

mnist__noise-current

October 6, 2020

```
[5]: '''  
    VARIABLE: METHOD OF DR  
  
    CONSTANT: N_EPOCHS, N_COMPONENTS, NOISE TYPE AND MAGNITUDE  
  
    '''
```

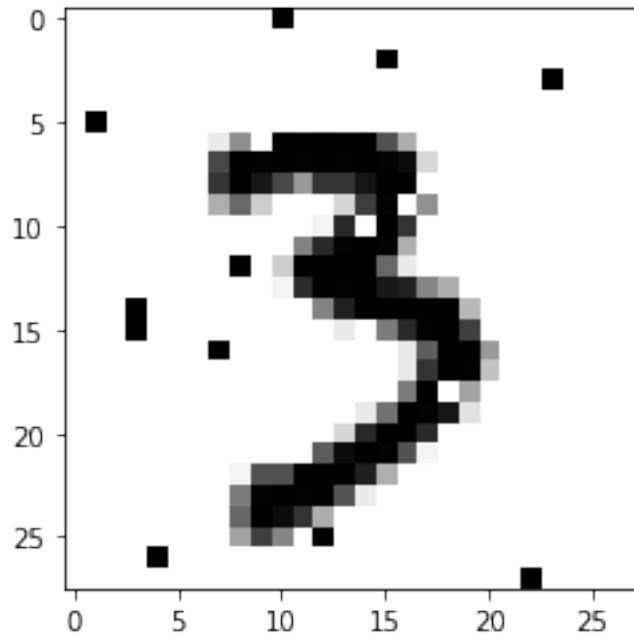
```
[5]: '\nVARIABLE: METHOD OF DR\n\nCONSTANT: N_EPOCHS, N_COMPONENTS, NOISE TYPE AND  
MAGNITUDE\n\n'
```

```
[6]: # -- 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
```

```
[7]: # -- 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="s&p")
```

```
[8]: # -- 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



```
[9]: # -- 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)
```

```
[10]: # -- 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)
```

```
[11]: # -- 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 15us/step - loss: 1.5671 - accuracy: 0.6049 - val_loss: 1.0885 - val_accuracy: 0.7790

Epoch 2/30

60000/60000 [=====] - 1s 10us/step - loss: 0.7541 - accuracy: 0.8478 - val_loss: 0.6172 - val_accuracy: 0.8624

Epoch 3/30

60000/60000 [=====] - 1s 11us/step - loss: 0.4894 - accuracy: 0.8802 - val_loss: 0.4674 - val_accuracy: 0.8831

Epoch 4/30

60000/60000 [=====] - 1s 10us/step - loss: 0.3954 - accuracy: 0.8964 - val_loss: 0.4048 - val_accuracy: 0.8936

Epoch 5/30

60000/60000 [=====] - 1s 10us/step - loss: 0.3490 - accuracy: 0.9049 - val_loss: 0.3683 - val_accuracy: 0.9034

Epoch 6/30

60000/60000 [=====] - 1s 10us/step - loss: 0.3199 - accuracy: 0.9124 - val_loss: 0.3529 - val_accuracy: 0.9024

Epoch 7/30

60000/60000 [=====] - 1s 10us/step - loss: 0.2991 - accuracy: 0.9176 - val_loss: 0.3322 - val_accuracy: 0.9090

Epoch 8/30

60000/60000 [=====] - 1s 9us/step - loss: 0.2823 - accuracy: 0.9221 - val_loss: 0.3199 - val_accuracy: 0.9108

Epoch 9/30

60000/60000 [=====] - 1s 9us/step - loss: 0.2690 - accuracy: 0.9257 - val_loss: 0.3105 - val_accuracy: 0.9147

Epoch 10/30

60000/60000 [=====] - 1s 9us/step - loss: 0.2573 - accuracy: 0.9291 - val_loss: 0.2987 - val_accuracy: 0.9178

Epoch 11/30

60000/60000 [=====] - 1s 9us/step - loss: 0.2469 - accuracy: 0.9317 - val_loss: 0.2958 - val_accuracy: 0.9178

Epoch 12/30

60000/60000 [=====] - 1s 9us/step - loss: 0.2376 - accuracy: 0.9346 - val_loss: 0.2858 - val_accuracy: 0.9207

Epoch 13/30

60000/60000 [=====] - 1s 13us/step - loss: 0.2291 - accuracy: 0.9369 - val_loss: 0.2839 - val_accuracy: 0.9216

Epoch 14/30

60000/60000 [=====] - 1s 11us/step - loss: 0.2214 - accuracy: 0.9391 - val_loss: 0.2790 - val_accuracy: 0.9227

Epoch 15/30

60000/60000 [=====] - 1s 11us/step - loss: 0.2142 -
accuracy: 0.9410 - val_loss: 0.2655 - val_accuracy: 0.9271
Epoch 16/30
60000/60000 [=====] - 1s 13us/step - loss: 0.2074 -
accuracy: 0.9427 - val_loss: 0.2654 - val_accuracy: 0.9267
Epoch 17/30
60000/60000 [=====] - 1s 11us/step - loss: 0.2011 -
accuracy: 0.9440 - val_loss: 0.2588 - val_accuracy: 0.9285
Epoch 18/30
60000/60000 [=====] - 1s 12us/step - loss: 0.1951 -
accuracy: 0.9460 - val_loss: 0.2585 - val_accuracy: 0.9276
Epoch 19/30
60000/60000 [=====] - 1s 15us/step - loss: 0.1896 -
accuracy: 0.9471 - val_loss: 0.2577 - val_accuracy: 0.9288
Epoch 20/30
60000/60000 [=====] - 1s 12us/step - loss: 0.1845 -
accuracy: 0.9487 - val_loss: 0.2504 - val_accuracy: 0.9305
Epoch 21/30
60000/60000 [=====] - 1s 11us/step - loss: 0.1794 -
accuracy: 0.9498 - val_loss: 0.2458 - val_accuracy: 0.9317
Epoch 22/30
60000/60000 [=====] - 1s 10us/step - loss: 0.1748 -
accuracy: 0.9511 - val_loss: 0.2462 - val_accuracy: 0.9320
Epoch 23/30
60000/60000 [=====] - 1s 10us/step - loss: 0.1704 -
accuracy: 0.9525 - val_loss: 0.2405 - val_accuracy: 0.9337
Epoch 24/30
60000/60000 [=====] - 1s 11us/step - loss: 0.1662 -
accuracy: 0.9539 - val_loss: 0.2449 - val_accuracy: 0.9311
Epoch 25/30
60000/60000 [=====] - 1s 12us/step - loss: 0.1621 -
accuracy: 0.9550 - val_loss: 0.2403 - val_accuracy: 0.9331
Epoch 26/30
60000/60000 [=====] - 1s 12us/step - loss: 0.1582 -
accuracy: 0.9561 - val_loss: 0.2369 - val_accuracy: 0.9327
Epoch 27/30
60000/60000 [=====] - 1s 11us/step - loss: 0.1545 -
accuracy: 0.9571 - val_loss: 0.2355 - val_accuracy: 0.9358
Epoch 28/30
60000/60000 [=====] - 1s 11us/step - loss: 0.1511 -
accuracy: 0.9581 - val_loss: 0.2283 - val_accuracy: 0.9383
Epoch 29/30
60000/60000 [=====] - 1s 11us/step - loss: 0.1479 -
accuracy: 0.9589 - val_loss: 0.2326 - val_accuracy: 0.9367
Epoch 30/30
60000/60000 [=====] - 1s 10us/step - loss: 0.1447 -
accuracy: 0.9597 - val_loss: 0.2277 - val_accuracy: 0.9382
Train on 60000 samples, validate on 10000 samples

Epoch 1/30
60000/60000 [=====] - 0s 4us/step - loss: 2.5570 -
accuracy: 0.2033 - val_loss: 4.9028 - val_accuracy: 0.2026

Epoch 2/30
60000/60000 [=====] - 0s 3us/step - loss: 1.4182 -
accuracy: 0.5411 - val_loss: 3.8068 - val_accuracy: 0.3169

Epoch 3/30
60000/60000 [=====] - 0s 3us/step - loss: 0.8642 -
accuracy: 0.7562 - val_loss: 3.2914 - val_accuracy: 0.3997

Epoch 4/30
60000/60000 [=====] - 0s 3us/step - loss: 0.6155 -
accuracy: 0.8302 - val_loss: 3.1681 - val_accuracy: 0.4480

Epoch 5/30
60000/60000 [=====] - 0s 3us/step - loss: 0.4921 -
accuracy: 0.8620 - val_loss: 3.2068 - val_accuracy: 0.4705

Epoch 6/30
60000/60000 [=====] - 0s 3us/step - loss: 0.4228 -
accuracy: 0.8787 - val_loss: 3.3285 - val_accuracy: 0.4820

Epoch 7/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3798 -
accuracy: 0.8905 - val_loss: 3.4835 - val_accuracy: 0.4832

Epoch 8/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3493 -
accuracy: 0.8983 - val_loss: 3.6174 - val_accuracy: 0.4890

Epoch 9/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3269 -
accuracy: 0.9042 - val_loss: 3.7940 - val_accuracy: 0.4883

Epoch 10/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3091 -
accuracy: 0.9093 - val_loss: 3.8855 - val_accuracy: 0.4917

Epoch 11/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2946 -
accuracy: 0.9136 - val_loss: 4.0221 - val_accuracy: 0.4898

Epoch 12/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2821 -
accuracy: 0.9169 - val_loss: 4.1182 - val_accuracy: 0.4909

Epoch 13/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2714 -
accuracy: 0.9195 - val_loss: 4.2223 - val_accuracy: 0.4901

Epoch 14/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2619 -
accuracy: 0.9224 - val_loss: 4.3148 - val_accuracy: 0.4894

Epoch 15/30
60000/60000 [=====] - 0s 4us/step - loss: 0.2534 -
accuracy: 0.9252 - val_loss: 4.3867 - val_accuracy: 0.4930

Epoch 16/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2457 -
accuracy: 0.9271 - val_loss: 4.4422 - val_accuracy: 0.4930

Epoch 17/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2386 -
accuracy: 0.9293 - val_loss: 4.5367 - val_accuracy: 0.4901

Epoch 18/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2322 -
accuracy: 0.9309 - val_loss: 4.5931 - val_accuracy: 0.4895

Epoch 19/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2262 -
accuracy: 0.9333 - val_loss: 4.6533 - val_accuracy: 0.4915

Epoch 20/30
60000/60000 [=====] - 0s 4us/step - loss: 0.2206 -
accuracy: 0.9346 - val_loss: 4.6870 - val_accuracy: 0.4929

Epoch 21/30
60000/60000 [=====] - 0s 4us/step - loss: 0.2154 -
accuracy: 0.9363 - val_loss: 4.7492 - val_accuracy: 0.4930

Epoch 22/30
60000/60000 [=====] - 0s 4us/step - loss: 0.2106 -
accuracy: 0.9378 - val_loss: 4.8026 - val_accuracy: 0.4925

Epoch 23/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2061 -
accuracy: 0.9391 - val_loss: 4.8441 - val_accuracy: 0.4911

Epoch 24/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2019 -
accuracy: 0.9402 - val_loss: 4.8976 - val_accuracy: 0.4922

Epoch 25/30
60000/60000 [=====] - 0s 3us/step - loss: 0.1978 -
accuracy: 0.9411 - val_loss: 4.8941 - val_accuracy: 0.4916

Epoch 26/30
60000/60000 [=====] - 0s 3us/step - loss: 0.1941 -
accuracy: 0.9423 - val_loss: 4.9635 - val_accuracy: 0.4914

Epoch 27/30
60000/60000 [=====] - 0s 3us/step - loss: 0.1905 -
accuracy: 0.9434 - val_loss: 4.9948 - val_accuracy: 0.4909

Epoch 28/30
60000/60000 [=====] - 0s 3us/step - loss: 0.1871 -
accuracy: 0.9442 - val_loss: 5.0177 - val_accuracy: 0.4920

Epoch 29/30
60000/60000 [=====] - 0s 3us/step - loss: 0.1839 -
accuracy: 0.9451 - val_loss: 5.0600 - val_accuracy: 0.4919

Epoch 30/30
60000/60000 [=====] - 0s 3us/step - loss: 0.1808 -
accuracy: 0.9459 - val_loss: 5.1028 - val_accuracy: 0.4926

Train on 60000 samples, validate on 10000 samples

Epoch 1/30
60000/60000 [=====] - 0s 4us/step - loss: 2.1817 -
accuracy: 0.2155 - val_loss: 2.0739 - val_accuracy: 0.2754

Epoch 2/30
60000/60000 [=====] - ETA: 0s - loss: 1.8428 -

accuracy: 0.46 - 0s 3us/step - loss: 1.8384 - accuracy: 0.4659 - val_loss: 1.7889 - val_accuracy: 0.4997

Epoch 3/30
60000/60000 [=====] - 0s 3us/step - loss: 1.5382 - accuracy: 0.6885 - val_loss: 1.5463 - val_accuracy: 0.6395

Epoch 4/30
60000/60000 [=====] - 0s 3us/step - loss: 1.2769 - accuracy: 0.7854 - val_loss: 1.3412 - val_accuracy: 0.7088

Epoch 5/30
60000/60000 [=====] - 0s 4us/step - loss: 1.0571 - accuracy: 0.8262 - val_loss: 1.1726 - val_accuracy: 0.7447

Epoch 6/30
60000/60000 [=====] - 0s 3us/step - loss: 0.8774 - accuracy: 0.8475 - val_loss: 1.0371 - val_accuracy: 0.7685

Epoch 7/30
60000/60000 [=====] - 0s 3us/step - loss: 0.7361 - accuracy: 0.8605 - val_loss: 0.9321 - val_accuracy: 0.7827

Epoch 8/30
60000/60000 [=====] - 0s 3us/step - loss: 0.6271 - accuracy: 0.8712 - val_loss: 0.8529 - val_accuracy: 0.7954

Epoch 9/30
60000/60000 [=====] - 0s 3us/step - loss: 0.5446 - accuracy: 0.8793 - val_loss: 0.7951 - val_accuracy: 0.8056

Epoch 10/30
60000/60000 [=====] - 0s 3us/step - loss: 0.4823 - accuracy: 0.8866 - val_loss: 0.7521 - val_accuracy: 0.8112

Epoch 11/30
60000/60000 [=====] - 0s 3us/step - loss: 0.4358 - accuracy: 0.8925 - val_loss: 0.7213 - val_accuracy: 0.8167

Epoch 12/30
60000/60000 [=====] - 0s 3us/step - loss: 0.4001 - accuracy: 0.8979 - val_loss: 0.6999 - val_accuracy: 0.8197

Epoch 13/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3723 - accuracy: 0.9022 - val_loss: 0.6833 - val_accuracy: 0.8231

Epoch 14/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3503 - accuracy: 0.9063 - val_loss: 0.6725 - val_accuracy: 0.8248

Epoch 15/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3325 - accuracy: 0.9093 - val_loss: 0.6650 - val_accuracy: 0.8275

Epoch 16/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3176 - accuracy: 0.9122 - val_loss: 0.6575 - val_accuracy: 0.8298

Epoch 17/30
60000/60000 [=====] - 0s 3us/step - loss: 0.3049 - accuracy: 0.9153 - val_loss: 0.6514 - val_accuracy: 0.8327

Epoch 18/30

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60000/60000 [=====] - 0s 3us/step - loss: 0.2942 -
accuracy: 0.9178 - val_loss: 0.6491 - val_accuracy: 0.8332
Epoch 19/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2847 -
accuracy: 0.9201 - val_loss: 0.6455 - val_accuracy: 0.8348
Epoch 20/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2764 -
accuracy: 0.9217 - val_loss: 0.6396 - val_accuracy: 0.8371
Epoch 21/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2689 -
accuracy: 0.9236 - val_loss: 0.6379 - val_accuracy: 0.8384
Epoch 22/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2621 -
accuracy: 0.9252 - val_loss: 0.6364 - val_accuracy: 0.8388
Epoch 23/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2559 -
accuracy: 0.9264 - val_loss: 0.6351 - val_accuracy: 0.8395
Epoch 24/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2501 -
accuracy: 0.9279 - val_loss: 0.6323 - val_accuracy: 0.8411
Epoch 25/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2447 -
accuracy: 0.9292 - val_loss: 0.6304 - val_accuracy: 0.8432
Epoch 26/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2397 -
accuracy: 0.9306 - val_loss: 0.6296 - val_accuracy: 0.8435
Epoch 27/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2349 -
accuracy: 0.9319 - val_loss: 0.6265 - val_accuracy: 0.8442
Epoch 28/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2304 -
accuracy: 0.9333 - val_loss: 0.6238 - val_accuracy: 0.8447
Epoch 29/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2262 -
accuracy: 0.9344 - val_loss: 0.6224 - val_accuracy: 0.8455
Epoch 30/30
60000/60000 [=====] - 0s 3us/step - loss: 0.2222 -
accuracy: 0.9357 - val_loss: 0.6204 - val_accuracy: 0.8464
Train on 60000 samples, validate on 10000 samples
Epoch 1/30
60000/60000 [=====] - 0s 4us/step - loss: 2.2998 -
accuracy: 0.1888 - val_loss: 2.2997 - val_accuracy: 0.1328
Epoch 2/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2973 -
accuracy: 0.1195 - val_loss: 2.2976 - val_accuracy: 0.1317
Epoch 3/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2948 -
accuracy: 0.1157 - val_loss: 2.2954 - val_accuracy: 0.1351

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Epoch 4/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2922 -
accuracy: 0.1155 - val_loss: 2.2930 - val_accuracy: 0.1394

Epoch 5/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2894 -
accuracy: 0.1161 - val_loss: 2.2904 - val_accuracy: 0.1437

Epoch 6/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2864 -
accuracy: 0.1168 - val_loss: 2.2877 - val_accuracy: 0.1490

Epoch 7/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2832 -
accuracy: 0.1184 - val_loss: 2.2848 - val_accuracy: 0.1535

Epoch 8/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2798 -
accuracy: 0.1190 - val_loss: 2.2817 - val_accuracy: 0.1638

Epoch 9/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2761 -
accuracy: 0.1238 - val_loss: 2.2784 - val_accuracy: 0.1769

Epoch 10/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2722 -
accuracy: 0.1362 - val_loss: 2.2749 - val_accuracy: 0.1876

Epoch 11/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2680 -
accuracy: 0.1487 - val_loss: 2.2712 - val_accuracy: 0.2015

Epoch 12/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2635 -
accuracy: 0.1635 - val_loss: 2.2672 - val_accuracy: 0.2149

Epoch 13/30
60000/60000 [=====] - 0s 4us/step - loss: 2.2587 -
accuracy: 0.1893 - val_loss: 2.2629 - val_accuracy: 0.2323

Epoch 14/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2537 -
accuracy: 0.2155 - val_loss: 2.2584 - val_accuracy: 0.2426

Epoch 15/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2483 -
accuracy: 0.2345 - val_loss: 2.2537 - val_accuracy: 0.2622

Epoch 16/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2427 -
accuracy: 0.2730 - val_loss: 2.2488 - val_accuracy: 0.2707

Epoch 17/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2367 -
accuracy: 0.2925 - val_loss: 2.2436 - val_accuracy: 0.2855

Epoch 18/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2305 -
accuracy: 0.3322 - val_loss: 2.2382 - val_accuracy: 0.3062

Epoch 19/30
60000/60000 [=====] - 0s 4us/step - loss: 2.2239 -
accuracy: 0.3716 - val_loss: 2.2327 - val_accuracy: 0.3219

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Epoch 20/30
60000/60000 [=====] - 0s 3us/step - loss: 2.2170 -
accuracy: 0.4191 - val_loss: 2.2267 - val_accuracy: 0.3271
Epoch 21/30
60000/60000 [=====] - 0s 4us/step - loss: 2.2098 -
accuracy: 0.4255 - val_loss: 2.2207 - val_accuracy: 0.3391
Epoch 22/30
60000/60000 [=====] - 0s 4us/step - loss: 2.2023 -
accuracy: 0.4730 - val_loss: 2.2145 - val_accuracy: 0.3443
Epoch 23/30
60000/60000 [=====] - 0s 4us/step - loss: 2.1945 -
accuracy: 0.4860 - val_loss: 2.2081 - val_accuracy: 0.3548
Epoch 24/30
60000/60000 [=====] - 0s 3us/step - loss: 2.1864 -
accuracy: 0.5076 - val_loss: 2.2014 - val_accuracy: 0.3604
Epoch 25/30
60000/60000 [=====] - 0s 3us/step - loss: 2.1780 -
accuracy: 0.5451 - val_loss: 2.1945 - val_accuracy: 0.3669
Epoch 26/30
60000/60000 [=====] - 0s 4us/step - loss: 2.1693 -
accuracy: 0.5637 - val_loss: 2.1876 - val_accuracy: 0.3704
Epoch 27/30
60000/60000 [=====] - 0s 4us/step - loss: 2.1603 -
accuracy: 0.5902 - val_loss: 2.1802 - val_accuracy: 0.3741
Epoch 28/30
60000/60000 [=====] - 0s 4us/step - loss: 2.1510 -
accuracy: 0.6032 - val_loss: 2.1730 - val_accuracy: 0.3804
Epoch 29/30
60000/60000 [=====] - 0s 4us/step - loss: 2.1413 -
accuracy: 0.6229 - val_loss: 2.1655 - val_accuracy: 0.3861
Epoch 30/30
60000/60000 [=====] - 0s 4us/step - loss: 2.1313 -
accuracy: 0.6297 - val_loss: 2.1580 - val_accuracy: 0.3856

```

```

[12]: # -- 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 (Salt and Pepper)")
plt.ylabel("Accuracy")
plt.xlabel("Epoch")
plt.legend(["None", "PCA", "FactorAnalysis", "FastICA"],loc="lower right")
plt.show()

```

