Assignment - 4
Foundation of Machine Learning (CS-564)

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1. Data

	Unnamed: 0	Article	Class
0	0	Ad sales boost Time Warner profit\n\nQuarterly...	business
1	1	Dollar gains on Greenspan speech\n\nThe dollar...	business
2	2	Yukos unit buyer faces loan claim\n\nThe owner...	business
3	3	High fuel prices hit BA's profits\n\nBritish A...	business
4	4	Pernod takeover talk lifts Domecq\n\nShares in...	business
...	...	...	...
1907	1907	BT program to beat dialler scams\n\nBT is intr...	tech
1908	1908	Spam e-mails tempt net shoppers\n\nComputer us...	tech
1909	1909	Be careful how you code\n\nA new European dire...	tech
1910	1910	US cyber security chief resigns\n\nThe man mak...	tech
1911	1911	Losing yourself in online gaming\n\nOnline rol...	tech

1912 row * 2 column

2. **Dropping the irrelevant first column.**

   Shuffling the whole data to get the mixed categorical articles in each data set.

	Article	Class
643	Rock group Korn's guitarist quits\n\nThe guita...	entertainment
629	'My memories of Marley...'\n\nTo mark the 60th...	entertainment
667	Queen recruit singer for new tour\n\nThe remai...	entertainment
598	Oscar nominee Dan O'Herlihy dies\n\nIrish acto...	entertainment
219	Standard Life concern at LSE bid\n\nStandard L...	business
...	...	...
431	BA to suspend two Saudi services\n\nBritish Ai...	business
1899	Mobile multimedia slow to catch on\n\nThere is...	tech
1111	Ministers 'naive' over phone-taps\n\nThe gover...	politics
1413	Man City 0-2 Man Utd\n\nManchester United redu...	sport
1275	Minimum wage increased to £5.05\n\nThe minimum...	politics

1912 rows × 2 columns

3. **After removing the stopwords from the datasets**

	Article	Class
1053	Petrol duties frozen , Brown says Chancellor G...	politics
718	US show sued rat-eating stunt A US TV network ...	entertainment
1118	Kennedy questions trust Blair Lib Dem leader C...	politics
1353	Gatlin Hayes win Owen awards American Olympic ...	sport
400	Marsh executive guilty plea An executive US in...	business
...	...	...
611	Day-Lewis set Berlin honour Actor Daniel Day-L...	entertainment
1344	Bekele sets sights world mark Olympic 10,000m ...	sport
1822	Web radio takes Spanish rap global Spin radio ...	tech
478	Ford gains finance cars Ford , US car company ...	business
407	South African car demand surges Car manufactur...	business

1912 rows × 2 columns

4. 70:10:20 split for training, validation and testing

Train size: 1338
Validation size: 191
Test size: 383

5. One hot encoding of target class

Inspect the dimensions of our training ,testing and validation data

X_train shape: (1338, 100)
X_test shape: (383, 100)
X_val shape: (191, 100)
y_train shape: (1338, 5)
y_test shape: (383, 5)
y_val shape: (383, 5)

6. Training the models with test data

6.1 Evaluation report for the FFN with Activation function : tanh , optimizer : adam

Evaluation report for the FFN with Activation function: tanh, Optimizer: adam

	1	2	3	4	5	accuracy	macro avg	weighted avg
precision	0.820687	0.911469	0.920651	0.877014	0.872108	0.876682	0.880386	0.879751
recall	0.895240	0.863833	0.907626	0.848153	0.850516	0.876682	0.873074	0.876682
f1-score	0.856004	0.886699	0.913677	0.862224	0.860375	0.876682	0.875796	0.877141
support	116.666667	95.666667	93.333333	48.000000	92.333333	0.876682	446.000000	446.000000

Class-wise accuracy for each fold:

```
[0.85046729 0.8        0.89130435 0.78947368 0.7752809 ]
[0.93442623 0.92307692 0.93258427 0.88461538 0.88043478]
[0.90082645 0.86842105 0.8989899  0.87037037 0.89583333]
```

6.2 Evaluation report for the FFN with Activation function : tanh , optimizer :SGD

Evaluation report for the FFN with Activation function: tanh, Optimizer: SGD

	1	2	3	4	5	accuracy	macro avg	weighted avg
precision	0.626913	0.722495	0.695871	0.691729	0.642202	0.661435	0.675842	0.679770
recall	0.802333	0.656809	0.786133	0.195831	0.619726	0.661435	0.612166	0.661435
f1-score	0.702296	0.673215	0.736472	0.302643	0.626232	0.661435	0.608172	0.646137
support	116.666667	95.666667	93.333333	48.000000	92.333333	0.661435	446.000000	446.000000

Class-wise accuracy for each fold:

```
[0.71962617 0.46666667 0.67391304 0.07894737 0.58426966]
[0.82786885 0.71428571 0.87640449 0.23076923 0.59782609]
[0.85950413 0.78947368 0.80808081 0.27777778 0.67708333]
```

6.3 Evaluation report for the FFN with Activation function : relu , optimizer :adam

Evaluation report for the FFN with Activation function: relu, Optimizer: adam

	1	2	3	4	5	accuracy	macro avg	weighted avg
precision	0.803821	0.922330	0.905867	0.865520	0.879086	0.867713	0.875325	0.873967
recall	0.896029	0.844673	0.928841	0.768731	0.838612	0.867713	0.855377	0.867713
f1-score	0.844508	0.881437	0.916680	0.808873	0.856671	0.867713	0.861634	0.867785
support	116.666667	95.666667	93.333333	48.000000	92.333333	0.867713	446.000000	446.000000

Class-wise accuracy for each fold:

```
[0.86915888 0.76666667 0.90217391 0.55263158 0.70786517]
[0.90983607 0.91208791 0.95505618 0.84615385 0.89130435]
[0.90909091 0.85526316 0.92929293 0.90740741 0.91666667]
```

6.4 Evaluation report for the FFN with Activation function : relu , optimizer :SGD

	1	2	3	4	5	accuracy	macro avg	weighted avg
precision	0.447244	0.547463	0.540204	0.0	0.495479	0.482063	0.406078	0.450231
recall	0.817836	0.304010	0.738543	0.0	0.261847	0.482063	0.424447	0.482063
f1-score	0.569514	0.365708	0.622222	0.0	0.324200	0.482063	0.376329	0.421097
support	116.666667	95.666667	93.333333	48.0	92.333333	0.482063	446.000000	446.000000

```
Class-wise accuracy for each fold:

[0.8317757  0.1        0.57608696 0.         0.08988764]
[0.7704918  0.28571429 0.83146067 0.         0.19565217]
[0.85123967 0.52631579 0.80808081 0.         0.5       ]
```

6.5 Evaluation report for the FFN with Activation function : sigmoid , optimizer :adam

	1	2	3	4	5	accuracy	macro avg	weighted avg
precision	0.579532	0.472612	0.798515	0.666667	0.933787	0.648729	0.690222	0.684000
recall	0.949896	0.573694	0.878885	0.143400	0.439534	0.648729	0.597082	0.648729
f1-score	0.692985	0.515233	0.832758	0.228590	0.547007	0.648729	0.563315	0.597283
support	116.666667	95.666667	93.333333	48.000000	92.333333	0.648729	446.000000	446.000000

```
Class-wise accuracy for each fold:

[0.98130841 0.         0.7826087  0.         0.08988764]
[0.92622951 0.81318681 0.95505618 0.11538462 0.48913043]
[0.94214876 0.90789474 0.8989899  0.31481481 0.73958333]
```

6.6 Evaluation report for the FFN with Activation function : relu , optimizer :adamax

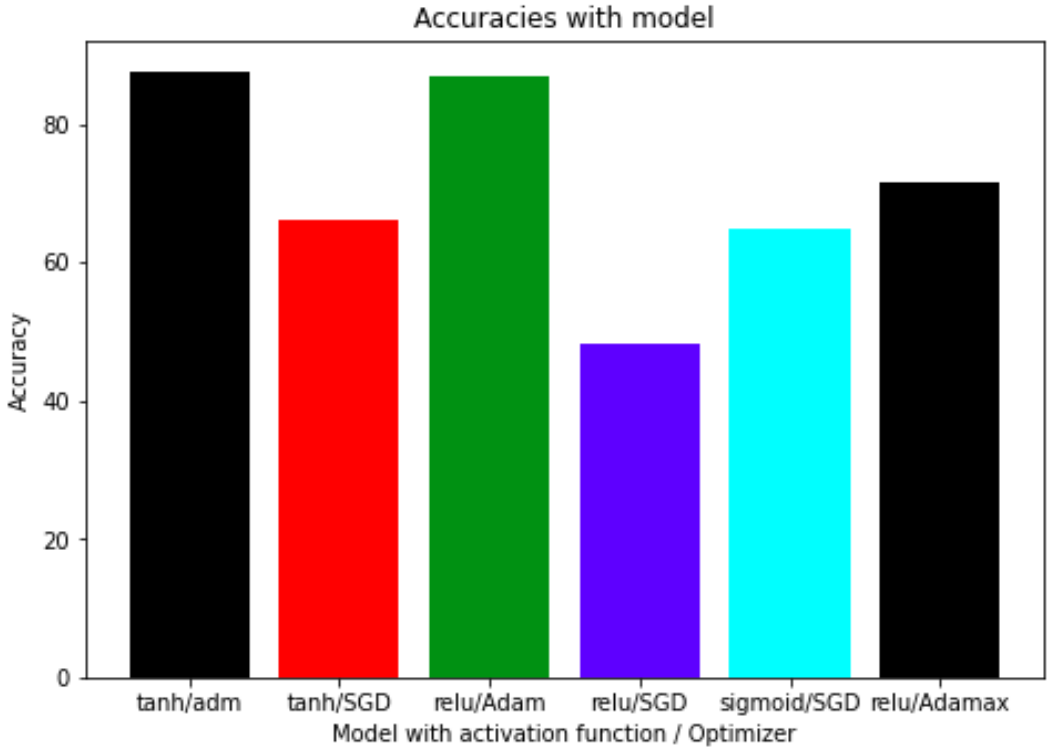
Evaluation report for the FFN with Activation function: relu, Optimizer: Adamax

	1	2	3	4	5	accuracy	macro avg	weighted avg
precision	0.649025	0.856345	0.730344	0.601852	0.762699	0.714499	0.720053	0.742701
recall	0.846516	0.647208	0.887400	0.300332	0.691133	0.714499	0.674518	0.714499
f1-score	0.726778	0.683120	0.796151	0.391534	0.724868	0.714499	0.664490	0.695189
support	116.666667	95.666667	93.333333	48.000000	92.333333	0.714499	446.000000	446.000000

Class-wise accuracy for each fold:

```
[0.79439252 0.26666667 0.82608696 0.         0.58426966]
[0.83606557 0.78021978 0.97752809 0.32692308 0.73913043]
[0.90909091 0.89473684 0.85858586 0.57407407 0.75      ]
```

7. Graph showing accuracies with various models



From the above analysis , It is obvious that for our data , these two models show better results.

1. **Activation function : tanh, Optimizer : adam**
2. **Activation function : relu, Optimizer : adam**