# Отчет по рубежному контролю №2

Работу выполнил студент группы РТ5-61Б Андреев Виктор

## Задание

Вариант №2, группа РТ5-61Б

Постройте модель классификации. Для построения моделей используйте методы "Дерево решений" и "Градиентный бустинг". Оцените качество моделей на основе подходящих метрик качества (не менее двух метрик).

Набор данных: <https://scikit-learn.org/stable/modules/generated/sklearn.datasets.load_wine.html#sklearn.datasets.load_wine>

## Ход работы

### Загрузка датасета

import pandas as pd  
import numpy as np  
import seaborn as sns  
import matplotlib.pyplot as plt  
from sklearn.datasets import \*  
from sklearn.preprocessing import MinMaxScaler  
from sklearn.model\_selection import train\_test\_split  
from sklearn import svm, tree  
from sklearn.ensemble import GradientBoostingClassifier  
from sklearn.tree import DecisionTreeClassifier  
from sklearn.metrics import accuracy\_score  
from sklearn.metrics import confusion\_matrix, ConfusionMatrixDisplay  
from operator import itemgetter  
  
def make\_dataframe(ds\_function):  
 ds = ds\_function()  
 df = pd.DataFrame(data= np.c\_[ds['data'], ds['target']],  
 columns= list(ds['feature\_names']) + ['target'])  
 return df  
  
wine = load\_wine()  
  
df = make\_dataframe(load\_wine)

# Первые 5 строк датасета  
df.head()

alcohol malic\_acid ash alcalinity\_of\_ash magnesium total\_phenols \  
0 14.23 1.71 2.43 15.6 127.0 2.80   
1 13.20 1.78 2.14 11.2 100.0 2.65   
2 13.16 2.36 2.67 18.6 101.0 2.80   
3 14.37 1.95 2.50 16.8 113.0 3.85   
4 13.24 2.59 2.87 21.0 118.0 2.80   
  
 flavanoids nonflavanoid\_phenols proanthocyanins color\_intensity hue \  
0 3.06 0.28 2.29 5.64 1.04   
1 2.76 0.26 1.28 4.38 1.05   
2 3.24 0.30 2.81 5.68 1.03   
3 3.49 0.24 2.18 7.80 0.86   
4 2.69 0.39 1.82 4.32 1.04   
  
 od280/od315\_of\_diluted\_wines proline target   
0 3.92 1065.0 0.0   
1 3.40 1050.0 0.0   
2 3.17 1185.0 0.0   
3 3.45 1480.0 0.0   
4 2.93 735.0 0.0

df.dtypes

alcohol float64  
malic\_acid float64  
ash float64  
alcalinity\_of\_ash float64  
magnesium float64  
total\_phenols float64  
flavanoids float64  
nonflavanoid\_phenols float64  
proanthocyanins float64  
color\_intensity float64  
hue float64  
od280/od315\_of\_diluted\_wines float64  
proline float64  
target float64  
dtype: object

Все значения имеют тип float64, поэтому нет необходимости в кодировании категориальных признаков

# Проверим наличие пустых значений  
# Цикл по колонкам датасета  
for col in df.columns:  
 # Количество пустых значений - все значения заполнены  
 temp\_null\_count = df[df[col].isnull()].shape[0]  
 print('{} - {}'.format(col, temp\_null\_count))

alcohol - 0  
malic\_acid - 0  
ash - 0  
alcalinity\_of\_ash - 0  
magnesium - 0  
total\_phenols - 0  
flavanoids - 0  
nonflavanoid\_phenols - 0  
proanthocyanins - 0  
color\_intensity - 0  
hue - 0  
od280/od315\_of\_diluted\_wines - 0  
proline - 0  
target - 0

Пустых значений нет, поэтому нет необходимости заполнять пропуски

### Разделение на тестовую и обучающую выборки

y = df['target']  
x = df.drop('target', axis = 1)  
  
scaler = MinMaxScaler()  
scaled\_data = scaler.fit\_transform(x)  
  
x\_train, x\_test, y\_train, y\_test = train\_test\_split(scaled\_data, y, test\_size = 0.2, random\_state = 0)  
  
print(f"Обучающая выборка:\n{x\_train, y\_train}")  
print(f"Тестовая выборка:\n{x\_test, y\_test}")

Обучающая выборка:  
(array([[0.7 , 0.49802372, 0.63101604, ..., 0.3902439 , 0.2014652 ,  
 0.28673324],  
 [0.43684211, 0.15612648, 0.48128342, ..., 0.3902439 , 0.28937729,  
 0.15477889],  
 [0.15526316, 0.24703557, 0.49197861, ..., 0.55284553, 0.61904762,  
 0.04778887],  
 ...,  
 [0.36578947, 0.17193676, 0.44385027, ..., 0.47154472, 0.61904762,  
 0.04778887],  
 [0.75526316, 0.18577075, 0.40641711, ..., 0.3495935 , 0.75457875,  
 0.5042796 ],  
 [0.82368421, 0.34980237, 0.59893048, ..., 0.11382114, 0.16117216,  
 0.2724679 ]]), 161 2.0  
92 1.0  
94 1.0  
174 2.0  
24 0.0  
 ...   
103 1.0  
67 1.0  
117 1.0  
47 0.0  
172 2.0  
Name: target, Length: 142, dtype: float64)  
Тестовая выборка:  
(array([[0.71315789, 0.18379447, 0.47593583, 0.29896907, 0.52173913,  
 0.55862069, 0.54008439, 0.1509434 , 0.38170347, 0.38993174,  
 0.35772358, 0.70695971, 0.55777461],  
 [0.46315789, 0.38142292, 0.59893048, 0.58762887, 0.45652174,  
 0.17241379, 0.21518987, 0.20754717, 0.2681388 , 0.81228669,  
 0. , 0.07326007, 0.14407989],  
 [0.35263158, 0.0770751 , 0.42780749, 0.43298969, 0.18478261,  
 0.86896552, 0.58227848, 0.11320755, 0.46056782, 0.27047782,  
 0.60162602, 0.58608059, 0.10128388],  
 [0.66578947, 0.19565217, 0.58823529, 0.51030928, 0.5 ,  
 0.68275862, 0.51476793, 0.13207547, 0.64353312, 0.42406143,  
 0.40650407, 0.64468864, 0.60057061],  
 [0.53157895, 1. , 0.41176471, 0.56185567, 0.17391304,  
 0.56551724, 0.48734177, 0.32075472, 0.50473186, 0.11262799,  
 0.20325203, 0.67032967, 0.07275321],  
 [0.13947368, 0.25889328, 1. , 0.92268041, 0.5326087 ,  
 0.75862069, 1. , 0.64150943, 0.46056782, 0.40273038,  
 0.36585366, 0.88644689, 0.13338088],  
 [0.79736842, 0.27865613, 0.6684492 , 0.36082474, 0.55434783,  
 0.55862069, 0.45780591, 0.33962264, 0.26498423, 0.32167235,  
 0.47154472, 0.84615385, 0.7253923 ],  
 [0.35 , 0.61067194, 0.54545455, 0.53608247, 0.19565217,  
 0.45517241, 0.12236287, 0.69811321, 0.19873817, 0.54351536,  
 0.06504065, 0.11355311, 0.17261056],  
 [0.32105263, 0.19565217, 0.40641711, 0.43298969, 0.10869565,  
 0.23103448, 0.35654008, 0.45283019, 0.38485804, 0.18088737,  
 0.42276423, 0.6959707 , 0.16547789],  
 [0.27631579, 0.21541502, 0.51336898, 0.40721649, 0.11956522,  
 0.2137931 , 0.24472574, 0.73584906, 0.38801262, 0.09556314,  
 0.48780488, 0.36630037, 0.14407989],  
 [0.61315789, 0.35968379, 0.52941176, 0.48453608, 0.20652174,  
 0.14482759, 0.03375527, 0.45283019, 0.07255521, 0.36860068,  
 0.17886179, 0.43956044, 0.35805991],  
 [0.75 , 0.84980237, 0.46524064, 0.48453608, 0.10869565,  
 0. , 0. , 0.50943396, 0.0851735 , 0.30887372,  
 0.08130081, 0.02197802, 0.09771755],  
 [0.83421053, 0.20158103, 0.5828877 , 0.2371134 , 0.45652174,  
 0.78965517, 0.64345992, 0.39622642, 0.49211356, 0.46672355,  
 0.46341463, 0.57875458, 0.83594864],  
 [0.35263158, 0.06521739, 0.39572193, 0.40721649, 0.19565217,  
 0.87586207, 0.71940928, 0.20754717, 0.48580442, 0.27474403,  
 0.45528455, 0.54945055, 0.2724679 ],  
 [0.67105263, 0.36363636, 0.71122995, 0.71649485, 0.38043478,  
 0.19655172, 0.10548523, 0.49056604, 0.35646688, 0.62969283,  
 0.21138211, 0.19413919, 0.33666191],  
 [0.25526316, 0.03557312, 0.34224599, 0.43298969, 0.17391304,  
 0.49655172, 0.40506329, 0.32075472, 0.32176656, 0.10409556,  
 0.73170732, 0.67765568, 0. ],  
 [0.71842105, 0.15612648, 0.71657754, 0.45876289, 0.67391304,  
 0.67931034, 0.50632911, 0.69811321, 0.29652997, 0.35153584,  
 0.62601626, 0.63369963, 0.68259629],  
 [0.83157895, 0.16798419, 0.59893048, 0.30412371, 0.41304348,  
 0.8 , 0.75738397, 0.35849057, 0.45741325, 0.6331058 ,  
 0.6097561 , 0.56776557, 1. ],  
 [0.42368421, 0.12252964, 0.35294118, 0.31958763, 0.32608696,  
 0.35862069, 0.2257384 , 0.75471698, 0.06624606, 0.38139932,  
 0.40650407, 0.11721612, 0.12268188],  
 [0.73684211, 0.1798419 , 0.6631016 , 0.34020619, 0.26086957,  
 0.50689655, 0.55907173, 0.16981132, 0.59305994, 0.36860068,  
 0.61788618, 0.76923077, 0.70399429],  
 [0.54736842, 0.05335968, 0.18181818, 0.22680412, 0.08695652,  
 0.68965517, 0.59915612, 0.24528302, 0.58990536, 0.34300341,  
 0.5203252 , 0.6996337 , 0.15977175],  
 [0.53157895, 0.1798419 , 0.63636364, 0.3814433 , 0.30434783,  
 0.50689655, 0.44092827, 0.30188679, 0.32492114, 0.25341297,  
 0.5203252 , 0.45421245, 0.58987161],  
 [0.58157895, 0.36561265, 0.80748663, 0.53608247, 0.52173913,  
 0.62758621, 0.49578059, 0.49056604, 0.44479495, 0.25938567,  
 0.45528455, 0.60805861, 0.32596291],  
 [0.38947368, 0.19565217, 0.3315508 , 0.51030928, 0.16304348,  
 0.42068966, 0.33333333, 0.35849057, 0.33753943, 0.14163823,  
 0.45528455, 0.84249084, 0.2810271 ],  
 [0.34210526, 0.07114625, 0.49197861, 0.27835052, 0.33695652,  
 0.36896552, 0.15822785, 0.94339623, 0. , 0.16979522,  
 0.62601626, 0.14652015, 0.28673324],  
 [0.39210526, 0.33399209, 0.43315508, 0.53608247, 0.19565217,  
 0.54137931, 0.407173 , 0.24528302, 0.2555205 , 0.06143345,  
 0.34146341, 0.55311355, 0.03352354],  
 [0.36842105, 0.15612648, 0.4973262 , 0.56185567, 0.17391304,  
 0.60689655, 0.592827 , 0.49056604, 0.42902208, 0.22696246,  
 0.17073171, 0.57509158, 0.05278174],  
 [0.29736842, 0.17193676, 0.50802139, 0.62886598, 0.2173913 ,  
 0.27586207, 0.28481013, 0.56603774, 0.36277603, 0.09982935,  
 0.69105691, 0.36263736, 0.15477889],  
 [0.19210526, 0.38339921, 0.8342246 , 0.48453608, 0.35869565,  
 0.26551724, 0.35654008, 0.88679245, 0.20189274, 0.21501706,  
 0.6097561 , 0.45054945, 0.23466476],  
 [0.72368421, 0.39920949, 0.5026738 , 0.58762887, 0.2173913 ,  
 0.12758621, 0.07172996, 0.52830189, 0.1955836 , 0.70819113,  
 0.17886179, 0.15018315, 0.2403709 ],  
 [0.62105263, 0.20355731, 0.67379679, 0.28350515, 0.25 ,  
 0.64482759, 0.54852321, 0.39622642, 0.32807571, 0.3003413 ,  
 0.35772358, 0.71428571, 0.65406562],  
 [0.83947368, 0.18972332, 0.5026738 , 0.29381443, 0.52173913,  
 0.76551724, 0.56118143, 0.24528302, 0.51104101, 0.43515358,  
 0.37398374, 0.74725275, 0.4935806 ],  
 [0.26578947, 0.70355731, 0.54545455, 0.58762887, 0.10869565,  
 0.3862069 , 0.29746835, 0.54716981, 0.29652997, 0.11262799,  
 0.25203252, 0.47619048, 0.21540656],  
 [0.83684211, 0.65217391, 0.57754011, 0.42783505, 0.44565217,  
 0.64482759, 0.48734177, 0.32075472, 0.26498423, 0.33788396,  
 0.31707317, 0.75457875, 0.57203994],  
 [1. , 0.17786561, 0.43315508, 0.17525773, 0.29347826,  
 0.62758621, 0.55696203, 0.30188679, 0.49526814, 0.33447099,  
 0.48780488, 0.57875458, 0.54707561],  
 [0.53157895, 0.20355731, 0.39572193, 0.32989691, 0.40217391,  
 0.69655172, 0.56118143, 0.28301887, 0.51104101, 0.32081911,  
 0.32520325, 0.76190476, 0.43295292]]), 54 0.0  
151 2.0  
63 1.0  
55 0.0  
123 1.0  
121 1.0  
7 0.0  
160 2.0  
106 1.0  
90 1.0  
141 2.0  
146 2.0  
5 0.0  
98 1.0  
168 2.0  
80 1.0  
33 0.0  
18 0.0  
61 1.0  
51 0.0  
66 1.0  
37 0.0  
4 0.0  
104 1.0  
60 1.0  
111 1.0  
126 1.0  
86 1.0  
112 1.0  
164 2.0  
26 0.0  
56 0.0  
129 1.0  
45 0.0  
8 0.0  
44 0.0  
Name: target, dtype: float64)

### Дерево решений

dt = DecisionTreeClassifier(random\_state=0)  
dt\_prediction = dt.fit(x\_train, y\_train).predict(x\_test)

### Градиентный бустинг

gb = GradientBoostingClassifier(random\_state=0)  
gb\_prediction = gb.fit(x\_train, y\_train).predict(x\_test)

### Оценка качества решений

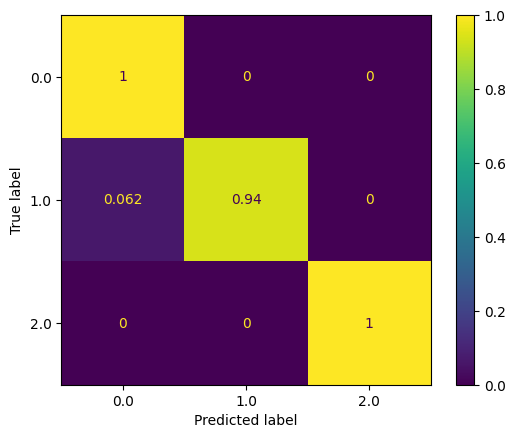
print("Decision tree: ", accuracy\_score(y\_test, dt\_prediction))  
print("Gradient boosting: ", accuracy\_score(y\_test, gb\_prediction))

Decision tree: 0.9722222222222222  
Gradient boosting: 0.9444444444444444

print("Decision tree: ", accuracy\_score(y\_test, dt\_prediction))  
  
cm = confusion\_matrix(y\_test, dt\_prediction, labels=np.unique(df.target), normalize='true')  
disp = ConfusionMatrixDisplay(confusion\_matrix=cm, display\_labels=np.unique(df.target))  
disp.plot()

Decision tree: 0.9722222222222222

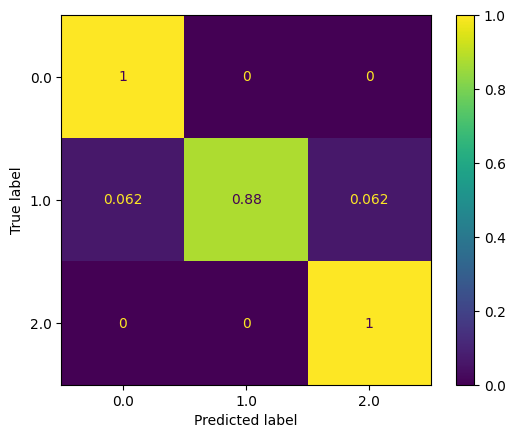
<sklearn.metrics.\_plot.confusion\_matrix.ConfusionMatrixDisplay at 0x7f84db4c2bb0>



print("Gradient boosting: ", accuracy\_score(y\_test, gb\_prediction))  
  
cm = confusion\_matrix(y\_test, gb\_prediction, labels=np.unique(df.target), normalize='true')  
disp = ConfusionMatrixDisplay(confusion\_matrix=cm, display\_labels=np.unique(df.target))  
disp.plot()

Gradient boosting: 0.9444444444444444

<sklearn.metrics.\_plot.confusion\_matrix.ConfusionMatrixDisplay at 0x7f84c898d790>



Для оценки качества решений были использованы метрики, подходящие для задач классификации: accuracy и confusion matrix.

По итогам исследования можно сделать вывод, что обе модели имеют достаточно высокую, однако не идеальную точность: 0.92 для дерева решений и 0.94 для градиентного бустинга.