**(Für unseren Fall macht nur MAX-Pooling Sinn)  
(Die Laufzeiten sind irgendwie zufällig und ergeben wenig Sinn!)  
(Es macht Sinn dass die Ergebnisse immer leicht unterschiedlich sind da jedes Mal unterschiedliche Trainingsdaten und Testdaten verwendet werden)**

**Ein Conv./Pooling layer (3x3)(2x2)**  
Ein Bild, das Text, Screenshot, Schrift enthält.

Automatisch generierte Beschreibung

|  |  |
| --- | --- |
| Normal | 98.69% |
| Shifted | 93.69% |
| Rotated | 96.29% |
| Shifted and rotated | 82.26% |
| Time | 6.96 min / 7.87 min |

**Ein Conv./Pooling layer (2x2) (2x2)**  
Ein Bild, das Text, Screenshot, Schrift enthält.

Automatisch generierte Beschreibung

|  |  |
| --- | --- |
| Normal | 98.33% |
| Shifted | 92.71% |
| Rotated | 95.50% |
| Shifted and rotated | 77.28% |

**Ein Conv./Pooling layer (3x3) (3x3)**  
Ein Bild, das Text, Screenshot, Schrift enthält.

Automatisch generierte Beschreibung

|  |  |
| --- | --- |
| Normal | 98.74% |
| Shifted | 94.18% |
| Rotated | 95.81% |
| Shifted and rotated | 81.09% |
| Time | 5.47 min |

**Ein Conv./Pooling layer (4x4) (4x4)**

|  |  |
| --- | --- |
| Normal | 98.77% |
| Shifted | 95.13% |
| Rotated | 96.85% |
| Shifted and rotated | 84.02% |
| Time | 4.96 min |

**Ein Conv./Pooling** layer **(4x4) (2x2)**

|  |  |
| --- | --- |
| Normal | 98.78% |
| Shifted | 95.05% |
| Rotated | 96.49% |
| Shifted and rotated | 84.00% |
| Time | 7.32 min |

* Kaum Unterschied zum vorherigen Test

**Ein Conv./Pooling layer (2x2) (4x4)**

|  |  |
| --- | --- |
| Normal | 98.05% |
| Shifted | 91.59% |
| Rotated | 94.74% |
| Shifted and rotated | 75.10% |

**1x(5x5)**

|  |  |
| --- | --- |
| Normal | 98.75% |
| Shifted | 92.56% |
| Rotated | 96.29% |
| Shifted and rotated | 79.77% |
| Time | 4.32 min |

**Fazit:**Das erhöhen der Filtergrößen bringt eine Verbesserung der Genauigkeit des Netzwerkes mit sich. Die Vergrößerung des Konvolution Filters hat dabei einen Größeren Einfluss.  
Der Sprung auf 4x4 bringt vor allem eine Verbesserung der Ergebnisse im Hinblick auf das „Shifted&Rotated“ Dataset mit sich.  
(Ergebnisse variieren von Run to Run!!!)  
(Die Testzeiten sind sehr Radom, daher eignen sie sich nicht zu einer guten Evaluation des Netzwerkes -> Nur auf Genauigkeit Fokussieren)

Das (4x4) (4x4) Netzwerk ist am besten

**Ein zweites Pooling/Convolution Layer direkt hinter der ersten**

**Ein Bild, das Text, Screenshot, Schrift enthält.

Automatisch generierte Beschreibung**Das zweite Layer hat (4x4) Conv. und (2x2) Pooling da 2x(4x4) nicht möglich ist

**Test mit (4x4,2x4)(4x4,4x2) linear**

|  |  |
| --- | --- |
| Normal | 98.24% |
| Shifted | 88.00% |
| Rotated | 94.19% |
| Shifted and rotated | 72.99% |
| Time | 5.56 min |

**Test mit (2x2) (2x2)**

|  |  |
| --- | --- |
| Normal | 98.63% |
| Shifted | 90.04% |
| Rotated | 94.97% |
| Shifted and rotated | 71.97% |
| Time | 5.52 min |

**Extra tests: 2x(3x3,2x2)(Nur vor der ersten Dense Schicht) linear**

|  |  |
| --- | --- |
| Normal | 98.89% |
| Shifted | 93.45% |
| Rotated | 94.98% |
| Shifted and rotated | 77.97% |
| Time | 6.87 min |

**Eine zweite Conv./Pooling Schicht zwischen den Dense-Layern**

**Test mit 2x(2x2)**

|  |  |
| --- | --- |
| Normal | 98.63% |
| Shifted | 95.87% |
| Rotated | 97.41% |
| Shifted and rotated | 85.57% |
| Time | 8.54 min |

**Extra tests: 2x(4x4,4x4) (erster Test mit zweiter Schicht zwischen den Schichten) linear**

|  |  |
| --- | --- |
| Normal | 98.73% |
| Shifted | 94.90% |
| Rotated | 96.98% |
| Shifted and rotated | 87.46% |
| Time | 11.23 min |

**Extra tests: 2x(3x3,2x2) (erster Test mit zweiter Schicht zwischen den Schichten) linear**

|  |  |
| --- | --- |
| Normal | 98.44% |
| Shifted | 96.03% |
| Rotated | 96.31% |
| Shifted and rotated | 85.25% |
| Time | 14.57 min |

**Extra tests: 2x(4x4,2x2) (erster Test mit zweiter Schicht zwischen den Schichten) linear**

|  |  |
| --- | --- |
| Normal | 98.68% |
| Shifted | 95.30% |
| Rotated | 96.42% |
| Shifted and rotated | 85.20% |
| Time | 12.69 min |

**Eine dritte Pooling/Convolution Schicht mit extra Dense-Layer**

**Ein Bild, das Text, Screenshot enthält.

Automatisch generierte Beschreibung**

|  |  |
| --- | --- |
| Normal | 98.40% |
| Shifted | 95.50% |
| Rotated | 95.93% |
| Shifted and rotated | 84.15% |
| Time | 19.02 min |

* **Not much improvements in the results**

**Drei am Anfang**

|  |  |
| --- | --- |
| Normal |  |
| Shifted |  |
| Rotated |  |
| Shifted and rotated |  |
| Time |  |

**Eine dritte Pooling/Convolution Schicht mit zwei am Anfang und einer zwischen den Dense layern**

**Extra tests: 3x(3x3,2x2) linear**

|  |  |
| --- | --- |
| Normal | 98.90% |
| Shifted | 95.49% |
| Rotated | 97.37% |
| Shifted and rotated | 87.38% |
| Time | 14.55 min |

**Extra tests: (4x4,4x4)(4x4,2x2) (4x4,4x4) linear**

|  |  |
| --- | --- |
| Normal | 98.04% |
| Shifted | 90.87% |
| Rotated | 95.51% |
| Shifted and rotated | 77.65% |
| Time | 10.40 min |

**Extra tests: 2x(3x3,2x2) (4x4,4x4) linear**

|  |  |
| --- | --- |
| Normal | 98.88% |
| Shifted | 94.06% |
| Rotated | 97.38% |
| Shifted and rotated | 87.17% |
| Time | 13.98 min |

**Auspobieren mit 64 Filtern pro Conv2**

|  |  |
| --- | --- |
| Normal | 99.08% |
| Shifted | 95.51% |
| Rotated | 97.28% |
| Shifted and rotated | 88.11% |
| Time | 36.78 min |

* **Huge increase in computation time!**

**32 nur im ersten Conv2D**

|  |  |
| --- | --- |
| Normal | 98.94% |
| Shifted | 95.99% |
| Rotated | 97.19% |
| Shifted and rotated | 85.16% |
| Time | 22.93 min |

**Dropout Layer einfügen**

**Mit Dropout layer (0.5)**

**Ein Bild, das Text, Screenshot, Schrift, Software enthält.

Automatisch generierte Beschreibung**

|  |  |
| --- | --- |
| Normal | 99.10% |
| Shifted | 96.45% |
| Rotated | 97.10% |
| Shifted and rotated | 86.28% |
| Time | 11.44 min |

* **Sepl does not have 2. Dense layer**

**Without 2. Dense layer**

|  |  |
| --- | --- |
| Normal | 99.22% |
| Shifted | 96.01% |
| Rotated | 97.41% |
| Shifted and rotated | 86.37% |
| Time | 11.14 min |

* **Dense layer was not the difference!!!**

**2 Dropout layers with 0.2 + 3 Filter layerEin Bild, das Text, Screenshot, Schrift enthält.

Automatisch generierte Beschreibung**

|  |  |
| --- | --- |
| Normal | 99.13% |
| Shifted | 96.33% |
| Rotated | 97.03% |
| Shifted and rotated | 88.57% |
| Time | 14.17 min |

* **Changing the third filter layer to 3x3 and 2x2 slightly worsens the results (could also just be fluctuations)**

**Sonstige Tests:**

**Convolutions layers now use ‘elu’ as an activation function (using best model from before)**

|  |  |
| --- | --- |
| Normal | 98.86% |
| Shifted | 95.31% |
| Rotated | 96.50% |
| Shifted and rotated | 86.60% |
| Time | 7.69 min |

* **No significant improvement**

**Convolutions layers now use ‘leaky\_relu’ as an activation function (using best model from before)**

|  |  |
| --- | --- |
| Normal | 98.62% |
| Shifted | 95.63% |
| Rotated | 96.74% |
| Shifted and rotated | 86.32% |
| Time | 8.54 min |

* **No significant improvement**

**2x(4x4),(4x4)(2x2), dense, (4x4)(2x2), dense**

|  |  |
| --- | --- |
| Normal | 98.32% |
| Shifted | 90.77% |
| Rotated | 95.84% |
| Shifted and rotated | 78.35% |
| Time | 9.47 min |

* **No significant improvement**

**Zero Padding**

**(1, 1) Padding before every conv. Layer**

**Ein Bild, das Text, Screenshot, Software, Display enthält.

Automatisch generierte Beschreibung**

|  |  |
| --- | --- |
| Normal | 99.13% |
| Shifted | 97.35% |
| Rotated | 97.79% |
| Shifted and rotated | 91.63% |
| Time | 22.56 min |

* **Much more time but best results for S&R!**
* **But also, more computation time**

**(2, 2) Padding before every conv. Layer**

|  |  |
| --- | --- |
| Normal | 99.42% |
| Shifted | 97.54% |
| Rotated | 97.69% |
| Shifted and rotated | 91.35% |
| Time | 29.52 min |

* **Keine Verbesserung aber deutlich längere Zeit -> (1,1) Padding reicht**

**Ändern der Aktivierungsfunktionen (Rest ist gleich wie beim vorherigen Test)**

**‚softmax‘**

|  |  |
| --- | --- |
| Normal | 11.35% |
| Shifted | 11.35% |
| Rotated | 11.35% |
| Shifted and rotated | 11.35% |
| Time | 23.82 min |

* **So niedrige Ergebnisse können schon durch zufälliges Raten erreicht werden**

**‚linear‘**

|  |  |
| --- | --- |
| Normal | 99.11% |
| Shifted | 97.80% |
| Rotated | 97.58% |
| Shifted and rotated | 92.29% |
| Time | 22.29 min |

* **New best result for S&R!**

**‚leaky\_relu‘**

|  |  |
| --- | --- |
| Normal | 98.90% |
| Shifted | 97.72% |
| Rotated | 97.92% |
| Shifted and rotated | 92.26% |
| Time | 26.30 min |

**‚elu‘**

|  |  |
| --- | --- |
| Normal | 99.00% |
| Shifted | 97.64% |
| Rotated | 97.70% |
| Shifted and rotated | 92.30% |
| Time | 22.97 min |

* **Wir bleiben bei linear, weil es eigentlich keinen Unterschied macht**

**„linear“ mit 4x4,3x3 beim letzten Filter-Layer**

|  |  |
| --- | --- |
| Normal | 98.25% |
| Shifted | 97.65% |
| Rotated | 97.42% |
| Shifted and rotated | 92.11% |
| Time | 18.09 min |