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Tools

- Tensorflow 2.x
- Keras
- Python 3.x

Observations

This is a basic classification problem of FizzBuzz with 4 classes, training on [101, 1000] & testing on [1, 100].

Here when I talk about "**BASE**", it implies the Number base in which the encoding for the input was done. I wanted to test which BASE works best for this problem, and which

- Model Configurations

  ### 2 Layer Model

```
tf.keras.layers.Dense(512, activation='relu'),
tf.keras.layers.Dropout(0.2),
tf.keras.layers.Dense(1024, activation='relu'),
tf.keras.layers.Dropout(0.2),
tf.keras.layers.Dense(CLASS_SIZE, activation='softmax')
```

  Result:

BASE (encoding)	EPOCHS	ACCURACY in % (on test data)
2	100	95
2	200	97
2	300	97
3	100	94
3	200	96
3	300	96

We see that 2 layers with Dropout is performing very good with few hundred EPOCHS. But I wanted to test if it is better to use multiple layers, as in is it helping me get better results than 1 layer model.

1 Layer Model

```
tf.keras.layers.Dense(1024, activation='relu'),
tf.keras.layers.Dense(CLASS_SIZE, activation='softmax')
```

Result:

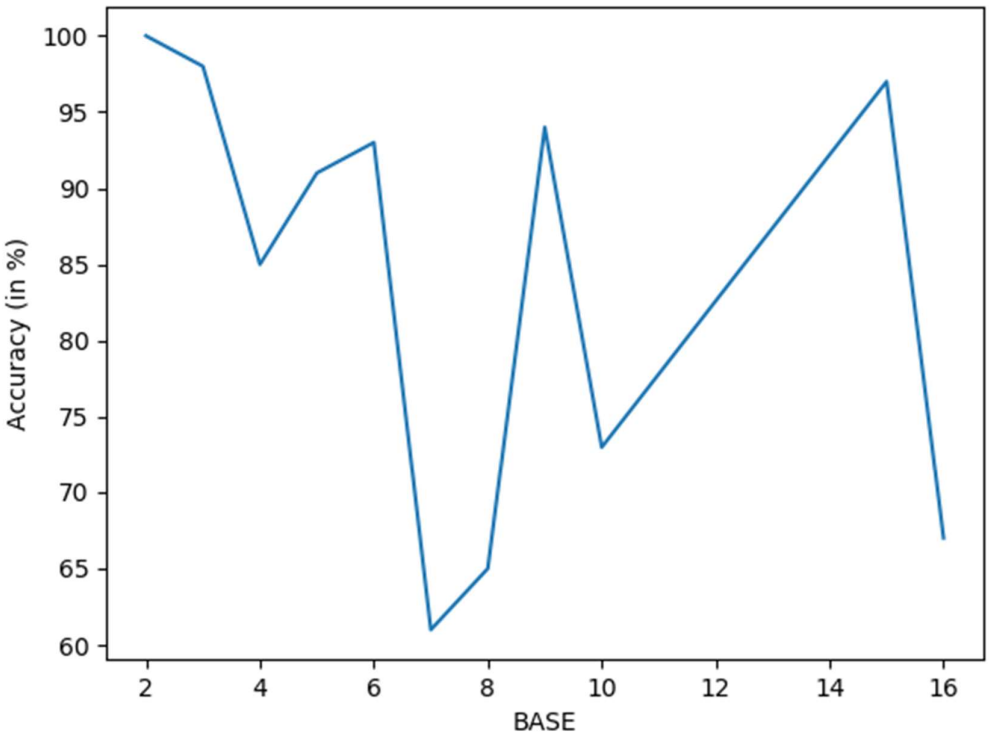
BASE (encoding)	EPOCHS	ACCURACY inn % (on test data)
2	100	97
2	300	100
3	100	85
3	300	96

With Increasing EPOCHs we get equivalent if not better results in 1-layer than in the 2-layer Model. So continuing with 1-layer Model.

- BASE finding

  For this I ran 1000 EPOCHs for each BASE to get the best one.

  Result:



  Inferences:

  - BASE = 2 performs the best, gives 100% accuracy on test data
  - All BASE values that are multiples of 3 perform better than others (except 2) because data has more multiples of 3 to label
  - All BASE values that are multiples of 5 perform better than prime numbers (except 2 & 3) because data has more multiples of 5 to label and prime numbers don't have a correlation with the data

- Not using DROPOUT helps in this case as it actually learns the pattern of the data and that is what is required to get perfect results

- Optimizer

  I observed that amongst “Adam”, “SGD” & “RMSprop”, “RMSprop” worked the best for this data set.

- Loss

  As we are solving a classification problem here, it is recommended to use “categorical_crossentropy”

- Activation

  For Hidden layers I observed that “relu” gave better performance over other activation functions like “softmax” & “tanh”

  And for Output Layer, the best activation function was “softmax”

Henceforth We can conclude that to get the best results on the test data we can use the following:

- EPOCHS = 1000
- BASE = 2
- Model: 1-Layer No Dropout Model
- Optimizer: “RMSprop”
- Loss: “categorical_crossentropy”
- Hidden layer activation: ”relu”
- Output Layer activation: “softmax”

```
model.compile(optimizer='RMSprop',
              loss='categorical_crossentropy',
              metrics=['accuracy'])
```

Points:

- Model with Encoding Base = 2 gives better accuracy than Encoding Base = 3
- Adding Dropout in the model gave worse results
- Accuracy with 1000 Epochs is 100 % on test data
- Increasing the number of levels in the model did not achieve 100 % accuracy on the test data