Penyelesaian Persoalan Convex Hull dengan Divide and Conquer (Quick Hull)

Tugas Kecil 2 IF2211 Strategi Algoritma

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TEKNIK INFORMATIKA

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BAB I

PSEUDO CODE DAN KOMPLEKSITAS ALGORITMA

Kompleksitas rata-rata = O(n log n)

Kompleksitas worst case = O(n^2)

PSEUDO CODE:

```
Using time
Using numpy
Using matplotlib.pyplot
function divide_conquer (input: list_of_points)

    // initialize min x and max x
    initialize min x to infinity
    initialize max x to 0
    initialize min y to 0
    initialize max y to 0

    // get the leftmost and rightmost point
    // in list of randomly generated points
    for (x,y) in list_of_points:
        if x is less than min x then
            min x = x, min y = y
        if x is more than max x then
            max x = x, min y = y

    set min equals to [min x, min y]
    set max equals to [max x, max y]

    // initial division
    set hull_points equals to quickhull(list_of_points, min, max)
    set hull_points equals to (hull_points + quickhull(list_of_points, max, min))
```

```
    returns hull_points

// function to sort and do the quick hull algorithm
function quickhull (input: list_of_points, min, max)

    //get all the points which situated in the left of the line
    set left_points equals to get_left_points(min, max, list_of_points)

    //set the furthest point from current line as a new hull point
    set hull_point equals to max_distance_point(min, max, left_points)

    // return the point max as hull point
    // if no points left in the left part of the line
    if length of list hull_point equals to 0 then
        returns max

    # divide recursively
    set hullpts equals to quickhull(left_points, min, hull_point)
    set hullpts equals to (hullpts + quickhull(left_points, hull_point, max))

    returns hullpts

// function to get all points located at the left part
// of the currently checked line that joins p1 and p2
function get_left_points (input: p1, p2, points)

    initialize pts as an empty array

    for pt in points do
        set val equals to ((p2.y-p1.y)*(pt.x-p2.x) - (p2.x-p1.x)*(pt.y-p2.y))
        if (val not equal to 0) and (val less than 0):
            insert pt to array pts
```

```
    returns array pts


// returns the furthest point from the line joining p1 and p2
function max_distance_point (input: p1, p2, points)


    initialize max_dist as 0
    initialize empty array max_point


    for point in points do
        if (point.x not equals to p1.x or point.y not equals to p1.y) and (point.y
not equals to p2.y or point.x not equals to p2.x):
            set dist equals to line_distance(p1, p2, point)
            if dist more than max_dist:
                set max_dist equals to dist
                set max_point equals to point


    returns array max_point


// function to calculate distance between a line joining p1 p2 and a point
function line_distance (input p1, p2, pt)
    set x1, y1 equals to p1
    set x2, y2 equals to p2
    set x0, y0 equals to pt
    set top equals to absolute of ((y2 - y1) * x0 - (x2 - x1) * y0 + x2 * y1 - y2 *
x1)
    set bottom equals to ((y2 - y1)**2 + (x2 - x1) ** 2) ** 0.5


    return result of top divided by bottom


// function to print convex hull result and draw it using matplotlib.pyplot
function draw (input : points)


    if length of points is less than 3 :
```

```
        print "convex hull cant be created"
        exit from function

    start timer
    set array quick_hull equals to result of function divide_conquer(points)

    print elements inside array quick_hull
    stop timer, print time result

    draw elements inside array quick_hull using matplotlib.myplot
    exit from function

// MAIN FUNCTION
main function ()

    input value of n

    initialize empty array points
    random n points, append to array points
    print elements inside array points
    scatter elements inside array points using matplotlib.pyplot

    draw(points)
    show using matplotlib.pyplot
```

BAB 2

KODE PROGRAM

```
# Implementing Quick Hull algorithm to find convex hull
# Hafizh Budiman, February 22nd 2018
# Informatics Engineering, Bandung Institute of Technology, 2018

import time
import numpy as np
import matplotlib.pyplot as plt

def divide_conquer(points):

    # initialize hull with leftmost and rightmost point
    # get the x min, and x max from the randomly generated points
    min_x = float('inf')
    max_x = 0
    min_y = 0
    max_y = 0

    for x,y in points:
        if x < min_x:
            min_x = x
            min_y = y
        if x > max_x:
            max_x = x
            max_y = y

    min, max = [min_x,min_y], [max_x,max_y]

    # initial division
    hullpts = quickhull(points, min, max)
    hullpts = hullpts + quickhull(points, max, min)

    return hullpts

'''
    Does the sorting for the quick hull sorting algorithm
'''
def quickhull(points, min, max):

    # get all points which situated in the
    # left part of the newly formed triangle
    left_points = get_left_points(min, max, points)
```

```
    # set the furthest point from the line as a new hull point
    hull_point = max_distance_point(min, max, left_points)

    if len(hull_point) < 1: # return the point max as hull points
        return [max]

    # divide recursively
    hullPts = quickhull(left_points, min, hull_point)
    hullPts = hullPts + quickhull(left_points, hull_point, max)

    return hullPts

'''
    Returns all points that a LEFT of a line
    that joins the point p1 and p2.
'''
def get_left_points(p1, p2, points):
    pts = []

    for pt in points:
        val = ((p2[1]-p1[1])*(pt[0]-p2[0]) - (p2[0]-p1[0])*(pt[1]-p2[1]))
        if (val != 0) and (val < 0):
            pts.append(pt)

    return pts

'''
    Returns the furthest point from
    a line joining the p1 and p2.
'''
def max_distance_point(p1, p2, points):
    max_dist = 0
    max_point = []

    for point in points:
        if (point[0]!=p1[0] or point[1]!=p1[1]) and (point[1]!=p2[1] or
point[0]!=p2[0]):
            dist = line_distance(p1, p2, point)
            if dist > max_dist:
                max_dist = dist
                max_point = point

    return max_point

'''
    Returns a value proportional to the distance
    between the point pt and the line joining p1 and p2.
'''
```

```
def line_distance(p1, p2, pts): # pt is the point
    x1, y1 = p1
    x2, y2 = p2
    x0, y0 = pts
    top = abs((y2 - y1) * x0 - (x2 - x1) * y0 + x2 * y1 - y2 * x1)
    bottom = ((y2 - y1)**2 + (x2 - x1) ** 2) ** 0.5
    result = top / bottom
    return result

'''
    Prints the hull results and draw it
'''
def draw(points):

    if (len(points) < 3):
        return

    start_time = time.time() # start timer

    quick_hull = divide_conquer(points) # call divide and conquer function

    # print convex hull points result
    print "\nQuick hull result:"
    for x in quick_hull: print x

    # print timestamp
    print("\nProccess done in: ")
    print("%s seconds" % (time.time() - start_time))

    # draw convex hull result using matplotlib.pyplot
    n = len(quick_hull)
    for i in range(n):
        plt.plot([quick_hull[i][0], quick_hull[(i+1)%n][0]],
[quick_hull[i][1],quick_hull[(i+1)%n][1]],'k-',lw=2)
        plt.pause(0.08)

    return

def main():
    # Entering number of points
    n = input("Enter the value for n: ")

    points = np.random.randint(100,size=(n,2))
    points[points[:0].argsort()] # sorting points

    print ("Randomly Generated Points: \n")
    for x in points:
        print x
```

```
        plt.scatter(x[0],x[1])

    draw(points.tolist())

    plt.show()

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

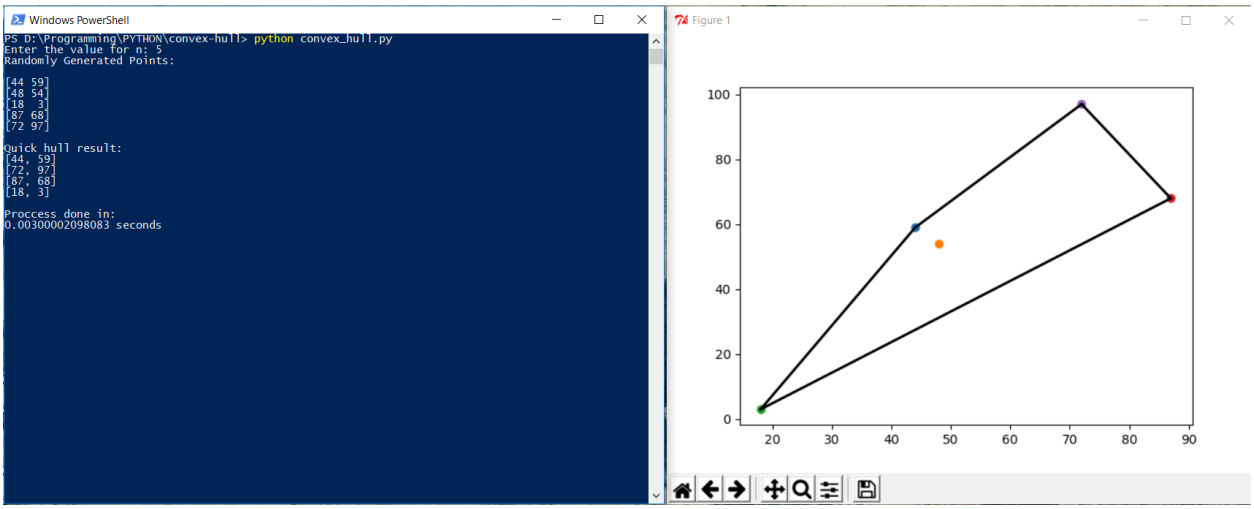
BAB 3

INPUT/OUTPUT PROGRAM

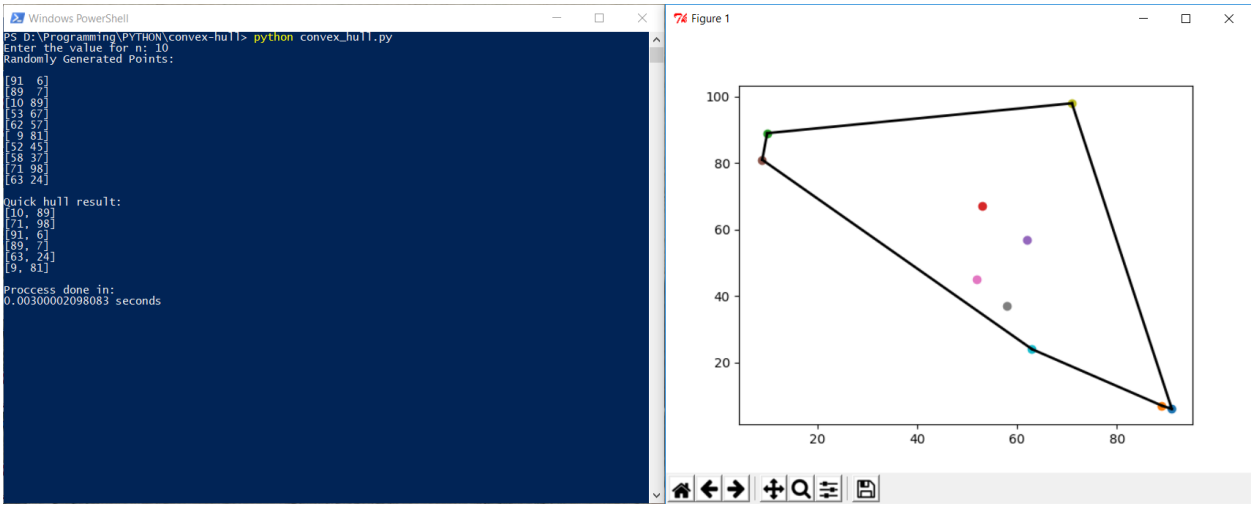
Spesifikasi komputer yang digunakan :

Item	Value
OS Name	Microsoft Windows 10 Home Single Language
Version	10.0.16299 Build 16299
Other OS Description	Not Available
OS Manufacturer	Microsoft Corporation
System Name	DESKTOP-KTE79OC
System Manufacturer	ASUSTeK COMPUTER INC.
System Model	G501VW
System Type	x64-based PC
System SKU	ASUS-NotebookSKU
Processor	Intel(R) Core(TM) i7-6700HQ CPU @ 2.60GHz, 2592 Mhz, 4 Core(s), 8 Logical Processor(s)
BIOS Version/Date	American Megatrends Inc. G501VW.204, 11/12/2015
SMBIOS Version	3.0
Embedded Controller V...	255.255
BIOS Mode	UEFI
BaseBoard Manufacturer	ASUSTeK COMPUTER INC.
BaseBoard Model	Not Available
BaseBoard Name	Base Board
Platform Role	Mobile
Secure Boot State	On
PCR7 Configuration	Elevation Required to View
Windows Directory	C:\WINDOWS
System Directory	C:\WINDOWS\system32
Boot Device	\Device\HarddiskVolume1
Locale	United States
Hardware Abstraction L...	Version = "10.0.16299.248"
User Name	DESKTOP-KTE79OC\Budiman
Time Zone	SE Asia Standard Time
Installed Physical Mem...	8.00 GB

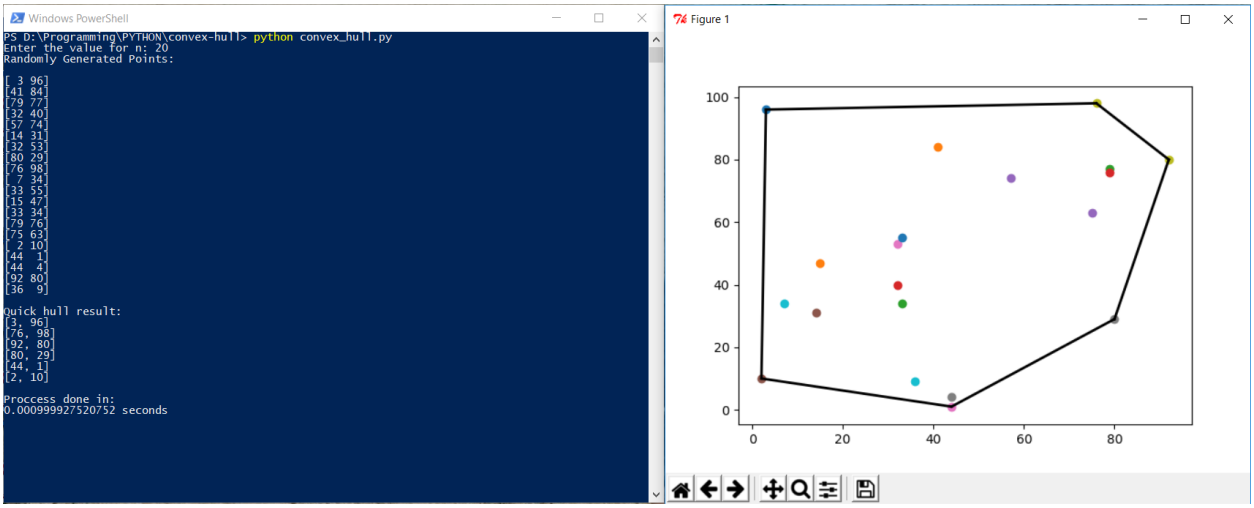
Input/output untuk n = 5:



Input/output untuk n = 10:



Input/output untuk n = 20:



Cek List Asisten

Poin	Ya	Tidak
1. Program berhasil dikompilasi	✓	
2. Program berhasil running	✓	
3. Program dapat menerima input dan menuliskan output.	✓	
4. Luaran sudah benar untuk semua n	✓	