CV Project 3 Implementation of the four basic Morphology Operations Java

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Project Due 02/27/23

Algorithm Steps

```
step 0: imgFile, elmFile, outFile1,
outFile2-->open
step 1:
 numImgRows, numImgCols, imgMin, imgMax --> read from imgFile
numStructRows, numStructCols, structMin, structMax --> read from elmFile
rowOrigin, colOrigin-->read from elmFile
step 2: zeroFramedAry, structAry, morphAry, tempAry-->dynamically allocate. // see description in the above
step 3: zero2DAry(zeroFramedAry, rowSize, colSize)
step 4: loadImg (imgFile, zeroFramedAry)
step 5:
imgReformat (zeroFramedAry, outFile1) // with caption.
prettyPrint (zeroFramedAry, outFile1) // with caption.
step 6:
zero2DAry(structAry, numStructRows, numStructCols) loadstruct (structFile, structAry)  prettyPrint (structAry, outFile1) // with caption.
step 7:
basicOperations (zeroFramedAry, morphAry, structAry, tempAry, outFile1)
step 8:  complexOperations (zeroFramedAry, morphAry, structAry, tempAry, outFile2)
step 9:  close all files.
```

<u>Data1 and elm1</u>

Output1.txt

```
44, 33, 0, 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 1 1 0 0 0 0 0 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 1 1 0 0 0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 0 0 1 1 0 0 0 0 0
0 0 0 1 0 0 0 0 0 0 0 0 1 1 1 1 0 0 1 1 1 0 0 0 0 0 1 0 0 0 0 0 0
0 0 0 0 0 0 1 0 0 0 0 1 1 1 1 1 0 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0
0 0 1 0 1 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 1 1 0 0 0 0
0 0 0 1 0 0 0 0 0 0 1 1 0 1 1 0 0 1 1 1 0 1 1 0 0 0 0 1 0 0 0 0 0
0 0 0 0 0 1 0 1 0 0 1 1 1 1 1 0 0 1 1 0 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 1 1 1 1 1 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 1 0 0 0 0 1 1 1 1 0 1 1 1 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0 0 1 1 1 1 0 1 1 1 1 1 1 0 1 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 0 0 1 1 0 1 1 1 1 0 0 0 0 1 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 1 1 1 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 1 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0
0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 1 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0
0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 0 0 0 0 0 1 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 1 0 0 0 0 0 1 1 1 1 1 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 1 0 1 0 0 0 1 1 1 1 0 0 1 1 1 0 1 0 1 1 1 1 0 0 0 0 0
0 0 0 0 0 1 0 0 0 1 0 1 1 1 1 1 1 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 0 0 0 0 0 1 1 1 0 0 1 1 1 1 0 0 1 1 0 1 0 0 1 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 1 1 1 1 0 0 1 1 0 0 0 0 1 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 1 0 1 1 1 1 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 0 0 0 0 0 1 1 1 1 1 1 1 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 1 1 0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 1 1 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 1 1 1 1 0 0 1 1 1 0 1 1 1 1 1 1 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 1 0 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0 1 0 0 0 0 0 0
0 0 0 0 0 0 0 0 1 0 0 0 0 1 1 1 1 1 1 1 0 0 0 0 0 0 0 1 0 0 0 0 0
0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0
0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0
0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0


44, 33, 0, 1


  1
  1 1                           1                           1
                              1 1 1
          1 1               1 1 1 1 1
          1 1             1 1 1 1 1 1 1             1 1
      1                 1 1 1 1     1 1 1           1
            1         1 1 1 1 1   1 1 1 1 1
    1   1           1 1 1 1 1 1 1 1 1 1 1 1 1         1 1
      1             1 1   1 1     1 1 1   1 1         1
          1   1     1 1 1 1 1     1 1   1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1     1 1 1 1
          1         1 1 1 1   1 1 1   1 1 1 1
        1             1 1 1 1   1 1 1 1 1 1   1
                    1     1 1   1 1 1 1         1
```

```
                  1         1 1 1 1 1             1
                1             1 1 1     1           1
              1                 1         1
                                1
        1                       1
      1 1 1                     1
      1 1 1                   1 1 1                 1
        1                   1 1 1               1
                            1 1 1 1 1           1
              1           1 1 1 1 1 1 1       1
            1   1       1 1 1 1     1 1 1   1   1 1 1 1
          1       1   1 1 1 1 1 1   1 1 1 1
      1 1           1 1 1     1 1 1 1     1 1   1     1 1
                    1 1 1     1 1 1 1     1 1         1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1   1 1 1 1     1 1 1 1
      1 1           1 1 1 1 1 1 1     1 1 1 1
      1 1           1 1 1 1 1 1 1 1 1 1   1 1
                    1 1 1 1     1 1 1   1 1 1 1 1 1
                  1   1 1 1 1 1 1 1 1 1 1 1         1
                1         1 1 1 1 1 1 1               1
              1             1 1 1 1 1                 1
      1 1   1                 1 1 1           1 1
          1                 1 1 1             1 1
  1 1                         1


44, 33, 0, 1

  1
1 1 1
  1

entering basicOperations method

 Printing result of ComputeDilation.


44, 33, 0, 1

  1
1 1 1                           1                           1
1 1 1 1                       1 1 1                       1 1 1
  1 1     1 1               1 1 1 1 1                       1
        1 1 1 1           1 1 1 1 1 1 1             1 1
      1 1 1 1 1         1 1 1 1 1 1 1 1 1         1 1 1 1
    1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1       1 1 1
    1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1
  1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1
    1 1 1 1   1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1
      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1       1
      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
        1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
        1         1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1
                1 1 1     1 1 1 1 1 1 1 1       1 1 1
              1 1 1         1 1 1 1 1 1 1 1       1 1 1
            1 1 1             1 1 1     1 1 1       1
        1     1               1 1 1       1
      1 1 1                   1 1 1
    1 1 1 1 1                   1 1 1               1
    1 1 1 1 1                 1 1 1 1 1             1 1 1
      1 1 1               1 1 1 1 1           1 1 1
        1     1           1 1 1 1 1 1 1       1 1 1
            1 1 1       1 1 1 1 1 1 1 1 1   1 1 1 1 1 1
          1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
    1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1     1 1
      1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
              1 1 1   1 1 1 1 1 1 1 1 1 1 1         1 1 1
      1 1   1 1 1         1 1 1 1 1 1 1       1 1   1 1 1
    1 1 1 1 1 1           1 1 1 1 1       1 1 1 1   1
  1 1 1 1 1 1             1 1 1 1 1         1 1 1 1
1 1 1 1   1                   1 1 1             1 1
  1 1                         1


 Printing result of ComputeErosion.


44, 33, 0, 1



                                1
                              1 1 1
                            1 1     1
                          1 1         1
                        1 1 1       1 1 1
                      1   1 1     1 1 1   1
                                    1
                      1   1               1
                      1   1 1     1 1   1 1
                    1       1 1 1     1 1 1 1
                      1   1   1         1 1
                      1 1       1       1 1
                          1       1   1
                                  1 1
                                1 1
                                1



        1
        1                       1
                                1
                              1 1 1
                            1 1     1
                          1 1         1
                        1   1
                      1         1
                      1         1 1
                      1       1 1         1
                            1 1         1 1
                      1   1 1 1           1
                      1 1 1     1
                      1 1         1       1
                          1     1 1 1
                            1 1 1 1 1
                              1 1 1
                                1
                                1



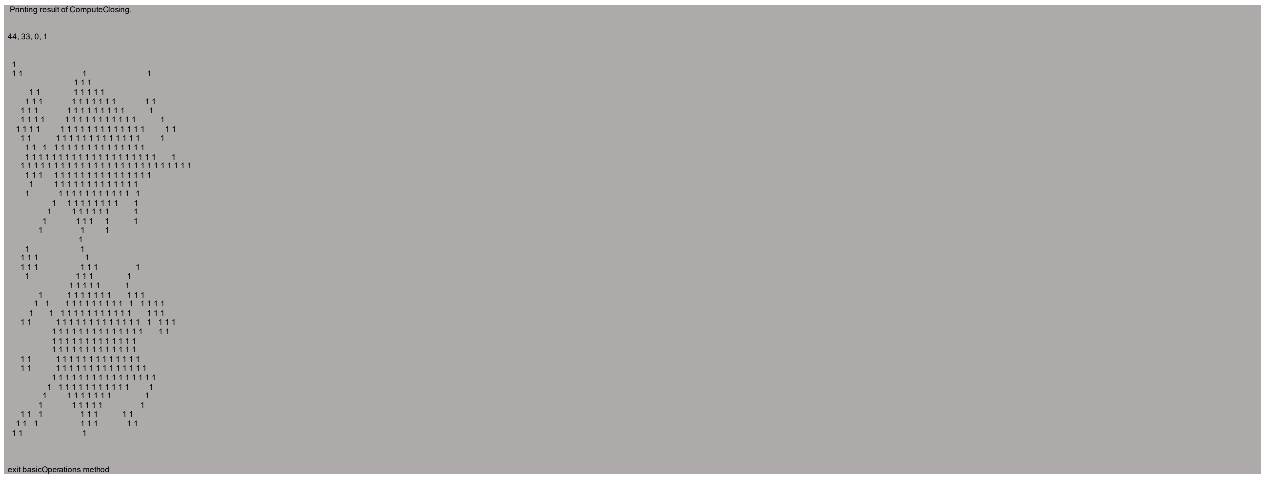
 Printing result of ComputeOpening.


44, 33, 0, 1



                                1
                              1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1     1 1 1
                      1 1 1 1 1   1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1   1 1     1 1 1   1
                    1 1 1 1 1     1 1   1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1   1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1     1 1 1 1
                    1 1 1 1   1 1 1   1 1 1 1
                      1 1 1 1   1 1 1 1 1 1
                          1     1 1 1 1
                              1 1 1 1
                              1 1 1
                                1

        1
      1 1 1                     1
      1 1 1                   1 1 1
        1                   1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1     1 1 1
                      1 1 1 1 1 1     1
                    1 1 1     1 1 1
                    1 1 1     1 1 1 1     1
                    1 1 1   1 1 1 1     1 1 1
                      1   1 1 1 1     1 1 1 1
                    1 1 1 1 1 1 1       1 1 1
                    1 1 1 1 1 1 1 1       1
                    1 1 1 1     1 1 1   1 1 1
                      1 1 1 1 1 1 1 1 1   1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                              1 1 1
                                1
```



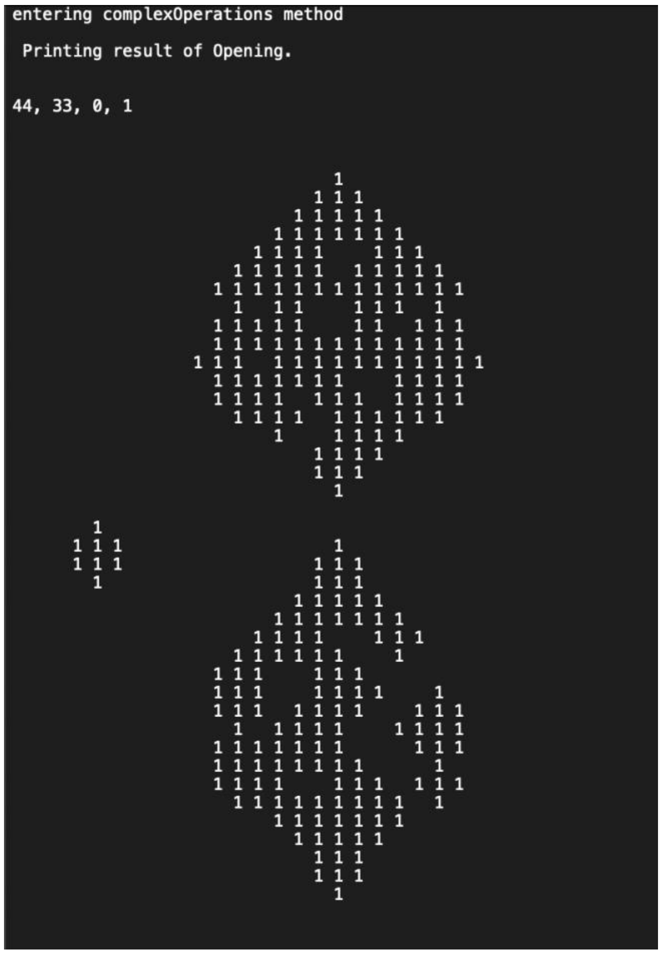
```
 Printing result of ComputeClosing.

44, 33, 0, 1

1
1 1                           1                           1
                            1 1 1
        1 1               1 1 1 1 1
      1 1 1             1 1 1 1 1 1 1             1 1
    1 1 1             1 1 1 1 1 1 1 1 1           1
    1 1 1 1         1 1 1 1 1 1 1 1 1 1 1           1
  1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1         1 1
    1 1           1 1 1 1 1 1 1 1 1 1 1 1 1         1
      1 1   1   1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1       1
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
        1         1 1 1 1 1 1 1 1 1 1 1 1 1
      1             1 1 1 1 1 1 1 1 1 1 1   1
                  1     1 1 1 1 1 1 1 1       1
                1         1 1 1 1 1 1           1
              1             1 1 1     1           1
            1                 1         1
                              1
      1                       1
    1 1 1                     1
    1 1 1                   1 1 1                 1
      1                     1 1 1               1
                          1 1 1 1 1           1
            1           1 1 1 1 1 1 1       1 1 1
          1   1       1 1 1 1 1 1 1 1 1   1   1 1 1 1
        1       1   1 1 1 1 1 1 1 1 1 1 1       1 1 1
    1 1           1 1 1 1 1 1 1 1 1 1 1 1 1   1   1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1 1         1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1           1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                1   1 1 1 1 1 1 1 1 1 1 1         1
              1         1 1 1 1 1 1 1               1
            1             1 1 1 1 1                 1
    1 1   1                 1 1 1           1 1
  1 1   1                   1 1 1             1 1
1 1                           1

exit basicOperations method
```

Output2.txt



```
entering complexOperations method

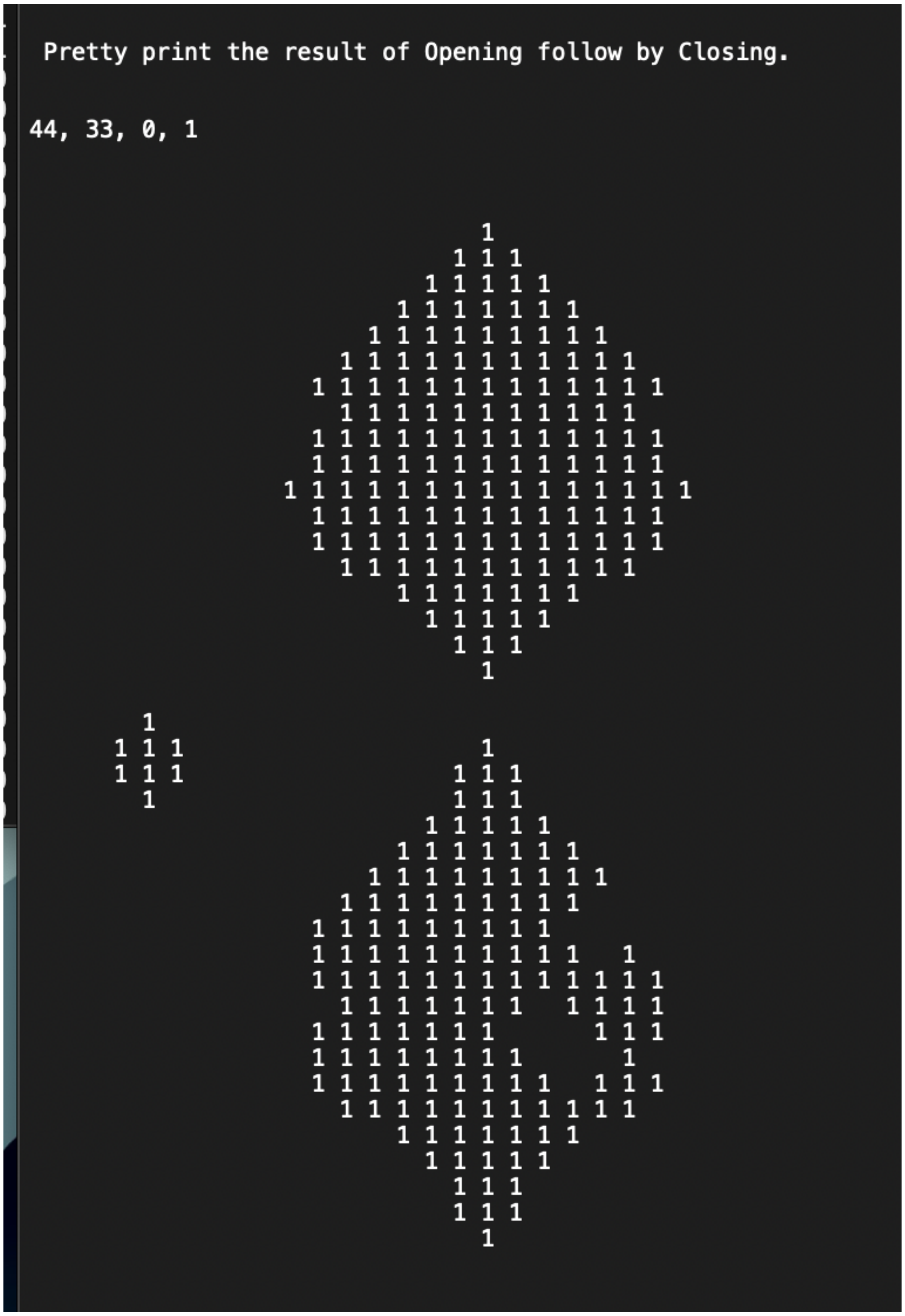
 Printing result of Opening.

44, 33, 0, 1



                                1
                              1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1     1 1 1
                      1 1 1 1 1   1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1   1 1     1 1 1   1
                    1 1 1 1 1     1 1   1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1   1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1     1 1 1 1
                    1 1 1 1   1 1 1   1 1 1 1
                      1 1 1 1   1 1 1 1 1 1
                          1     1 1 1 1
                              1 1 1 1
                              1 1 1
                                1

        1
      1 1 1                     1
      1 1 1                   1 1 1
        1                     1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1     1 1 1
                      1 1 1 1 1 1     1
                    1 1 1     1 1 1
                    1 1 1     1 1 1 1     1
                    1 1 1   1 1 1 1     1 1 1
                      1   1 1 1 1     1 1 1 1
                    1 1 1 1 1 1 1       1 1 1
                    1 1 1 1 1 1 1 1       1
                    1 1 1 1     1 1 1   1 1 1
                      1 1 1 1 1 1 1 1 1   1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                              1 1 1
                                1
```

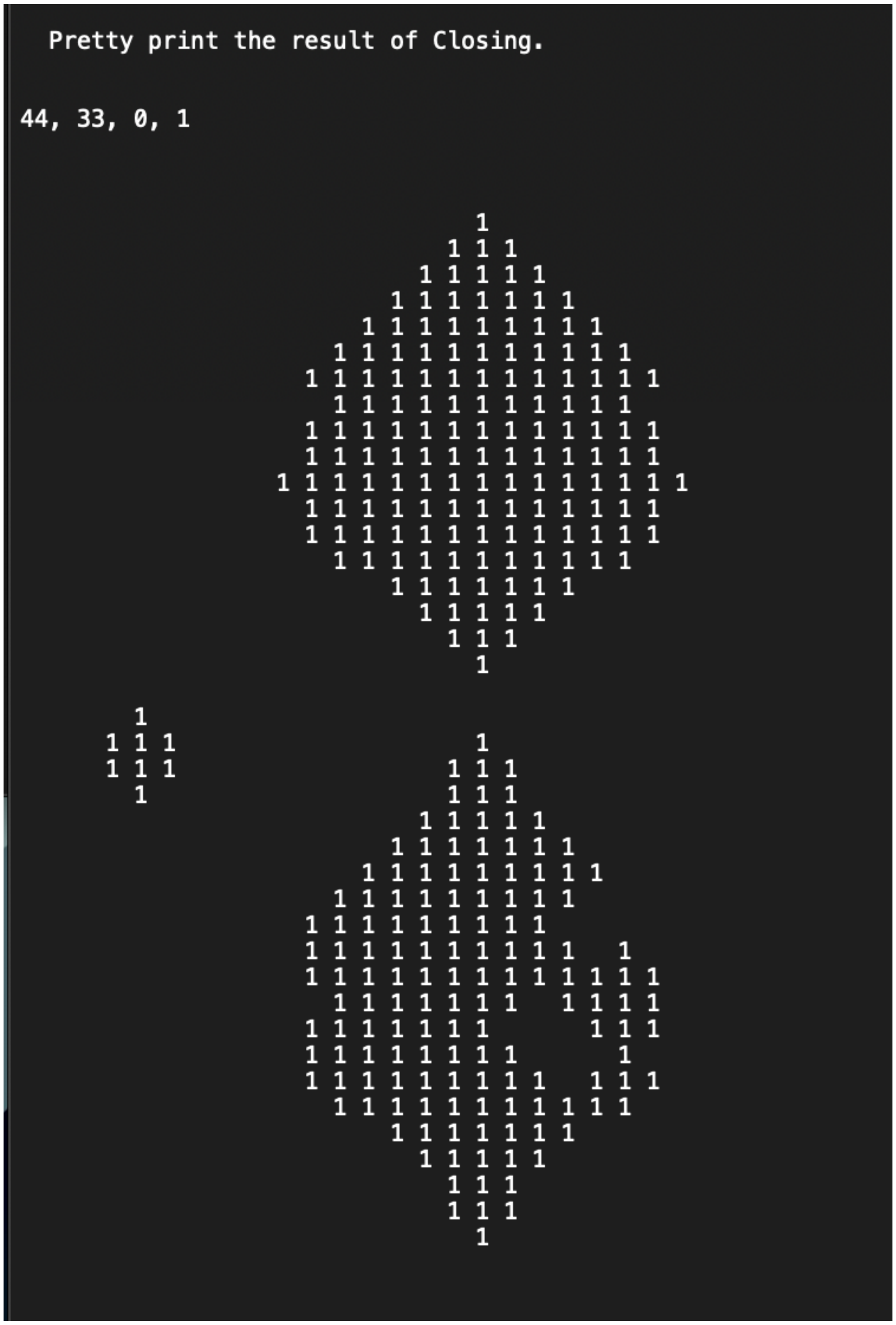


```
 Pretty print the result of Opening follow by Closing.

44, 33, 0, 1

                                1
                              1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                                1

        1
      1 1 1                     1
      1 1 1                   1 1 1
        1                     1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1   1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1   1 1 1 1
                    1 1 1 1 1 1 1       1 1 1
                    1 1 1 1 1 1 1 1       1
                    1 1 1 1 1 1 1 1 1   1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                              1 1 1
                                1
```



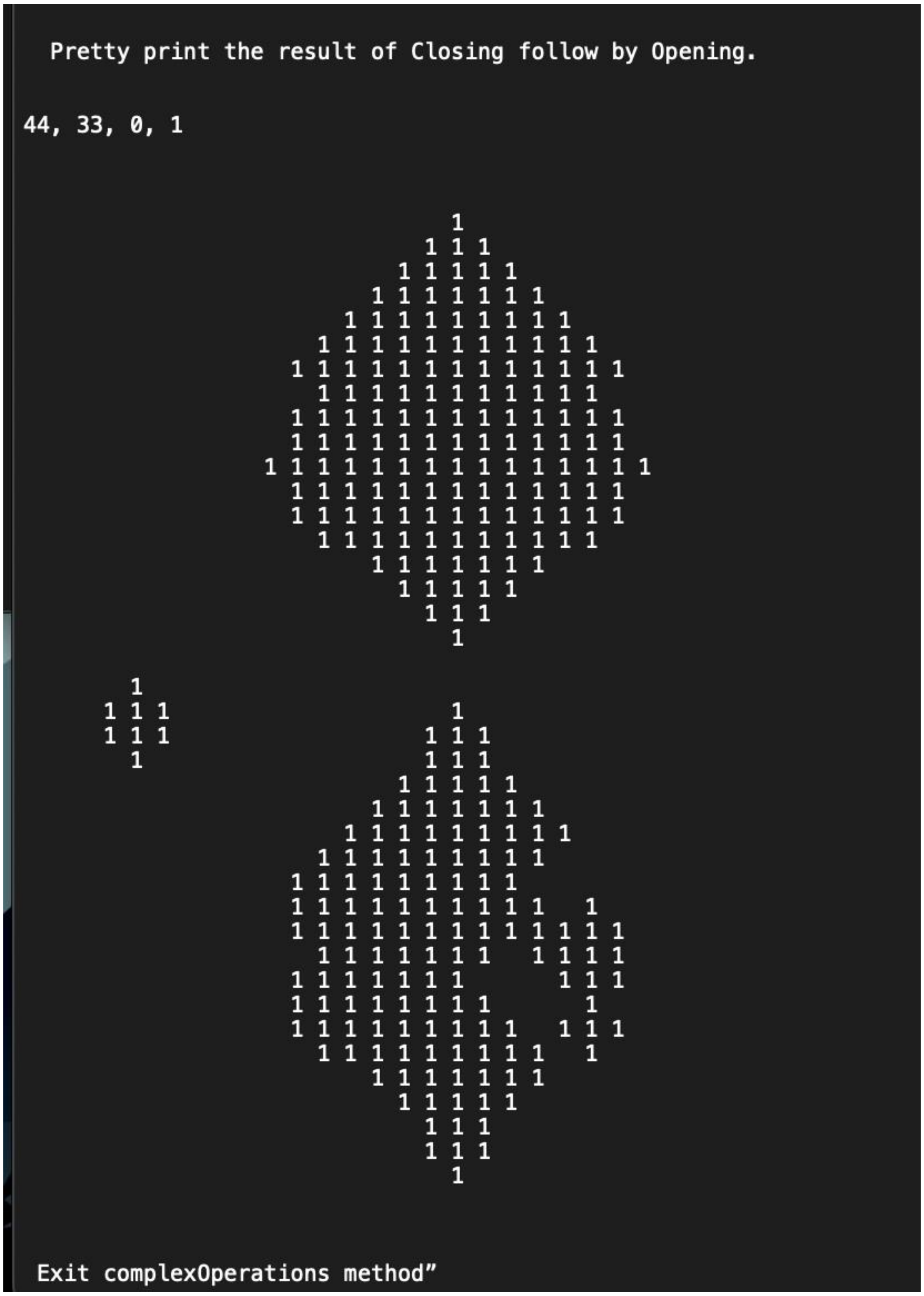
```
  Pretty print the result of Closing.


44, 33, 0, 1



                                1
                              1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                                1

        1
      1 1 1                     1
      1 1 1                   1 1 1
        1                     1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1   1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1   1 1 1 1
                    1 1 1 1 1 1 1       1 1 1
                    1 1 1 1 1 1 1 1       1
                    1 1 1 1 1 1 1 1 1   1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                              1 1 1
                                1
```



```
  Pretty print the result of Closing follow by Opening.

44, 33, 0, 1

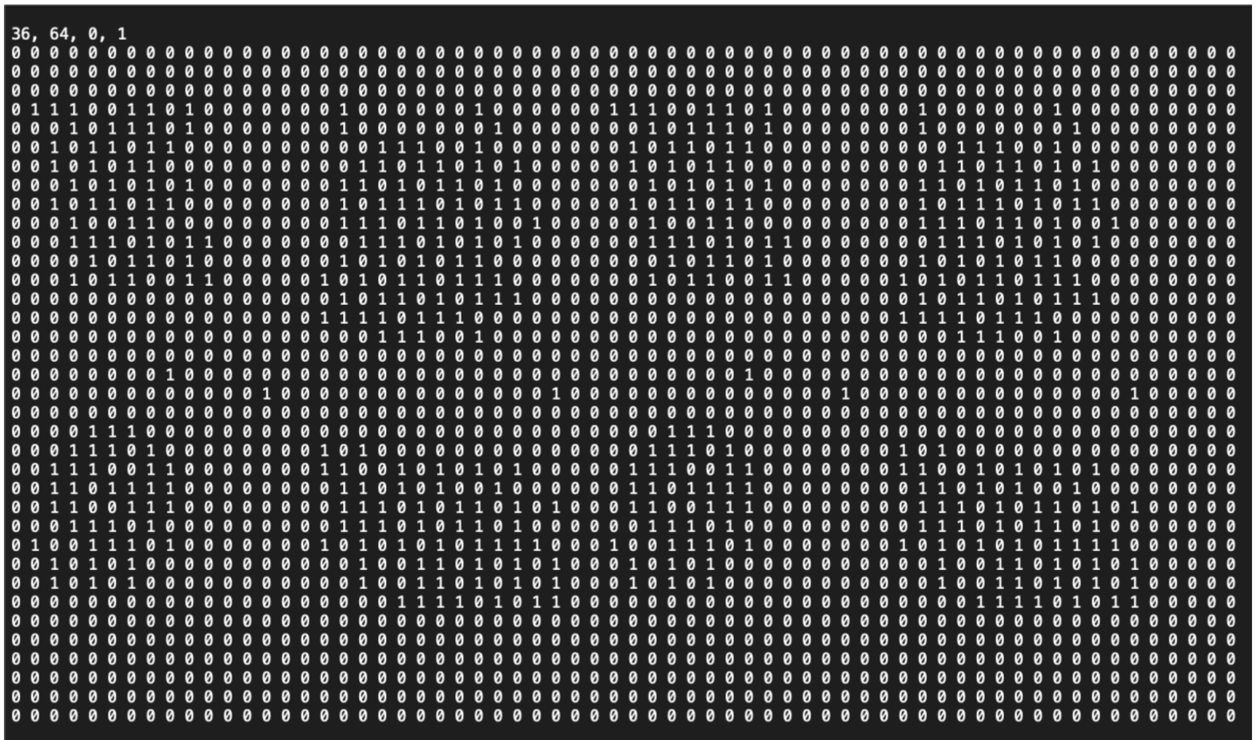

                                1
                              1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1 1 1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                                1

        1
      1 1 1                     1
      1 1 1                   1 1 1
        1                     1 1 1
                            1 1 1 1 1
                          1 1 1 1 1 1 1
                        1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1   1
                    1 1 1 1 1 1 1 1 1 1 1 1 1
                      1 1 1 1 1 1 1   1 1 1 1
                    1 1 1 1 1 1 1       1 1 1
                    1 1 1 1 1 1 1 1       1
                    1 1 1 1 1 1 1 1 1   1 1 1
                      1 1 1 1 1 1 1 1 1   1
                          1 1 1 1 1 1 1
                            1 1 1 1 1
                              1 1 1
                              1 1 1
                                1


 Exit complexOperations method”
```

<u>Data2 and elm2</u>

Output1.txt



```
36, 64, 0, 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 1 1 1 0 0 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 1 0 0 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0
0 0 0 1 0 1 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 1 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0
0 0 1 0 1 1 0 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 0 0 0 0 0 1 0 1 1 0 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 0 0 0 0 0 0 0
0 0 1 0 1 0 1 1 0 0 0 0 0 0 0 0 0 0 1 1 0 1 1 0 1 0 1 0 0 0 0 0 1 0 1 0 1 1 0 0 0 0 0 0 0 0 0 0 1 1 0 1 1 0 1 0 1 0 0 0 0 0 0 0
0 0 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 1 1 0 1 0 1 1 0 1 0 0 0 0 0 0 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 1 1 0 1 0 1 1 0 1 0 0 0 0 0 0 0 0
0 0 1 0 1 1 0 1 1 0 0 0 0 0 0 0 0 1 0 1 1 1 0 1 0 1 1 0 0 0 0 0 1 0 1 1 0 1 1 0 0 0 0 0 0 0 0 1 0 1 1 1 0 1 0 1 1 0 0 0 0 0 0 0
0 0 0 1 0 0 1 1 0 0 0 0 0 0 0 0 0 1 1 1 0 1 1 0 1 0 0 1 0 0 0 0 0 1 0 0 1 1 0 0 0 0 0 0 0 0 0 1 1 1 0 1 1 0 1 0 0 1 0 0 0 0 0 0
0 0 0 1 1 1 0 1 0 1 1 0 0 0 0 0 0 0 1 1 1 0 1 0 1 0 1 0 0 0 0 0 0 1 1 1 0 1 0 1 1 0 0 0 0 0 0 0 1 1 1 0 1 0 1 0 1 0 0 0 0 0 0 0
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0 0 0 1 0 1 1 0 0 1 1 0 0 0 0 0 1 0 1 0 1 1 0 1 1 1 0 0 0 0 0 0 0 1 0 1 1 0 0 1 1 0 0 0 0 0 1 0 1 0 1 1 0 1 1 1 0 0 0 0 0 0 0 0
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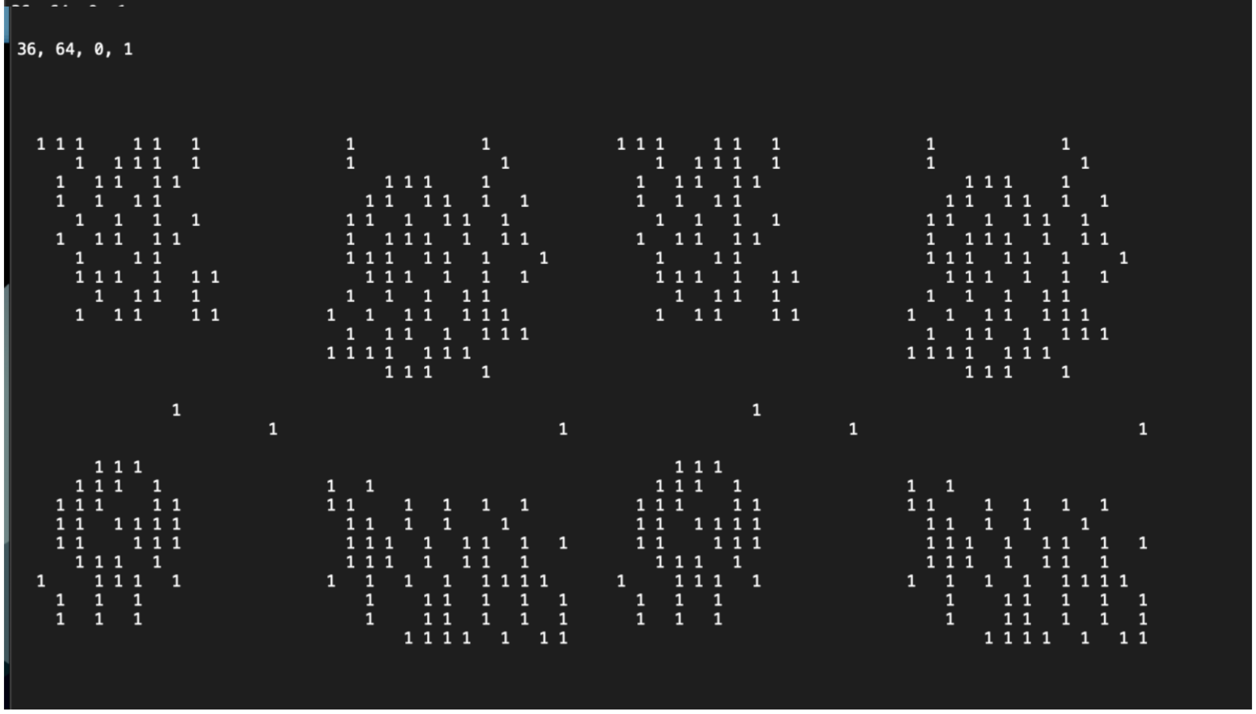
```



```
36, 64, 0, 1



  1 1 1     1 1   1               1             1             1 1 1     1 1   1               1             1
      1   1 1 1   1               1               1               1   1 1 1   1               1               1
    1   1 1   1 1                     1 1 1     1               1   1 1   1 1                     1 1 1     1
    1   1   1 1                     1 1   1 1   1   1           1   1   1 1                     1 1   1 1   1   1
      1   1   1   1               1 1   1   1 1   1               1   1   1   1               1 1   1   1 1   1
    1   1 1   1 1                 1   1 1 1   1   1 1           1   1 1   1 1                 1   1 1 1   1   1 1
      1     1 1                   1 1 1   1 1   1     1           1     1 1                   1 1 1   1 1   1     1
      1 1 1   1   1 1               1 1 1   1   1   1             1 1 1   1   1 1               1 1 1   1   1   1
        1   1 1   1               1   1   1   1 1                   1   1 1   1               1   1   1   1 1
      1   1 1     1 1           1   1   1 1   1 1 1               1   1 1     1 1           1   1   1 1   1 1 1
                                  1   1 1   1   1 1 1                                         1   1 1   1   1 1 1
                                1 1 1 1   1 1 1                                             1 1 1 1   1 1 1
                                      1 1 1     1                                                 1 1 1     1

                1                                                           1
                          1                             1                             1                             1

        1 1 1                                                       1 1 1
      1 1 1   1                 1   1                             1 1 1   1                 1   1
    1 1 1     1 1               1 1     1   1   1   1           1 1 1     1 1               1 1     1   1   1   1
    1 1   1 1 1 1                 1 1   1   1     1             1 1   1 1 1 1                 1 1   1   1     1
    1 1     1 1 1                 1 1 1   1   1 1   1   1       1 1     1 1 1                 1 1 1   1   1 1   1   1
      1 1 1   1                   1 1 1   1   1 1   1             1 1 1   1                   1 1 1   1   1 1   1
  1     1 1 1   1               1   1   1   1   1 1 1 1       1     1 1 1   1               1   1   1   1   1 1 1 1
    1   1   1                       1     1 1   1   1   1       1   1   1                       1     1 1   1   1   1
    1   1   1                       1     1 1   1   1   1       1   1   1                       1     1 1   1   1   1
                                        1 1 1 1   1   1 1                                           1 1 1 1   1   1 1
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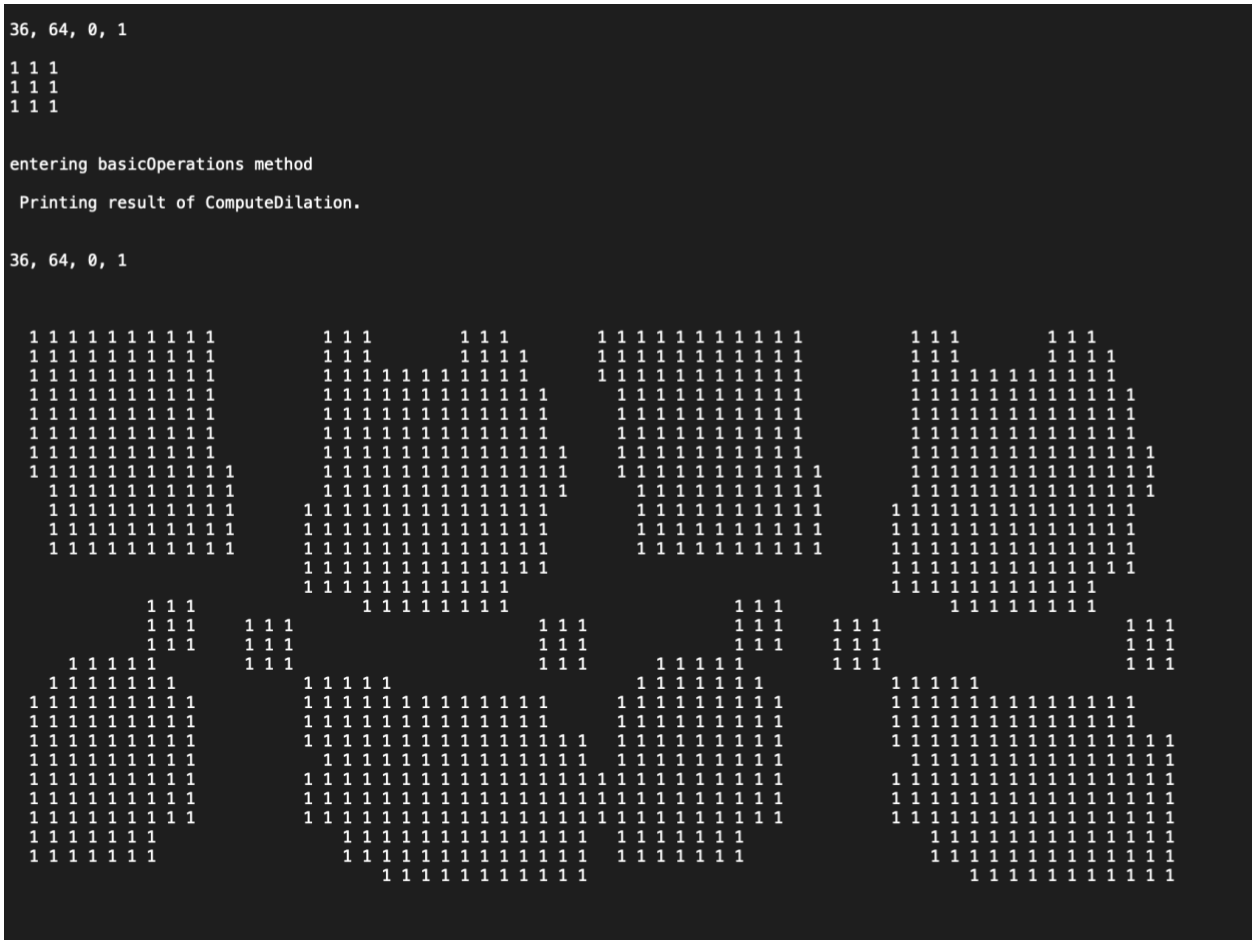


```
36, 64, 0, 1

1 1 1
1 1 1
1 1 1

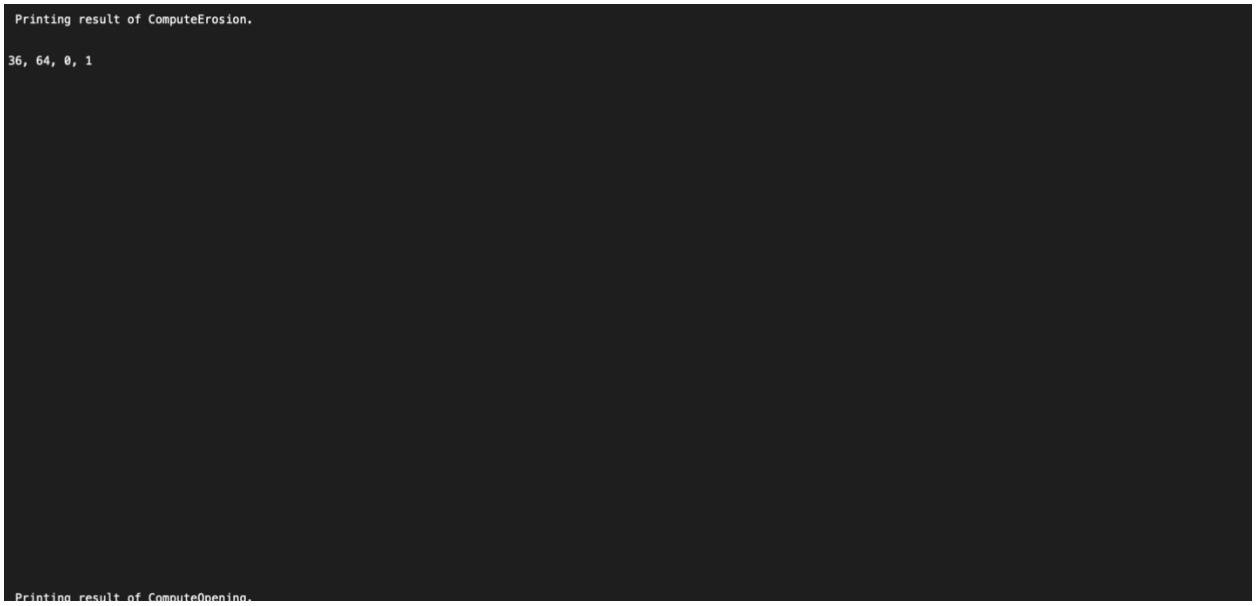

entering basicOperations method

 Printing result of ComputeDilation.


36, 64, 0, 1



  1 1 1 1 1 1 1 1 1 1           1 1 1         1 1 1         1 1 1 1 1 1 1 1 1 1 1           1 1 1         1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1         1 1 1 1       1 1 1 1 1 1 1 1 1 1 1           1 1 1         1 1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1 1 1 1 1 1 1 1                                   1 1 1 1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1 1 1 1 1 1                                       1 1 1 1 1 1 1 1 1 1 1
              1 1 1                 1 1 1 1 1 1 1 1                       1 1 1                 1 1 1 1 1 1 1 1
              1 1 1     1 1 1                         1 1 1               1 1 1     1 1 1                         1 1 1
              1 1 1     1 1 1                         1 1 1               1 1 1     1 1 1                         1 1 1
      1 1 1 1 1         1 1 1                         1 1 1       1 1 1 1 1         1 1 1                         1 1 1
    1 1 1 1 1 1 1             1 1 1 1 1                         1 1 1 1 1 1 1             1 1 1 1 1
  1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1 1 1 1
                                      1 1 1 1 1 1 1 1 1 1 1                                       1 1 1 1 1 1 1 1 1 1 1
```



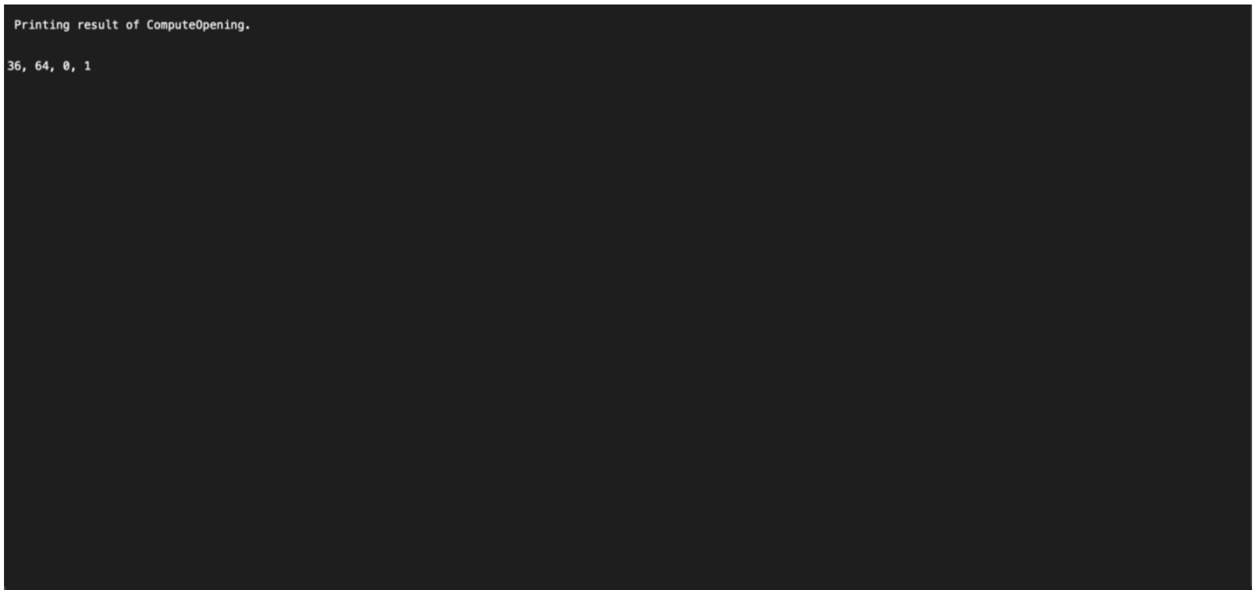
```
 Printing result of ComputeErosion.

36, 64, 0, 1



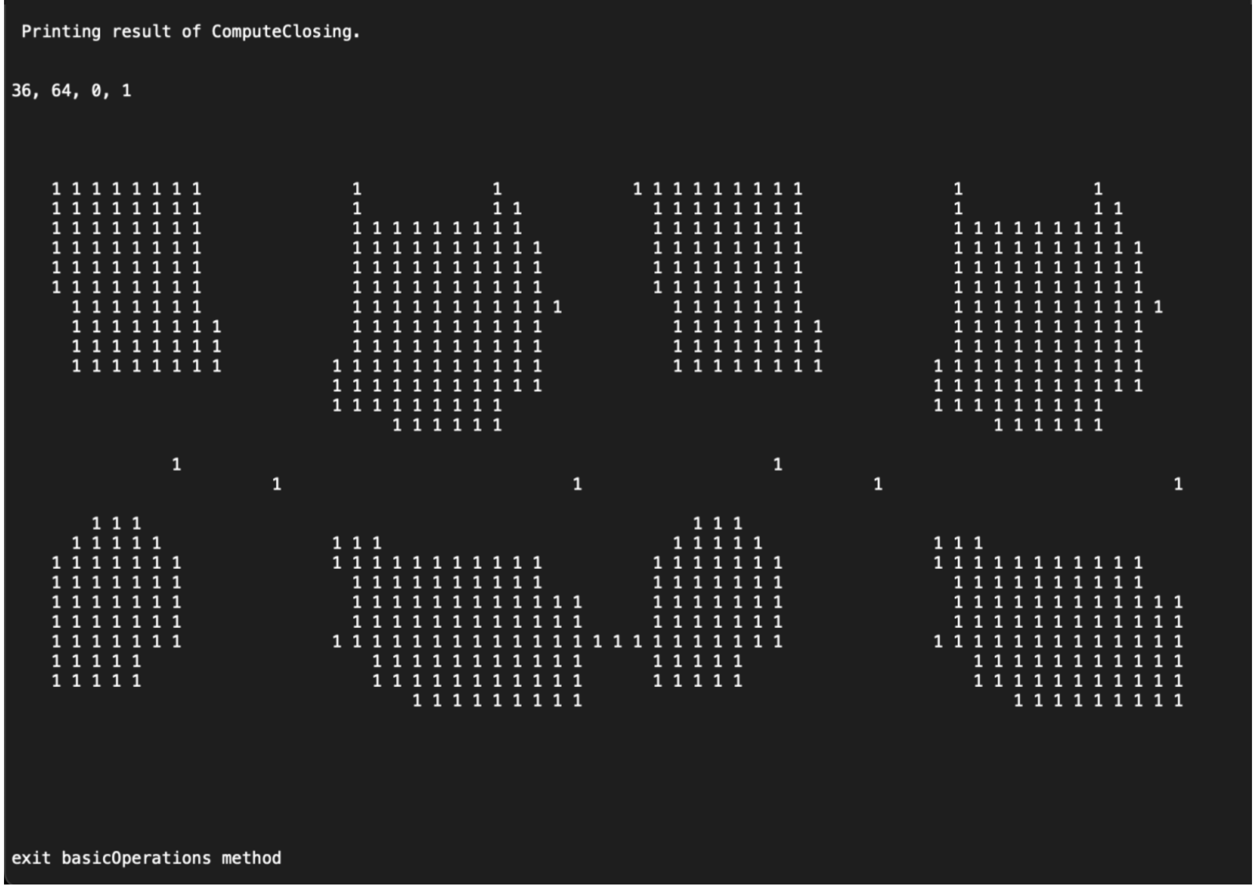



 Printing result of ComputeOpening.
```



```
 Printing result of ComputeOpening.

36, 64, 0, 1
```



```
 Printing result of ComputeClosing.

36, 64, 0, 1


    1 1 1 1 1 1 1 1               1             1             1 1 1 1 1 1 1 1 1               1             1
    1 1 1 1 1 1 1 1               1             1 1             1 1 1 1 1 1 1 1               1             1 1
    1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1
                                1 1 1 1 1 1 1 1 1 1 1                                       1 1 1 1 1 1 1 1 1 1 1
                                1 1 1 1 1 1 1 1 1                                           1 1 1 1 1 1 1 1 1
                                      1 1 1 1 1 1                                                 1 1 1 1 1 1

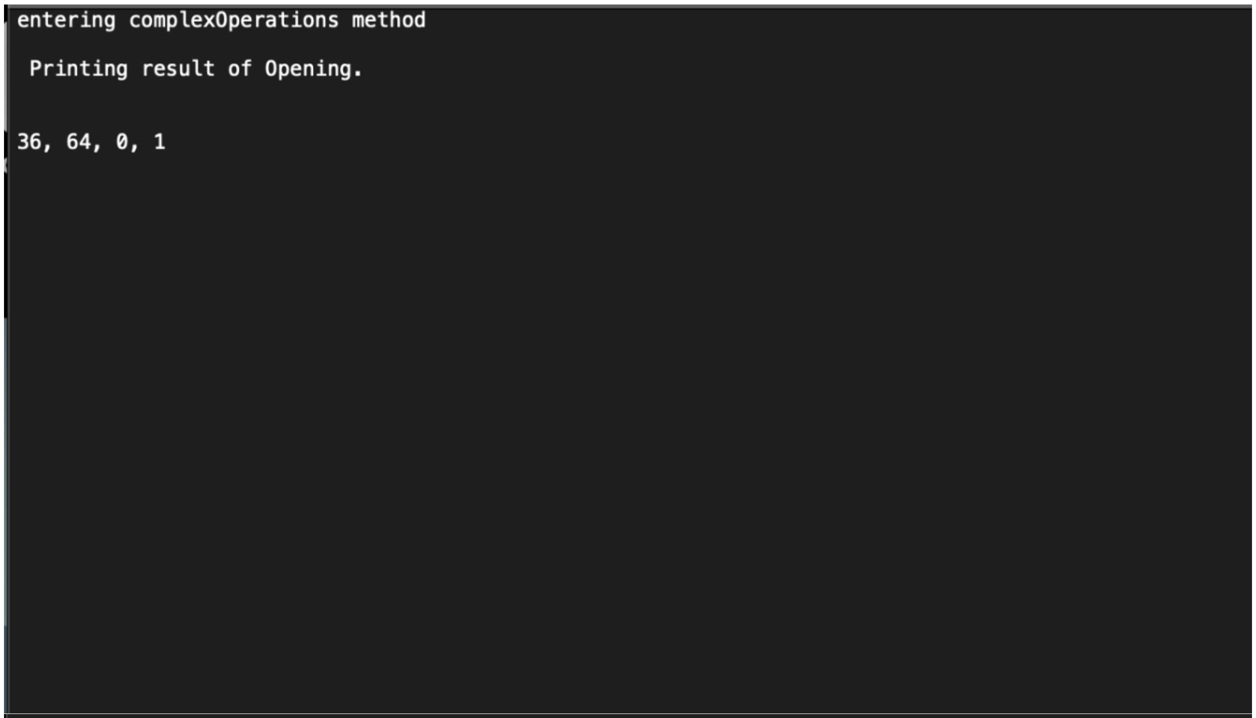
                1                                                           1
                          1                             1                             1                             1

        1 1 1                                                       1 1 1
      1 1 1 1 1                 1 1 1                             1 1 1 1 1                 1 1 1
    1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1                       1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1                       1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1                       1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1                       1 1 1 1 1 1 1 1 1 1 1
                                        1 1 1 1 1 1 1 1 1                                           1 1 1 1 1 1 1 1 1



exit basicOperations method
```

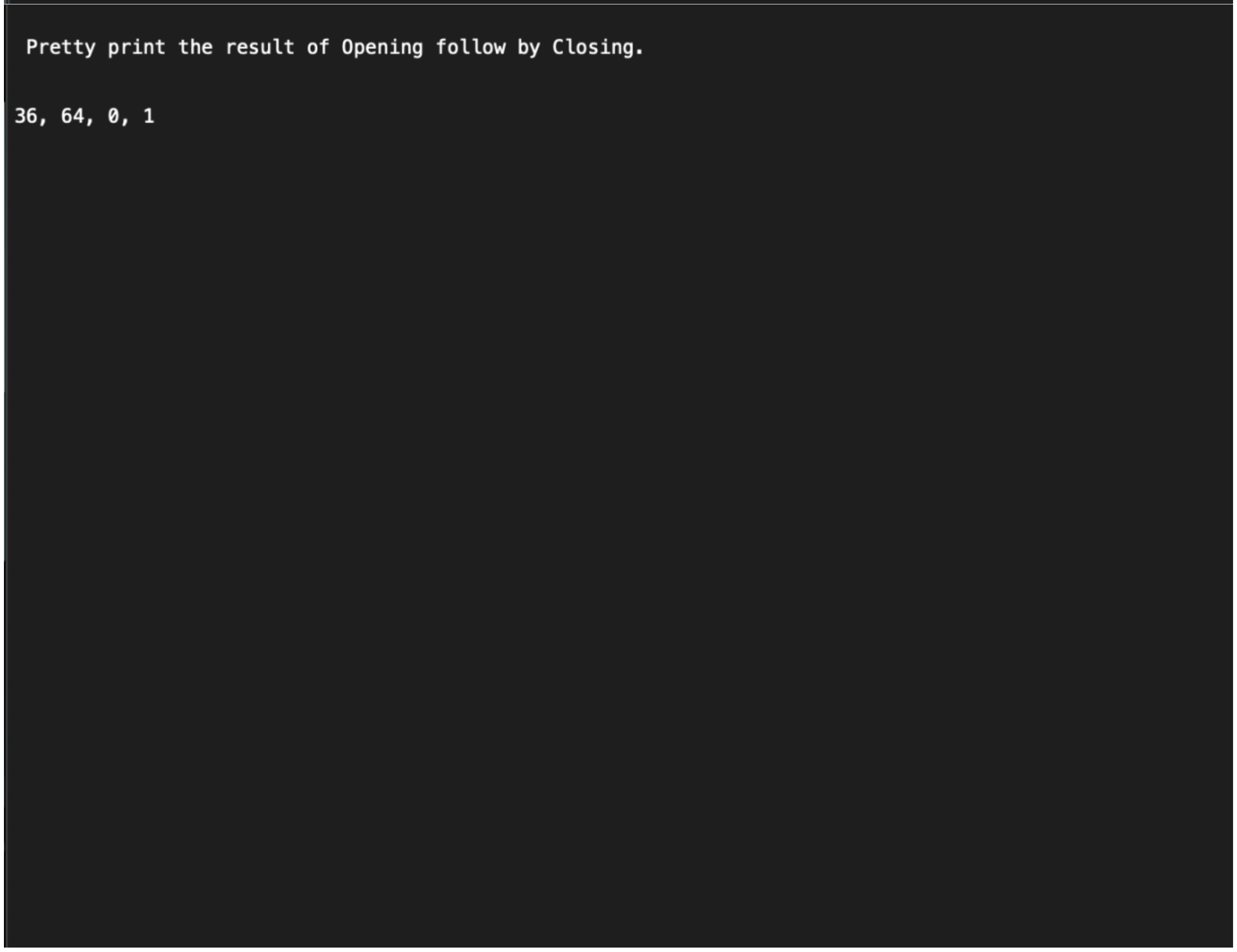
Output2.txt



```
entering complexOperations method

 Printing result of Opening.


36, 64, 0, 1
```



```
 Pretty print the result of Opening follow by Closing.


36, 64, 0, 1
```

```
  Pretty print the result of Closing.

36, 64, 0, 1
```

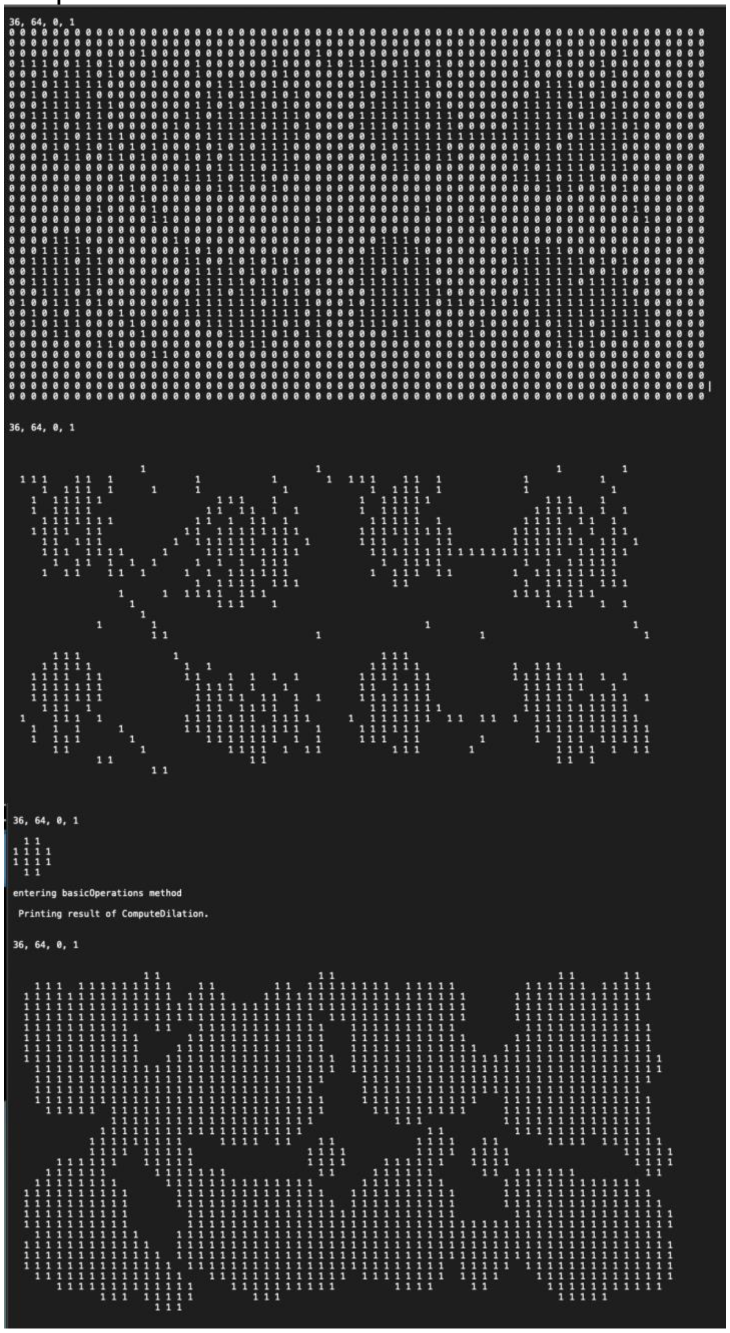
```
  Pretty print the result of Closing follow by Opening.

36, 64, 0, 1
```

```
 Exit complexOperations method”
```

Data3 and elm3

Output1.txt



```
36, 64, 0, 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 0 0 0
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0 0 1 1 1 1 0 1 1 0 0 0 0 0 0 0 1 1 0 0 1 0 1 0 1 0 1 0 0 0 0 0 1 1 1 1 0 1 1 0 0 0 0 0 0 0 1 1 1 1 1 1 1 0 1 0 1 0 0 0 0 0 0 0
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0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

36, 64, 0, 1


                        1                               1                                           1           1
  1 1 1     1 1   1               1             1         1   1 1 1     1 1   1               1             1
      1   1 1 1   1       1       1               1               1   1 1 1   1               1               1
    1   1 1 1 1 1                     1 1 1     1               1   1 1 1 1 1                     1 1 1     1
    1   1 1 1 1                     1 1   1 1   1   1           1   1 1 1 1                     1 1 1 1 1   1   1
      1 1 1 1 1 1 1               1 1   1   1 1   1               1 1 1 1 1   1               1 1 1 1   1 1   1
    1 1 1 1   1 1               1 1   1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1           1 1 1 1 1 1   1   1 1
      1 1   1 1 1             1   1 1 1 1 1 1   1 1   1         1 1 1   1 1   1 1           1 1 1 1 1 1 1   1 1   1
      1 1 1   1 1 1 1       1       1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1
        1   1 1   1   1   1       1   1   1   1 1 1                 1   1 1 1 1               1   1   1 1 1 1 1
      1   1 1     1 1   1       1   1   1 1 1 1 1 1               1   1 1 1   1 1           1   1 1 1 1 1 1 1 1
                                  1   1 1 1 1   1 1 1                 1 1                     1   1 1 1 1   1 1 1
                    1       1   1 1 1 1   1 1 1                                             1 1 1 1   1 1 1
                      1               1 1 1     1                                                 1 1 1     1   1
                        1
                1         1                                                 1                                     1
                          1 1                           1                             1                             1

        1 1 1                 1                                     1 1 1
      1 1 1 1 1                 1   1                             1 1 1 1 1                 1   1 1 1
    1 1 1 1   1 1               1 1     1   1   1   1           1 1 1 1   1 1               1 1 1 1 1 1 1   1   1
    1 1 1 1 1 1 1                 1 1 1 1   1     1             1 1   1 1 1 1                 1 1 1 1 1 1     1
    1 1 1 1 1 1 1                 1 1 1 1 1   1 1   1   1       1 1 1 1 1 1 1                 1 1 1 1 1   1 1 1 1   1
      1 1 1 1   1                 1 1 1   1 1 1 1   1             1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1
  1     1 1 1   1               1 1 1 1 1 1 1   1 1 1 1       1   1 1 1 1 1 1   1 1   1 1   1   1 1 1 1 1 1 1 1 1 1
    1   1   1       1           1 1 1 1 1 1 1 1 1 1 1   1       1 1 1 1 1 1                       1 1 1 1 1 1 1 1 1 1 1
    1   1 1 1         1             1 1 1 1 1 1 1   1   1       1 1 1   1 1           1         1   1 1 1   1 1 1 1 1
        1 1             1               1 1 1 1   1   1 1               1 1 1             1               1 1 1 1   1   1 1
                1 1                                         1 1                                                     1 1   1
                          1 1

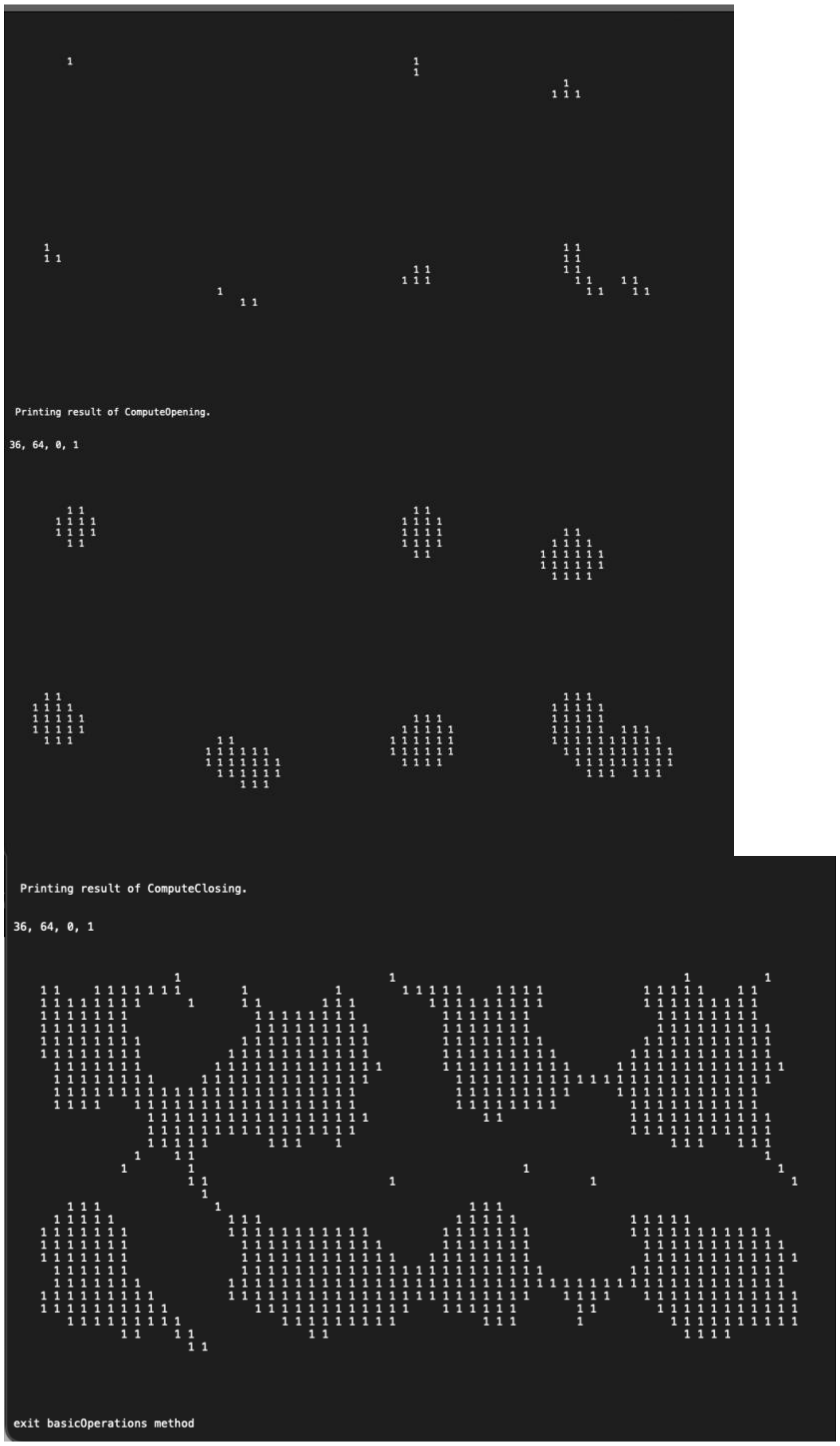



36, 64, 0, 1
  1 1
1 1 1 1
1 1 1 1
  1 1
entering basicOperations method

 Printing result of ComputeDilation.

36, 64, 0, 1

                        1 1                             1 1                                         1 1         1 1
    1 1 1   1 1 1 1 1 1 1 1 1     1 1           1 1   1 1 1 1 1 1 1 1   1 1 1 1 1             1 1 1 1 1 1   1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1     1 1     1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1
                  1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1               1 1 1               1 1 1 1 1 1 1 1 1 1 1 1 1 1
                1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1                       1 1             1 1 1 1 1 1 1 1 1 1 1 1 1
              1 1 1 1 1 1 1 1 1       1 1 1 1   1 1     1 1               1 1 1 1     1 1         1 1 1 1   1 1 1 1 1 1
              1 1 1 1   1 1 1 1 1                     1 1 1 1             1 1 1 1   1 1 1 1                     1 1 1 1 1
        1 1 1 1 1 1     1 1 1 1 1                     1 1 1 1       1 1 1 1 1 1     1 1 1 1                       1 1 1 1
      1 1 1 1 1 1         1 1 1 1 1 1 1                 1 1       1 1 1 1 1 1         1 1   1 1 1 1 1 1             1 1
    1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
  1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1   1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1   1 1 1 1 1 1 1 1   1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1
        1 1 1 1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1           1 1 1 1       1 1           1 1 1 1 1 1 1 1 1 1 1
                1 1 1   1 1 1 1 1           1 1 1                                                   1 1 1 1 1
                          1 1 1
```



```
          1                                                         1
                                                                    1
                                                                                              1
                                                                                            1 1 1













      1                                                                                       1 1
      1 1                                                                                     1 1
                                                                    1 1                       1 1
                                                                  1 1 1                         1 1     1 1
                                    1                                                             1 1     1 1
                                        1 1










 Printing result of ComputeOpening.

36, 64, 0, 1




          1 1                                                       1 1
        1 1 1 1                                                   1 1 1 1
        1 1 1 1                                                   1 1 1 1                     1 1
          1 1                                                     1 1 1 1                   1 1 1 1
                                                                    1 1                   1 1 1 1 1 1
                                                                                          1 1 1 1 1 1
                                                                                            1 1 1 1










      1 1                                                                                     1 1 1
    1 1 1 1                                                                                 1 1 1 1 1
    1 1 1 1 1                                                       1 1 1                   1 1 1 1 1
    1 1 1 1 1                                                     1 1 1 1 1                 1 1 1 1 1   1 1 1
      1 1 1                         1 1                         1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1
                                  1 1 1 1 1 1                   1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1
                                  1 1 1 1 1 1 1                   1 1 1 1                       1 1 1 1 1 1 1 1 1
                                    1 1 1 1 1 1                                                   1 1 1   1 1 1
                                        1 1 1








 Printing result of ComputeClosing.

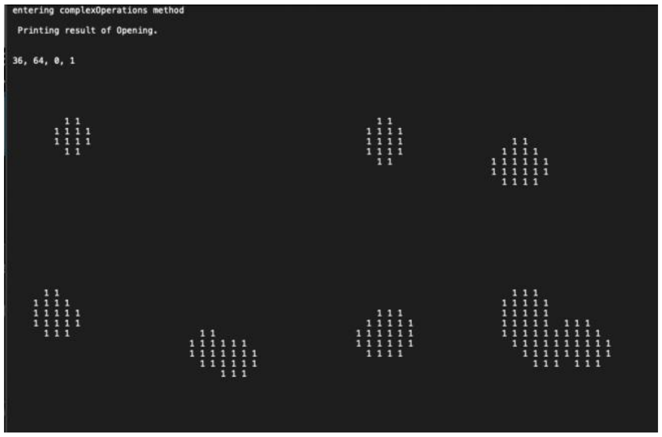
36, 64, 0, 1


                        1                               1                                           1           1
    1 1     1 1 1 1 1 1 1         1             1         1 1 1 1 1     1 1 1 1               1 1 1 1 1     1 1
    1 1 1 1 1 1 1 1       1       1 1         1 1 1           1 1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1             1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1       1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1                 1 1                   1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1                                         1 1 1 1 1 1 1 1 1 1 1
                    1 1 1 1 1         1 1 1     1                                                 1 1 1     1 1 1
                  1     1 1                                                                                     1
                1         1                                                   1                                   1
                          1 1                           1                             1                             1
                            1
        1 1 1                 1                                     1 1 1
      1 1 1 1 1                 1 1 1                             1 1 1 1 1                 1 1 1 1 1
    1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1         1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1
      1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1           1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1     1 1 1 1 1 1 1 1 1 1 1 1
    1 1 1 1 1 1 1 1 1 1             1 1 1 1 1 1 1 1 1 1 1 1     1 1 1 1 1 1         1 1         1 1 1 1 1 1 1 1 1 1 1
        1 1 1 1 1 1 1 1 1               1 1 1 1 1 1 1 1 1             1 1 1         1             1 1 1 1 1 1 1 1 1 1
                1 1     1 1                 1 1                                                     1 1 1 1
                          1 1



exit basicOperations method
```

Output2.txt



```
entering complexOperations method

 Printing result of Opening.

36, 64, 0, 1


      1 1                                                         1 1
    1 1 1 1                                                     1 1 1 1
    1 1 1 1                                                     1 1 1 1                     1 1
      1 1                                                       1 1 1 1                   1 1 1 1
                                                                  1 1                   1 1 1 1 1 1
                                                                                        1 1 1 1 1 1
                                                                                          1 1 1 1

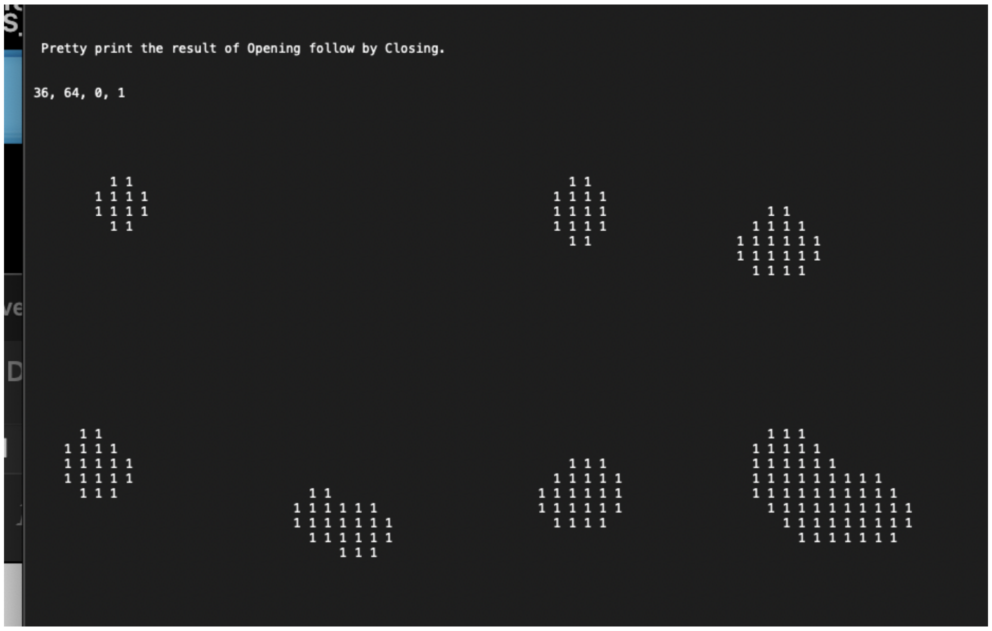









  1 1                                                                                       1 1 1
1 1 1 1                                                                                   1 1 1 1 1
1 1 1 1 1                                                         1 1 1                   1 1 1 1 1
1 1 1 1 1                                                       1 1 1 1 1                 1 1 1 1 1   1 1 1
  1 1 1                         1 1                           1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1                     1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1 1                     1 1 1 1                       1 1 1 1 1 1 1 1 1
                                1 1 1 1 1 1                                                     1 1 1   1 1 1
                                    1 1 1
```



```
 Pretty print the result of Opening follow by Closing.

36, 64, 0, 1


      1 1                                                         1 1
    1 1 1 1                                                     1 1 1 1
    1 1 1 1                                                     1 1 1 1                     1 1
      1 1                                                       1 1 1 1                   1 1 1 1
                                                                  1 1                   1 1 1 1 1 1
                                                                                        1 1 1 1 1 1
                                                                                          1 1 1 1

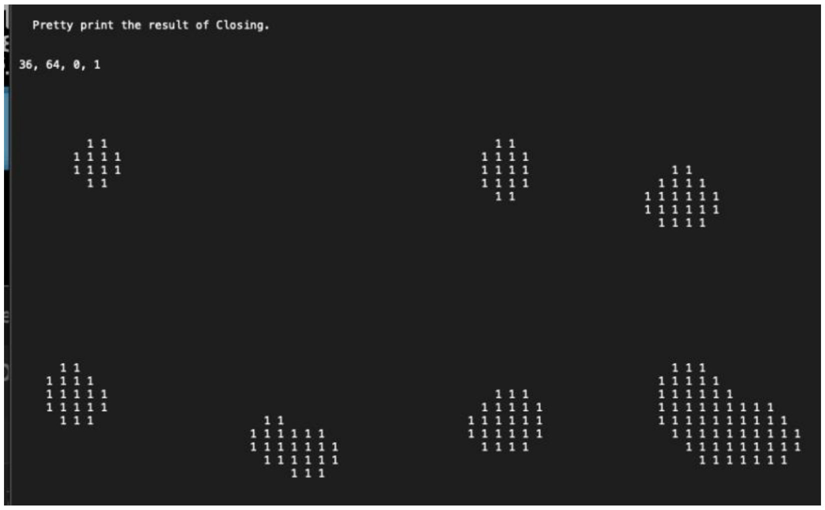









  1 1                                                                                       1 1 1
1 1 1 1                                                                                   1 1 1 1 1
1 1 1 1 1                                                         1 1 1                   1 1 1 1 1 1
1 1 1 1 1                                                       1 1 1 1 1                 1 1 1 1 1 1 1 1 1
  1 1 1                         1 1                           1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1                     1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1 1                     1 1 1 1                       1 1 1 1 1 1 1 1 1
                                1 1 1 1 1 1                                                     1 1 1 1 1 1 1
                                    1 1 1
```



```
 Pretty print the result of Closing.

36, 64, 0, 1


      1 1                                                         1 1
    1 1 1 1                                                     1 1 1 1
    1 1 1 1                                                     1 1 1 1                     1 1
      1 1                                                       1 1 1 1                   1 1 1 1
                                                                  1 1                   1 1 1 1 1 1
                                                                                        1 1 1 1 1 1
                                                                                          1 1 1 1

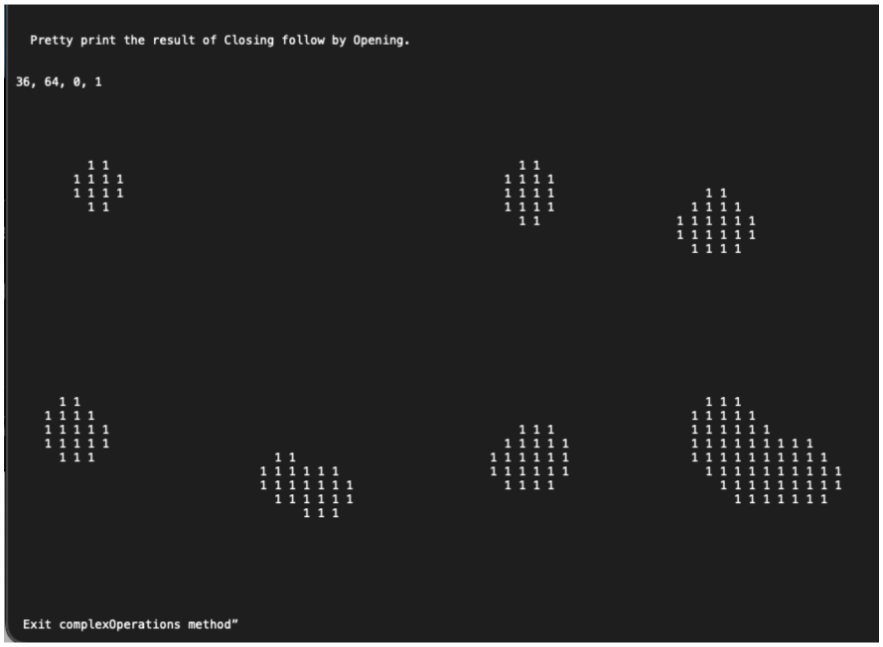









  1 1                                                                                       1 1 1
1 1 1 1                                                                                   1 1 1 1 1
1 1 1 1 1                                                         1 1 1                   1 1 1 1 1 1
1 1 1 1 1                                                       1 1 1 1 1                 1 1 1 1 1 1 1 1 1
  1 1 1                         1 1                           1 1 1 1 1 1                 1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1                     1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1
                              1 1 1 1 1 1 1                     1 1 1 1                       1 1 1 1 1 1 1 1 1
                                1 1 1 1 1 1                                                     1 1 1 1 1 1 1
                                    1 1 1
```



```
 Pretty print the result of Closing follow by Opening.

36, 64, 0, 1


          1 1                                                         1 1
        1 1 1 1                                                     1 1 1 1
        1 1 1 1                                                     1 1 1 1                     1 1
          1 1                                                       1 1 1 1                   1 1 1 1
                                                                      1 1                   1 1 1 1 1 1
                                                                                            1 1 1 1 1 1
                                                                                              1 1 1 1










      1 1                                                                                         1 1 1
    1 1 1 1                                                                                     1 1 1 1 1
    1 1 1 1 1                                                         1 1 1                     1 1 1 1 1 1
    1 1 1 1 1                                                       1 1 1 1 1                   1 1 1 1 1 1 1 1 1
      1 1 1                         1 1                           1 1 1 1 1 1                   1 1 1 1 1 1 1 1 1 1
                                  1 1 1 1 1 1                     1 1 1 1 1 1                     1 1 1 1 1 1 1 1 1 1
                                  1 1 1 1 1 1 1                     1 1 1 1                         1 1 1 1 1 1 1 1 1
                                    1 1 1 1 1 1                                                       1 1 1 1 1 1 1
                                        1 1 1







 Exit complexOperations method"
```

Source code

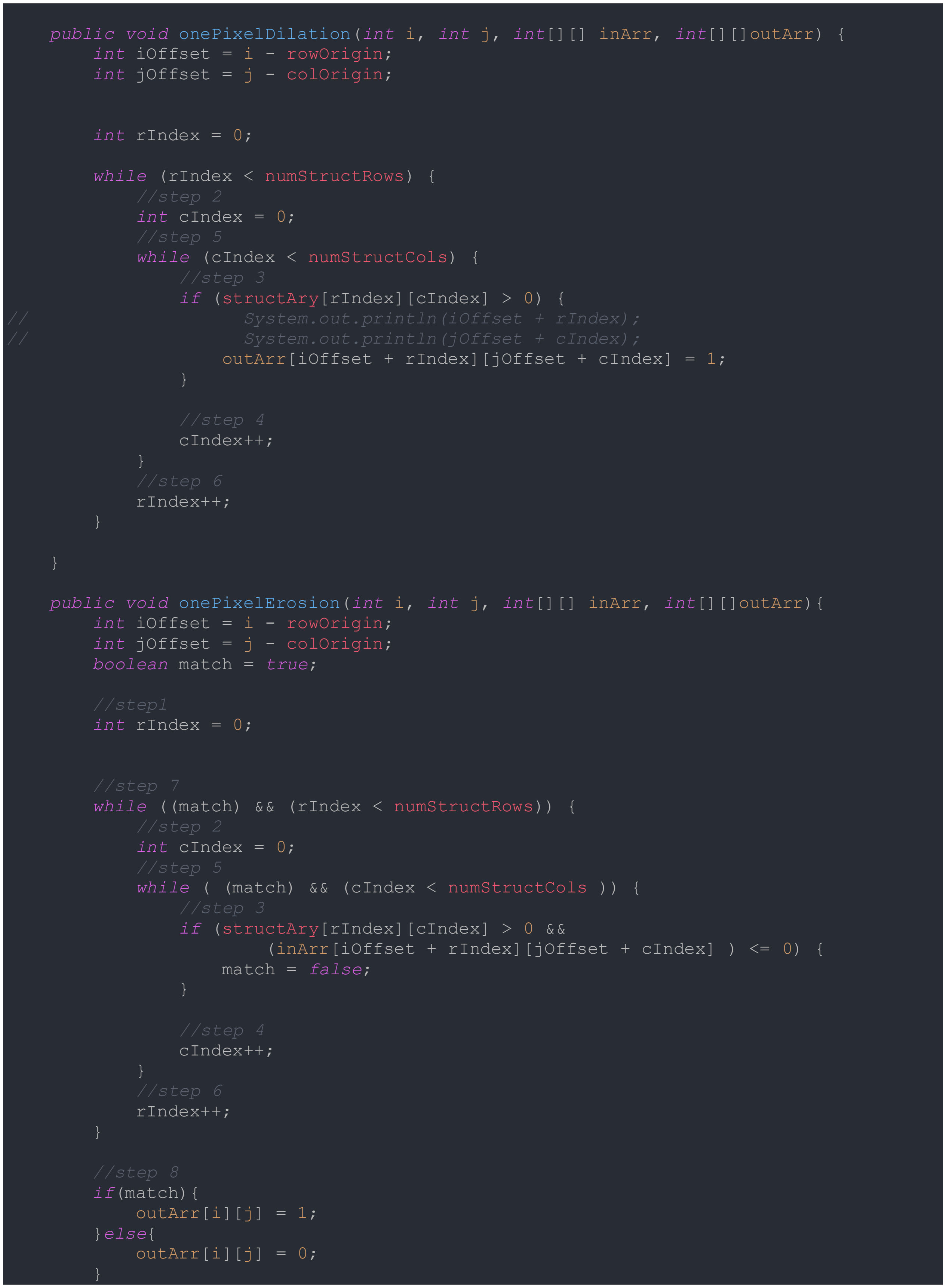
Main.java

```java
import java.io.*;

public class Main {

    public static void main(String[] args) throws IOException {
        File img = new File(args[0]);
        File elm = new File(args[1]);
        File output1 = new File(args[2]);
        File output2 = new File(args[3]);
x
        FileReader imgFile = new FileReader(img);
        FileReader elmFile = new FileReader(elm);

        FileWriter out1 = new FileWriter(output1);
        FileWriter out2 = new FileWriter(output2);

        //step1
        BufferedReader br = new BufferedReader(imgFile);
        String line = br.readLine();
        String[] values = line.split(" ");
        int numImgRows = Integer.parseInt(values[0]),
                numImgCols = Integer.parseInt(values[1]),
                imgMin = Integer.parseInt(values[2]),
                imgMax = Integer.parseInt(values[3]);

        br = new BufferedReader(elmFile);
        line = br.readLine();
        values = line.split(" ");
        int numStructRows = Integer.parseInt(values[0]),
                numStructCols = Integer.parseInt(values[1]),
                structMin = Integer.parseInt(values[2]),
                structMax = Integer.parseInt(values[3]);

        line = br.readLine();
        values = line.split(" ");
        int rowOrigin = Integer.parseInt(values[0]),
                colOrigin = Integer.parseInt(values[1]);


//          for (String s: values)
//              System.out.println(s);
//          System.out.println();

        //step 2
        Morphology proj = new Morphology(numImgRows, numImgCols, imgMin, imgMax,
numStructRows, numStructCols, structMin, structMax, rowOrigin, colOrigin);

        //step 3
//          done in constructor

        //step 4
        imgFile.close();
        imgFile = new FileReader(img);
        proj.loadImg(imgFile);
        //step 5
        proj.imgReformat(out1);
        proj.prettyPrint(proj.zeroFramedAry, out1);

        //step 6
        elmFile.close();
        elmFile = new FileReader(elm);
        proj.loadStruct(elmFile);
        proj.prettyPrint(proj.structAry, out1);

        //step 7
        proj.basicOP(out1);
        out1.close();

        //step8
        proj.complexOP(out2);

        //step 9
        imgFile.close();
        elmFile.close();

        out2.close();


    }
}
```

Morphology.java

```
import java.io.BufferedReader;
import java.io.FileReader;
import java.io.FileWriter;
import java.io.IOException;

public class Morphology {

    int numImgRows;
    int numImgCols;
    int imgMin;
    int imgMax;
    int numStructRows;
    int numStructCols;
    int structMin;
    int structMax;
    int rowOrigin;
```

```java
    int colOrigin;
    int rowFrameSize;
    int colFrameSize;
    int extraRows;
    int extraCols;
    int rowSize;
    int colSize;
    public int[][] zeroFramedAry;
    public int[][] morphAry;
    public int[][] tempAry;
    public int[][] structAry;


    public Morphology(int numImgRows, int numImgCols, int imgMin, int imgMax, int
numStructRows, int numStructCols, int structMin, int structMax, int rowOrigin, int
colOrigin){

        this.numImgRows = numImgRows;
        this.numImgCols = numImgCols;
        this.imgMin = imgMin;
        this.imgMax = imgMax;
        this.numStructRows = numStructRows;
        this.numStructCols = numStructCols;
        this.structMin = structMin;
        this.structMax = structMax;
        this.rowOrigin = rowOrigin;
        this.colOrigin = colOrigin;

        this.rowFrameSize = numStructRows /2;
        this.colFrameSize = numStructCols /2;

        this.extraRows = rowFrameSize*2;
        this.extraCols = colFrameSize*2;
        this.rowSize = numImgRows + extraRows;
        this.colSize = numImgCols + extraCols;
//
//          System.out.println("numimg rows:" + numImgRows);
//          System.out.println("numimg col:" + numImgCols);
//          System.out.println("extraRows rows:" + extraRows);
//          System.out.println("extraCols rows:" + extraCols);
//          System.out.println("rowSize rows:" + rowSize);
//          System.out.println("colSize rows:" + colSize);

        this.zeroFramedAry = new int[rowSize][colSize];
        this.morphAry = new int[rowSize][colSize];
        this.tempAry = new int[rowSize][colSize];
        this.structAry = new int[numStructRows][numStructCols];

        zero2DAry(zeroFramedAry);
        zero2DAry(morphAry);
        zero2DAry(tempAry);
        zero2DAry(structAry);
    }

    public void zero2DAry (int[][] arr){

        int r = arr.length, c = arr[0].length;
        for (int i=0; i<r;i++){
            for (int j=0; j<c;j++){
                arr[i][j]=0;
            }
        }
    }
```



```java
    public void onePixelDilation(int i, int j, int[][] inArr, int[][]outArr) {
        int iOffset = i - rowOrigin;
        int jOffset = j - colOrigin;


        int rIndex = 0;

        while (rIndex < numStructRows) {
            //step 2
            int cIndex = 0;
            //step 5
            while (cIndex < numStructCols) {
                //step 3
                if (structAry[rIndex][cIndex] > 0) {
//                      System.out.println(iOffset + rIndex);
//                      System.out.println(jOffset + cIndex);
                    outArr[iOffset + rIndex][jOffset + cIndex] = 1;
                }

                //step 4
                cIndex++;
            }
            //step 6
            rIndex++;
        }

    }

    public void onePixelErosion(int i, int j, int[][] inArr, int[][]outArr){
        int iOffset = i - rowOrigin;
        int jOffset = j - colOrigin;
        boolean match = true;

        //step1
        int rIndex = 0;


        //step 7
        while ((match) && (rIndex < numStructRows)) {
            //step 2
            int cIndex = 0;
            //step 5
            while ( (match) && (cIndex < numStructCols )) {
                //step 3
                if (structAry[rIndex][cIndex] > 0 &&
                        (inArr[iOffset + rIndex][jOffset + cIndex] ) <= 0) {
                    match = false;
                }

                //step 4
                cIndex++;
            }
            //step 6
            rIndex++;
        }

        //step 8
        if(match){
            outArr[i][j] = 1;
        }else{
            outArr[i][j] = 0;
        }
    }

    public void computeDilation (int[][] inArr, int[][]outArr){
        //step 1
        int i = rowFrameSize;

        //step 7
        while (i<rowSize) {

            //step 2
            int j = colFrameSize;

            //step 5
            while (j < colSize) {

                //step 3
                if (inArr[i][j] > 0) {
                    onePixelDilation(i, j, inArr, outArr);
                }

                //step 4
                j++;
            }

            //step 6;
            i++;
        }
    }

    public void computeErosion (int[][] inArr, int[][]outArr){
        //step1
        int i = rowFrameSize;

        //step 7
        while (i<rowSize) {
            //step2
            int j = colFrameSize;

            //step5

            while (j < colSize) {
                //step 3
                if (inArr[i][j] > 0) {
                    onePixelErosion(i, j, inArr, outArr);
                }

                //step 4
                j++;
            }

            //step6
            i++;
        }
    }

    public void computeClosing(){
        computeDilation(zeroFramedAry,tempAry);
        computeErosion(tempAry, morphAry);
        zero2DAry(tempAry);
    }

    public void computeOpening(){
        computeErosion(zeroFramedAry, tempAry);
        computeDilation(tempAry,morphAry);
        zero2DAry(tempAry);
    }

    public void loadImg(FileReader input) throws IOException {
        BufferedReader br = new BufferedReader(input);
        String line = br.readLine();
        int i=1;
        while((line=br.readLine())!=null){
            String[] c = line.split(" ");
            for(int j=1; j<c.length; j++){
                zeroFramedAry[i][j] = Integer.parseInt(c[j-1]);
            }
            i++;
        }
    }

    public void loadStruct(FileReader input) throws IOException {
        BufferedReader br = new BufferedReader(input);
        String line = br.readLine();
        line = br.readLine();
        int i=0;
        while((line=br.readLine())!=null){
            String[] c = line.split(" ");
            for(int j=0; j<c.length; j++){
                structAry[i][j] = Integer.parseInt(c[j]);
//                  System.out.print(c[j]);
            }
//              System.out.println();
            i++;
        }
    }

    public void imgReformat(FileWriter output) throws IOException {
        output.write("\n" + zeroFramedAry.length + ", " + zeroFramedAry[0].length + ",
0, 1\n");

        int width = 1;

        int r = 0;

        while (r<zeroFramedAry.length){
            int c = 0;
            while (c<zeroFramedAry[0].length){

                output.write(zeroFramedAry[r][c] + " ");
                c++;
            }
            output.write("\n");
            r++;
        }

    }

    public void prettyPrint(int[][] arr, FileWriter output) throws IOException {

        output.write("\n\n" + zeroFramedAry.length + ", " + zeroFramedAry[0].length +
", 0, 1\n\n");
        for (int i = 0; i < arr.length; i++)
        {
            for (int j = 0; j < arr[0].length; j++)
            {
```

```java
                if(arr[i][j]>0){
                    output.write(arr[i][j] + " ");
                }else{
                    output.write( "  ");
                }
            }
            output.write("\n");

        }
    }

    public void basicOP(FileWriter output)throws IOException{

        //step 0
        output.write("\nentering basicOperations method \n");
        //step 1
        zero2DAry(morphAry);
        computeDilation(zeroFramedAry, morphAry);
        output.write("\n Printing result of ComputeDilation. \n");
        prettyPrint(morphAry,output);
        //step 2
        zero2DAry(morphAry);
        computeErosion(zeroFramedAry, morphAry);
        output.write("\n Printing result of ComputeErosion. \n");
        prettyPrint(morphAry,output);
        //step 3
        zero2DAry(morphAry);
        computeOpening();
        output.write("\n Printing result of ComputeOpening. \n");
        prettyPrint(morphAry,output);
        //step 4
        zero2DAry(morphAry);
        computeClosing();
        output.write("\n Printing result of ComputeClosing. \n");
        prettyPrint(morphAry,output);

        //step 5
        output.write("\nexit basicOperations method\n");
    }

    public void complexOP(FileWriter output)throws IOException{
        //step 0
        output.write("entering complexOperations method \n");

        //step 1
        zero2DAry(morphAry);
        computeOpening();
        output.write("\n Printing result of Opening. \n");
        prettyPrint(morphAry,output);
        copyArr();

        //step 2
        zero2DAry(morphAry);
        computeClosing();
        output.write("\n Pretty print the result of Opening follow by Closing. \n");
        prettyPrint(morphAry,output);
        copyArr();

        //step 3
        zero2DAry(morphAry);
        computeClosing();
        output.write("\n  Pretty print the result of Closing. \n");
        prettyPrint(morphAry,output);
        copyArr();

        //step 4
        zero2DAry(morphAry);
        computeOpening();
        output.write("\n  Pretty print the result of Closing follow by Opening. \n");
        prettyPrint(morphAry, output);


        output.write("\n Exit complexOperations method” \n");
    }

    void copyArr(){
        for (int i=0; i<zeroFramedAry.length;i++){
            System.arraycopy(morphAry[i], 0, zeroFramedAry[i], 0,
zeroFramedAry[0].length);
        }
    }

}
```