Zwischenergebnisse

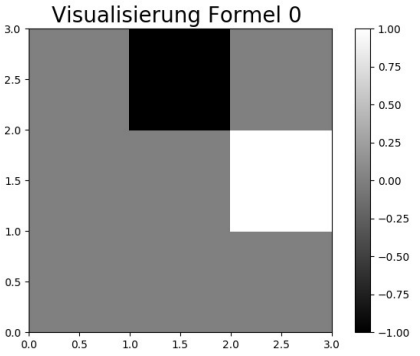
Funktionsweise SLS

Input

	0	1	2	3	4	5	6	7	8
0	1	1	1	0	1	1	1	1	0
1	0	1	1	0	1	0	1	1	0
2	0	0	1	0	1	0	0	1	0
3	1	1	0	1	1	1	1	1	0
4	1	0	0	0	0	1	0	0	0
5	0	0	0	0	0	0	0	0	0
6	1	0	1	0	0	0	0	0	1
7	1	0	0	0	0	0	0	0	0
8	1	0	1	0	0	0	0	0	1
9	0	0	1	0	1	1	0	0	0
10	1	1	1	0	1	1	1	1	0
11	0	1	1	0	1	0	1	1	0
12	0	0	1	0	1	0	0	1	0
13	1	1	0	1	1	1	1	1	0
14	1	0	0	0	0	1	0	0	0
15	0	0	0	0	0	0	0	0	0
16	1	0	1	0	0	0	0	0	1
17	1	0	0	0	0	0	0	0	0
18	1	0	1	0	0	0	0	0	1
19	0	0	1	0	1	1	0	0	0
20	1	1	1	0	1	1	1	1	0
21	0	1	1	0	1	0	1	1	0
22	0	0	1	0	1	0	0	1	0
23	1	1	0	1	1	1	1	1	0
24	1	0	0	0	0	1	0	0	0
25	0	0	0	0	0	0	0	0	0
26	1	0	1	0	0	0	0	0	1

Label

```
[0,
 0,
 0,
 0,
 1,
 0,
 1,
 0,
 1,
 1,
 0,
 0,
 0,
 0,
 1,
 0,
 1,
 0,
 1,
 1,
 0,
 0,
 0,
 0,
 1,
 0,
 1,
```



Pixel 0 links unten.
Weißer Pixel: Wert muss True sein.
Schwarz Wert: Ert muss False sein, damit Formel zu True auswertet

DNF found for test_sls_algorithm_1()

($0 \wedge 1 \wedge 2 \wedge 3 \wedge 4 \wedge 1_5 \wedge 6 \wedge -1_7 \wedge 8 \wedge 9 \wedge 10 \wedge 11 \wedge 12 \wedge 13 \wedge 14 \wedge 15$) $\vee$

($0 \wedge 1 \wedge 1_2 \wedge 3 \wedge 4 \wedge 5 \wedge 6 \wedge -1_7 \wedge 8 \wedge 9 \wedge 10 \wedge 11 \wedge 12 \wedge 13 \wedge 14 \wedge 15$)

Verwendung von Dither-Bilder

Schwarz/Weiß Bild mit gelernten Layer

Schwarz/Weiß Bild mit Dither-verfahren

Verwendung von Ripper statt SLS

- Versuch mit WEKA
  - Problem Java-Bridge funktioniert nur mit JVM 8
- Versuch mit https://github.com/imoscovitz/wittgenstein

  - Auf kleinen Datensatz gleiches Ergebnis wie SLS, auf Fasion-Mnist auf den ersten Blick nicht sinnvoller

Problem der Visualisierung

- Jede Disjunktion ein Bild

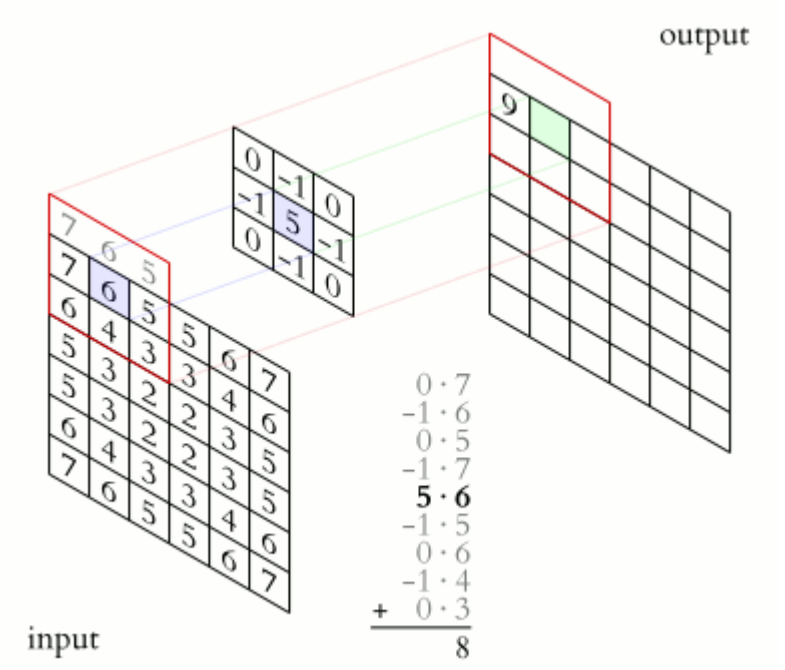
  => SLS liefert am besten DNF mit nur einer Disjunktion

  Problem 1: SLS muss stark abstrahieren

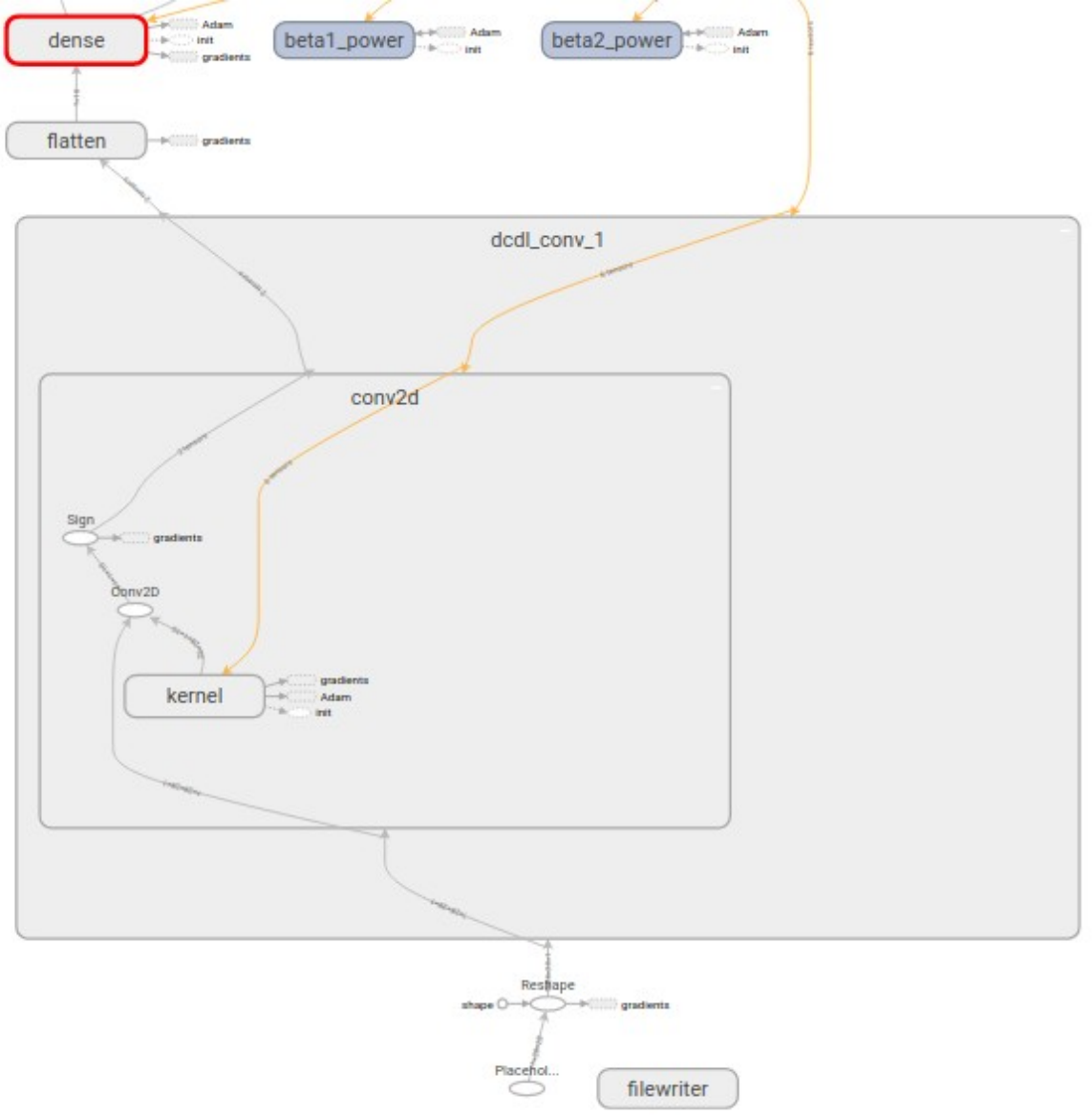
  Problem 2: DNF-Formel <=> Berechnung der Convolution
  - sehr unterschiedliche Operationen

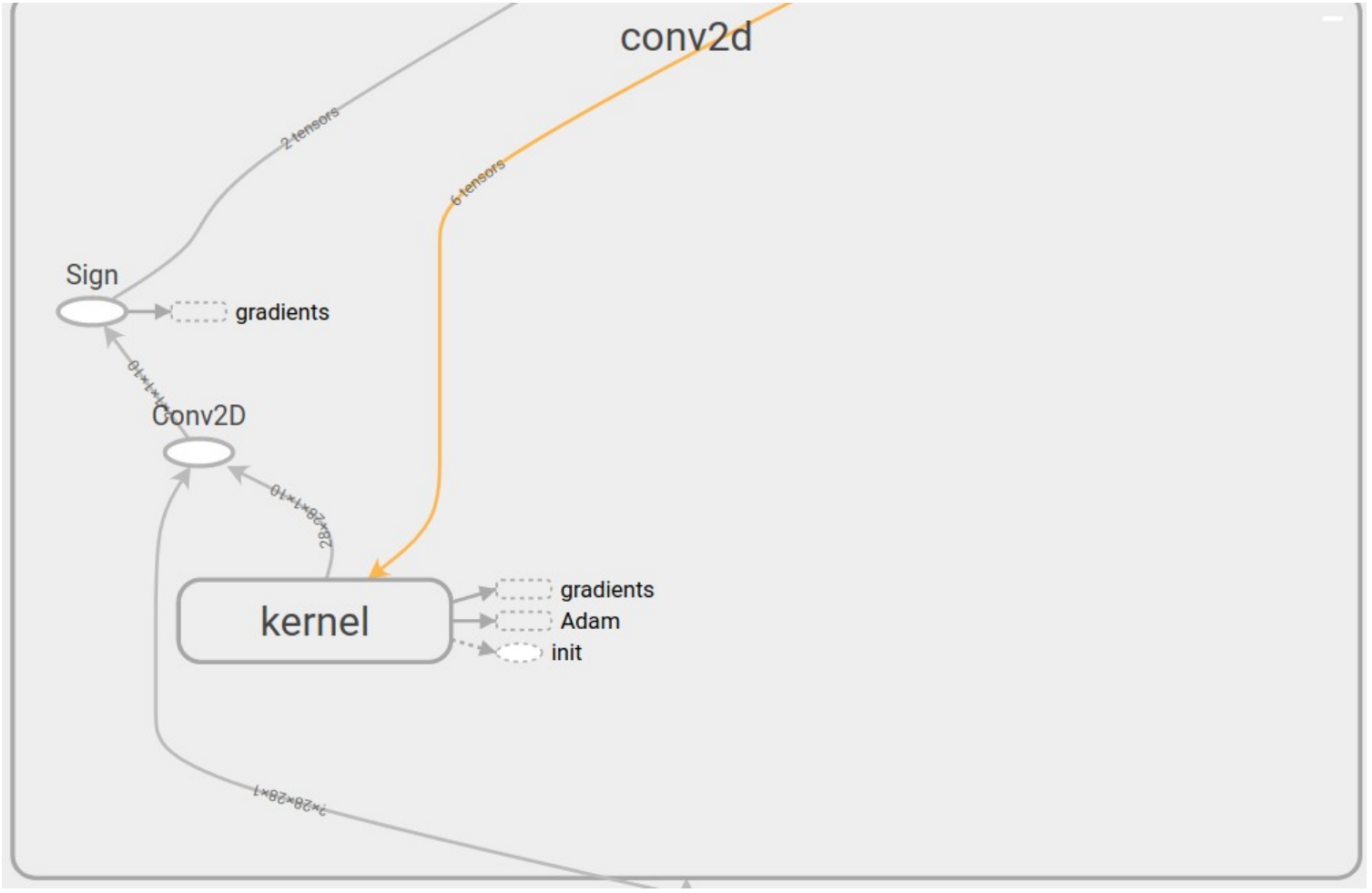
  Logische Formel <=> Skalarprodukt mir reellen Zahlen als Resultat

Beispiel Convolution

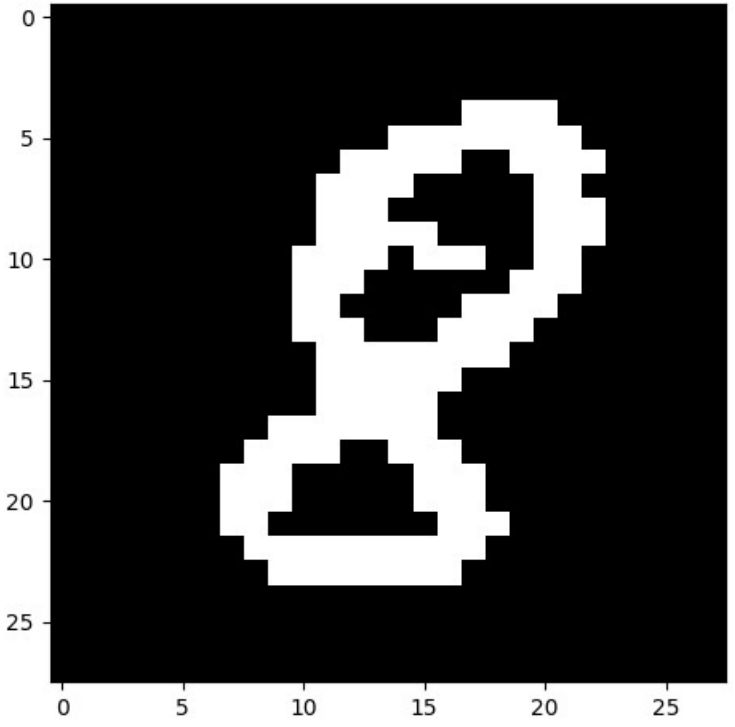


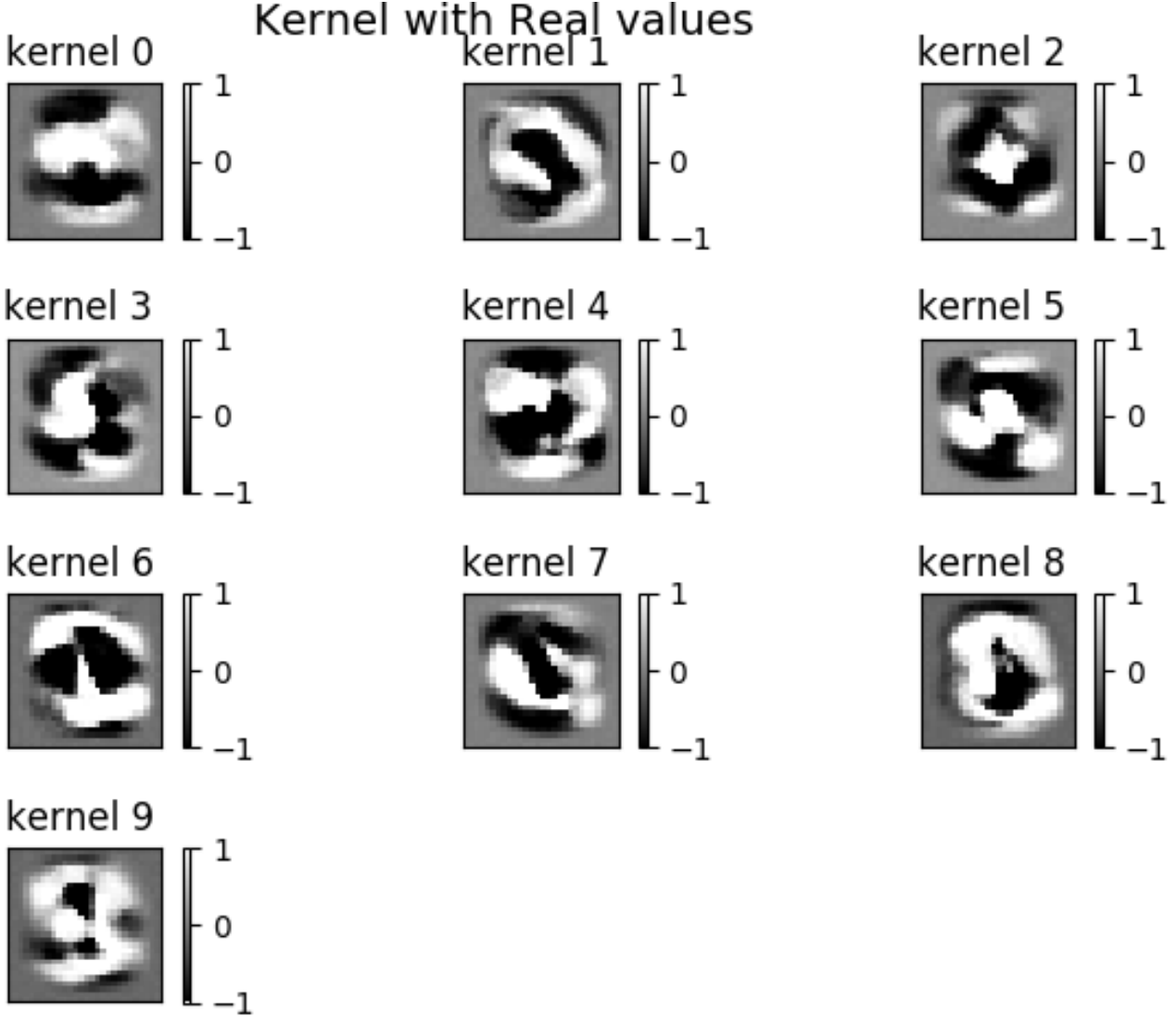
Struktur des verwendeten Netzes

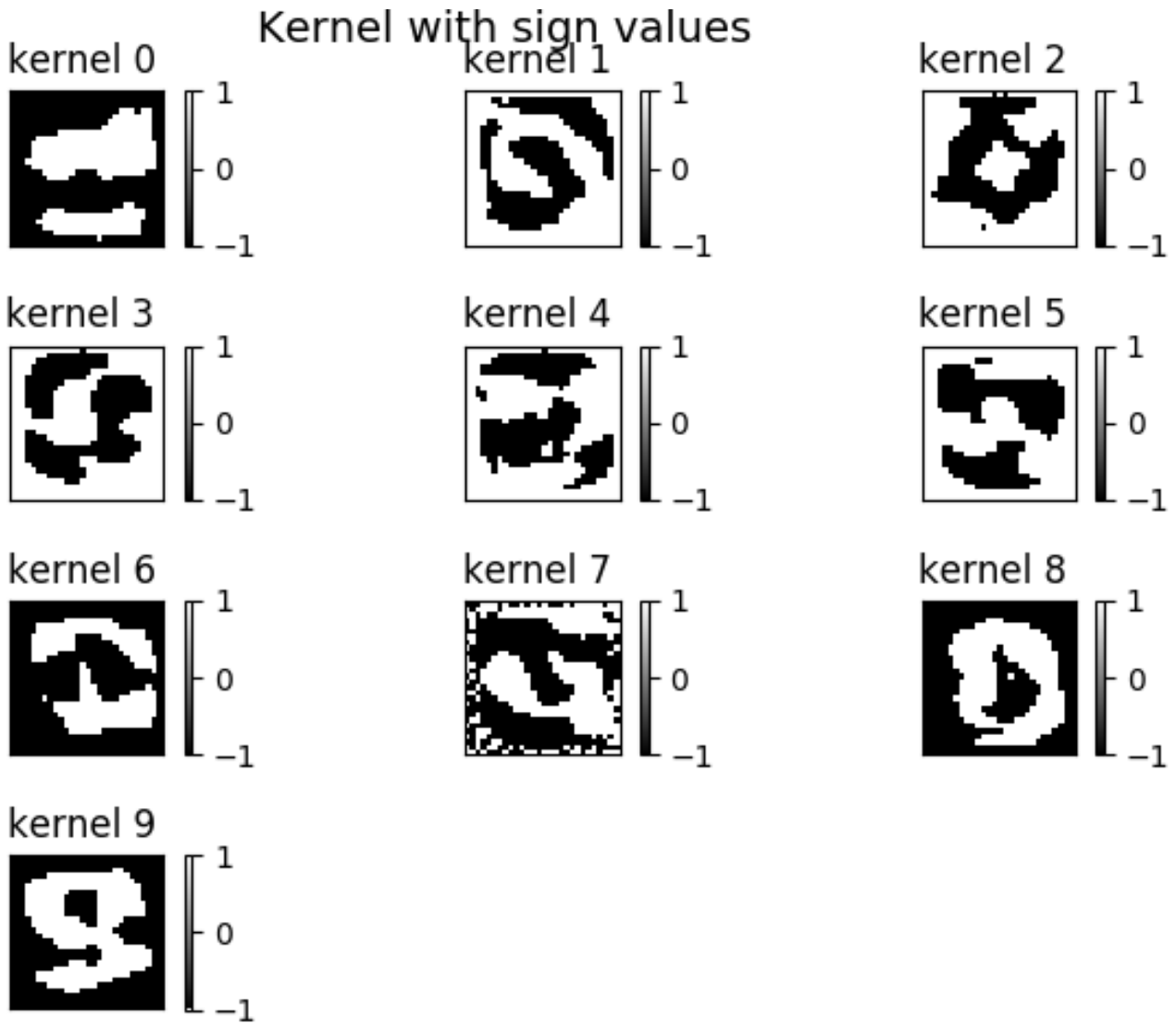



conv2d
2 tensors
6 tensors
Sign
gradients
Conv2D
kernel
gradients
Adam
init

Dataset Mnist



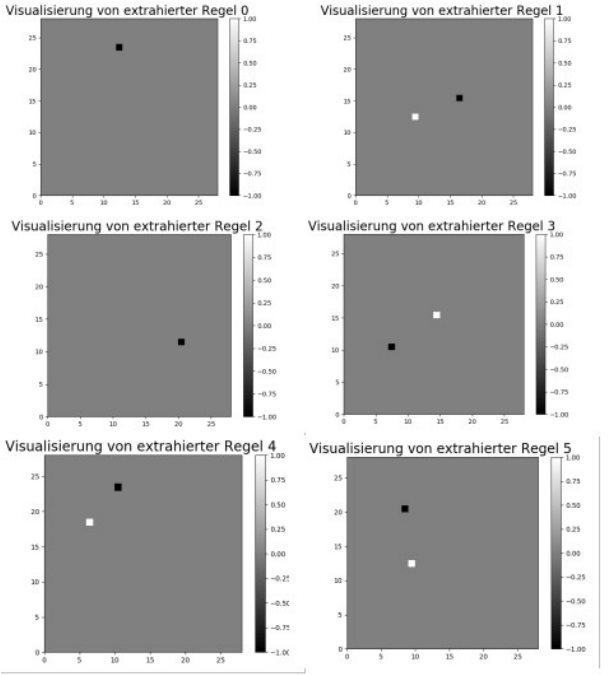

Kernel with Real values
kernel 0
kernel 1
kernel 2
kernel 3
kernel 4
kernel 5
kernel 6
kernel 7
kernel 8
kernel 9
1
0
−1


Kernel with sign values
kernel 0
kernel 1
kernel 2
kernel 3
kernel 4
kernel 5
kernel 6
kernel 7
kernel 8
kernel 9
1
0
−1

SLS gelernt mit Convolution daten

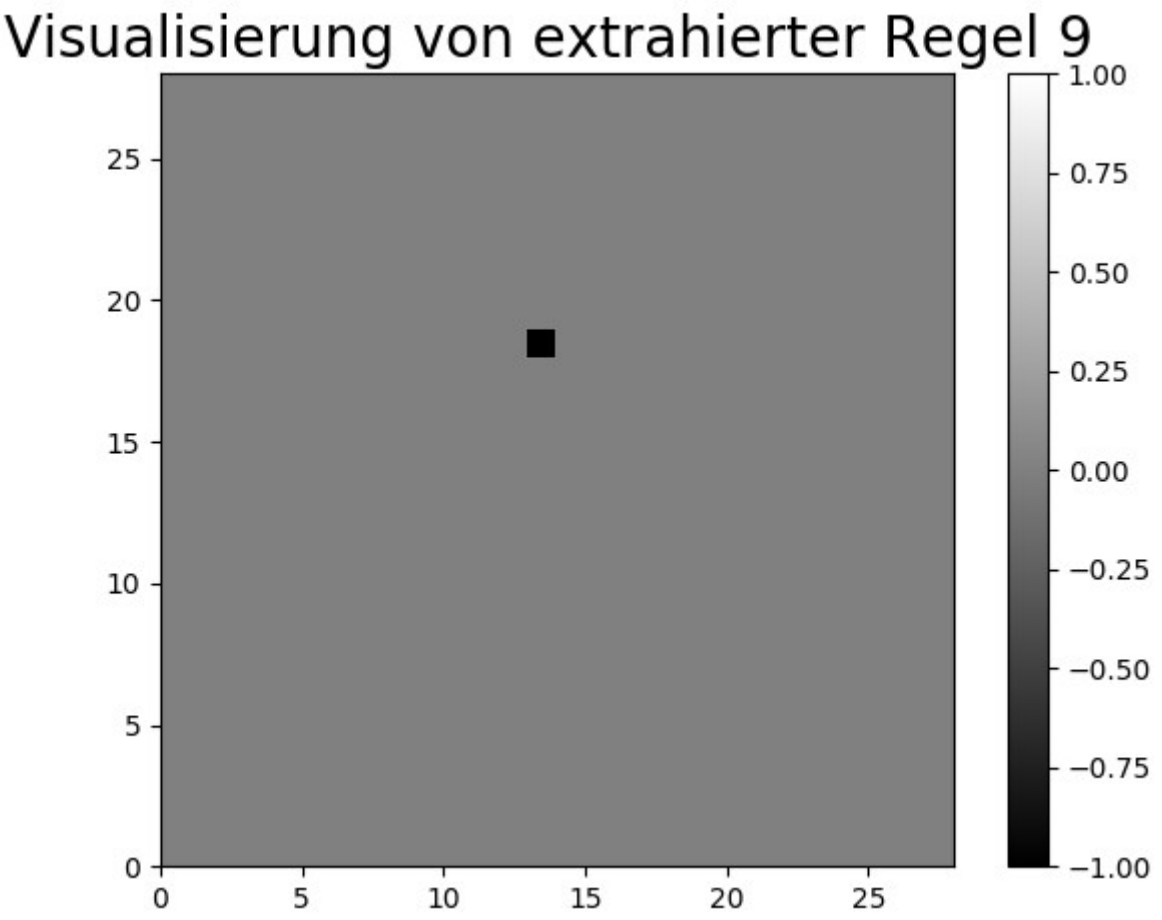
- 10000 Bilder Input
- Eine Disjunktion pro Kernel
- `Maximum_Steps_in_SKS = 10 000`

Kernel	False Negativ	False Posetiv	Total
0	1029	1948	2977
1	1542	504	2046
2	678	1890	2568
3	1450	1554	3004
4	1678	289	1967
5	1859	915	2774



Durchschnittlich 2215,41 Fehler

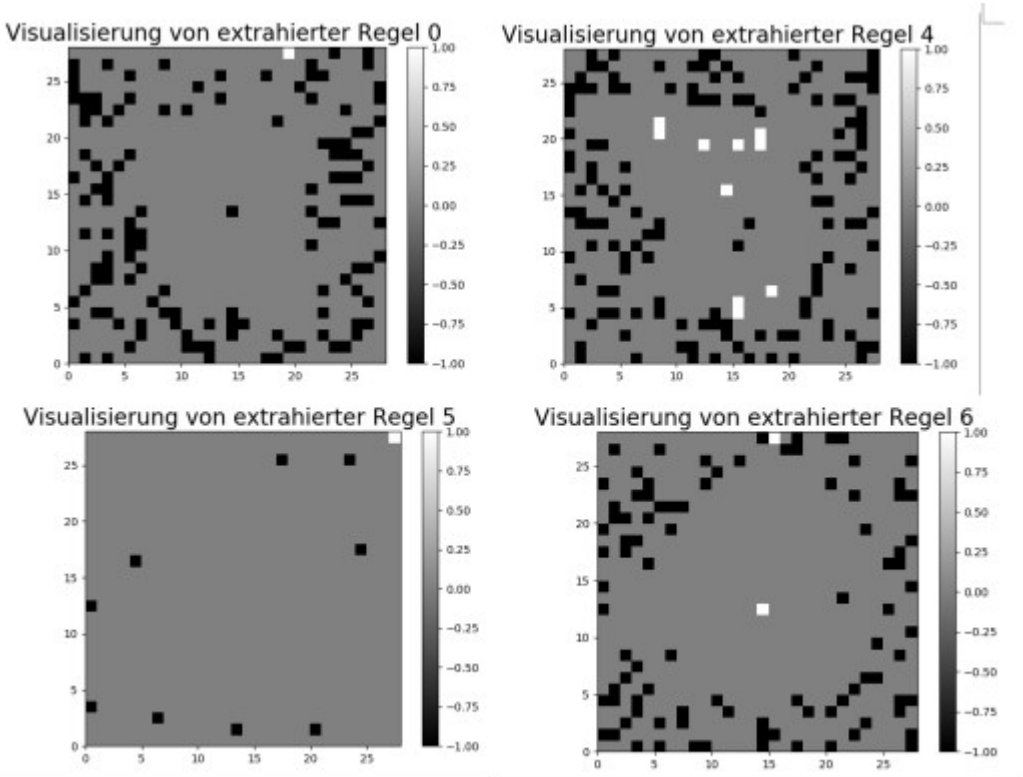
- Extration
- Ruleextraction for Kernel 0
- step: 10000 Min Score 2977 Wrongly classified as negative 1029 Wrongly classified as positive 1948
- # elapsed time (MULTI_CORE_SLS): 15.7772s
- #Bits set in total 1
- Ruleextraction for Kernel 1
- step: 10000 Min Score 2046 Wrongly classified as negative 1542 Wrongly classified as positive 504
- # elapsed time (MULTI_CORE_SLS): 13.0996s
- #Bits set in total 2
- Ruleextraction for Kernel 2
- step: 10000 Min Score 2568 Wrongly classified as negative 678 Wrongly classified as positive 1890
- # elapsed time (MULTI_CORE_SLS): 13.5637s
- #Bits set in total 1
- Ruleextraction for Kernel 3
- step: 10000 Min Score 3004 Wrongly classified as negative 1450 Wrongly classified as positive 1554
- # elapsed time (MULTI_CORE_SLS): 19.3584s
- #Bits set in total 2
- Ruleextraction for Kernel 4
- step: 10000 Min Score 1967 Wrongly classified as negative 1678 Wrongly classified as positive 289
- # elapsed time (MULTI_CORE_SLS): 25.1421s
- #Bits set in total 2
- Ruleextraction for Kernel 5
- step: 10000 Min Score 2774 Wrongly classified as negative 1859 Wrongly classified as positive 915
- # elapsed time (MULTI_CORE_SLS): 20.4178s
- #Bits set in total 2
- Ruleextraction for Kernel 6
- step: 10000 Min Score 2401 Wrongly classified as negative 1180 Wrongly classified as positive 1221
- # elapsed time (MULTI_CORE_SLS): 18.4416s
- #Bits set in total 1
- Ruleextraction for Kernel 7
- step: 10000 Min Score 2607 Wrongly classified as negative 1544 Wrongly classified as positive 1063
- # elapsed time (MULTI_CORE_SLS): 22.8768s
- #Bits set in total 1
- Ruleextraction for Kernel 8
- step: 10000 Min Score 3272 Wrongly classified as negative 2576 Wrongly classified as positive 696
- # elapsed time (MULTI_CORE_SLS): 25.4242s
- #Bits set in total 1
- Ruleextraction for Kernel 9
- step: 10000 Min Score 3263 Wrongly classified as negative 1477 Wrongly classified as positive 1786
- # elapsed time (MULTI_CORE_SLS): 20.7573s
- #Bits set in total 1



SLS gelernt mit Convolution daten

- 10000 Bilder Input
- 150 Disjunktionen pro Kernel
- `Maximum_Steps_in_SKS = 10 000`

Kernel	False Negativ	false posetiv	Total
0	871	2087	2958
1	1276	515	1791
2	937	1438	2375
3	1411	922	2333
4	1121	583	1704
5	1705	390	2095



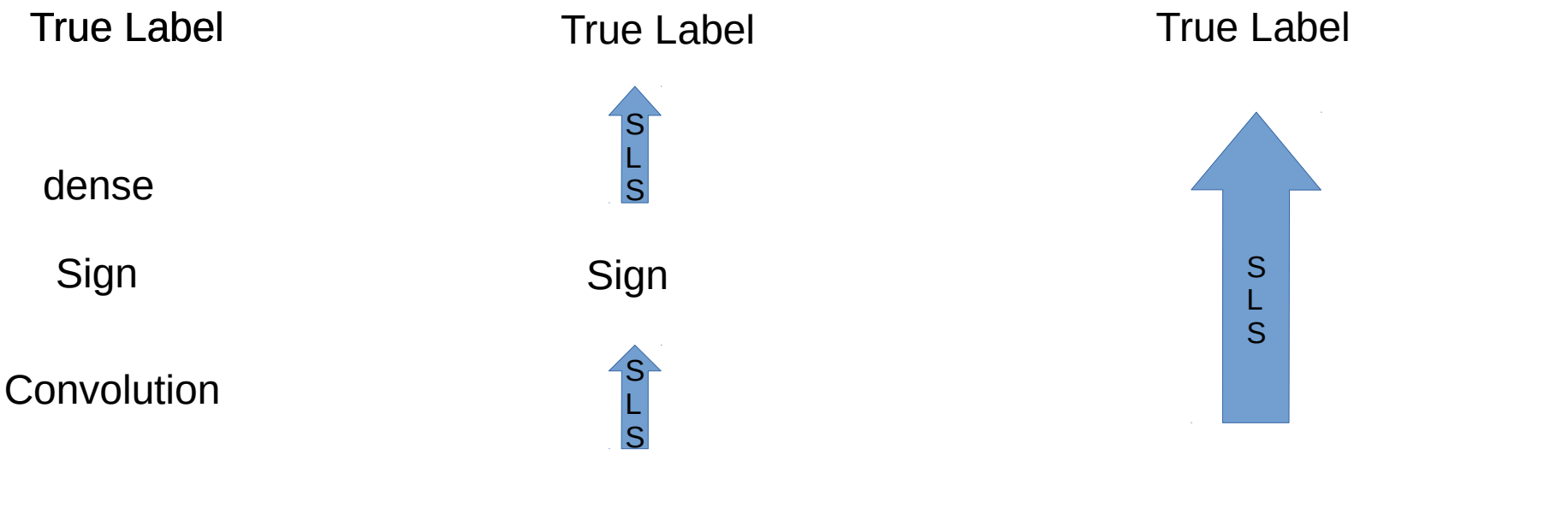
Durchschnittlich 2209,3 Fehler

SLS gelernt mit Convolution daten

- 10000 Bilder Input
- 150 Disjunktionen pro Kernel
- `Maximum_Steps_in_SKS = 100 000`

Kernel	False Negativ	false posetiv	Total
0	1116	1575	2691
1	1205	380	1585
2			
3	Läuft noch		
4			
5			

One against all - Vergleich accuracy



Ausblick

- Komplexere Datensätze
  - Fasion Mnist
  - Cifar
- Vereinfacung der DNFS
  - Quine Mc Clusekey-Verfahren
- Convolution mit boolscher Algebra

Weiterbeschäftigung über den 31.03 hinaus

Masterarbeit Neuseeland

- Thema?
- Wann?
- 31.03 ist Deadline für Promos 2 Jahreshälfte 2020
- Benötige eine Zeitplan