LAB 2 REPORT – Aaron Bruner

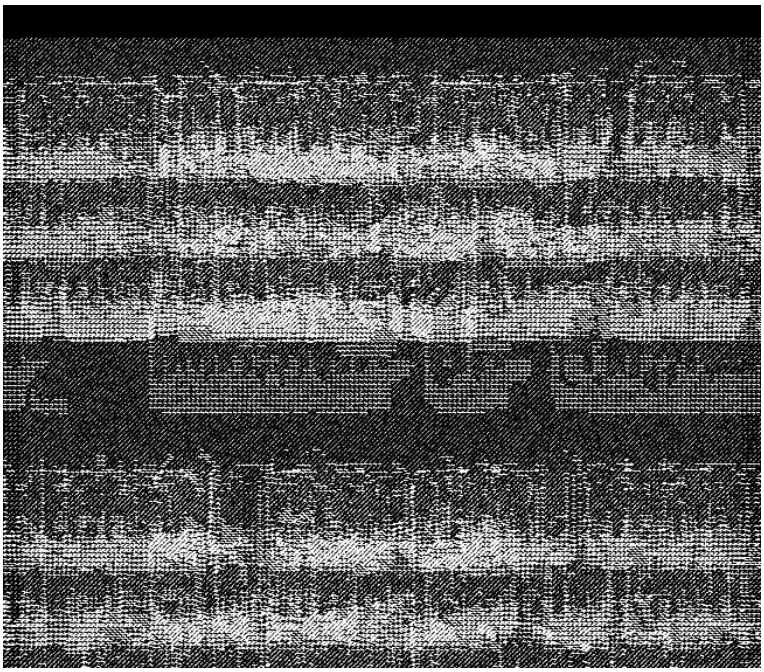
The purpose of this lab was to detect the location of characters in an image. The lab instructions laid out 4 steps for us to follow. The first step was to read the input image, template image, and ground truth files.

```
./lab2
Step 1:
Performing matched filter on images [parenthood.ppm] and [parenthood_e_template.ppm] using ground
truth [parenthood_gt.txt]
        * Reading in source image...    [SUCCESS]
        * Reading in template image...  [SUCCESS]
        * Opening ground truth file...  [SUCCESS]
        * Found 1261 number of rows in the ground truth file
        * Allocating space for ground truth file... [SUCCESS]
        * Scanning in values from ground truth file...  [Read in 1261 rows]
```

The above text is the first step output from the terminal when we execute out code. As we can see, the files parenthood.ppm, parenthood_e_template.ppm and parenthood_gt.txt are used since command line arguments were not provided. We have the option of specifying which files we want to use by using the following command: ./lab2 (sourceFile.ppm) (templateFile.ppm) (groundTruth.txt). We can see that 1261 rows were read in from the ground truth and all files were successfully opened and read in.

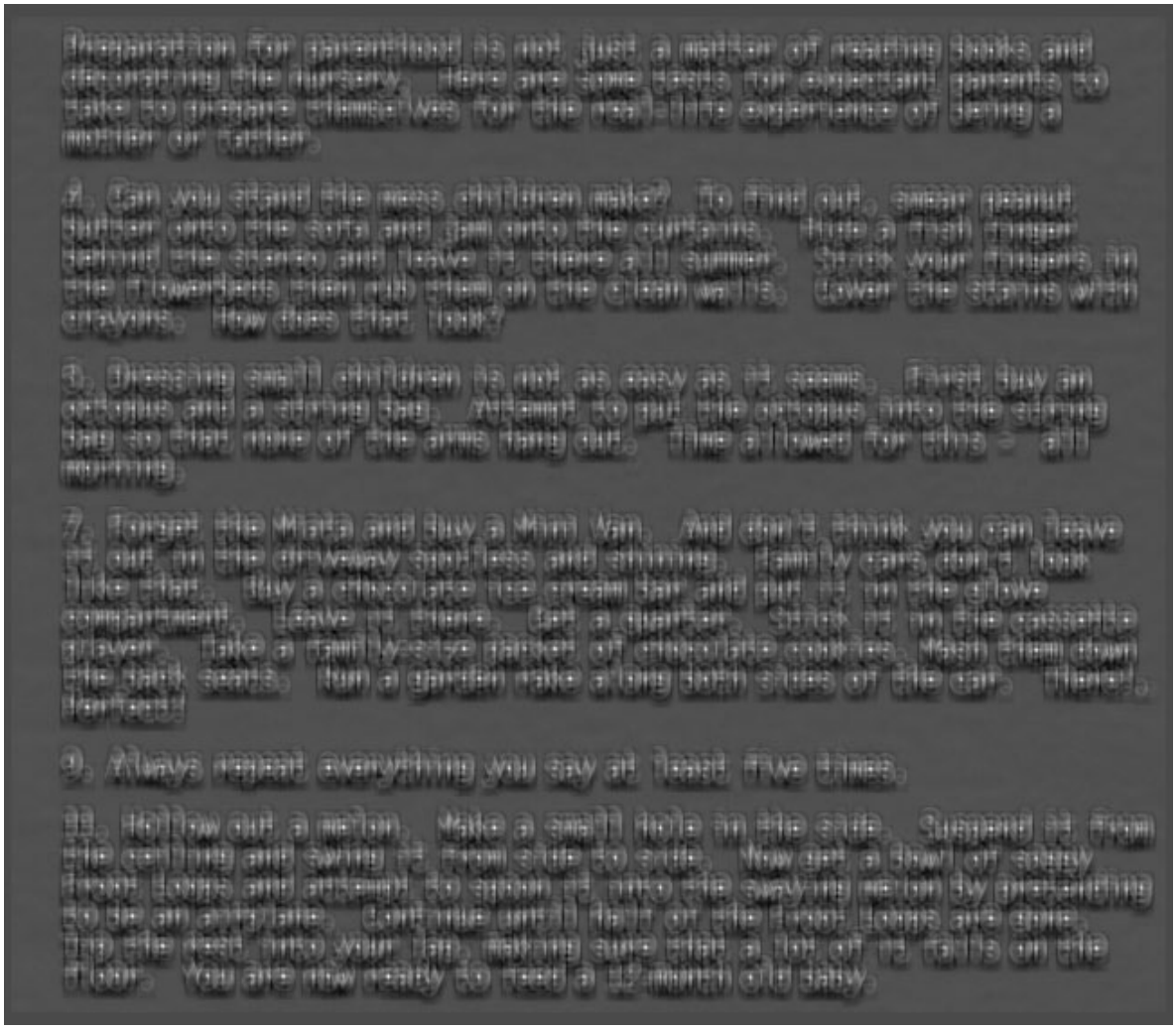
Step 2 asked us to calculate the matched-spatial filter (MSF) image. Below is the output from the terminal and the MSF image.

```
Step 2:
Calculate the mean of the template image...
        * Mean pixel value in the template image = 165
        * Generating the zero mean template image
                * Allocating space for template MSF image...    [SUCCESS]
                * Allocating space for MSF image...     [SUCCESS]
                * Convolving source and zero-mean centered image...     [SUCCESS]
```



Step 3 asked us to normalize the MSF image to 8-bits. Below is the output from the terminal and the normalized image.

```
Step 3:
Finding the minimum pixel and maximum pixel of the MSF...
        * Calculating the minimum and maximum pixel in MSF image...     [SUCCESS]
                * Minimum determined to be: -128215
                * Maximum determined to be: 309645
        * Normalizing the MSF image to 8-bit...
                * Creating space for normalized image...        [SUCCESS]
```

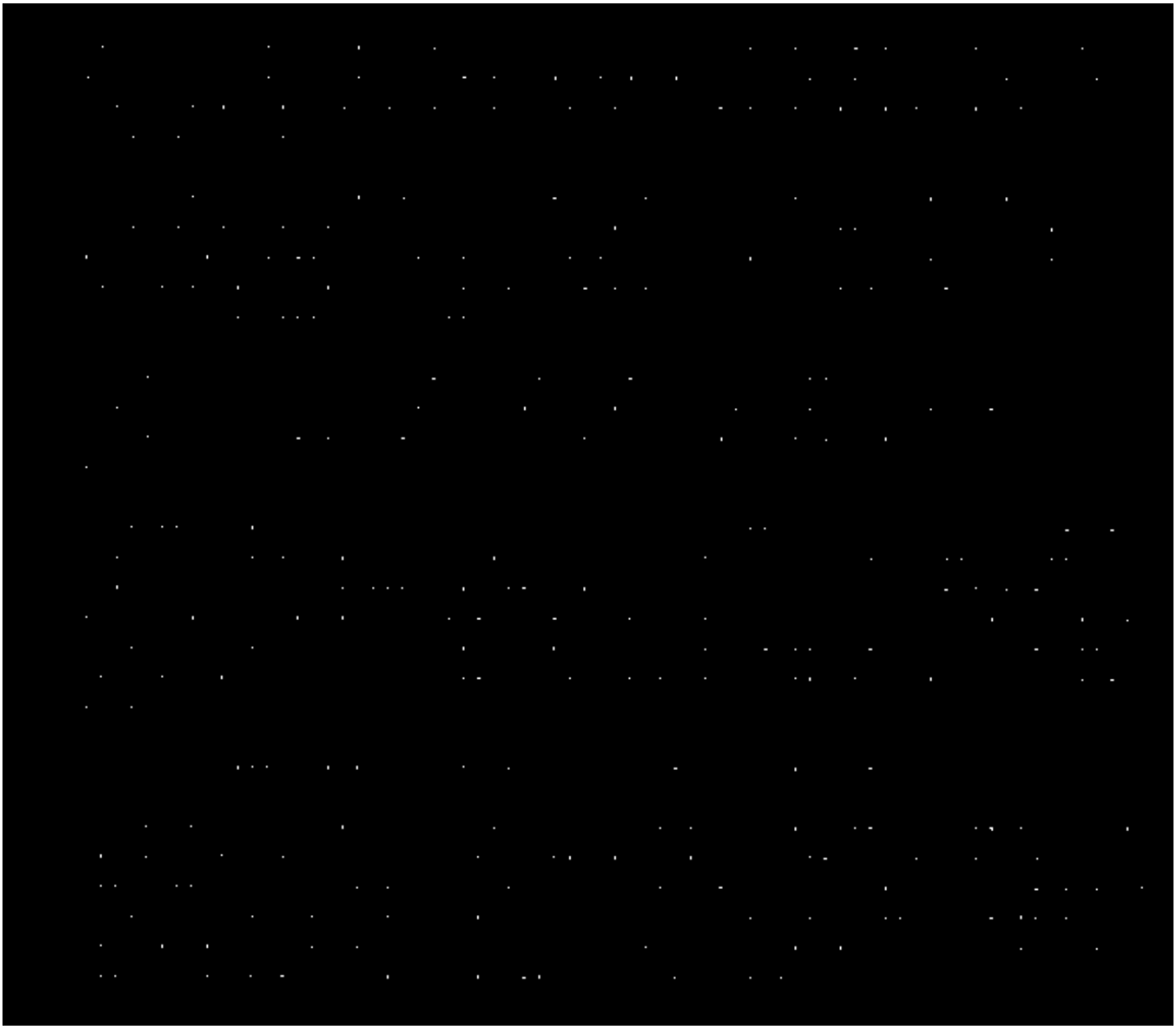


The pixel values with values closer to 255 are more likely to be e.

Step 4 has us thresholding the above image for ranging values of T. The ideal value of T was determined to be 200 which yields the highest number of e's with the lowest number of FP.

```
Step 4:
Creating a binary image using the threshold...
        * Allocating space for result image     [SUCCESS]
        * Loop over the MSF image with threshold values from 0 to 255 incrementing by 10...
        * Generating the ideal OCR image using threshold value [200]... [SUCCESS]
        * Sending result image to idealImage.ppm...     [SUCCESS]
```

The full output of TP and FP values for T values ranging from 0 to 255 are on the next page along with the ideal output image at 200.



Threshold [0] : TP = 151 | FP = 1111
Threshold [1] : TP = 151 | FP = 1111
Threshold [2] : TP = 151 | FP = 1111
Threshold [3] : TP = 151 | FP = 1111
Threshold [4] : TP = 151 | FP = 1111
Threshold [5] : TP = 151 | FP = 1111
Threshold [6] : TP = 151 | FP = 1111
Threshold [7] : TP = 151 | FP = 1111
Threshold [8] : TP = 151 | FP = 1111
Threshold [9] : TP = 151 | FP = 1111
Threshold [10] : TP = 151 | FP = 1111
Threshold [11] : TP = 151 | FP = 1111
Threshold [12] : TP = 151 | FP = 1111
Threshold [13] : TP = 151 | FP = 1111
Threshold [14] : TP = 151 | FP = 1111
Threshold [15] : TP = 151 | FP = 1111
Threshold [16] : TP = 151 | FP = 1111
Threshold [17] : TP = 151 | FP = 1111
Threshold [18] : TP = 151 | FP = 1111
Threshold [19] : TP = 151 | FP = 1111
Threshold [20] : TP = 151 | FP = 1111
Threshold [21] : TP = 151 | FP = 1111
Threshold [22] : TP = 151 | FP = 1111
Threshold [23] : TP = 151 | FP = 1111
Threshold [24] : TP = 151 | FP = 1111
Threshold [25] : TP = 151 | FP = 1111
Threshold [26] : TP = 151 | FP = 1111
Threshold [27] : TP = 151 | FP = 1111
Threshold [28] : TP = 151 | FP = 1111
Threshold [29] : TP = 151 | FP = 1111
Threshold [30] : TP = 151 | FP = 1111
Threshold [31] : TP = 151 | FP = 1111
Threshold [32] : TP = 151 | FP = 1111
Threshold [33] : TP = 151 | FP = 1111
Threshold [34] : TP = 151 | FP = 1111
Threshold [35] : TP = 151 | FP = 1111
Threshold [36] : TP = 151 | FP = 1111
Threshold [37] : TP = 151 | FP = 1111
Threshold [38] : TP = 151 | FP = 1111
Threshold [39] : TP = 151 | FP = 1111
Threshold [40] : TP = 151 | FP = 1111
Threshold [41] : TP = 151 | FP = 1111
Threshold [42] : TP = 151 | FP = 1111
Threshold [43] : TP = 151 | FP = 1111
Threshold [44] : TP = 151 | FP = 1111
Threshold [45] : TP = 151 | FP = 1111
Threshold [46] : TP = 151 | FP = 1111
Threshold [47] : TP = 151 | FP = 1111
Threshold [48] : TP = 151 | FP = 1111
Threshold [49] : TP = 151 | FP = 1111
Threshold [50] : TP = 151 | FP = 1111
Threshold [51] : TP = 151 | FP = 1111
Threshold [52] : TP = 151 | FP = 1111
Threshold [53] : TP = 151 | FP = 1111
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Threshold [56] : TP = 151 | FP = 1111
Threshold [57] : TP = 151 | FP = 1111
Threshold [58] : TP = 151 | FP = 1111
Threshold [59] : TP = 151 | FP = 1111
Threshold [60] : TP = 151 | FP = 1111
Threshold [61] : TP = 151 | FP = 1111
Threshold [62] : TP = 151 | FP = 1111
Threshold [63] : TP = 151 | FP = 1111
Threshold [64] : TP = 151 | FP = 1111
Threshold [65] : TP = 151 | FP = 1111
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Threshold [67] : TP = 151 | FP = 1111
Threshold [68] : TP = 151 | FP = 1111
Threshold [69] : TP = 151 | FP = 1111
Threshold [70] : TP = 151 | FP = 1111
Threshold [71] : TP = 151 | FP = 1111
Threshold [72] : TP = 151 | FP = 1111
Threshold [73] : TP = 151 | FP = 1111
Threshold [74] : TP = 151 | FP = 1111

Threshold [75] : TP = 151 | FP = 1111
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Threshold [77] : TP = 151 | FP = 1111
Threshold [78] : TP = 151 | FP = 1111
Threshold [79] : TP = 151 | FP = 1111
Threshold [80] : TP = 151 | FP = 1111
Threshold [81] : TP = 151 | FP = 1111
Threshold [82] : TP = 151 | FP = 1111
Threshold [83] : TP = 151 | FP = 1111
Threshold [84] : TP = 151 | FP = 1111
Threshold [85] : TP = 151 | FP = 1111
Threshold [86] : TP = 151 | FP = 1111
Threshold [87] : TP = 151 | FP = 1111
Threshold [88] : TP = 151 | FP = 1111
Threshold [89] : TP = 151 | FP = 1111
Threshold [90] : TP = 151 | FP = 1111
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Threshold [94] : TP = 151 | FP = 1111
Threshold [95] : TP = 151 | FP = 1111
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Threshold [102] : TP = 151| FP = 1111
Threshold [103] : TP = 151| FP = 1111
Threshold [104] : TP = 151| FP = 1111
Threshold [105] : TP = 151| FP = 1111
Threshold [106] : TP = 151| FP = 1111
Threshold [107] : TP = 151| FP = 1111
Threshold [108] : TP = 151| FP = 1110
Threshold [109] : TP = 151| FP = 1110
Threshold [110] : TP = 151| FP = 1110
Threshold [111] : TP = 151| FP = 1110
Threshold [112] : TP = 151| FP = 1109
Threshold [113] : TP = 151| FP = 1109
Threshold [114] : TP = 151| FP = 1108
Threshold [115] : TP = 151| FP = 1107
Threshold [116] : TP = 151| FP = 1106
Threshold [117] : TP = 151| FP = 1105
Threshold [118] : TP = 151| FP = 1105
Threshold [119] : TP = 151| FP = 1102
Threshold [120] : TP = 151| FP = 1101
Threshold [121] : TP = 151| FP = 1097
Threshold [122] : TP = 151| FP = 1097
Threshold [123] : TP = 151| FP = 1096
Threshold [124] : TP = 151| FP = 1096
Threshold [125] : TP = 151| FP = 1094
Threshold [126] : TP = 151| FP = 1091
Threshold [127] : TP = 151| FP = 1088
Threshold [128] : TP = 151| FP = 1084
Threshold [129] : TP = 151| FP = 1079
Threshold [130] : TP = 151| FP = 1073
Threshold [131] : TP = 151| FP = 1068
Threshold [132] : TP = 151| FP = 1066
Threshold [133] : TP = 151| FP = 1058
Threshold [134] : TP = 151| FP = 1053
Threshold [135] : TP = 151| FP = 1047
Threshold [136] : TP = 151| FP = 1041
Threshold [137] : TP = 151| FP = 1035
Threshold [138] : TP = 151| FP = 1026
Threshold [139] : TP = 151| FP = 1016
Threshold [140] : TP = 151| FP = 1010
Threshold [141] : TP = 151| FP = 1003
Threshold [142] : TP = 151| FP = 994
Threshold [143] : TP = 151| FP = 984
Threshold [144] : TP = 151| FP = 971
Threshold [145] : TP = 151| FP = 957
Threshold [146] : TP = 151| FP = 947
Threshold [147] : TP = 151| FP = 929
Threshold [148] : TP = 151| FP = 921
Threshold [149] : TP = 151| FP = 908
Threshold [150] : TP = 151| FP = 889
Threshold [151] : TP = 151| FP = 873
Threshold [152] : TP = 151| FP = 849
Threshold [153] : TP = 151| FP = 830
Threshold [154] : TP = 151| FP = 809
Threshold [155] : TP = 151| FP = 791
Threshold [156] : TP = 151| FP = 767
Threshold [157] : TP = 151| FP = 746
Threshold [158] : TP = 151| FP = 726
Threshold [159] : TP = 151| FP = 699
Threshold [160] : TP = 151| FP = 675
Threshold [161] : TP = 151| FP = 656
Threshold [162] : TP = 151| FP = 643
Threshold [163] : TP = 151| FP = 624
Threshold [164] : TP = 151| FP = 612
Threshold [165] : TP = 151| FP = 597
Threshold [166] : TP = 151| FP = 580
Threshold [167] : TP = 151| FP = 565
Threshold [168] : TP = 151| FP = 554
Threshold [169] : TP = 151| FP = 544
Threshold [170] : TP = 151| FP = 535
Threshold [171] : TP = 151| FP = 519
Threshold [172] : TP = 151| FP = 509
Threshold [173] : TP = 151| FP = 492
Threshold [174] : TP = 151| FP = 477
Threshold [175] : TP = 151| FP = 468
Threshold [176] : TP = 151| FP = 450
Threshold [177] : TP = 151| FP = 440
Threshold [178] : TP = 151| FP = 421
Threshold [179] : TP = 151| FP = 400
Threshold [180] : TP = 151| FP = 386
Threshold [181] : TP = 151| FP = 372
Threshold [182] : TP = 151| FP = 349
Threshold [183] : TP = 151| FP = 339
Threshold [184] : TP = 151| FP = 319
Threshold [185] : TP = 151| FP = 308
Threshold [186] : TP = 151| FP = 292
Threshold [187] : TP = 151| FP = 283
Threshold [188] : TP = 151| FP = 272
Threshold [189] : TP = 151| FP = 253
Threshold [190] : TP = 151| FP = 231
Threshold [191] : TP = 151| FP = 215
Threshold [192] : TP = 151| FP = 200
Threshold [193] : TP = 151| FP = 187
Threshold [194] : TP = 151| FP = 180
Threshold [195] : TP = 151| FP = 169
Threshold [196] : TP = 151| FP = 162
Threshold [197] : TP = 151| FP = 148
Threshold [198] : TP = 151| FP = 141
Threshold [199] : TP = 151| FP = 133
Threshold [200] : TP = 151| FP = 124
Threshold [201] : TP = 150| FP = 113
Threshold [202] : TP = 150| FP = 108
Threshold [203] : TP = 150| FP = 101
Threshold [204] : TP = 149| FP = 90
Threshold [205] : TP = 148| FP = 82
Threshold [206] : TP = 147| FP = 75
Threshold [207] : TP = 146| FP = 69
Threshold [208] : TP = 145| FP = 65
Threshold [209] : TP = 144| FP = 64
Threshold [210] : TP = 143| FP = 59
Threshold [211] : TP = 142| FP = 54
Threshold [212] : TP = 142| FP = 52
Threshold [213] : TP = 140| FP = 48
Threshold [214] : TP = 139| FP = 45
Threshold [215] : TP = 133| FP = 43
Threshold [216] : TP = 133| FP = 42
Threshold [217] : TP = 130| FP = 40
Threshold [218] : TP = 128| FP = 37
Threshold [219] : TP = 122| FP = 34
Threshold [220] : TP = 121| FP = 30
Threshold [221] : TP = 118| FP = 25
Threshold [222] : TP = 115| FP = 20
Threshold [223] : TP = 111| FP = 17
Threshold [224] : TP = 104| FP = 16
Threshold [225] : TP = 99 | FP = 14
Threshold [226] : TP = 98 | FP = 10
Threshold [227] : TP = 93 | FP = 7
Threshold [228] : TP = 89 | FP = 7
Threshold [229] : TP = 81 | FP = 5
Threshold [230] : TP = 75 | FP = 5
Threshold [231] : TP = 68 | FP = 4
Threshold [232] : TP = 63 | FP = 4
Threshold [233] : TP = 60 | FP = 2
Threshold [234] : TP = 53 | FP = 2
Threshold [235] : TP = 48 | FP = 1
Threshold [236] : TP = 43 | FP = 1
Threshold [237] : TP = 41 | FP = 0
Threshold [238] : TP = 39 | FP = 0
Threshold [239] : TP = 35 | FP = 0
Threshold [240] : TP = 31 | FP = 0
Threshold [241] : TP = 28 | FP = 0
Threshold [242] : TP = 24 | FP = 0
Threshold [243] : TP = 23 | FP = 0
Threshold [244] : TP = 20 | FP = 0
Threshold [245] : TP = 16 | FP = 0
Threshold [246] : TP = 13 | FP = 0
Threshold [247] : TP = 11 | FP = 0
Threshold [248] : TP = 8 | FP = 0
Threshold [249] : TP = 6 | FP = 0
Threshold [250] : TP = 5 | FP = 0
Threshold [251] : TP = 1 | FP = 0
Threshold [252] : TP = 1 | FP = 0
Threshold [253] : TP = 1 | FP = 0
Threshold [254] : TP = 1 | FP = 0
Threshold [255] : TP = 1 | FP = 0