Kathmandu University

Department of Computer Science and Engineering

Dhulikhel, Kavre

Mini Report

on

"Lab 2"

[Course Code: COMP 342]

(For partial fulfillment of III Year/ I Semester in Computer Science)

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Submitted To

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1. Implement Digital Differential Analyzer Line drawing algorithm.

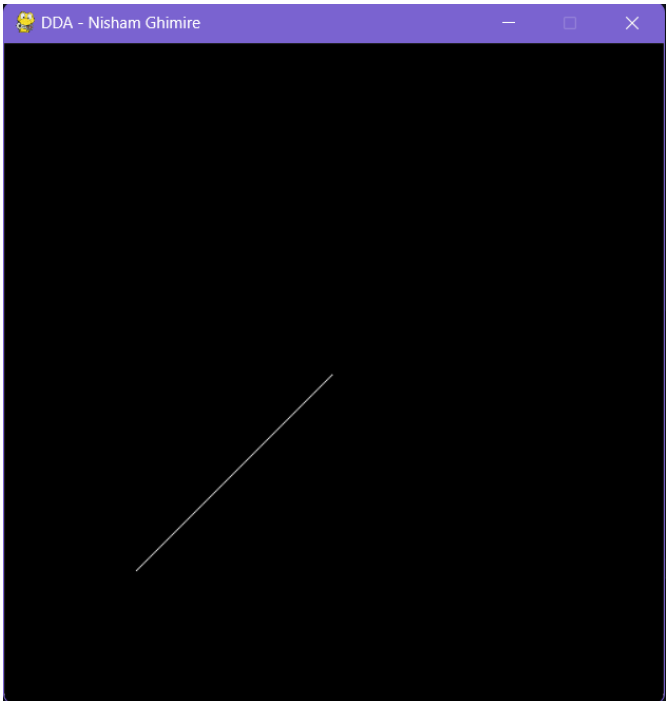
Ans:

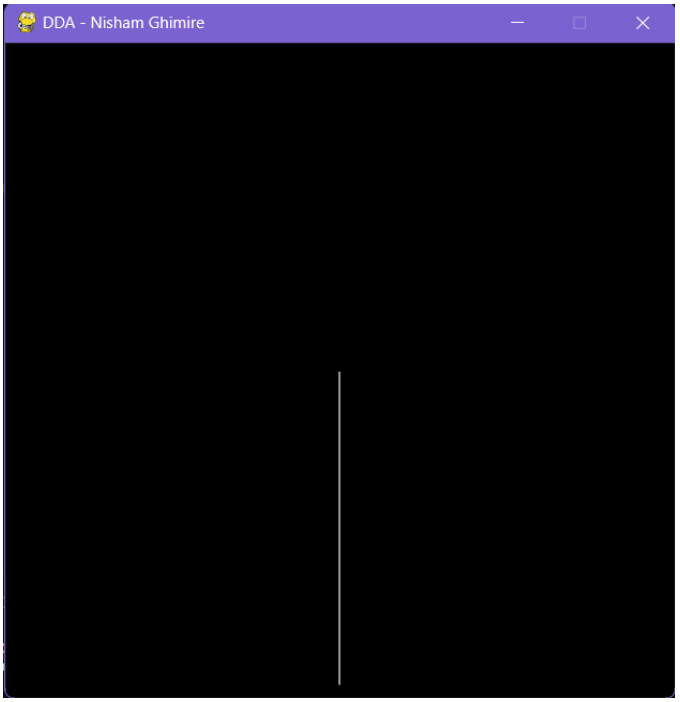
1. *Start Algorithm*
2. *Declare variables:*
   Declare x1, y1, x2, y2, dx, dy, steps, Xinc, Yinc, X, Y, and vertices.
3. *Input coordinates: Assign the values of x1, y1, x2, and y2.*
4. *Calculate dx and dy: Calculate dx as x2 - x1 and dy as y2 - y1.*
5. *Calculate steps: Calculate steps as the maximum of abs(dx) and abs(dy).*
6. *Calculate Xinc and Yinc: Calculate Xinc as dx / steps and Yinc as dy / steps.*
7. *Initialize X and Y: Assign X to x1 and Y to y1.*
8. *Calculate vertices: Repeat steps times:*
   a. Append (X, Y) to vertices.
   b. Add Xinc to X.
   c. Add Yinc to Y.
9. *Append end coordinate: Append (x2, y2) to vertices.*
10. *Draw line: For each vertex in vertices, call glVertex2f with the x and y coordinates of the vertex.*
11. *End Algorithm*

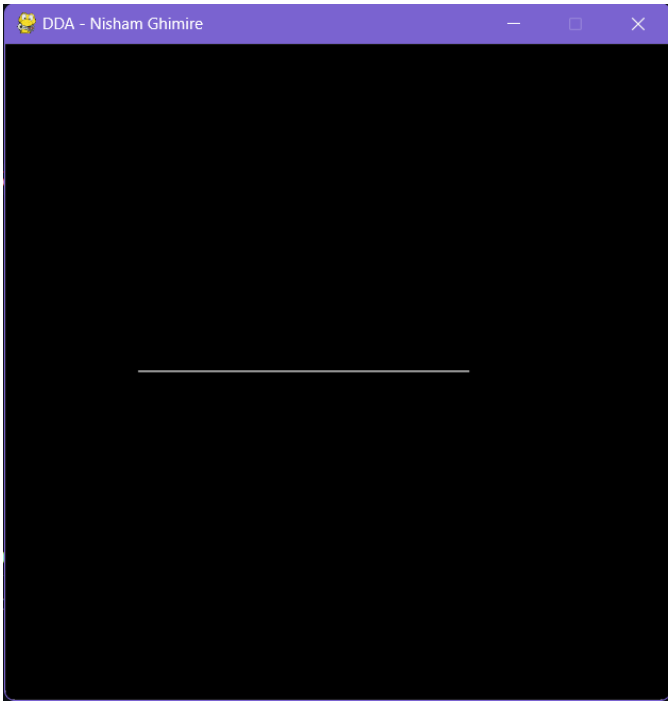
```
from typing import Tuple
import pygame as pg
from pygame import display, event
from pygame.locals import *
from OpenGL.GL import *
from OpenGL.GLU import *

def DDA(start_coordinate: Tuple[int, int], end_coordinate: Tuple[int,
int]) -> list[Tuple[float, float]]:
    x1, y1 = start_coordinate
    x2, y2 = end_coordinate

    dx = x2 - x1
    dy = y2 - y1

    steps = max(abs(dx), abs(dy))

    Xinc = dx / steps
    Yinc = dy / steps

    X = x1
    Y = y1
    vertices: list[Tuple[float, float]] = []

    for i in range(steps):
        vertices.append((X, Y))
        X = X + Xinc
```

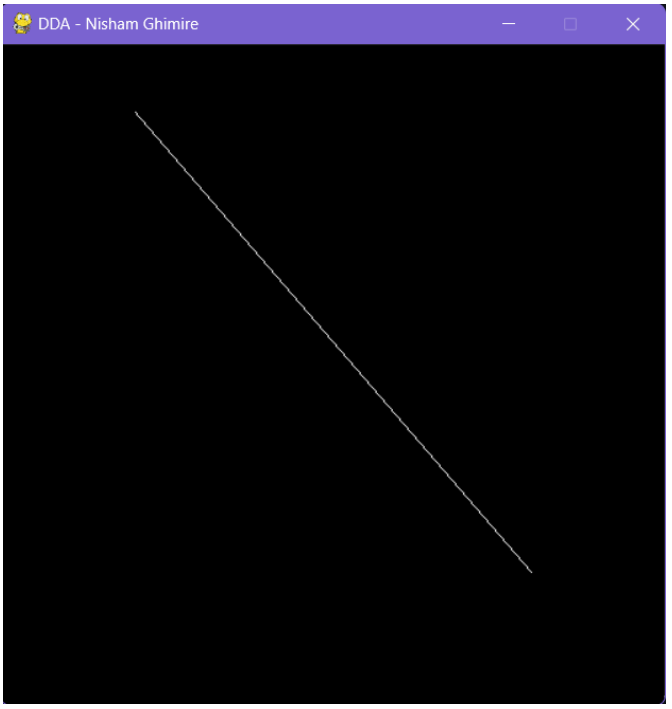
```
        Y = Y + Yinc
    return vertices

def drawDDA():
    vertices = DDA((100, 250), (350, 450))
    glClear(GL_COLOR_BUFFER_BIT)
    glBegin(GL_LINE_STRIP)
    glColor3f(1.0, 1.0, 1.0)
    for v in vertices:
        x, y = v
        glVertex2f(x, y)
    glEnd()
    glFlush()

def main():
    pg.init()
    display.set_mode((500, 500), DOUBLEBUF | OPENGL | GL_RGB)
    display.set_caption("DDA - Nisham Ghimire")
    gluOrtho2D(0, 500, 0, 500)

    while True:
        for ev in event.get():
            if ev.type == pg.QUIT:
                pg.quit()
                quit()
        drawDDA()
        display.flip()

main()
```

Output:


DDA - Nisham Ghimire


DDA - Nisham Ghimire


DDA - Nisham Ghimire


DDA - Nisham Ghimire

2. Implement Bresenham Line Drawing algorithm for both slopes(|m|<1 and |m|>=1).
Ans:

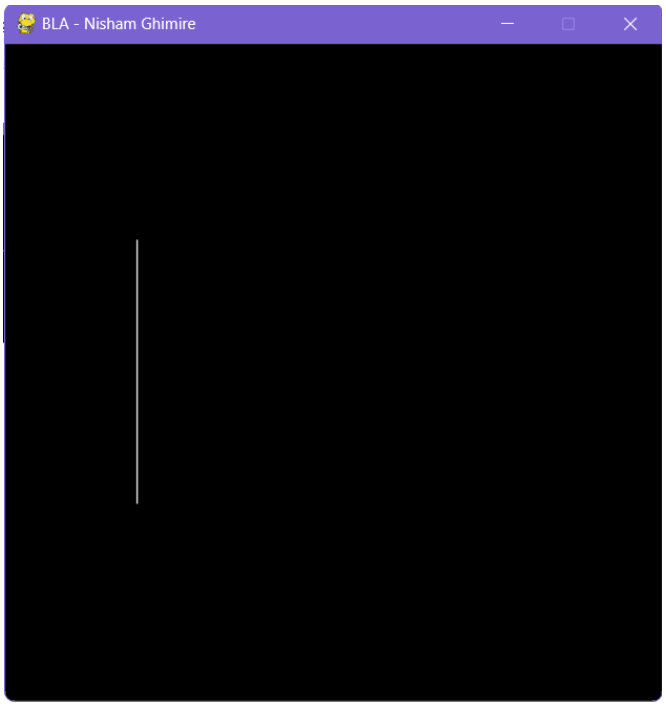
1. **Start Algorithm**
2. **Declare variables:** Declare $x1$, $y1$, $x2$, $y2$, dx, dy, M, p, x, and y.
3. **Input coordinates:** Assign the values of $x1$, $y1$, $x2$, and $y2$.
4. **Calculate slope M:**
   a. If $x2 - x1$ equals 0, set $M = y2 - y1$.
   b. Else, calculate $M = \frac{y2-y1}{x2-x1}$.
5. **Check slope magnitude:**
   a. If $|M| < 1$:
   i. Swap points if $x1 > x2$ to ensure $x1$ is always smaller.
   ii. Calculate $dx = |x2 - x1|$ and $dy = |y2 - y1|$.
   iii. Initialize decision parameter $p = 2 \cdot dy - dx$.
   iv. Initialize x and y to $x1$ and $y1$ respectively.
   v. Draw points using GL_POINTS and the following loop:
   1. While $x \leq x2$:
   a. Plot (x, y) as a point.
   b. Increment x by 1.
   c. If $p \geq 0$:
   i. If $M < 1$, increment y by 1.
   ii. If $M \geq 1$, decrement y by 1.
   iii. Update $p = p + 2 \cdot dy - 2 \cdot dx$.
   d. Else, update $p = p + 2 \cdot dy$.
   b. If $|M| \geq 1$:
   i. Swap points if $y1 > y2$ to ensure $y1$ is always smaller.
   ii. Calculate $dx = |x2 - x1|$ and $dy = |y2 - y1|$.
   iii. Initialize decision parameter $p = 2 \cdot dx - dy$.
   iv. Initialize x and y to $x1$ and $y1$ respectively.
   v. Draw points using GL_POINTS and the following loop:
   1. While $y \leq y2$:
   a. Plot (x, y) as a point.
   b. Increment y by 1.
   c. If $p \geq 0$:
   i. If $M \geq 1$, increment x by 1.
   ii. If $M < 1$, decrement x by 1.
   iii. Update $p = p + 2 \cdot dx - 2 \cdot dy$.
   d. Else, update $p = p + 2 \cdot dx$.
6. **End Algorithm**

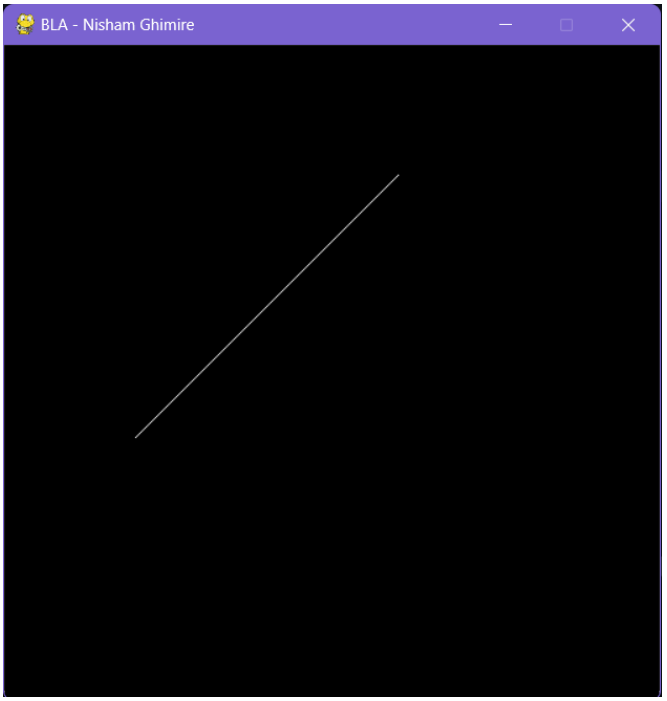
```
import pygame
from pygame import display,event
from OpenGL.GL import *
from OpenGL.GLU import *
import math

def Draw():
    x1, y1, x2, y2 = 100, 200 , 300, 400
    glClear(GL_COLOR_BUFFER_BIT)

    if (x2-x1) == 0:
```

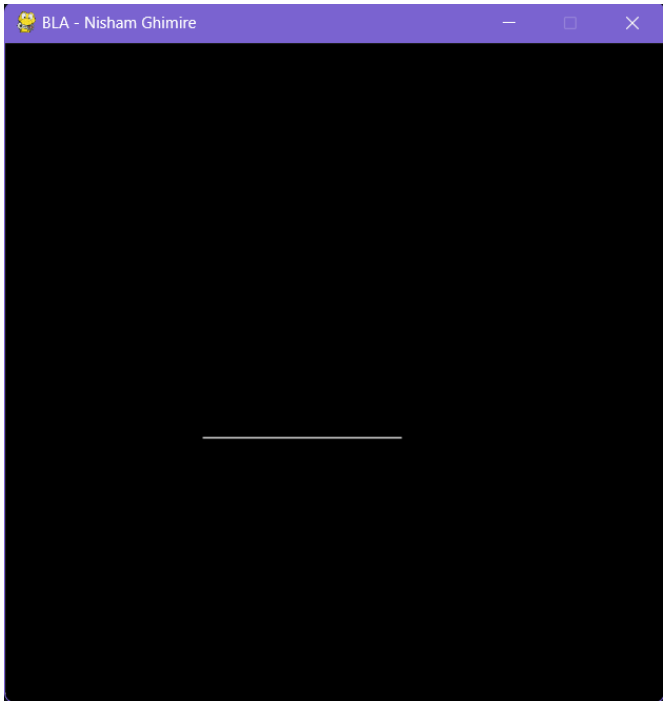
```
        M = (y2-y1)
    else:
        M = (y2-y1)/(x2-x1)

    if abs(M) < 1:
        if x1 > x2:
            t = x1
            x1 = x2
            x2 = t

            t = y1
            y1 = y2
            y2 = t

        dx = abs(x2-x1)
        dy = abs(y2-y1)

        p = 2*dy-dx

        x = x1
        y = y1

        glBegin(GL_POINTS)
        while x <= x2:
            glVertex2f(x, y)
            x = x+1

            if p >= 0:
                if M < 1:
                    y = y+1
                else:
                    y = y-1
                p = p+2*dy-2*dx
            else:
                y = y
                p = p+2*dy
        glEnd()

    if abs(M) >= 1:
        if y1 > y2:
            t = x1
            x1 = x2
            x2 = t

            t = y1
            y1 = y2
            y2 = t

        dx = abs(x2-x1)
        dy = abs(y2-y1)
```

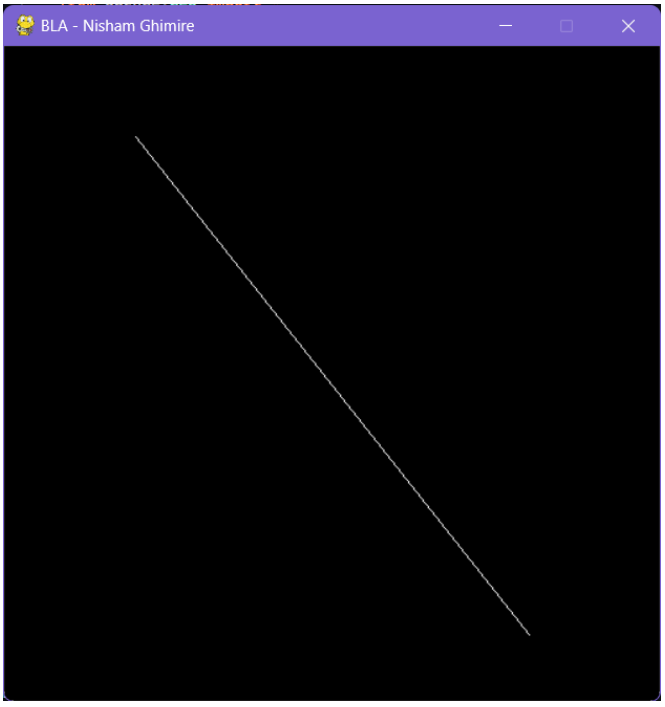
```
        p = 2*dx-dy

        x = x1
        y = y1

        glBegin(GL_POINTS)
        while y <= y2:
            glVertex2f(x, y)
            y = y+1

            if p >= 0:
                if M >= 1:
                    x = x+1
                else:
                    x = x-1
                p = p+2*dx-2*dy
            else:
                x = x
                p = p+2*dx
        glEnd()

    glFlush()

def main():
    pygame.init()
    display.set_mode((500, 500), pygame.DOUBLEBUF | pygame.OPENGL )
    display.set_caption("BLA - Nisham Ghimire")

    gluOrtho2D(0, 500, 0, 500)

    while True:
        for event in pygame.event.get():
            if event.type == pygame.QUIT:
                pygame.quit()
                quit()

        Draw()

        pygame.display.flip()

if __name__ == '__main__':
    main()
```

Output:









Conclusion:

After completing this lab work, I have learned how to draw lines using DDA and Bresenham algorithms in Python. I utilized Python, OpenGL APIs, and pygame for window creation. This practical experience enhanced my understanding of computer graphics and equipped me with valuable programming skills.