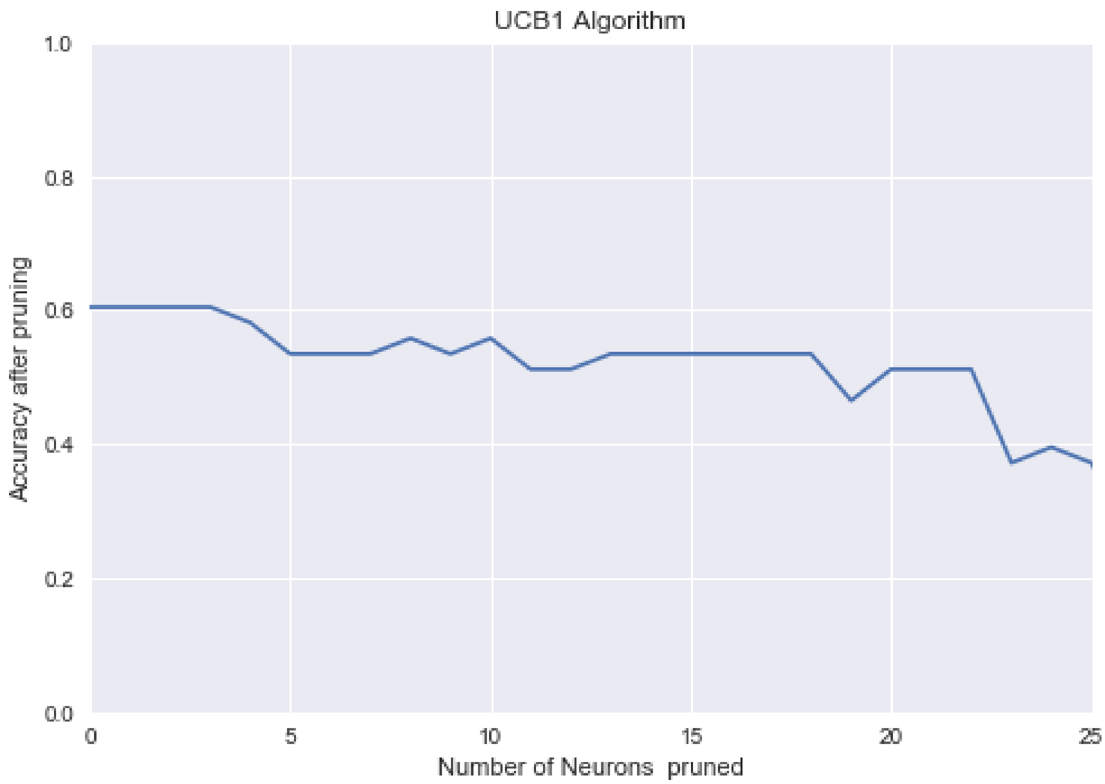


1.2 Run UCB1 pruning Algorithm

```
In [6]: algo = UCB1([], [])
        Alg_name = 'UCB1 Algorithm'
        path = './UCB1/'
        sys.path.append("./UCB1")
        exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
```

```
The time for running this method is 0.07487010955810547 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.56
Test after pruning= 0.53
Test after pruning= 0.56
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.47
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.37
Test after pruning= 0.40
Test after pruning= 0.37
Test after pruning= 0.23
Test after pruning= 0.28
Test after pruning= 0.35
Test after pruning= 0.35
Test after pruning= 0.47
Test after pruning= 0.53
Test after pruning= 0.44
Test after pruning= 0.44
Test after pruning= 0.44
```

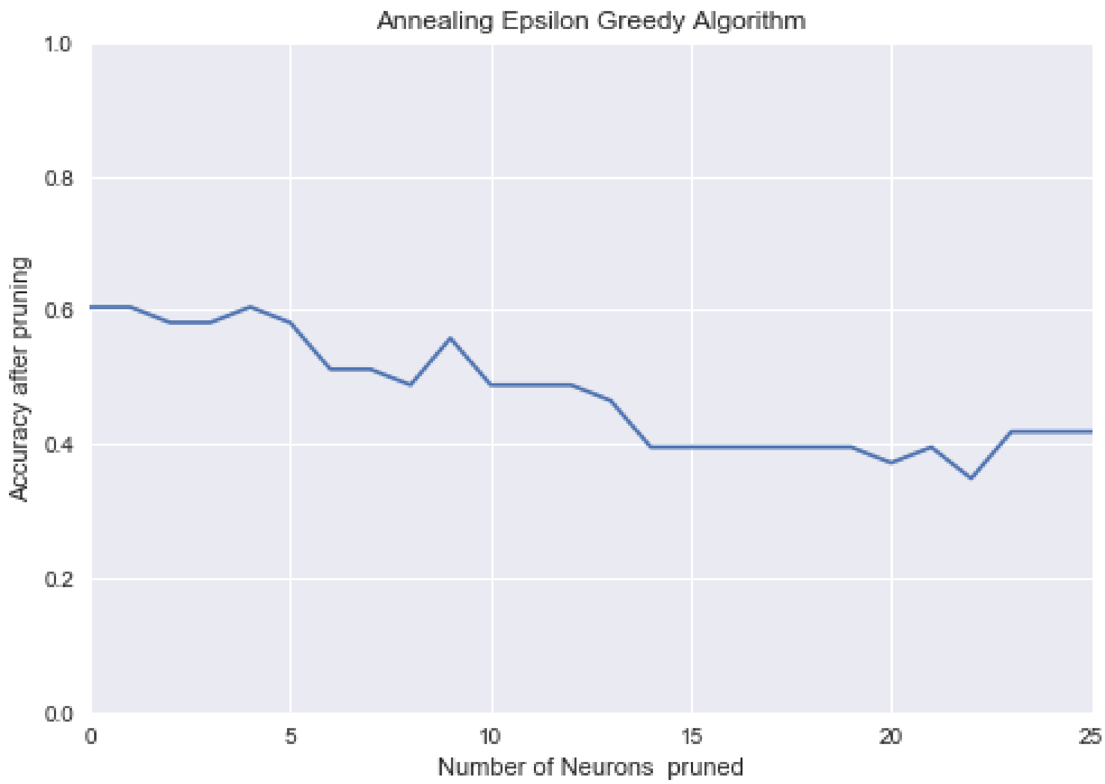


2 Run Annealing Epsilon Greedy pruning Algorithm

```
In [7]: algo = AnnealingEpsilonGreedy([], [])
        Alg_name = 'Annealing Epsilon Greedy Algorithm'
        path = './AnnealingEpsilonGreedy/'
        sys.path.append("./AnnealingEpsilonGreedy")
        exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
The time for running this method is 0.09195494651794434 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.58
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.49
```

```
Test after pruning= 0.56
Test after pruning= 0.49
Test after pruning= 0.49
Test after pruning= 0.49
Test after pruning= 0.47
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.37
Test after pruning= 0.40
Test after pruning= 0.35
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.44
Test after pruning= 0.44
Test after pruning= 0.44
```

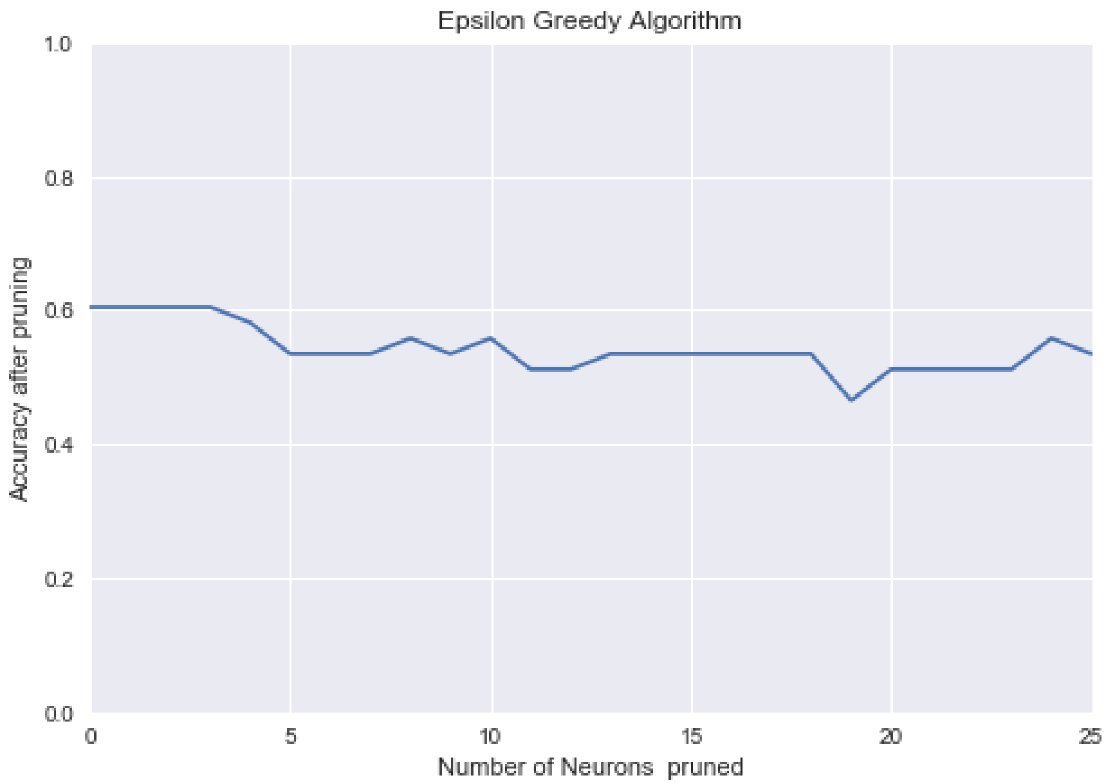


3 Run Epsilon Greedy pruning Algorithm

```
In [8]: epsilon = 0.9 # epsilon = (0,1)
        algo = EpsilonGreedy(epsilon, [], [])
        Alg_name = 'Epsilon Greedy Algorithm'
        path = './EpsilonGreedy/'
        sys.path.append("./AnnealingEpsilonGreedy")
        exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
The time for running this method is 0.07386636734008789 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
```

```
Test after pruning= 0.56
Test after pruning= 0.53
Test after pruning= 0.56
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.47
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.56
Test after pruning= 0.53
Test after pruning= 0.56
Test after pruning= 0.40
Test after pruning= 0.37
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.28
Test after pruning= 0.44
Test after pruning= 0.44
Test after pruning= 0.44
```

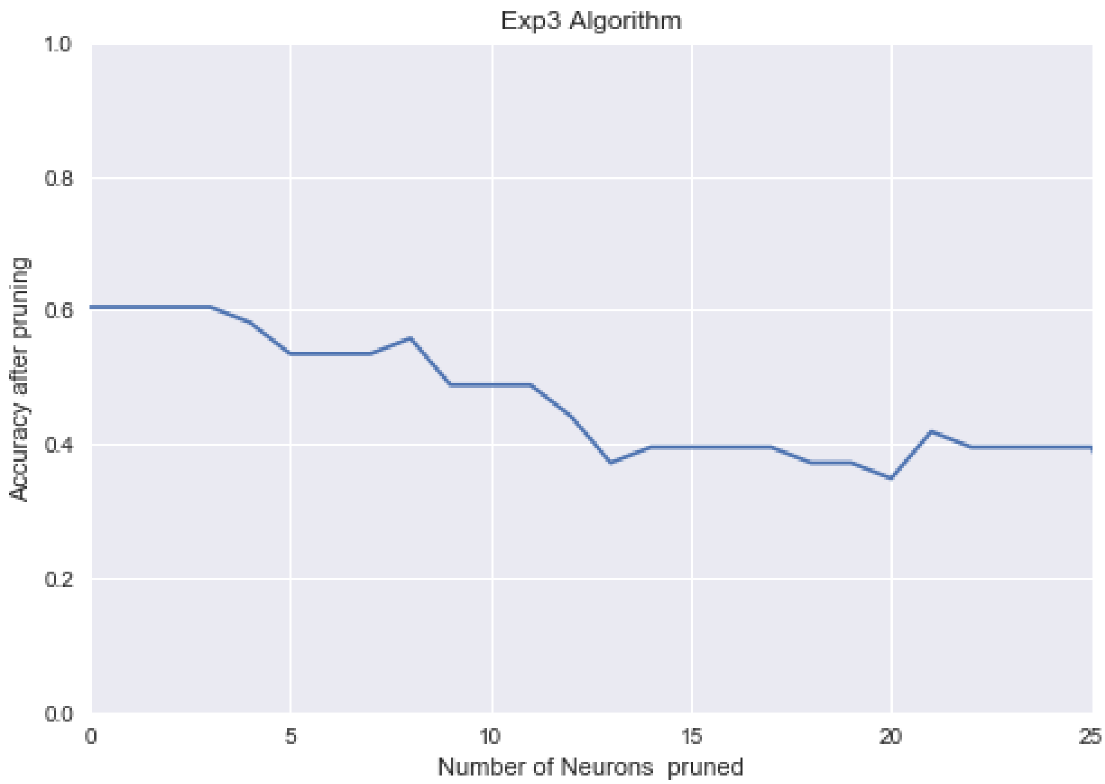


4 Run Exp3 pruning Algorithm

```
In [9]: exp3_gamma = 0.2 #exp3_gamma in [0.1, 0.2, 0.3, 0.4, 0.5]
        algo = Exp3(exp3_gamma, [])
        Alg_name = 'Exp3 Algorithm'
        path = './Exp3/'
        sys.path.append("./EpsilonGreedy")
        exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
The time for running this method is 0.09780478477478027 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
```

```
Test after pruning= 0.56
Test after pruning= 0.49
Test after pruning= 0.49
Test after pruning= 0.49
Test after pruning= 0.44
Test after pruning= 0.37
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.37
Test after pruning= 0.37
Test after pruning= 0.35
Test after pruning= 0.42
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.26
Test after pruning= 0.40
Test after pruning= 0.47
Test after pruning= 0.44
Test after pruning= 0.47
Test after pruning= 0.51
Test after pruning= 0.44
Test after pruning= 0.44
Test after pruning= 0.44
```

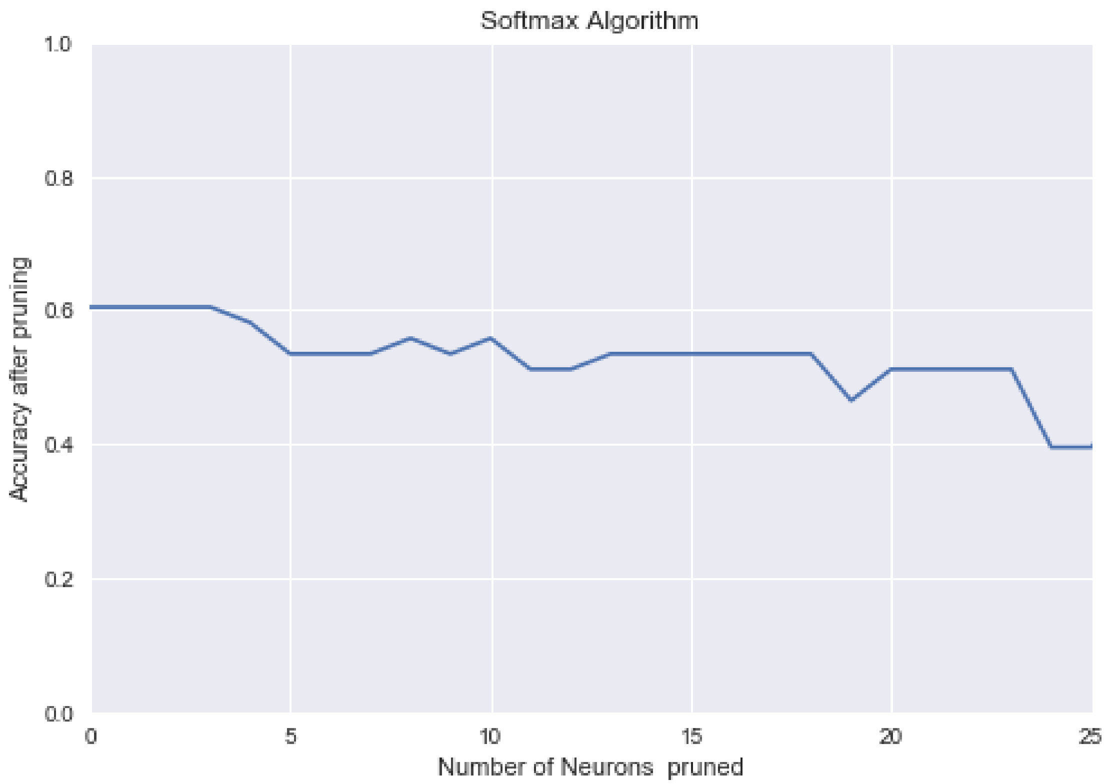


5 Run Softmax pruning Algorithm

```
In [10]: temperature = 0.9
         algo = Softmax(temperature, [], [])
         Alg_name = 'Softmax Algorithm'
         path = './Softmax/'
         sys.path.append("./Softmax")
         exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
The time for running this method is 0.07596015930175781 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
```

```
Test after pruning= 0.56
Test after pruning= 0.53
Test after pruning= 0.56
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.47
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.49
Test after pruning= 0.49
Test after pruning= 0.37
Test after pruning= 0.37
Test after pruning= 0.40
Test after pruning= 0.37
Test after pruning= 0.35
Test after pruning= 0.53
Test after pruning= 0.44
```

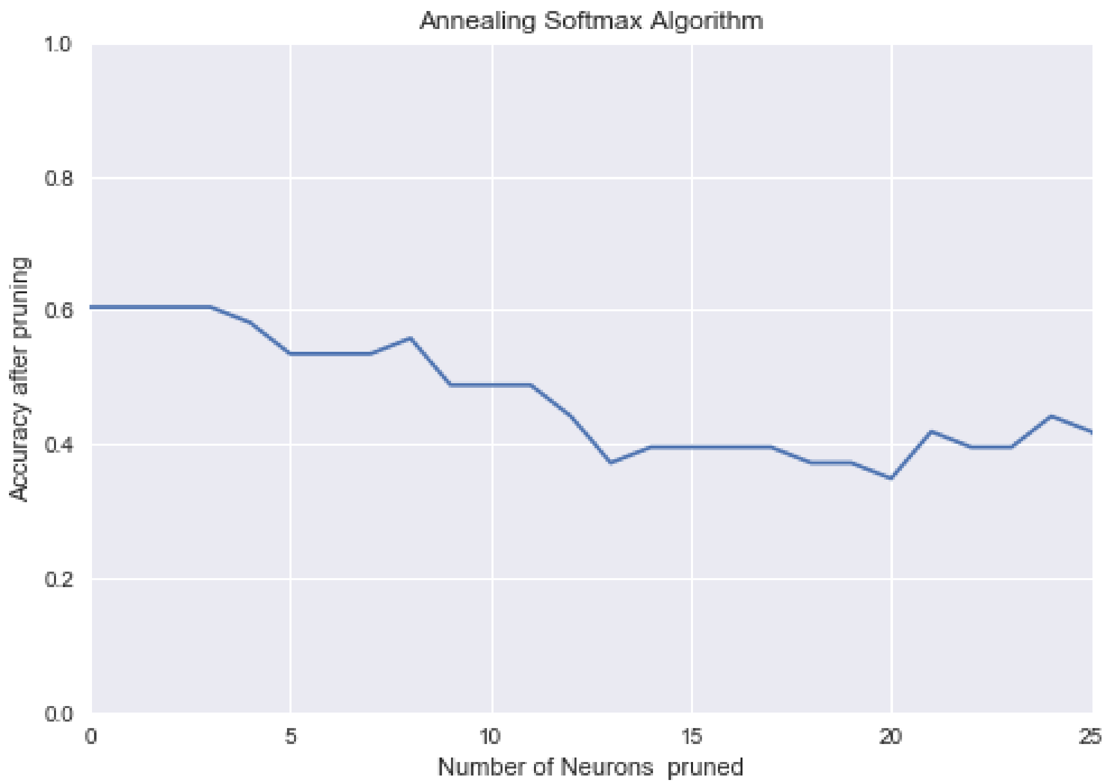


6 Run Annealing Softmax pruning Algorithm

```
In [11]: algo = AnnealingSoftmax([], [])
         Alg_name = 'Annealing Softmax Algorithm'
         path = './AnnealingSoftmax/'
         sys.path.append("./AnnealingSoftmax")
         exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
The time for running this method is 0.09937381744384766 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.56
```

```
Test after pruning= 0.49
Test after pruning= 0.49
Test after pruning= 0.49
Test after pruning= 0.44
Test after pruning= 0.37
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.37
Test after pruning= 0.37
Test after pruning= 0.35
Test after pruning= 0.42
Test after pruning= 0.40
Test after pruning= 0.40
Test after pruning= 0.44
Test after pruning= 0.42
Test after pruning= 0.35
Test after pruning= 0.33
Test after pruning= 0.30
Test after pruning= 0.37
Test after pruning= 0.28
Test after pruning= 0.30
Test after pruning= 0.47
Test after pruning= 0.49
Test after pruning= 0.44
```

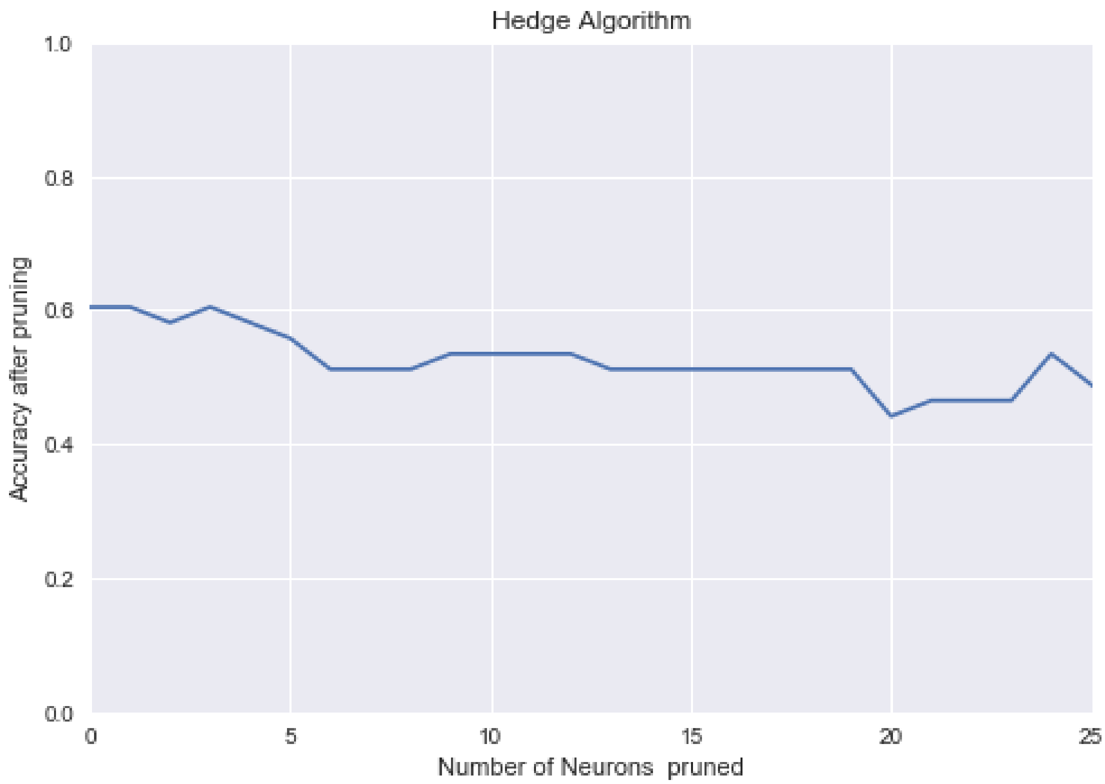


7 Run Hedge pruning Algorithm

```
In [12]: eta = 0.9  # eta in [.5, .8, .9, 1, 2]
         algo = Hedge(eta, [], [])
         Alg_name = 'Hedge Algorithm'
         path = './Hedge/'
         sys.path.append("./Hedge")
         exec(open("mnist_cnnFORTESTING.py").read())
```

```
Test fraction correct (NN-Score) = 0.99
Test fraction correct (NN-Accuracy) = 0.60
The time for running this method is 0.0799098014831543 seconds
Finsh playing start pruining:
Test after pruning= 0.60
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.60
Test after pruning= 0.58
Test after pruning= 0.56
Test after pruning= 0.51
Test after pruning= 0.51
```

```
Test after pruning= 0.51
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.53
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.51
Test after pruning= 0.44
Test after pruning= 0.47
Test after pruning= 0.47
Test after pruning= 0.47
Test after pruning= 0.53
Test after pruning= 0.49
Test after pruning= 0.44
Test after pruning= 0.51
Test after pruning= 0.44
Test after pruning= 0.44
Test after pruning= 0.42
Test after pruning= 0.42
Test after pruning= 0.35
Test after pruning= 0.33
Test after pruning= 0.44
```

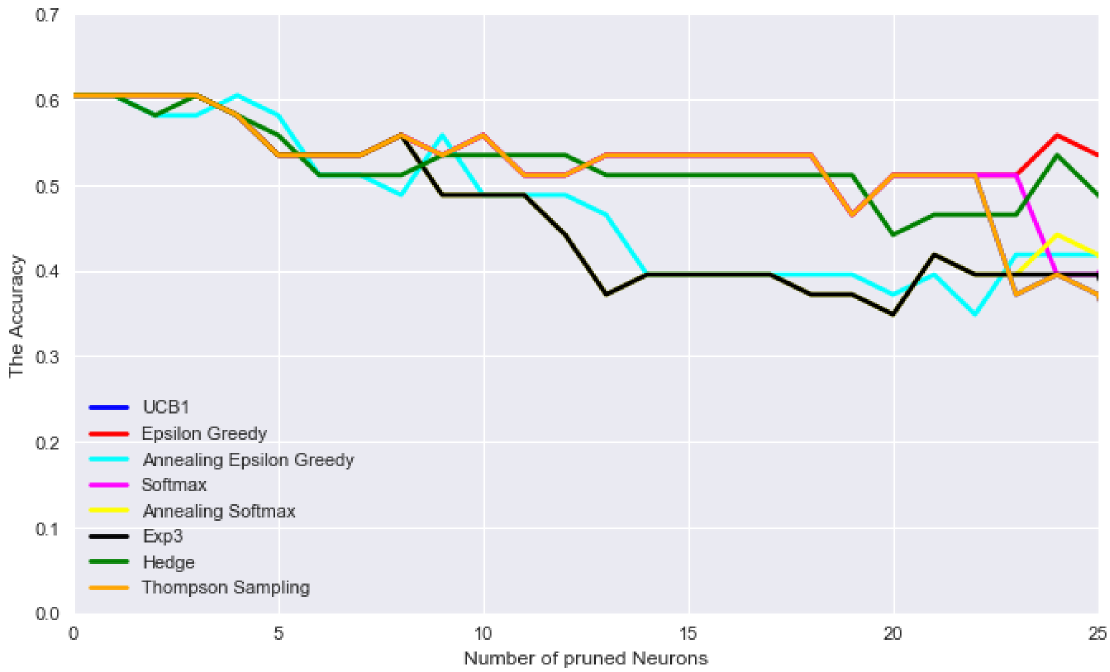


8 Compare the accuracy of the models

In [13]:
```
ucb1 = np.load('./UCB1/AccuracyAftrerPrune.npy')
EpsilonGreedy = np.load('./EpsilonGreedy/AccuracyAftrerPrune.npy')
AnnealingEpsilonGreedy = np.load('./AnnealingEpsilonGreedy/AccuracyAftrerPrune.npy')
Softmax = np.load('./Softmax/AccuracyAftrerPrune.npy')
AnnealingSoftmax = np.load('./AnnealingSoftmax/AccuracyAftrerPrune.npy')
Exp3 = np.load('./Exp3/AccuracyAftrerPrune.npy')
Hedge = np.load('./Hedge/AccuracyAftrerPrune.npy')
ThompsonSampling = np.load('./Thompson_Sampling/AccuracyAftrerPrune.npy')
Accuracy = np.load('AccuracyBeforePruning.npy')
```

In [14]:
```
fig = plt.figure(figsize=(10, 6), dpi=80)
ax = fig.add_subplot(111)
N = len(ucb1)
## necessary variables
ind = np.arange(N)                # the x locations for the groups
plt.plot(ind , ucb1 , color="blue", linewidth=2.5, linestyle="-", label="UCB1")
plt.plot(ind , EpsilonGreedy, color="red", linewidth=2.5, linestyle="-", label="Epsilon
plt.plot(ind , AnnealingEpsilonGreedy, color="cyan", linewidth=2.5, linestyle="-", labe
plt.plot(ind , Softmax, color="magenta", linewidth=2.5, linestyle="-", label="Softmax")
```

```
plt.plot(ind , AnnealingSoftmax, color="yellow", linewidth=2.5, linestyle="-", label="A
plt.plot(ind , Exp3, color="black", linewidth=2.5, linestyle="-", label="Exp3")
plt.plot(ind , Hedge, color="green", linewidth=2.5, linestyle="-", label="Hedge")
plt.plot(ind , ThompsonSampling, color="orange", linewidth=2.5, linestyle="-", label="T
plt.legend(loc = 3)
plt.axis([0, 25, 0, 0.7])
plt.xlabel('Number of pruned Neurons')
plt.ylabel('The Accuracy')
plt.grid(True)
plt.show()
```

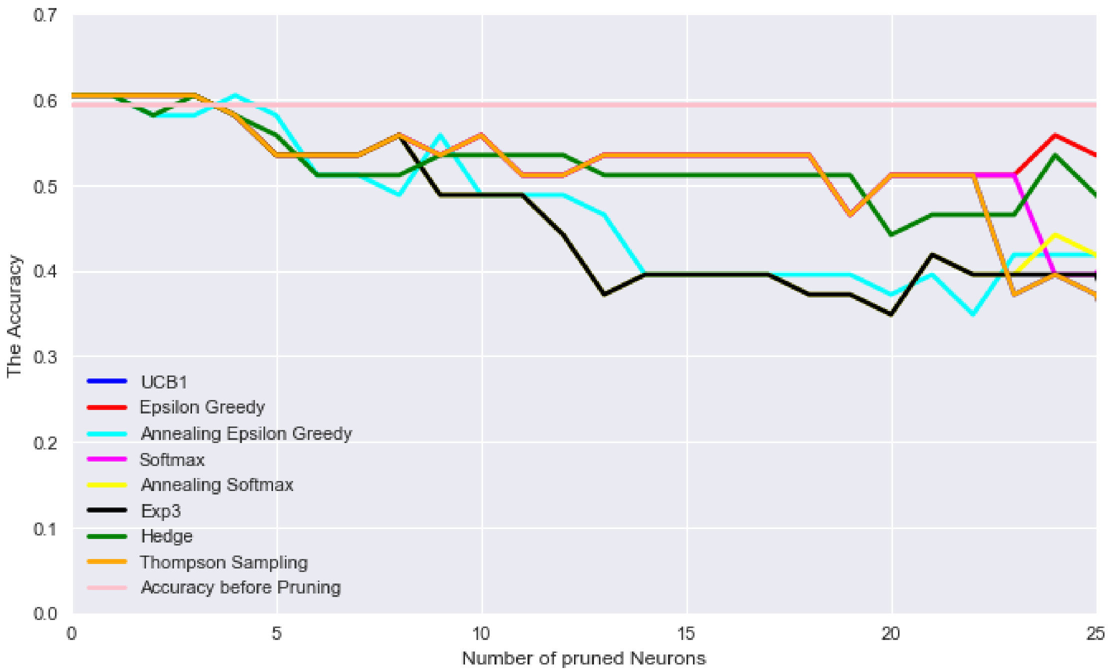


In [15]:
```
p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)


#p1.circle(ind, ucb1, legend="ucb1", color="orange")
p1.line(ind, ucb1, legend="ucb1", line_color="orange", line_width=2)

#p1.square(ind, EpsilonGreedy, legend="Epsilon Greedy", fill_color=None, line_color="re
p1.line(ind, EpsilonGreedy, legend="Epsilon Greedy", line_color="red", line_width=2)

#p1.ellipse(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color=
p1.line(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color="blu

#p1.diamond(ind, Softmax, legend="Softmax", line_color="green")
p1.line(ind, Softmax, legend="Softmax", line_color="green", line_width=2)
```

```
#p1.arc(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", end_angle
p1.line(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", line_widt

#p1.oval(ind, Exp3, legend="Exp3", line_color="black", height=0.01, width=0.01)
p1.line(ind, Exp3, legend="Exp3", line_color="black", line_width=2)

#p1.arc(ind, Hedge, legend="Hedge", line_color="yellow")
#p1.triangle(ind, Hedge, legend="Hedge", line_color="yellow")
p1.line(ind, Hedge, legend="Hedge", line_color="yellow", line_width=2)


#p1.square_cross(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink")
p1.line(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink", line_widt


#p1.line(ind, Exp3, legend="2*sin(x)", line_dash=(4, 4), line_color="orange", line_widt
#p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

8.1 Comparing All algorithms with the model before pruning

In [16]:
```
fig = plt.figure(figsize=(10, 6), dpi=80)
ax = fig.add_subplot(111)
N = len(ucb1)
Acc = [Accuracy for col in range(N)]
## necessary variables
ind = np.arange(N)                # the x locations for the groups
plt.plot(ind , ucb1 , color="blue", linewidth=2.5, linestyle="-", label="UCB1")
plt.plot(ind , EpsilonGreedy, color="red", linewidth=2.5, linestyle="-", label="Epsilon
plt.plot(ind , AnnealingEpsilonGreedy, color="cyan", linewidth=2.5, linestyle="-", labe
plt.plot(ind , Softmax, color="magenta", linewidth=2.5, linestyle="-", label="Softmax")
plt.plot(ind , AnnealingSoftmax, color="yellow", linewidth=2.5, linestyle="-", label="A
plt.plot(ind , Exp3, color="black", linewidth=2.5, linestyle="-", label="Exp3")
plt.plot(ind , Hedge, color="green", linewidth=2.5, linestyle="-", label="Hedge")
plt.plot(ind , ThompsonSampling, color="orange", linewidth=2.5, linestyle="-", label="T
plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
plt.legend(loc = 3)
plt.axis([0, 25, 0, 0.7])
plt.xlabel('Number of pruned Neurons')
plt.ylabel('The Accuracy')
plt.grid(True)
plt.show()
```

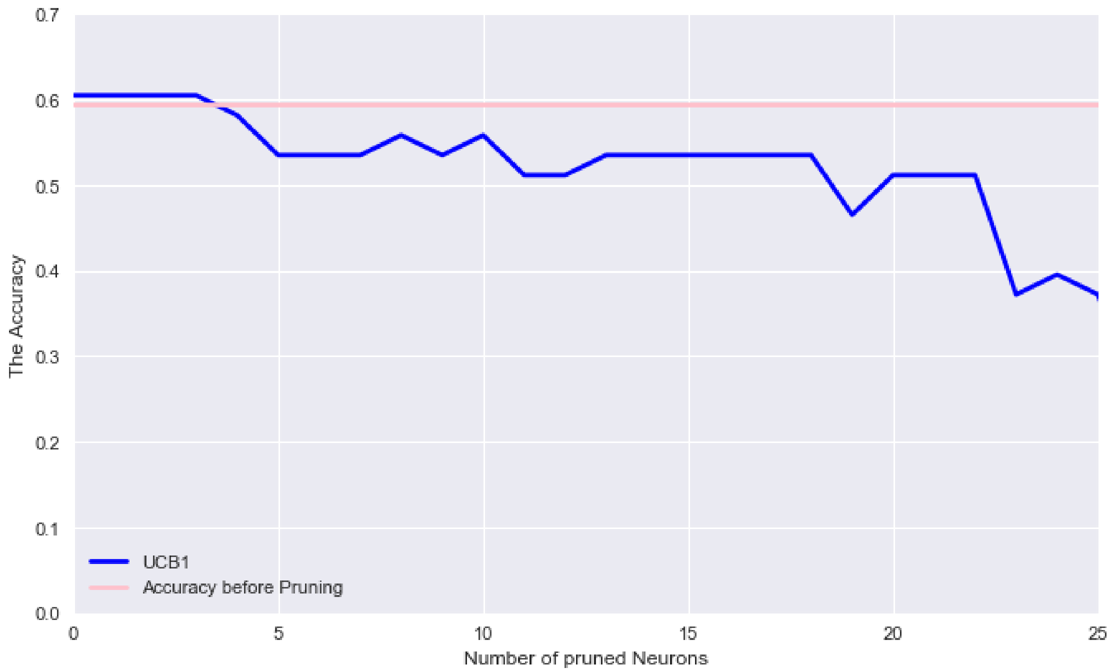



```
In [17]: p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)


         #p1.circle(ind, ucb1, legend="ucb1", color="orange")
         p1.line(ind, ucb1, legend="ucb1", line_color="orange", line_width=2)

         #p1.square(ind, EpsilonGreedy, legend="Epsilon Greedy", fill_color=None, line_color="re
         p1.line(ind, EpsilonGreedy, legend="Epsilon Greedy", line_color="red", line_width=2)

         #p1.ellipse(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color=
         p1.line(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color="blu

         #p1.diamond(ind, Softmax, legend="Softmax", line_color="green")
         p1.line(ind, Softmax, legend="Softmax", line_color="green", line_width=2)

         #p1.arc(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", end_angle
         p1.line(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", line_widt

         #p1.oval(ind, Exp3, legend="Exp3", line_color="black", height=0.01, width=0.01)
         p1.line(ind, Exp3, legend="Exp3", line_color="black", line_width=2)

         #p1.arc(ind, Hedge, legend="Hedge", line_color="yellow")
         #p1.triangle(ind, Hedge, legend="Hedge", line_color="yellow")
         p1.line(ind, Hedge, legend="Hedge", line_color="yellow", line_width=2)
```

```
#p1.square_cross(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink")
p1.line(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink", line_widt


p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
#p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

8.2 UCB1

```
In [18]: fig = plt.figure(figsize=(10, 6), dpi=80)
         ax = fig.add_subplot(111)
         N = len(ucb1)
         Acc = [Accuracy for col in range(N)]
         ## necessary variables
         ind = np.arange(N)                # the x locations for the groups
         plt.plot(ind , ucb1 , color="blue", linewidth=2.5, linestyle="-", label="UCB1")
         plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
         plt.legend(loc = 3)
         plt.axis([0, 25, 0, 0.7])
         plt.xlabel('Number of pruned Neurons')
         plt.ylabel('The Accuracy')
         plt.grid(True)
         plt.show()
```

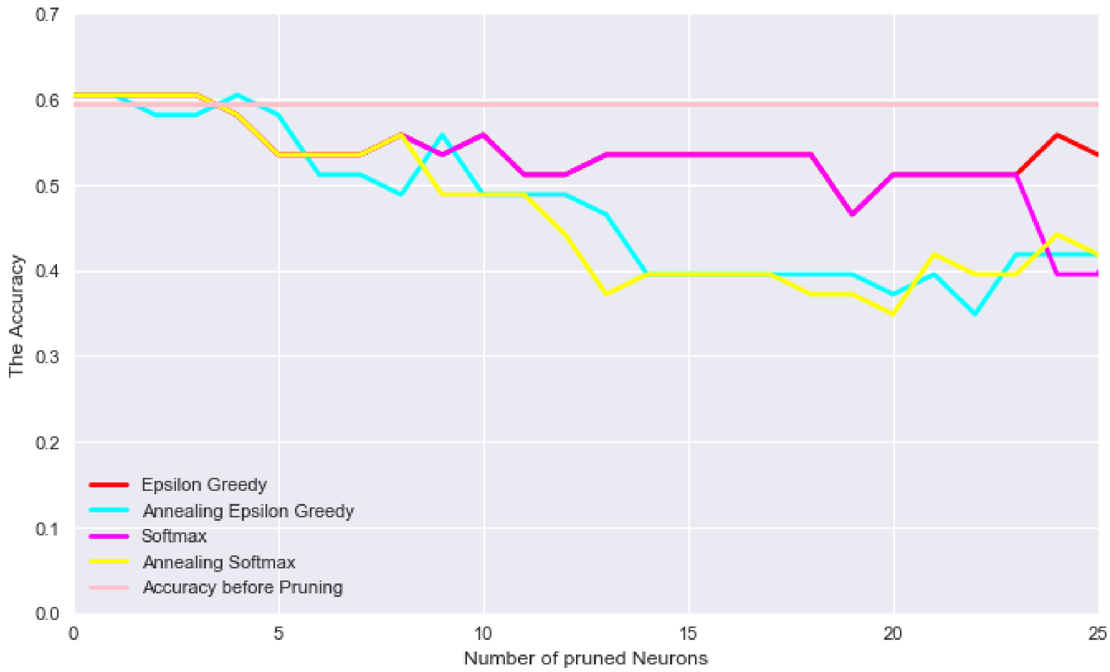



```
In [19]: p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)


         #p1.circle(ind, ucb1, legend="ucb1", color="orange")
         p1.line(ind, ucb1, legend="ucb1", line_color="orange", line_width=2)
         p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
         #p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
         p1.title.align = "center"


         show(p1)
         #show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

8.3 Epsilon greedy and Softmax

```
In [20]: fig = plt.figure(figsize=(10, 6), dpi=80)
         ax = fig.add_subplot(111)
         N = len(EpsilonGreedy)
         Acc = [Accuracy for col in range(N)]
         ## necessary variables
         ind = np.arange(N)                # the x locations for the groups
         plt.plot(ind , EpsilonGreedy, color="red", linewidth=2.5, linestyle="-", label="Epsilon
         plt.plot(ind , AnnealingEpsilonGreedy, color="cyan", linewidth=2.5, linestyle="-", labe
         plt.plot(ind , Softmax, color="magenta", linewidth=2.5, linestyle="-", label="Softmax")
         plt.plot(ind , AnnealingSoftmax, color="yellow", linewidth=2.5, linestyle="-", label="A
```

```
plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
plt.legend(loc = 3)
plt.axis([0, 25, 0, 0.7])
plt.xlabel('Number of pruned Neurons')
plt.ylabel('The Accuracy')
plt.grid(True)
plt.show()
```

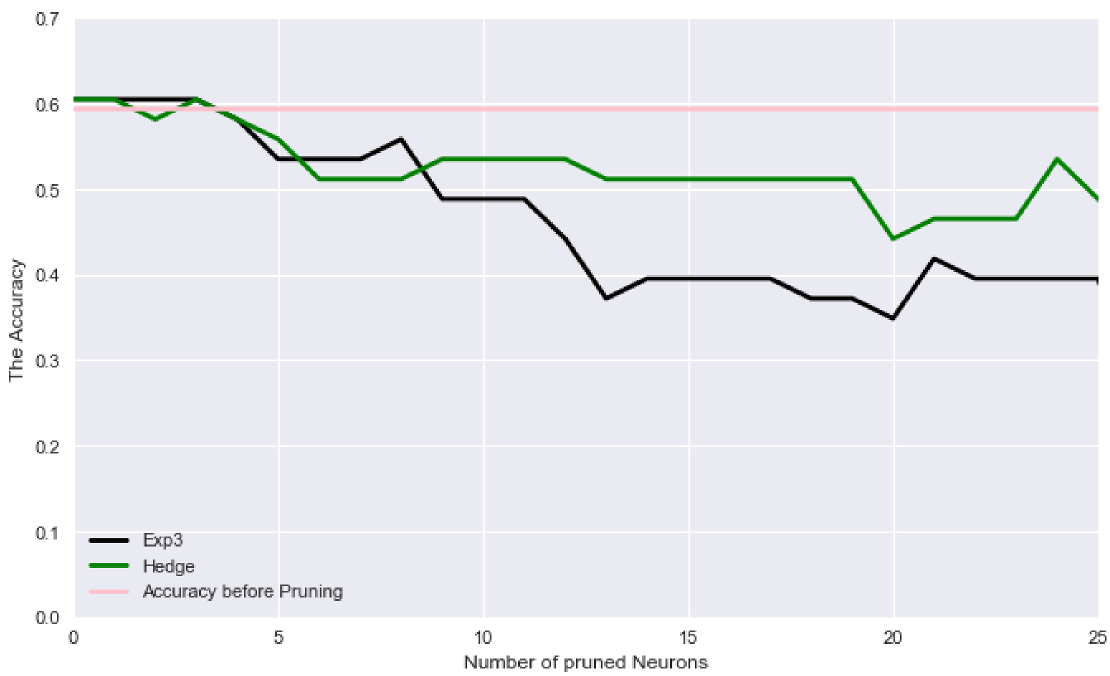



```
In [21]: p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)


         #p1.square(ind, EpsilonGreedy, legend="Epsilon Greedy", fill_color=None, line_color="re
         p1.line(ind, EpsilonGreedy, legend="Epsilon Greedy", line_color="red", line_width=2)

         #p1.ellipse(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color=
         p1.line(ind, AnnealingEpsilonGreedy, legend="Annealing Epsilon Greedy", line_color="blu

         #p1.diamond(ind, Softmax, legend="Softmax", line_color="green")
         p1.line(ind, Softmax, legend="Softmax", line_color="green", line_width=2)

         #p1.arc(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", end_angle
         p1.line(ind, AnnealingSoftmax, legend="Annealing Softmax", line_color="grey", line_widt

         p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
         #p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
```

```
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

8.4 Adversial Bandits Hedge and EXP3

```
In [22]: fig = plt.figure(figsize=(10, 6), dpi=80)
         ax = fig.add_subplot(111)
         N = len(Exp3)
         Acc = [Accuracy for col in range(N)]
         ## necessary variables
         ind = np.arange(N)                # the x locations for the groups
         plt.plot(ind , Exp3, color="black", linewidth=2.5, linestyle="-", label="Exp3")
         plt.plot(ind , Hedge, color="green", linewidth=2.5, linestyle="-", label="Hedge")
         plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
         plt.legend(loc = 3)
         plt.axis([0, 25, 0, 0.7])
         plt.xlabel('Number of pruned Neurons')
         plt.ylabel('The Accuracy')
         plt.grid(True)
         plt.show()
```

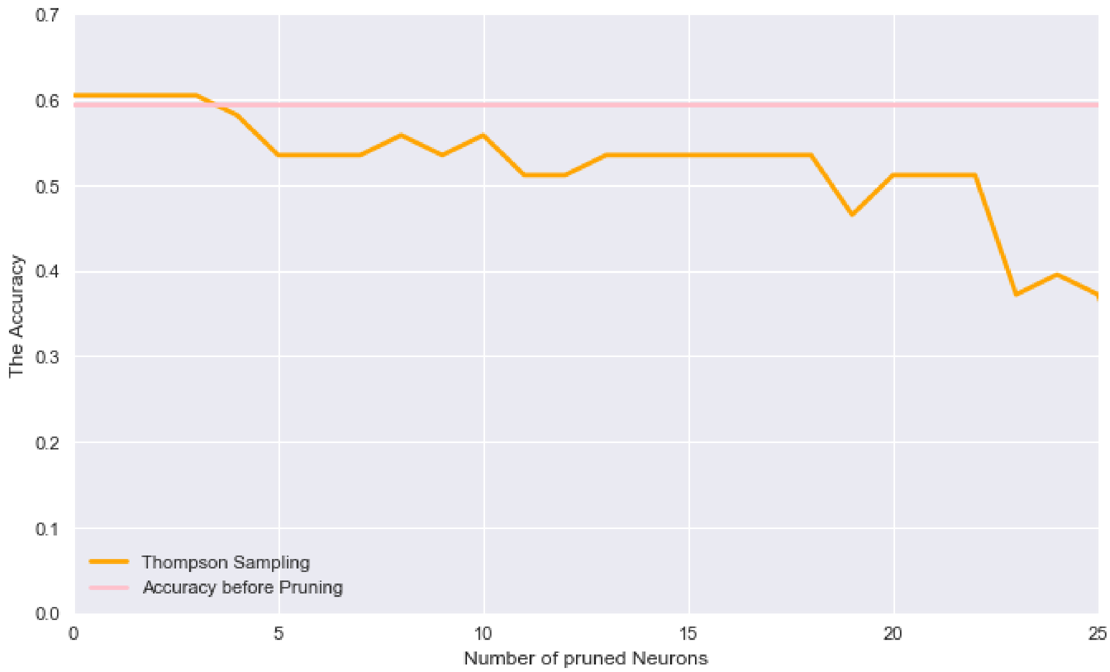



```
In [23]: p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)
```

```
#p1.oval(ind, Exp3, legend="Exp3", line_color="black", height=0.01, width=0.01)
p1.line(ind, Exp3, legend="Exp3", line_color="black", line_width=2)

#p1.arc(ind, Hedge, legend="Hedge", line_color="yellow")
#p1.triangle(ind, Hedge, legend="Hedge", line_color="yellow")
p1.line(ind, Hedge, legend="Hedge", line_color="yellow", line_width=2)

p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
#p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
p1.title.align = "center"


show(p1)
#show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```

9 Thompson Sampling

```
In [24]: fig = plt.figure(figsize=(10, 6), dpi=80)
         ax = fig.add_subplot(111)
         N = len(ThompsonSampling)
         Acc = [Accuracy for col in range(N)]
         ## necessary variables
         ind = np.arange(N)                # the x locations for the groups
         plt.plot(ind , ThompsonSampling, color="orange", linewidth=2.5, linestyle="-", label="T
         plt.plot(ind , Acc, color="pink", linewidth=2.5, linestyle="-", label="Accuracy before
         plt.legend(loc = 3)
         plt.axis([0, 25, 0, 0.7])
         plt.xlabel('Number of pruned Neurons')
         plt.ylabel('The Accuracy')
         plt.grid(True)
         plt.show()
```




```
In [25]: p1 = figure(title="The Performance over the number of neurons' pruned", tools=TOOLS)

         #p1.square_cross(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink")
         p1.line(ind, ThompsonSampling, legend="Thompson Sampling", line_color="pink", line_widt


         p1.line(ind, Acc, legend="Accuracy", line_dash=(4, 4), line_color="orange", line_width=
         #p1.square(ind, Hedge, legend="3*sin(x)", fill_color=None, line_color="brown")
         p1.title.align = "center"


         show(p1)
         #show(gridplot(p1, p2, ncols=2, plot_width=400, plot_height=400))  # open a browser
```