

Ziffernerkennung

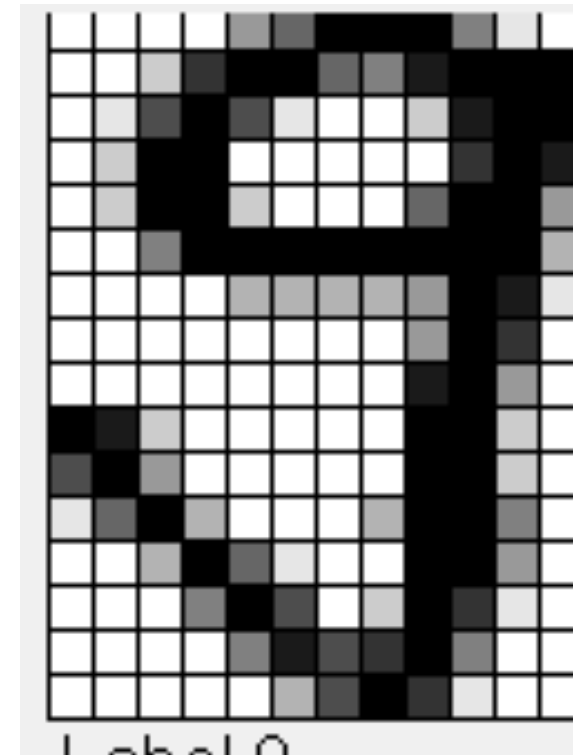
Daten



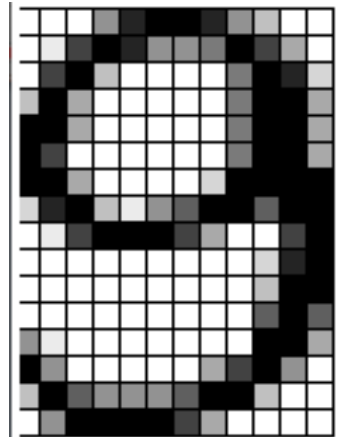
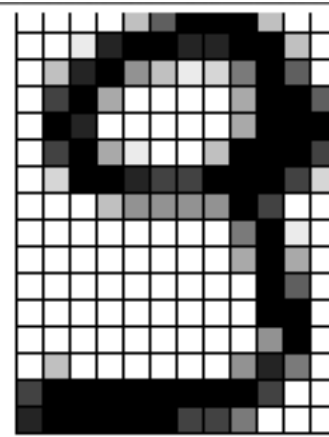
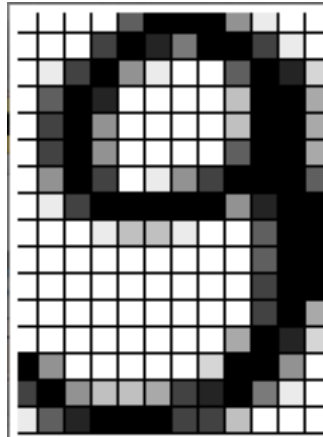
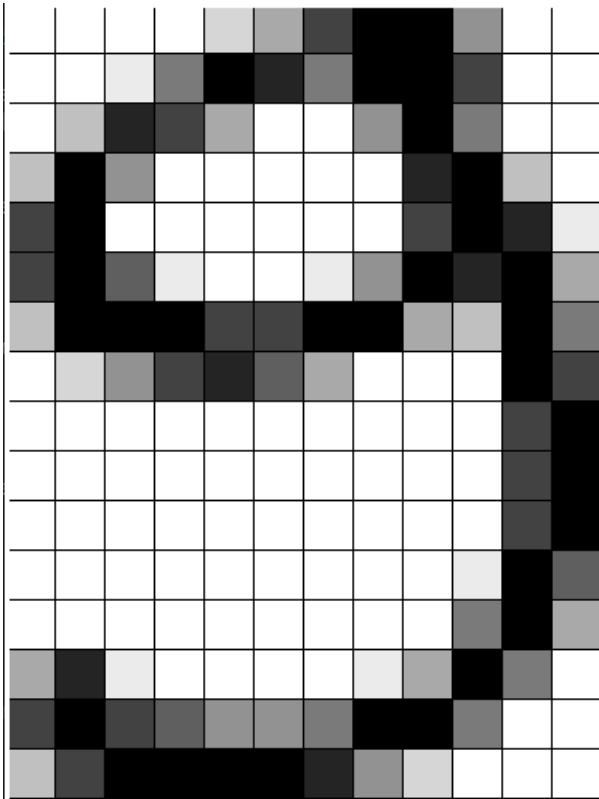
Methode 1: Nächste Nachbarn

- Um aus Bildern Punkte zu machen schreiben wir sie pixelweise hintereinander

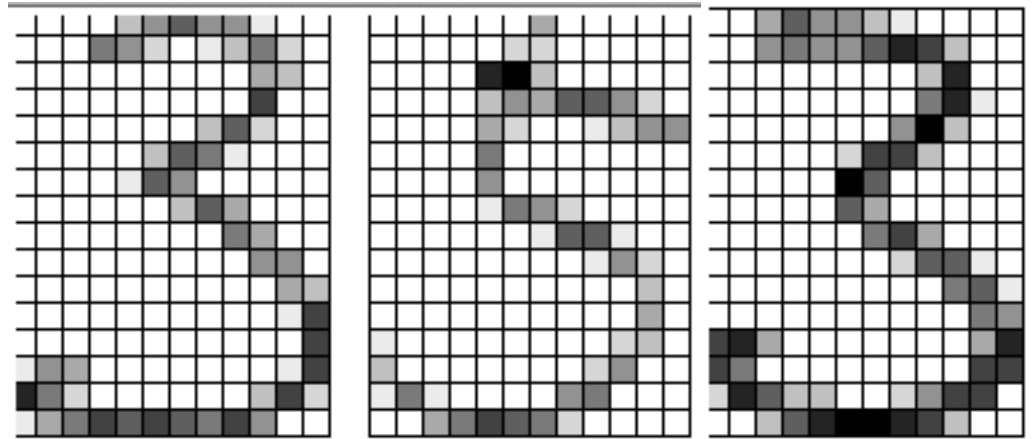
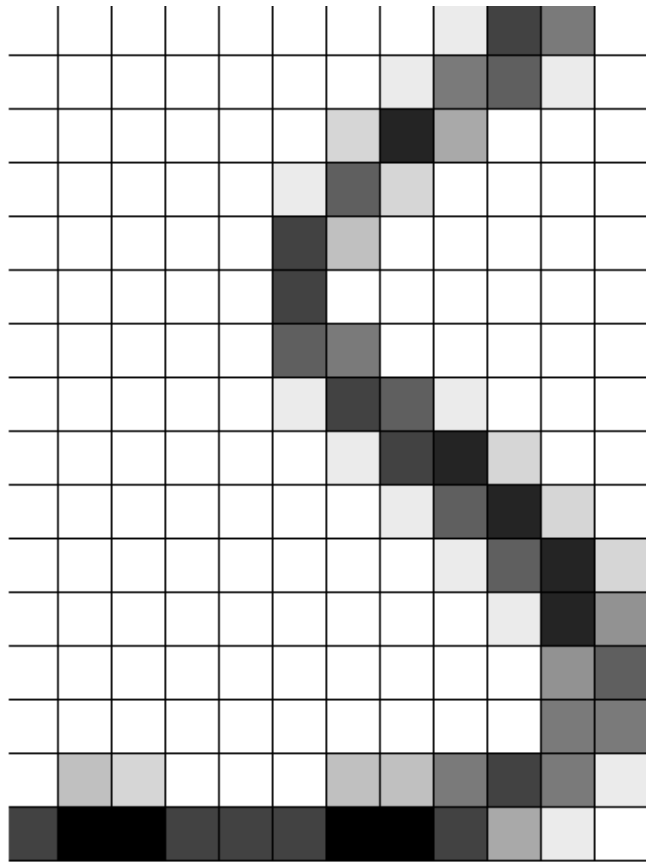
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0.0 0.0 0.0 0.2 0.3 0.4 0.8 1.0 1.0 0.7 0.3 0.1
0.0 0.5 0.8 0.9 1.0 1.0 1.0 1.0 1.0 1.0 1.0 0.5
0.3 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 0.9
0.3 1.0 1.0 1.0 1.0 1.0 0.8 1.0 1.0 1.0 1.0 0.8
0.3 1.0 1.0 1.0 1.0 0.8 0.1 0.9 1.0 1.0 0.8 0.2
0.0 0.7 1.0 1.0 1.0 0.8 0.8 1.0 1.0 1.0 0.4 0.0
0.0 0.2 1.0 1.0 1.0 1.0 1.0 1.0 0.9 0.3 0.0 0.0
0.0 0.1 0.7 1.0 1.0 1.0 1.0 0.8 0.1 0.0 0.0 0.0
0.0 0.6 1.0 1.0 1.0 1.0 0.9 0.1 0.0 0.0 0.0 0.0
0.6 1.0 1.0 1.0 1.0 1.0 1.0 0.3 0.0 0.0 0.0 0.0
0.8 1.0 1.0 0.5 0.1 0.7 1.0 0.8 0.2 0.0 0.0 0.0
0.5 1.0 1.0 0.3 0.0 0.0 0.9 1.0 0.9 0.1 0.0 0.0
0.4 1.0 1.0 0.3 0.0 0.0 0.5 1.0 1.0 0.5 0.0 0.0
0.0 0.4 1.0 1.0 0.5 0.3 0.5 1.0 1.0 1.0 0.2 0.0
0.0 0.0 0.5 1.0 1.0 1.0 1.0 1.0 1.0 0.8 0.1 0.0
0.0 0.0 0.0 0.2 0.5 0.7 1.0 1.0 0.9 0.3 0.0 0.0
```



Beispiele

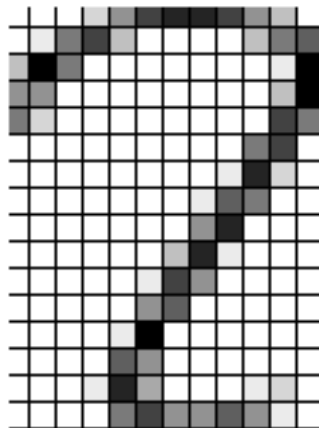
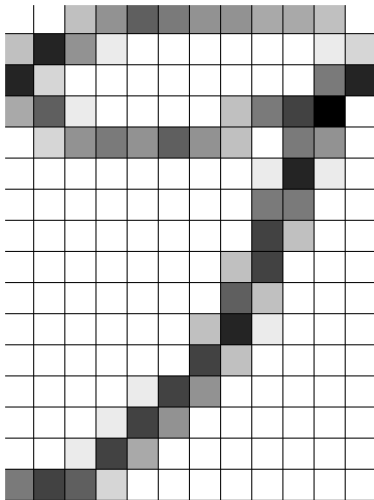


Beispiele

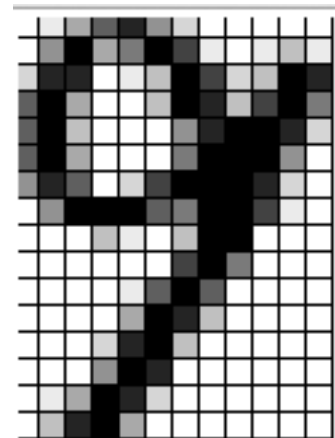


“Nähe”

- Es gibt verschiedene Arten “nah” zu definieren
- Für zwei Punkte x, y zum Beispiel:
 - Die Länge des Weges zwischen x und y
 - Der Winkel zwischen den Punkten

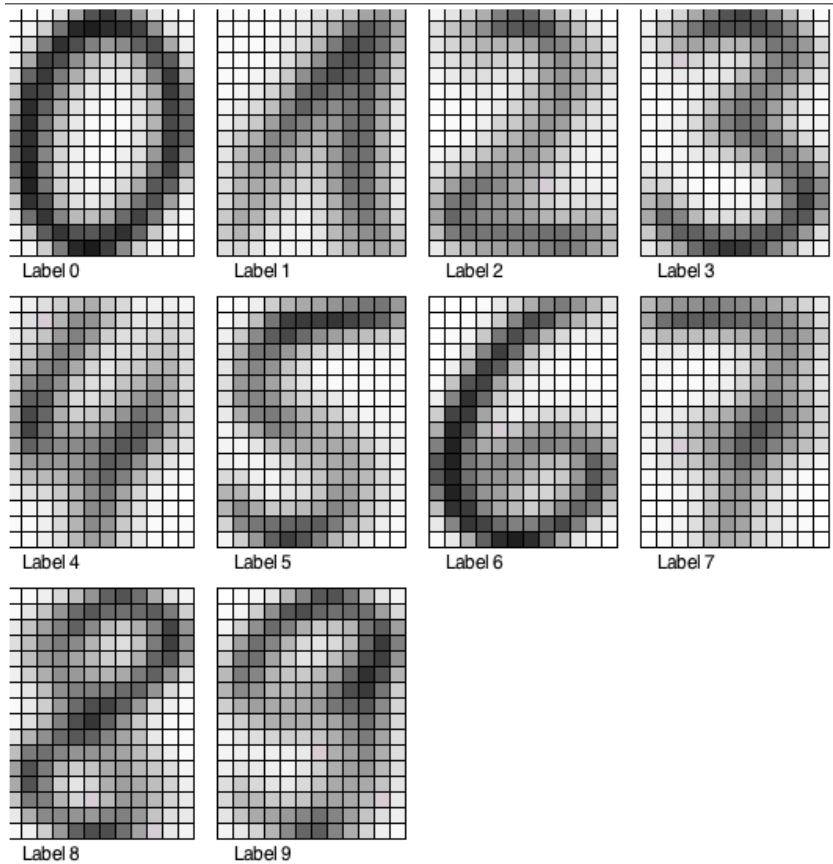


Weglänge

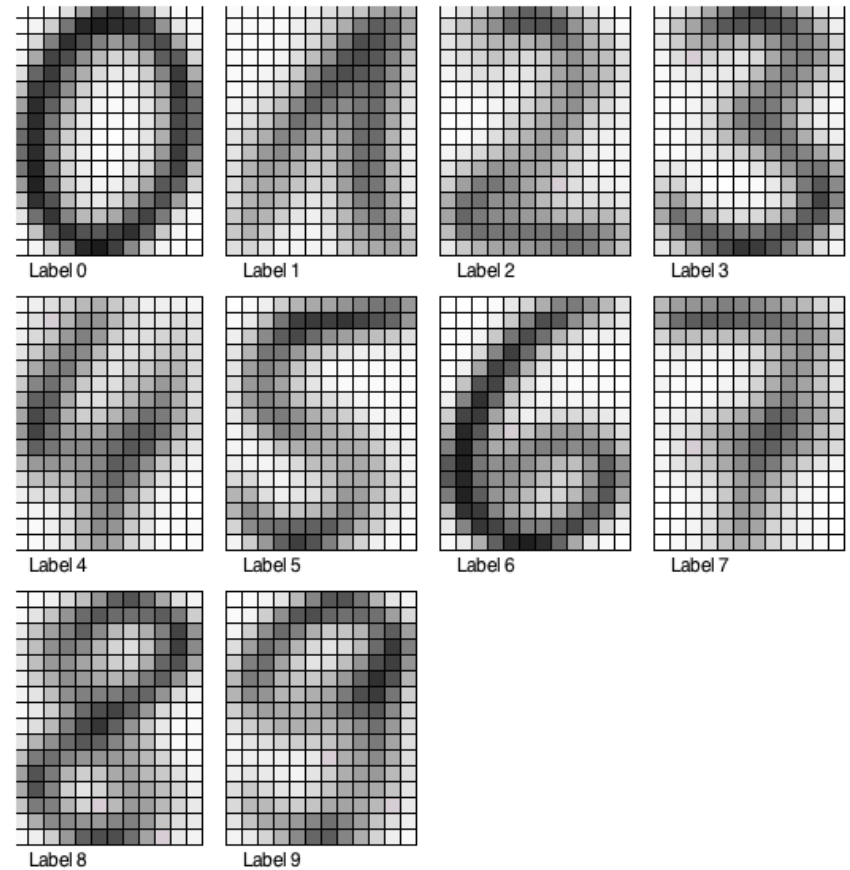


Winkel

Methode 2: Zentren ausrechnen

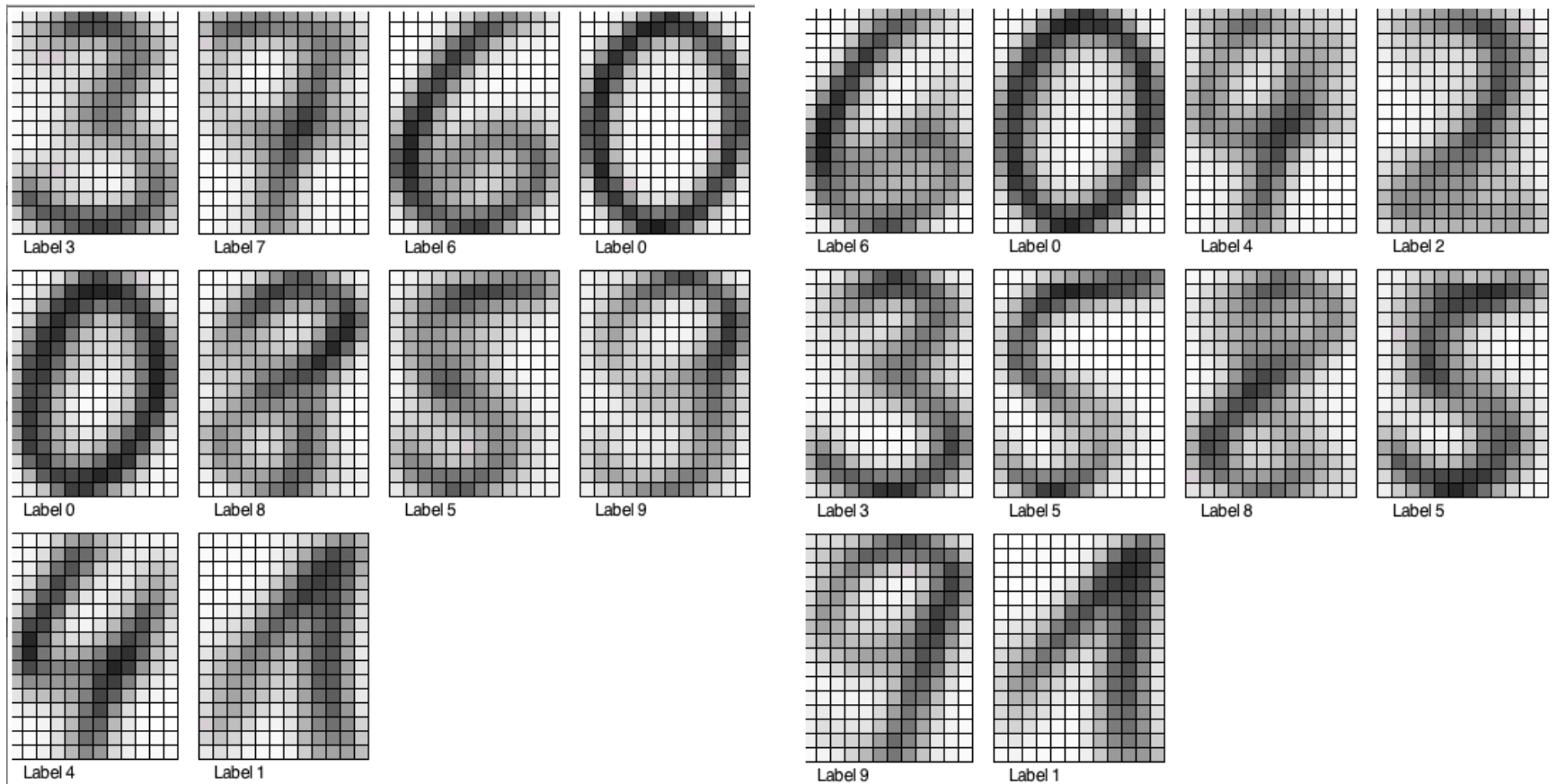


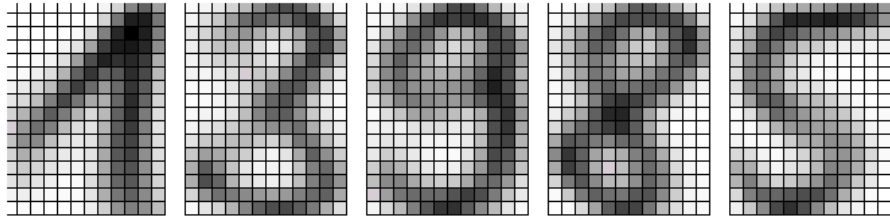
Weglänge



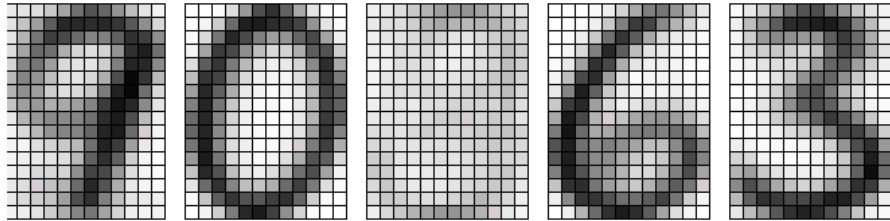
Winkel

Methode 3: k-Means

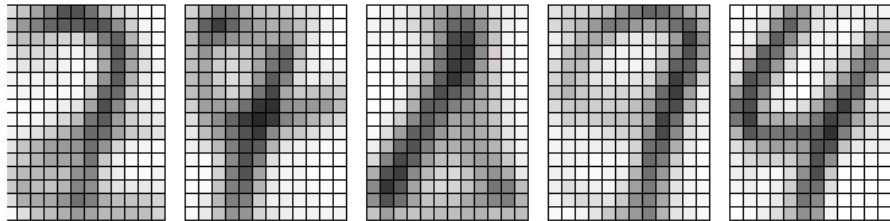




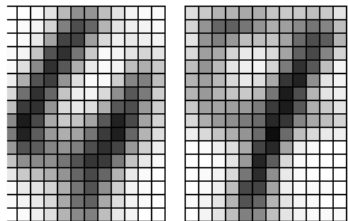
Label 1 Label 3 Label 9 Label 8 Label 5



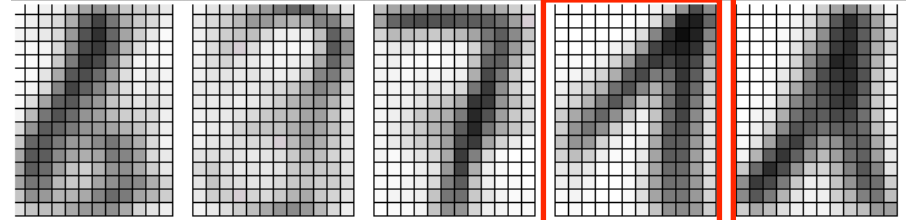
Label 9 Label 0 Label 3 Label 6 Label 3



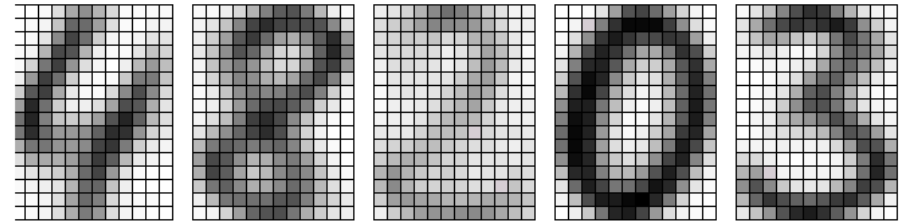
Label 2 Label 7 Label 1 Label 9 Label 4



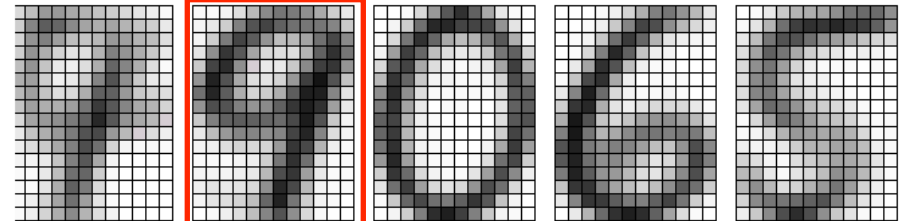
Label 4 Label 7



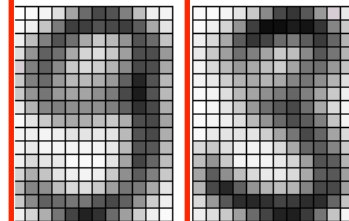
Label 1 Label 9 Label 7 Label 1 Label 1



Label 4 Label 8 Label 2 Label 0 Label 3



Label 7 Label 9 Label 0 Label 6 Label 5



Label 9 Label 3

Ergebnisse

Methode	Genauigkeit	
Nächster Nachbar	93.47% (Länge)	93.97% (Winkel)
3-Nächste Nachbarn	94.97%;	92.96%
9-Nächste Nachbarn	92.46%;	92.47%
Nächste Nachbarn (clever) Belongie et al. 2002		99.37%
Zentren ausrechnen	85.43%	89.45%
17-Means	65-80%	65-85%
Beste Methode Ciresan et al. 2012		99.78%