# Optical Mark Recognition

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## Digital Image Processing

## Dr. Akhtar Jamil

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## Introduction:

Using the basics of computing which is to automate a tedious and tiring task that was done manually beforehand, we discovered a very common problem scenario. Multiple Choice Question examinations used to be checked manually. Doing so would require manpower to manually look at each and every answer and compare it to an answer key. This process is very time consuming and error prone as human beings are not perfect.

To make this task quicker and less error prone, we realized that we could use computers to check the answer sheets for us, compare it to an answer key and then log the records to a database. 3 steps that had been done manually would now be automated and done by the computer for us.

## Literature review:

https://staff.informatics.buu.ac.th/~krisana/cv/paper/spie99.pdf

https://ijeir.org/administrator/components/com_jresearch/files/publications/IJEIR_2338_FINAL.pdf

https://www.researchgate.net/publication/330977246_An_Image_Processing_Oriented_Optical_Mark_Recognition_and_Evaluation_System

## Data Set:

Considering we recognized the problem in our university, we used another university's pre-existing dataset of multiple choice questions answer sheets to use as our input images. We would use these images as our sample input and write our program in such a way that it can use these images and produce the desired output.

The sample dataset for some of the pictures can be seen below:

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## CEVAP KARTI

**ADI ve SOYADI** (Adı ve soyadı arasında bir boşluk bırakınız.)

MERVE ASIKUZUNOĞLU

**ÖĞRENCİ NUMARASI**

| 6 | 0 | 7 | 0 | 8 | 1 | 7 | 2 | 0 |
|---|---|---|---|---|---|---|---|---|

**SINAV TÜRÜ**

○ QUİZ ○ ARA ● FİNAL ○ BÜTÜNLEME

| | |
|---|---|
| SORU GRUBU | ● B C D E |
| Öğretim Elemanı Onayı | ● B C D E |

**ÖĞRENCİ BİLGİLERİ**

| | |
|---|---|
| Adı | : Merve |
| Soyadı | : ASIKUZUNOĞLU |
| Numarası | : 607081720 |
| Programı | : Yazılım mühendisliği |
| Dersin Adı | : Makine Öğrenmesi |
| Tarih | : 18 / 02 / 2020 |
| İmza | |

**DİKKAT!**
Optik form üzerindeki tüm işaretlemelerinizde YALNIZ KURŞUN KALEM KULLANINIZ.

**DOĞRU İŞARETLEME ÖRNEĞİ**

*Başarı Dileklerimizle.*

**CEVAPLAR**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B | C | D | 31 | A | C | D | E | 61 | A | B | D | E | 91 | A | B | C | E |
| 2 | B | C | D | 32 | A | B | C | E | 62 | A | B | C | D | 92 | A | C | D | E |
| 3 | B | D | D | 33 | A | C | D | E | 63 | A | C | D | E | 93 | A | B | C | D | E |
| 4 | B | C | D | 34 | A | B | D | E | 64 | A | B | C | E | 94 | B | B | D | E |
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| 7 | B | C | D | E | 37 | A | B | C | D | E | 67 | B | C | E | 97 | A | B | D | E |
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| 9 | B | D | E | 39 | A | B | C | D | 69 | A | B | C | D | 99 | A | B | C | D | E |
| 10 | B | C | D | E | 40 | A | C | D | E | 70 | A | C | D | E | 100 | A | C | D | E |
| 11 | B | C | D | E | 41 | A | B | D | E | 71 | B | C | D | E | 101 | A | B | C | E |
| 12 | A | B | C | D | E | 42 | B | C | D | E | 72 | A | B | C | E | 102 | B | C | D | E |
| 13 | B | D | E | 43 | A | C | E | 73 | A | C | D | E | 103 | A | B | C | E |
| 14 | B | C | E | 44 | A | B | C | D | E | 74 | A | B | C | E | 104 | A | B | C | D | E |
| 15 | B | D | E | 45 | A | C | D | E | 75 | A | C | D | E | 105 | A | C | D | E |
| 16 | B | C | D | E | 46 | A | B | D | 76 | A | B | C | D | E | 106 | A | B | C | D | E |
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| 23 | B | E | 53 | B | C | D | E | 83 | A | B | C | E | 113 | X | X | D | E |
| 24 | B | C | D | E | 54 | A | C | E | 84 | A | B | D | E | 114 | B | C | D | E |
| 25 | B | D | E | 55 | A | C | D | 85 | A | X | C | D | E | 115 | C | X | X |
| 26 | B | C | D | E | 56 | B | C | D | E | 86 | X | C | 116 | A | B | C | D | E |
| 27 | B | C | D | E | 57 | A | C | D | E | 87 | B | C | D | E | 117 | B | C | E |
| 28 | A | B | C | D | E | 58 | A | B | C | D | 88 | A | B | D | E | 118 | A | C | D | E |
| 29 | A | B | C | D | E | 59 | B | C | D | E | 89 | A | B | C | E | 119 | A | B | C | E |
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Form Kodu: Y

xc/50b/a4

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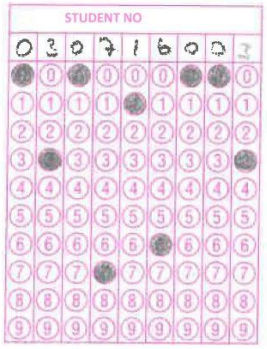
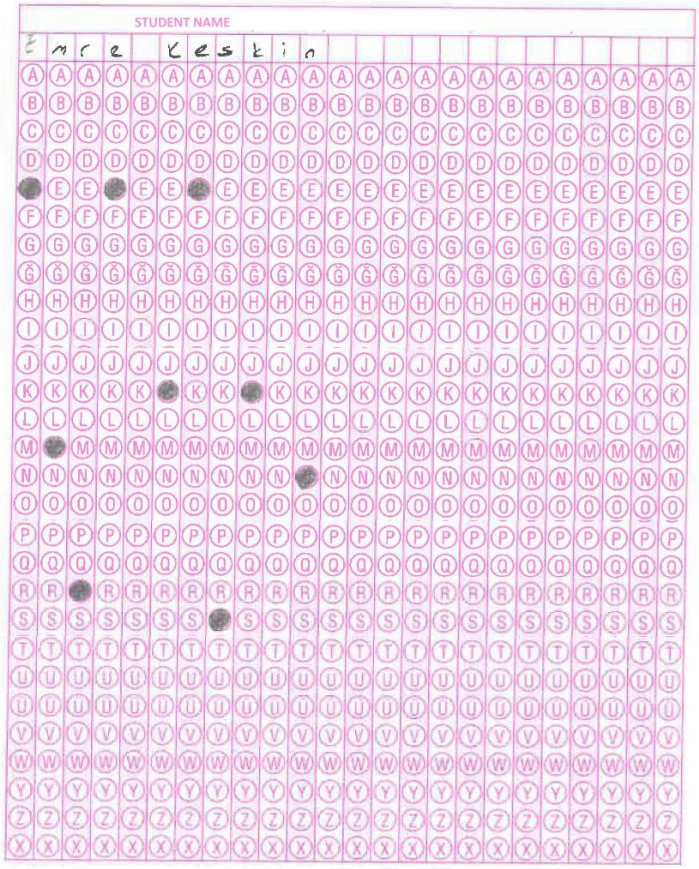
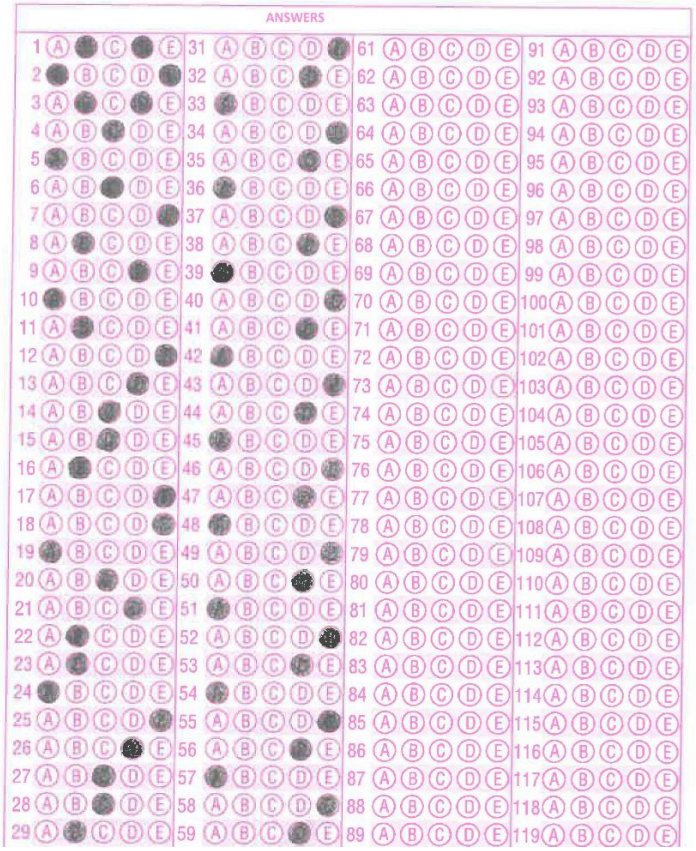
**ANSWER SHEET**



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# CEVAP KARTI

**ÖĞRENCİ NUMARASI**

0 3 0 7 1 6 0 0 4

**SINAV TÜRÜ**

○ QUİZ ○ ARA ● FİNAL ○ BÜTÜNLEME

| SORU GRUBU | ● Ⓑ Ⓒ Ⓓ Ⓔ |
|---|---|
| Öğretim Elemanı Onayı | ● Ⓑ Ⓒ Ⓓ Ⓔ |

**ÖĞRENCİ BİLGİLERİ**

| | |
|---|---|
| Adı | Edanur |
| Soyadı | ANLAYAN |
| Numarası | 030716004 |
| Programı | Yazılım Mühendisliği |
| Dersin Adı | Makine Öğrenmesi |
| Tarih | 18 / 02 / 2020 |
| İmza | Edanur |

**DİKKAT!**
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**DOĞRU İŞARETLEME ÖRNEĞİ**

*Başarı Dileklerimizle.*

**ADI ve SOYADI** (Adı ve soyadı arasında bir boşluk bırakınız.)

E D A N U R A N L A Y A N

**CEVAPLAR**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | ● | 31 | ● | 61 | ● | 91 | ● | | |
| 2 | A | 32 | A | 62 | | 92 | A | | |
| 3 | A | 33 | A | 63 | | 93 | A | | |
| 4 | A | 34 | A | 64 | A | 94 | | | |
| 5 | A | 35 | A | 65 | A | 95 | A | | |
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| 9 | A | 39 | A | 69 | A | 99 | A | | |
| 10 | A | 40 | A | 70 | A | 100 | | | |
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| 12 | A | 42 | A | 72 | A | 102 | A | | |
| 13 | A | 43 | A | 73 | A | 103 | A | | |
| 14 | A | 44 | A | 74 | | 104 | A | | |
| 15 | A | 45 | | 75 | A | 105 | | | |
| 16 | A | 46 | A | 76 | A | 106 | A | | |
| 17 | A | 47 | A | 77 | A | 107 | A | | |
| 18 | A | 48 | A | 78 | | 108 | A | | |
| 19 | ● | 49 | A | 79 | A | 109 | ● | | |
| 20 | A | 50 | A | 80 | A | 110 | A | | |
| 21 | ● | 51 | A | 81 | A | 111 | A | | |
| 22 | A | 52 | | 82 | | 112 | A | | |
| 23 | A | 53 | A | 83 | A | 113 | A | | |
| 24 | ● | 54 | A | 84 | A | 114 | ● | | |
| 25 | A | 55 | A | 85 | | 115 | A | | |
| 26 | A | 56 | | 86 | A | 116 | A | | |
| 27 | A | 57 | A | 87 | A | 117 | A | | |
| 28 | A | 58 | A | 88 | A | 118 | A | | |
| 29 | A | 59 | A | 89 | A | 119 | A | | |
| 30 | ● | 60 | A | 90 | A | 120 | ● | | |

Form Kodu: Y

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**ÖĞRENCİ NUMARASI**

0 3 0 1 1 6 0 0 4

**SINAV TÜRÜ**

○ QUİZ ○ ARA ● FİNAL ○ BÜTÜNLEME

| SORU GRUBU | Ⓑ Ⓒ Ⓓ Ⓔ |
|---|---|
| Öğretim Elemanı Onayı | Ⓑ Ⓒ Ⓓ Ⓔ |

**ÖĞRENCİ BİLGİLERİ**

Adı : Halil İbrahim

Soyadı : SEZER

Numarası : 030116004

Programı : B.Ü. Mühendislik

Dersin Adı :

Tarih : / /

İmza :

**DİKKAT!**
**Optik form üzerindeki tüm işaretlemelerinizde YALNIZ KURŞUN KALEM KULLANINIZ.**

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**ADI ve SOYADI** (Adı ve soyadı arasında bir boşluk bırakınız.)

HALİL İBRAHİM SEZER

**CEVAPLAR**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | B | 31 | | 61 | | 91 | | | |
| 2 | B | 32 | | 62 | | 92 | | | |
| 3 | C | 33 | | 63 | | 93 | | | |
| 4 | B | 34 | | 64 | | 94 | | | |
| 5 | C | 35 | | 65 | | 95 | | | |
| 6 | D | 36 | | 66 | | 96 | | | |
| 7 | D | 37 | | 67 | | 97 | | | |
| 8 | B | 38 | | 68 | | 98 | | | |
| 9 | E | 39 | | 69 | | 99 | | | |
| 10 | E | 40 | | 70 | | 100 | | | |
| 11 | D | 41 | | 71 | | 101 | | | |
| 12 | E | 42 | | 72 | | 102 | | | |
| 13 | D | 43 | | 73 | | 103 | | | |
| 14 | E | 44 | | 74 | | 104 | | | |
| 15 | B | 45 | | 75 | | 105 | | | |
| 16 | B | 46 | | 76 | | 106 | | | |
| 17 | B | 47 | | 77 | | 107 | | | |
| 18 | C | 48 | | 78 | | 108 | | | |
| 19 | B | 49 | | 79 | | 109 | | | |
| 20 | B | 50 | | 80 | | 110 | | | |
| 21 | C | 51 | | 81 | | 111 | | | |
| 22 | C | 52 | | 82 | | 112 | | | |
| 23 | C | 53 | | 83 | | 113 | | | |
| 24 | C | 54 | | 84 | | 114 | | | |
| 25 | C | 55 | | 85 | | 115 | | | |
| 26 | C | 56 | | 86 | | 116 | | | |
| 27 | C | 57 | | 87 | | 117 | | | |
| 28 | C | 58 | | 88 | | 118 | | | |
| 29 | C | 59 | | 89 | | 119 | | | |
| 30 | C | 60 | | 90 | | 120 | | | |

Form Kodu: Y

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## Methodology:

Our methodology is somewhat simple in this regard. From the dataset, we can see that each part of the image has different segments that are constant. The name of the student is in the top right corner. The roll number is somewhat in the top left corner. The answers for the respective questions are in the bottom right corner.

We can therefore make 3 separate images out of this image that are separated into 3 segments of name, roll number and answers. This will make our work easier.

Taking an example from below image, we can have 3 separate images

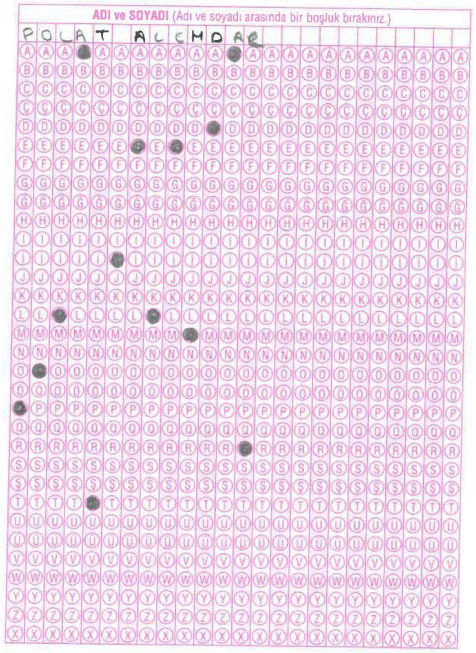




Image of Name bubbles

Image of Roll Number

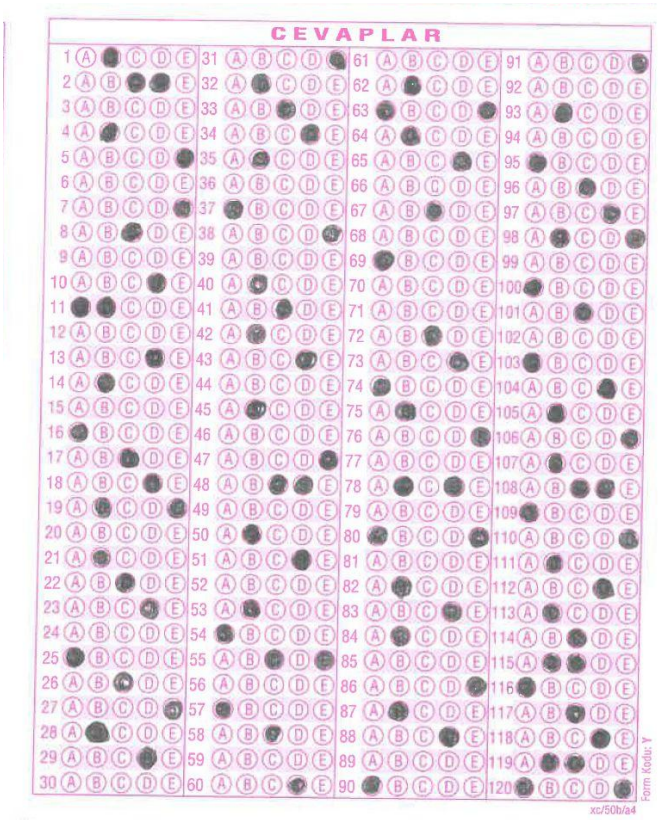



Image of Answers

The next step in the program would be to convert the image to grayscale as this would highlight the spots that have been marked in pencil. Pencil has a generic colour of grey that would be emphasized by converting the image to grayscale.

After this, we can apply thresholding on the resultant images to enhance the marked dots on the sheet. This will help us in clearly distinguishing between the empty circles and the filled circles.

For the Student Name and Roll Number, we will then start from the top left side of the image and keep collecting the filled circles according to the row value of the circle.

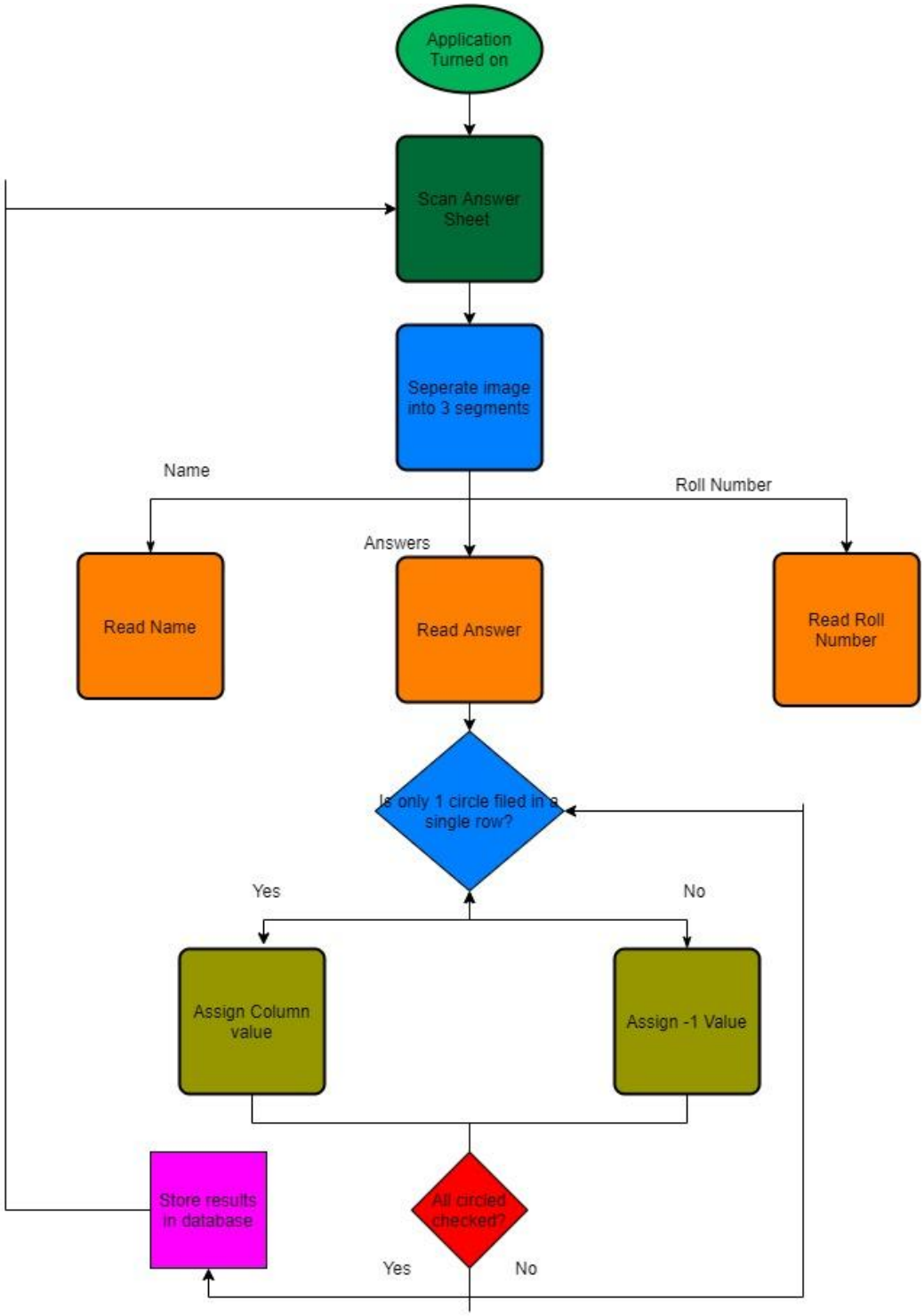
For the answers, we would make a key, value map. Whereas, if there is an empty circle or multiple filled circles in a single row, we would assign it a value of -1 and if there is one filled circle in the row, we would assign it the value of the column it is filled in. This way, we would have an entire array of values for the answer sheet.

After this, we can match these values to the answer key already stored in the database and then keep a record of the total marks of the students.

An example of the circles counting and their respective values is as below:


As can be seen, the rows with 2 or more circles filled or 0 circles filled, they will be given -1 value whereas 1 circle filled will be given the value of their respective column starting from 0.

We have also made a flowchart depicting how our program functions according to the input. The link for the flowchart is here for better viewing.



## Software Packages:

| Name | Tasks |
|---|---|
| Danyal Faheem | Answer choice with Answer Key mapping |
| Mehmood Amjad | Image Segmentation, Circle Detection |
| Muhammad | Image Conversion and Separation |

## Bibliography:


https://staff.informatics.buu.ac.th/~krisana/cv/paper/spie99.pdf

https://ijeir.org/administrator/components/com_jresearch/files/publications/IJEIR_2338_FINAL.pdf

https://www.researchgate.net/publication/330977246_An_Image_Processing_Oriented_Optical_Mark_Recognition_and_Evaluation_System


***Thank you!***