

```
1  """ md
2  <h1 style="color:rgb(0,120,170)">Machine Learning: Supervised Techniques WS24 <br> Assignment 0</h1>
3
4  Within this introductory assignment we want to give you the chance to familiarize yourself with Jupyter Notebooks and this course's requirements for your submissions.
5  """ md
6  <h2 style="color:rgb(0,120,170)">Copyrighting and Fare Use</h2>
7
8  This material, no matter whether in printed or electronic form,
9  may be used for personal and non-commercial educational use
10 only. Any reproduction of this material, no matter whether as a
11 whole or in parts, no matter whether in printed or in electronic
12 form, requires explicit prior acceptance of the authors.
13 """ md
14 <h2 style="color:rgb(0,120,170)">Automatic Testing Guidelines</h2>
15
16 Your submissions are tested for correctness and plagiarism automatically using both visible and invisible assert statements.
17 Automatic unittesting requires you, as a student, to submit a notebook which contains strictly defined objects.
18
19 Within the notebook we provide detailed instruction which you may want to follow, in order to maximise your final grade.
20
21 Please make sure to rerun your complete Notebook before submitting, this can reveal mistakes that could lead to point deductions!
22 """ md
23 <h2 style="color:rgb(0,120,170)">LaTeX</h2>
24 <p>
25     During the course you will be often supposed to derive formulas and perform calculations.<br>
26     The perfect tool to use in that case is LaTeX.<br>
27     By developers definition: <i>"LaTeX is a high-quality typesetting system which includes features designed for the production of technical and scientific documentation."</i>
28 </p>
29 <p>
30     Tips how to use LaTeX:
31     <ul>
32     <li>Enter LaTeX mode (inline) by typing inside of <b>two dollar signs.</b><br>
33         Your first LaTeX statement  $y = x^2$ 
34     </li>
35     <li>For centered, larger, stand-alone formulas use <b>double dollar signs</b> on each side:
36         
$$y = \sqrt{x^2}$$

37     </li>
38     <li>Use <b>curly brackets</b> to define arguments:<br>
39         No argument definition:  $x^2 \cdot x^3 \neq x^{2+3}$ <br>
40         Using brackets for argument definition:  $x^2 \cdot x^3 = x^{2+3}$ <br>
41     </li>
42     <li>
43         Go for fancy tags to make your styling readable.<br>
44         Blackboard Bold style can be used for sets of numbers. Use <b>\mathbb{<b>
45         Fractions can be written with <b>\frac</b> tag. Example:  $\frac{x^2-1}{x-1}=\frac{(x-1)(x+1)}{x-1}=x+1$ 
46     </li>
47     <li>Adjust bracked hight with <b>\left \right</b> tags.<br>
48         Formula without brackets adjustments:  $y = (\frac{\mathbb{E}(X)}{\mathbb{E}(Y)})^{x-y}$ <br>
49         Formula with brackets adjustments:  $y = \left(\frac{\mathbb{E}(X)}{\mathbb{E}(Y)}\right)^{x-y}$ 
50     </li>
51     <li> <a href="https://wch.github.io/latexsheet/">Full latex cheatsheet</a>
52     </li>
53     </ul>
54 </p>
55
56 """ md
57 <h2 style="color:rgb(210,90,80)">Task 1: Write a LaTeX formula (7 points)</h2>
58 <p>
59     Show that for  $ax^2+bx+c$  roots are: $x_{1,2}=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ 
60 </p>
61 """ md
62 YOUR ANSWER HERE
63
64 The roots of  $ax^2 + bx + c$  can be show as :
65
66 
$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

67 """ md
68 <h2 style="color:rgb(0,120,170)">Coding</h2>
69
70 In order to pass unittests please follow the instructions carefully.
71
72 <h3 style="color:rgb(210,90,80)">Imports</h3>
73 Install and import packages you need.
74 """
75 import numpy as np
76 from matplotlib import pyplot as plt
77 """ md
78 <h3 style="color:rgb(210,90,80)"> Task 2: Write a function (5 points)</h3><br>
79 Write a function <code>bivar_normal()</code> which returns a numpy array of shape (1000,2) filled with normally distributed random datapoints with <code>mean=0</code>, <code>std=0.01</code>.
80 """
81 # Do not change function names!
82 def bivar_normal():
83     """Function bivar_normal takes no argument and returns a numpy array
84
85     Returns
86     -----
87     np.ndarray
88         numpy array of shape (1000,2) of np.float32 dtype with no rounding of values.
89     """
90     # YOUR CODE HERE
91     return np.random.normal(0,0.01,(1000,2)).astype(np.float32)
92
93 """
94 assert bivar_normal().dtype == np.float32, "Wrong datatype!"
95 """
96 assert bivar_normal().shape == (1000, 2)
97 """ md
98 <h3 style="color:rgb(210,90,80)">Task 3: Plot (5 points)</h3>
99 Define a variable <code>data</code> through calling the <code>bivar_normal()</code> function developed above.<br>
100 Plot your <code>data</code> in a scatterplot by using the matplotlib library. Set axis labels and plot title properly.
101 """
102 # Define `data` variable that stores the output of `bivar_normal()`
103 data = bivar_normal()
104 """
105 def gen_plot(data):
106     """Write a function that plots the data."""
107     # YOUR CODE HERE
108     plt.figure(figsize=(10,10))
109     plt.scatter(data[:,0],data[:,1],alpha=0.5)
110     plt.title("Bivariate Normal Distribution")
111     plt.xlabel("First Variable")
112     plt.ylabel("Second Variable")
113     plt.grid(True)
114     plt.show()
115
116 """
117 # Plot the data using your function
118 gen_plot(data)
119 """ md
120 <h3 style="color:rgb(210,90,80)">Task 4: Test question (3 points)</h3>
121
122 What is true? Multiple answers might be correct.<br>
123
124 Pegasus is:<br>
125 a_) half horse, half human<br>
126 b_) a horse with wings<br>
127 c_) an elephant flying with its huge ears<br>
128 d_) a mythical creature<br>
129
130 To answer these questions, store the results in variables reflecting the actual question letters. For example, if you think that a_ is true, then create a variable called `a_` and assign the boolean value `True` to it: `a_ = True`. Do the same for the other options b_), c_) and d_).<br>
131 Please assign _boolean_ values to all question variables**
132
133 """
134 # Examples for you (not the actual solution):
135 # a_ = True
136 # b_ = False
137 # c_ = True
138 # d_ = False
139
140 # YOUR CODE HERE
141 a_ = False
142 b_ = True
143 c_ = False
144 d_ = True
145 """
146 assert a_ is not None, "Store True/False!"
147 assert a_ in [True, False], "Invalid Answer!"
148 """
149 assert b_ is not None, "Store True/False!"
150 assert b_ in [True, False], "Invalid Answer!"
151 """
152 assert c_ is not None, "Store True/False!"
153 assert c_ in [True, False], "Invalid Answer!"
154 """
155 assert d_ is not None, "Store True/False!"
156 assert d_ in [True, False], "Invalid Answer!"
```