Decrypt-cipher

December 18, 2019

[1]:
```
from __future__ import print_function

import numpy as np

from faker import Faker
import random
from tqdm import tqdm
from babel.dates import format_date

import matplotlib.pyplot as plt

# %matplotlib inline

import json
import pickle
import os
from model import DeCryptModel
from decrypt_utils import *
from cipher_take_home import *
from sklearn.model_selection import train_test_split


import matplotlib.pyplot as plt
```

```
Using TensorFlow backend.
/Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:526: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
/Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:527: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
/Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:528: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
```

```
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
/Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:529: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
/Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:530: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
/Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/framework/dtypes.py:535: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
```

[2]:
```
plain, cipher = generate_data(1 << 14)

X_train, X_test, y_train, y_test = train_test_split(cipher, plain, test_size=0.
 ↪04, random_state=42)
m = len(X_train)
Tx = 42
X_one_hot, Y_one_hot, vocab, inv_vocab = prepare_dataset(X_train, y_train, Tx)

model = DeCryptModel(Xoh=X_one_hot, Yoh=Y_one_hot, Tx=Tx, m=m)
```

```
100%|      | 15728/15728 [00:00<00:00, 523219.31it/s]
```

0.0.1 Building model from scratch

[3]:
```
model.train(epochs=30)
```

```
WARNING:tensorflow:From /Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/framework/op_def_library.py:263: colocate_with (from
tensorflow.python.framework.ops) is deprecated and will be removed in a future
version.
Instructions for updating:
Colocations handled automatically by placer.
WARNING:tensorflow:From /Users/dkurra/miniconda3/lib/python3.7/site-
packages/tensorflow/python/ops/math_ops.py:3066: to_int32 (from
tensorflow.python.ops.math_ops) is deprecated and will be removed in a future
version.
Instructions for updating:
Use tf.cast instead.
Epoch 1/30
15728/15728 [==============================] - 35s 2ms/step - loss: 80.4159 -
```

```
dense_1_loss: 0.0998 - dense_1_acc: 0.1063 - dense_1_acc_1: 0.3113 -
dense_1_acc_2: 0.1175 - dense_1_acc_3: 0.1368 - dense_1_acc_4: 0.1698 -
dense_1_acc_5: 0.1158 - dense_1_acc_6: 0.1353 - dense_1_acc_7: 0.1362 -
dense_1_acc_8: 0.1256 - dense_1_acc_9: 0.1216 - dense_1_acc_10: 0.1097 -
dense_1_acc_11: 0.1441 - dense_1_acc_12: 0.1336 - dense_1_acc_13: 0.1665 -
dense_1_acc_14: 0.1806 - dense_1_acc_15: 0.1758 - dense_1_acc_16: 0.2021 -
dense_1_acc_17: 0.2133 - dense_1_acc_18: 0.2381 - dense_1_acc_19: 0.2897 -
dense_1_acc_20: 0.3142 - dense_1_acc_21: 0.3712 - dense_1_acc_22: 0.4074 -
dense_1_acc_23: 0.4278 - dense_1_acc_24: 0.4626 - dense_1_acc_25: 0.4987 -
dense_1_acc_26: 0.5627 - dense_1_acc_27: 0.5897 - dense_1_acc_28: 0.6422 -
dense_1_acc_29: 0.7043 - dense_1_acc_30: 0.7553 - dense_1_acc_31: 0.8028 -
dense_1_acc_32: 0.8630 - dense_1_acc_33: 0.9177 - dense_1_acc_34: 0.9620 -
dense_1_acc_35: 0.9931 - dense_1_acc_36: 0.9980 - dense_1_acc_37: 0.9986 -
dense_1_acc_38: 0.9987 - dense_1_acc_39: 0.9989 - dense_1_acc_40: 0.9994 -
dense_1_acc_41: 0.9997
Epoch 2/30
15728/15728 [==============================] - 12s 757us/step - loss: 65.9279 -
dense_1_loss: 6.1653e-06 - dense_1_acc: 0.2490 - dense_1_acc_1: 0.3891 -
dense_1_acc_2: 0.1831 - dense_1_acc_3: 0.2049 - dense_1_acc_4: 0.3861 -
dense_1_acc_5: 0.0903 - dense_1_acc_6: 0.3234 - dense_1_acc_7: 0.3103 -
dense_1_acc_8: 0.2102 - dense_1_acc_9: 0.1647 - dense_1_acc_10: 0.1862 -
dense_1_acc_11: 0.3375 - dense_1_acc_12: 0.1748 - dense_1_acc_13: 0.4012 -
dense_1_acc_14: 0.4662 - dense_1_acc_15: 0.3589 - dense_1_acc_16: 0.4042 -
dense_1_acc_17: 0.3234 - dense_1_acc_18: 0.3612 - dense_1_acc_19: 0.4802 -
dense_1_acc_20: 0.4219 - dense_1_acc_21: 0.5362 - dense_1_acc_22: 0.5444 -
dense_1_acc_23: 0.5114 - dense_1_acc_24: 0.5425 - dense_1_acc_25: 0.4966 -
dense_1_acc_26: 0.6482 - dense_1_acc_27: 0.6125 - dense_1_acc_28: 0.6314 -
dense_1_acc_29: 0.7307 - dense_1_acc_30: 0.7796 - dense_1_acc_31: 0.8012 -
dense_1_acc_32: 0.8804 - dense_1_acc_33: 0.9346 - dense_1_acc_34: 0.9636 -
dense_1_acc_35: 0.9961 - dense_1_acc_36: 0.9998 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 3/30
15728/15728 [==============================] - 12s 769us/step - loss: 58.8631 -
dense_1_loss: 4.4705e-06 - dense_1_acc: 0.2567 - dense_1_acc_1: 0.4996 -
dense_1_acc_2: 0.3917 - dense_1_acc_3: 0.4333 - dense_1_acc_4: 0.5813 -
dense_1_acc_5: 0.1601 - dense_1_acc_6: 0.3957 - dense_1_acc_7: 0.4402 -
dense_1_acc_8: 0.2757 - dense_1_acc_9: 0.3015 - dense_1_acc_10: 0.4255 -
dense_1_acc_11: 0.4421 - dense_1_acc_12: 0.3108 - dense_1_acc_13: 0.4329 -
dense_1_acc_14: 0.5156 - dense_1_acc_15: 0.3751 - dense_1_acc_16: 0.4477 -
dense_1_acc_17: 0.3481 - dense_1_acc_18: 0.3999 - dense_1_acc_19: 0.5066 -
dense_1_acc_20: 0.4414 - dense_1_acc_21: 0.6057 - dense_1_acc_22: 0.5869 -
dense_1_acc_23: 0.5729 - dense_1_acc_24: 0.5526 - dense_1_acc_25: 0.5371 -
dense_1_acc_26: 0.6514 - dense_1_acc_27: 0.6474 - dense_1_acc_28: 0.6488 -
dense_1_acc_29: 0.7351 - dense_1_acc_30: 0.7887 - dense_1_acc_31: 0.7991 -
dense_1_acc_32: 0.8805 - dense_1_acc_33: 0.9353 - dense_1_acc_34: 0.9662 -
dense_1_acc_35: 0.9957 - dense_1_acc_36: 0.9998 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
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dense_1_acc_41: 1.0000
Epoch 4/30
15728/15728 [==============================] - 12s 747us/step - loss: 52.6943 -
dense_1_loss: 5.3399e-06 - dense_1_acc: 0.2571 - dense_1_acc_1: 0.6024 -
dense_1_acc_2: 0.5705 - dense_1_acc_3: 0.5284 - dense_1_acc_4: 0.6448 -
dense_1_acc_5: 0.2652 - dense_1_acc_6: 0.4727 - dense_1_acc_7: 0.4984 -
dense_1_acc_8: 0.3997 - dense_1_acc_9: 0.4081 - dense_1_acc_10: 0.5806 -
dense_1_acc_11: 0.5141 - dense_1_acc_12: 0.4852 - dense_1_acc_13: 0.4728 -
dense_1_acc_14: 0.5771 - dense_1_acc_15: 0.4369 - dense_1_acc_16: 0.4931 -
dense_1_acc_17: 0.4190 - dense_1_acc_18: 0.4332 - dense_1_acc_19: 0.5347 -
dense_1_acc_20: 0.4701 - dense_1_acc_21: 0.6637 - dense_1_acc_22: 0.6271 -
dense_1_acc_23: 0.6282 - dense_1_acc_24: 0.5659 - dense_1_acc_25: 0.5830 -
dense_1_acc_26: 0.6562 - dense_1_acc_27: 0.6677 - dense_1_acc_28: 0.7040 -
dense_1_acc_29: 0.7523 - dense_1_acc_30: 0.8024 - dense_1_acc_31: 0.7982 -
dense_1_acc_32: 0.8813 - dense_1_acc_33: 0.9364 - dense_1_acc_34: 0.9727 -
dense_1_acc_35: 0.9954 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 5/30
15728/15728 [==============================] - 12s 754us/step - loss: 47.5082 -
dense_1_loss: 6.5481e-06 - dense_1_acc: 0.3285 - dense_1_acc_1: 0.6261 -
dense_1_acc_2: 0.6290 - dense_1_acc_3: 0.6035 - dense_1_acc_4: 0.6711 -
dense_1_acc_5: 0.3810 - dense_1_acc_6: 0.5440 - dense_1_acc_7: 0.5237 -
dense_1_acc_8: 0.4816 - dense_1_acc_9: 0.5083 - dense_1_acc_10: 0.6360 -
dense_1_acc_11: 0.5622 - dense_1_acc_12: 0.5808 - dense_1_acc_13: 0.5259 -
dense_1_acc_14: 0.6205 - dense_1_acc_15: 0.5179 - dense_1_acc_16: 0.5123 -
dense_1_acc_17: 0.4856 - dense_1_acc_18: 0.4472 - dense_1_acc_19: 0.5773 -
dense_1_acc_20: 0.5183 - dense_1_acc_21: 0.6923 - dense_1_acc_22: 0.6570 -
dense_1_acc_23: 0.6482 - dense_1_acc_24: 0.5926 - dense_1_acc_25: 0.6449 -
dense_1_acc_26: 0.6929 - dense_1_acc_27: 0.7146 - dense_1_acc_28: 0.7268 -
dense_1_acc_29: 0.7637 - dense_1_acc_30: 0.8130 - dense_1_acc_31: 0.8010 -
dense_1_acc_32: 0.8894 - dense_1_acc_33: 0.9308 - dense_1_acc_34: 0.9746 -
dense_1_acc_35: 0.9954 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 6/30
15728/15728 [==============================] - 13s 827us/step - loss: 43.1138 -
dense_1_loss: 9.3180e-06 - dense_1_acc: 0.3603 - dense_1_acc_1: 0.6650 -
dense_1_acc_2: 0.6558 - dense_1_acc_3: 0.6851 - dense_1_acc_4: 0.6979 -
dense_1_acc_5: 0.4981 - dense_1_acc_6: 0.5895 - dense_1_acc_7: 0.5612 -
dense_1_acc_8: 0.5371 - dense_1_acc_9: 0.5842 - dense_1_acc_10: 0.6740 -
dense_1_acc_11: 0.6051 - dense_1_acc_12: 0.6492 - dense_1_acc_13: 0.5940 -
dense_1_acc_14: 0.6484 - dense_1_acc_15: 0.5917 - dense_1_acc_16: 0.5792 -
dense_1_acc_17: 0.5738 - dense_1_acc_18: 0.4927 - dense_1_acc_19: 0.6141 -
dense_1_acc_20: 0.5909 - dense_1_acc_21: 0.7154 - dense_1_acc_22: 0.6699 -
dense_1_acc_23: 0.6672 - dense_1_acc_24: 0.6092 - dense_1_acc_25: 0.6851 -
dense_1_acc_26: 0.7302 - dense_1_acc_27: 0.7455 - dense_1_acc_28: 0.7513 -
dense_1_acc_29: 0.7759 - dense_1_acc_30: 0.8171 - dense_1_acc_31: 0.8056 -
```

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dense_1_acc_32: 0.8995 - dense_1_acc_33: 0.9305 - dense_1_acc_34: 0.9748 -
dense_1_acc_35: 0.9950 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 7/30
15728/15728 [==============================] - 12s 732us/step - loss: 39.3620 -
dense_1_loss: 1.4049e-05 - dense_1_acc: 0.3752 - dense_1_acc_1: 0.6671 -
dense_1_acc_2: 0.6829 - dense_1_acc_3: 0.7265 - dense_1_acc_4: 0.7227 -
dense_1_acc_5: 0.5776 - dense_1_acc_6: 0.6294 - dense_1_acc_7: 0.5863 -
dense_1_acc_8: 0.5775 - dense_1_acc_9: 0.6395 - dense_1_acc_10: 0.6988 -
dense_1_acc_11: 0.6508 - dense_1_acc_12: 0.6999 - dense_1_acc_13: 0.6444 -
dense_1_acc_14: 0.6832 - dense_1_acc_15: 0.6583 - dense_1_acc_16: 0.6387 -
dense_1_acc_17: 0.6485 - dense_1_acc_18: 0.5595 - dense_1_acc_19: 0.6740 -
dense_1_acc_20: 0.6701 - dense_1_acc_21: 0.7372 - dense_1_acc_22: 0.6883 -
dense_1_acc_23: 0.6882 - dense_1_acc_24: 0.6167 - dense_1_acc_25: 0.7104 -
dense_1_acc_26: 0.7492 - dense_1_acc_27: 0.7640 - dense_1_acc_28: 0.7634 -
dense_1_acc_29: 0.7784 - dense_1_acc_30: 0.8217 - dense_1_acc_31: 0.8087 -
dense_1_acc_32: 0.9041 - dense_1_acc_33: 0.9287 - dense_1_acc_34: 0.9746 -
dense_1_acc_35: 0.9948 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 8/30
15728/15728 [==============================] - 12s 737us/step - loss: 36.2148 -
dense_1_loss: 2.1236e-05 - dense_1_acc: 0.4395 - dense_1_acc_1: 0.6697 -
dense_1_acc_2: 0.7033 - dense_1_acc_3: 0.7560 - dense_1_acc_4: 0.7455 -
dense_1_acc_5: 0.6371 - dense_1_acc_6: 0.6694 - dense_1_acc_7: 0.6038 -
dense_1_acc_8: 0.6223 - dense_1_acc_9: 0.6825 - dense_1_acc_10: 0.7292 -
dense_1_acc_11: 0.6901 - dense_1_acc_12: 0.7368 - dense_1_acc_13: 0.6816 -
dense_1_acc_14: 0.7133 - dense_1_acc_15: 0.7149 - dense_1_acc_16: 0.6836 -
dense_1_acc_17: 0.7193 - dense_1_acc_18: 0.6373 - dense_1_acc_19: 0.7252 -
dense_1_acc_20: 0.7284 - dense_1_acc_21: 0.7658 - dense_1_acc_22: 0.7119 -
dense_1_acc_23: 0.7073 - dense_1_acc_24: 0.6337 - dense_1_acc_25: 0.7358 -
dense_1_acc_26: 0.7564 - dense_1_acc_27: 0.7785 - dense_1_acc_28: 0.7703 -
dense_1_acc_29: 0.7810 - dense_1_acc_30: 0.8281 - dense_1_acc_31: 0.8098 -
dense_1_acc_32: 0.9077 - dense_1_acc_33: 0.9285 - dense_1_acc_34: 0.9737 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 9/30
15728/15728 [==============================] - 11s 712us/step - loss: 33.5437 -
dense_1_loss: 3.0035e-05 - dense_1_acc: 0.5351 - dense_1_acc_1: 0.6871 -
dense_1_acc_2: 0.7155 - dense_1_acc_3: 0.7867 - dense_1_acc_4: 0.7740 -
dense_1_acc_5: 0.6817 - dense_1_acc_6: 0.7085 - dense_1_acc_7: 0.6293 -
dense_1_acc_8: 0.6743 - dense_1_acc_9: 0.7146 - dense_1_acc_10: 0.7496 -
dense_1_acc_11: 0.7225 - dense_1_acc_12: 0.7686 - dense_1_acc_13: 0.7140 -
dense_1_acc_14: 0.7461 - dense_1_acc_15: 0.7574 - dense_1_acc_16: 0.7129 -
dense_1_acc_17: 0.7673 - dense_1_acc_18: 0.7023 - dense_1_acc_19: 0.7639 -
dense_1_acc_20: 0.7700 - dense_1_acc_21: 0.7906 - dense_1_acc_22: 0.7319 -
```

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dense_1_acc_23: 0.7222 - dense_1_acc_24: 0.6513 - dense_1_acc_25: 0.7567 -
dense_1_acc_26: 0.7627 - dense_1_acc_27: 0.7875 - dense_1_acc_28: 0.7726 -
dense_1_acc_29: 0.7835 - dense_1_acc_30: 0.8302 - dense_1_acc_31: 0.8110 -
dense_1_acc_32: 0.9104 - dense_1_acc_33: 0.9283 - dense_1_acc_34: 0.9736 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 10/30
15728/15728 [==============================] - 11s 713us/step - loss: 31.2414 -
dense_1_loss: 3.7203e-05 - dense_1_acc: 0.5553 - dense_1_acc_1: 0.6998 -
dense_1_acc_2: 0.7260 - dense_1_acc_3: 0.8131 - dense_1_acc_4: 0.7935 -
dense_1_acc_5: 0.7140 - dense_1_acc_6: 0.7438 - dense_1_acc_7: 0.6514 -
dense_1_acc_8: 0.7301 - dense_1_acc_9: 0.7504 - dense_1_acc_10: 0.7691 -
dense_1_acc_11: 0.7500 - dense_1_acc_12: 0.8035 - dense_1_acc_13: 0.7480 -
dense_1_acc_14: 0.7758 - dense_1_acc_15: 0.7880 - dense_1_acc_16: 0.7328 -
dense_1_acc_17: 0.7972 - dense_1_acc_18: 0.7537 - dense_1_acc_19: 0.7897 -
dense_1_acc_20: 0.7950 - dense_1_acc_21: 0.8137 - dense_1_acc_22: 0.7527 -
dense_1_acc_23: 0.7359 - dense_1_acc_24: 0.6680 - dense_1_acc_25: 0.7717 -
dense_1_acc_26: 0.7696 - dense_1_acc_27: 0.7958 - dense_1_acc_28: 0.7753 -
dense_1_acc_29: 0.7874 - dense_1_acc_30: 0.8331 - dense_1_acc_31: 0.8128 -
dense_1_acc_32: 0.9105 - dense_1_acc_33: 0.9283 - dense_1_acc_34: 0.9736 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.00001s - loss: 31.3505 - dense_1_loss: 3.6939e-05 -
dense_1_acc: 0.5487 - dense_1_acc_1: 0.6969 - dense_1_acc_2: 0.7245 -
dense_1_acc_3: 0.8127 - dense_1_acc_4: 0.7917 - dense_1_acc_5: 0.7136 -
dense_1_acc_6: 0.7431 - dense_1_acc_7: 0.6529 - dense_1_acc_8: 0.7269 -
dense_1_acc_9: 0.7487 - dense_1_acc_10: 0.7662 - dense_1_acc_11: 0.7497 -
dense_1_acc_12: 0.8009 - dense_1_acc_13: 0.7464 - dense_1_acc_14: 0.7742 -
dense_1_acc_15: 0.7859 - dense_1_acc_16: 0.7318 - dense_1_acc_17: 0.7960 -
dense_1_acc_18: 0.7546 - dense_1_acc_19: 0.7891 - dense_1_acc_20: 0.7943 -
dense_1_acc_21: 0.8149 - dense_1_acc_22: 0.7510 - dense_1_acc_23: 0.7369 -
dense_1_acc_24: 0.6653 - dense_1_acc_25: 0.7723 - dense_1_acc_26: 0.7686 -
dense_1_acc_27: 0.7969 - dense_1_acc_28: 0.7749 - dense_1_acc_29: 0.7850 -
dense_1_acc_30: 0.8324 - dense_1_acc_31: 0.8113 - dense_1_acc_32: 0.9088 -
dense_1_acc_33: 0.9278 - dense_1_acc_34: 0.9735 - dense_1_acc_35: 0.9946 -
dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 - dense_1_acc_38: 1.0000 -
dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 - dense_1
Epoch 11/30
15728/15728 [==============================] - 12s 735us/step - loss: 29.2385 -
dense_1_loss: 4.2264e-05 - dense_1_acc: 0.6197 - dense_1_acc_1: 0.7401 -
dense_1_acc_2: 0.7448 - dense_1_acc_3: 0.8310 - dense_1_acc_4: 0.8149 -
dense_1_acc_5: 0.7419 - dense_1_acc_6: 0.7764 - dense_1_acc_7: 0.6751 -
dense_1_acc_8: 0.7725 - dense_1_acc_9: 0.7737 - dense_1_acc_10: 0.7850 -
dense_1_acc_11: 0.7756 - dense_1_acc_12: 0.8298 - dense_1_acc_13: 0.7780 -
dense_1_acc_14: 0.8067 - dense_1_acc_15: 0.8085 - dense_1_acc_16: 0.7595 -
dense_1_acc_17: 0.8269 - dense_1_acc_18: 0.7832 - dense_1_acc_19: 0.8192 -
dense_1_acc_20: 0.8109 - dense_1_acc_21: 0.8307 - dense_1_acc_22: 0.7675 -
```

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dense_1_acc_23: 0.7493 - dense_1_acc_24: 0.6928 - dense_1_acc_25: 0.7873 -
dense_1_acc_26: 0.7754 - dense_1_acc_27: 0.8020 - dense_1_acc_28: 0.7785 -
dense_1_acc_29: 0.7942 - dense_1_acc_30: 0.8338 - dense_1_acc_31: 0.8140 -
dense_1_acc_32: 0.9116 - dense_1_acc_33: 0.9284 - dense_1_acc_34: 0.9745 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 12/30
15728/15728 [==============================] - 11s 727us/step - loss: 27.4840 -
dense_1_loss: 4.4702e-05 - dense_1_acc: 0.6327 - dense_1_acc_1: 0.7433 -
dense_1_acc_2: 0.7625 - dense_1_acc_3: 0.8440 - dense_1_acc_4: 0.8332 -
dense_1_acc_5: 0.7611 - dense_1_acc_6: 0.8011 - dense_1_acc_7: 0.6937 -
dense_1_acc_8: 0.7986 - dense_1_acc_9: 0.7943 - dense_1_acc_10: 0.8050 -
dense_1_acc_11: 0.8034 - dense_1_acc_12: 0.8499 - dense_1_acc_13: 0.8080 -
dense_1_acc_14: 0.8350 - dense_1_acc_15: 0.8269 - dense_1_acc_16: 0.7808 -
dense_1_acc_17: 0.8487 - dense_1_acc_18: 0.8022 - dense_1_acc_19: 0.8408 -
dense_1_acc_20: 0.8259 - dense_1_acc_21: 0.8440 - dense_1_acc_22: 0.7791 -
dense_1_acc_23: 0.7641 - dense_1_acc_24: 0.7140 - dense_1_acc_25: 0.8004 -
dense_1_acc_26: 0.7821 - dense_1_acc_27: 0.8083 - dense_1_acc_28: 0.7807 -
dense_1_acc_29: 0.8029 - dense_1_acc_30: 0.8349 - dense_1_acc_31: 0.8168 -
dense_1_acc_32: 0.9118 - dense_1_acc_33: 0.9287 - dense_1_acc_34: 0.9751 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 13/30
15728/15728 [==============================] - 11s 718us/step - loss: 25.9378 -
dense_1_loss: 4.6389e-05 - dense_1_acc: 0.6889 - dense_1_acc_1: 0.7505 -
dense_1_acc_2: 0.7702 - dense_1_acc_3: 0.8538 - dense_1_acc_4: 0.8503 -
dense_1_acc_5: 0.7788 - dense_1_acc_6: 0.8190 - dense_1_acc_7: 0.7225 -
dense_1_acc_8: 0.8156 - dense_1_acc_9: 0.8077 - dense_1_acc_10: 0.8175 -
dense_1_acc_11: 0.8235 - dense_1_acc_12: 0.8689 - dense_1_acc_13: 0.8298 -
dense_1_acc_14: 0.8554 - dense_1_acc_15: 0.8438 - dense_1_acc_16: 0.8065 -
dense_1_acc_17: 0.8686 - dense_1_acc_18: 0.8246 - dense_1_acc_19: 0.8588 -
dense_1_acc_20: 0.8376 - dense_1_acc_21: 0.8566 - dense_1_acc_22: 0.7895 -
dense_1_acc_23: 0.7745 - dense_1_acc_24: 0.7249 - dense_1_acc_25: 0.8108 -
dense_1_acc_26: 0.7864 - dense_1_acc_27: 0.8105 - dense_1_acc_28: 0.7826 -
dense_1_acc_29: 0.8117 - dense_1_acc_30: 0.8362 - dense_1_acc_31: 0.8194 -
dense_1_acc_32: 0.9125 - dense_1_acc_33: 0.9298 - dense_1_acc_34: 0.9751 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 14/30
15728/15728 [==============================] - 11s 707us/step - loss: 24.5446 -
dense_1_loss: 4.7083e-05 - dense_1_acc: 0.7093 - dense_1_acc_1: 0.7592 -
dense_1_acc_2: 0.7827 - dense_1_acc_3: 0.8690 - dense_1_acc_4: 0.8664 -
dense_1_acc_5: 0.7897 - dense_1_acc_6: 0.8362 - dense_1_acc_7: 0.7436 -
dense_1_acc_8: 0.8302 - dense_1_acc_9: 0.8229 - dense_1_acc_10: 0.8329 -
dense_1_acc_11: 0.8442 - dense_1_acc_12: 0.8839 - dense_1_acc_13: 0.8486 -
```

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dense_1_acc_14: 0.8723 - dense_1_acc_15: 0.8583 - dense_1_acc_16: 0.8290 -
dense_1_acc_17: 0.8850 - dense_1_acc_18: 0.8422 - dense_1_acc_19: 0.8716 -
dense_1_acc_20: 0.8498 - dense_1_acc_21: 0.8681 - dense_1_acc_22: 0.7984 -
dense_1_acc_23: 0.7830 - dense_1_acc_24: 0.7386 - dense_1_acc_25: 0.8183 -
dense_1_acc_26: 0.7939 - dense_1_acc_27: 0.8166 - dense_1_acc_28: 0.7848 -
dense_1_acc_29: 0.8213 - dense_1_acc_30: 0.8374 - dense_1_acc_31: 0.8252 -
dense_1_acc_32: 0.9127 - dense_1_acc_33: 0.9309 - dense_1_acc_34: 0.9755 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 15/30
15728/15728 [==============================] - 11s 720us/step - loss: 23.3104 -
dense_1_loss: 4.8243e-05 - dense_1_acc: 0.7668 - dense_1_acc_1: 0.7695 -
dense_1_acc_2: 0.7946 - dense_1_acc_3: 0.8774 - dense_1_acc_4: 0.8812 -
dense_1_acc_5: 0.7979 - dense_1_acc_6: 0.8538 - dense_1_acc_7: 0.7672 -
dense_1_acc_8: 0.8396 - dense_1_acc_9: 0.8345 - dense_1_acc_10: 0.8435 -
dense_1_acc_11: 0.8546 - dense_1_acc_12: 0.8950 - dense_1_acc_13: 0.8662 -
dense_1_acc_14: 0.8862 - dense_1_acc_15: 0.8735 - dense_1_acc_16: 0.8529 -
dense_1_acc_17: 0.8965 - dense_1_acc_18: 0.8583 - dense_1_acc_19: 0.8811 -
dense_1_acc_20: 0.8606 - dense_1_acc_21: 0.8756 - dense_1_acc_22: 0.8063 -
dense_1_acc_23: 0.7887 - dense_1_acc_24: 0.7515 - dense_1_acc_25: 0.8258 -
dense_1_acc_26: 0.7993 - dense_1_acc_27: 0.8236 - dense_1_acc_28: 0.7876 -
dense_1_acc_29: 0.8310 - dense_1_acc_30: 0.8393 - dense_1_acc_31: 0.8289 -
dense_1_acc_32: 0.9130 - dense_1_acc_33: 0.9322 - dense_1_acc_34: 0.9759 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 16/30
15728/15728 [==============================] - 11s 700us/step - loss: 22.2001 -
dense_1_loss: 4.7785e-05 - dense_1_acc: 0.8453 - dense_1_acc_1: 0.7782 -
dense_1_acc_2: 0.8030 - dense_1_acc_3: 0.8841 - dense_1_acc_4: 0.8908 -
dense_1_acc_5: 0.8098 - dense_1_acc_6: 0.8657 - dense_1_acc_7: 0.7878 -
dense_1_acc_8: 0.8477 - dense_1_acc_9: 0.8477 - dense_1_acc_10: 0.8558 -
dense_1_acc_11: 0.8681 - dense_1_acc_12: 0.9055 - dense_1_acc_13: 0.8787 -
dense_1_acc_14: 0.8962 - dense_1_acc_15: 0.8884 - dense_1_acc_16: 0.8709 -
dense_1_acc_17: 0.9088 - dense_1_acc_18: 0.8737 - dense_1_acc_19: 0.8915 -
dense_1_acc_20: 0.8702 - dense_1_acc_21: 0.8822 - dense_1_acc_22: 0.8123 -
dense_1_acc_23: 0.7936 - dense_1_acc_24: 0.7584 - dense_1_acc_25: 0.8312 -
dense_1_acc_26: 0.8045 - dense_1_acc_27: 0.8311 - dense_1_acc_28: 0.7912 -
dense_1_acc_29: 0.8387 - dense_1_acc_30: 0.8421 - dense_1_acc_31: 0.8380 -
dense_1_acc_32: 0.9138 - dense_1_acc_33: 0.9343 - dense_1_acc_34: 0.9760 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.00004s - loss: 22.3940 - dense_1_loss: 4.7874e-05 -
dense_1_acc: 0.8255 - dense_1_acc_1: 0.7695 - dense_1_acc_2: 0.7994 -
dense_1_acc_3: 0.8838 - dense_1_acc_4: 0.8885 - dense_1_acc_5: 0.8079 -
dense_1_acc_6: 0.8656 - dense_1_acc_7: 0.7780 - dense_1_acc_8: 0.8506 -
dense_1_acc_9: 0.8456 - dense_1_acc_10: 0.8535 - dense_1_acc_11: 0.8655 -
```

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dense_1_acc_12: 0.9055 - dense_1_acc_13: 0.8779 - dense_1_acc_14: 0.8934 -
dense_1_acc_15: 0.8835 - dense_1_acc_16: 0.8693 - dense_1_acc_17: 0.9083 -
dense_1_acc_18: 0.8719 - dense_1_acc_19: 0.8940 - dense_1_acc_20: 0.8715 -
dense_1_acc_21: 0.8812 - dense_1_acc_22: 0.8126 - dense_1_acc_23: 0.7964 -
dense_1_acc_24: 0.7571 - dense_1_acc_25: 0.8304 - dense_1_acc_26: 0.8052 -
dense_1_acc_27: 0.8300 - dense_1_acc_28: 0.7895 - dense_1_acc_29: 0.8345 -
dense_1_acc_30: 0.8431 - dense_1_acc_31: 0.8334 - dense_1_acc_32: 0.9117 -
dense_1_acc_33: 0.9338 - dense_1_acc_34: 0.9759 - dense_1_acc_35: 0.9941 -
dense_1_acc_36: 0.9998 - dense_1_acc_37: 1.0000 - dense_1_acc_38: 1.0000 -
dense_1_acc_ - ETA: 0s - loss: 22.1933 - dense_1_loss: 4.7862e-05 - dense_1_acc:
0.8450 - dense_1_acc_1: 0.7778 - dense_1_acc_2: 0.8031 - dense_1_acc_3: 0.8845 -
dense_1_acc_4: 0.8907 - dense_1_acc_5: 0.8095 - dense_1_acc_6: 0.8662 -
dense_1_acc_7: 0.7872 - dense_1_acc_8: 0.8474 - dense_1_acc_9: 0.8477 -
dense_1_acc_10: 0.8557 - dense_1_acc_11: 0.8675 - dense_1_acc_12: 0.9054 -
dense_1_acc_13: 0.8783 - dense_1_acc_14: 0.8963 - dense_1_acc_15: 0.8879 -
dense_1_acc_16: 0.8712 - dense_1_acc_17: 0.9086 - dense_1_acc_18: 0.8733 -
dense_1_acc_19: 0.8915 - dense_1_acc_20: 0.8703 - dense_1_acc_21: 0.8826 -
dense_1_acc_22: 0.8121 - dense_1_acc_23: 0.7944 - dense_1_acc_24: 0.7585 -
dense_1_acc_25: 0.8319 - dense_1_acc_26: 0.8048 - dense_1_acc_27: 0.8318 -
dense_1_acc_28: 0.7917 - dense_1_acc_29: 0.8386 - dense_1_acc_30: 0.8424 -
dense_1_acc_31: 0.8377 - dense_1_acc_32: 0.9139 - dense_1_acc_33: 0.9343 -
dense_1_acc_34: 0.9762 - dense_1_acc_35: 0.9946 - dense_1_acc_36: 0.9998 -
dense_1_acc_37: 1.0000 - dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 -
dense_1_acc_40: 1.0000 - dense_1_acc_41: 1.0
Epoch 17/30
15728/15728 [==============================] - 11s 691us/step - loss: 21.1917 -
dense_1_loss: 4.7470e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.7864 -
dense_1_acc_2: 0.8100 - dense_1_acc_3: 0.8902 - dense_1_acc_4: 0.9010 -
dense_1_acc_5: 0.8199 - dense_1_acc_6: 0.8812 - dense_1_acc_7: 0.8102 -
dense_1_acc_8: 0.8545 - dense_1_acc_9: 0.8583 - dense_1_acc_10: 0.8667 -
dense_1_acc_11: 0.8796 - dense_1_acc_12: 0.9124 - dense_1_acc_13: 0.8892 -
dense_1_acc_14: 0.9061 - dense_1_acc_15: 0.8990 - dense_1_acc_16: 0.8839 -
dense_1_acc_17: 0.9179 - dense_1_acc_18: 0.8858 - dense_1_acc_19: 0.8979 -
dense_1_acc_20: 0.8793 - dense_1_acc_21: 0.8891 - dense_1_acc_22: 0.8188 -
dense_1_acc_23: 0.7970 - dense_1_acc_24: 0.7710 - dense_1_acc_25: 0.8357 -
dense_1_acc_26: 0.8133 - dense_1_acc_27: 0.8347 - dense_1_acc_28: 0.7976 -
dense_1_acc_29: 0.8407 - dense_1_acc_30: 0.8443 - dense_1_acc_31: 0.8444 -
dense_1_acc_32: 0.9133 - dense_1_acc_33: 0.9372 - dense_1_acc_34: 0.9760 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.00004s - loss: 21.3437 - dense_1_loss: 4.6998e-05 -
dense_1_acc: 0.8736 - dense_1_acc_1: 0.7830 - dense_1_acc_2: 0.8104 -
dense_1_acc_3: 0.8906 - dense_1_acc_4: 0.8998 - dense_1_acc_5: 0.8149 -
dense_1_acc_6: 0.8796 - dense_1_acc_7: 0.8053 - dense_1_acc_8: 0.8546 -
dense_1_acc_9: 0.8590 - dense_1_acc_10: 0.8662 - dense_1_acc_11: 0.8787 -
dense_1_acc_12: 0.9106 - dense_1_acc_13: 0.8850 - dense_1_acc_14: 0.9037 -
dense_1_acc_15: 0.8918 - dense_1_acc_16: 0.8788 - dense_1_acc_17: 0.9156 -
dense_1_acc_18: 0.8844 - dense_1_acc_19: 0.8970 - dense_1_acc_20: 0.8798 -
```

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dense_1_acc_21: 0.8846 - dense_1_acc_22: 0.8200 - dense_1_acc_23: 0.7976 -
dense_1_acc_24: 0.7669 - dense_1_acc_25: 0.8377 - dense_1_acc_26: 0.8122 -
dense_1_acc_27: 0.8360 - dense_1_acc_28: 0.7930 - dense_1_acc_29: 0.8407 -
dense_1_acc_30: 0.8467 - dense_1_acc_31: 0.8470 - dense_1_acc_32: 0.9156 -
dense_1_acc_33: 0.9366 - dense_1_acc_34: 0.9770 - dense_1_acc_35: 0.9947 -
dense_1_acc_36: 0.9999 - dense_1_acc_37: 1.0000 - dense_1_acc_38: 1.0000 - dense
Epoch 18/30
15728/15728 [==============================] - 11s 710us/step - loss: 20.2860 -
dense_1_loss: 4.8055e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.7979 -
dense_1_acc_2: 0.8185 - dense_1_acc_3: 0.8940 - dense_1_acc_4: 0.9095 -
dense_1_acc_5: 0.8297 - dense_1_acc_6: 0.8900 - dense_1_acc_7: 0.8266 -
dense_1_acc_8: 0.8602 - dense_1_acc_9: 0.8691 - dense_1_acc_10: 0.8732 -
dense_1_acc_11: 0.8899 - dense_1_acc_12: 0.9194 - dense_1_acc_13: 0.8973 -
dense_1_acc_14: 0.9121 - dense_1_acc_15: 0.9111 - dense_1_acc_16: 0.8956 -
dense_1_acc_17: 0.9244 - dense_1_acc_18: 0.8971 - dense_1_acc_19: 0.9049 -
dense_1_acc_20: 0.8868 - dense_1_acc_21: 0.8934 - dense_1_acc_22: 0.8243 -
dense_1_acc_23: 0.8009 - dense_1_acc_24: 0.7796 - dense_1_acc_25: 0.8393 -
dense_1_acc_26: 0.8208 - dense_1_acc_27: 0.8403 - dense_1_acc_28: 0.8026 -
dense_1_acc_29: 0.8428 - dense_1_acc_30: 0.8491 - dense_1_acc_31: 0.8475 -
dense_1_acc_32: 0.9143 - dense_1_acc_33: 0.9386 - dense_1_acc_34: 0.9763 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 19/30
15728/15728 [==============================] - 11s 710us/step - loss: 19.4494 -
dense_1_loss: 4.9212e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8144 -
dense_1_acc_2: 0.8275 - dense_1_acc_3: 0.8987 - dense_1_acc_4: 0.9151 -
dense_1_acc_5: 0.8383 - dense_1_acc_6: 0.8980 - dense_1_acc_7: 0.8445 -
dense_1_acc_8: 0.8673 - dense_1_acc_9: 0.8819 - dense_1_acc_10: 0.8816 -
dense_1_acc_11: 0.8995 - dense_1_acc_12: 0.9250 - dense_1_acc_13: 0.9021 -
dense_1_acc_14: 0.9184 - dense_1_acc_15: 0.9193 - dense_1_acc_16: 0.9051 -
dense_1_acc_17: 0.9293 - dense_1_acc_18: 0.9083 - dense_1_acc_19: 0.9112 -
dense_1_acc_20: 0.8948 - dense_1_acc_21: 0.8968 - dense_1_acc_22: 0.8315 -
dense_1_acc_23: 0.8057 - dense_1_acc_24: 0.7883 - dense_1_acc_25: 0.8401 -
dense_1_acc_26: 0.8285 - dense_1_acc_27: 0.8459 - dense_1_acc_28: 0.8042 -
dense_1_acc_29: 0.8466 - dense_1_acc_30: 0.8524 - dense_1_acc_31: 0.8525 -
dense_1_acc_32: 0.9144 - dense_1_acc_33: 0.9404 - dense_1_acc_34: 0.9762 -
dense_1_acc_35: 0.9948 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 20/30
15728/15728 [==============================] - 11s 709us/step - loss: 18.6995 -
dense_1_loss: 4.8815e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8185 -
dense_1_acc_2: 0.8350 - dense_1_acc_3: 0.9061 - dense_1_acc_4: 0.9194 -
dense_1_acc_5: 0.8491 - dense_1_acc_6: 0.9037 - dense_1_acc_7: 0.8595 -
dense_1_acc_8: 0.8741 - dense_1_acc_9: 0.8913 - dense_1_acc_10: 0.8880 -
dense_1_acc_11: 0.9110 - dense_1_acc_12: 0.9310 - dense_1_acc_13: 0.9072 -
dense_1_acc_14: 0.9238 - dense_1_acc_15: 0.9254 - dense_1_acc_16: 0.9133 -
```

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dense_1_acc_17: 0.9349 - dense_1_acc_18: 0.9165 - dense_1_acc_19: 0.9172 -
dense_1_acc_20: 0.9019 - dense_1_acc_21: 0.9006 - dense_1_acc_22: 0.8344 -
dense_1_acc_23: 0.8104 - dense_1_acc_24: 0.7967 - dense_1_acc_25: 0.8458 -
dense_1_acc_26: 0.8341 - dense_1_acc_27: 0.8504 - dense_1_acc_28: 0.8101 -
dense_1_acc_29: 0.8520 - dense_1_acc_30: 0.8558 - dense_1_acc_31: 0.8561 -
dense_1_acc_32: 0.9164 - dense_1_acc_33: 0.9418 - dense_1_acc_34: 0.9769 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 21/30
15728/15728 [==============================] - 11s 722us/step - loss: 17.9963 -
dense_1_loss: 4.8780e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8344 -
dense_1_acc_2: 0.8448 - dense_1_acc_3: 0.9125 - dense_1_acc_4: 0.9241 -
dense_1_acc_5: 0.8603 - dense_1_acc_6: 0.9103 - dense_1_acc_7: 0.8739 -
dense_1_acc_8: 0.8806 - dense_1_acc_9: 0.9003 - dense_1_acc_10: 0.8954 -
dense_1_acc_11: 0.9179 - dense_1_acc_12: 0.9340 - dense_1_acc_13: 0.9101 -
dense_1_acc_14: 0.9306 - dense_1_acc_15: 0.9304 - dense_1_acc_16: 0.9199 -
dense_1_acc_17: 0.9404 - dense_1_acc_18: 0.9243 - dense_1_acc_19: 0.9239 -
dense_1_acc_20: 0.9083 - dense_1_acc_21: 0.9037 - dense_1_acc_22: 0.8395 -
dense_1_acc_23: 0.8166 - dense_1_acc_24: 0.8072 - dense_1_acc_25: 0.8473 -
dense_1_acc_26: 0.8387 - dense_1_acc_27: 0.8550 - dense_1_acc_28: 0.8148 -
dense_1_acc_29: 0.8568 - dense_1_acc_30: 0.8584 - dense_1_acc_31: 0.8602 -
dense_1_acc_32: 0.9175 - dense_1_acc_33: 0.9430 - dense_1_acc_34: 0.9768 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 22/30
15728/15728 [==============================] - 12s 781us/step - loss: 17.3492 -
dense_1_loss: 4.7775e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8443 -
dense_1_acc_2: 0.8504 - dense_1_acc_3: 0.9190 - dense_1_acc_4: 0.9292 -
dense_1_acc_5: 0.8701 - dense_1_acc_6: 0.9154 - dense_1_acc_7: 0.8889 -
dense_1_acc_8: 0.8876 - dense_1_acc_9: 0.9086 - dense_1_acc_10: 0.9031 -
dense_1_acc_11: 0.9250 - dense_1_acc_12: 0.9390 - dense_1_acc_13: 0.9141 -
dense_1_acc_14: 0.9372 - dense_1_acc_15: 0.9344 - dense_1_acc_16: 0.9254 -
dense_1_acc_17: 0.9446 - dense_1_acc_18: 0.9310 - dense_1_acc_19: 0.9307 -
dense_1_acc_20: 0.9163 - dense_1_acc_21: 0.9071 - dense_1_acc_22: 0.8438 -
dense_1_acc_23: 0.8237 - dense_1_acc_24: 0.8156 - dense_1_acc_25: 0.8510 -
dense_1_acc_26: 0.8442 - dense_1_acc_27: 0.8587 - dense_1_acc_28: 0.8170 -
dense_1_acc_29: 0.8620 - dense_1_acc_30: 0.8603 - dense_1_acc_31: 0.8650 -
dense_1_acc_32: 0.9177 - dense_1_acc_33: 0.9438 - dense_1_acc_34: 0.9774 -
dense_1_acc_35: 0.9948 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 23/30
15728/15728 [==============================] - 11s 699us/step - loss: 16.7543 -
dense_1_loss: 4.7558e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8468 -
dense_1_acc_2: 0.8561 - dense_1_acc_3: 0.9227 - dense_1_acc_4: 0.9342 -
dense_1_acc_5: 0.8800 - dense_1_acc_6: 0.9218 - dense_1_acc_7: 0.8995 -
```

```
dense_1_acc_8: 0.8966 - dense_1_acc_9: 0.9150 - dense_1_acc_10: 0.9102 -
dense_1_acc_11: 0.9311 - dense_1_acc_12: 0.9416 - dense_1_acc_13: 0.9177 -
dense_1_acc_14: 0.9409 - dense_1_acc_15: 0.9385 - dense_1_acc_16: 0.9296 -
dense_1_acc_17: 0.9473 - dense_1_acc_18: 0.9350 - dense_1_acc_19: 0.9369 -
dense_1_acc_20: 0.9208 - dense_1_acc_21: 0.9113 - dense_1_acc_22: 0.8469 -
dense_1_acc_23: 0.8293 - dense_1_acc_24: 0.8234 - dense_1_acc_25: 0.8538 -
dense_1_acc_26: 0.8467 - dense_1_acc_27: 0.8644 - dense_1_acc_28: 0.8207 -
dense_1_acc_29: 0.8660 - dense_1_acc_30: 0.8619 - dense_1_acc_31: 0.8670 -
dense_1_acc_32: 0.9196 - dense_1_acc_33: 0.9449 - dense_1_acc_34: 0.9777 -
dense_1_acc_35: 0.9948 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 24/30
15728/15728 [==============================] - 12s 732us/step - loss: 16.1938 -
dense_1_loss: 4.7154e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8476 -
dense_1_acc_2: 0.8607 - dense_1_acc_3: 0.9275 - dense_1_acc_4: 0.9399 -
dense_1_acc_5: 0.8881 - dense_1_acc_6: 0.9269 - dense_1_acc_7: 0.9116 -
dense_1_acc_8: 0.9023 - dense_1_acc_9: 0.9215 - dense_1_acc_10: 0.9174 -
dense_1_acc_11: 0.9359 - dense_1_acc_12: 0.9440 - dense_1_acc_13: 0.9229 -
dense_1_acc_14: 0.9447 - dense_1_acc_15: 0.9417 - dense_1_acc_16: 0.9348 -
dense_1_acc_17: 0.9521 - dense_1_acc_18: 0.9396 - dense_1_acc_19: 0.9423 -
dense_1_acc_20: 0.9254 - dense_1_acc_21: 0.9135 - dense_1_acc_22: 0.8527 -
dense_1_acc_23: 0.8344 - dense_1_acc_24: 0.8309 - dense_1_acc_25: 0.8562 -
dense_1_acc_26: 0.8522 - dense_1_acc_27: 0.8668 - dense_1_acc_28: 0.8225 -
dense_1_acc_29: 0.8728 - dense_1_acc_30: 0.8639 - dense_1_acc_31: 0.8715 -
dense_1_acc_32: 0.9207 - dense_1_acc_33: 0.9461 - dense_1_acc_34: 0.9776 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 25/30
15728/15728 [==============================] - 12s 741us/step - loss: 15.6700 -
dense_1_loss: 4.6187e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8506 -
dense_1_acc_2: 0.8688 - dense_1_acc_3: 0.9346 - dense_1_acc_4: 0.9452 -
dense_1_acc_5: 0.8950 - dense_1_acc_6: 0.9317 - dense_1_acc_7: 0.9207 -
dense_1_acc_8: 0.9117 - dense_1_acc_9: 0.9288 - dense_1_acc_10: 0.9217 -
dense_1_acc_11: 0.9414 - dense_1_acc_12: 0.9470 - dense_1_acc_13: 0.9273 -
dense_1_acc_14: 0.9502 - dense_1_acc_15: 0.9451 - dense_1_acc_16: 0.9397 -
dense_1_acc_17: 0.9552 - dense_1_acc_18: 0.9429 - dense_1_acc_19: 0.9456 -
dense_1_acc_20: 0.9296 - dense_1_acc_21: 0.9166 - dense_1_acc_22: 0.8575 -
dense_1_acc_23: 0.8412 - dense_1_acc_24: 0.8383 - dense_1_acc_25: 0.8599 -
dense_1_acc_26: 0.8552 - dense_1_acc_27: 0.8711 - dense_1_acc_28: 0.8250 -
dense_1_acc_29: 0.8757 - dense_1_acc_30: 0.8657 - dense_1_acc_31: 0.8734 -
dense_1_acc_32: 0.9228 - dense_1_acc_33: 0.9467 - dense_1_acc_34: 0.9779 -
dense_1_acc_35: 0.9948 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 26/30
15728/15728 [==============================] - 11s 700us/step - loss: 15.1804 -
```

```
dense_1_loss: 4.5592e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8512 -
dense_1_acc_2: 0.8704 - dense_1_acc_3: 0.9366 - dense_1_acc_4: 0.9484 -
dense_1_acc_5: 0.9030 - dense_1_acc_6: 0.9368 - dense_1_acc_7: 0.9284 -
dense_1_acc_8: 0.9179 - dense_1_acc_9: 0.9349 - dense_1_acc_10: 0.9269 -
dense_1_acc_11: 0.9451 - dense_1_acc_12: 0.9486 - dense_1_acc_13: 0.9320 -
dense_1_acc_14: 0.9532 - dense_1_acc_15: 0.9482 - dense_1_acc_16: 0.9440 -
dense_1_acc_17: 0.9573 - dense_1_acc_18: 0.9449 - dense_1_acc_19: 0.9489 -
dense_1_acc_20: 0.9323 - dense_1_acc_21: 0.9203 - dense_1_acc_22: 0.8629 -
dense_1_acc_23: 0.8484 - dense_1_acc_24: 0.8456 - dense_1_acc_25: 0.8619 -
dense_1_acc_26: 0.8584 - dense_1_acc_27: 0.8753 - dense_1_acc_28: 0.8291 -
dense_1_acc_29: 0.8809 - dense_1_acc_30: 0.8675 - dense_1_acc_31: 0.8761 -
dense_1_acc_32: 0.9238 - dense_1_acc_33: 0.9470 - dense_1_acc_34: 0.9780 -
dense_1_acc_35: 0.9948 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 27/30
15728/15728 [==============================] - 11s 717us/step - loss: 14.7202 -
dense_1_loss: 4.3795e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8589 -
dense_1_acc_2: 0.8753 - dense_1_acc_3: 0.9392 - dense_1_acc_4: 0.9511 -
dense_1_acc_5: 0.9101 - dense_1_acc_6: 0.9404 - dense_1_acc_7: 0.9351 -
dense_1_acc_8: 0.9228 - dense_1_acc_9: 0.9386 - dense_1_acc_10: 0.9315 -
dense_1_acc_11: 0.9484 - dense_1_acc_12: 0.9509 - dense_1_acc_13: 0.9359 -
dense_1_acc_14: 0.9560 - dense_1_acc_15: 0.9514 - dense_1_acc_16: 0.9485 -
dense_1_acc_17: 0.9601 - dense_1_acc_18: 0.9488 - dense_1_acc_19: 0.9520 -
dense_1_acc_20: 0.9376 - dense_1_acc_21: 0.9231 - dense_1_acc_22: 0.8695 -
dense_1_acc_23: 0.8532 - dense_1_acc_24: 0.8539 - dense_1_acc_25: 0.8659 -
dense_1_acc_26: 0.8636 - dense_1_acc_27: 0.8772 - dense_1_acc_28: 0.8335 -
dense_1_acc_29: 0.8839 - dense_1_acc_30: 0.8687 - dense_1_acc_31: 0.8782 -
dense_1_acc_32: 0.9250 - dense_1_acc_33: 0.9478 - dense_1_acc_34: 0.9781 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
Epoch 28/30
15728/15728 [==============================] - 11s 694us/step - loss: 14.2917 -
dense_1_loss: 4.2388e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8595 -
dense_1_acc_2: 0.8834 - dense_1_acc_3: 0.9439 - dense_1_acc_4: 0.9532 -
dense_1_acc_5: 0.9175 - dense_1_acc_6: 0.9432 - dense_1_acc_7: 0.9409 -
dense_1_acc_8: 0.9270 - dense_1_acc_9: 0.9447 - dense_1_acc_10: 0.9365 -
dense_1_acc_11: 0.9526 - dense_1_acc_12: 0.9518 - dense_1_acc_13: 0.9400 -
dense_1_acc_14: 0.9587 - dense_1_acc_15: 0.9543 - dense_1_acc_16: 0.9538 -
dense_1_acc_17: 0.9618 - dense_1_acc_18: 0.9510 - dense_1_acc_19: 0.9547 -
dense_1_acc_20: 0.9413 - dense_1_acc_21: 0.9277 - dense_1_acc_22: 0.8743 -
dense_1_acc_23: 0.8592 - dense_1_acc_24: 0.8597 - dense_1_acc_25: 0.8679 -
dense_1_acc_26: 0.8665 - dense_1_acc_27: 0.8796 - dense_1_acc_28: 0.8372 -
dense_1_acc_29: 0.8895 - dense_1_acc_30: 0.8703 - dense_1_acc_31: 0.8799 -
dense_1_acc_32: 0.9274 - dense_1_acc_33: 0.9486 - dense_1_acc_34: 0.9784 -
dense_1_acc_35: 0.9948 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
```

```
dense_1_acc_41: 1.0000
Epoch 29/30
15728/15728 [==============================] - 11s 713us/step - loss: 13.8834 -
dense_1_loss: 4.1117e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8595 -
dense_1_acc_2: 0.8903 - dense_1_acc_3: 0.9447 - dense_1_acc_4: 0.9550 -
dense_1_acc_5: 0.9258 - dense_1_acc_6: 0.9454 - dense_1_acc_7: 0.9462 -
dense_1_acc_8: 0.9310 - dense_1_acc_9: 0.9481 - dense_1_acc_10: 0.9403 -
dense_1_acc_11: 0.9547 - dense_1_acc_12: 0.9540 - dense_1_acc_13: 0.9427 -
dense_1_acc_14: 0.9617 - dense_1_acc_15: 0.9568 - dense_1_acc_16: 0.9584 -
dense_1_acc_17: 0.9638 - dense_1_acc_18: 0.9543 - dense_1_acc_19: 0.9571 -
dense_1_acc_20: 0.9437 - dense_1_acc_21: 0.9311 - dense_1_acc_22: 0.8817 -
dense_1_acc_23: 0.8653 - dense_1_acc_24: 0.8657 - dense_1_acc_25: 0.8721 -
dense_1_acc_26: 0.8697 - dense_1_acc_27: 0.8836 - dense_1_acc_28: 0.8386 -
dense_1_acc_29: 0.8922 - dense_1_acc_30: 0.8725 - dense_1_acc_31: 0.8823 -
dense_1_acc_32: 0.9276 - dense_1_acc_33: 0.9488 - dense_1_acc_34: 0.9784 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.000010s - loss: 14.2374 - dense_1_loss: 4.2196e-05 -
dense_1_acc: 0.8800 - dense_1_acc_1: 0.8650 - dense_1_acc_2: 0.8825 -
dense_1_acc_3: 0.9525 - dense_1_acc_4: 0.9663 - dense_1_acc_5: 0.9100 -
dense_1_acc_6: 0.9387 - dense_1_acc_7: 0.9388 - dense_1_acc_8: 0.9313 -
dense_1_acc_9: 0.9425 - dense_1_acc_10: 0.9338 - dense_1_acc_11: 0.9487 -
dense_1_acc_12: 0.9487 - dense_1_acc_13: 0.9363 - dense_1_acc_14: 0.9613 -
dense_1_acc_15: 0.9525 - dense_1_acc_16: 0.9488 - dense_1_acc_17: 0.9638 -
dense_1_acc_18: 0.9550 - dense_1_acc_19: 0.9688 - dense_1_acc_20: 0.9450 -
dense_1_acc_21: 0.9325 - dense_1_acc_22: 0.8713 - dense_1_acc_23: 0.8487 -
dense_1_acc_24: 0.8562 - dense_1_acc_25: 0.8638 - dense_1_acc_26: 0.8750 -
dense_1_acc_27: 0.8838 - dense_1_acc_28: 0.8200 - dense_1_acc_29: 0.8850 -
dense_1_acc_30: 0.8538 - dense_1_acc_31: 0.9000 - dense_1_acc_32: 0.9200 -
dense_1_acc_33: 0.9412 - dense_1_acc_34: 0.9813 - dense_1_acc_35: 0.99
Epoch 30/30
15728/15728 [==============================] - 11s 715us/step - loss: 13.5032 -
dense_1_loss: 3.8915e-05 - dense_1_acc: 0.8729 - dense_1_acc_1: 0.8595 -
dense_1_acc_2: 0.8948 - dense_1_acc_3: 0.9463 - dense_1_acc_4: 0.9575 -
dense_1_acc_5: 0.9325 - dense_1_acc_6: 0.9487 - dense_1_acc_7: 0.9496 -
dense_1_acc_8: 0.9319 - dense_1_acc_9: 0.9505 - dense_1_acc_10: 0.9442 -
dense_1_acc_11: 0.9578 - dense_1_acc_12: 0.9551 - dense_1_acc_13: 0.9450 -
dense_1_acc_14: 0.9635 - dense_1_acc_15: 0.9587 - dense_1_acc_16: 0.9603 -
dense_1_acc_17: 0.9655 - dense_1_acc_18: 0.9557 - dense_1_acc_19: 0.9586 -
dense_1_acc_20: 0.9474 - dense_1_acc_21: 0.9344 - dense_1_acc_22: 0.8865 -
dense_1_acc_23: 0.8709 - dense_1_acc_24: 0.8726 - dense_1_acc_25: 0.8754 -
dense_1_acc_26: 0.8726 - dense_1_acc_27: 0.8870 - dense_1_acc_28: 0.8424 -
dense_1_acc_29: 0.8957 - dense_1_acc_30: 0.8728 - dense_1_acc_31: 0.8842 -
dense_1_acc_32: 0.9289 - dense_1_acc_33: 0.9491 - dense_1_acc_34: 0.9786 -
dense_1_acc_35: 0.9947 - dense_1_acc_36: 0.9997 - dense_1_acc_37: 1.0000 -
dense_1_acc_38: 1.0000 - dense_1_acc_39: 1.0000 - dense_1_acc_40: 1.0000 -
dense_1_acc_41: 1.0000
```

[4]:
```
print('Decrypting holdout (test) samples ....')
predicts_test = model.predict(X_test, vocab, inv_vocab)
print("--- Test Sample score %s ---" % score(predicts_test, y_test))
```

```
Decrypting holdout (test) samples …
--- Test Sample score 0.9329268292682927 ---
```

[5]:
```
print('Decrypting all samples ....')
predicts = model.predict(cipher, vocab, inv_vocab)
print("--- Entire dataset score %s ---" % score(predicts, plain))
```

```
Decrypting all samples …
--- Entire dataset score 0.92474365234375 ---
```

0.0.2 Using Pretrained model

[6]:
```
model.load_model()
```

[7]:
```
print('Decrypting holdout (test) samples ....')
predicts_test = model.predict(X_test, vocab, inv_vocab)
print("--- Test Sample score %s ---" % score(predicts_test, y_test))

print('Decrypting all samples ....')
predicts = model.predict(cipher, vocab, inv_vocab)
print("--- Entire dataset score %s ---" % score(predicts, plain))
```

```
Decrypting holdout (test) samples …
--- Test Sample score 0.9908536585365854 ---
Decrypting all samples …
--- Entire dataset score 0.99017333984375 ---
```

[ ]:
```

```