



```
In[1]:= Clear["Global`*"]

In[2]:= SetDirectory[$UserDocumentsDirectory];

In[3]:= << JLink` ;
InstallJava[];
ReinstallJava[JVMArguments -> "-Xmx2048m"]

Out[5]= LinkObject[

|                                                                                   |                                                                                   |                                                                                           |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
|  |  | Name: '/Applications/Mathematica.app/SystemFiles/Links/JLink/JLink.a<br>Link mode: Listen |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|

]
```

TRAIN SET;

```
In[6]:= a0 = Import["mnist_train.csv"];

In[22]:= {Dimensions[a0], Dimensions[Flatten[a0]]}

Out[22]= {{60 000, 785}, {47 100 000}}
```

TEST SET;

```
In[7]:= a = Import["mnist_test.csv"];

In[23]:= {Dimensions[a], Dimensions[Flatten[a]]}

Out[23]= {{10 000, 785}, {7 850 000}}

In[8]:= t0 = a0[[#]][[1]] & /@ Table[k, {k, 1, Dimensions[a0][[1]], 1}];

In[9]:= b0 = Drop[a0[[#]], 1] & /@ Table[k, {k, 1, Dimensions[a0][[1]], 1}];

In[10]:= o0 = Partition[b0[[#]], 28] & /@ Table[k, {k, 1, Dimensions[a0][[1]], 1}];
```

TEST SET;

```
In[39]:= t = a[[#]][[1]] & /@ Table[k, {k, 1, Dimensions[a][[1]], 1}]

Out[39]= {7, 2, 1, 0, 4, 1, 4, 9, 5, 9, 0, 6, 9, 0, 1, 5, 9, 7, 3, 4, 9, 6, 6, 5, 4, 0, 7, 4, 0, 1, 3, 1, 3, 4, 7, 2, 7, 1, 2, 1, 1, 7, 4, 2, 3, 5, 1, 2,
4, 4, 6, 3, 5, 5, 6, 0, 4, 1, 9, 5, 7, 8, 9, 3, 7, 4, 6, 4, 3, 0, 7, 0, 2, 9, 1, 7, 3, 2, 9, 7, 7, 6, 2, 7, 8, 4, 7, 3, 6, 1, 3, 6,
9, 3, 1, 4, 1, 7, 6, 9, 6, 0, 5, 4, 9, 9, 2, 1, 9, 4, 8, 7, 3, 9, 7, 4, 4, 4, 9, 2, 5, 4, 7, 6, 7, 9, 0, 5, 8, 5, 6, 6, 5, 7, 8, 1,
0, 1, 6, 4, 6, 7, 3, 1, 7, 1, 8, 2, 0, 2, 9, 9, 5, 5, 1, 5, 6, 0, 3, 4, 4, 6, 5, 4, 6, 5, 4, 5, 1, 4, 4, 7, 2, 3, 2, 7, 1, 8, 1, 8,
1, 8, 5, 0, 8, 9, 2, 5, 0, 1, 1, 1, 0, 9, 0, 3, 1, 6, 4, 2, 3, 6, 1, 1, 1, 3, 9, 5, 2, 9, 4, 5, 9, 3, 9, 0, 3, 6, 5, 5, 7, 2, 2, 7,
1, 2, 8, 4, 1, 7, 3, 3, 8, 8, 7, 9, 2, 2, 4, 1, 5, 9, 8, 7, 2, 3, 0, 4, 4, 2, 4, 1, 9, 5, 7, 7, 2, 8, 2, 6, 8, 5, 7, 7, 9, 1, 8, 1,
8, 0, 3, 0, 1, 9, 9, 4, 1, 8, 2, 1, 2, 9, 7, 5, 9, 2, 6, 4, 1, 5, 8, 2, 9, 2, 0, 4, 0, 0, 2, 8, 4, 7, 1, 2, 4, 0, 2, 7, 4, 3, 3, 0,
0, 3, 1, 9, 6, 5, 2, 5, 9, 2, 9, 3, 0, 4, 2, 0, 7, 1, 1, 2, 1, 5, 3, 3, 9, 7, 8, 6, 5, 6, 1, 3, 8, 1, 0, 5, 1, 3, 1, 5, 5, 6, 1, 8,
5, 1, 7, 9, 4, 6, 2, 2, 5, 0, 6, 5, 6, 3, 7, 2, 0, 8, 8, 5, 4, 1, 1, 4, 0, 3, 3, 7, 6, 1, 6, 2, 1, 9, 2, 8, 6, 1, 9, 5, 2, 5, 4, 4,
2, 8, 3, 8, 2, 4, 5, 0, 3, 1, 7, 7, 5, 7, 9, 7, 1, 9, 2, 1, 4, 2, 9, 2, 0, 4, 9, 1, 4, 8, 1, 8, 4, 5, 9, 8, 8, 3, 7, 6, 0, 0, 3, 0,
2, 6, 6, 4, 9, 3, 3, 3, 2, 3, 9, 1, 2, 6, 8, 0, 5, 6, 6, 6, 3, 8, 8, 2, 7, 5, 8, 9, 6, 1, 8, 4, 1, 2, 5, 9, 1, 9, 7, 5, 4, 0, 8, 9,
9, 1, 0, 5, 2, 3, 7, 8, 9, 4, 0, 6, 3, 9, 5, 2, 1, 3, 1, 3, 6, 5, 7, 4, 2, 2, 6, 3, 2, 6, 5, 4, 8, 9, 7, 1, 3, 0, 3, 8, 3, 1, 9, 3,
4, 4, 6, 4, 2, 1, 8, 2, 5, 4, 8, 8, 4, 0, 0, 2, 3, 2, 7, 7, 0, 8, 7, 4, 4, 7, 9, 6, 9, 0, 9, 8, 0, 4, 6, 0, 6, 3, 5, 4, 8, 3, 3, 9,
3, 3, 3, 7, 8, 0, 8, 2, 1, 7, 0, 6, 5, 4, 3, 8, 0, 9, 6, 3, 8, 0, 9, 9, 6, 8, 6, 8, 5, 7, 8, 6, 0, 2, 4, 0, 2, 2, 3, 1, 9, 7, 5, 1,
0, 8, 4, 6, 2, 6, 7, 9, 3, 2, 9, 8, 2, 2, 9, 2, 7, 3, 5, 9, 1, 8, 0, 2, 0, 5, 2, 1, 3, 7, 6, 7, 1, 2, 5, 8, 0, 3, 7, 2, 4, 0, 9, 1,
8, 6, 7, 7, 4, 3, 4, 9, 1, 9, 5, 1, 7, 3, 9, 7, 6, 9, 1, 3, 7, 8, 3, 3, 6, 7, 2, 8, 5, 8, 5, 1, 1, 4, 4, 3, 1, 0, 7, 7, 0, 7, 9, 4,
4, 8, 5, 5, 4, 0, 8, 2, 1, 0, 8, 4, 5, 0, 4, 0, 6, 1, 7, 3, 2, 6, 7, 2, 6, 9, 3, 1, 4, 6, 2, 5, 4, 2, 0, 6, 2, 1, 7, 3, 4, 1, 0, 5,
4, 3, 1, 1, 7, 4, 9, 9, 4, 8, 4, 0, 2, 4, 5, 1, 1, 6, 4, 7, 1, 9, 4, 2, 4, 1, 5, 5, 3, 8, 3, 1, 4, 5, 6, 8, 9, 4, 1, 5, 3, 8, 0, 3,
2, 5, 1, 2, 8, 3, 4, 4, 0, 8, 8, 3, 3, 1, 7, 3, 5, 9, 6, 3, 2, 6, 1, 3, 6, 0, 7, 2, 1, 7, 1, 4, 2, 4, 2, 1, 7, 9, 6, 1, 1, 2, 4, 8,
1, 7, 7, 4, 8, 0, 7, 3, 1, 3, 1, 0, 7, 7, 0, 3, 5, 5, 2, 7, 6, 6, 9, 2, 8, 3, 5, 2, 2, 5, 6, 0, 8, 2, 9, 2, 8, 8, 8, 8, 7, 4, 9, 3,
0, 6, 6, 3, 2, 1, 3, 2, 2, 9, 3, 0, 0, 5, 7, 8, 1, 4, 4, 6, 0, 2, 9, 1, 4, 7, 4, 7, 3, 9, 8, 8, 4, 7, 1, 2, 1, 2, 2, 3, 2, 3, 2, 3,
9, 1, 7, 4, 0, 3, 5, 5, 8, 6, 3, 2, 6, 7, 6, 6, 3, 2, 7, 8, 1, 1, 7, 5, 6, 4, 9, 5, 1, 3, 3, 4, 7, 8, 9, 1, 1, 6, 9, 1, 4, 4, 5, 4,
0, 6, 2, 2, 3, 1, 5, 1, 2, 0, 3, 8, 1, 2, 6, 7, 1, 6, 2, 3, 9, 0, 1, 2, 2, 0, 8, 9, 9, 0, 2, 5, 1, 9, 7, 8, 1, 0, 4, 1, 7, 9, 6, 4,
2, 6, 8, 1, 3, 7, 5, 4, 4, 1, 8, 1, 3, 8, 1, 2, 5, 8, 0, 6, 2, 1, 1, 7, 1, 5, 3, 4, 6, 9, 5, 0, 9, 2, 2, 4, 8, 2, 1, 7, 2, 4, 9, 4,
4, 0, 3, 9, 2, 2, 3, 3, 8, 3, 5, 7, 3, 5, 8, 1, 2, 4, 4, 6, 4, 9, 5, 1, 0, 6, 9, 5, 9, 5, 9, 7, 3, 8, 0, 3, 7, 1, 3, 6, 7, 8, 5, 9,
7, 9, 6, 9, 6, 3, 7, 4, 4, 5, 3, 5, 4, 7, 8, 7, 8, 0, 7, 6, 8, 8, 7, 3, 3, 1, 9, 5, 2, 7, 3, 5, 1, 1, 2, 1, 4, 7, 4, 7, 5, 4, 5, 4,
0, 8, 3, 6, 9, 6, 0, 2, 7, 4, 4, 4, 4, 6, 6, 4, 7, 9, 3, 4, 5, 8, 8, 7, 3, 3, 7, 2, 7, 0, 2, 4, 1, 1, 6, 6, 9, 2, 8, 7, 2, 0, 1, 5, 0,
9, 1, 7, 0, 6, 0, 8, 6, 8, 1, 8, 0, 3, 3, 7, 2, 3, 6, 2, 1, 6, 1, 1, 3, 3, 7, 9, 0, 8, 0, 5, 4, 0, 2, 8, 7, 2, 9, 8, 4, 0, 9, 5, 8, 5,
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8, 8, 7, 9, 7, 1, 4, 5, 6, 0, 5, 2, 2, 2, 1, 5, 5, 2, 4, 9, 6, 2, 7, 7, 2, 2, 1, 1, 2, 8, 3, 7, 2, 4, 1, 7, 1, 7, 6, 7, 8, 2, 7, 3,
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2, 4, 9, 8, 0, 9, 9, 4, 6, 5, 4, 9, 1, 8, 3, 4, 9, 9, 1, 2, 2, 8, 1, 9, 6, 4, 0, 9, 4, 8, 3, 8, 6, 0, 2, 5, 1, 9, 6, 2, 9, 4, 0, 9,
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7, 9, 8, 3, 0, 7, 2, 7, 9, 4, 5, 4, 9, 3, 2, 1, 4, 0, 2, 3, 7, 5, 7, 8, 8, 5, 0, 1, 1, 4, 8, 3, 9, 0, 0, 0, 6, 6, 2, 3, 7, 8, 4, 7,
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6, 5, 2, 4, 4, 3, 2, 3, 5, 6, 8, 8, 6, 2, 3, 1, 0, 5, 8, 9, 2, 9, 6, 7, 0, 4, 8, 7, 1, 7, 4, 1, 0, 9, 7, 2, 0, 0, 9, 1, 7, 8, 7, 8,
4, 7, 2, 0, 4, 6, 0, 3, 1, 1, 3, 3, 9, 6, 7, 4, 1, 5, 3, 0, 8, 7, 3, 9, 6, 9, 3, 5, 0, 2, 7, 4, 5, 1, 7, 5, 8, 0, 8, 8, 1, 5, 0, 3,
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0, 7, 5, 2, 9, 8, 7, 4, 4, 2, 6, 6, 1, 9, 6, 8, 2, 9, 0, 8, 3, 1, 1, 6, 3, 5, 1, 1, 1, 3, 1, 2, 3, 0, 2, 0, 1, 3, 5, 5, 7, 4, 8, 9,
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6, 4, 6, 8, 4, 8, 2, 7, 4, 5, 2, 0, 3, 9, 4, 6, 7, 2, 5, 6, 1, 1, 2, 3, 6, 7, 8, 7, 6, 4, 8, 9, 4, 8, 6, 3, 8, 3, 1, 0, 6, 2, 2, 5,
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9, 9, 0, 0, 2, 8, 8, 2, 3, 7, 1, 3, 0, 3, 4, 4, 3, 8, 9, 2, 3, 9, 7, 1, 1, 7, 0, 4, 9, 6, 5, 9, 1, 7, 0, 2, 0, 0, 4, 6, 7, 0, 7, 1,
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3, 7, 2, 5, 8, 1, 8, 6, 2, 9, 5, 7, 5, 7, 8, 6, 2, 5, 1, 4, 8, 4, 5, 8, 3, 0, 6, 2, 7, 3, 3, 2, 1, 0, 7, 3, 4, 0, 3, 9, 3, 2, 8,
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4, 3, 5, 4, 3, 9, 5, 0, 1, 5, 3, 8, 9, 1, 9, 7, 9, 5, 5, 2, 7, 4, 6, 0, 1, 1, 1, 0, 4, 4, 7, 6, 3, 0, 0, 4, 3, 0, 6, 1, 9, 6, 1,
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6, 3, 5, 9, 3, 4, 5, 5, 8, 5, 3, 0, 4, 0, 2, 9, 6, 8, 2, 3, 1, 2, 1, 1, 5, 6, 9, 8, 0, 6, 6, 5, 5, 3, 8, 6, 2, 1, 4, 5, 4, 3, 7,
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8, 8, 8, 4, 0, 4, 4, 1, 5, 2, 8, 3, 4, 9, 5, 2, 8, 1, 5, 3, 7, 9, 4, 2, 5, 6, 3, 5, 9, 3, 5, 9, 3, 1, 9, 5, 3, 0, 6, 9, 8, 4, 0,
4, 9, 2, 9, 0, 1, 0, 3, 1, 6, 5, 8, 1, 5, 3, 3, 0, 3, 5, 5, 9, 2, 8, 7, 0, 4, 9, 1, 9, 7, 7, 5, 5, 2, 0, 9, 1, 8, 6, 2, 3, 9, 6,
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0, 3, 2, 7, 7, 2, 6, 4, 7, 5, 5, 5, 2, 9, 2, 8, 4, 6, 8, 6, 5, 0, 0, 8, 7, 6, 1, 7, 1, 1, 2, 7, 4, 0, 0, 7, 7, 6, 3, 8, 6, 4, 2,
0, 9, 4, 0, 5, 7, 8, 2, 7, 4, 7, 1, 1, 3, 6, 6, 2, 9, 1, 9, 4, 8, 3, 6, 9, 5, 9, 6, 2, 4, 6, 7, 7, 0, 6, 6, 9, 4, 8, 3, 5, 3, 4,
9, 0, 0, 5, 2, 5, 0, 7, 1, 1, 1, 6, 7, 6, 7, 9, 6, 6, 4, 1, 4, 3, 1, 1, 2, 2, 4, 1, 0, 8, 7, 6, 3, 4, 0, 0, 6, 3, 3, 0, 7, 1, 7,
1, 1, 3, 1, 0, 9, 9, 7, 5, 4, 1, 4, 8, 9, 5, 3, 5, 1, 9, 8, 2, 3, 3, 9, 9, 0, 1, 0, 2, 9, 3, 9, 3, 3, 6, 2, 4, 9, 8, 3, 7, 4, 0,
4, 7, 8, 4, 9, 8, 9, 9, 7, 5, 9, 2, 8, 2, 2, 0, 2, 2, 3, 8, 4, 6, 8, 6, 8, 2, 4, 6, 7, 9, 3, 3, 9, 4, 3, 1, 4, 4, 7, 0, 5, 9, 6,
0, 4, 4, 4, 4, 6, 1, 2, 3, 3, 6, 4, 5, 9, 6, 8, 5, 6, 5, 8, 6, 4, 1, 8, 6, 5, 2, 8, 4, 5, 5, 4, 7, 7, 0, 7, 8, 2, 2, 3, 7, 0, 1,
8, 0, 7, 1, 9, 8, 7, 5, 5, 9, 1, 7, 5, 4, 9, 1, 2, 2, 1, 6, 6, 7, 1, 1, 4, 0, 7, 4, 2, 4, 0, 6, 4, 7, 6, 9, 5, 3, 4, 6, 5, 0, 1,
8, 8, 2, 8, 3, 5, 7, 8, 0, 8, 5, 7, 1, 1, 0, 1, 3, 7, 8, 5, 0, 7, 1, 1, 0, 1, 1, 4, 5, 2, 7, 6, 2, 3, 0, 2, 8, 5, 9, 6, 9, 7, 2,
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 8, 9, 7, 5, 5, 1, 9, 9, 7, 1, 0, 0, 5, 9, 7, 1, 7, 2, 2, 3, 6, 8, 3, 2, 0, 0, 6, 1, 7, 5, 8, 6, 2, 9, 4, 8, 8, 7, 1, 0, 8, 7,
 7, 5, 8, 5, 3, 4, 6, 1, 1, 5, 5, 0, 7, 2, 3, 6, 4, 1, 2, 4, 1, 5, 4, 2, 0, 4, 8, 6, 1, 9, 0, 2, 5, 6, 9, 3, 6, 3, 6, 0, 1, 2,
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In[12]:= b = Drop[a[[#]], 1] & /@Table[k, {k, 1, Dimensions[a][[1]], 1}];

In[13]:= o = Partition[b[[#]], 28] & /@Table[k, {k, 1, Dimensions[a][[1]], 1}];

In[14]:= t2 = Total[Abs[Flatten[o[[1]]] - Flatten[o0[[#]]]] & /@Table[k, {k, 1, Dimensions[o0][[1]], 1}];

In[15]:= t3 = Flatten[Position[t2, Min[t2]]];

In[16]:= f[x_] := Flatten[Position[Total[Abs[Flatten[o[[x]]] - Flatten[o0[[#]]]]] & /@Table[k, {k, 1, Dimensions[o0][[1]], 1}],
  Min[Total[Abs[Flatten[o[[x]]] - Flatten[o0[[#]]]]] & /@Table[k, {k, 1, Dimensions[o0][[1]], 1}]]];

In[17]:= t5 = f /@Table[k, {k, 1, Dimensions[t][[1]], 1}];

In[18]:= t55 = Flatten[If[Dimensions[t5[[#]]][[1]] > 1, t5[[#]][[1]], t5[[#]]] & /@Table[k, {k, 1, Dimensions[t5][[1]], 1}];

In[19]:= tt = t0[[#]] & /@Flatten[t55];

```

In[20]:= **ACCURACY;**

In[21]:= **N[Count[t - tt, 0] / Dimensions[t][[1]]]**

Out[21]= 0.9631

SAMPLE OF 1, 000 OUTPUTS;

```

In[38]:= {t[[#]], MatrixPlot[o[[#]], ImageSize -> 80], MatrixPlot[o0[[t55[[#]]]], ImageSize -> 80]} & /@Table[k, {k, 1, 1000, 1}]

```

