Convex Hull dengan Divide and Conquer

Sebagai Tugas Kecil 2 Strategi Algoritma

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I. Algoritma

1. Dari seluruh titik yang ada, pilih titik dengan absis (point1) terendah dan titik dengan absis tertinggi (point2)
2. Pisah ke dua region yang terpisah di antara garis yang menghubungkan dua titik tadi
3. Masukkan dua titik tersebut ke dalam solusi
3. Dari dua titik tersebut, pilih titik terjauh dari garis, dan masukkan dalam solusi
4. ulangi step 3 untuk dua buah set point baru yaitu point1 dan point terjauh serta point terjauh dan point2 hingga sudah tidak ada titik yang ada di atas (atau di bawah untuk region bawah) kedua garis tersebut

II. Kode Program

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn import datasets
from functools import cmp_to_key
from enum import Enum
import itertools

class PointLoc(Enum):
    UPPER = 0
    LOWER = 1
    INLINE = 2

class MyConvexHull():
    def __init__(self, data, colx, coly):
        self.origdat = data
        self.data = pd.DataFrame(data.data, columns=data.feature_names)
        self.data['target'] = pd.Series(data.target)
        self.colx = colx
        self.coly = coly
        self.color = ['b','r','g', 'cyan', 'orange', 'yellow', 'pink',
'purple', 'brown', 'black', 'gray', 'olive', 'lime', 'navy', 'teal',
'maroon', 'limegreen', 'darkgreen', 'darkblue', 'darkred', 'darkcyan',
'darkmagenta', 'darkorange', 'darkgoldenrod', 'darkgray', 'darkorchid',
'darkseagreen', 'deeppink', 'deepskyblue', 'dodgerblue', 'firebrick',
'forestgreen', 'fuchsia', 'gold', 'green', 'hotpink', 'indigo',
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'khaki', 'limegreen', 'maroon', 'mediumaquamarine', 'mediumblue',
'mediumorchid', 'mediumseagreen', 'mediumslateblue',
'mediumspringgreen', 'mediumturquoise', 'mediumvioletred',
'midnightblue', 'navy', 'olive', 'orangered', 'orchid',
'palegoldenrod', 'palegreen', 'paleturquoise', 'palevioletred', 'peru',
'plum', 'powderblue', 'rosybrown', 'royalblue', 'saddlebrown',
'salmon', 'sandybrown', 'seagreen', 'sienna', 'skyblue', 'slateblue',
'slategray', 'springgreen', 'steelblue', 'tan', 'thistle', 'tomato',
'turquoise', 'violet', 'wheat', 'yellowgreen']
    def _locOfPTS(self, point1, point2, tgtpoint):
        det = np.linalg.det([[point1[0], point1[1], 1], [point2[0],
point2[1], 1], [tgtpoint[0], tgtpoint[1], 1]])
        if (np.isclose(det, 0)):
            return PointLoc.INLINE
        elif det > 0:
            return PointLoc.UPPER
        else:
            return PointLoc.LOWER

    def _comparator(self, a, b):
        if a[0] < b[0]:
            return -1
        elif a[0] > b[0]:
            return 1
        else:
            if a[1] < b[1]:
                return -1
            elif a[1] > b[1]:
                return 1
            else:
                return 0

    def _dbtp(self, point1, point2):
        return abs(np.sqrt((point1[0] - point2[0])**2 + (point1[1] -
point2[1])**2))

    def _computeDegree(self, point1, arcpoint, point2):
        return np.arccos((self._dbtp(arcpoint, point1)**2 +
self._dbtp(arcpoint, point2)**2 - self._dbtp(point1,
point2)**2)/(2*self._dbtp(point1, arcpoint)*self._dbtp(arcpoint,
point2)))

    def _computeDistance(self, point1, point2, tgtpoint):
        x_a, y_a = point1
        x_b, y_b = point2
        x_p, y_p = tgtpoint
        return abs((1/2)* abs((x_a - x_p) * (y_b-y_a) - (x_a - x_b)*
(y_p - y_a)))
```

```
    def _divideWithFarthest(self, setofPoints, point1, point2):
        i = -1
        h = -1
        candidate = []
        for i in range(len(setofPoints)):
            curArea = self._computeDistance(point1, point2,
setofPoints[i])
            if np.isclose(curArea, h):
                candidate.append(i)
            elif curArea > h:
                h = curArea
                if (len(candidate) > 0):
                    candidate.pop()
                candidate.append(i)
        degree = -4 # -4 is the small than the smallest degree
        if len(candidate) > 1:
            for posib in candidate:
                curDegree = self._computeDegree(setofPoints[posib],
point1, point2)
                if curDegree > degree:
                    degree = curDegree
                    result = posib
            return setofPoints[result]
        else:
            return setofPoints[candidate[0]]

    def _findNext(self, setOfPoints, point1, point2, enumparam):
        if len(setOfPoints) > 0:
            setOfDesiredPoint = []
            result = []
            setOfInlinePoint = []
            for point in setOfPoints:
                if self._locOfPTS(point1, point2, point) == enumparam:
                    setOfDesiredPoint.append(point)
                elif self._locOfPTS(point1, point2, point) ==
PointLoc.INLINE and (not np.array_equal(point, point1) and not
np.array_equal(point, point2)):
                    setOfInlinePoint.append(point)
            if len(setOfDesiredPoint) > 0:
                fpoint = self._divideWithFarthest(setOfDesiredPoint,
point1, point2)
                result.append(fpoint)
                prop1 = self._findNext(setOfDesiredPoint, point1,
fpoint, enumparam)
                prop2 = self._findNext(setOfDesiredPoint, fpoint,
point2, enumparam)
                if (len(prop1) > 0):
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                    for point in prop1:
                        result.append(point)
                if (len(prop2) > 0):
                    for point in prop2:
                        result.append(point)
            else:
                if (len(setOfInlinePoint) > 0):
                    for point in setOfInlinePoint:
                        result.append(point)
        else:
            result = []
        return result

    def _compute(self, setofPointsUnordered, point1=None, point2=None):
        if (len(setofPointsUnordered) == 0):
            return Exception("Empty set of points")
        elif (len(setofPointsUnordered) > 2):
            setofPointsUnordered = setofPointsUnordered.tolist()
            setofPoints = sorted(setofPointsUnordered,
key=cmp_to_key(self._comparator))
            if point1 is None and point2 is None:
                point1 = setofPoints[0]
                point2 = setofPoints[-1]
            setOfUpperPoint = []
            setOfLowerPoint = []
            result = [point1]
            setOfInlinePoint = []
            for point in setofPoints:
                if self._locOfPTS(point1, point2, point) ==
PointLoc.UPPER:
                    setOfUpperPoint.append(point)
                elif self._locOfPTS(point1, point2, point) ==
PointLoc.LOWER:
                    setOfLowerPoint.append(point)
                elif not np.array_equal(point, point1) and not
np.array_equal(point, point2):
                    setOfInlinePoint.append(point)
            if (len(setOfUpperPoint) > 0):
                prop = self._findNext(setOfUpperPoint, point1, point2,
PointLoc.UPPER)
                if len(prop) > 0:
                    prop = sorted(prop,
key=cmp_to_key(self._comparator))
                    prop = list(j for j, _ in itertools.groupby(prop))
                    for point in prop:
                        result.append(point)
            result.append(point2)
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            if (len(setOfUpperPoint) == 0 or len(setOfLowerPoint) ==
0):
                if len(setOfInlinePoint) > 0:
                    result.pop()
                    setOfInlinePoint = sorted(setOfInlinePoint,
key=cmp_to_key(self._comparator))
                    setOfInlinePoint = list(j for j, _ in
itertools.groupby(setOfInlinePoint))
                    for point in setOfInlinePoint:
                        result.append(point)
                    result.append(point2)
            if (len(setOfLowerPoint) > 0):
                prop = self._findNext(setOfLowerPoint, point1, point2,
PointLoc.LOWER)
                if len(prop) > 0:
                    prop = sorted(prop,
key=cmp_to_key(self._comparator))
                    prop = list(j for j, _ in itertools.groupby(prop))
                    prop.reverse()
                    for point in prop:
                        result.append(point)
            result.append(point1)
        else:
            result = setofPointsUnordered
        rindices = [setofPointsUnordered.index(i) for i in result]
        pairedidx = [[rindices[i], rindices[i+1]] for i in
range(len(rindices)-1)]
        self.pointofdat = pairedidx
        return self.pointofdat

    def show(self):
        plt.clf()
        plt.figure(figsize = (10, 6))
        plt.title(f'{self.origdat.feature_names[self.colx]} vs
{self.origdat.feature_names[self.coly]}')
        plt.xlabel(self.origdat.feature_names[self.colx])
        plt.ylabel(self.origdat.feature_names[self.coly])
        for i in range(len(self.origdat.target_names)):
            rawdat = self.data[self.data['target'] == i].iloc[:,
[self.colx, self.coly]].values
            plt.scatter(rawdat[:, 0], rawdat[:, 1], label =
self.origdat.target_names[i])
            self._compute(rawdat)
            for s in self.pointofdat:
                plt.plot(rawdat[s, 0], rawdat[s, 1], self.color[i])
        plt.legend()
        plt.show()
```
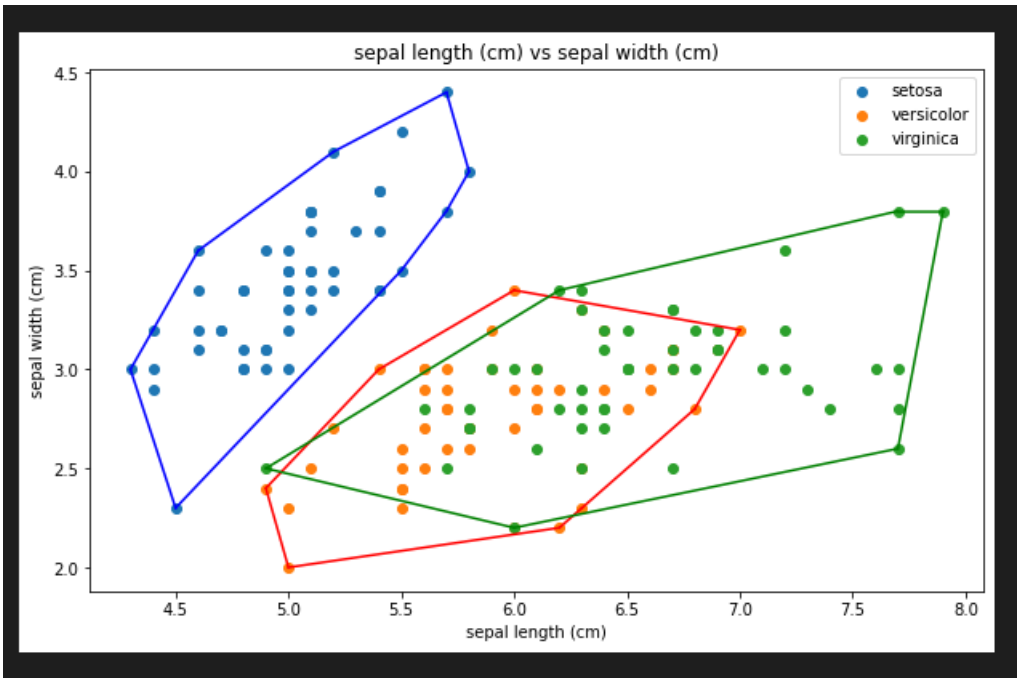
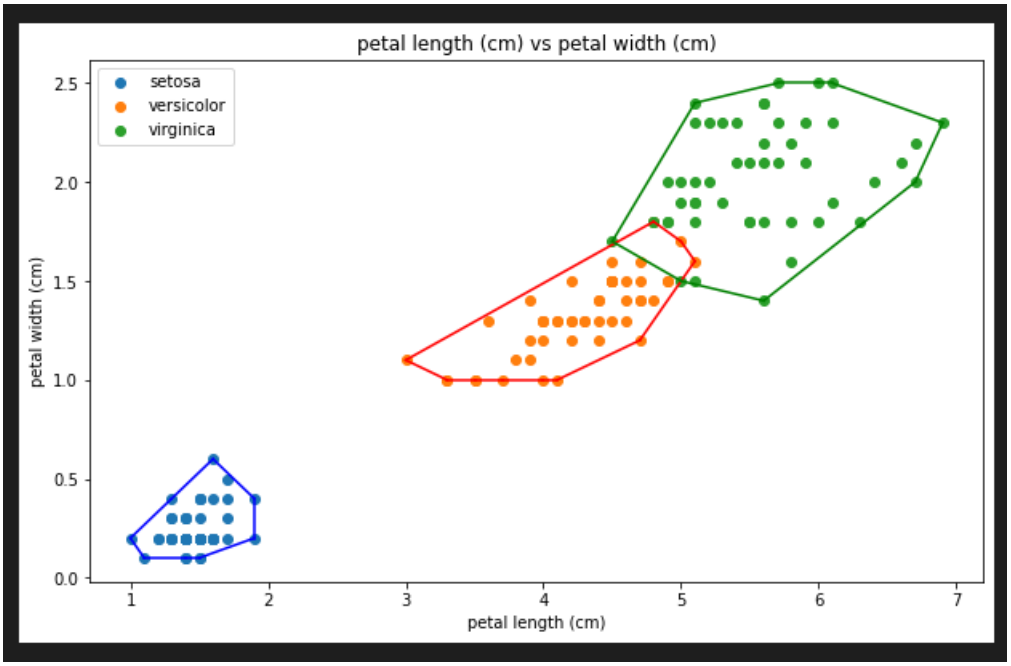

```
inst = MyConvexHull(datasets.load_iris(), 0, 1)
inst.show()
inst = MyConvexHull(datasets.load_iris(), 2, 3)
inst.show()

inst = MyConvexHull(datasets.load_wine(), 0, 1)
inst.show()
inst = MyConvexHull(datasets.load_wine(), 2, 3)
inst.show()

inst = MyConvexHull(datasets.load_breast_cancer(), 0, 1)
inst.show()
inst = MyConvexHull(datasets.load_breast_cancer(), 2, 3)
inst.show()
```

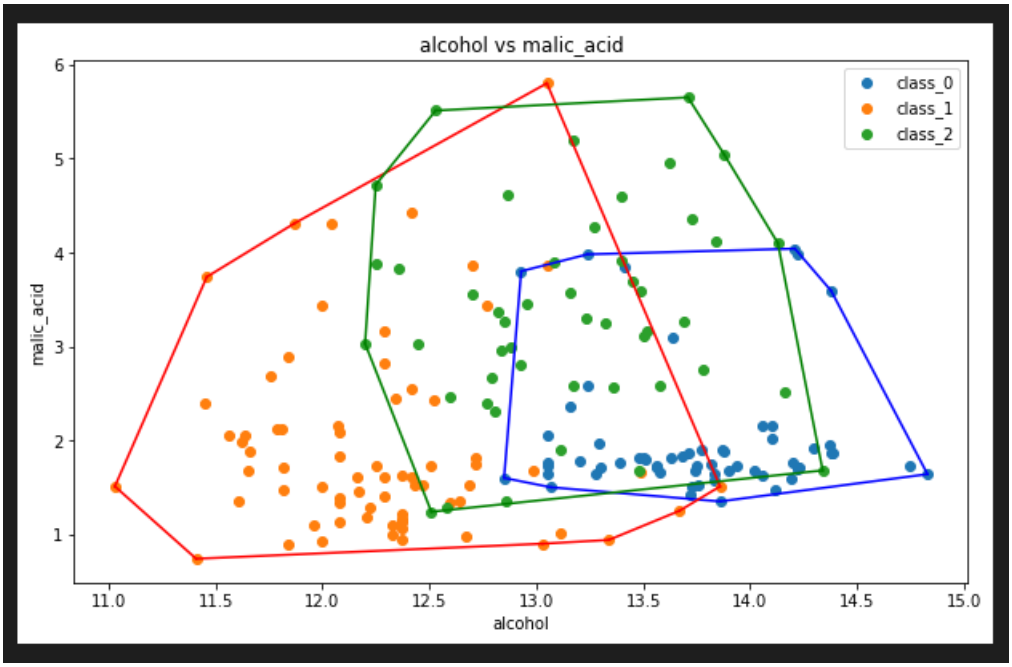
III. Screenshot

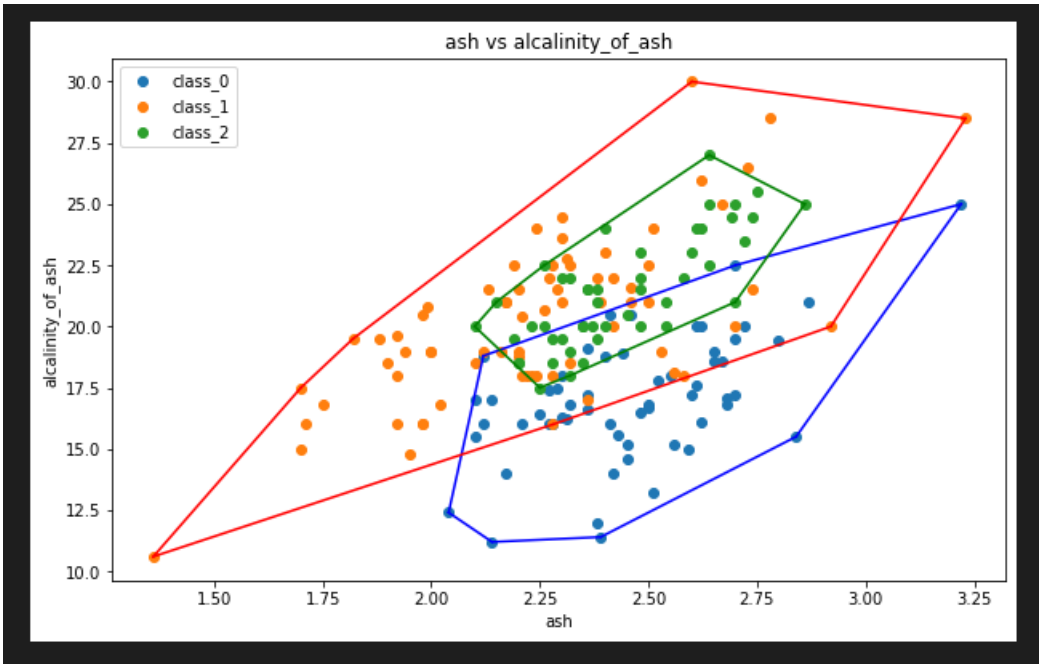
1. Iris Dataset



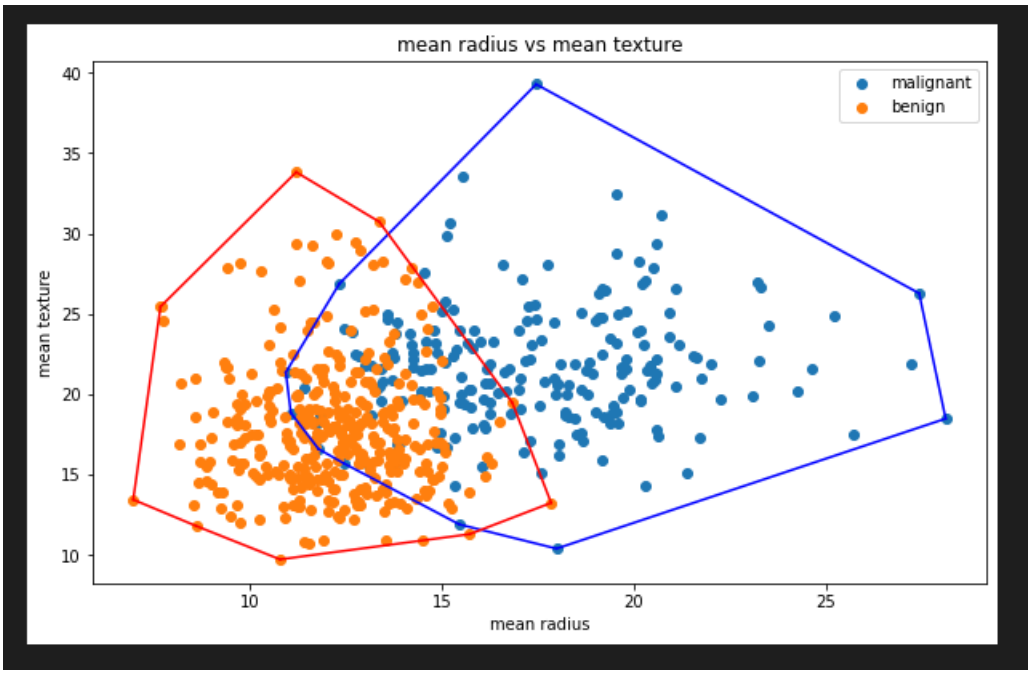


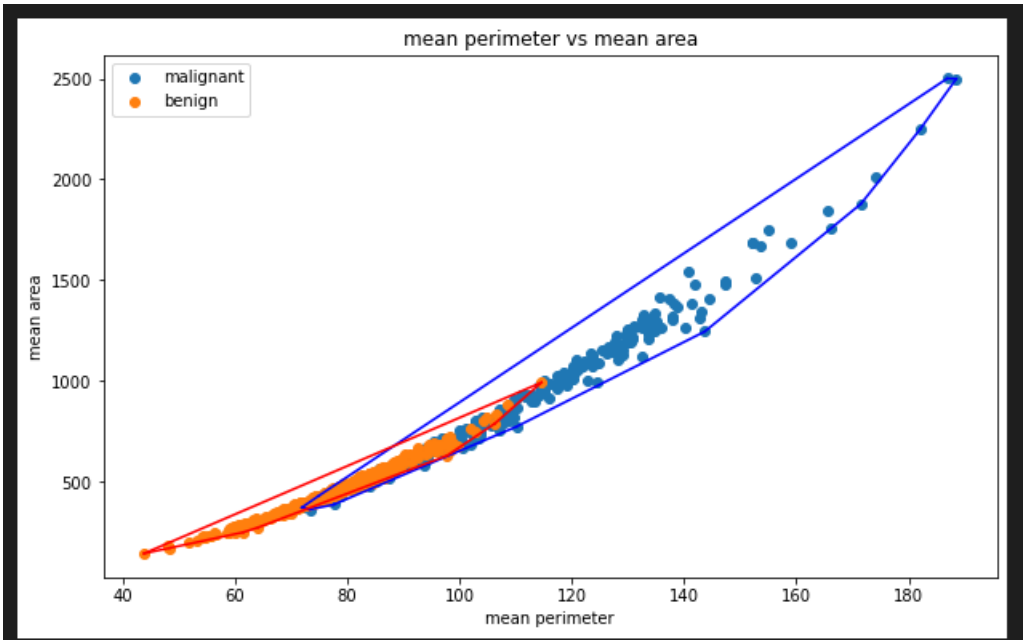
2. Wine Dataset





3. Breast Cancer Dataset





IV. Link Program

https://github.com/reverseon/Convex-Hull-DnC