Convolutional Neural Networks

Seminar Klassifikation und Clutering WS22/23

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Gliederung

01 • **CNN-Algorithmus**

02 • **Implementierung& Ergebnisse**

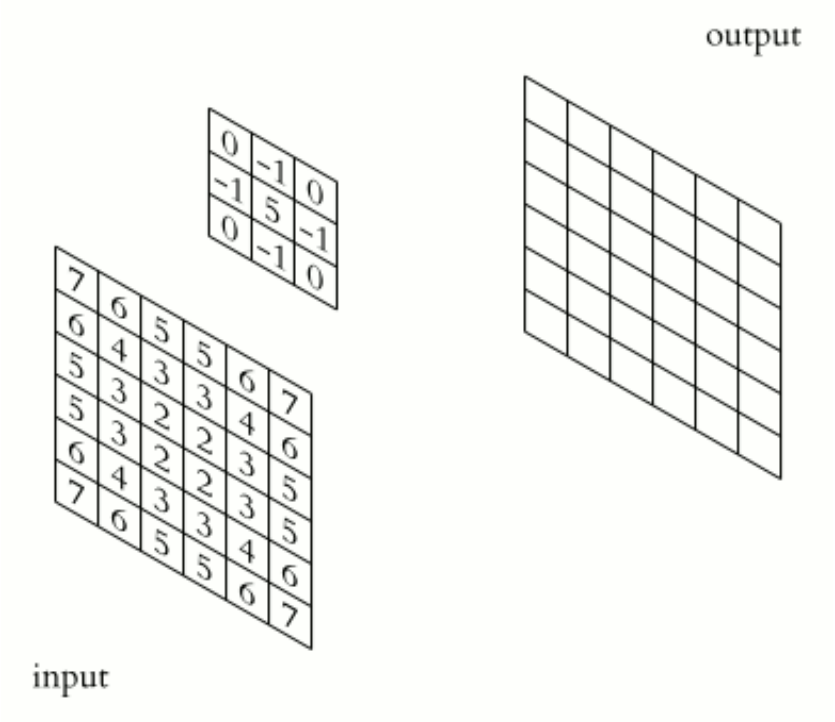
03 • **Quellen**

PART 01

CNN-Algorithmus

- ursprünglich aus Computer Vision
- Grundidee: --Input durch n Convolutional Layers durchlaufen
  --jedes Convolutional Layer hat m Filter
  --Outputs werden durch pooling konkateniert

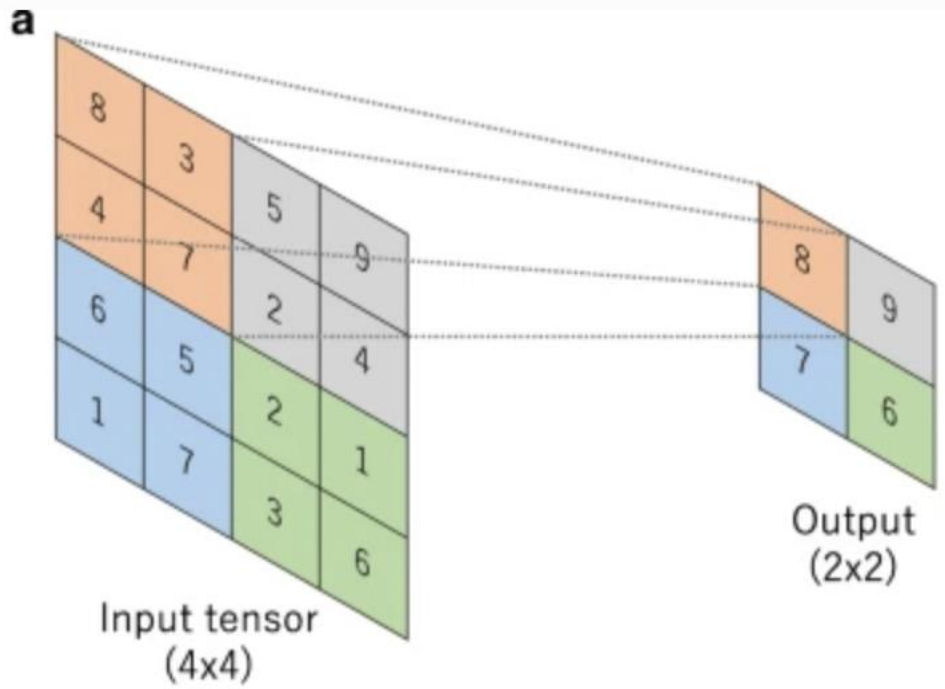
Filter



- **Filter initialisieren**
- **elementweise multiplizieren und aufsummieren**
- **Output-Wert generieren**
- **Filter bewegen**
- **Output-Tensor generieren**
- **Aktivierungsfunktion anwenden**

Quelle: https://commons.wikimedia.org/wiki/File:2D_Convolution_Animation.gif

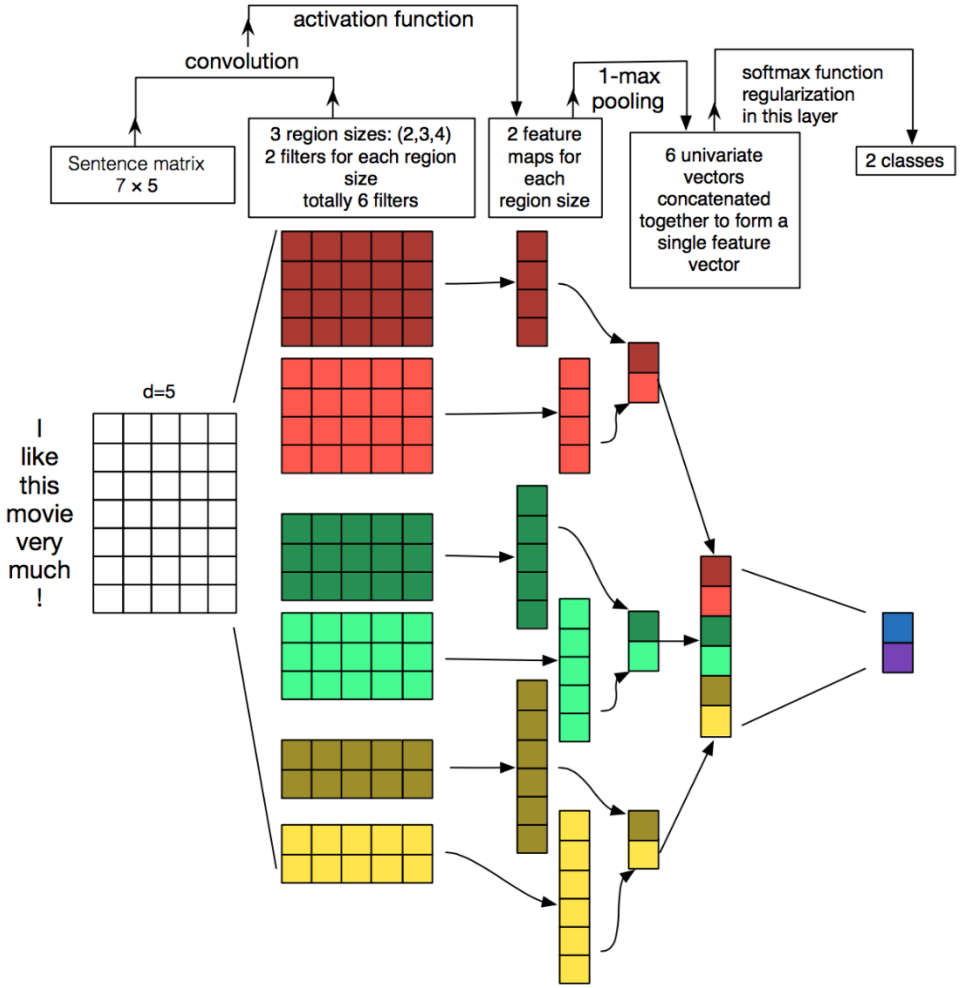
Pooling



- **Max (oder Durchschnitt)**
- **Größe des Tensors reduzieren**
- **dominante Merkmale extrahieren**
- **dropout**

Quelle: https://insightsimaging.springeropen.com/articles/10.1007/s13244-018-0639-9

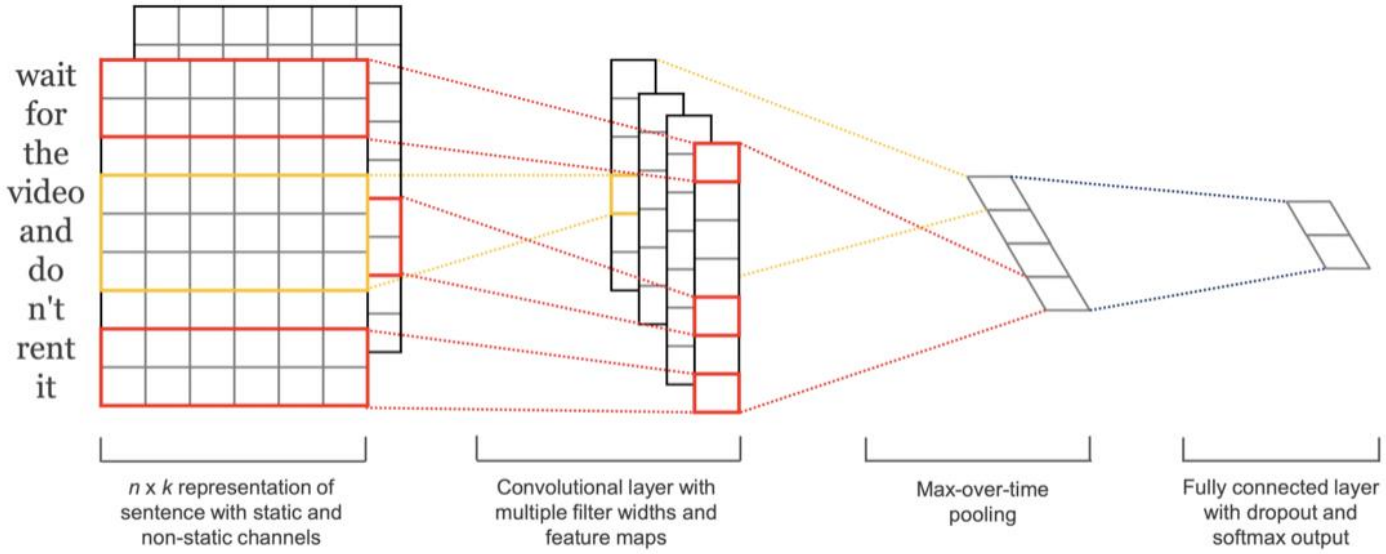
Überblick



- **Feed-Forward Modell**
- **Parameters durch Backpropagation lernen**

Quelle: Zhang, Y., & Wallace, B. (2015). A Sensitivity Analysis of Convolutional Neural Networks for Sentence Classification.

Pro&Con



Source: Y. Kim.(2014). Convolutional Neural Networks for Sentence Classification

- **räumliche Beziehungen zwischen Nachbarn nutzen**
- **Parameter sharing**

- ❖ **Ausdrücke können von vielen Wörtern dazwischen getrennt werden**
- ❖ **beschränkte Anwendung**

Hyperparameters&Setup

- **Epoch:** Wie viele Male trainieren wir die ganzen Datensätze?
- **Batch size:** Wie viele Proben bearbeiten wir, bevor wir die Parameters vom Modell aktualisieren?
- **Embedding size:** Embedding-Dimension von jedem Wort.
- **Dropout:** Wie viele Prozent von Units ignorieren wir?
- **Anzahl von ConvLayers**
- **Anzahl von Filtern:** Hidden Dimension
- **Kernel size:** Filtergröße
- **Stride:** Wie weit bewegen wir die Filter in jedem Schritt?
- **Pretrained Embeddings**
- **Loss-Funktion**
- **Optimizer**

PART 02

Implementierung & Ergebnisse

Encoder

Word Embeddings:

zufällig initialisiert / pretrained Word Embeddings

max_length = 1000 (Sentiment-Daten)

Classification Model

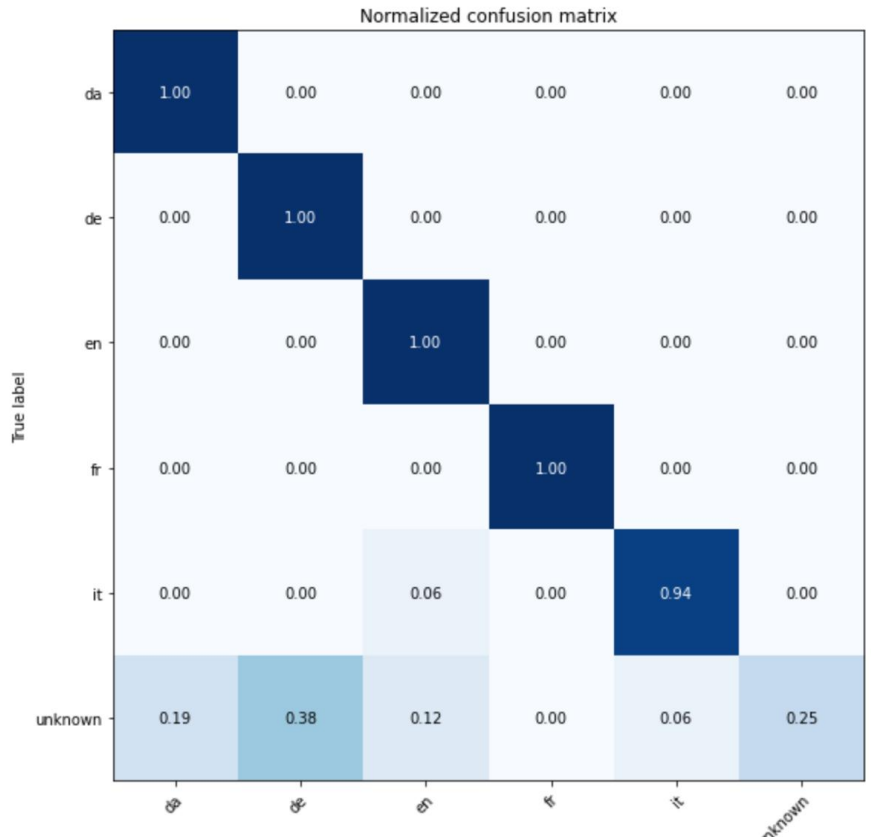
1D Convolutional neural network

Parameters:

- **Embedding Size: 300**
- **Stride: 1**
- **Anzahl von filtern: 100**
- **Batch Size: 64**
- **Dropout: 0.5**
- **Loss-Funktion: CrossEntropyLoss**
- **Optimizer: Adam**

Ergebnisse
Klassifikation der Sprache

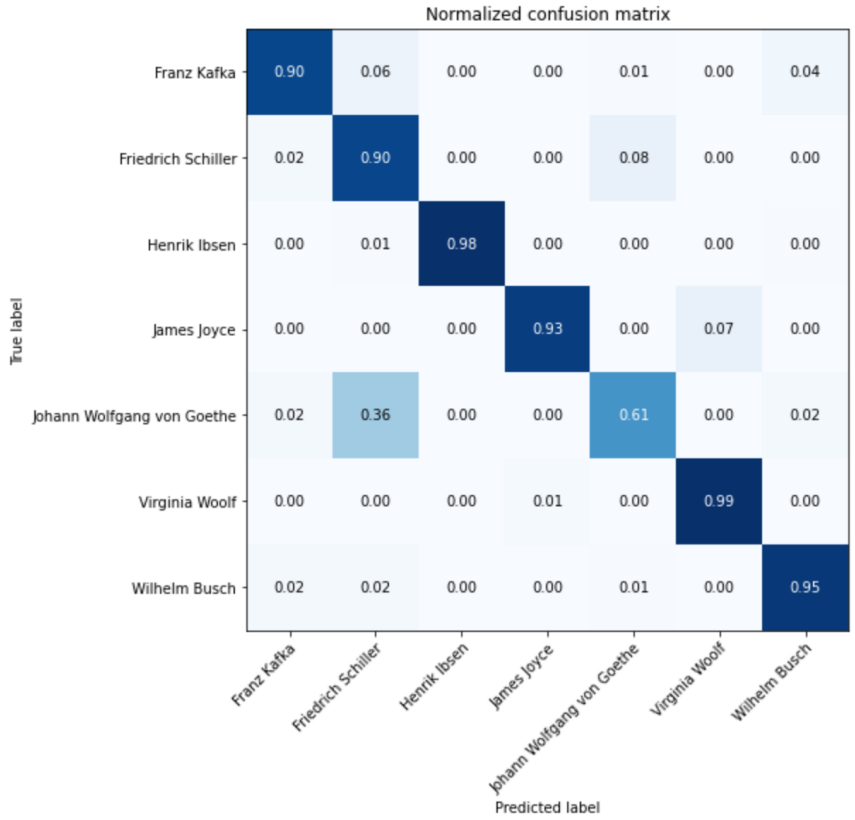
- **Anzahl von ConvLayers: 3**
- **Kernel Size: (2,3,4)**



	precision	recall	f1-score	support
da	1.00	1.00	1.00	838
de	0.99	1.00	1.00	1443
en	1.00	1.00	1.00	2517
fr	1.00	1.00	1.00	36
it	0.91	0.94	0.92	31
unknown	0.67	0.25	0.36	16
accuracy			1.00	4881
macro avg	0.93	0.86	0.88	4881
weighted avg	0.99	1.00	0.99	4881

Ergebnisse
Klassifikation der Autoren

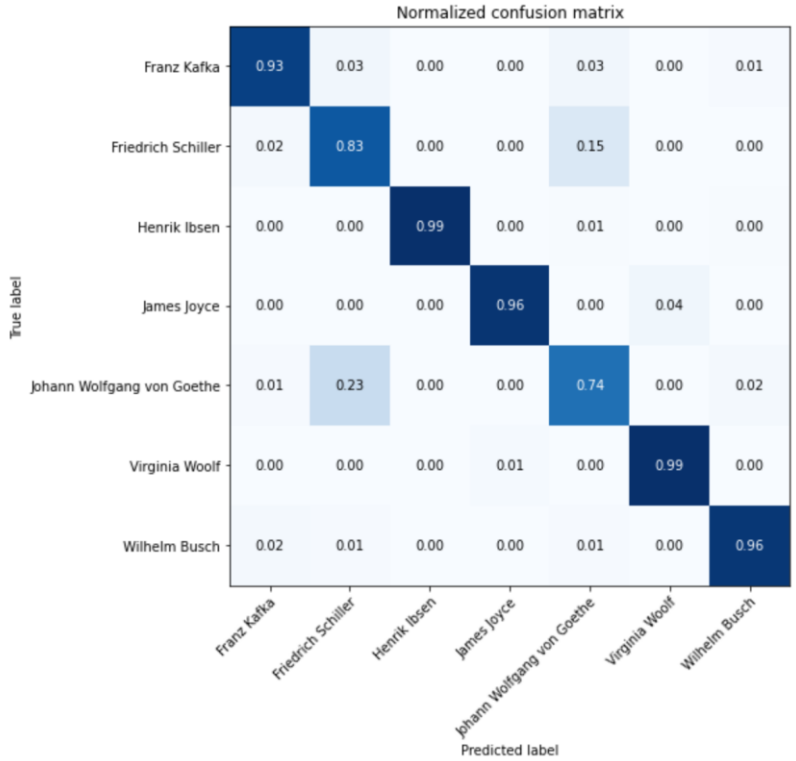
- **Anzahl von ConvLayers : 3**
- **Kernel Size: (2,3,4)**
- **Anzahl der Epochen: 5**



	precision	recall	f1-score	support
James Joyce	0.95	0.93	0.94	682
Henrik Ibsen	1.00	0.98	0.99	897
Virginia Woolf	0.97	0.99	0.98	1901
Wilhelm Busch	0.97	0.95	0.96	627
Franz Kafka	0.92	0.90	0.91	280
Friedrich Schiller	0.67	0.90	0.77	266
Johann Wolfgang von Goethe	0.83	0.61	0.70	228
accuracy			0.95	4881
macro avg	0.90	0.89	0.89	4881
weighted avg	0.95	0.95	0.95	4881

Ergebnisse
Klassifikation der Autoren

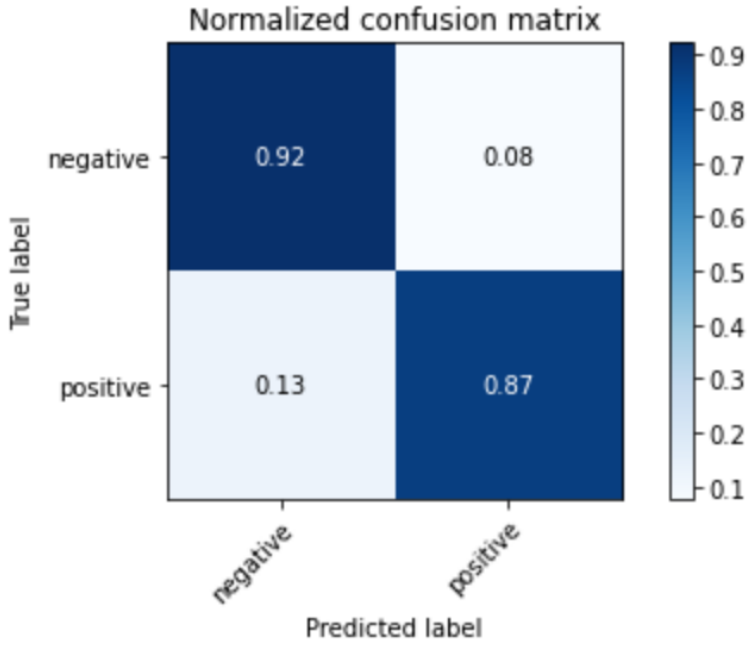
- **Anzahl von ConvLayers: 3**
- **Kernel Size: (2,3,4)**
- **Pretrained Embeddings**
- **Anzahl der Epochen: 3**



	precision	recall	f1-score	support
Henrik Ibsen	1.00	0.99	0.99	897
Virginia Woolf	0.99	0.99	0.99	1901
Franz Kafka	0.93	0.93	0.93	280
Friedrich Schiller	0.77	0.83	0.80	266
Wilhelm Busch	0.98	0.96	0.97	627
James Joyce	0.96	0.96	0.96	682
Johann Wolfgang von Goethe	0.73	0.74	0.74	228
accuracy			0.96	4881
macro avg	0.91	0.91	0.91	4881
weighted avg	0.96	0.96	0.96	4881

Ergebnisse Sentiment-Analyse

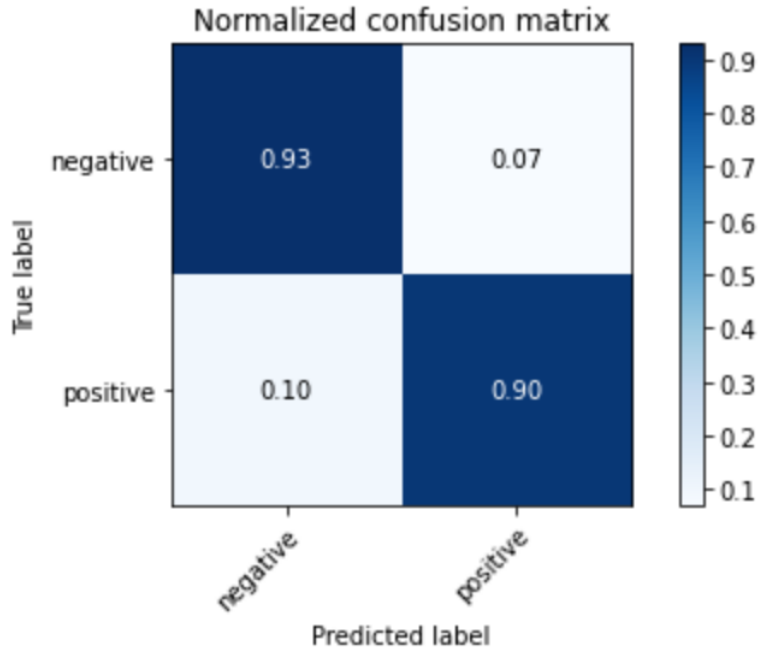
- **Anzahl von ConvLayers: 3**
- **Kernel Size: (2,3,4)**
- **Anzahl der Epochen: 5**



	precision	recall	f1-score	support
positive	0.92	0.87	0.90	5015
negative	0.88	0.92	0.90	4985
accuracy			0.90	10000
macro avg	0.90	0.90	0.90	10000
weighted avg	0.90	0.90	0.90	10000

Ergebnisse Sentiment-Analyse

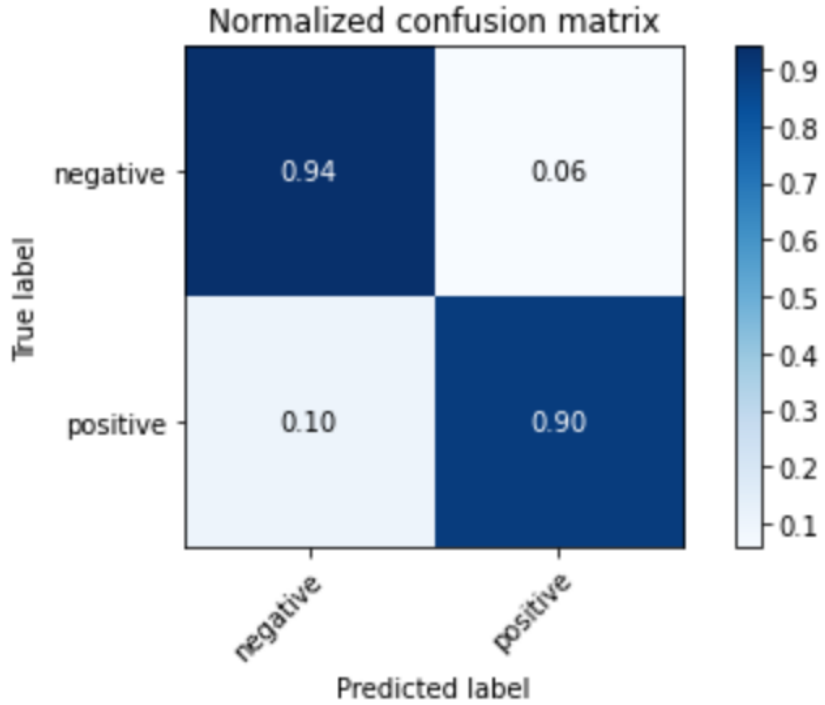
- **Anzahl der ConvLayers: 3**
- **Kernel Size: (2,3,4)**
- **Pretrained Embeddings**
- **Anzahl der Epochen: 3**



	precision	recall	f1-score	support
negative	0.91	0.93	0.92	4985
positive	0.93	0.90	0.92	5015
accuracy			0.92	10000
macro avg	0.92	0.92	0.92	10000
weighted avg	0.92	0.92	0.92	10000

Ergebnisse Sentiment-Analyse

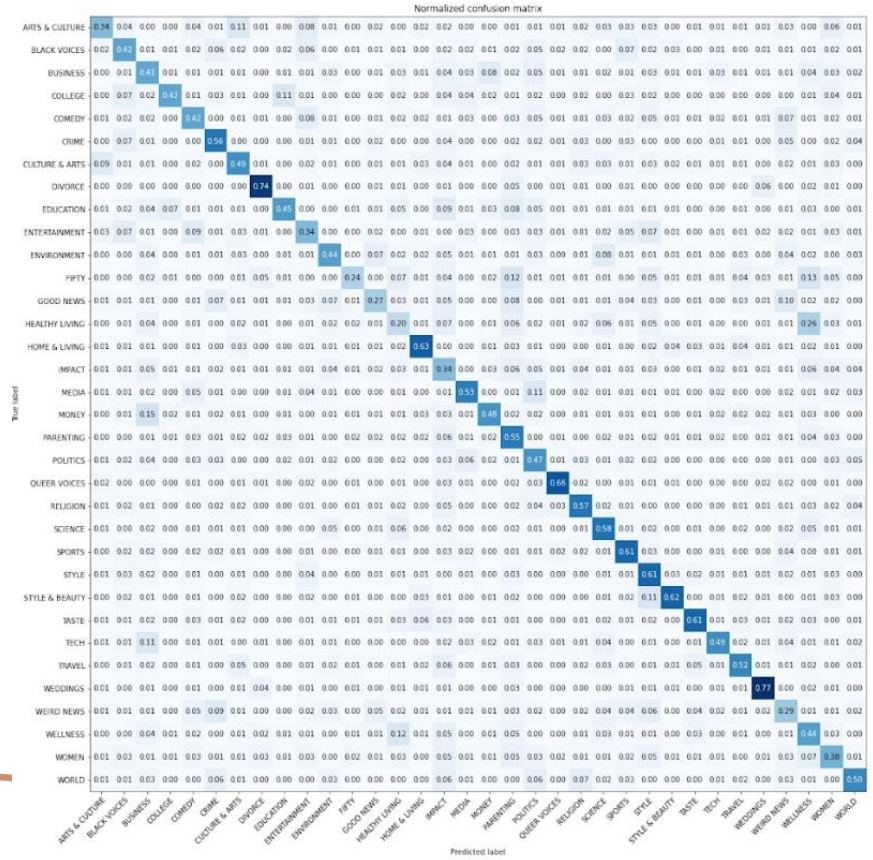
- **Anzahl von ConvLayers: 3**
- **Kernel Size: (3,5,7)**
- **Pretrained Embeddings**
- **Anzahl der Epochen: 3**



	precision	recall	f1-score	support
positive	0.94	0.90	0.92	5015
negative	0.90	0.94	0.92	4985
accuracy			0.92	10000
macro avg	0.92	0.92	0.92	10000
weighted avg	0.92	0.92	0.92	10000

Ergebnisse
Klassifikation der News

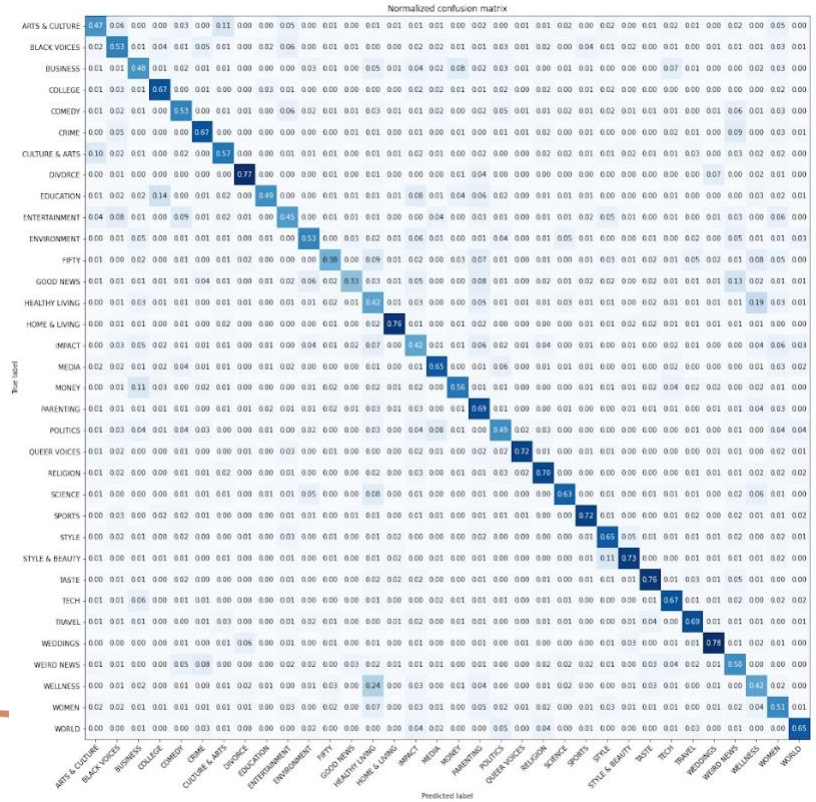
- **Anzahl von ConvLayers: 3**
- **Kernel Size: (2,3,4)**
- **Anzahl der Epochen: 6**



	precision	recall	f1-score	support
ARTS & CULTURE	0.46	0.36	0.40	282
BLACK VOICES	0.39	0.43	0.41	392
BUSINESS	0.36	0.37	0.37	380
COLLEGE	0.55	0.44	0.49	212
COMEDY	0.50	0.44	0.47	399
CRIME	0.64	0.56	0.60	409
CULTURE & ARTS	0.45	0.50	0.48	391
DIVORCE	0.80	0.75	0.77	419
EDUCATION	0.51	0.50	0.51	198
ENTERTAINMENT	0.40	0.35	0.37	387
ENVIRONMENT	0.41	0.54	0.46	355
FIFTY	0.36	0.25	0.30	273
GOOD NEWS	0.40	0.27	0.32	305
HEALTHY LIVING	0.22	0.40	0.28	386
HOME & LIVING	0.65	0.72	0.68	386
IMPACT	0.31	0.31	0.31	400
MEDIA	0.55	0.52	0.53	395
MONEY	0.58	0.53	0.55	324
PARENTING	0.48	0.50	0.49	391
POLITICS	0.39	0.47	0.43	420
QUEER VOICES	0.75	0.67	0.71	415
RELIGION	0.59	0.53	0.56	440
SCIENCE	0.62	0.52	0.57	414
SPORTS	0.59	0.59	0.59	410
STYLE	0.44	0.59	0.51	413
STYLE & BEAUTY	0.78	0.63	0.70	391
TASTE	0.65	0.63	0.64	397
TECH	0.56	0.53	0.55	416
TRAVEL	0.68	0.48	0.57	405
WEDDINGS	0.76	0.77	0.76	400
WEIRD NEWS	0.33	0.38	0.35	408
WELLNESS	0.38	0.31	0.35	407
WOMEN	0.32	0.43	0.37	400
WORLD	0.58	0.52	0.55	404
accuracy			0.50	12824
macro avg	0.51	0.49	0.50	12824
weighted avg	0.52	0.50	0.50	12824

Ergebnisse
Klassifikation der News

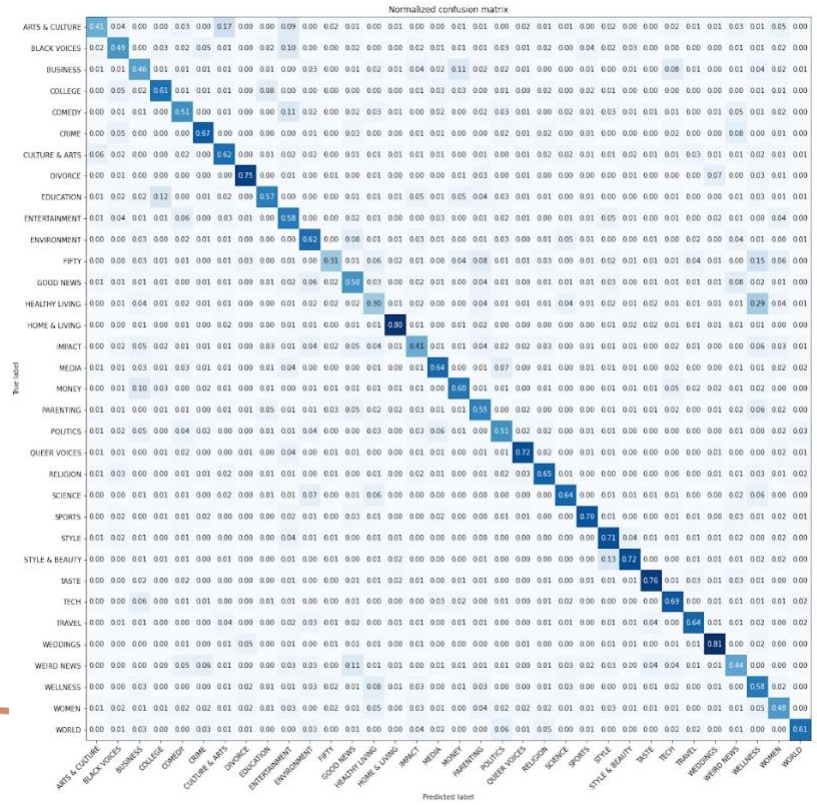
- **Anzahl von ConvLayers: 3**
- **Kernel Size: (2,3,4)**
- **Pretrained Embeddings**
- **Epochen: 3**



	precision	recall	f1-score	support
ARTS & CULTURE	0.50	0.47	0.48	282
BLACK VOICES	0.50	0.53	0.51	392
BUSINESS	0.47	0.48	0.47	380
COLLEGE	0.54	0.67	0.60	212
COMEDY	0.52	0.53	0.52	399
CRIME	0.67	0.67	0.67	409
CULTURE & ARTS	0.62	0.57	0.59	391
DIVORCE	0.82	0.77	0.79	419
EDUCATION	0.66	0.49	0.56	198
ENTERTAINMENT	0.52	0.45	0.48	387
ENVIRONMENT	0.59	0.53	0.56	355
FIFTY	0.48	0.38	0.42	273
GOOD NEWS	0.61	0.33	0.43	305
HEALTHY LIVING	0.30	0.42	0.35	386
HOME & LIVING	0.78	0.76	0.77	386
IMPACT	0.40	0.42	0.41	400
MEDIA	0.65	0.65	0.65	395
MONEY	0.64	0.56	0.60	324
PARENTING	0.49	0.69	0.57	391
POLITICS	0.54	0.49	0.52	420
QUEER VOICES	0.83	0.72	0.77	415
RELIGION	0.68	0.70	0.69	440
SCIENCE	0.73	0.63	0.68	414
SPORTS	0.74	0.72	0.73	410
STYLE	0.63	0.65	0.64	413
STYLE & BEAUTY	0.74	0.73	0.74	391
TASTE	0.73	0.76	0.74	397
TECH	0.65	0.67	0.66	416
TRAVEL	0.68	0.69	0.68	405
WEDDINGS	0.75	0.78	0.77	400
WEIRD NEWS	0.44	0.50	0.47	408
WELLNESS	0.39	0.42	0.41	407
WOMEN	0.44	0.51	0.47	400
WORLD	0.71	0.65	0.68	404
accuracy			0.59	12824
macro avg	0.60	0.59	0.59	12824
weighted avg	0.60	0.59	0.60	12824

Ergebnisse
Klassifikation der News

- **Anzahl von ConvLayers: 3**
- **Kernel Size: (3,5,7)**
- **Pretrained Embeddings**
- **Anzahl der Epochen: 3**



	precision	recall	f1-score	support
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BLACK VOICES	0.53	0.49	0.51	392
BUSINESS	0.44	0.46	0.45	380
COLLEGE	0.53	0.61	0.57	212
COMEDY	0.52	0.51	0.52	399
CRIME	0.69	0.67	0.68	409
CULTURE & ARTS	0.58	0.62	0.60	391
DIVORCE	0.81	0.75	0.78	419
EDUCATION	0.51	0.57	0.54	198
ENTERTAINMENT	0.45	0.58	0.51	387
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GOOD NEWS	0.40	0.50	0.44	305
HEALTHY LIVING	0.35	0.30	0.32	386
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IMPACT	0.48	0.41	0.44	400
MEDIA	0.65	0.64	0.64	395
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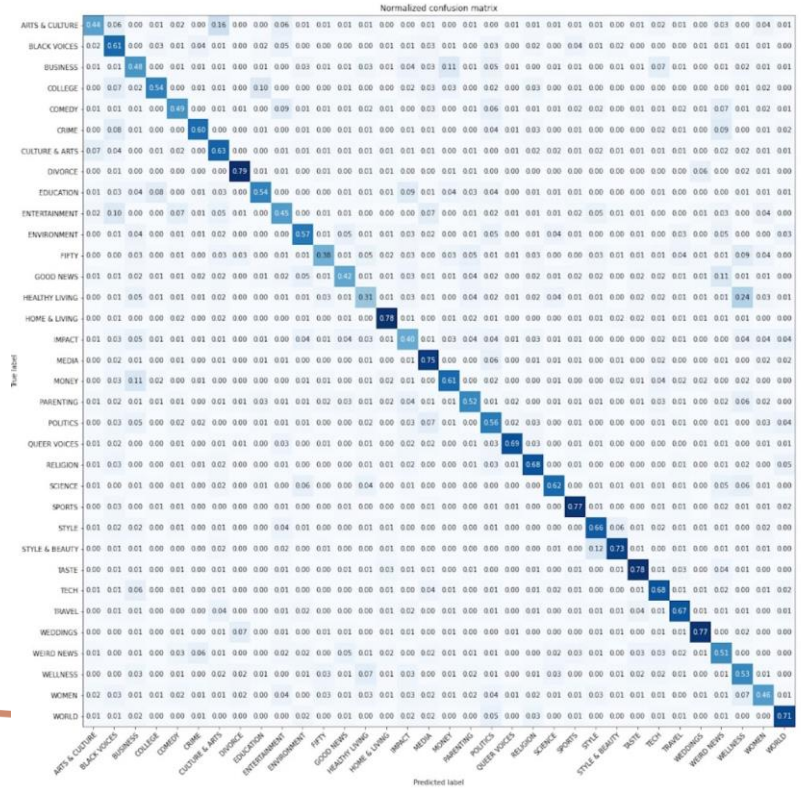
WORLD	0.76	0.61	0.68	404
accuracy			0.60	12824
macro avg	0.59	0.59	0.59	12824
weighted avg	0.60	0.60	0.59	12824

Ergebnisse
Klassifikation der News

- **Anzahl der ConvLayers: 4**
- **Kernel Size: (2,3,4,5)**
- **Pretrained Embeddings**
- **Anzahl der Epochen: 3**



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COMEDY	0.57	0.49	0.52	399
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MEDIA	0.61	0.75	0.67	395
MONEY	0.59	0.61	0.60	324
PARENTING	0.60	0.52	0.56	391
POLITICS	0.47	0.56	0.51	420
QUEER VOICES	0.82	0.69	0.75	415
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WORLD	0.68	0.71	0.70	404
accuracy			0.60	12824
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weighted avg	0.60	0.60	0.60	12824

Quellen

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- Zhang, Y., & Wallace, B. (2015). A Sensitivity Analysis of Convolutional Neural Networks for Sentence Classification.

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