

\*\*\*\*\*Draft\*\*\*\*\*

## Principal component analysis (PCA)

09/07/19

\*\*\*\*\*Draft\*\*\*\*\*

The  $-t$  parameter of the raspistill is dependent on the position of the camera with the ir-sw and the speed of the belt.

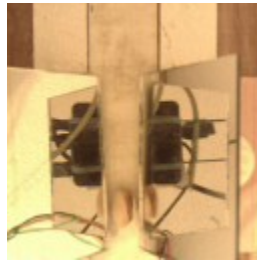
Tests indicate that the lowest value of  $-t$  is 260 msec since the image at  $-t$  250 is quite dark.



t250thumb.bmp



t260thumb.bmp



t275thumb.bmp



t300thumb.bmp

```
sudo raspistill -e bmp -vf -h 128 -w 128 -t 250 -o thumb.bmp
```

```
pi@watson2:~/tmp/testrepo/camerawatson/C/klt $ make
```

```
280          17    293          r1
```

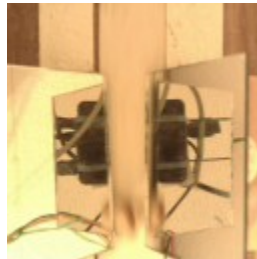
```
pi@watson2:~/tmp/testrepo/camerawatson/C/klt $ ps -ax | grep exe1
```

```
pi@watson2:~/tmp/testrepo/camerawatson/C/klt $ sudo kill -9 8098 8103
```

```
280          14    328          r2
```

```
285          12    215          r3
```

```
285          14    342          r4
```



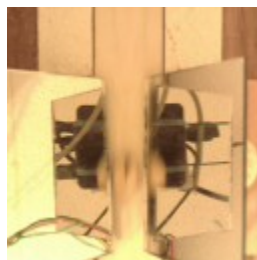
r1thumb0000.bmp



r1thumb0000.pgm



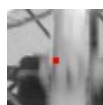
r1feat1.ppm



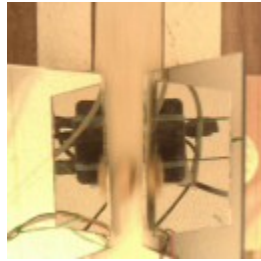
r2thumb0000.bmp



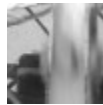
r2thumb0000.pgm



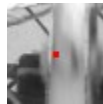
r2feat1.ppm



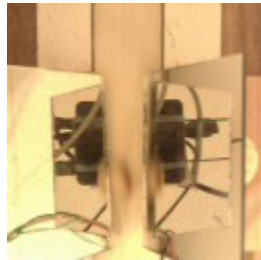
r3thumb0000.bmp



r3thumb0000.pgm



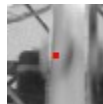
r3feat1.ppm



r4thumb0000.bmp



r4thumb0000.pgm



r4feat1.ppm

Feel free to place comments here.

!!

!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 10

feature | (x,y)=val

```
-----+-----  
0 | ( 24, 25)= 342  
1 | ( -1, -1)= -1  
2 | ( -1, -1)= -1  
3 | ( -1, -1)= -1  
4 | ( -1, -1)= -1  
5 | ( -1, -1)= -1  
6 | ( -1, -1)= -1  
7 | ( -1, -1)= -1  
8 | ( -1, -1)= -1  
9 | ( -1, -1)= -1  
r4feat1.txt
```

\*\*\*\*\*Draft\*\*\*\*\*

## Principal component analysis (PCA)

09/06/19

\*\*\*\*\*Draft\*\*\*\*\*

In this test the pistachio was pre positioned and the ir-sw was triggered manually.

-t 275

```
offset = 30;  
endofline = headInfo.width - offset - ncols;  
ncols = 50;//number of cols to be extracted  
nrows = 50;//number of rows to be extracted  
rows = 17;
```

If the pistachio travels 2 1/4 in. from the ir-sw  
the cracked pistachio has a quite high value of 1325.

the results are in files /data/savedklt090619/r1\*.

if the not cracked pistachio travels 2 1/4 in from the ir-sw

the not cracked pistachio has a much lower value of 409

the results are in files /data/savedklt090619/r2\*.

Feel free to place comments here.

!!

!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 10

```
feature | (x,y)=val
-----+-----
0 | ( 24, 24)= 1325
```

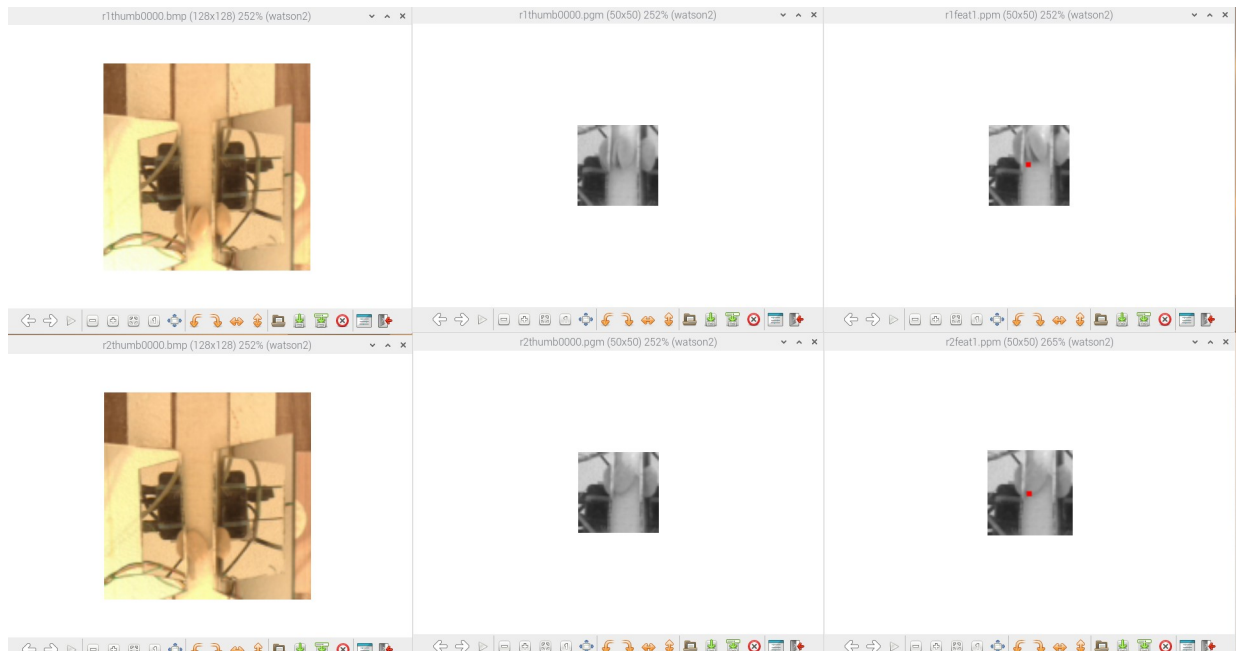
Feel free to place comments here.

!!  
 !!! Warning: This is a KLT data file. Do not modify below this line !!!

```
-----
KLT Feature List
-----
```

nFeatures = 10

```
feature | (x,y)=val
-----+-----
0 | ( 24, 25)= 409
```



**\*\*\*\*\*Draft\*\*\*\*\***  
**Principal component analysis (PCA)**  
**09/05/19**  
**\*\*\*\*\*Draft\*\*\*\*\***

```
exe1.c
-      rows = 19;
+      rows = 17;
```



r2thumb0000.bmp cracked



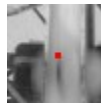
r3thumb0000.bmp not cracked



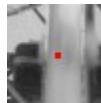
r2thumb0000.pgm cracked



r3thumb0000.pgm not cracked



r2feat1.ppm cracked



r3feat1.ppm not cracked  
Feel free to place comments here.

!!  
!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 10

```
feature | (x,y)=val
-----+-----
0 | ( 25, 25)= 274
1 | ( -1, -1)= -1
2 | ( -1, -1)= -1
3 | ( -1, -1)= -1
4 | ( -1, -1)= -1
5 | ( -1, -1)= -1
6 | ( -1, -1)= -1
7 | ( -1, -1)= -1
8 | ( -1, -1)= -1
9 | ( -1, -1)= -1
```

r2feat1.txt cracked

Feel free to place comments here.

!!  
 !!! Warning: This is a KLT data file. Do not modify below this line !!!

```
-----
KLT Feature List
-----
```

nFeatures = 10

```
feature | (x,y)=val
-----+-----
0 | ( 25, 25)= 74
1 | ( -1, -1)= -1
2 | ( -1, -1)= -1
3 | ( -1, -1)= -1
4 | ( -1, -1)= -1
5 | ( -1, -1)= -1
6 | ( -1, -1)= -1
7 | ( -1, -1)= -1
8 | ( -1, -1)= -1
9 | ( -1, -1)= -1
```

r3feat1.txt not cracked

There are several variables the control the extraction of the image  
 where the feature is tested from the original image.  
 As can be seen below if the cracked image is placed correctly the value  
 increases to 0 | ( 24, 25)= 402

```
offset = 30;
endofline = headInfo.width - offset - ncols;
```

```

ncols = 50;//number of cols to be extracted
nrows = 50;//number of rows to be extracted
rows = 19;
rowsdn = (headInfo.width * rows) + offset;
pr = pr + rowsdn; //rows + 1 lines dn + offset
for (j = (rows+1); j < (rows+1+nrows); j++) {
    for (i = offset; i < (ncols+offset); i++) {
        *prwr = *pr;
        pr++;
        prwr++;
    }
    pr = pr + endofline; //headInfo.width - offset - ncols
    pr = pr + offset;
}
pr = pr - rowsdn - ((50*50)+(78*50));
prwr = prwr - (50*50);

```

Feel free to place comments here.

!!  
!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 10

feature | (x,y)=val  
-----+-----  
0 | ( 24, 25)= 402  
1 | ( -1, -1)= -1

```

diff --git a/C/klt/exe1.c b/C/klt/exe1.c
index b60fa95..a0eff20 100644
--- a/C/klt/exe1.c
+++ b/C/klt/exe1.c
@@ -46,7 +46,7 @@ int main(void) {
    KLT_FeatureList fl;
    int nFeatures = 10;
    int ncols, nrows;
-
+    int rowsdn, rows, offset, endofline;
    wiringPiSetup();

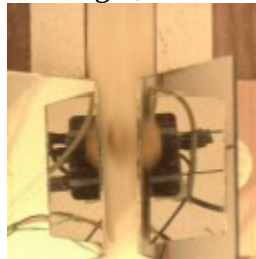
```



```

pinMode(PIN_SW, INPUT);
@@ -156,17 +156,23 @@ int main(void) {
    }
    //befor free the memory need to restore the pointers
    pr = pr - headInfo.width*headInfo.height;
-   pr = pr + 2462; //19 lines dn + 60
-   for (j = 20; j <70;j++) {
-       for (i = 30; i <80 ; i++) {
+       offset = 30;
+       endoffline = headInfo.width - offset - ncols;
+       ncols = 50;//number of cols to be extracted
+       offset = 30;
+       endoffline = headInfo.width - offset - ncols;
+       ncols = 50;//number of cols to be extracted
+       nrows = 50;//number of rows to be extracted
+       rows = 19;
+       rowsdn = (headInfo.width * rows) + offset;
+       pr = pr + rowsdn; //rows + 1 lines dn + offset
+       for (j = (rows+1); j <(rows+1+nrows);j++) {
+           for (i = offset; i <ncols+offset ; i++) {
+               *prwr = *pr;
+               pr++;
+               prwr++;
+           }
-       pr = pr + 48;//110 -128 end of row
-       pr = pr + 30;
+       pr = pr + endoffline;//headInfo.width - offset - ncols
+       pr = pr + offset;
+   }
-   pr = pr - 2462 - ((50*50)+(78*50));
+   pr = pr - rowsdn - ((50*50)+(78*50));
    prwr = prwr - (50*50);
    pg = pg - headInfo.width*headInfo.height;
    pb = pb - headInfo.width*headInfo.height;

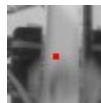
```



r1thumb0000.bmp



r1thumb0000.pgm



r1feat1.ppm

Feel free to place comments here.

!!

!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 10

feature | (x,y)=val

-----+-----  
0 | ( 24, 25)= 402  
1 | ( -1, -1)= -1  
2 | ( -1, -1)= -1  
3 | ( -1, -1)= -1  
4 | ( -1, -1)= -1  
5 | ( -1, -1)= -1  
6 | ( -1, -1)= -1  
7 | ( -1, -1)= -1  
8 | ( -1, -1)= -1  
9 | ( -1, -1)= -1

r1feat1.txt

\*\*\*\*\***Draft**\*\*\*\*\*

**Principal component analysis (PCA)**

**09/04/19**

\*\*\*\*\***Draft**\*\*\*\*\*

**Test run Tue 03 Sep 2019 09:26:52 PM MDT**

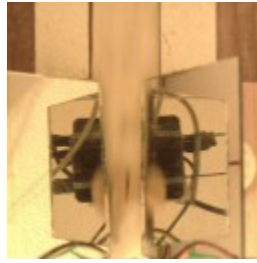
**The files subimg.m & im1.m are needed to determine  
the values needed to extract from the 128 x 128 to 50 x 50.  
when determining the thumb0000.pgm from thumb0000.bmp.  
This needs to be run on a stretch version of octave.**

**The number of cables causes a problem positioning and keeping the  
camera in the correct position.**

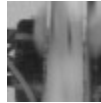
**Belt speed, and camera position are very critical in determining the feature value obtained.**

**Feature #0: (24.000000,25.000000) with value of 125.**

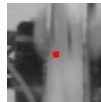
```
diff --git a/C/klt/exe1.c b/C/klt/exe1.c
index 62cd705..b60fa95 100644
--- a/C/klt/exe1.c
+++ b/C/klt/exe1.c
@@ -85,7 +85,7 @@ int main(void) {
    while (flag == 1) {
//      0123456789012345678901234567890123456789012345678901234567
-      char cam_pre[] = "sudo raspistill -e bmp -vf -h 128 -w 128 -t 300 -o thumb";
+      char cam_pre[] = "sudo raspistill -e bmp -vf -h 128 -w 128 -t 275 -o thumb";
        char s3[] = "thumb";
        printf("%s %d\n",cam_pre,sizeof(cam_pre));
        sprintf(pframe_suf, "%04d.bmp",count);
@@ -156,17 +156,17 @@ int main(void) {
    }
    //befor free the memory need to restore the pointers
    pr = pr - headInfo.width*headInfo.height;
-    pr = pr + 2492; //19 lines dn + 60
+    pr = pr + 2462; //19 lines dn + 60
    for (j = 20; j <70;j++) {
@@ -156,17 +156,17 @@ int main(void) {
    }
    //befor free the memory need to restore the pointers
    pr = pr - headInfo.width*headInfo.height;
-    pr = pr + 2492; //19 lines dn + 60
+    pr = pr + 2462; //19 lines dn + 60
    for (j = 20; j <70;j++) {
-      for (i = 60; i <110 ; i++) {
+      for (i = 30; i <80 ; i++) {
        *prwr = *pr;
        pr++;
        prwr++;
      }
-      pr = pr + 18;//110 -128 end of row
-      pr = pr + 60;
+      pr = pr + 48;//110 -128 end of row
+      pr = pr + 30;
    }
-    pr = pr - 2492 - ((50*50)+(78*50));
+    pr = pr - 2462 - ((50*50)+(78*50));
    prwr = prwr - (50*50);
    pg = pg - headInfo.width*headInfo.height;
    pb = pb - headInfo.width*headInfo.height;
```



**r1thumb0000.bmp**



**r1thumb0000.pgm**



**r1feat1.ppm**

**Feel free to place comments here.**

!!

**!!! Warning: This is a KLT data file. Do not modify below this line !!!**

-----  
**KLT Feature List**  
-----

**nFeatures = 10**

**feature | (x,y)=val**

-----+-----  
0 | ( 24, 25)= 125  
1 | ( -1, -1)= -1  
2 | ( -1, -1)= -1  
3 | ( -1, -1)= -1  
4 | ( -1, -1)= -1  
5 | ( -1, -1)= -1  
6 | ( -1, -1)= -1  
7 | ( -1, -1)= -1  
8 | ( -1, -1)= -1

**r1feat1.txt**

\*\*\*\*\*Draft\*\*\*\*\*

## Principal component analysis (PCA)

09/02/19

\*\*\*\*\*Draft\*\*\*\*\*

Took the 128 x 128 from the camera and wrote a subimage of 50 x 50 to the file thumb0000.pgm.

This 50 x 50 image was processed with example1.c which both img1 & img2 used thumb0000.pgm.

the images in data/savedklt090219 r1\* are with a cracked pistachio crack is on the right.

0 | ( 25, 24)= 285

the images in data/savedklt090219 r2\* are with a not cracked pistachio

0 | ( 24, 24)= 45

the images in data/savedklt090219 r3\* are with a cracked pistachio crack is on the left.

0 | ( 24, 25)= 101

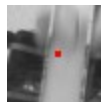
the image in data/savedklt090219 r4\* are with a cracked pistachio now the code from example1.c is included in exe1.c increased the -t variable from 275 to 300 msec which moves the pistachio into the field of view.



r1Thumb0000.bmp



r1Thumb0000.pgm

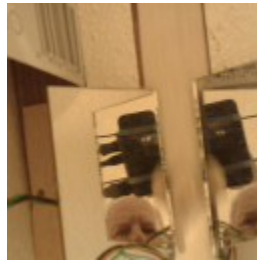


r1feat1.ppm

feature | (x,y)=val

-----+-----

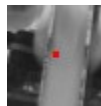
0 | ( 25, 24)= 285  
r1feat1.txt



r2Thumb0000.bmp

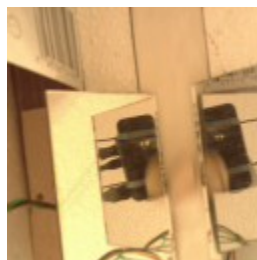


r2Thumb0000.pgm



r2feat1.ppm  
feature | (x,y)=val  
-----+-----  
0 | ( 24, 24)= 45

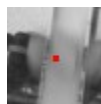
r2feat1.txt



r3Thumb0000.bmp



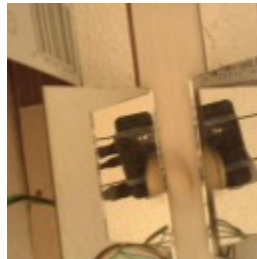
r3Thumb0000.pgm



r3feat1.ppm

```
feature | (x,y)=val
-----+-----
0 | ( 24, 25)= 101
```

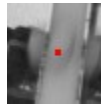
r3feat1.txt



r4Thumb0000.bmp



r4Thumb0000.pgm



```
r4feat1.ppm
feature | (x,y)=val
-----+-----
0 | ( 25, 24)= 152
r4feat1.txt
```

\*\*\*\*\***Draft**\*\*\*\*\*

## Principal component analysis (PCA)

08/31/19

\*\*\*\*\***Draft**\*\*\*\*\*

Created a smaller set of images which were a cut from thumb0000yes1.pgm & thumb0000no1.pgm.  
These were then used in example1.c.



Thumb0000yes1sm.pgm



Thumb0000no1sm.pgm



The image above is 78 x 50 zoom of 476%.

Feel free to place comments here.

!!

!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----



nFeatures = 100

feature | (x,y)=val

-----+-----  
0 | ( 50, 24)= 2280  
1 | ( 34, 24)= 747  
2 | ( 24, 24)= 635

\*\*\*\*\*Draft\*\*\*\*\*

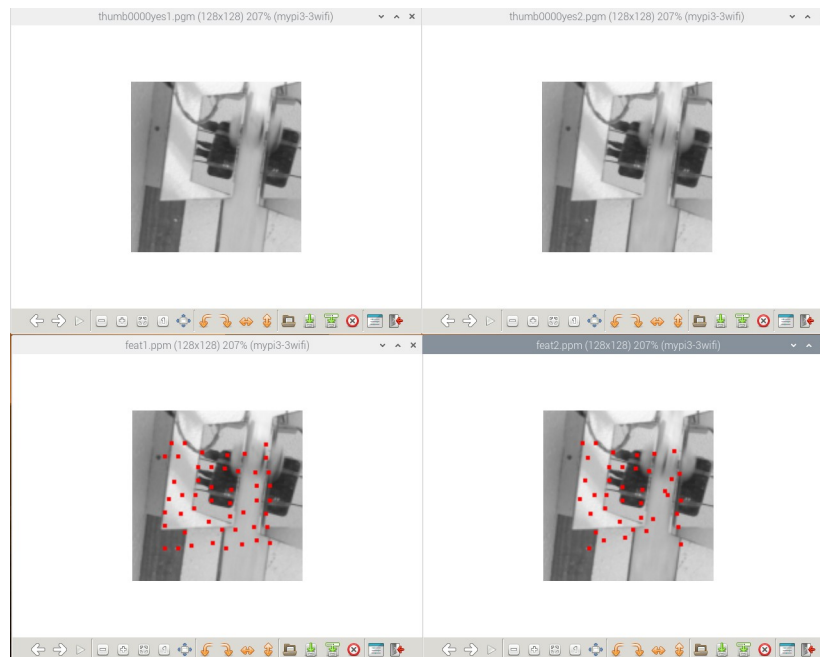
## Principal component analysis (PCA)

08/31/19

\*\*\*\*\*Draft\*\*\*\*\*

Looking the feature extraction from ultibo\_numlib/klt. Converted the 4 test images bmp images to pgm which was the format that was used.

Modified example1.c to use thumb0000yes1.pgm and thumb0000yes2.pgm



feat1.txt

Feel free to place comments here.

!!

!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 100

feature | (x,y)=val

-----+-----  
0 | ( 59, 42)=12494  
1 | ( 49, 52)=11437  
2 | ( 71, 33)=11096  
3 | ( 39, 91)=10412  
4 | ( 59, 67)=10405  
5 | (100, 77)= 9171  
6 | ( 73, 69)= 8453  
7 | ( 24, 86)= 8441  
8 | ( 52, 31)= 7226  
9 | ( 49, 42)= 5225  
10 | ( 67, 89)= 3450  
11 | ( 74, 59)= 3192  
12 | (100, 35)= 2280  
13 | (101, 87)= 2264  
14 | ( 59, 57)= 1547  
15 | (103, 99)= 1533  
16 | (100, 25)= 1514  
17 | ( 46, 73)= 1183  
18 | (103, 67)= 1166  
19 | ( 79, 45)= 1089  
20 | ( 84, 32)= 1085  
21 | ( 47, 63)= 906  
22 | (102, 46)= 836  
23 | ( 39, 24)= 757  
24 | ( 34,103)= 730  
25 | ( 69, 43)= 473  
26 | ( 57, 83)= 468  
27 | ( 31, 53)= 407  
28 | ( 24, 34)= 270  
29 | ( 24, 76)= 236  
30 | ( 92, 46)= 210  
31 | ( 73, 79)= 168  
32 | (103, 56)= 145  
33 | ( 27, 66)= 130  
34 | ( 29, 24)= 97  
35 | ( 93, 56)= 80  
36 | ( 24,103)= 65  
37 | ( 93, 97)= 52  
38 | ( 36, 77)= 44  
39 | ( 77, 89)= 40  
40 | ( 44,101)= 28

41 | ( 60, 99)= 25  
42 | ( 34, 34)= 21  
43 | ( 93, 67)= 15  
44 | ( 91, 87)= 13  
45 | ( 70,103)= 5  
46 | ( 82,100)= 4  
47 | ( 83, 76)= 4  
48 | ( 37, 63)= 1  
49 | ( -1, -1)= -1  
50 | ( -1, -1)= -1  
51 | ( -1, -1)= -1  
52 | ( -1, -1)= -1  
53 | ( -1, -1)= -1  
54 | ( -1, -1)= -1  
55 | ( -1, -1)= -1  
56 | ( -1, -1)= -1  
57 | ( -1, -1)= -1  
58 | ( -1, -1)= -1  
59 | ( -1, -1)= -1  
60 | ( -1, -1)= -1  
61 | ( -1, -1)= -1  
62 | ( -1, -1)= -1  
63 | ( -1, -1)= -1  
64 | ( -1, -1)= -1  
65 | ( -1, -1)= -1  
66 | ( -1, -1)= -1  
67 | ( -1, -1)= -1  
68 | ( -1, -1)= -1  
69 | ( -1, -1)= -1  
70 | ( -1, -1)= -1  
71 | ( -1, -1)= -1  
72 | ( -1, -1)= -1  
73 | ( -1, -1)= -1  
74 | ( -1, -1)= -1  
75 | ( -1, -1)= -1  
76 | ( -1, -1)= -1  
77 | ( -1, -1)= -1  
78 | ( -1, -1)= -1  
79 | ( -1, -1)= -1  
80 | ( -1, -1)= -1  
81 | ( -1, -1)= -1  
82 | ( -1, -1)= -1  
83 | ( -1, -1)= -1  
84 | ( -1, -1)= -1  
85 | ( -1, -1)= -1  
86 | ( -1, -1)= -1  
87 | ( -1, -1)= -1  
88 | ( -1, -1)= -1  
89 | ( -1, -1)= -1

```

90 | ( -1, -1)= -1
91 | ( -1, -1)= -1
92 | ( -1, -1)= -1
93 | ( -1, -1)= -1
94 | ( -1, -1)= -1
95 | ( -1, -1)= -1
96 | ( -1, -1)= -1
97 | ( -1, -1)= -1
98 | ( -1, -1)= -1
99 | ( -1, -1)= -1

```

feat2.txt

Feel free to place comments here.

!!

!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 100

feature | (x,y)=val

```

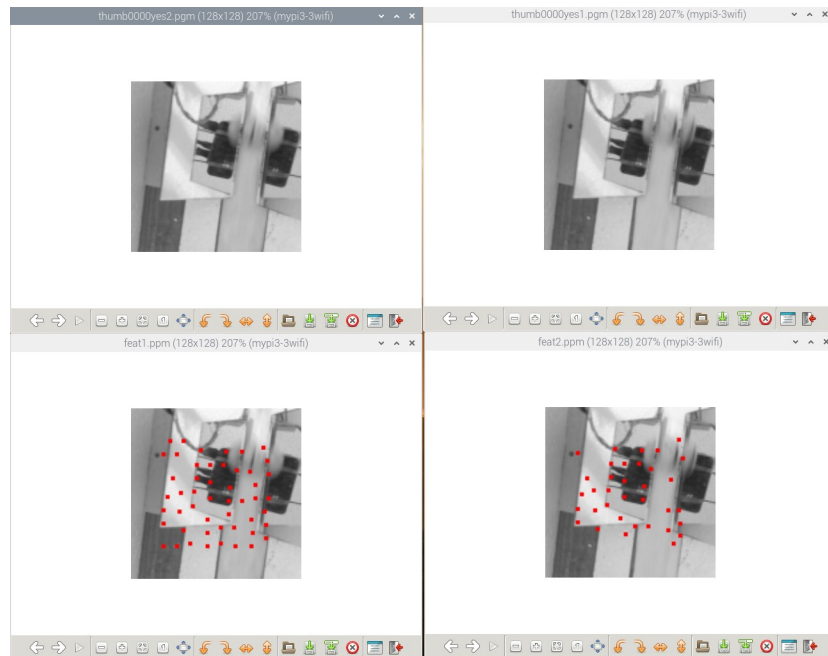
-----+-----
 0 | ( 59.1, 42.1)=  0
 1 | ( 49.2, 52.0)=  0
 2 | ( 70.3, 33.2)=  0
 3 | ( 38.9, 91.1)=  0
 4 | ( 59.1, 66.9)=  0
 5 | (100.0, 76.9)=  0
 6 | ( 73.0, 68.8)=  0
 7 | ( -1.0, -1.0)= -4
 8 | ( 52.2, 31.1)=  0
 9 | ( 49.1, 42.1)=  0
10 | ( 66.9, 89.2)=  0
11 | ( 74.0, 58.9)=  0
12 | ( -1.0, -1.0)= -4
13 | (101.0, 87.1)=  0
14 | ( 59.1, 56.9)=  0
15 | (102.8, 99.5)=  0
16 | ( 98.0, 29.9)=  0
17 | ( 46.2, 72.8)=  0
18 | (103.0, 66.9)=  0
19 | ( 79.3, 45.3)=  0
20 | ( 83.2, 32.1)=  0
21 | ( 47.2, 62.8)=  0
22 | (102.1, 47.5)=  0

```

23 | ( 39.2, 24.2)= 0  
24 | ( 33.8,102.9)= 0  
25 | ( 68.7, 43.5)= 0  
26 | ( 57.5, 82.9)= 0  
27 | ( 31.0, 52.1)= 0  
28 | ( -1.0, -1.0)= -4  
29 | ( -1.0, -1.0)= -4  
30 | ( 95.9, 50.8)= 0  
31 | ( 73.5, 80.0)= 0  
32 | ( -1.0, -1.0)= -4  
33 | ( 26.9, 66.3)= 0  
34 | ( 28.9, 24.4)= 0  
35 | ( 90.7, 59.8)= 0  
36 | ( -1.0, -1.0)= -4  
37 | ( -1.0, -1.0)= -3  
38 | ( 35.3, 77.3)= 0  
39 | ( 77.3, 89.6)= 0  
40 | ( 44.9, 96.9)= 0  
41 | ( 60.9, 95.4)= 0  
42 | ( 33.3, 35.3)= 0  
43 | ( 93.0, 62.8)= 0  
44 | ( -1.0, -1.0)= -3  
45 | ( -1.0, -1.0)= -4  
46 | ( -1.0, -1.0)= -4  
47 | ( 81.6, 81.2)= 0  
48 | ( 37.8, 63.2)= 0  
49 | ( -1.0, -1.0)= -1  
50 | ( -1.0, -1.0)= -1  
51 | ( -1.0, -1.0)= -1  
52 | ( -1.0, -1.0)= -1  
53 | ( -1.0, -1.0)= -1  
54 | ( -1.0, -1.0)= -1  
55 | ( -1.0, -1.0)= -1  
56 | ( -1.0, -1.0)= -1  
57 | ( -1.0, -1.0)= -1  
58 | ( -1.0, -1.0)= -1  
59 | ( -1.0, -1.0)= -1  
60 | ( -1.0, -1.0)= -1  
61 | ( -1.0, -1.0)= -1  
62 | ( -1.0, -1.0)= -1  
63 | ( -1.0, -1.0)= -1  
64 | ( -1.0, -1.0)= -1  
65 | ( -1.0, -1.0)= -1  
66 | ( -1.0, -1.0)= -1  
67 | ( -1.0, -1.0)= -1  
68 | ( -1.0, -1.0)= -1  
69 | ( -1.0, -1.0)= -1  
70 | ( -1.0, -1.0)= -1  
71 | ( -1.0, -1.0)= -1

```
72 | ( -1.0, -1.0)= -1
73 | ( -1.0, -1.0)= -1
74 | ( -1.0, -1.0)= -1
75 | ( -1.0, -1.0)= -1
76 | ( -1.0, -1.0)= -1
77 | ( -1.0, -1.0)= -1
78 | ( -1.0, -1.0)= -1
79 | ( -1.0, -1.0)= -1
80 | ( -1.0, -1.0)= -1
81 | ( -1.0, -1.0)= -1
82 | ( -1.0, -1.0)= -1
83 | ( -1.0, -1.0)= -1
84 | ( -1.0, -1.0)= -1
85 | ( -1.0, -1.0)= -1
86 | ( -1.0, -1.0)= -1
87 | ( -1.0, -1.0)= -1
88 | ( -1.0, -1.0)= -1
89 | ( -1.0, -1.0)= -1
90 | ( -1.0, -1.0)= -1
91 | ( -1.0, -1.0)= -1
92 | ( -1.0, -1.0)= -1
93 | ( -1.0, -1.0)= -1
94 | ( -1.0, -1.0)= -1
95 | ( -1.0, -1.0)= -1
96 | ( -1.0, -1.0)= -1
97 | ( -1.0, -1.0)= -1
98 | ( -1.0, -1.0)= -1
99 | ( -1.0, -1.0)= -1
```

end of feat.txt



Modified example1.c to use thumb0000yes2.pgm and thumb0000yes1.pgm

feat1.txt

Feel free to place comments here.

!!

!!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
KLT Feature List  
-----

nFeatures = 100

feature | (x,y)=val

-----+-----  
0 | ( 59, 42)=12951  
1 | ( 71, 32)=11510  
2 | ( 49, 52)=11472  
3 | ( 59, 67)=10930  
4 | ( 39, 91)=10416  
5 | (100, 77)= 9166  
6 | ( 73, 69)= 8837  
7 | ( 24, 86)= 8779  
8 | ( 52, 31)= 7268  
9 | ( 49, 42)= 5364  
10 | ( 74, 59)= 3307  
11 | ( 67, 89)= 2881  
12 | (101, 87)= 2445  
13 | ( 83, 32)= 1920  
14 | (102, 39)= 1830  
15 | (101, 97)= 1785  
16 | (103, 49)= 1728  
17 | ( 59, 55)= 1637  
18 | (103, 67)= 1183  
19 | ( 46, 73)= 1097  
20 | ( 79, 46)= 1035  
21 | ( 69, 42)= 974  
22 | ( 47, 62)= 929  
23 | ( 89, 47)= 928  
24 | ( 99, 29)= 804  
25 | ( 39, 24)= 781  
26 | ( 34,103)= 731  
27 | ( 57, 83)= 470  
28 | ( 31, 52)= 415  
29 | ( 24, 34)= 256  
30 | ( 73, 79)= 253  
31 | ( 24, 76)= 232

32 | ( 93, 57)= 121  
33 | ( 27, 66)= 121  
34 | ( 29, 24)= 93  
35 | ( 91, 93)= 60  
36 | ( 24,103)= 57  
37 | ( 36, 77)= 54  
38 | ( 77, 89)= 42  
39 | ( 67,101)= 33  
40 | ( 34, 34)= 24  
41 | ( 44,101)= 23  
42 | ( 90,103)= 23  
43 | ( 78,103)= 19  
44 | ( 93, 67)= 15  
45 | ( 57, 93)= 8  
46 | ( 90, 83)= 7  
47 | ( 57,103)= 7  
48 | ( 37, 63)= 2  
49 | ( 83, 69)= 2  
50 | ( -1, -1)= -1  
51 | ( -1, -1)= -1  
52 | ( -1, -1)= -1  
53 | ( -1, -1)= -1  
54 | ( -1, -1)= -1  
55 | ( -1, -1)= -1  
56 | ( -1, -1)= -1  
57 | ( -1, -1)= -1  
58 | ( -1, -1)= -1  
59 | ( -1, -1)= -1  
60 | ( -1, -1)= -1  
61 | ( -1, -1)= -1  
62 | ( -1, -1)= -1  
63 | ( -1, -1)= -1  
64 | ( -1, -1)= -1  
65 | ( -1, -1)= -1  
66 | ( -1, -1)= -1  
67 | ( -1, -1)= -1  
68 | ( -1, -1)= -1  
69 | ( -1, -1)= -1  
70 | ( -1, -1)= -1  
71 | ( -1, -1)= -1  
72 | ( -1, -1)= -1  
73 | ( -1, -1)= -1  
74 | ( -1, -1)= -1  
75 | ( -1, -1)= -1  
76 | ( -1, -1)= -1  
77 | ( -1, -1)= -1  
78 | ( -1, -1)= -1  
79 | ( -1, -1)= -1  
80 | ( -1, -1)= -1



```

81 | ( -1, -1)= -1
82 | ( -1, -1)= -1
83 | ( -1, -1)= -1
84 | ( -1, -1)= -1
85 | ( -1, -1)= -1
86 | ( -1, -1)= -1
87 | ( -1, -1)= -1
88 | ( -1, -1)= -1
89 | ( -1, -1)= -1
90 | ( -1, -1)= -1
91 | ( -1, -1)= -1
92 | ( -1, -1)= -1
93 | ( -1, -1)= -1
94 | ( -1, -1)= -1
95 | ( -1, -1)= -1
96 | ( -1, -1)= -1
97 | ( -1, -1)= -1
98 | ( -1, -1)= -1
99 | ( -1, -1)= -1

```

feat2.txt  
 Feel free to place comments here.

!!  
 !!! Warning: This is a KLT data file. Do not modify below this line !!!

-----  
 KLT Feature List  
 -----

nFeatures = 100

```

feature | (x,y)=val
-----+-----
  0 | ( 58.8, 41.9)=  0
  1 | ( 71.7, 31.9)=  0
  2 | ( 48.8, 52.0)=  0
  3 | ( 58.9, 67.0)=  0
  4 | ( 39.1, 90.9)=  0
  5 | (100.0, 77.1)=  0
  6 | ( 73.0, 69.1)=  0
  7 | ( 24.1, 85.9)=  0
  8 | ( 51.9, 30.9)=  0
  9 | ( 49.0, 41.9)=  0
 10 | ( 74.0, 59.1)=  0
 11 | ( 67.1, 88.8)=  0

```

12 | (101.0, 86.9)= 0  
13 | ( 83.7, 31.9)= 0  
14 | (102.8, 38.2)= 0  
15 | (101.3, 96.2)= 0  
16 | ( -1.0, -1.0)= -4  
17 | ( 58.9, 55.0)= 0  
18 | ( -1.0, -1.0)= -4  
19 | ( 45.9, 73.2)= 0  
20 | ( 78.7, 45.7)= 0  
21 | ( 69.6, 41.8)= 0  
22 | ( 46.9, 62.3)= 0  
23 | ( -1.0, -1.0)= -5  
24 | (100.3, 24.0)= 0  
25 | ( -1.0, -1.0)= -4  
26 | ( -1.0, -1.0)= -4  
27 | ( 56.4, 83.0)= 0  
28 | ( 31.0, 52.9)= 0  
29 | ( 24.1, 33.9)= 0  
30 | ( -1.0, -1.0)= -3  
31 | ( 24.1, 75.6)= 0  
32 | ( 93.8, 54.0)= 0  
33 | ( 27.2, 65.4)= 0  
34 | ( -1.0, -1.0)= -4  
35 | ( 92.4, 92.2)= 0  
36 | ( -1.0, -1.0)= -4  
37 | ( 36.7, 76.6)= 0  
38 | ( 76.7, 88.6)= 0  
39 | ( -1.0, -1.0)= -4  
40 | ( -1.0, -1.0)= -3  
41 | ( -1.0, -1.0)= -4  
42 | ( 96.3,102.3)= 0  
43 | ( -1.0, -1.0)= -3  
44 | ( -1.0, -1.0)= -3  
45 | ( 59.7, 94.7)= 0  
46 | ( 91.6, 77.4)= 0  
47 | ( -1.0, -1.0)= -4  
48 | ( 35.9, 62.4)= 0  
49 | ( -1.0, -1.0)= -3  
50 | ( -1.0, -1.0)= -1  
51 | ( -1.0, -1.0)= -1  
52 | ( -1.0, -1.0)= -1  
53 | ( -1.0, -1.0)= -1  
54 | ( -1.0, -1.0)= -1  
55 | ( -1.0, -1.0)= -1  
56 | ( -1.0, -1.0)= -1  
57 | ( -1.0, -1.0)= -1  
58 | ( -1.0, -1.0)= -1  
59 | ( -1.0, -1.0)= -1  
60 | ( -1.0, -1.0)= -1

61 | ( -1.0, -1.0)= -1  
62 | ( -1.0, -1.0)= -1  
63 | ( -1.0, -1.0)= -1  
64 | ( -1.0, -1.0)= -1  
65 | ( -1.0, -1.0)= -1  
66 | ( -1.0, -1.0)= -1  
67 | ( -1.0, -1.0)= -1  
68 | ( -1.0, -1.0)= -1  
69 | ( -1.0, -1.0)= -1  
70 | ( -1.0, -1.0)= -1  
71 | ( -1.0, -1.0)= -1  
72 | ( -1.0, -1.0)= -1  
73 | ( -1.0, -1.0)= -1  
74 | ( -1.0, -1.0)= -1  
75 | ( -1.0, -1.0)= -1  
76 | ( -1.0, -1.0)= -1  
77 | ( -1.0, -1.0)= -1  
78 | ( -1.0, -1.0)= -1  
79 | ( -1.0, -1.0)= -1  
80 | ( -1.0, -1.0)= -1  
81 | ( -1.0, -1.0)= -1  
82 | ( -1.0, -1.0)= -1  
83 | ( -1.0, -1.0)= -1  
84 | ( -1.0, -1.0)= -1  
85 | ( -1.0, -1.0)= -1  
86 | ( -1.0, -1.0)= -1  
87 | ( -1.0, -1.0)= -1  
88 | ( -1.0, -1.0)= -1  
89 | ( -1.0, -1.0)= -1  
90 | ( -1.0, -1.0)= -1  
91 | ( -1.0, -1.0)= -1  
92 | ( -1.0, -1.0)= -1  
93 | ( -1.0, -1.0)= -1  
94 | ( -1.0, -1.0)= -1  
95 | ( -1.0, -1.0)= -1  
96 | ( -1.0, -1.0)= -1  
97 | ( -1.0, -1.0)= -1  
98 | ( -1.0, -1.0)= -1  
99 | ( -1.0, -1.0)= -1

end of feat.txt

\*\*\*\*\***Draft**\*\*\*\*\*

**Principal component analysis (PCA)**

**08/29/19**

\*\*\*\*\*Draft\*\*\*\*\*

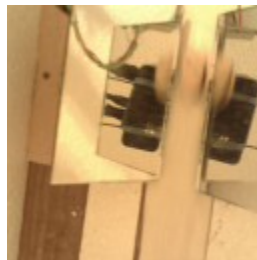
Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables (entities each of which takes on various numerical values) into a set of values of linearly uncorrelated variables called principal components.

## 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.

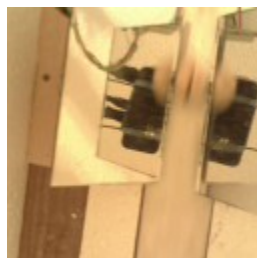
Thumb0000yes1.bmp



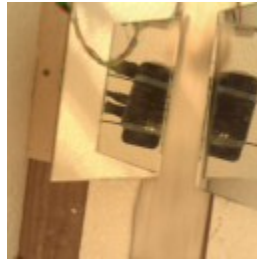
thumb0000no1.bmp



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