**********Draft**********

Principal component analysis (PCA)

08/29/19

**********Draft**********

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables (entities each of which takes on various numerical values) into a set of values of linearly uncorrelated variables called principal components.

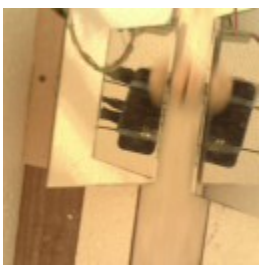
Machine Learning — Singular Value Decomposition (SVD) & Principal Component Analysis (PCA)

Analysis of 4 images 2 cracked and 2 not cracked. The (SVD) or (PCA) does appears to track that pistachios that are cracked do have a higher (PCA) than pistachios that are not cracked.

Thumb0000yes1.bmp

thumb0000no1.bmp

Thumb0000yes2.bmp



thumb0000n2.bmp

thumb0000yes1.bmp thumb0000no1.bmp thumb0000yes2.bmp thumb0000n2.bmp
pca1(1:20)
ans =

2.5118e+04 2.4510e+04 2.5212e+04 2.4252e+04
4.1047e+03
1.7342e+03
1.3414e+03
1.3223e+03
1.0863e+03
8.6049e+02
7.6984e+02
6.8771e+02
6.0650e+02
5.2599e+02
4.5459e+02
4.4436e+02
3.8315e+02
3.7725e+02
3.3203e+02
3.1981e+02
2.7991e+02
2.7412e+02
2.5770e+02

pca2(1:20)
ans =

2.0217e+04 1.9552e+04 2.0434e+04 1.9248e+04
3.8104e+03
1.5775e+03
1.3825e+03
1.1628e+03
1.0376e+03

7.8174e+02
7.4592e+02
6.8873e+02
5.8089e+02
5.1885e+02
4.6897e+02
4.5024e+02
4.0410e+02
3.6088e+02
3.2620e+02
3.0089e+02
2.8690e+02
2.6073e+02
2.4677e+02

pca3(1:20)
ans =

1.3455e+04 1.2802e+04 1.3600e+04 1.2537e+04
2.7543e+03
1.2505e+03
1.0014e+03
8.8897e+02
7.7139e+02
6.2903e+02
5.8134e+02
5.3249e+02
4.6860e+02
4.0902e+02
3.9088e+02
3.6356e+02
3.4791e+02
3.0013e+02
2.6766e+02
2.5222e+02
2.3809e+02
2.1705e+02
2.0159e+02

thumb0000no1.bmp
pca1(1:20)
ans =

2.4510e+04
4.0433e+03
1.9649e+03
1.4272e+03
1.3475e+03
9.9684e+02

```
   8.2375e+02
   7.9589e+02
   6.8341e+02
   5.8102e+02
   5.0413e+02
   4.6857e+02
   4.2710e+02
   4.0367e+02
   3.7746e+02
   3.4601e+02
   3.3557e+02
   2.9683e+02
   2.8394e+02
   2.5602e+02

pca2(1:20)
ans =

   1.9552e+04
   3.6803e+03
   1.6822e+03
   1.4549e+03
   1.1840e+03
   9.1180e+02
   7.5005e+02
   7.1683e+02
   6.8642e+02
   5.3968e+02
   4.8279e+02
   4.4007e+02
   4.3046e+02
   4.0756e+02
   3.5801e+02
   3.3369e+02
   3.1684e+02
   2.8013e+02
   2.6143e+02
   2.4284e+02

pca3(1:20)
ans =

   1.2802e+04
   2.6358e+03
   1.2603e+03
   1.1070e+03
   8.7383e+02
   7.0593e+02
   5.8519e+02
```

5.8225e+02
5.2708e+02
4.2259e+02
3.9897e+02
3.7471e+02
3.5758e+02
3.3290e+02
3.1216e+02
2.7739e+02
2.5960e+02
2.3723e+02
2.1209e+02
2.0476e+02

thumb0000yes2.bmp
pca1(1:20)
ans =

2.5212e+04
4.0210e+03
1.8347e+03
1.4258e+03
1.3558e+03
1.0733e+03
8.3836e+02
7.6427e+02
6.8187e+02
6.1109e+02
5.2345e+02
4.8893e+02
4.5993e+02
4.1018e+02
4.0371e+02
3.5510e+02
3.3618e+02
2.9982e+02
2.6943e+02
2.5862e+02

pca2(1:20)
ans =

2.0434e+04
3.7564e+03
1.6314e+03
1.4176e+03
1.2380e+03
1.0131e+03
7.6505e+02

7.4708e+02
6.7221e+02
5.7194e+02
5.2257e+02
4.7293e+02
4.6234e+02
4.2547e+02
3.7508e+02
3.3221e+02
3.3095e+02
2.8798e+02
2.6839e+02
2.5635e+02

pca3(1:20)
ans =

1.3600e+04
2.7226e+03
1.2751e+03
1.0553e+03
9.2998e+02
7.9118e+02
6.0423e+02
5.9610e+02
5.1626e+02
4.6031e+02
4.2646e+02
4.0938e+02
3.8739e+02
3.5952e+02
3.1919e+02
2.8066e+02
2.6825e+02
2.4342e+02
2.2798e+02
2.1238e+02

thumb0000n2.bmp

pca1(1:20)
ans =

2.4252e+04
4.3798e+03
1.6566e+03
1.4539e+03
1.2313e+03
9.4545e+02

```
   8.6362e+02
   7.0752e+02
   6.3207e+02
   5.8339e+02
   5.0927e+02
   4.6314e+02
   4.3968e+02
   3.7103e+02
   3.2726e+02
   3.1503e+02
   2.9399e+02
   2.7929e+02
   2.6932e+02
   2.6126e+02

>> pca2(1:20)
ans =

   1.9248e+04
   3.8751e+03
   1.6063e+03
   1.3434e+03
   1.0795e+03
   8.8676e+02
   7.6481e+02
   6.9949e+02
   5.9415e+02
   5.6022e+02
   4.9497e+02
   4.3213e+02
   4.0966e+02
   3.5401e+02
   3.1833e+02
   2.9621e+02
   2.8560e+02
   2.7431e+02
   2.5903e+02
   2.4629e+02

>> pca3(1:20)
ans =

   1.2537e+04
   2.7423e+03
   1.2570e+03
   1.0034e+03
   7.9929e+02
   6.7685e+02
   5.8549e+02
```

5.6615e+02
4.7492e+02
4.3317e+02
4.0130e+02
3.5044e+02
3.3603e+02
3.0458e+02
2.7552e+02
2.5449e+02
2.4492e+02
2.2631e+02
2.1090e+02
2.0487e+02