School of Informatics

Cover Sheet for Coursework 2

Module Code: Co7215

Assignment: GLCM

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Date: 10-12-2021

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Introduction

(Lloyd et al.) **What is the Gray-Level Co-occurrence matrix?** The gray-Level Co-occurrence matrix is a statistical approach to examining how frequently do two pixels in an image appear to be closer to each other. GLCM is used to segment an image at different angles and distances. GLCM cannot provide information about the shapes of the image but can provide the information about Texture of the image. Detecting the pixels closer to each other is easier in angles 0° and 90° and difficult to detect in 45° and 135°.

(Lloyd et al.) In the picture, the GLCM file carries information about the mixed appearance of the two linked pixels. On the other hand, GLCM includes 22 functions. There are only five boundaries that are generally considered important: Phrase contrast, homogeneity, dissimilarity, energy, and entropy are all used to characterize the properties of the system. If you put these five ideas into practice, you will be able to put them into practice. It is helpful to understand how surface elements are represented in Multiple surfaces.

All the features used in the experiment are listed below.

I'll explain what each of these terms means in the context of texture analysis. p (I, j) represents the (I j) Normalized GLCM item or value in all expressions.

1) **(Lloyd et al.)** **Contrast -** Contrast is a local variation in gray levels in a grayscale match matrix. This is a linear relationship between the gray levels of the surrounding pixels.

$$Contrast = \sum_{i,j} |i-j|^2 \, p(i,j) \qquad (1)$$

In (1), The flat and vertical unit organizes are I and j, individually, and the unit esteem is p. On the off chance that the dark qualities of adjoining pixels are the same, the difference in the picture is moderately low. On account of the surface, the adjustment of the dark scale mirrors the adjustment of the surface. Substantial surfaces ought to have high difference esteems, while smooth, delicate surfaces ought to have low differentiation esteems. The scope of Contrast is [0, (size (GLCM,1)- 1)2]. For a consistent picture, Contrast is equivalent to 0.

2) **(Lloyd et al.)** **Homogeneity-** The consistency of the non-zero elements in the GLCM is referred to as homogeneity. The inverse of contrast weight is used to calculate weight values.

$$Homogeneity = \sum_{i,j} \frac{1}{1-(i-j)^2} \, p(i,j) \qquad (2)$$

Assuming the GLCMs are focused askew, that is, in case there are numerous pixels with the equivalent or very much like dark level qualities, then, at that point, the GLCM consistency for any surface will be high. The lower the consistency of GLCM, the higher the differentiation of GLCM. The more prominent the variety in the dim worth, the less uniform the GLCM and the higher the differentiation of the GLCM. The scope of consistency is [0,1]. Assuming the picture is less scattered, the consistency is high, and on the off chance that there is no adjustment of the picture, it is 1. Subsequently, profoundly homogeneous surfaces have better rehashing structures, while less homogeneous surfaces have a great deal of adaptability in both surface pieces and their spatial game plans. Pictures with "lopsided surfaces" do have not many redundancies of surface components and no spatial comparability.

3) **(Lloyd et al.)** **Dissimilarity-** Dissimilarity is a metric that describes how different grey level pairs in an image vary. It's the most comparable to Contrast with a weight difference - Contrast, unlike Dissimilarity, develops quadratically

$$Dissimilarity = \sum_{i,j} |i-j| \, p(i,j) \tag{3}$$

Because they use different weights to calculate the same parameters, these two measurements should behave similarly for the same texture. The dissimilarity always produces greater results than contrast. When the gray levels of the reference pixel and the neighboring pixels are at the extreme of the potential gray value of the texture sample, the degree of dissimilarity reaches [0,1].

4) **(Lloyd et al.)Entropy-** In any system, entropy indicates disorder, and in tissue analysis, it is a measure
of the spatial disorder [1.8].

$$Entropy = -\sum_{i,j} p(i,j) \log\left(p(i,j)\right) \tag{4}$$

Since it reflects disorder, truly irregular occupancy will have incredibly high entropy. The entropy value of a strong tone picture is 0. This property can be used to determine whether the entropy of a solid surface or a smooth surface is higher, allowing us to determine which surface is easier to measure turbulence.

5) **(Lloyd et al.)Energy-** Energy is a proportion of nearby homogeneity and accordingly addresses something contrary to the Entropy. Essentially this element will let us know how uniform the surface is [1,8].

$$Energy = \sum_{i,j} p(i,j)^2 \tag{5}$$

The texture's uniformity increases as the Energy value rises. Energy has a range of [0,1], with Energy equal to 1 for a constant picture.

Figure 1. Magnified area of the image enclosed by a certain distance from 2 to 18 pixels with step of 2 for sample 16c (scale2)

By using the above-explained 5 Computational Formulas we can detect the Gray Level Co-occurrence Matrix in a magnified area of the image.

Demonstration of the Gray-Level co-occurrence matrix (GLCM) Application

The Application is Developed in Python and Visual Studio IDE is used. We have selected 3 distances in the matrix i.e. d=1,2,3 and in 4 different angles i.e. θ= 0,45,90,135 degrees. The Application runs on the clicks of the buttons, we have one Input matrix and a button to generate the input matrix and one output matrix which on selecting distance and angle and on click of output matrix button, output matrix is generated with the distance and angle. We can check if it's working by selecting the numbers in the output matrix and the changes will be reflected in the input matrix.

- Frontend is created using HTML

Step 1- defined an Input matrix of 5x5 using Table heading from 1 to 5 in HTML

```
<div class="w3-row-padding w3-center w3-margin-top">
        <div class="w3-third">
            <div class="w3-card w3-container" style="min-height: 460px">
                <h3 style="color: blue; font-weight: bold">INPUT MATRIX</h3>
                <br>
                <table class="w3-table">
                    <thead>
                        <tr style="color: darkblue">
                            <th></th>
                            <th>0</th>
                            <th>1</th>
                            <th>2</th>
                            <th>3</th>
                            <th>4</th>
                            <th>5</th>
                        </tr>
                    </thead>
```

Step 2- Firstly, we have defined the distance and the angles used in the heading

```
<div class="w3-half" style="color: darkblue; font-weight: bold">
    <h4>Distance(D)</h4>
    <select class="w3-button" id="d" name="d" required>
    <option value="1">Distance</option>
    <option value="1">1</option>
    <option value="2">2</option>
    <option value="3">3</option>
    </select> <br>
</div>

<div class="w3-half" style="color: darkblue; font-weight: bold">
    <h4>Angle</h4>
        <select class="w3-button" id="a" name="a" required>
        <option value="0">Angle</option>
        <option value="0">0</option>
        <option value="45">45</option>
        <option value="90">90</option>
        <option value="135">135</option>
</select> <br> <br>
```

Step 3- Created a button Input matrix and Output matrix which onclick Generates an Output Matrix and Input Matrix i.e call Generate Input matrix and Output matrix function.

```
var input_matrix = [];
function GenerateInputMatrix()
    {
        $.ajax({type: "POST",url: "/",data:
            {button: "button1",csrfmiddlewaretoken:'{{ csrf_token }}'},
            success: function (data)
            {
                input_matrix=data.FirstMatrix;
                showTable(data.FirstMatrix,1);
            }
        });
        }
```

```
function GenerateOutputMatrix()
    {
        input_matrix=JSON.stringify(input_matrix);
        $.ajax({
            type: "POST",
            url: "/",
            data: {
                angle:$("#a option:selected").val(),
                button: "button2",
                distance:$("#d option:selected").val(),
                inputarray:input_matrix,
                csrfmiddlewaretoken:'{{ csrf_token }}'
                },
        success: function(data){

                showTable(data.SecondMatrix,2);
```

Step 4- Defined the working of angles and distances using the python as below

```
            distance=int(distance)
            if(int(angle)==0):
                if((position+distance)<6 and (clecnmat[first][position+distance]==list2)):
                    duplicate.append((first,position))
                    print("pair found")
            elif(int(angle)==90):
                if((first+distance)<6 and (clecnmat[first+distance][position]==list2)):
                    duplicate.append((first,position))
                    print("pair found")
            elif(int(angle)==45):
                if((position+distance)<6 and (clecnmat[first-distance][position+distance]==list2)):
                    duplicate.append((first,position))
                    print("pair found")
            elif(int(angle)==135):
                if((position+distance)<6 and (clecnmat[first-distance][position-distance]==list2)):
                    duplicate.append((first,position))
                    print("pair found")
        finalResults=np.array(duplicate)
        finalResults=json.dumps(finalResults.tolist())
        return JsonResponse({'Result_Pair':finalResults})
```

Step 5- On requesting the angles and distances by sending Ajax request and reply from the server with the angles and distances.

```
    elif navig== 'button2':
        distance=request.POST.get('distance')
        angle=request.POST.get('angle')
        IA=request.POST.get('inputarray')
        return JsonResponse({'SecondMatrix':convertTOjson(greycomatrix(clearmatrix(IA), [distance], [angle], levels=6))})
    elif navig=='buttonSearch':
        btnid=str(request.POST.get('clicked_id'))
        innputarray=request.POST.get('inputarray')
        distance=request.POST.get('distance')
        angle=request.POST.get('angle')
```

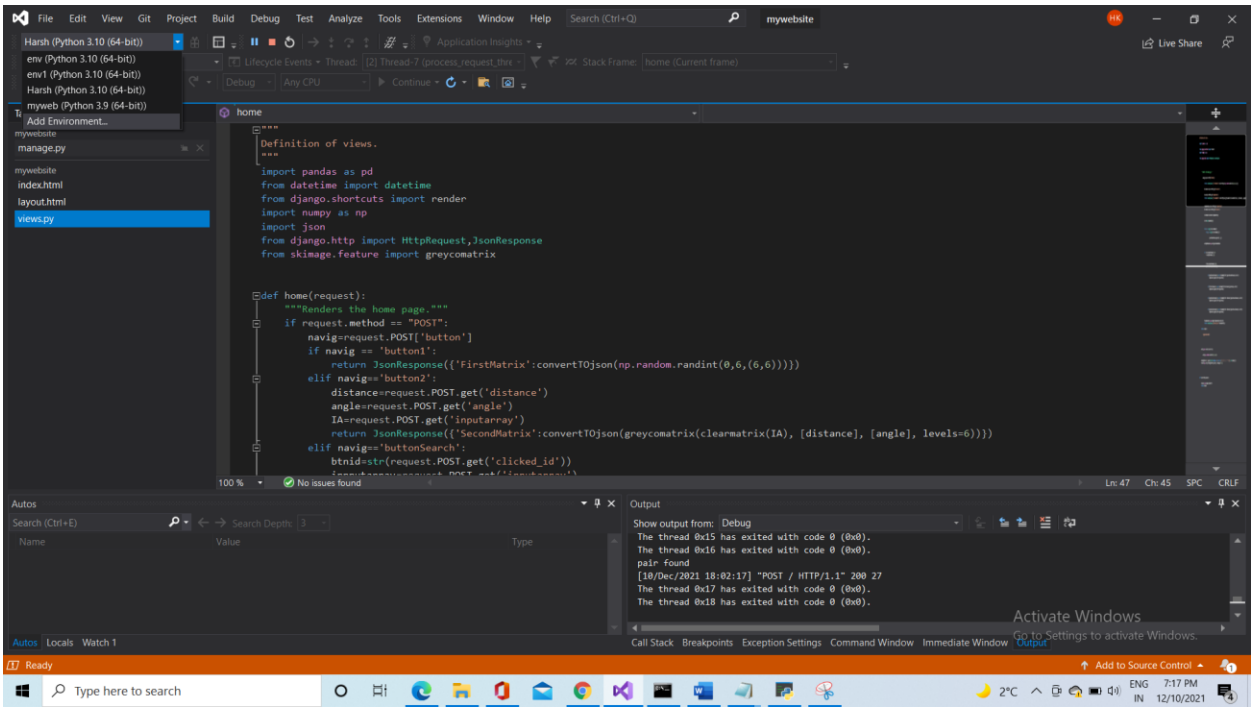
Step 6- you can run the project by installing a few packages mentioned in the Required.txt file in the command prompt and run manage.py file in the command prompt using python manage.py run server to run the server and open the browser on the localhost

Django~=2.2
Django==2.2.24
pip==21.1.3
pytz==2021.3
setuptools==56.0.0
sqlparse==0.4.2
scikit-image==0.18.3
pandas==1.3.4
NumPy==1.21.0

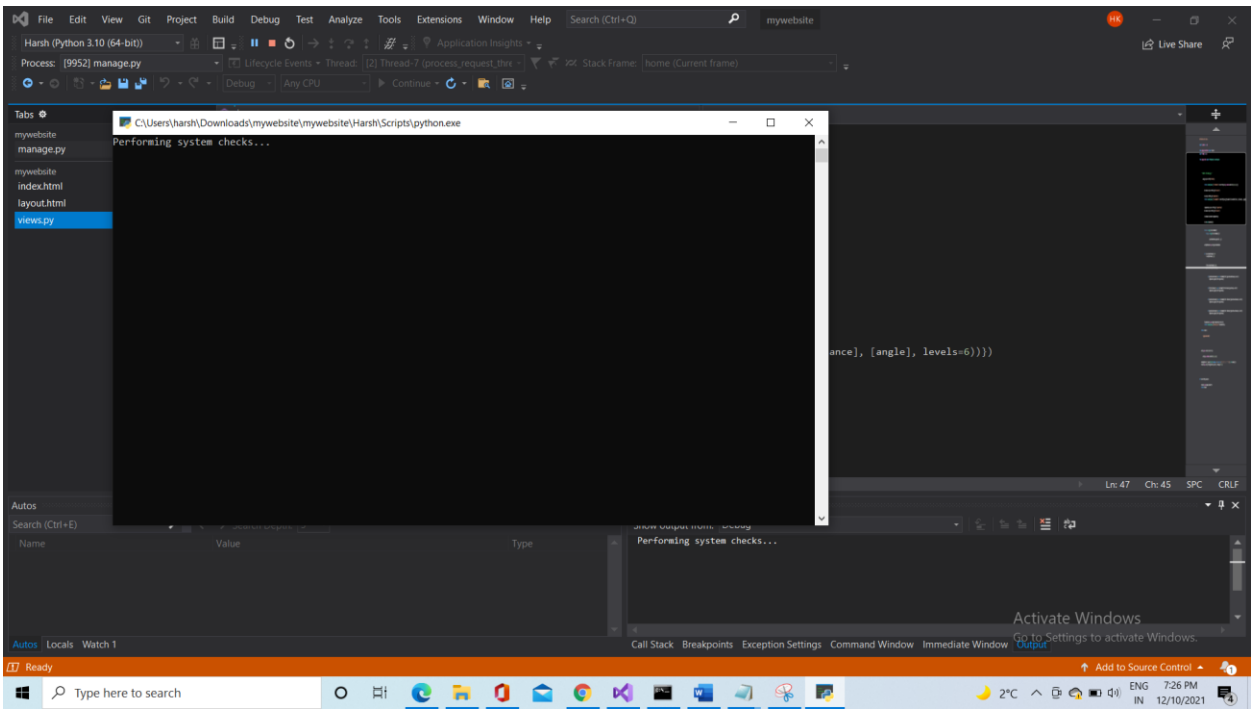
Or

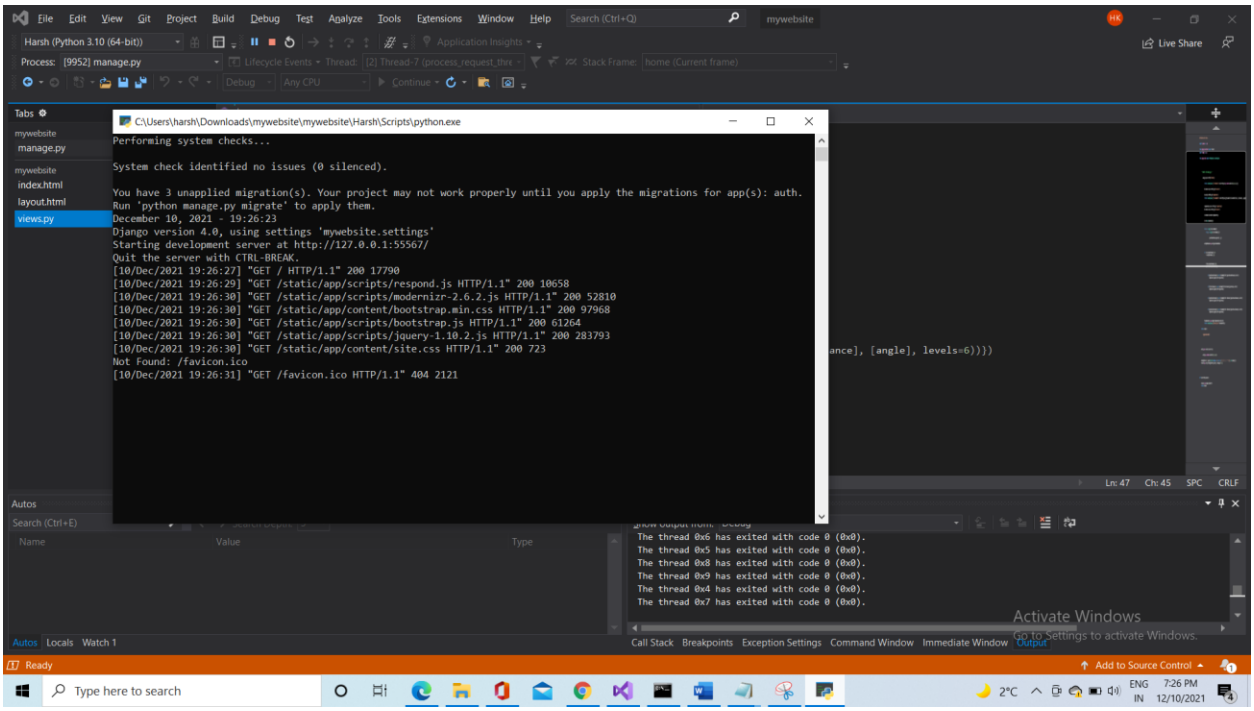
You can open your project in Visual Studio IDE and create a new environment in the top right corner and create the environment and then install the above-mentioned libraries in the terminal

1) Pip install Django
2) Pip Install Numpy

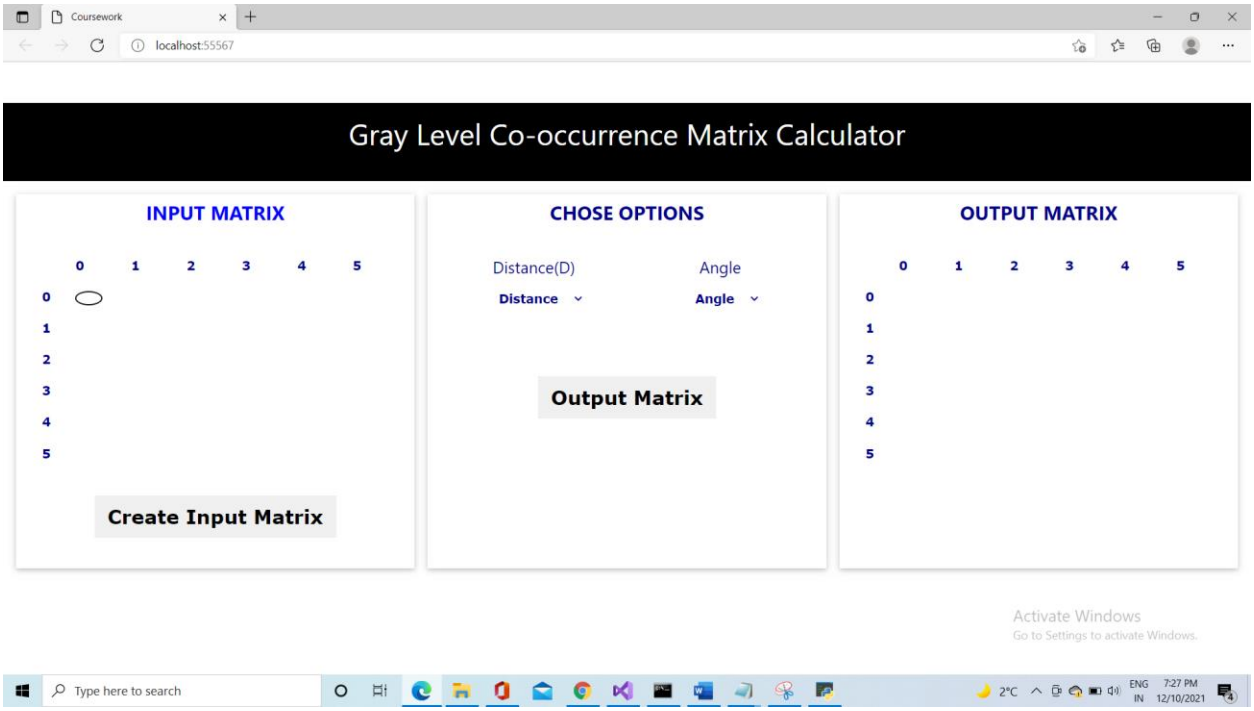


Run the project after downloading all the packages by clicking on run Web browser

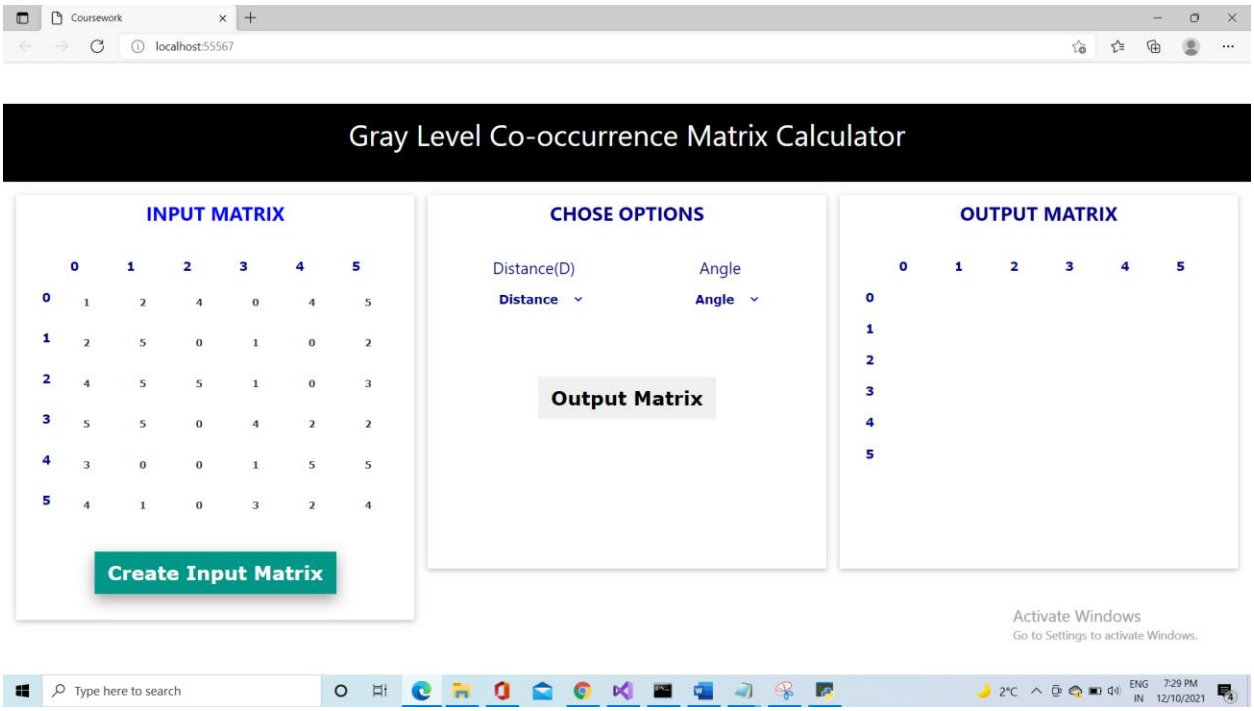




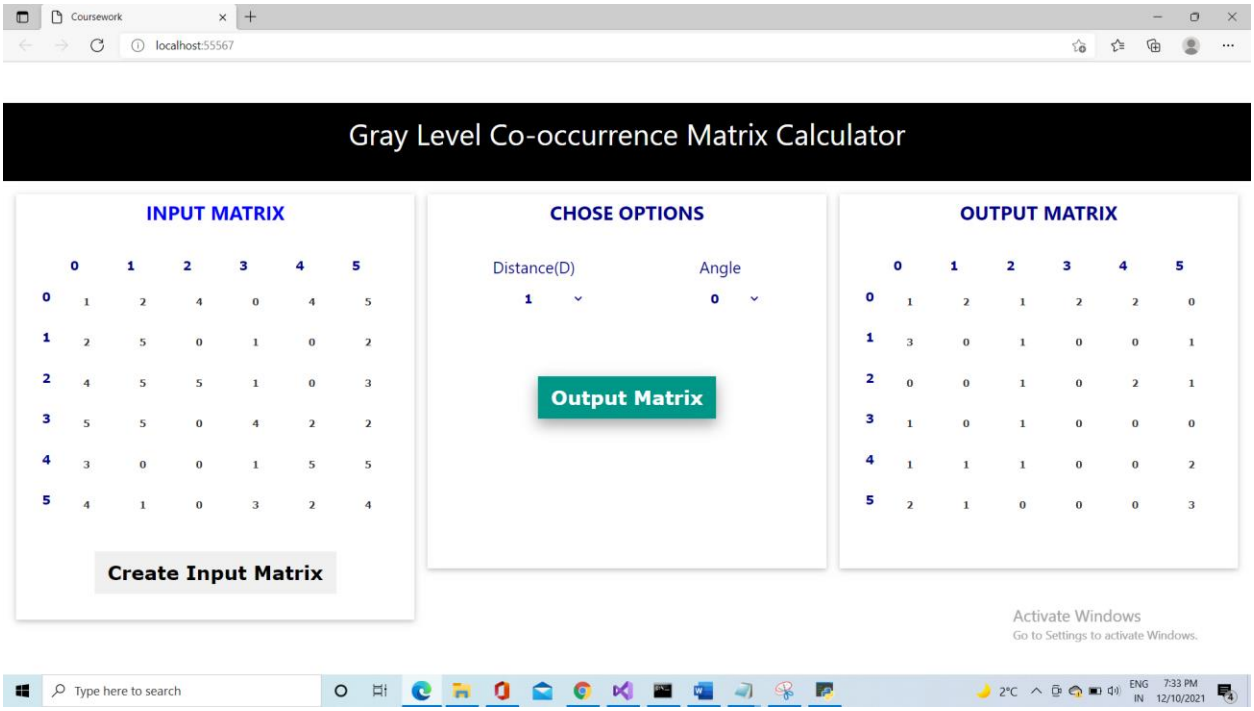
After this web browser opens in Localhost

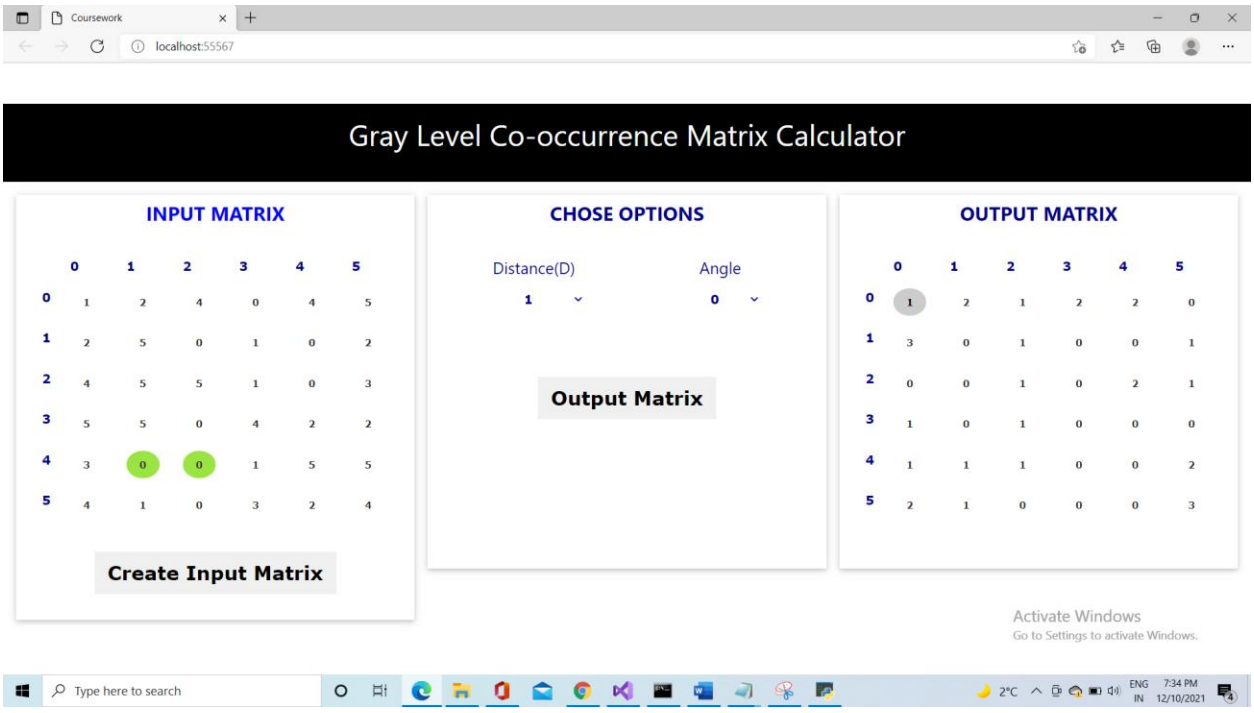


The above application opens in the web browser and then you click on create Input Matrix to create a new Input Matrix



After creating Input Matrix you specify Distance and the Angle from the dropdown arrow and then click on the Output Matix and the output matrix is created in the tabular form.





In the output matrix on clicking on the number 1 where i=0 and j=0 we can see the onclick locates 0 and 0 at angle 0 and distance 1

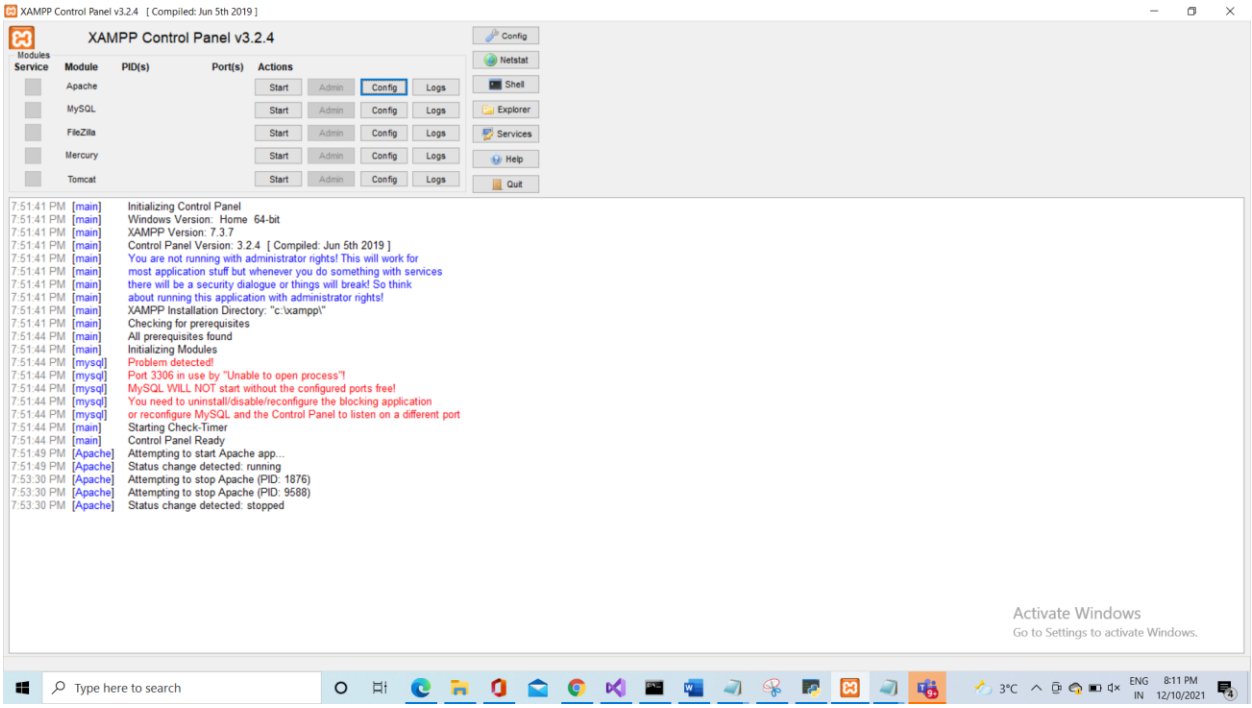
Running Application on a Local Area Network Machines

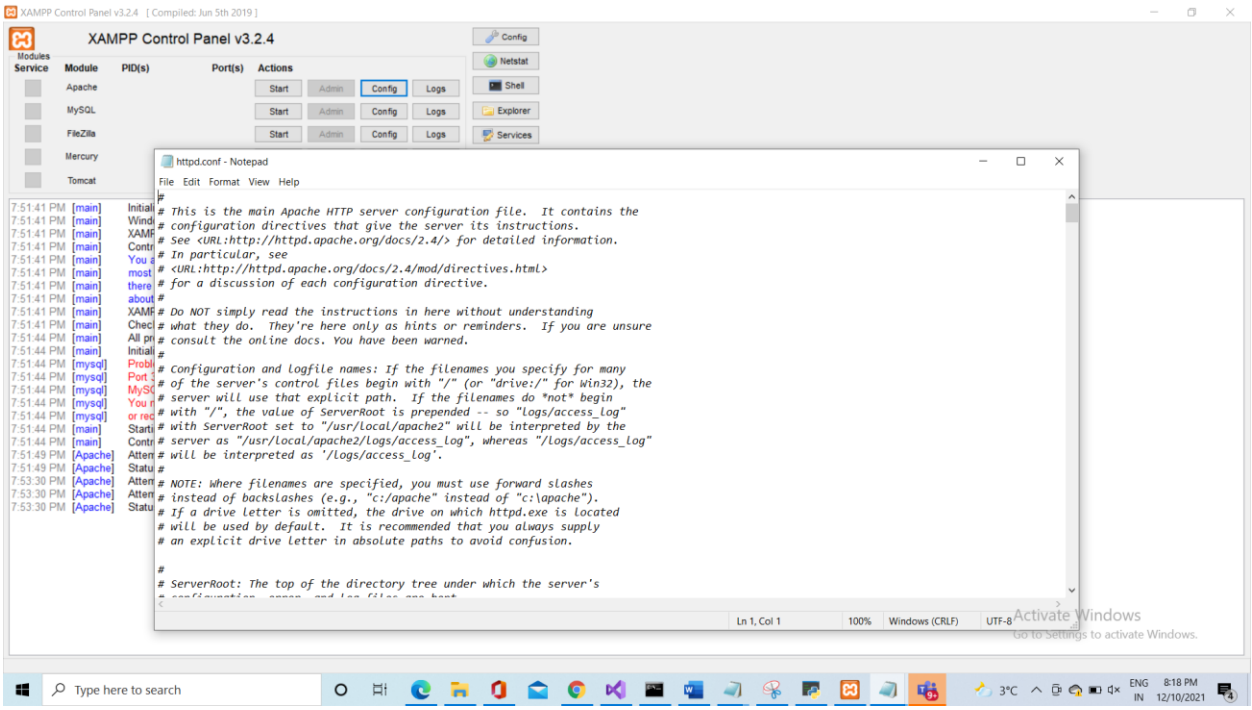
Step 1- Download Xampp

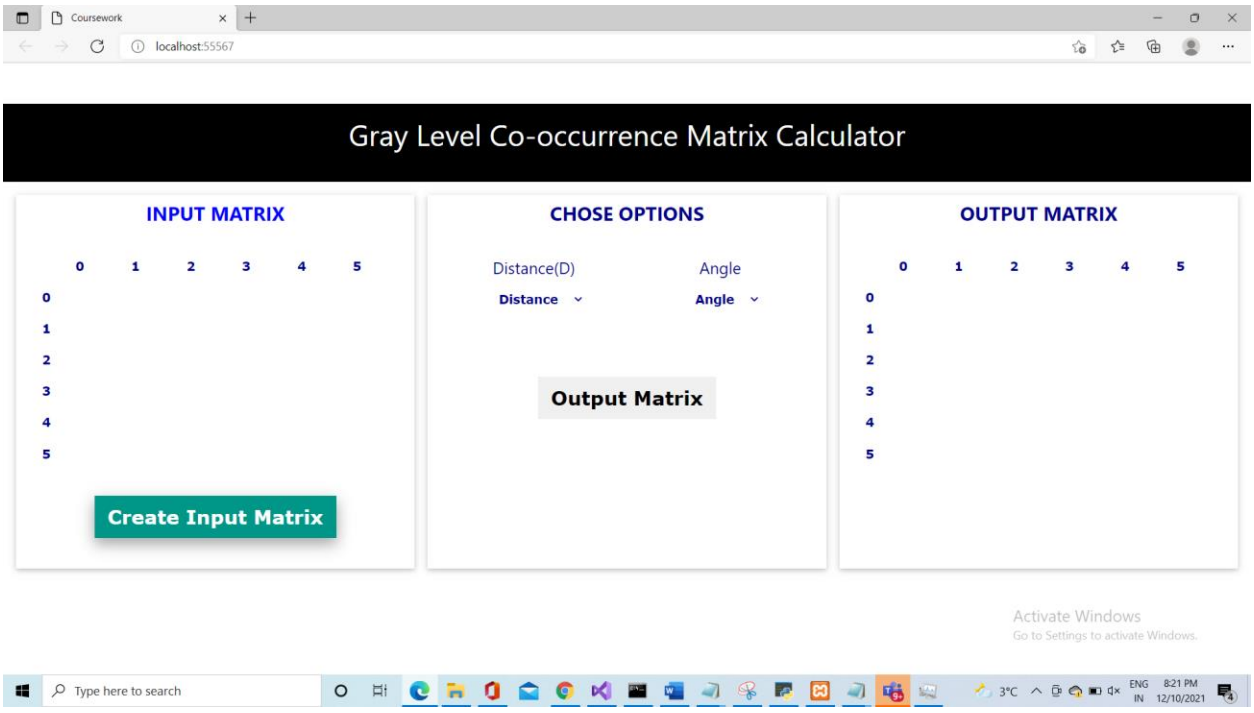
Step 2- Open Xampp and click on Apache Start and see if its running completely fine.

Step 3- Configure httpd.config and search for Listen and copy the port number

Step 4- open Task Manager and select ipv4 address of wifi and paste it in the browser and append port number and click enter and the


XAMPP Control Panel v3.2.4 [Compiled: Jun 5th 2019]
XAMPP Control Panel v3.2.4
Modules
Service
Module
PID(s)
Port(s)
Actions
Apache
MySQL
FileZilla
Mercury
Tomcat
Start
Admin
Config
Logs
Config
Netstat
Shell
Explorer
Services
Help
Quit
7:51:41 PM [main] Initializing Control Panel
7:51:41 PM [main] Windows Version: Home 64-bit
7:51:41 PM [main] XAMPP Version: 7.3.7
7:51:41 PM [main] Control Panel Version: 3.2.4 [Compiled: Jun 5th 2019]
7:51:41 PM [main] You are not running with administrator rights! This will work for
7:51:41 PM [main] most application stuff but whenever you do something with services
7:51:41 PM [main] there will be a security dialogue or things will breakl So think
7:51:41 PM [main] about running this application with administrator rights!
7:51:41 PM [main] XAMPP Installation Directory: "c:\xampp\"
7:51:41 PM [main] Checking for prerequisites
7:51:44 PM [main] All prerequisites found
7:51:44 PM [main] Initializing Modules
7:51:44 PM [mysql] Problem detected!
7:51:44 PM [mysql] Port 3306 in use by "Unable to open process"!
7:51:44 PM [mysql] MySQL WILL NOT start without the configured ports free!
7:51:44 PM [mysql] You need to uninstall/disable/reconfigure the blocking application
7:51:44 PM [mysql] or reconfigure MySQL and the Control Panel to listen on a different port
7:51:44 PM [main] Starting Check-Timer
7:51:44 PM [main] Control Panel Ready
7:51:49 PM [Apache] Attempting to start Apache app...
7:51:49 PM [Apache] Status change detected: running
7:53:30 PM [Apache] Attempting to stop Apache (PID: 1876)
7:53:30 PM [Apache] Attempting to stop Apache (PID: 9588)
7:53:30 PM [Apache] Status change detected: stopped
Activate Windows
Go to Settings to activate Windows.
Type here to search
3°C
ENG
IN
8:11 PM
12/10/2021


XAMPP Control Panel v3.2.4 [Compiled: Jun 5th 2019]
XAMPP Control Panel v3.2.4
httpd.conf - Notepad
File Edit Format View Help
#
This is the main Apache HTTP server configuration file. It contains the
configuration directives that give the server its instructions.
See <URL:http://httpd.apache.org/docs/2.4/> for detailed information.
In particular, see
<URL:http://httpd.apache.org/docs/2.4/mod/directives.html>
for a discussion of each configuration directive.
#
Do NOT simply read the instructions in here without understanding
what they do. They're here only as hints or reminders. If you are unsure
consult the online docs. You have been warned.
#
Configuration and logfile names: If the filenames you specify for many
of the server's control files begin with "/" (or "drive:/" for Win32), the
server will use that explicit path. If the filenames do *not* begin
with "/", the value of ServerRoot is prepended -- so "logs/access_log"
with ServerRoot set to "/usr/local/apache2" will be interpreted by the
server as "/usr/local/apache2/logs/access_log", whereas "/logs/access_log"
will be interpreted as '/logs/access_log'.
#
NOTE: Where filenames are specified, you must use forward slashes
instead of backslashes (e.g., "c:/apache" instead of "c:\apache").
If a drive letter is omitted, the drive on which httpd.exe is located
will be used by default. It is recommended that you always supply
an explicit drive letter in absolute paths to avoid confusion.
#
ServerRoot: The top of the directory tree under which the server's
Ln 1, Col 1
100%
Windows (CRLF)
UTF-8
Activate Windows
Go to Settings to activate Windows.
Type here to search
3°C
ENG
IN
8:18 PM
12/10/2021



Conclusion

Taking everything into consideration, we can conclude that Gray Level Cooccurrence Matrix is used to detect two neighboring pixels in an image. Calculations can be made using the Formulas and the grey level in the image can be detected using the formulas. The Application of Gray level co occurrence runs completely fine, on clicking on Create Input matrix, a new input matrix gets created and on selecting distance and the angle, and on clicking Create output matrix, a new output matrix is created.

References

1)Lloyd, Kaelon et al. "Detecting Violent And Abnormal Crowd Activity Using Temporal Analysis Of Grey Level Co-Occurrence Matrix (GLCM)-Based Texture Measures". *Machine Vision And Applications*, vol 28, no. 3-4, 2017, pp. 361-371. *Springer Science And Business Media LLC*, https://doi.org/10.1007/s00138-017-0830-x.

2) Lloyd, Kaelon et al. "Detecting Violent And Abnormal Crowd Activity Using Temporal Analysis Of Grey Level Co-Occurrence Matrix (GLCM)-Based Texture Measures". *Machine Vision And Applications*, vol 28, no. 3-4, 2017, pp. 361-371. *Springer Science And Business Media LLC*, https://doi.org/10.1007/s00138-017-0830-x.

3) Lloyd, Kaelon et al. "Detecting Violent And Abnormal Crowd Activity Using Temporal Analysis Of Grey Level Co-Occurrence Matrix (GLCM)-Based Texture Measures". *Machine Vision And Applications*, vol 28, no. 3-4, 2017, pp. 361-371. *Springer Science And Business Media LLC*, https://doi.org/10.1007/s00138-017-0830-x.

4) Lloyd, Kaelon et al. "Detecting Violent And Abnormal Crowd Activity Using Temporal Analysis Of Grey Level Co-Occurrence Matrix (GLCM)-Based Texture Measures". *Machine Vision And Applications*, vol 28, no. 3-4, 2017, pp. 361-371. *Springer Science And Business Media LLC*, https://doi.org/10.1007/s00138-017-0830-x.

5) Lloyd, Kaelon et al. "Detecting Violent And Abnormal Crowd Activity Using Temporal Analysis Of Grey Level Co-Occurrence Matrix (GLCM)-Based Texture Measures". *Machine Vision And Applications*, vol 28, no. 3-4, 2017, pp. 361-371. *Springer Science And Business Media LLC*, https://doi.org/10.1007/s00138-017-0830-x.