Exp No. 8

Rishab Mandal

Batch: C23

Code:

Exp8FrequencyReuse.py :

```
#!/usr/bin/python

from math import *

# import everything from Tkinter module
from tkinter import *

# Base class for Hexagon shape
class Hexagon(object):
    def __init__(self, parent, x, y, length, color, tags):
        self.parent = parent
        self.x = x
        self.y = y
        self.length = length
        self.color = color
        self.size = None
        self.tags = tags
    self.draw_hex()

# draw one hexagon
def draw_hex(self):
    start_x = self.x
    start_y = self.y
    angle = 60
    coords = []
    for i in range(6):
        end_x = start_x + self.length * cos(radians(angle * i))
        end_y = start_y + self.length * sin(radians(angle * i))
        coords.append([start_x, start_y])
        start_x = end_x
        start_y = end_y
    self.parent.create_polygon(coords[0][0],
                            coords[0][1],
                            coords[1][0],
                            coords[1][1],
                            coords[2][0],
                            coords[2][1],
                            coords[3][0],
                            coords[3][1],
                            coords[4][0],
                            coords[4][1],
                            coords[5][0],
                                                                      coords[5][1],
                                                                      fill=self.color,
                                                                      outline="black",
                                                                      tags=self.tags)

# class holds frequency reuse logic and related methods
class FrequencyReuse(Tk):
        CANVAS_WIDTH = 800
        CANVAS_HEIGHT = 650
        TOP_LEFT = (20, 20)
        BOTTOM_LEFT = (790, 560)
        TOP_RIGHT = (780, 20)
        BOTTOM_RIGHT = (780, 560)

        def __init__(self, cluster_size, columns=16, rows=10, edge_len=30):
                Tk.__init__(self)
                self.textbox = None
                self.curr_angle = 330
                self.first_click = True
                self.reset = False
                self.edge_len = edge_len
                self.cluster_size = cluster_size
                self.reuse_list = []
                self.all_selected = False
                self.curr_count = 0
        self.hexagons = []
        self.co_cell_endp = []
        self.reuse_xy = []
        self.canvas = Canvas(self,
                                        width=self.CANVAS_WIDTH,
                                        height=self.CANVAS_HEIGHT,
                                        bg="#4dd0e1")
        self.canvas.bind("<Button-1>", self.call_back)
        self.canvas.focus_set()
        self.canvas.bind('<Shift-R>', self.resets)
        self.canvas.pack()
        self.title("Frequency reuse and co-channel selection")
        self.create_grid(16, 10)
        self.create_textbox()
        self.cluster_reuse_calc()

    # show lines joining all co-channel cells
    def show_lines(self):
        # center(x,y) of first hexagon
        approx_center = self.co_cell_endp[0]
        self.line_ids = []
        for k in range(1, len(self.co_cell_endp)):

            end_xx = (self.co_cell_endp[k])[0]
            end_yy = (self.co_cell_endp[k])[1]
            # move i^th steps
            l_id = self.canvas.create_line(approx_center[0],
approx_center[1],
                                        end_xx,
end_yy)
            if j == 0:
                self.line_ids.append(l_id)
                dist = 0
            elif i >= j and j != 0:
                self.line_ids.append(l_id)
                dist = j
                # rotate counter-clockwise and move j^th step
                l_id = self.canvas.create_line(
                    end_xx, end_yy, end_xx + self.center_dist *
dist *
                    cos(radians(self.curr_angle - 60)),
                    end_yy + self.center_dist * dist *
                    sin(radians(self.curr_angle - 60)))
                self.line_ids.append(l_id)
            self.curr_angle -= 60

    def create_textbox(self):
        txt = Text(self.canvas,
                width=80,
                height=1,
                        font=("Helvatica", 12),
                        padx=10,
                        pady=10)
                txt.tag_configure("center", justify="center")
                txt.insert("1.0", "Select a Hexagon")
                txt.tag_add("center", "1.0", "end")
                self.canvas.create_window((0, 600), anchor='w', window=txt)
                txt.config(state=DISABLED)
                self.textbox = txt

        def resets(self, event):
                if event.char == 'R':
                        self.reset_grid()

        # clear hexagonal grid for new i/p
        def reset_grid(self, button_reset=False):
                self.first_click = True
                self.curr_angle = 330
                self.curr_count = 0
                self.co_cell_endp = []
                self.reuse_list = []
                for i in self.hexagons:
                        self.canvas.itemconfigure(i.tags, fill=i.color)

                try:
```

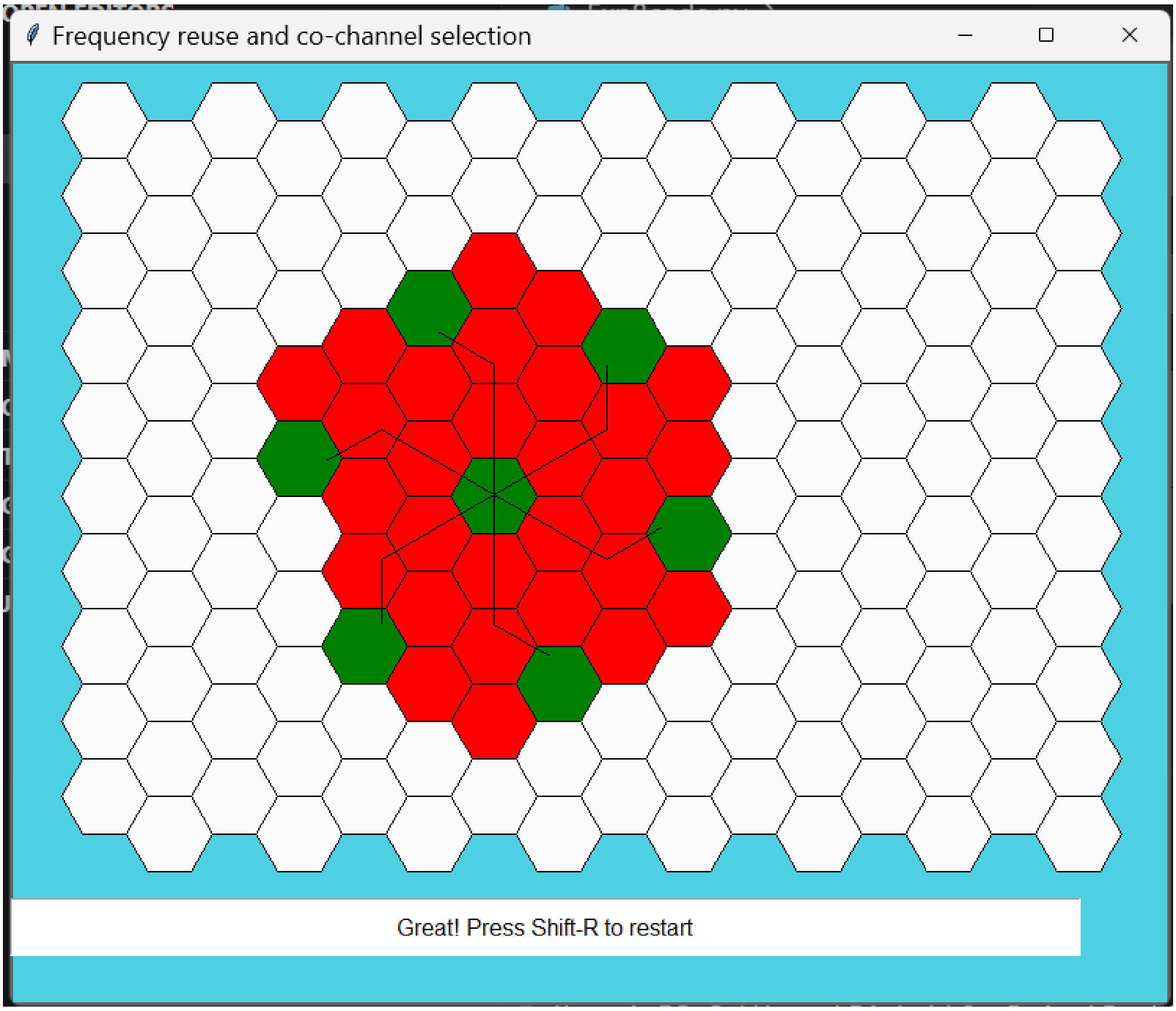
```
            self.line_ids
        except AttributeError:
            pass
        else:
            for i in self.line_ids:
                self.canvas.after(0, self.canvas.delete, i)
            self.line_ids = []

        if button_reset:
            self.write_text("Select a Hexagon")

    # create a grid of Hexagons
    def create_grid(self, cols, rows):
        size = self.edge_len
        for c in range(cols):
            if c % 2 == 0:
                offset = 0
            else:
                offset = size * sqrt(3) / 2
            for r in range(rows):
                x = c * (self.edge_len * 1.5) + 50
                y = (r * (self.edge_len * sqrt(3))) + offset + 15
                hx = Hexagon(self.canvas, x, y, self.edge_len,
"#fafafa",
                            "{},{}".format(r, c))
                self.hexagons.append(hx)

    # calculate reuse distance, center distance and radius of the hexagon
    def cluster_reuse_calc(self):
        self.hex_radius = sqrt(3) / 2 * self.edge_len
        self.center_dist = sqrt(3) * self.hex_radius
        self.reuse_dist = self.hex_radius * sqrt(3 * self.cluster_size)

    def write_text(self, text):
        self.textbox.config(state=NORMAL)
        self.textbox.delete('1.0', END)
        self.textbox.insert('1.0', text, "center")
        self.textbox.config(state=DISABLED)

    #check if the co-channels are within visible canvas
    def is_within_bound(self, coords):
        if self.TOP_LEFT[0] < coords[0] < self.BOTTOM_RIGHT[0] \
        and self.TOP_RIGHT[1] < coords[1] < self.BOTTOM_RIGHT[1]:
            return True
        return False

    #gets called when user selects a hexagon
    #This function applies frequency reuse logic in order to
    #figure out the positions of the co-channels
    def call_back(self, evt):

        selected_hex_id = self.canvas.find_closest(evt.x, evt.y)[0]
        hexagon = self.hexagons[int(selected_hex_id - 1)]
        s_x, s_y = hexagon.x, hexagon.y
        approx_center = (s_x + 15, s_y + 25)

        if self.first_click:
            self.first_click = False
            self.write_text(
                """Now, select another hexagon such
                that it should be a co-cell of
                the original hexagon."""
            )
            self.co_cell_endp.append(approx_center)
            self.canvas.itemconfigure(hexagon.tags, fill="green")

            for _ in range(6):

                end_xx = approx_center[0] + self.center_dist * i *
cos(
                    radians(self.curr_angle))
                end_yy = approx_center[1] + self.center_dist * i *
sin(
                    radians(self.curr_angle))
                reuse_x = end_xx + (self.center_dist * j) * cos(
                    radians(self.curr_angle - 60))
                reuse_y = end_yy + (self.center_dist * j) * sin(
                    radians(self.curr_angle - 60))

                if not self.is_within_bound((reuse_x, reuse_y)):
                    self.write_text(
                        """co-cells are exceeding canvas
boundary.
                        Select cell in the center"""
                    )
                    self.reset_grid()
                    break

                if j == 0:
                    self.reuse_list.append(
                        self.canvas.find_closest(end_xx,
end_yy)[0])
                elif i >= j and j != 0:
                    self.reuse_list.append(
                        self.canvas.find_closest(reuse_x,
reuse_y)[0])

                self.co_cell_endp.append((end_xx, end_yy))
                self.curr_angle -= 60
```

```
        else:
            curr = self.canvas.find_closest(s_x, s_y)[0]
            if curr in self.reuse_list:
                self.canvas.itemconfigure(hexagon.tags,
fill="green")
                self.write_text("Correct! Cell {} is a co-
cell.".format(
                    hexagon.tags))
                if self.curr_count == len(self.reuse_list) - 1:
                    self.write_text("Great! Press Shift-R to
restart")
                    self.show_lines()
                self.curr_count += 1

            else:
                self.write_text("Incorrect! Cell {} is not a co-
cell.".format(
                    hexagon.tags))
                self.canvas.itemconfigure(hexagon.tags,
fill="red")

if __name__ == '__main__':
    print(
        """Enter i & j values. common (i,j) values are:
        (1,0), (1,1), (2,0), (2,1), (3,0), (2,2)"""
    )
```

```
i = int(input("Enter i: "))
j = int(input("Enter j: "))
if i == 0 and j == 0:
    raise ValueError("i & j both cannot be zero")
elif j > i:
    raise ValueError("value of j cannot be greater than i")
else:
    N = (i**2 + i * j + j**2)
    print("N is {}".format(N))
freqreuse = FrequencyReuse(cluster_size=N)
freqreuse.mainloop()
```

Output:

```
(base) PS C:\Users\Rishab\OneDrive\Desktop\MCC Exp Documents> python Exp8code.py
Enter i & j values. common (i,j) values are:
        (1,0), (1,1), (2,0), (2,1), (3,0), (2,2)
Enter i: 2
Enter j: 1
N is 7
```



Frequency reuse and co-channel selection

Great! Press Shift-R to restart