Learning Rate

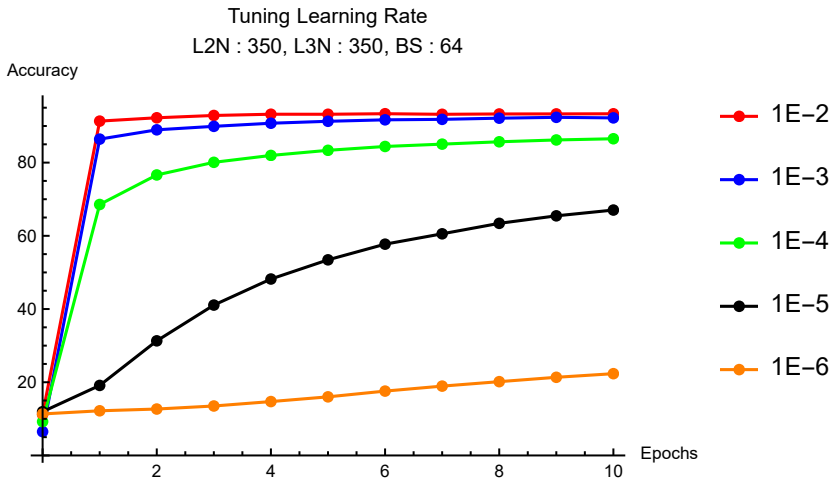
epochs : 10, L2N : 350, L3N : 350, BS : 64

In[15]:=
```
x = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10};
y1 = {11.21, 91.34, 92.25, 92.88, 93.22, 93.21, 93.36, 93.2, 93.29, 93.31, 93.34};
(*1e-02*)
y2 = {6.5, 86.42, 88.96, 89.91, 90.76, 91.29, 91.69, 91.82, 92.14, 92.37, 92.22}; (*1e-03*)
y3 = {9.24, 68.56, 76.63, 80.08, 81.96, 83.36, 84.41, 85.05, 85.69, 86.19, 86.52};
(*1e-04*)
y4 = {11.95, 19.13, 31.31, 41.08, 48.2, 53.44, 57.72, 60.55, 63.41, 65.46, 67.04};
(*1e-05*)
y5 = {11.34, 12.2, 12.68, 13.51, 14.72, 16.01, 17.58, 18.94, 20.16, 21.35, 22.34};
(*1e-06*)

P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → All,
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Tuning Learning Rate
L2N : 350, L3N : 350, BS : 64",
  AxesLabel → {"Epochs", "Accuracy"}]

Show[P[y1, Red, "1E-2"], P[y2, Blue, "1E-3"],
 P[y3, Green, "1E-4"], P[y4, Black, "1E-5"], P[y5, Orange, "1E-6"]]
```

Out[22]=



Node Count

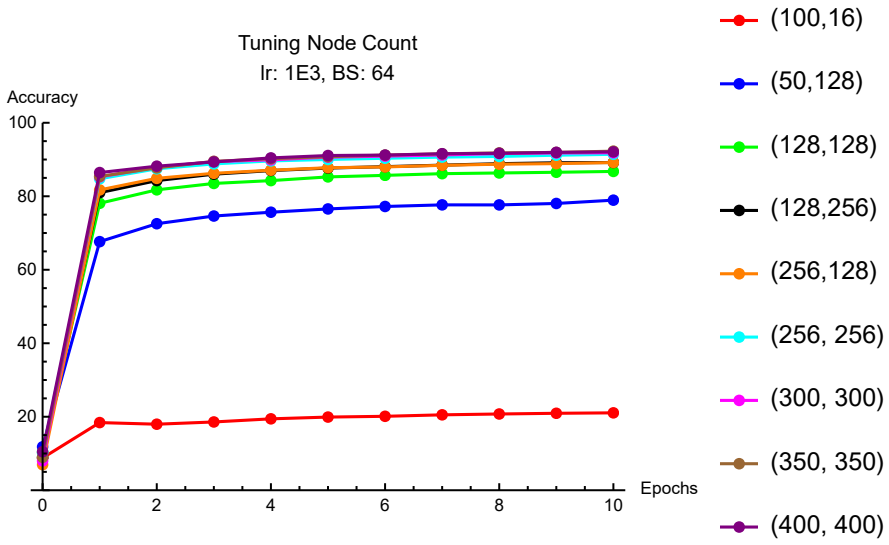
Initial Plot

In[23]:=
```
x = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10};
y1 = {8.78, 18.41, 17.97, 18.58, 19.43, 19.91, 20.12, 20.52, 20.75, 20.94, 21.06};
(*100, 16*)
y2 = {11.81, 67.65, 72.53, 74.62, 75.66, 76.55, 77.22, 77.66, 77.65, 78.04, 78.94};
(*50, 128*)
y3 = {10.34, 78.09, 81.75, 83.49, 84.26, 85.27, 85.69, 86.15, 86.34, 86.53, 86.76};
(*128, 128*)
y4 = {8.89, 80.98, 84.26, 86.01, 86.99, 87.67, 88.06, 88.47, 88.87, 89.12, 89.19};
(*128, 256*)
y5 = {6.95, 81.73, 84.88, 86.25, 87.09, 87.77, 87.98, 88.42, 88.73, 88.88, 89.18};
(*256, 128*)
y6 = {10.19, 84.76, 87.47, 88.81, 89.62, 90.01, 90.34, 90.66, 90.84, 91.17, 91.42};
(*256, 256*)
y7 = {7.98, 85.28, 87.89, 89.44, 89.91, 90.64, 90.92, 91.24, 91.62, 91.77, 91.84};
(*300, 300*)
y8 = {8.96, 85.4, 87.73, 89.5, 90.21, 90.76, 91.2, 91.55, 91.8, 91.93, 92.28}; (*350, 350*)
y9 = {10.48, 86.45, 88.19, 89.34, 90.44, 91.09, 91.21, 91.58, 91.69, 91.95, 92.08};
(*400, 400*)

P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → {0, 100},
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Tuning Node Count
lr: 1E3, BS: 64",
  AxesLabel → {"Epochs", "Accuracy"}]

Show[P[y1, Red, "(100,16)"], P[y2, Blue, "(50,128)"],
 P[y3, Green, "(128,128)"], P[y4, Black, "(128,256)"], P[y5, Orange, "(256,128)"],
 P[y6, Cyan, "(256, 256)"], P[y7, Magenta, "(300, 300)"],
 P[y8, Brown, "(350, 350)"], P[y9, Purple, "(400, 400)"]]
```

Out[34]=

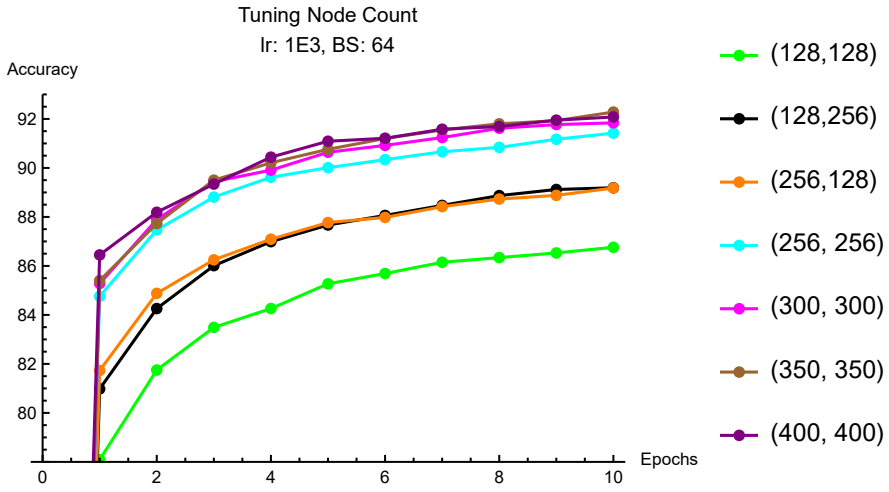


Changing Range

In[35]:=
```
P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → {78, 93},
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Tuning Node Count
lr: 1E3, BS: 64",
  AxesLabel → {"Epochs", "Accuracy"}]

Show[P[y3, Green, "(128,128)"], P[y4, Black, "(128,256)"], P[y5, Orange, "(256,128)"],
 P[y6, Cyan, "(256, 256)"], P[y7, Magenta, "(300, 300)"],
 P[y8, Brown, "(350, 350)"], P[y9, Purple, "(400, 400)"]]
```

Out[36]=



Epochs

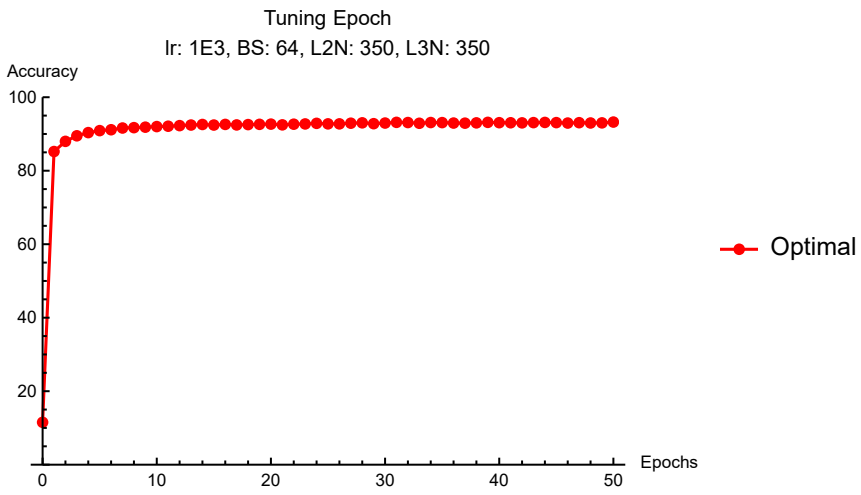
Initial Plot
epochs : 50, η : 0.001, L2N : 350, L3N : 350, BS : 64

In[37]:=
```
x = Range[51] - 1;
y1 = {11.53, 85.22, 87.99, 89.5, 90.37, 90.91, 91.15, 91.62,
    91.72, 91.85, 92.01, 92.11, 92.27, 92.43, 92.58, 92.43, 92.6, 92.46, 92.55,
    92.62, 92.68, 92.48, 92.66, 92.73, 92.89, 92.75, 92.75, 92.93, 93.03, 92.8,
    92.97, 93.16, 93.11, 92.91, 93.11, 93.09, 92.97, 92.94, 93.02, 93.16, 93.07,
    93.05, 93.02, 93.09, 93.14, 93.09, 92.97, 93.07, 92.99, 93.02, 93.24};

P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → {0, 100},
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Tuning Epoch
lr: 1E3, BS: 64, L2N: 350, L3N: 350",
  AxesLabel → {"Epochs", "Accuracy"}]

Show[P[y1, Red, "Optimal"]]
```

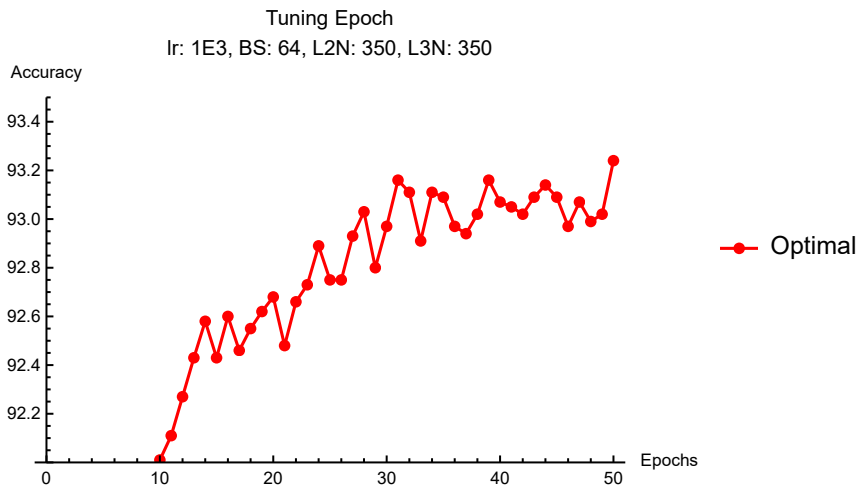
Out[40]=



In[41]:=
```
P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → {92, 93.5},
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Tuning Epoch
lr: 1E3, BS: 64, L2N: 350, L3N: 350",
  AxesLabel → {"Epochs", "Accuracy"}]

Show[P[y1, Red, "Optimal"]]
```

Out[42]=



Batch Size

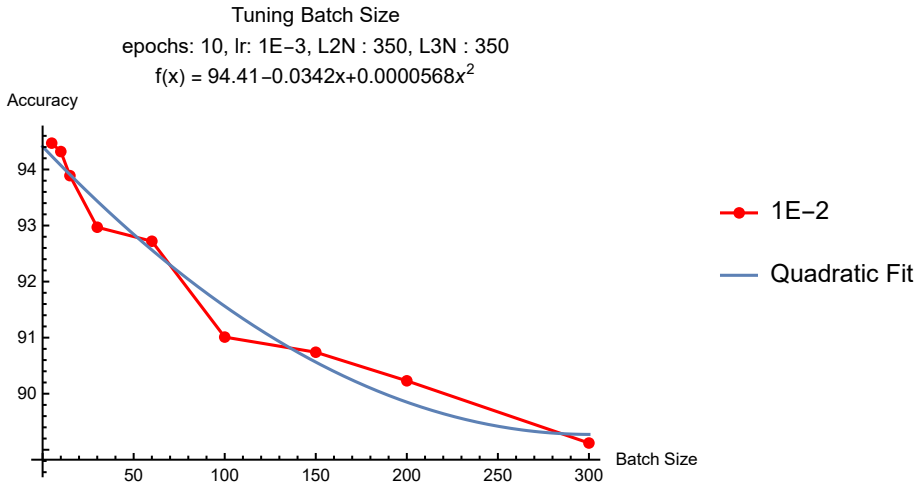
In[43]:=
```
x = {5, 10, 15, 30, 60, 100, 150, 200, 300};
y1 = {94.47, 94.32, 93.89, 92.97, 92.72, 91.01, 90.74, 90.23, 89.12};

P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → All,
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Tuning Batch Size
epochs: 10, lr: 1E-3, L2N : 350, L3N : 350
f(x) = 94.41-0.0342x+0.0000568x^2",
  AxesLabel → {"Batch Size", "Accuracy"}]

parabola = Fit[Transpose[{x, y1}], {1, X, X^2}, X];
fit = Plot[parabola, {X, 0, 300}, PlotLegends → {"Quadratic Fit"}];

Show[P[y1, Red, "1E-2"], fit]
```

Out[48]=



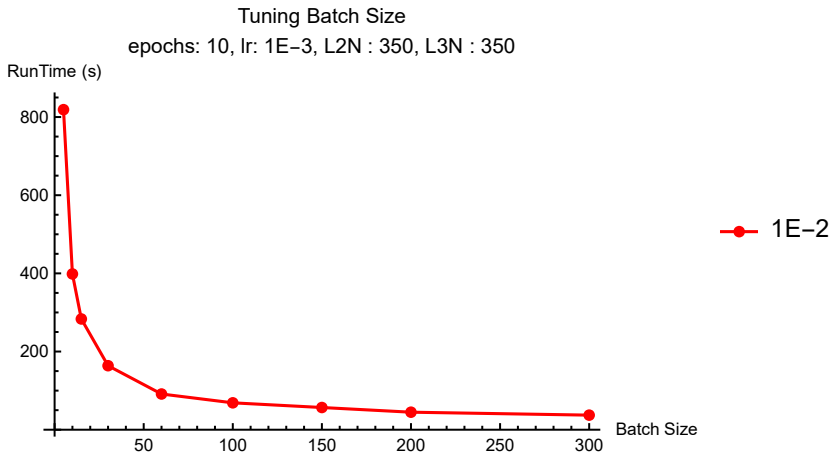
Time Plot

In[49]:=
```
x = {5, 10, 15, 30, 60, 100, 150, 200, 300};
y1 = {818.8888082504272, 398.53656244277954,
    283.3242139816284, 163.744811296463, 91.35605120658875, 68.79773378372192,
    56.801451683044434, 44.8243203163147, 37.292243003845215};

P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → All,
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Tuning Batch Size
epochs: 10, lr: 1E-3, L2N : 350, L3N : 350",
  AxesLabel → {"Batch Size", "RunTime (s)"}]

Show[P[y1, Red, "1E-2"]]
```

Out[52]=



ReLU vs . Sigmoid

In[53]:=
```
x = Range[51] - 1;
y1 = {11.53, 85.22, 87.99, 89.5, 90.37, 90.91, 91.15, 91.62, 91.72,
    91.85, 92.01, 92.11, 92.27, 92.43, 92.58, 92.43, 92.6, 92.46, 92.55, 92.62,
    92.68, 92.48, 92.66, 92.73, 92.89, 92.75, 92.75, 92.93, 93.03, 92.8, 92.97,
    93.16, 93.11, 92.91, 93.11, 93.09, 92.97, 92.94, 93.02, 93.16, 93.07, 93.05,
    93.02, 93.09, 93.14, 93.09, 92.97, 93.07, 92.99, 93.02, 93.24}; (*ReLU*)
y2 = {12.9, 18.45, 25.16, 31.29, 36.62, 41.42, 45.05, 48.14, 50.46,
    52.47, 54.65, 56.53, 57.97, 59.56, 60.62, 61.72, 62.78, 63.69, 64.6, 65.52,
    66.27, 67.05, 67.67, 68.32, 68.86, 69.3, 69.64, 70.08, 70.42, 70.8, 71.2,
    71.51, 71.79, 72.01, 72.31, 72.63, 72.9, 73.18, 73.41, 73.76, 74.02, 74.25,
    74.42, 74.7, 74.85, 75.1, 75.31, 75.56, 75.84, 75.99, 76.26}; (*Sigmoid*)
y3 = {9.54, 21.88, 34.93, 45.55, 52.53, 57.19, 60.78, 63.64, 65.7, 67.69,
    69.02, 70.28, 71.5, 72.29, 73.06, 73.93, 74.5, 75.16, 75.76, 76.23, 76.8,
    77.29, 77.64, 77.88, 78.29, 78.68, 78.97, 79.24, 79.47, 79.77, 80.01, 80.27,
    80.46, 80.71, 80.83, 81.1, 81.35, 81.54, 81.75, 81.94, 82.11, 82.29, 82.45,
    82.51, 82.67, 82.83, 82.92, 83.04, 83.18, 83.25, 83.35}; (*ReLU lr = 1E-5*)

P[y_, color_, label_] := ListPlot[Transpose[{x, y}], Joined → True, PlotRange → {0, 100},
  PlotMarkers → Automatic, PlotStyle → color, PlotLegends → {label},
  PlotLabel → "Sigmoid vs. ReLU
lr: 1E3, BS: 64, L2N: 350, L3N: 350",
  AxesLabel → {"Epochs", "Accuracy"}]

Show[P[y1, Red, "ReLU"], P[y3, Black, "ReLU (lr: 1E-5)"], P[y2, Blue, "Sigmoid"]]
```

Out[58]=