Kohonen Maps

Application au MNIST

In[3]:=
```
mnistData = ExampleData[{"MachineLearning", "MNIST"}, "Data"];
```
données d'exemples

In[4]:=
```
maxDigits = 10;
```

In[5]:=
```
GetDataFromMNIST[] := Module[{i, dataToPCA = {}, images, dataGroup},
```
module
```
  For[i = 0, i < maxDigits, i++,
```
pour chaque
```
   images = #[[1]] & /@ Select[mnistData, #[[2]] == i &];
```
sélectionne
```
   dataGroup = Flatten /@ ImageData /@ images;
```
aplatis données d'image
```
   dataToPCA = Join[dataToPCA, dataGroup];
```
joins
```
  ];
  dataToPCA
 ]
```

In[6]:=
```
dataToPCA = GetDataFromMNIST[];
```

Kohonen

- Initialisation des représentants de la map

In[22]:=
```
weights = Table[{i, j, RandomReal[1, 784]}, {i, 1, 10}, {j, 1, 10}] // Flatten[#, 1] &;
```
table nombre réel aléatoire aplatis

Apprentissage (attention au nombre d'itération, ça peut être long ...)

In[61]:=
```
weights =
 Module[{i, t, bmu, shuffleData, updatedWeights},
  Print[Dynamic[i]];
  updatedWeights = weights;
  For[i = 0, i < 50000, i++,
   shuffleData = RandomSample[dataToPCA, 200];
   For[t = 1, t ≤ Length[shuffleData[[1 ;; 100]]], t++,
    bmu = MinimalBy[updatedWeights, Norm[#[[3]] - shuffleData[[t]], 2] &, 1][[1]];
    updatedWeights =
     ((# + {0, 0, (Exp[-0.5 * Power[Norm[#[[1 ;; 2]] - bmu[[1 ;; 2]], 2], 2]) *
          0.1 * (shuffleData[[t]] - #[[3]])}) & /@ updatedWeights);
   ];
  ];
  updatedWeights
 ]
```

50 000

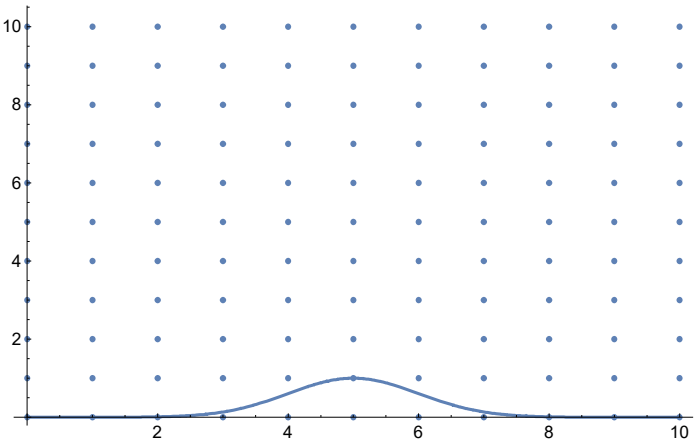
Out[61]=
```
{{1, 1, {1., 1., 1., 1., 1., 1., 1., 1., 1., 1., ··· 764 ···,
    1., 1., 1., 1., 1., 1., 1., 1., 1., 1.}}, ··· 98 ···, ··· 1 ···}
```

large output | show less | show more | show all | set size limit...

Représentation de la grille et de l'impact de la fonction de voisinage

```
In[ ]:= Show[ListPlot[Table[{i, j}, {i, 0, 10}, {j, 0, 10}] // (Flatten[#, 1] &)],
          mon·· tracé de li··· table                          aplatis
        Plot[Exp[-0.5 * Power[x - 5, 2]], {x, 0, 10}]]
          trac··· exponentielle puissance
```

Out[ ]=



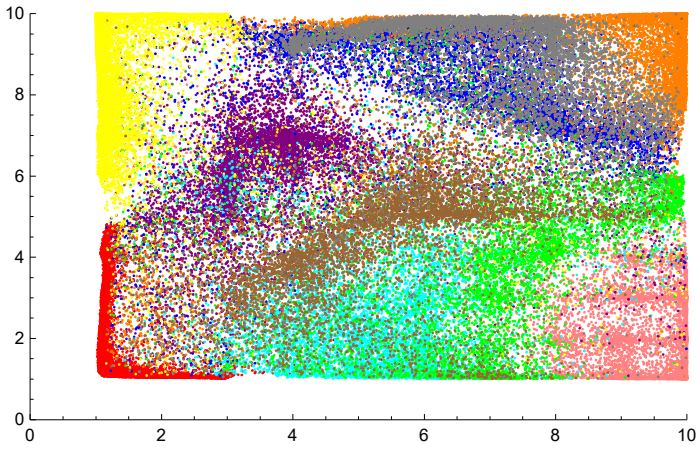
Préparation de la visualisation de la projection des points dans l'espace des représentants

```
In[26]:= classesCount = Table[Length[Select[mnistData, #[[2]] == i &]], {i, 0, 9}];
                        table  longueur sélectionne

In[27]:= classesStart = Table[Total[classesCount[[1 ;; i]]], {i, 0, 9}];
                        table  total

In[28]:= classesEnd = Table[classesStart[[i + 1]] + classesCount[[i + 1]], {i, 0, 9}];
                      table

In[29]:= colors = {Pink, Red, Purple, Cyan, Blue, Green, Yellow, Orange, Brown, Gray};
                 rose  ro···  violet  cyan  bleu  vert  jaune  orange  marron  gris
```

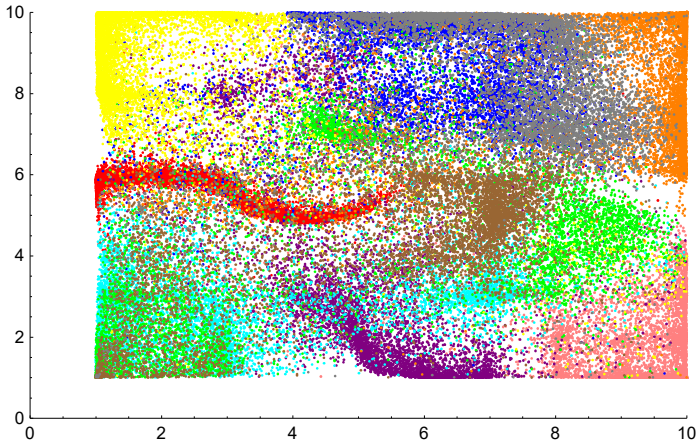
Projection des points dans l'espace des représentants

In[62]:=
```
Show[Table[ListPlot[Table[Total[bests = Table[{w[[1]], w[[2]],
Exp[-Min[0.5 * Power[Norm[elt - w[[3]], 2], 2], 200]]}, {w, weights}];
bests * bests[[ ;; , 3]] / Total[bests[[ ;; , 3]]]], {elt,
dataToPCA[[classesStart[[i + 1]] + 1 ;; classesEnd[[i + 1]]]]}][[ ;; , 1 ;; 2]],
PlotStyle → {colors[[i + 1]]}, PlotRange → {{0, 10}, {0, 10}}], {i, 0, 9}]]
```

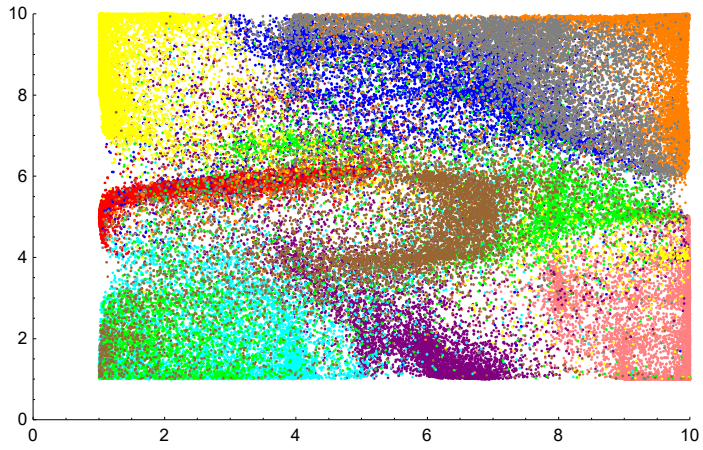
Out[62]=



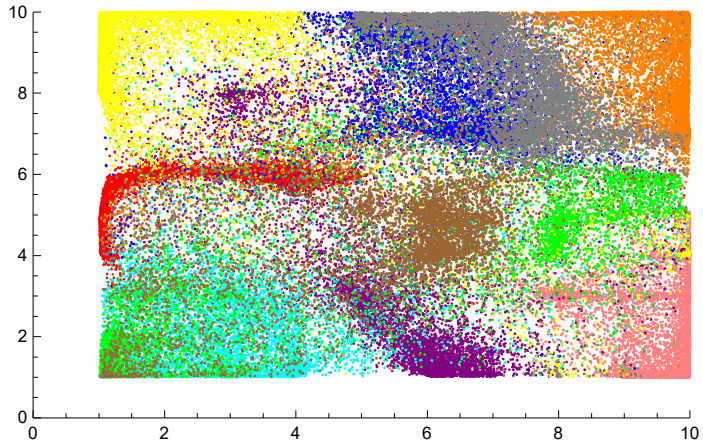
Iteration 100 x batch 200



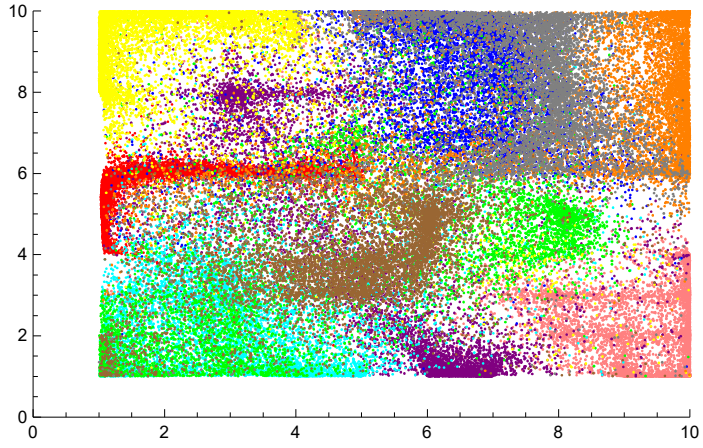
Iteration 200 x batch 200



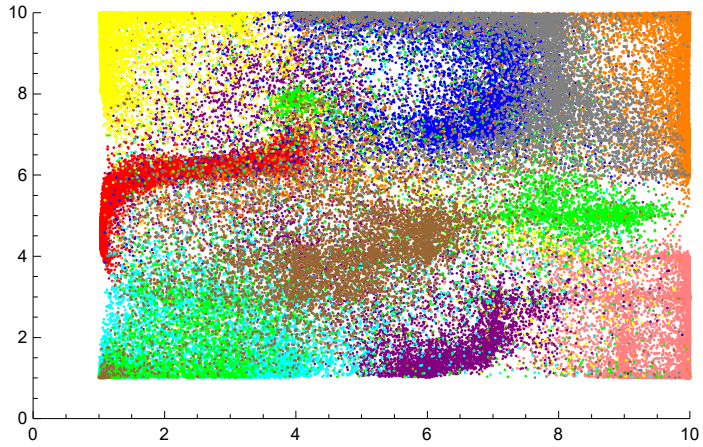
Iteration 500 x batch 200



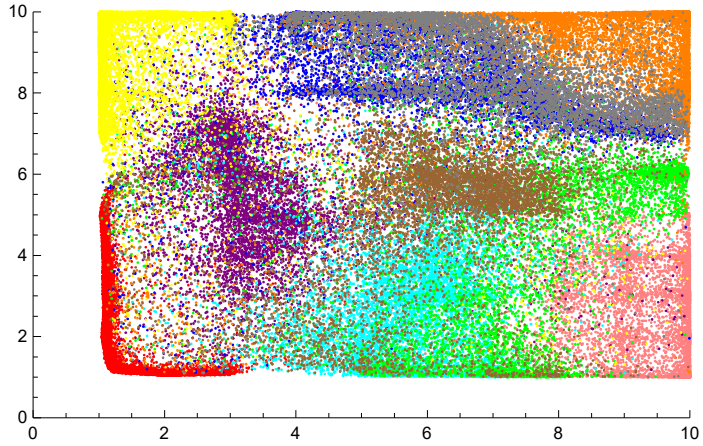
Iteration 1000 x batch 200



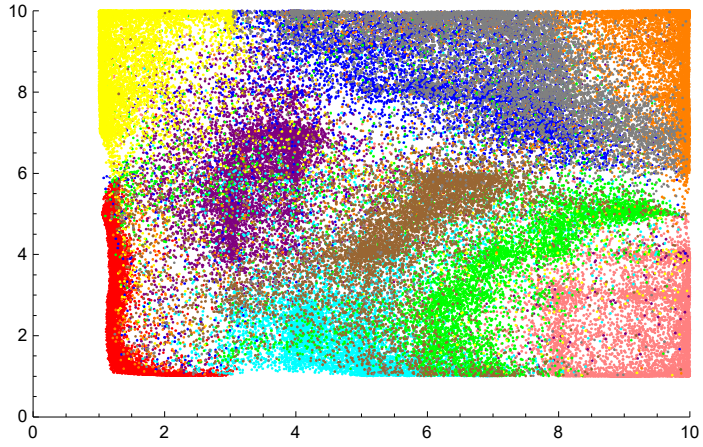
Iteration 2000 x batch 200



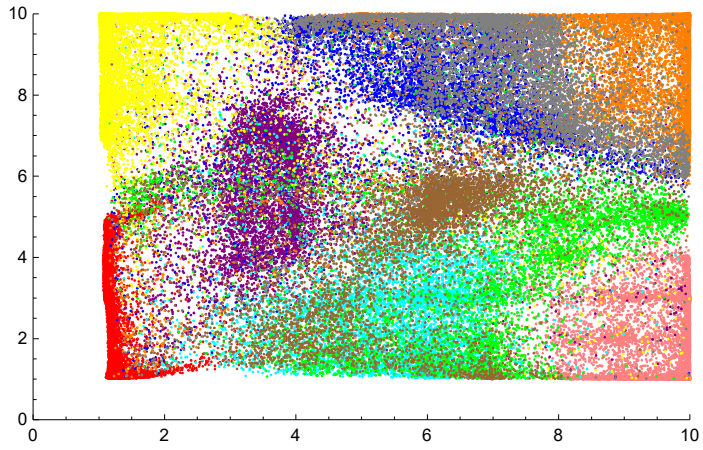
Iteration 10000 x batch 200



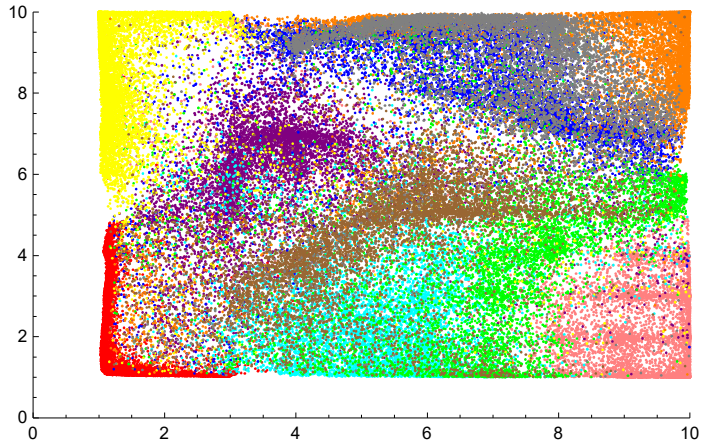
Iteration 20000 x batch 200



Iteration 50000 x batch 200



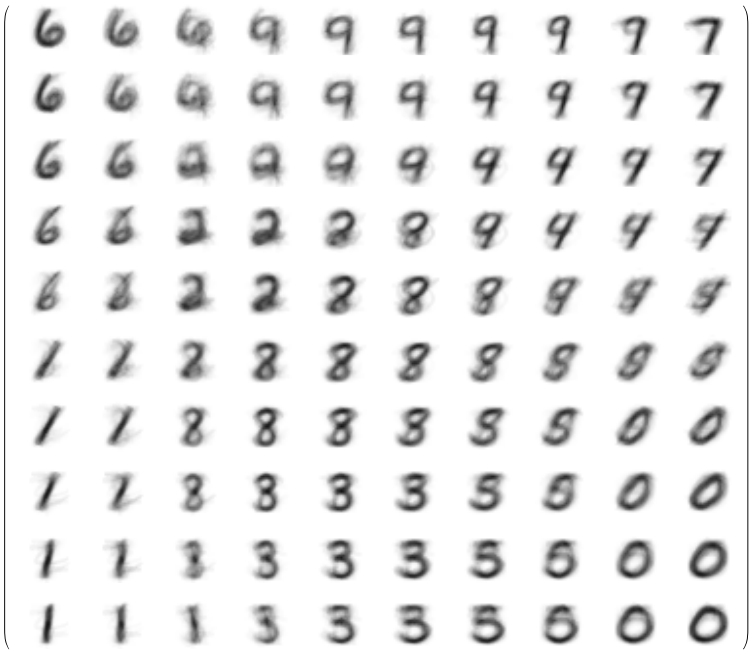
Iteration 100000 x batch 200



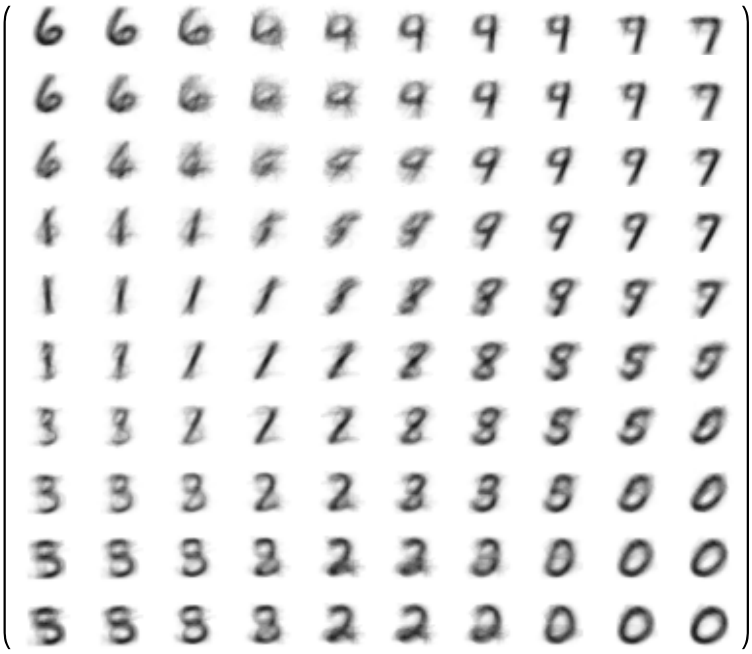
- Affichage sous forme d'image des représentants de la SOM :

In[63]:=
```
ArrayReshape[Image /@ (ArrayReshape[#, {28, 28}] & /@ weights[[ ;; , 3]]), {10, 10}] //
Transpose // Reverse // MatrixForm
```
redimensionne … image … redimensionne tableau
transposée … renverses … apparence matricielle

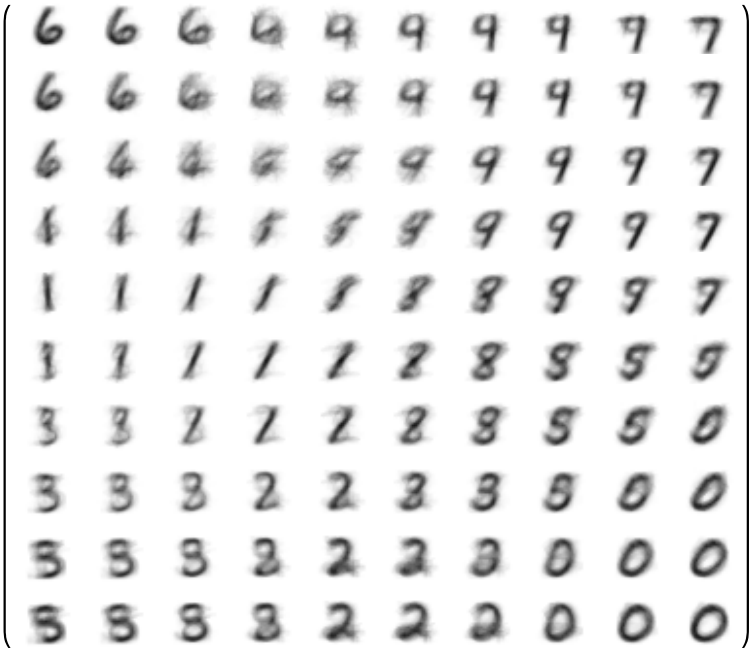
Out[63]//MatrixForm=



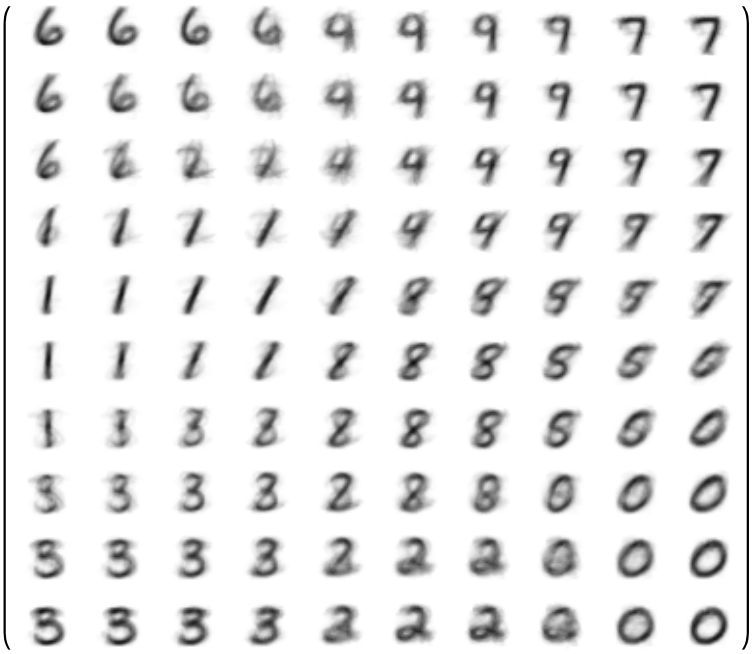
Iteration 100 x batch 200



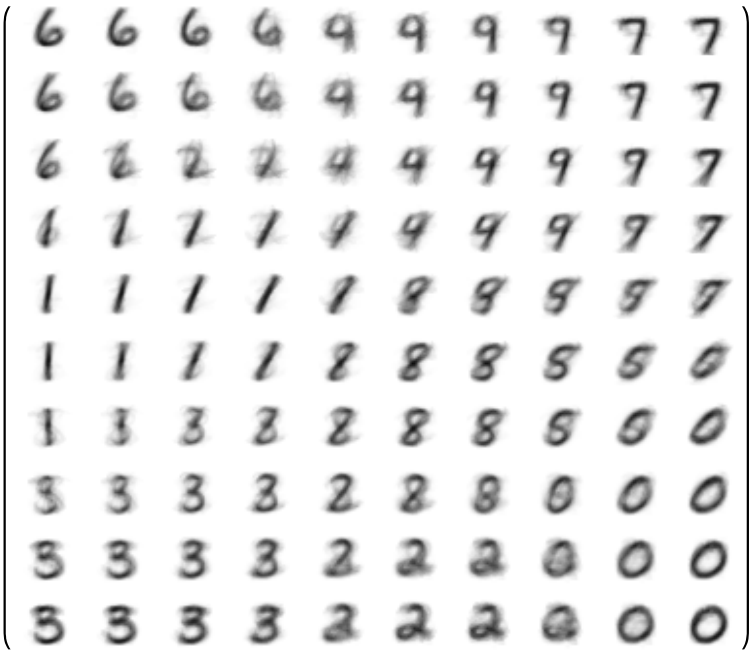
Iteration 200 x batch 200



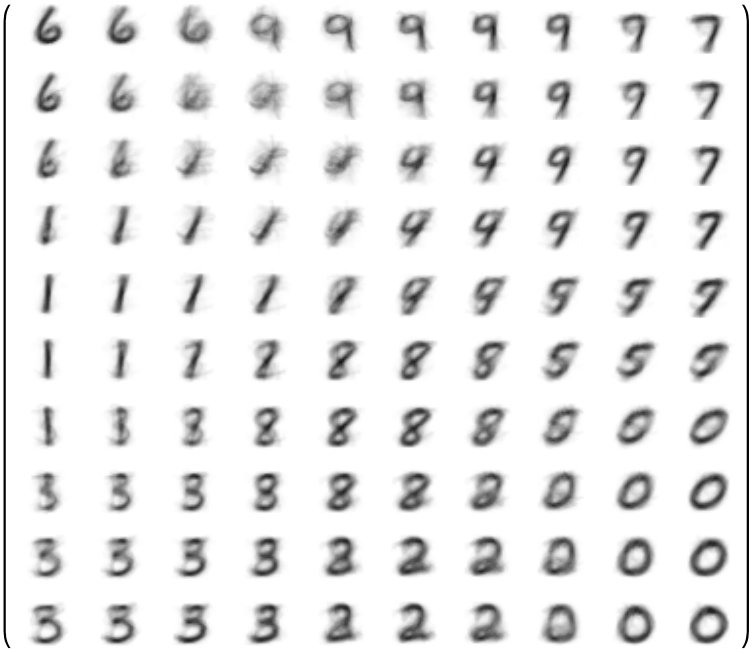
Iteration 500 x batch 200



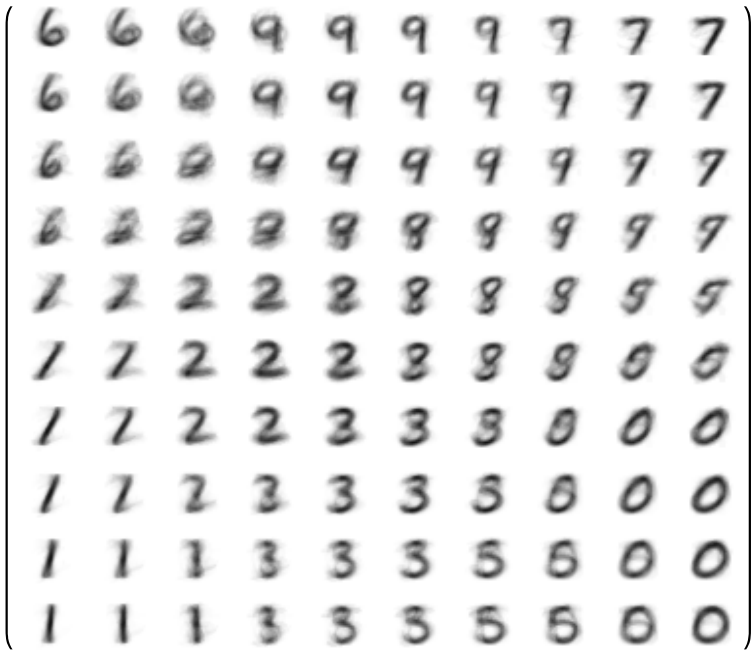
Iteration 1000 x batch 200



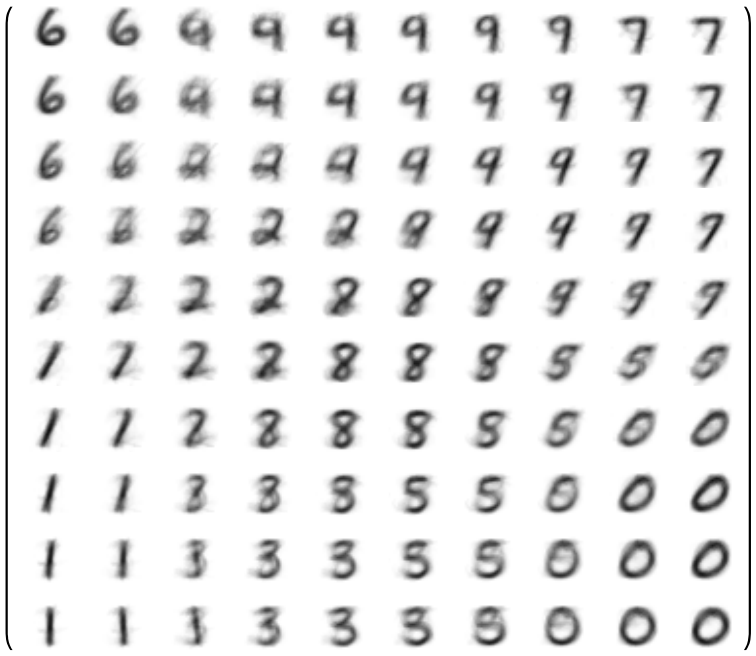
Iteration 2000 x batch 200



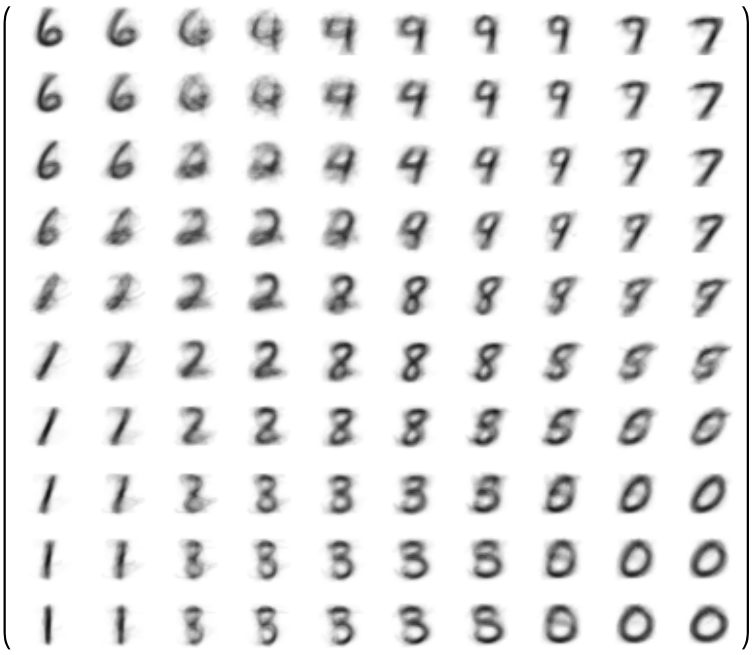
Iteration 10000 x batch 200



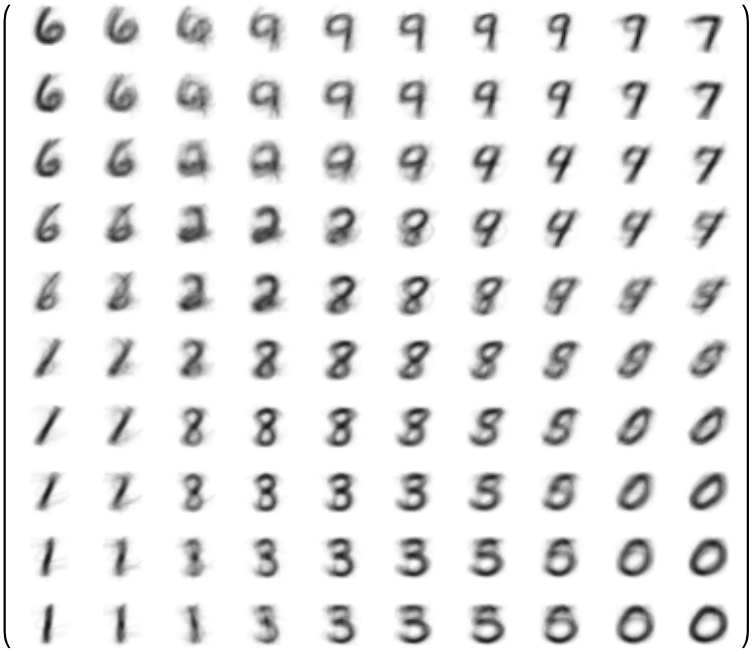
Iteration 20000 x batch 200



Iteration 50000 x batch 200



Iteration 100000 x batch 200



In[67]:=
```
Manipulate[
 ((Total[bests = Table[{w[[3]], Exp[-Min[
                  0.5 * Power[Norm[{i, j} - {w[[1]], w[[2]]}, 2], 2], 200]]}, {w, weights}];
     bests * bests[[ ;; , 2]] / Total[bests[[ ;; , 2]]][[1]]) //
   ArrayReshape[#, {28, 28}] &) // Image

 , {i, 0, 10}, {j, 0, 10}]
```

Out[67]=