

mnist_noise-current-Copy1

October 6, 2020

```
[1]: '''  
    VARIABLE: METHOD OF DR  
  
    CONSTANT: N_EPOCHS, N_COMPONENTS, NOISE TYPE AND MAGNITUDE  
              (30)      (30)      (SPECKLE, std=0.1)  
  
    '''
```

```
[1]: '\nVARIABLE: METHOD OF DR\n\nCONSTANT: N_EPOCHS, N_COMPONENTS, NOISE TYPE AND  
MAGNITUDE\n\n'
```

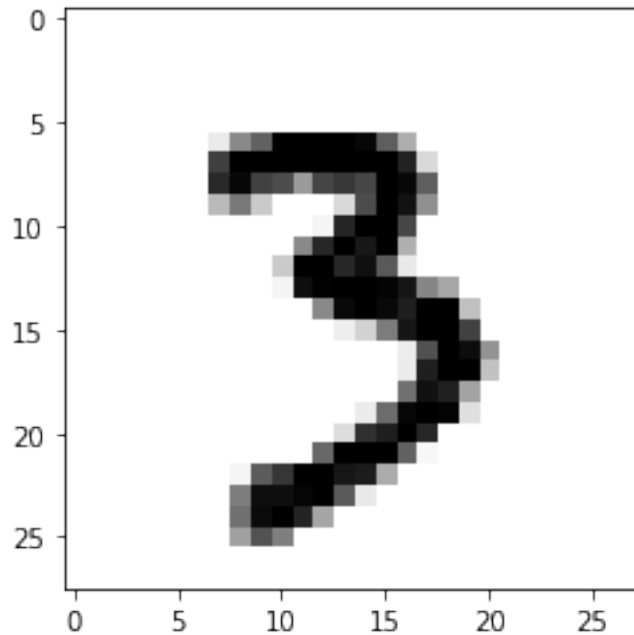
```
[2]: # -- IMPORTS -- #  
import math  
import scipy  
import numpy as np  
from skimage import util  
import matplotlib.pyplot as plt  
from keras.datasets import mnist  
from keras.utils import to_categorical
```

Using TensorFlow backend.

```
[3]: # -- TRAIN AND TEST DATA PREPARATION -- #  
(x_train, y_train), (x_test, y_test) = mnist.load_data()  
x_test_noisy = np.empty((len(x_test),28,28),dtype="float64")  
  
std = 0.1  
for i in range(len(x_test)):  
    x_test_noisy[i] = util.random_noise(x_test[i],mode="speckle",var=std**2)
```

```
[4]: # -- OUTPUT SNR AND SAMPLE NOISY IMAGE -- #  
p_signal = np.mean(x_test[30])  
p_noise = std  
snr = 10 * math.log(p_signal/p_noise,10)  
print(snr)  
  
plt.imshow(x_test_noisy[30],cmap=plt.cm.binary)  
plt.show()
```

25.023887949131005



```
[5]: # -- CONVERTING DATA FOR INPUT INTO NEURAL NETWORK -- #
```

```
x_train = x_train.reshape((60000,28*28))
x_train = x_train.astype("float32") / 255

x_test = x_test.reshape((10000,28*28))
x_test_noisy = x_test_noisy.reshape((10000,28*28))

y_train = to_categorical(y_train)
y_test = to_categorical(y_test)
```

```
[6]: # -- DIMENSIONALITY REDUCTION -- #
```

```
import dim_reduction
x_train0, x_test_noisy0 = x_train.copy(), x_test_noisy.copy()
x_train1, x_test_noisy1 = dim_reduction.apply(30, x_train, x_test_noisy, "PCA")
x_train2, x_test_noisy2 = dim_reduction.apply(30, x_train, x_test_noisy, "FA")
x_train3, x_test_noisy3 = dim_reduction.apply(30, x_train, x_test_noisy, "ICA")
```

```
C:\Users\Carl\.conda\envs\tf\lib\site-
packages\sklearn\decomposition\_fastica.py:120: ConvergenceWarning: FastICA did
not converge. Consider increasing tolerance or the maximum number of iterations.
ConvergenceWarning)
```

```
[7]: # -- NEURAL NETWORK -- #
```

```
import neural_network
```

```

history0 = neural_network.fit(784, 30, x_train0, y_train, x_test_noisy0, y_test)
history1 = neural_network.fit(30, 30, x_train1, y_train, x_test_noisy1, y_test)
history2 = neural_network.fit(30, 30, x_train2, y_train, x_test_noisy2, y_test)
history3 = neural_network.fit(30, 30, x_train3, y_train, x_test_noisy3, y_test)

```

Train on 60000 samples, validate on 10000 samples

Epoch 1/30

60000/60000 [=====] - 1s 16us/step - loss: 1.5959 - accuracy: 0.6132 - val_loss: 1.0231 - val_accuracy: 0.8123

Epoch 2/30

60000/60000 [=====] - 1s 15us/step - loss: 0.7628 - accuracy: 0.8375 - val_loss: 0.5656 - val_accuracy: 0.8741

Epoch 3/30

60000/60000 [=====] - 1s 15us/step - loss: 0.4922 - accuracy: 0.8794 - val_loss: 0.4177 - val_accuracy: 0.8992

Epoch 4/30

60000/60000 [=====] - 1s 15us/step - loss: 0.3929 - accuracy: 0.8973 - val_loss: 0.3531 - val_accuracy: 0.9112

Epoch 5/30

60000/60000 [=====] - 1s 15us/step - loss: 0.3439 - accuracy: 0.9078 - val_loss: 0.3183 - val_accuracy: 0.9166

Epoch 6/30

60000/60000 [=====] - 1s 15us/step - loss: 0.3139 - accuracy: 0.9148 - val_loss: 0.2956 - val_accuracy: 0.9201

Epoch 7/30

60000/60000 [=====] - 1s 14us/step - loss: 0.2924 - accuracy: 0.9198 - val_loss: 0.2801 - val_accuracy: 0.9228

Epoch 8/30

60000/60000 [=====] - 1s 14us/step - loss: 0.2756 - accuracy: 0.9237 - val_loss: 0.2649 - val_accuracy: 0.9260

Epoch 9/30

60000/60000 [=====] - 1s 14us/step - loss: 0.2617 - accuracy: 0.9273 - val_loss: 0.2521 - val_accuracy: 0.9300

Epoch 10/30

60000/60000 [=====] - 1s 16us/step - loss: 0.2499 - accuracy: 0.9306 - val_loss: 0.2421 - val_accuracy: 0.9313

Epoch 11/30

60000/60000 [=====] - 1s 15us/step - loss: 0.2394 - accuracy: 0.9341 - val_loss: 0.2350 - val_accuracy: 0.9339

Epoch 12/30

60000/60000 [=====] - 1s 15us/step - loss: 0.2301 - accuracy: 0.9366 - val_loss: 0.2252 - val_accuracy: 0.9371

Epoch 13/30

60000/60000 [=====] - 1s 16us/step - loss: 0.2217 - accuracy: 0.9389 - val_loss: 0.2175 - val_accuracy: 0.9389

Epoch 14/30

60000/60000 [=====] - 1s 14us/step - loss: 0.2140 -

accuracy: 0.9411 - val_loss: 0.2113 - val_accuracy: 0.9395
 Epoch 15/30
 60000/60000 [=====] - 1s 14us/step - loss: 0.2067 -
 accuracy: 0.9431 - val_loss: 0.2055 - val_accuracy: 0.9419
 Epoch 16/30
 60000/60000 [=====] - 1s 14us/step - loss: 0.2000 -
 accuracy: 0.9449 - val_loss: 0.2005 - val_accuracy: 0.9429
 Epoch 17/30
 60000/60000 [=====] - 1s 14us/step - loss: 0.1939 -
 accuracy: 0.9469 - val_loss: 0.1940 - val_accuracy: 0.9449
 Epoch 18/30
 60000/60000 [=====] - 1s 14us/step - loss: 0.1880 -
 accuracy: 0.9481 - val_loss: 0.1893 - val_accuracy: 0.9465
 Epoch 19/30
 60000/60000 [=====] - 1s 14us/step - loss: 0.1826 -
 accuracy: 0.9497 - val_loss: 0.1838 - val_accuracy: 0.9485
 Epoch 20/30
 60000/60000 [=====] - 1s 14us/step - loss: 0.1772 -
 accuracy: 0.9512 - val_loss: 0.1794 - val_accuracy: 0.9489
 Epoch 21/30
 60000/60000 [=====] - 1s 15us/step - loss: 0.1724 -
 accuracy: 0.9526 - val_loss: 0.1758 - val_accuracy: 0.9497
 Epoch 22/30
 60000/60000 [=====] - 1s 16us/step - loss: 0.1676 -
 accuracy: 0.9532 - val_loss: 0.1714 - val_accuracy: 0.9499
 Epoch 23/30
 60000/60000 [=====] - 1s 15us/step - loss: 0.1633 -
 accuracy: 0.9547 - val_loss: 0.1677 - val_accuracy: 0.9515
 Epoch 24/30
 60000/60000 [=====] - 1s 15us/step - loss: 0.1592 -
 accuracy: 0.9556 - val_loss: 0.1644 - val_accuracy: 0.9511
 Epoch 25/30
 60000/60000 [=====] - 1s 15us/step - loss: 0.1551 -
 accuracy: 0.9567 - val_loss: 0.1610 - val_accuracy: 0.9536
 Epoch 26/30
 60000/60000 [=====] - 1s 15us/step - loss: 0.1512 -
 accuracy: 0.9578 - val_loss: 0.1577 - val_accuracy: 0.9537
 Epoch 27/30
 60000/60000 [=====] - 1s 18us/step - loss: 0.1477 -
 accuracy: 0.9589 - val_loss: 0.1559 - val_accuracy: 0.9541
 Epoch 28/30
 60000/60000 [=====] - 1s 16us/step - loss: 0.1443 -
 accuracy: 0.9594 - val_loss: 0.1518 - val_accuracy: 0.9555
 Epoch 29/30
 60000/60000 [=====] - 1s 15us/step - loss: 0.1409 -
 accuracy: 0.9606 - val_loss: 0.1499 - val_accuracy: 0.9547
 Epoch 30/30
 60000/60000 [=====] - 1s 15us/step - loss: 0.1378 -

accuracy: 0.9615 - val_loss: 0.1466 - val_accuracy: 0.9574
 Train on 60000 samples, validate on 10000 samples
 Epoch 1/30
 60000/60000 [=====] - 0s 7us/step - loss: 2.8295 -
 accuracy: 0.2147 - val_loss: 2.0149 - val_accuracy: 0.3561
 Epoch 2/30
 60000/60000 [=====] - 0s 5us/step - loss: 1.5895 -
 accuracy: 0.5065 - val_loss: 1.1773 - val_accuracy: 0.6379
 Epoch 3/30
 60000/60000 [=====] - 0s 4us/step - loss: 0.9694 -
 accuracy: 0.7133 - val_loss: 0.7735 - val_accuracy: 0.7838
 Epoch 4/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.6760 -
 accuracy: 0.8096 - val_loss: 0.5794 - val_accuracy: 0.8425
 Epoch 5/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.5325 -
 accuracy: 0.8494 - val_loss: 0.4780 - val_accuracy: 0.8671
 Epoch 6/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.4528 -
 accuracy: 0.8701 - val_loss: 0.4178 - val_accuracy: 0.8833
 Epoch 7/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.4033 -
 accuracy: 0.8824 - val_loss: 0.3790 - val_accuracy: 0.8938
 Epoch 8/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.3696 -
 accuracy: 0.8915 - val_loss: 0.3511 - val_accuracy: 0.8988
 Epoch 9/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.3442 -
 accuracy: 0.8985 - val_loss: 0.3299 - val_accuracy: 0.9045
 Epoch 10/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.3246 -
 accuracy: 0.9042 - val_loss: 0.3133 - val_accuracy: 0.9091
 Epoch 11/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.3086 -
 accuracy: 0.9083 - val_loss: 0.3001 - val_accuracy: 0.9117
 Epoch 12/30
 60000/60000 [=====] - 0s 6us/step - loss: 0.2952 -
 accuracy: 0.9123 - val_loss: 0.2883 - val_accuracy: 0.9151
 Epoch 13/30
 60000/60000 [=====] - 0s 6us/step - loss: 0.2834 -
 accuracy: 0.9162 - val_loss: 0.2780 - val_accuracy: 0.9188
 Epoch 14/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.2730 -
 accuracy: 0.9193 - val_loss: 0.2693 - val_accuracy: 0.9208
 Epoch 15/30
 60000/60000 [=====] - 0s 5us/step - loss: 0.2638 -
 accuracy: 0.9216 - val_loss: 0.2613 - val_accuracy: 0.9223
 Epoch 16/30

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60000/60000 [=====] - 0s 5us/step - loss: 0.2556 -
accuracy: 0.9244 - val_loss: 0.2543 - val_accuracy: 0.9238
Epoch 17/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2480 -
accuracy: 0.9264 - val_loss: 0.2479 - val_accuracy: 0.9260
Epoch 18/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2410 -
accuracy: 0.9283 - val_loss: 0.2419 - val_accuracy: 0.9286
Epoch 19/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2346 -
accuracy: 0.9307 - val_loss: 0.2366 - val_accuracy: 0.9309
Epoch 20/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2287 -
accuracy: 0.9320 - val_loss: 0.2316 - val_accuracy: 0.9324
Epoch 21/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2231 -
accuracy: 0.9339 - val_loss: 0.2270 - val_accuracy: 0.9335
Epoch 22/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2181 -
accuracy: 0.9353 - val_loss: 0.2226 - val_accuracy: 0.9350
Epoch 23/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2133 -
accuracy: 0.9369 - val_loss: 0.2187 - val_accuracy: 0.9364
Epoch 24/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2087 -
accuracy: 0.9382 - val_loss: 0.2148 - val_accuracy: 0.9379
Epoch 25/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2045 -
accuracy: 0.9389 - val_loss: 0.2112 - val_accuracy: 0.9390
Epoch 26/30
60000/60000 [=====] - 0s 4us/step - loss: 0.2005 -
accuracy: 0.9400 - val_loss: 0.2078 - val_accuracy: 0.9400
Epoch 27/30
60000/60000 [=====] - 0s 4us/step - loss: 0.1967 -
accuracy: 0.9413 - val_loss: 0.2046 - val_accuracy: 0.9405
Epoch 28/30
60000/60000 [=====] - 0s 4us/step - loss: 0.1931 -
accuracy: 0.9418 - val_loss: 0.2015 - val_accuracy: 0.9425
Epoch 29/30
60000/60000 [=====] - 0s 5us/step - loss: 0.1896 -
accuracy: 0.9431 - val_loss: 0.1987 - val_accuracy: 0.9424
Epoch 30/30
60000/60000 [=====] - 0s 5us/step - loss: 0.1864 -
accuracy: 0.9434 - val_loss: 0.1961 - val_accuracy: 0.9436
Train on 60000 samples, validate on 10000 samples
Epoch 1/30
60000/60000 [=====] - 0s 5us/step - loss: 2.2081 -
accuracy: 0.1996 - val_loss: 2.0231 - val_accuracy: 0.3303

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Epoch 2/30
60000/60000 [=====] - 0s 5us/step - loss: 1.8530 -
accuracy: 0.4662 - val_loss: 1.6971 - val_accuracy: 0.5942

Epoch 3/30
60000/60000 [=====] - 0s 5us/step - loss: 1.5454 -
accuracy: 0.6719 - val_loss: 1.4113 - val_accuracy: 0.7452

Epoch 4/30
60000/60000 [=====] - 0s 4us/step - loss: 1.2799 -
accuracy: 0.7731 - val_loss: 1.1663 - val_accuracy: 0.8051

Epoch 5/30
60000/60000 [=====] - 0s 5us/step - loss: 1.0571 -
accuracy: 0.8189 - val_loss: 0.9626 - val_accuracy: 0.8365

Epoch 6/30
60000/60000 [=====] - 0s 5us/step - loss: 0.8765 -
accuracy: 0.8414 - val_loss: 0.7997 - val_accuracy: 0.8533

Epoch 7/30
60000/60000 [=====] - 0s 4us/step - loss: 0.7351 -
accuracy: 0.8559 - val_loss: 0.6741 - val_accuracy: 0.8652

Epoch 8/30
60000/60000 [=====] - 0s 5us/step - loss: 0.6272 -
accuracy: 0.8678 - val_loss: 0.5789 - val_accuracy: 0.8756

Epoch 9/30
60000/60000 [=====] - 0s 5us/step - loss: 0.5458 -
accuracy: 0.8770 - val_loss: 0.5072 - val_accuracy: 0.8864

Epoch 10/30
60000/60000 [=====] - 0s 5us/step - loss: 0.4843 -
accuracy: 0.8847 - val_loss: 0.4538 - val_accuracy: 0.8927

Epoch 11/30
60000/60000 [=====] - 0s 5us/step - loss: 0.4381 -
accuracy: 0.8908 - val_loss: 0.4135 - val_accuracy: 0.8970

Epoch 12/30
60000/60000 [=====] - 0s 5us/step - loss: 0.4027 -
accuracy: 0.8964 - val_loss: 0.3826 - val_accuracy: 0.9024

Epoch 13/30
60000/60000 [=====] - 0s 5us/step - loss: 0.3751 -
accuracy: 0.9010 - val_loss: 0.3586 - val_accuracy: 0.9063

Epoch 14/30
60000/60000 [=====] - 0s 5us/step - loss: 0.3529 -
accuracy: 0.9050 - val_loss: 0.3391 - val_accuracy: 0.9082

Epoch 15/30
60000/60000 [=====] - 0s 5us/step - loss: 0.3349 -
accuracy: 0.9081 - val_loss: 0.3232 - val_accuracy: 0.9104

Epoch 16/30
60000/60000 [=====] - 0s 5us/step - loss: 0.3199 -
accuracy: 0.9104 - val_loss: 0.3100 - val_accuracy: 0.9132

Epoch 17/30
60000/60000 [=====] - 0s 4us/step - loss: 0.3072 -
accuracy: 0.9134 - val_loss: 0.2987 - val_accuracy: 0.9153

Epoch 18/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2962 -
accuracy: 0.9158 - val_loss: 0.2889 - val_accuracy: 0.9172

Epoch 19/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2865 -
accuracy: 0.9184 - val_loss: 0.2802 - val_accuracy: 0.9202

Epoch 20/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2779 -
accuracy: 0.9201 - val_loss: 0.2725 - val_accuracy: 0.9218

Epoch 21/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2701 -
accuracy: 0.9222 - val_loss: 0.2655 - val_accuracy: 0.9238

Epoch 22/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2630 -
accuracy: 0.9241 - val_loss: 0.2591 - val_accuracy: 0.9249

Epoch 23/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2566 -
accuracy: 0.9259 - val_loss: 0.2533 - val_accuracy: 0.9264

Epoch 24/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2506 -
accuracy: 0.9273 - val_loss: 0.2479 - val_accuracy: 0.9280

Epoch 25/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2450 -
accuracy: 0.9287 - val_loss: 0.2430 - val_accuracy: 0.9297

Epoch 26/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2398 -
accuracy: 0.9301 - val_loss: 0.2382 - val_accuracy: 0.9316

Epoch 27/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2348 -
accuracy: 0.9318 - val_loss: 0.2337 - val_accuracy: 0.9328

Epoch 28/30
60000/60000 [=====] - 0s 4us/step - loss: 0.2302 -
accuracy: 0.9331 - val_loss: 0.2295 - val_accuracy: 0.9334

Epoch 29/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2258 -
accuracy: 0.9343 - val_loss: 0.2256 - val_accuracy: 0.9340

Epoch 30/30
60000/60000 [=====] - 0s 5us/step - loss: 0.2217 -
accuracy: 0.9355 - val_loss: 0.2219 - val_accuracy: 0.9355

Train on 60000 samples, validate on 10000 samples

Epoch 1/30
60000/60000 [=====] - 0s 6us/step - loss: 2.2997 -
accuracy: 0.1646 - val_loss: 2.2984 - val_accuracy: 0.1215

Epoch 2/30
60000/60000 [=====] - 0s 5us/step - loss: 2.2972 -
accuracy: 0.1227 - val_loss: 2.2961 - val_accuracy: 0.1165

Epoch 3/30
60000/60000 [=====] - 0s 6us/step - loss: 2.2949 -

accuracy: 0.1168 - val_loss: 2.2936 - val_accuracy: 0.1182
 Epoch 4/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2923 -
 accuracy: 0.1175 - val_loss: 2.2910 - val_accuracy: 0.1208
 Epoch 5/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2895 -
 accuracy: 0.1239 - val_loss: 2.2882 - val_accuracy: 0.1247
 Epoch 6/30
 60000/60000 [=====] - 0s 6us/step - loss: 2.2866 -
 accuracy: 0.1279 - val_loss: 2.2852 - val_accuracy: 0.1339
 Epoch 7/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2835 -
 accuracy: 0.1349 - val_loss: 2.2821 - val_accuracy: 0.1486
 Epoch 8/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2802 -
 accuracy: 0.1635 - val_loss: 2.2787 - val_accuracy: 0.1387
 Epoch 9/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2767 -
 accuracy: 0.1526 - val_loss: 2.2751 - val_accuracy: 0.1520
 Epoch 10/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2729 -
 accuracy: 0.1592 - val_loss: 2.2713 - val_accuracy: 0.1733
 Epoch 11/30
 60000/60000 [=====] - 0s 6us/step - loss: 2.2689 -
 accuracy: 0.1792 - val_loss: 2.2671 - val_accuracy: 0.1876
 Epoch 12/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2646 -
 accuracy: 0.2004 - val_loss: 2.2627 - val_accuracy: 0.1949
 Epoch 13/30
 60000/60000 [=====] - 0s 4us/step - loss: 2.2600 -
 accuracy: 0.2226 - val_loss: 2.2581 - val_accuracy: 0.1959
 Epoch 14/30
 60000/60000 [=====] - 0s 4us/step - loss: 2.2551 -
 accuracy: 0.2248 - val_loss: 2.2531 - val_accuracy: 0.2415
 Epoch 15/30
 60000/60000 [=====] - 0s 4us/step - loss: 2.2499 -
 accuracy: 0.2516 - val_loss: 2.2479 - val_accuracy: 0.2839
 Epoch 16/30
 60000/60000 [=====] - 0s 4us/step - loss: 2.2444 -
 accuracy: 0.3013 - val_loss: 2.2423 - val_accuracy: 0.2880
 Epoch 17/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2386 -
 accuracy: 0.3261 - val_loss: 2.2365 - val_accuracy: 0.3101
 Epoch 18/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2326 -
 accuracy: 0.3309 - val_loss: 2.2304 - val_accuracy: 0.3513
 Epoch 19/30
 60000/60000 [=====] - 0s 5us/step - loss: 2.2263 -

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accuracy: 0.3636 - val_loss: 2.2241 - val_accuracy: 0.3873
Epoch 20/30
60000/60000 [=====] - 0s 4us/step - loss: 2.2197 -
accuracy: 0.4011 - val_loss: 2.2173 - val_accuracy: 0.3963
Epoch 21/30
60000/60000 [=====] - 0s 5us/step - loss: 2.2128 -
accuracy: 0.4134 - val_loss: 2.2104 - val_accuracy: 0.4274
Epoch 22/30
60000/60000 [=====] - 0s 5us/step - loss: 2.2055 -
accuracy: 0.4371 - val_loss: 2.2031 - val_accuracy: 0.4540
Epoch 23/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1980 -
accuracy: 0.4636 - val_loss: 2.1955 - val_accuracy: 0.4620
Epoch 24/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1902 -
accuracy: 0.4725 - val_loss: 2.1877 - val_accuracy: 0.4964
Epoch 25/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1821 -
accuracy: 0.5064 - val_loss: 2.1795 - val_accuracy: 0.5041
Epoch 26/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1736 -
accuracy: 0.5110 - val_loss: 2.1711 - val_accuracy: 0.5333
Epoch 27/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1649 -
accuracy: 0.5348 - val_loss: 2.1623 - val_accuracy: 0.5426
Epoch 28/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1559 -
accuracy: 0.5468 - val_loss: 2.1533 - val_accuracy: 0.5594
Epoch 29/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1466 -
accuracy: 0.5644 - val_loss: 2.1440 - val_accuracy: 0.5730
Epoch 30/30
60000/60000 [=====] - 0s 5us/step - loss: 2.1371 -
accuracy: 0.5816 - val_loss: 2.1344 - val_accuracy: 0.5793

```

```

[8]: # -- OUTPUT PLOTS -- #
plt.plot(history0.history["val_accuracy"])
plt.plot(history1.history["val_accuracy"])
plt.plot(history2.history["val_accuracy"])
plt.plot(history3.history["val_accuracy"])
plt.title("Model Accuracy (Gaussain)")
plt.ylabel("Accuracy")
plt.xlabel("Epoch")
plt.legend(["None", "PCA", "FactorAnalysis", "FastICA"],loc="lower right")
plt.show()

```

