# Spring 2024 CS 4641/7641 A: Machine Learning Homework 4

## Instructor: Dr. Mahdi Roozbahani

## Deadline: Friday, April 19, 2024 11:59 pm EST

- No unapproved extension of the deadline is allowed. Submission past our 48-hour penalized acceptance period will lead to 0 credit.
- Discussion is encouraged on Ed as part of the Q/A. However, all assignments should be done individually.
- Plagiarism is a **serious offense**. You are responsible for completing your own work. You are not allowed to copy and paste, or paraphrase, or submit materials created or published by others, as if you created the materials. All materials submitted must be your own.
- All incidents of suspected dishonesty, plagiarism, or violations of the Georgia Tech Honor Code will be subject to the institute's Academic Integrity procedures. If we observe any (even small) similarities/plagiarisms detected by Gradescope or our TAs, **WE WILL DIRECTLY REPORT ALL CASES TO OSI**, which may, unfortunately, lead to a very harsh outcome. **Consequences can be severe, e.g., academic probation or dismissal, grade penalties, a 0 grade for assignments concerned, and prohibition from withdrawing from the class.**

## Instructions for the assignment

- This assignment consists of both programming and theory questions.
- Unless a theory question explicitly states that no work is required to be shown, you must provide an explanation, justification, or calculation for your answer.
- To switch between cell for code and for markdown, see the menu -> Cell -> Cell Type
- You can directly type Latex equations into markdown cells.
- If a question requires a picture, you could use this syntax `<img src="" style="width: 300px;"/>` to include them within your ipython notebook.

- Your write up must be submitted in PDF form. You may use either Latex, markdown, or any word processing software. We will **NOT** accept handwritten work. Make sure that your work is formatted correctly, for example submit $\sum_{i=0} x_i$ instead of \text{sum_{i=0} x_i}
- When submitting the non-programming part of your assignment, you must correctly map pages of your PDF to each question/subquestion to reflect where they appear. **Improperly mapped questions may not be graded correctly and/or will result in point deductions for the error.**
- All assignments should be done individually, and each student must write up and submit their own answers.
- **Graduate Students**: You are required to complete any sections marked as Bonus for Undergrads

## Using the autograder

- You will find three assignments (for grads) on Gradescope that correspond to HW4: "Assignment 4 Programming", "Assignment 4 - Non-programming" and "Assignment 4 Programming - Bonus for all". Undergrads will have an additional assignment called "Assignment 4 Programming - Bonus for Undergrads".
- You will submit your code for the autograder in the Assignment 4 Programming sections. Please refer to the Deliverables and Point Distribution section for what parts are considered required, bonus for undergrads, and bonus for all".
- We provided you different .py files and we added libraries in those files please DO NOT remove those lines and add your code after those lines. Note that these are the only allowed libraries that you can use for the homework
- You are allowed to make as many submissions until the deadline as you like. Additionally, note that the autograder tests each function separately, therefore it can serve as a useful tool to help you debug your code if you are not sure of what part of your implementation might have an issue
- **For the "Assignment 4 - Non-programming" part, you will need to submit to Gradescope a PDF copy of your Jupyter Notebook with the cells ran. See this EdStem Post for multiple ways on to convert your .ipynb into a .pdf file.** Please refer to the **Deliverables and Point Distribution** section for an outline of the non-programming questions.
- **When submitting to Gradescope, please make sure to mark the page(s) corresponding to each problem/sub-problem. The pages in the PDF should be of size 8.5" x 11", otherwise there may be a deduction in points for extra long sheets.**
- You **MUST** pass the Autograder Test to gain points for the programming section. There will not be any partial credit or manual grading for this part.

# Using the local tests

- For some of the programming questions we have included a local test using a small toy dataset to aid in debugging. The local test sample data and outputs are stored in localtests.py
- There are no points associated with passing or failing the local tests, you must still pass the autograder to get points.
- **It is possible to fail the local test and pass the autograder** since the autograder has a certain allowed error tolerance while the local test allowed error may be smaller. Likewise, passing the local tests does not guarantee passing the autograder.
- **You do not need to pass both local and autograder tests to get points, passing the Gradescope autograder is sufficient for credit.**
- It might be helpful to comment out the tests for functions that have not been completed yet.
- It is recommended to test the functions as it gets completed instead of completing the whole class and then testing. This may help in isolating errors. Do not solely rely on the local tests, continue to test on the autograder regularly as well.

# Deliverables and Points Distribution

## Q1: Classification with Two Layer NN [80 pts; 55pts + 25pts Grad / 3.3% Undergrad Bonus]

### Deliverables: NN.py and Notebook Graphs

- **1.1 NN Implementation** [65pts; 50pts + 15pts Grad / 2% **Bonus for Undergrad**] - *programming*
    - Leaky_relu [5pts]
    - Softmax [5pts]
    - Cross Entropy loss [5pts]
    - dropout [5pts]
    - forward propagation and with and without dropout [5pts + 5pts]
    - compute gradients and update weights [2.5pts + 2.5pts]
    - backward without momentum [5pt]
    - Gradient Descent [10pts]

    - Batch Gradient Descent [10pts Grad / 1.3% **Bonus for Undergrad**]
    - Momentum [5pts Grad / 0.7% **Bonus for Undergrad**]
- **1.2 Loss plot and CE for Gradient Descent** [5pts] - *non-programming*
- **1.3 Loss plot and CE for Batch Gradient Descent** [5pts Grad / 0.7% **Bonus for Undergrad**] - *non-programming*
- **1.4 Loss plot and CE value for NN with Gradient Descent with Momentum** [5pts Grad / 0.6% **Bonus for Undergrad**] - *non-programming*

## Q2: CNN [25pts; 20pts Grad / 2.7% Bonus for Undergrad + 1.1% Bonus for All]

### Deliverables: cnn.py, cnn_image_transformations.py and Written Report

- **2.1 Image Classification using Pytorch CNN** [20pts Grad / 2.7% **Bonus for Undergrad**]
    - 2.1.1 Loading the Model [5pts Grad / 0.7% **Bonus for Undergrad**] - *programming*
    - 2.1.3 Building the Model [5pts Grad / 0.7% **Bonus for Undergrad**] - *non-programming*
    - 2.1.4 Training the Model [8pts Grad / 1% **Bonus for Undergrad**] - *non-programming*
    - 2.1.5 Examining Accuracy and Loss [2pts Grad / 0.3% **Bonus for Undergrad**] - *non-programming*
- **2.2 Exploring Deep CNN Architectures** [1.1% **Bonus for All**] - *non-programming*

## Q3: Random Forest [45pts; 40pts + 1.1% Bonus for All]

### Deliverables: random_forest.py and Written Report

- 3.1 Random Forest Implementation [35pts] - *programming*
- 3.2 Hyperparameter Tuning with a Random Forest [5pts] - *programming*
- 3.3 Plotting Feature Importance [1.1% **Bonus for All**] - *non-programming*

## Q4: SVM [7.8% Bonus for all]

### Deliverables: feature.py and Written Report

- 4.1: Fitting an SVM Classifier by hand [5.5%] - *non programming*

- 4.2: Feature Mapping [2.3%] - *programming*

# Environment Setup

In [ ]:
```
import sys
import time
from collections import Counter
from math import log2, sqrt

import matplotlib
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
from NN import NeuralNet
from scipy import stats
from sklearn import svm
from sklearn.datasets import fetch_california_housing, load_diabetes, make_m
from sklearn.metrics import accuracy_score, classification_report, mean_squa
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder, MinMaxScaler
from sklearn.tree import DecisionTreeClassifier
from utilities.utils import get_housing_dataset

print("Version information")

print("python: {}".format(sys.version))
print("matplotlib: {}".format(matplotlib.__version__))
print("numpy: {}".format(np.__version__))

%load_ext autoreload
%autoreload 2
%reload_ext autoreload
```

```
Version information
python: 3.11.8 (main, Feb 26 2024, 15:36:12) [Clang 14.0.6 ]
matplotlib: 3.8.0
numpy: 1.26.4
The autoreload extension is already loaded. To reload it, use:
  %reload_ext autoreload
```

# Coding and Emissions

Coding and computational research contribute to greenhouse gas emissions. The main source of these emissions is the power draw of computers during compute- and data-intensive computational analyses. In 2020, the sector of information and communication technologies was responsible for between 1.8% and 2.8% of GHG emissions, surprisingly more than the sector of aviation [1]. Machine learning models, especially large ones, can consume significant amounts of energy during training and inference, which contributes to greenhouse gas emissions. Artificial intelligence, including large language models, is also a significant emitter of carbon [2].

Carbon footprint of coding impacts several Sustainable Development Goals (SDGs), particularly SDG 13 (Climate Action) and SDG 12 (Responsible Consumption and Production).[3] This means writing clean and efficient code transcends functionality—it's an environmental imperative. As coders, we can play a role in mitigating this impact.

## Measuring Our Impact:

CodeCarbon estimates the amount of CO2 produced by the cloud or personal computing resources used to execute the code[4] .

Using CodeCarbon in your upcoming assignment will help you understand the environmental impact of your code and explore ways to reduce it.

In [ ]:
```
from codecarbon import EmissionsTracker

tracker = EmissionsTracker()
tracker.start()
```

```
[codecarbon INFO @ 02:16:48] [setup] RAM Tracking...
[codecarbon INFO @ 02:16:48] [setup] GPU Tracking...
[codecarbon INFO @ 02:16:48] No GPU found.
[codecarbon INFO @ 02:16:48] [setup] CPU Tracking...
[codecarbon WARNING @ 02:16:48] No CPU tracking mode found. Falling back on
CPU constant mode.
[codecarbon INFO @ 02:16:48] CPU Model on constant consumption mode: Apple M
1
[codecarbon INFO @ 02:16:48] >>> Tracker's metadata:
[codecarbon INFO @ 02:16:48]   Platform system: macOS-14.1-arm64-arm-64bit
[codecarbon INFO @ 02:16:48]   Python version: 3.11.8
[codecarbon INFO @ 02:16:48]   CodeCarbon version: 2.3.5
[codecarbon INFO @ 02:16:48]   Available RAM : 8.000 GB
[codecarbon INFO @ 02:16:48]   CPU count: 8
[codecarbon INFO @ 02:16:48]   CPU model: Apple M1
[codecarbon INFO @ 02:16:48]   GPU count: None
[codecarbon INFO @ 02:16:48]   GPU model: None
[codecarbon INFO @ 02:16:50] Energy consumed for RAM : 0.000075 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:16:50] Energy consumed for all CPUs : 0.000125 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:16:50] 0.000200 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:16:50] Energy consumed for all CPUs : 0.000125 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:16:50] 0.000200 kWh of electricity used since the begi
nning.
```

# 1: Two Layer Neural Network [80 pts; 55pts + 25pts Grad / 3.3% Undergrad Bonus] [P] [W]

# 1.1 NN Implementation [65pts; 50pts + 15pts Grad / 2% Bonus for Undergrad] [P]

In this section, you will implement a two layer fully connected neural network to perform a Classification Task. You will also experiment with different activation functions and optimization techniques. We provide two activation functions here - Leaky Relu and Softmax. You will implement a neural network where the first hidden layer has a Leaky Relu activation and the second hidden layer leads to a Softmax.

You'll also implement Gradient Descent (GD) and Batch Gradient Descent (BGD) algorithms for training these neural nets. **GD is mandatory for all. BGD is bonus for undergraduate students but mandatory for graduate students.**

In the **NN.py** file, complete the following functions:

- **leaky_relu**
- **softmax**
- **cross_entropy_loss**
- **_dropout**
- **forward**
- **compute_gradients**
- **update_weights**
- **backward**: Note Hint 2, if you still have issues passing the autograder make sure to address Hint 1 as well.
- **gradient_descent**
- **batch_gradient_descent**: **Mandatory for graduate students, bonus for undergraduate students.** Please batch your data in a wraparound manner. For example, given a dataset of 9 numbers, [1, 2, 3, 4, 5, 6, 7, 8, 9], and a batch size of 6, the first iteration batch will be [1, 2, 3, 4, 5, 6], the second iteration batch will be [7, 8, 9, 1, 2, 3], the third iteration batch will be [4, 5, 6, 7, 8, 9], etc...

We'll train this neural net on sklearn's California Housing dataset.

# Activation Function

There are many activation functions that are used for various purposes. For this question, we use leaky ReLU and the softmax activation functions. We encourage you to explore the plethora of options, many of which are listed on Wikipedia.

## Sigmoid

The sigmoid function is a non-linear function with an S-shaped curve and is regarded as a foundational activation function. Its output is in the range $(0, 1)$, making it the function

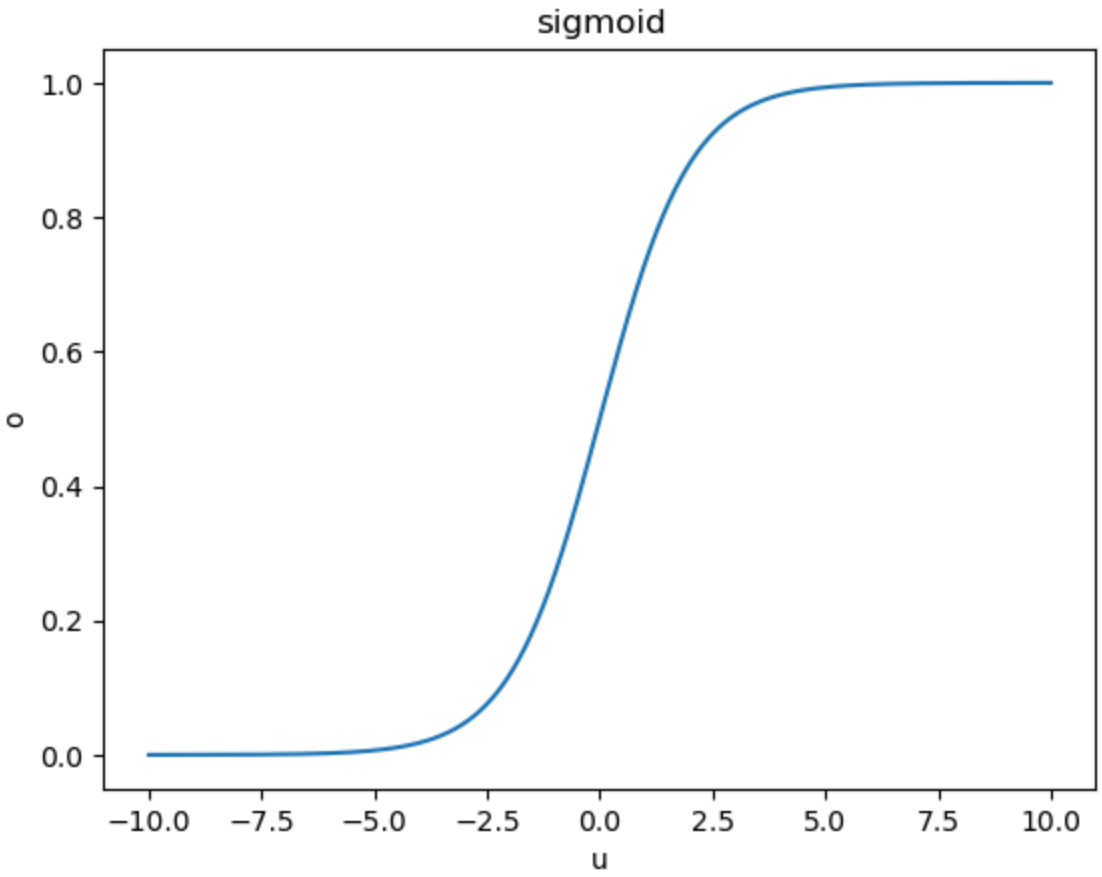
to use for binary classification output. The function is expressed as

$$o = \phi(u) = \frac{1}{1 + e^{-u}}$$

The derivation of the sigmoid function is given by

$$o' = \phi'(u) = \frac{1}{1 + e^{-u}} \left(1 - \frac{1}{1 + e^{-u}}\right) = o(1 - o)$$

**Note:** We do not use sigmoid in this homework; it is only included for the sake of completeness.




## Softmax

Softmax is a common activation function used in neural networks, especially for multiclass classification problems like the one we are tackling. It is used to convert a vector of raw outputs from the last layer of the Neural Network into a probability distribution over multiple classes. The softmax function takes as input a vector of real numbers and transforms them into a probability distribution, ensuring that the probabilities sum to 1.

Mathematically, given an input vector of [x1, x2, ..., xn], the softmax function calculates the probability p(y=i) for each class i as follows:

p(y=i) = $e^{xi} / (e^{x1} + e^{x2} + \ldots + e^{xn})$

$$\text{Softmax}(x_i) = \frac{\exp(x_i)}{\sum_j \exp(x_j)}$$

As discussed in class, the equation that we will use in this Neural network accounts for both the x values and the weights:

$$softmax(x\theta) = \frac{\exp(x\theta)_m}{\sum_{j=0}^{k} \exp(x\theta)_j}$$

**TODO:** Implement the function **softmax** in **NN.py**.

In [ ]:
```
from utilities.localtests import TestNN

TestNN("test_softmax").test_softmax()
```

```
[codecarbon INFO @ 04:54:55] Energy consumed for RAM : 0.007976 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:54:55] Energy consumed for all CPUs : 0.013298 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:54:55] 0.021274 kWh of electricity used since the begi
nning.
Input u shape: (2, 3)
Input u type: int64
Max_u shape: (2, 1)
Max_u type: float64
test_softmax passed!
```

```
[codecarbon INFO @ 04:54:58] Energy consumed for RAM : 0.008026 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:54:58] Energy consumed for all CPUs : 0.013380 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:54:58] 0.021406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:10] Energy consumed for RAM : 0.007989 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:10] Energy consumed for all CPUs : 0.013318 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:10] 0.021307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:13] Energy consumed for RAM : 0.008039 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:13] Energy consumed for all CPUs : 0.013401 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:13] 0.021439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:25] Energy consumed for RAM : 0.008001 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:25] Energy consumed for all CPUs : 0.013339 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:25] 0.021340 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:28] Energy consumed for RAM : 0.008051 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:28] Energy consumed for all CPUs : 0.013422 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:28] 0.021473 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:40] Energy consumed for RAM : 0.008014 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:40] Energy consumed for all CPUs : 0.013360 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:40] 0.021374 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:43] Energy consumed for RAM : 0.008064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:43] Energy consumed for all CPUs : 0.013442 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:43] 0.021506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:55] Energy consumed for RAM : 0.008026 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:55] Energy consumed for all CPUs : 0.013381 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:55] 0.021407 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:55:58] Energy consumed for RAM : 0.008076 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:55:58] Energy consumed for all CPUs : 0.013463 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:55:58] 0.021539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:10] Energy consumed for RAM : 0.008039 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:56:10] Energy consumed for all CPUs : 0.013402 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:10] 0.021440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:13] Energy consumed for RAM : 0.008089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:56:13] Energy consumed for all CPUs : 0.013484 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:13] 0.021573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:25] Energy consumed for RAM : 0.008051 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:56:25] Energy consumed for all CPUs : 0.013423 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:25] 0.021474 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:28] Energy consumed for RAM : 0.008101 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:56:28] Energy consumed for all CPUs : 0.013505 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:28] 0.021606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:40] Energy consumed for RAM : 0.008064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:56:40] Energy consumed for all CPUs : 0.013444 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:40] 0.021507 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:43] Energy consumed for RAM : 0.008114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:56:43] Energy consumed for all CPUs : 0.013526 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:43] 0.021639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:55] Energy consumed for RAM : 0.008076 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:56:55] Energy consumed for all CPUs : 0.013464 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:55] 0.021540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:56:58] Energy consumed for RAM : 0.008126 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:56:58] Energy consumed for all CPUs : 0.013547 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:56:58] 0.021673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:10] Energy consumed for RAM : 0.008089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:10] Energy consumed for all CPUs : 0.013485 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:57:10] 0.021574 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:13] Energy consumed for RAM : 0.008139 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:13] Energy consumed for all CPUs : 0.013567 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:57:13] 0.021706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:25] Energy consumed for RAM : 0.008101 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:25] Energy consumed for all CPUs : 0.013506 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:57:25] 0.021607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:28] Energy consumed for RAM : 0.008151 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:28] Energy consumed for all CPUs : 0.013588 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:57:28] 0.021739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:40] Energy consumed for RAM : 0.008114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:40] Energy consumed for all CPUs : 0.013527 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:57:40] 0.021640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:43] Energy consumed for RAM : 0.008164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:43] Energy consumed for all CPUs : 0.013609 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:57:43] 0.021773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:55] Energy consumed for RAM : 0.008126 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:55] Energy consumed for all CPUs : 0.013548 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:57:55] 0.021674 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:57:58] Energy consumed for RAM : 0.008176 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:57:58] Energy consumed for all CPUs : 0.013630 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:57:58] 0.021806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:58:10] Energy consumed for RAM : 0.008139 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:10] Energy consumed for all CPUs : 0.013568 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:10] 0.021707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:58:13] Energy consumed for RAM : 0.008189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:13] Energy consumed for all CPUs : 0.013651 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:13] 0.021839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:58:25] Energy consumed for RAM : 0.008151 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:25] Energy consumed for all CPUs : 0.013589 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:25] 0.021740 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:58:28] Energy consumed for RAM : 0.008201 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:28] Energy consumed for all CPUs : 0.013672 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:28] 0.021873 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:58:40] Energy consumed for RAM : 0.008164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:40] Energy consumed for all CPUs : 0.013610 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:40] 0.021774 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:58:43] Energy consumed for RAM : 0.008214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:43] Energy consumed for all CPUs : 0.013692 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:43] 0.021906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:58:55] Energy consumed for RAM : 0.008176 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:55] Energy consumed for all CPUs : 0.013631 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:55] 0.021807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:58:58] Energy consumed for RAM : 0.008226 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:58:58] Energy consumed for all CPUs : 0.013713 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:58:58] 0.021939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:10] Energy consumed for RAM : 0.008189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:59:10] Energy consumed for all CPUs : 0.013652 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:10] 0.021840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:13] Energy consumed for RAM : 0.008239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:59:13] Energy consumed for all CPUs : 0.013734 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:13] 0.021973 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:25] Energy consumed for RAM : 0.008201 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:59:25] Energy consumed for all CPUs : 0.013673 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:25] 0.021874 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:28] Energy consumed for RAM : 0.008251 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:59:28] Energy consumed for all CPUs : 0.013755 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:28] 0.022006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:40] Energy consumed for RAM : 0.008214 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:59:40] Energy consumed for all CPUs : 0.013694 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:40] 0.021907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:43] Energy consumed for RAM : 0.008264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:59:43] Energy consumed for all CPUs : 0.013776 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:43] 0.022039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:55] Energy consumed for RAM : 0.008226 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:59:55] Energy consumed for all CPUs : 0.013714 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:55] 0.021940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:59:58] Energy consumed for RAM : 0.008276 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:59:58] Energy consumed for all CPUs : 0.013797 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:59:58] 0.022073 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:10] Energy consumed for RAM : 0.008239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:10] Energy consumed for all CPUs : 0.013735 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:00:10] 0.021974 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:13] Energy consumed for RAM : 0.008289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:13] Energy consumed for all CPUs : 0.013817 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:00:13] 0.022106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:25] Energy consumed for RAM : 0.008251 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:25] Energy consumed for all CPUs : 0.013756 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:00:25] 0.022007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:28] Energy consumed for RAM : 0.008301 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:28] Energy consumed for all CPUs : 0.013838 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:00:28] 0.022139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:40] Energy consumed for RAM : 0.008264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:40] Energy consumed for all CPUs : 0.013777 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:00:40] 0.022040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:43] Energy consumed for RAM : 0.008314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:43] Energy consumed for all CPUs : 0.013859 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 05:00:43] 0.022173 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:55] Energy consumed for RAM : 0.008276 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:55] Energy consumed for all CPUs : 0.013798 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:00:55] 0.022074 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:00:58] Energy consumed for RAM : 0.008326 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:00:58] Energy consumed for all CPUs : 0.013880 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:00:58] 0.022206 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:01:10] Energy consumed for RAM : 0.008289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:10] Energy consumed for all CPUs : 0.013819 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:10] 0.022107 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:01:13] Energy consumed for RAM : 0.008339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:13] Energy consumed for all CPUs : 0.013901 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:13] 0.022239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:01:25] Energy consumed for RAM : 0.008301 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:25] Energy consumed for all CPUs : 0.013839 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:25] 0.022140 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:01:28] Energy consumed for RAM : 0.008351 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:28] Energy consumed for all CPUs : 0.013922 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:28] 0.022273 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:01:40] Energy consumed for RAM : 0.008314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:40] Energy consumed for all CPUs : 0.013860 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:40] 0.022174 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:01:43] Energy consumed for RAM : 0.008364 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:43] Energy consumed for all CPUs : 0.013942 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:43] 0.022306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:01:55] Energy consumed for RAM : 0.008326 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:55] Energy consumed for all CPUs : 0.013881 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:55] 0.022207 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 05:01:58] Energy consumed for RAM : 0.008376 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:01:58] Energy consumed for all CPUs : 0.013963 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:01:58] 0.022339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:02:10] Energy consumed for RAM : 0.008339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:02:10] Energy consumed for all CPUs : 0.013902 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:02:10] 0.022240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:02:13] Energy consumed for RAM : 0.008389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:02:13] Energy consumed for all CPUs : 0.013984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:02:13] 0.022373 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:02:25] Energy consumed for RAM : 0.008351 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:02:25] Energy consumed for all CPUs : 0.013923 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:02:25] 0.022274 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 05:02:28] Energy consumed for RAM : 0.008401 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 05:02:28] Energy consumed for all CPUs : 0.014005 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 05:02:28] 0.022406 kWh of electricity used since the begi
nning.
```

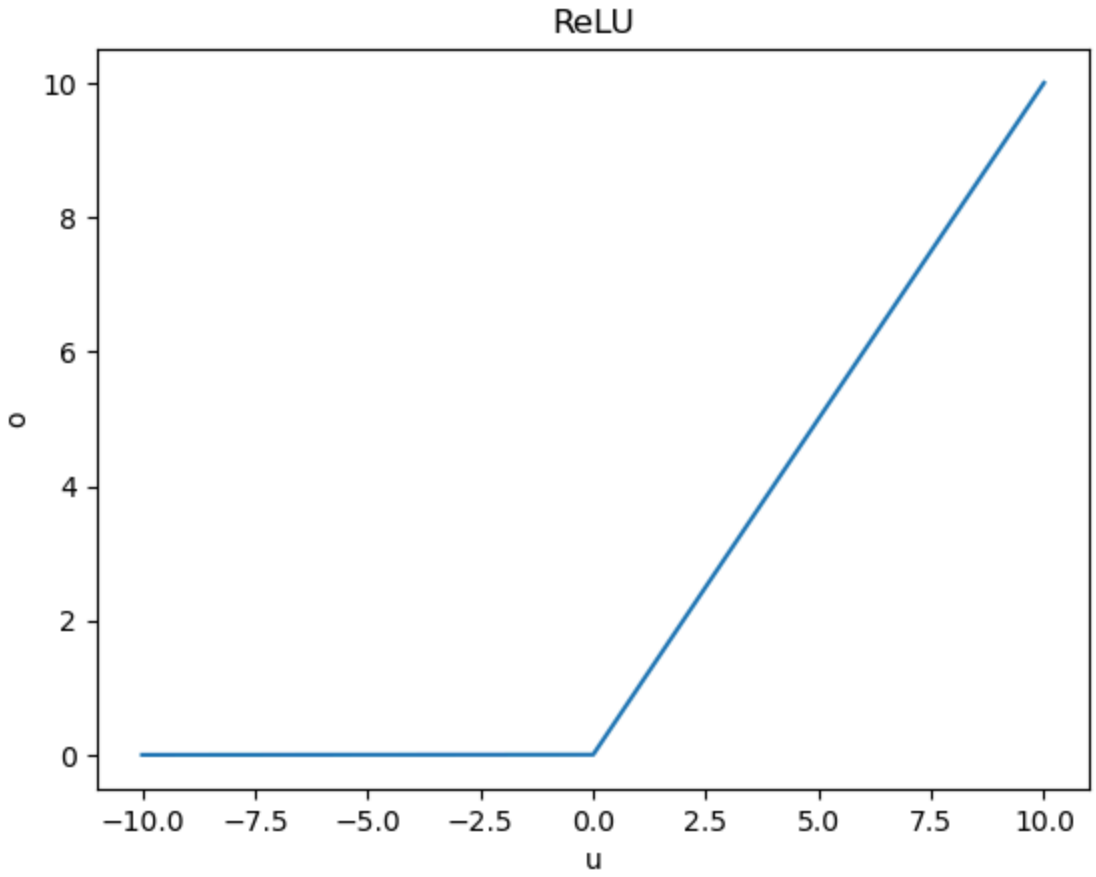
## ReLU and Leaky ReLU

The rectified linear unit (ReLU) is the most commonly used activation function in deep learning today. It takes the form

$$o = \phi(u) = \max(0, u).$$

Note that ReLU can be computed very quickly due to its simplicity. The derivative of ReLU is given by

$$o' = \phi'(u) = \begin{cases} 0 & u \leq 0 \\ 1 & u > 0 \end{cases}.$$

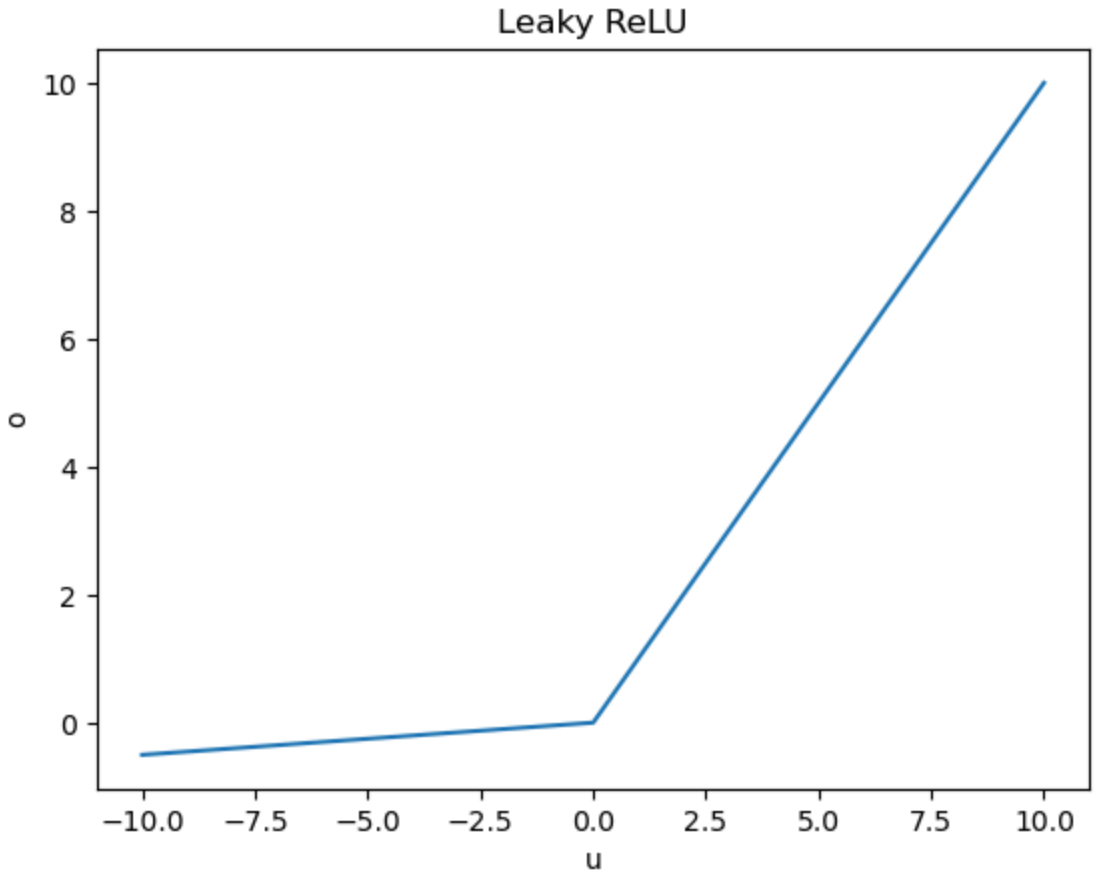



Unfortunately, ReLU loses information for negative inputs; it always returns zero. For this reason, some researchers use a variant called leaky ReLU. Unlike ReLU, its leaky counterpart has a small slope (such as $\alpha = 0.05$) for negative inputs instead of a flat slope.

It takes the form

$$o = \phi(u) = \begin{cases} \alpha u & u \leq 0 \\ u & u > 0 \end{cases}$$

In this homework, we implement Leaky ReLU.




**TODO:** Implement the function **leaky_relu** in **NN.py**.

In [ ]:
```
from utilities.localtests import TestNN

TestNN("test_leaky_relu").test_leaky_relu()
TestNN("test_d_leaky_relu").test_d_leaky_relu()
```

```
test_leaky_relu passed!
test_d_leaky_relu passed!
```

## Perceptron

A single layer perceptron can be thought of as a linear hyperplane as in logistic regression followed by a non-linear activation function.

$$u_i = \sum_{j=1}^{d} \theta_{ij} x_j + b_i$$

$$o_i = \phi\left(\sum_{j=1}^{d} \theta_{ij} x_j + b_i\right) = \phi(\theta_i^T x + b_i)$$

where $x$ is a d-dimensional vector i.e. $x \in R^d$. It is one datapoint with $d$ features. $\theta_i \in R^d$ is the weight vector for the $i^{th}$ hidden unit, $b_i \in R$ is the bias element for the $i^{th}$ hidden unit and $\phi(.)$ is a non-linear activation function that has been described below.

$u_i$ is a linear combination of the features in $x_j$ weighted by $\theta_i$ whereas $o_i$ is the $i^{th}$ output unit from the activation layer.

## Fully connected Layer

Typically, a modern neural network contains millions of perceptrons as the one shown in the previous image. Perceptrons interact in different configurations such as cascaded or parallel. In this part, we describe a fully connected layer configuration in a neural network which comprises multiple parallel perceptrons forming one layer.

We extend the previous notation to describe a fully connected layer. Each layer in a fully connected network has a number of input/hidden/output units cascaded in parallel. Let us a define a single layer of the neural net as follows:
$m$ denotes the number of hidden units in a single layer $l$ whereas $n$ denotes the number of units in the previous layer $l-1$.

$$u^{[l]} = \theta^{[l]} o^{[l-1]} + b^{[l]}$$

where $u^{[l]} \in R^m$ is a m-dimensional vector pertaining to the hidden units of the $l^{th}$ layer of the neural network after applying linear operations. Similarly, $o^{[l-1]} \in R^n$ is the n-dimensional output vector corresponding to the hidden units of the $(l-1)^{th}$ activation layer. $\theta^{[l]} \in R^{m \times n}$ is the weight matrix of the $l^{th}$ layer where each row of $\theta^{[l]}$ is analogous to $\theta_i$ described in the previous section i.e. each row corresponds to one hidden unit of the $l^{th}$ layer. $b^{[l]} \in R^m$ is the bias vector of the layer where each element of b pertains to one hidden unit of the $l^{th}$ layer. This is followed by element wise non-linear activation function $o^{[l]} = \phi(u^{[l]})$. The whole operation can be summarized as,

$$o^{[l]} = \phi(\theta^{[l]} o^{[l-1]} + b^{[l]})$$

where $o^{[l-1]}$ is the output of the previous layer.

## Dropout

A dropout layer is a regularization technique used in neural networks to reduce overfitting. During training, a dropout layer looks at each input unit and randomly decide if it will be dropped (set to zero) with some given probability $p$. The decision for each unit is made independently. Formally, given an input of shape $N \times K$ (where $N$ is the number of data points and $K$ is the number of features), it samples from $\text{Bernoulli}(p)$ for each unit, resulting in an output where approximately $pNK$ of the units are zero (in expectation). This forces the network to learn more robust and generalizable features, since it cannot rely too much on any particular input. During inference, the dropout layer is turned off, and the full network is used to make predictions.

The dropout probability $p$ is a hyperparameter than can be tuned to adjust the strength of regularization. Setting $p = 0$ is equivalent to no dropout.

Note that the derivative of $\text{dropout}(u)$ with respect to $u$ has the same shape as $u$. The values of the derivative depend on the random mask.

Use this as a reference for your implementation.

Note that after applying the mask, we must scale the result by a factor of $1/(1-p)$. Why is this necessary?

**TODO:** Implement the **_dropout** function in **NN.py**.

In [ ]:
```
from utilities.localtests import TestNN

TestNN("test_dropout").test_dropout()
```

```
test_dropout passed!
```

# Cross Entropy Loss

Cross-Entropy Loss is a widely used loss function in machine learning and deep learning, especially for classification tasks. It measures the dissimilarity between the predicted probability distribution and the true probability distribution of a classification problem. If it is closer to zero, the better the learnt function is.

## Implementation details

For classification problems as in this exercise, we compute the loss as follows:

$$CE = -\frac{1}{N}\sum_{i=1}^{N}(y_i \cdot log(\hat{y}_i))$$

where $y_i$ is the true label and $\hat{y}_i$ is the estimated label.

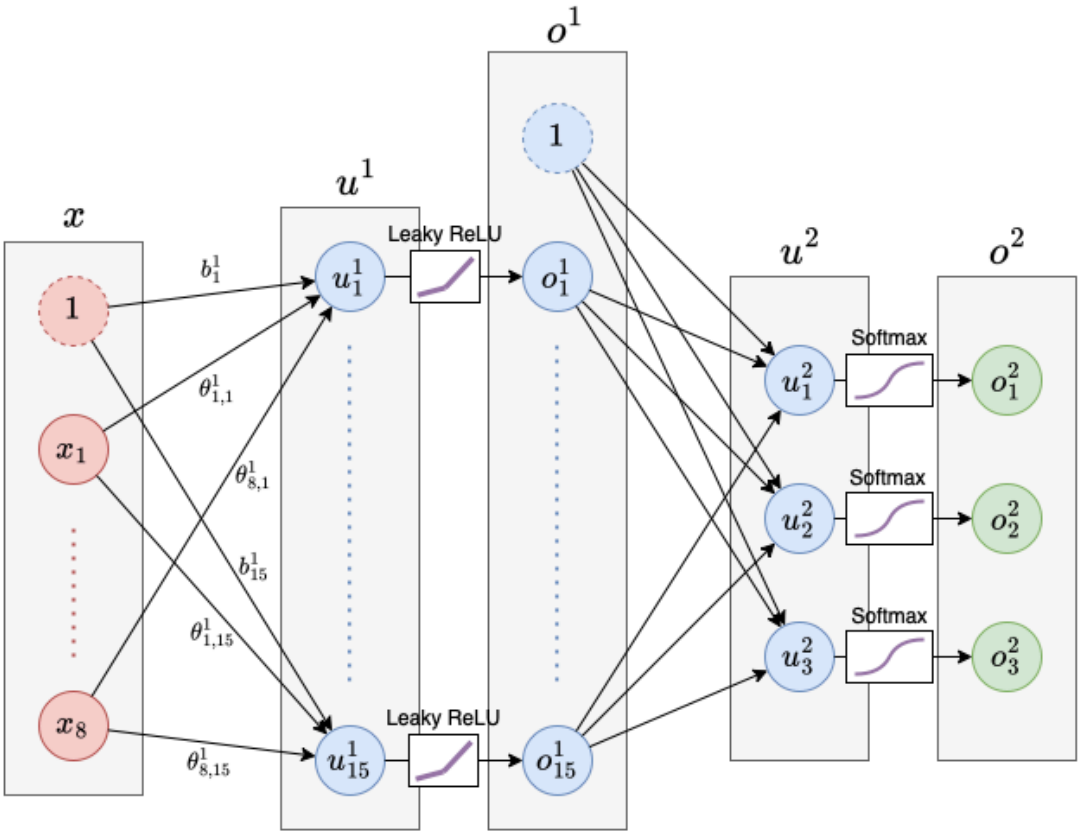
**TODO:** Implement the **cross_entropy_loss** function in **NN.py**.

In [ ]:
```
from utilities.localtests import TestNN

TestNN("test_loss").test_loss()
```

```
test_loss passed!
```

# Neural Network Architecture

*The architecture of our neural network.*




The above diagram shows the dimensions of the neural network you will implement, along with the relationships between the quantities. Note that the neural network consists of two linear layers, with a leaky ReLU activation in between. The logits outputted by the second linear layer are passed through the softmax function, which turns them into probability distributions over the 3 classes.

Here is a helpful guide that walks through the matrix multiplication operations and shapes involved in a forward and backward pass.

## Initialization

We start by initializing the weights of the fully connected layer using Xavier initialization. (At a high level, we are using a uniform distribution for weight initialization). This is already implemented for you.

## Forward Propagation

During training, we pass all data points through the network, layer by layer, using forward propagation. The equations for forward propagation are as follows:

$$
\begin{aligned}
u^{[0]} &= x \\
u^{[1]} &= \theta^{[1]} u^{[0]} + b^{[1]} \\
o^{[1]} &= \text{Dropout}(\text{LeakyRelu}(u^{[1]})) \\
u^{[2]} &= \theta^{[2]} o^{[1]} + b^{[2]} \\
\hat{y} = o^{[2]} &= \text{Softmax}(u^{[2]}).
\end{aligned}
$$

We then use the output of the network to compute the loss

$$CE = -\frac{1}{N} \sum_{i=1}^{N} (y_i \cdot log(\hat{y}_i))$$

**TODO:** Implement the **forward** function in **NN.py**.

Hint: Refer to this guide for more detail on the forward pass.

In [ ]:
```
from utilities.localtests import TestNN

TestNN("test_forward_without_dropout").test_forward_without_dropout()
TestNN("test_forward").test_forward()
```

```
test_forward_without_dropout passed!
test_forward passed!
```

# Backward Propagation: Update Weights and Compute Gradients

After the forward pass, we do back propagation to update the weights and biases in the direction of the negative gradient of the loss function.

## Update Weights

So, we update the weights and biases using the following formulas

$$
\begin{aligned}
\theta^{[2]} &:= \theta^{[2]} - lr \times \frac{\partial l}{\partial \theta^{[2]}} \\
b^{[2]} &:= b^{[2]} - lr \times \frac{\partial l}{\partial b^{[2]}} \\
\theta^{[1]} &:= \theta^{[1]} - lr \times \frac{\partial l}{\partial \theta^{[1]}} \\
b^{[1]} &:= b^{[1]} - lr \times \frac{\partial l}{\partial b^{[1]}}
\end{aligned}
$$

where $lr$ is the learning rate. It decides the step size we want to take in the direction of the negative gradient.

**TODO:** Implement the **update_weights** function in **NN.py** with use_momentum=False.

Hint: Refer to this guide for more detail on the backward pass.

In [ ]:
```
from utilities.localtests import TestNN

TestNN("test_update_weights").test_update_weights()
```

```
test_update_weights passed!
```

## Update Weights with Momentum [Bonus for Undergrad]

Gradient descent does a generally good job of facilitating the convergence of the model's parameters to minimize the loss function. However, the process of doing so can be slow and/or noisy. **Momentum** is a technique used to stabilize this convergence.

As a reminder, vanilla gradient descent applies the following update function to the parameters:

$$\theta_{t+1} = \theta_t - \alpha \nabla f(\theta_t) \tag{1}$$

where $\theta_t$ represents the parameters at time $t$, $\alpha$ represents the learning rate, and $f$ is the loss function.

Momentum proposes the following tweak to our parameter update function:

$$z_{t+1} = \beta z_t + \nabla f(\theta_t)$$
$$\theta_{t+1} = \theta_t - \alpha z_{t+1}$$

where $\beta \in [0, 1]$ is the momentum constant and $z_t$ represents the momentum records at time $t$.

You can think of momentum as taking our previous changes into consideration. If we've been moving in a certain direction recently, it's likely we should keep moving in that direction. The recurrence relation given shows that we use an exponentially-weighted average of the previous updates for our current update.

A useful analogy about momentum from this great article on Distill:

> Here's a popular story about momentum: gradient descent is a man walking down a hill. He follows the steepest path downwards; his progress is slow, but steady. Momentum is a heavy ball rolling down the same hill. The added inertia acts both as a smoother and an accelerator, dampening oscillations and causing us to barrel through narrow valleys, small humps and local minima.

**TODO:** Implement the **update_weights** function in **NN.py** with use_momentum=True.

**HINT**: $z$ is stored in `self.change`

In [ ]:
```
from utilities.localtests import TestNN

TestNN("test_update_weights_with_momentum").test_update_weights_with_momentu
```

```
test_update_weights_with_momentum passed!
```

## Compute Gradients

In order to compute the gradients of the loss with respect to each parameter, we use the equations that make up the forward pass:

$$\begin{aligned} u_1 &= \theta_1 X + b_1 \\ o_1 &= \text{leaky\_relu}(u_1) \\ u_2 &= \theta_2 o_1 + b_2 \\ o_2 &= \text{softmax}(u_2) \\ l &= \text{cross\_entropy}(o_2) \end{aligned}$$

When computing gradients, we travel backwards from the loss all the way back ot the input. We first seek to obtain the derivative of the loss $l$ with respect to the logits $u_2$. Note that they have the relation

$$l = \text{cross\_entropy}(\text{softmax}(u_2))$$

. Computing the derivative of this seems very involved, but it actually has a very elegant result:

$$\frac{\partial l}{\partial u_2} = \text{softmax}(u_2) - y = \hat{y} - y.$$

While this is given to you, we encourage you to derive it for yourself! You can find a great explanation of the derivation in this article.

Now that we have $\frac{\partial l}{\partial u_2}$, we seek to move further back and compute $\frac{\partial l}{\partial \theta_2}$ and $\frac{\partial l}{\partial b_2}$. This is done using the chain rule:

$$\begin{aligned} \frac{\partial l}{\partial \theta_2} &= \frac{\partial l}{\partial u_2} \cdot \frac{\partial u_2}{\partial \theta_2} \\ \frac{\partial l}{\partial b_2} &= \frac{\partial l}{\partial u_2} \cdot \frac{\partial u_2}{\partial b_2}. \end{aligned}$$

The quantities $\frac{\partial u_2}{\partial \theta_2}$ and $\frac{\partial u_2}{\partial b_2}$ are easy to derive from the relation $u_2 = \theta_2 o_1 + b_2$. We see that

$$\begin{aligned} \frac{\partial l}{\partial \theta_2} &= \frac{\partial l}{\partial u_2} \cdot o_1 \\ \frac{\partial l}{\partial b_2} &= \frac{\partial l}{\partial u_2} \cdot 1. \end{aligned}$$

Note that the derivative involves $o_1$, which we computed during the forward pass. Fortunately, we saved that value in `self.cache`, so we don't need to compute it again!

The same procedure is repeated to obtain the gradients for the upstream parameters $\theta_1$ and $b_1$. We must first perform the intermediate steps of computing the derivative of the loss with respect to $o_1$ and then $u_1$. These are given by

$$\frac{\partial l}{\partial o_1} = \frac{\partial l}{\partial u_2} \cdot \theta_2$$
$$\frac{\partial l}{\partial u_1} = \frac{\partial l}{\partial o_1} \cdot \frac{\partial \, \text{leaky\_relu}}{\partial u_1}.$$

In the second relation, we must consider our use of dropout! If we applied dropout on a particular neuron, it should not be adjusted. To account for this, in the case of `use_dropout=True`, we must instead use

$$\frac{\partial l}{\partial u_1} = \frac{\partial l}{\partial o_1} \cdot \frac{\partial \, \text{leaky\_relu}}{\partial u_1} \cdot \text{dropout\_mask} \cdot \frac{1}{1-p},$$

where $1/(1-p)$ is the scaling factor and dropout_mask is stored in `self.cache`.

The final step! We can use these values to compute the gradients for $\theta_1$ and $b_1$, using the relation $u_1 = \theta_1 X + b_1$, which are given by

$$\frac{\partial l}{\partial \theta_1} = \frac{\partial l}{\partial u_1} \cdot X$$
$$\frac{\partial l}{\partial b_1} = \frac{\partial l}{\partial u_1} \cdot 1.$$

## Implementation Tips

The above equations are given in matrix notation. When implementing these computations in code, the easiest way to make sure you are calculating the values correctly and in the right order is to check shapes. Any time you are doing a matrix/vector operation in NumPy, **check the shapes**.

Since we are computing these gradients over $N$ data points, we must divide the gradients by $N$ to take the *average* gradient. Make sure you are dividing by $N$ exactly once, no more and no less!

**TODO:** Implement the **compute_gradients** function in **NN.py**.

Hint: Refer to this guide for more detail on computing gradients.

In [ ]:
```
from utilities.localtests import TestNN

TestNN(
```

```
    "test_compute_gradients_without_dropout"
).test_compute_gradients_without_dropout()
TestNN("test_compute_gradients").test_compute_gradients()
```

```
test_compute_gradients_without_dropout passed!
test_compute_gradients passed!
```

```
[codecarbon INFO @ 04:43:55] Energy consumed for RAM : 0.007426 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:43:55] Energy consumed for all CPUs : 0.012381 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:43:55] 0.019807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:43:58] Energy consumed for RAM : 0.007476 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:43:58] Energy consumed for all CPUs : 0.012463 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:43:58] 0.019939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:10] Energy consumed for RAM : 0.007439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:44:10] Energy consumed for all CPUs : 0.012402 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:10] 0.019841 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:13] Energy consumed for RAM : 0.007489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:44:13] Energy consumed for all CPUs : 0.012484 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:13] 0.019973 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:25] Energy consumed for RAM : 0.007451 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:44:25] Energy consumed for all CPUs : 0.012423 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:25] 0.019874 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:28] Energy consumed for RAM : 0.007501 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:44:28] Energy consumed for all CPUs : 0.012505 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:28] 0.020006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:40] Energy consumed for RAM : 0.007464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:44:40] Energy consumed for all CPUs : 0.012443 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:40] 0.019907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:43] Energy consumed for RAM : 0.007514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:44:43] Energy consumed for all CPUs : 0.012526 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:43] 0.020039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:55] Energy consumed for RAM : 0.007476 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:44:55] Energy consumed for all CPUs : 0.012464 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:55] 0.019941 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:44:58] Energy consumed for RAM : 0.007526 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:44:58] Energy consumed for all CPUs : 0.012546 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:44:58] 0.020073 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:10] Energy consumed for RAM : 0.007489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:10] Energy consumed for all CPUs : 0.012485 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:10] 0.019974 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:13] Energy consumed for RAM : 0.007539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:13] Energy consumed for all CPUs : 0.012567 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:13] 0.020106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:25] Energy consumed for RAM : 0.007501 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:25] Energy consumed for all CPUs : 0.012506 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:25] 0.020007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:28] Energy consumed for RAM : 0.007551 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:28] Energy consumed for all CPUs : 0.012588 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:28] 0.020139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:40] Energy consumed for RAM : 0.007514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:40] Energy consumed for all CPUs : 0.012527 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:40] 0.020041 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:43] Energy consumed for RAM : 0.007564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:43] Energy consumed for all CPUs : 0.012609 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:43] 0.020173 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:55] Energy consumed for RAM : 0.007526 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:55] Energy consumed for all CPUs : 0.012548 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:55] 0.020074 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:45:58] Energy consumed for RAM : 0.007576 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:45:58] Energy consumed for all CPUs : 0.012630 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:45:58] 0.020206 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:10] Energy consumed for RAM : 0.007539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:10] Energy consumed for all CPUs : 0.012568 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:46:10] 0.020107 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:13] Energy consumed for RAM : 0.007589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:13] Energy consumed for all CPUs : 0.012651 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:46:13] 0.020239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:25] Energy consumed for RAM : 0.007551 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:25] Energy consumed for all CPUs : 0.012589 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:46:25] 0.020141 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:28] Energy consumed for RAM : 0.007601 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:28] Energy consumed for all CPUs : 0.012671 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:46:28] 0.020273 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:40] Energy consumed for RAM : 0.007564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:40] Energy consumed for all CPUs : 0.012610 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:46:40] 0.020174 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:43] Energy consumed for RAM : 0.007614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:43] Energy consumed for all CPUs : 0.012692 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:46:43] 0.020306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:55] Energy consumed for RAM : 0.007576 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:55] Energy consumed for all CPUs : 0.012631 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:46:55] 0.020207 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:46:58] Energy consumed for RAM : 0.007626 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:46:58] Energy consumed for all CPUs : 0.012713 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:46:58] 0.020339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:47:10] Energy consumed for RAM : 0.007589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:10] Energy consumed for all CPUs : 0.012652 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:10] 0.020241 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:47:13] Energy consumed for RAM : 0.007639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:13] Energy consumed for all CPUs : 0.012734 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:13] 0.020373 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:47:25] Energy consumed for RAM : 0.007601 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:25] Energy consumed for all CPUs : 0.012673 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:25] 0.020274 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:47:28] Energy consumed for RAM : 0.007651 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:28] Energy consumed for all CPUs : 0.012755 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:28] 0.020406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:47:40] Energy consumed for RAM : 0.007614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:40] Energy consumed for all CPUs : 0.012693 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:40] 0.020307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:47:43] Energy consumed for RAM : 0.007664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:43] Energy consumed for all CPUs : 0.012776 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:43] 0.020439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:47:55] Energy consumed for RAM : 0.007626 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:55] Energy consumed for all CPUs : 0.012714 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:55] 0.020341 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:47:58] Energy consumed for RAM : 0.007676 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:47:58] Energy consumed for all CPUs : 0.012796 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:47:58] 0.020473 kWh of electricity used since the begi
nning.
```

Now that we know how to compute relevant gradients and how to update the weights of our network, we can perform the entire backwards step.

**TODO:** Implement the **backward** function in **NN.py**.

### 1.1.1 Local Test: Gradient Descent

You may test your implementation of the GD function contained in **NN.py** in the cell below. See Using the Local Tests for more details. Look at the function documentation in gradient_descent for guidance.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
from utilities.localtests import TestNN
```

```
TestNN("test_gradient_descent").test_gradient_descent()
```

```
Iteration 0: Loss = 1.1821349083552721
Iteration 1: Loss = 1.1801326554281033
Iteration 2: Loss = 1.1781840593231951

Your GD losses works within the expected range: True
[codecarbon INFO @ 04:13:54] Energy consumed for RAM : 0.005927 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:13:54] Energy consumed for all CPUs : 0.009880 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:13:54] 0.015807 kWh of electricity used since the begi
nning.
```

### 1.1.2 Local Test: Batch Gradient Descent [No Points]

You may test your implementation of the BGD function contained in **NN.py** in the cell below. See Using the Local Tests for more details. Look at the function documentation in gradient_descent for guidance.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################

from utilities.localtests import TestNN

TestNN("test_batch_gradient_descent").test_batch_gradient_descent()
```

```
Unexpected exception formatting exception. Falling back to standard exceptio
n
```

```
Traceback (most recent call last):
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/interactiveshell.py", line 3553, in run_code
    exec(code_obj, self.user_global_ns, self.user_ns)
  File "/var/folders/rx/4mtzy3y13t9f2njmm29j60pm0000gp/T/ipykernel_63473/350
9729522.py", line 7, in <module>
    TestNN("test_batch_gradient_descent").test_batch_gradient_descent()
  File "/Users/viditpokharna/Desktop/georgia-tech/spring24/cs7641-mahdi-vp/H
W4/student_files/utilities/localtests.py", line 812, in test_batch_gradient_
descent
    nn.batch_gradient_descent(
  File "/Users/viditpokharna/Desktop/georgia-tech/spring24/cs7641-mahdi-vp/H
W4/student_files/NN.py", line 413, in batch_gradient_descent
    self.backward(y_batch, y_hat, use_dropout=True, use_momentum=use_momentu
m)
  File "/Users/viditpokharna/Desktop/georgia-tech/spring24/cs7641-mahdi-vp/H
W4/student_files/NN.py", line 322, in backward
    gradients = self.compute_gradients(y, yh, use_dropout)
                ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/Desktop/georgia-tech/spring24/cs7641-mahdi-vp/H
W4/student_files/NN.py", line 282, in compute_gradients
    dLoss_theta2 = self.cache["o1"].T.dot(dLoss_u2) / y.shape[0]
                   ~~~~~~~~~~~^^^^^^
KeyError: 'o1'

During handling of the above exception, another exception occurred:

Traceback (most recent call last):
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/interactiveshell.py", line 2144, in showtraceback
    stb = self.InteractiveTB.structured_traceback(
          ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/ultratb.py", line 1435, in structured_traceback
    return FormattedTB.structured_traceback(
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/ultratb.py", line 1326, in structured_traceback
    return VerboseTB.structured_traceback(
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/ultratb.py", line 1173, in structured_traceback
    formatted_exception = self.format_exception_as_a_whole(etype, evalue, et
b, number_of_lines_of_context,
                          ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/ultratb.py", line 1088, in format_exception_as_a_whole
    frames.append(self.format_record(record))
                  ^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/ultratb.py", line 970, in format_record
    frame_info.lines, Colors, self.has_colors, lvals
    ^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/IPython/core/ultratb.py", line 792, in lines
```

```
    return self._sd.lines
           ^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/stack_data/utils.py", line 145, in cached_property_wrapper
    value = obj.__dict__[self.func.__name__] = self.func(obj)
                                               ^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/stack_data/core.py", line 698, in lines
    pieces = self.included_pieces
             ^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/stack_data/utils.py", line 145, in cached_property_wrapper
    value = obj.__dict__[self.func.__name__] = self.func(obj)
                                               ^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/stack_data/core.py", line 649, in included_pieces
    pos = scope_pieces.index(self.executing_piece)
                             ^^^^^^^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/stack_data/utils.py", line 145, in cached_property_wrapper
    value = obj.__dict__[self.func.__name__] = self.func(obj)
                                               ^^^^^^^^^^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/stack_data/core.py", line 628, in executing_piece
    return only(
           ^^^^^
  File "/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packa
ges/executing/executing.py", line 164, in only
    raise NotOneValueFound('Expected one value, found 0')
executing.executing.NotOneValueFound: Expected one value, found 0
[codecarbon INFO @ 04:13:57] Energy consumed for RAM : 0.005976 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:13:57] Energy consumed for all CPUs : 0.009963 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:13:57] 0.015939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:09] Energy consumed for RAM : 0.005939 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:14:09] Energy consumed for all CPUs : 0.009901 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:09] 0.015840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:12] Energy consumed for RAM : 0.005989 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:14:12] Energy consumed for all CPUs : 0.009983 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:12] 0.015972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:24] Energy consumed for RAM : 0.005952 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:14:24] Energy consumed for all CPUs : 0.009922 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:24] 0.015874 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:27] Energy consumed for RAM : 0.006002 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:14:27] Energy consumed for all CPUs : 0.010004 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:27] 0.016006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:39] Energy consumed for RAM : 0.005964 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:14:39] Energy consumed for all CPUs : 0.009943 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:39] 0.015907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:42] Energy consumed for RAM : 0.006014 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:14:42] Energy consumed for all CPUs : 0.010025 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:42] 0.016039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:54] Energy consumed for RAM : 0.005977 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:14:54] Energy consumed for all CPUs : 0.009964 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:54] 0.015940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:14:57] Energy consumed for RAM : 0.006026 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:14:57] Energy consumed for all CPUs : 0.010046 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:14:57] 0.016072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:15:09] Energy consumed for RAM : 0.005989 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:09] Energy consumed for all CPUs : 0.009984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:15:09] 0.015974 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:15:12] Energy consumed for RAM : 0.006039 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:12] Energy consumed for all CPUs : 0.010067 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:15:12] 0.016106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:15:24] Energy consumed for RAM : 0.006002 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:24] Energy consumed for all CPUs : 0.010005 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:15:24] 0.016007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:15:27] Energy consumed for RAM : 0.006051 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:27] Energy consumed for all CPUs : 0.010088 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:15:27] 0.016139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:15:39] Energy consumed for RAM : 0.006014 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:39] Energy consumed for all CPUs : 0.010026 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:15:39] 0.016040 kWh of electricity used since the begi
nning.
```

### 1.1.3 Local Test: Gradient Descent with Momentum

You may test your implementation of the GD function with momentum contained in **NN.py** in the cell below. See Using the Local Tests for more details. Revisit your implementation for update_weights.

In [ ]:
```
##############################
### DO NOT CHANGE THIS CELL ###
##############################

from utilities.localtests import TestNN

TestNN("test_gradient_descent_with_momentum").test_gradient_descent_with_mom
```

```
[codecarbon INFO @ 04:15:42] Energy consumed for RAM : 0.006064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:42] Energy consumed for all CPUs : 0.010109 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:15:42] 0.016173 kWh of electricity used since the begi
nning.
Iteration 0: Loss = 1.1821349083552721
Iteration 1: Loss = 1.1801326554281033
Iteration 2: Loss = 1.1772072264478595

Your GD losses works within the expected range: True
```

## 1.2 Loss plot and CE value for NN with Gradient Descent [5pts] [W]

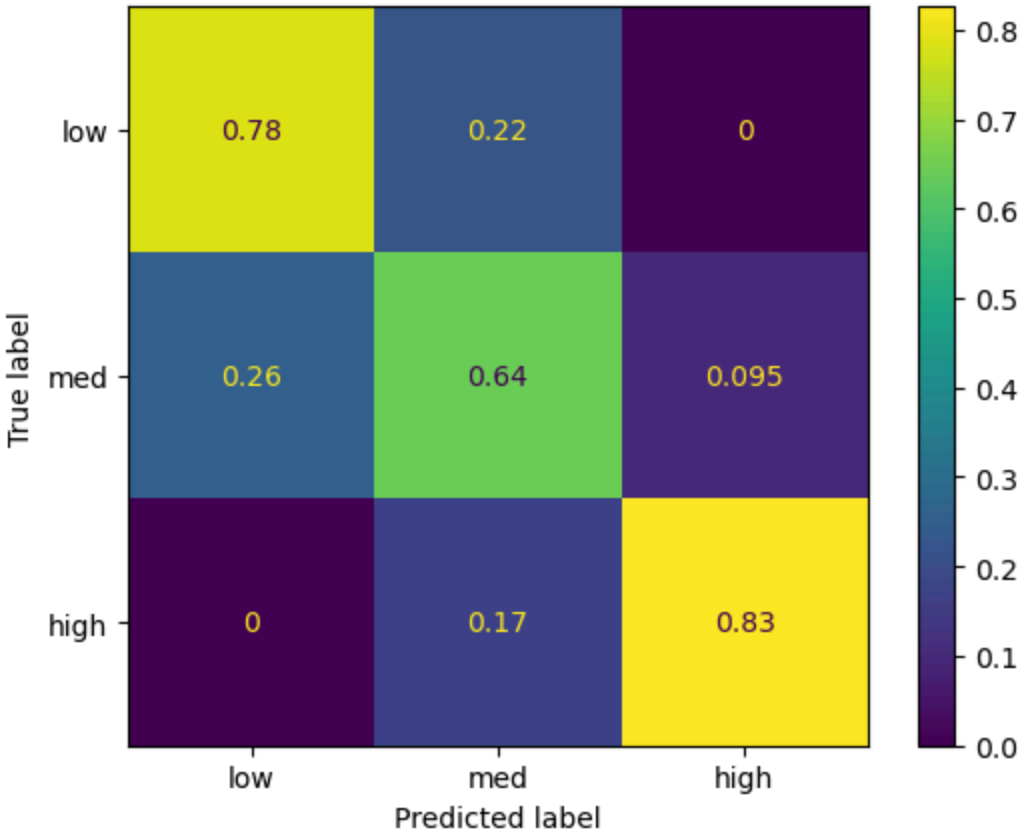
Train your neural net implementation with gradient descent and print out the loss at every 1000th iteration (starting at iteration 0). The following cells will plot the loss vs epoch graph and calculate the final test CE.

In [ ]:
```
##############################
### DO NOT CHANGE THIS CELL ###
##############################
from NN import NeuralNet
from sklearn.metrics import ConfusionMatrixDisplay, confusion_matrix

x_train, y_train, x_test, y_test = get_housing_dataset()

nn = NeuralNet(
    y_train, lr=0.01, use_dropout=False, use_momentum=False
)  # initalize neural net class
nn.gradient_descent(x_train, y_train, iter=60000)  # train
```

```
Iteration 0: Loss = 1.1821349083552721
Iteration 1000: Loss = 1.015625141033514
Iteration 2000: Loss = 0.9073306197990985
Iteration 3000: Loss = 0.810578132541653
Iteration 4000: Loss = 0.7431299257869337
Iteration 5000: Loss = 0.7002884095202481
Iteration 6000: Loss = 0.6723178887686831
Iteration 7000: Loss = 0.6526220698014406
Iteration 8000: Loss = 0.6376421074686497
Iteration 9000: Loss = 0.6254331331097435
Iteration 10000: Loss = 0.6155121495841273
Iteration 11000: Loss = 0.6070795058047862
Iteration 12000: Loss = 0.5997240362846191
Iteration 13000: Loss = 0.592748292179928
Iteration 14000: Loss = 0.5859696818083453
Iteration 15000: Loss = 0.580367777602475
Iteration 16000: Loss = 0.575354803603716
Iteration 17000: Loss = 0.5707408829274436
Iteration 18000: Loss = 0.5665760017202444
Iteration 19000: Loss = 0.5627742530724222
Iteration 20000: Loss = 0.559175746011243
Iteration 21000: Loss = 0.5557748477842221
Iteration 22000: Loss = 0.5527409071266429
Iteration 23000: Loss = 0.549943286341617
Iteration 24000: Loss = 0.54737534419616
Iteration 25000: Loss = 0.544993545076374
Iteration 26000: Loss = 0.5428044329276774
Iteration 27000: Loss = 0.5407024607829822
Iteration 28000: Loss = 0.5387166534629494
Iteration 29000: Loss = 0.5369362612028364
Iteration 30000: Loss = 0.5351890000017362
Iteration 31000: Loss = 0.5335971286146891
Iteration 32000: Loss = 0.532165250761478
Iteration 33000: Loss = 0.5308353758900638
Iteration 34000: Loss = 0.5295826355866495
Iteration 35000: Loss = 0.528409894400138
Iteration 36000: Loss = 0.5273192747481503
Iteration 37000: Loss = 0.5262914915298162
Iteration 38000: Loss = 0.5253155191389499
Iteration 39000: Loss = 0.5243868398895661
Iteration 40000: Loss = 0.5234998314680707
Iteration 41000: Loss = 0.5226540904348338
Iteration 42000: Loss = 0.5218464461980202
Iteration 43000: Loss = 0.5210680465746346
Iteration 44000: Loss = 0.520315074527185
Iteration 45000: Loss = 0.5195844658432204
Iteration 46000: Loss = 0.5188747650590463
Iteration 47000: Loss = 0.518183390285228
Iteration 48000: Loss = 0.5175100243695915
Iteration 49000: Loss = 0.5168509412082805
Iteration 50000: Loss = 0.5162067380146425
Iteration 51000: Loss = 0.5155752226781267
Iteration 52000: Loss = 0.5149548999312145
Iteration 53000: Loss = 0.5143410785687484
Iteration 54000: Loss = 0.5137392128054324
Iteration 55000: Loss = 0.5131486054842583
```

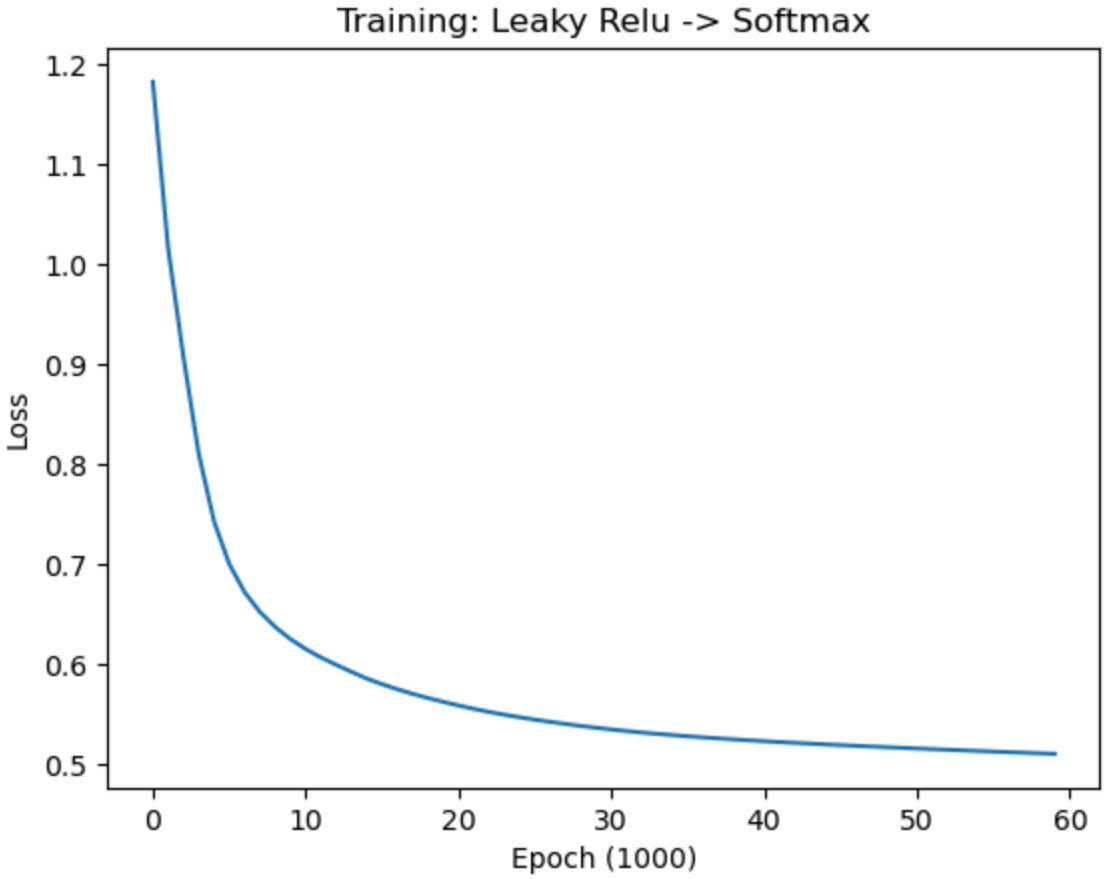
```
[codecarbon INFO @ 04:15:54] Energy consumed for RAM : 0.006027 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:54] Energy consumed for all CPUs : 0.010047 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:15:54] 0.016074 kWh of electricity used since the begi
nning.
Iteration 56000: Loss = 0.5125675273715841
Iteration 57000: Loss = 0.5119943267346897
Iteration 58000: Loss = 0.5114286984739267
Iteration 59000: Loss = 0.5108693907620523
[codecarbon INFO @ 04:15:57] Energy consumed for RAM : 0.006076 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:15:57] Energy consumed for all CPUs : 0.010129 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:15:57] 0.016206 kWh of electricity used since the begi
nning.
```

In [ ]:
```
# Plot confusion matrix
y_true = np.argmax(y_test, axis=1)
y_pred = nn.predict(x_test)
display_labels = ["low", "med", "high"]
ConfusionMatrixDisplay.from_predictions(
    y_true, y_pred, normalize="true", display_labels=display_labels
)
plt.show()
```



```
[codecarbon INFO @ 04:16:09] Energy consumed for RAM : 0.006039 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:09] Energy consumed for all CPUs : 0.010068 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:09] 0.016107 kWh of electricity used since the begi
nning.
```

In [ ]:
```
# Plot training loss
fig = plt.plot(np.array(nn.loss).squeeze())
plt.title(f"Training: {nn.neural_net_type}")
plt.xlabel("Epoch (1000)")
plt.ylabel("Loss")
plt.show()
```




```
[codecarbon INFO @ 04:16:12] Energy consumed for RAM : 0.006089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:12] Energy consumed for all CPUs : 0.010150 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:12] 0.016239 kWh of electricity used since the begi
nning.
```

In [ ]:
```
# Total loss
y_hat = nn.forward(x_test, use_dropout=False)
print("Cross entropy loss:", round(nn.cross_entropy_loss(y_test, y_hat), 3))
```

```
Cross entropy loss: 0.752
```

```
[codecarbon INFO @ 04:16:24] Energy consumed for RAM : 0.006052 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:24] Energy consumed for all CPUs : 0.010089 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:24] 0.016140 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:16:27] Energy consumed for RAM : 0.006101 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:27] Energy consumed for all CPUs : 0.010171 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:27] 0.016272 kWh of electricity used since the begi
nning.
```

## 1.3 Loss plot and CE value for NN with BGD [5pts Grad / 0.7% Bonus for Undergrad] [W]

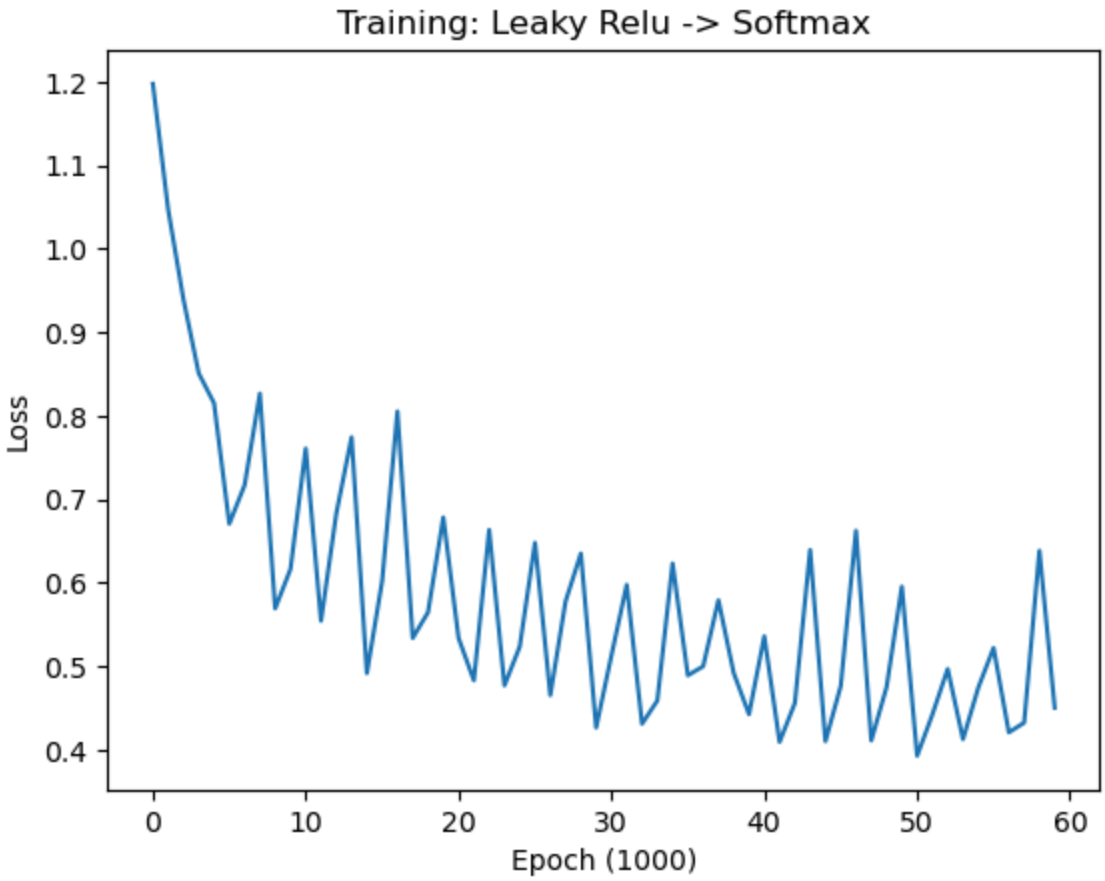
Train your neural net implementation with batch gradient descent and print out the loss at every 1000th iteration (starting at iteration 0). The following cells will plot the loss vs epoch graph and calculate the final test CE.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
from NN import NeuralNet
from sklearn.metrics import ConfusionMatrixDisplay, confusion_matrix

x_train, y_train, x_test, y_test = get_housing_dataset()

nn = NeuralNet(
    y_train, lr=0.01, use_dropout=True, use_momentum=False
)  # initalize neural net class
nn.batch_gradient_descent(x_train, y_train, iter=60000, use_momentum=False)
```

```
Iteration 0, Loss: 1.1975700080459264
Iteration 1000, Loss: 1.047014693124903
Iteration 2000, Loss: 0.9394148233831359
Iteration 3000, Loss: 0.8509927747558794
Iteration 4000, Loss: 0.8152518510298619
Iteration 5000, Loss: 0.6707470250762821
Iteration 6000, Loss: 0.7170841662942928
Iteration 7000, Loss: 0.8266692539282692
Iteration 8000, Loss: 0.5693199325954419
Iteration 9000, Loss: 0.6163971282936322
Iteration 10000, Loss: 0.760887884837642
Iteration 11000, Loss: 0.554579984186095
Iteration 12000, Loss: 0.6831033009789866
Iteration 13000, Loss: 0.7744995416225702
Iteration 14000, Loss: 0.4918666537300444
Iteration 15000, Loss: 0.602357989611155
Iteration 16000, Loss: 0.805420558725469
Iteration 17000, Loss: 0.5339966961716451
Iteration 18000, Loss: 0.5647714609994379
Iteration 19000, Loss: 0.6784579610789878
Iteration 20000, Loss: 0.5338115247671618
Iteration 21000, Loss: 0.4832106767871922
Iteration 22000, Loss: 0.6635019882807549
Iteration 23000, Loss: 0.4771153905489181
Iteration 24000, Loss: 0.5237168629121056
Iteration 25000, Loss: 0.6480459782186088
Iteration 26000, Loss: 0.4655661288177983
Iteration 27000, Loss: 0.5779085937478572
Iteration 28000, Loss: 0.6352308767310038
Iteration 29000, Loss: 0.4267521818354539
Iteration 30000, Loss: 0.5132024796646272
Iteration 31000, Loss: 0.5976794951234856
Iteration 32000, Loss: 0.4312589679645711
Iteration 33000, Loss: 0.4589420605141199
Iteration 34000, Loss: 0.6232379547841784
Iteration 35000, Loss: 0.4892754455444667
Iteration 36000, Loss: 0.5001044036491354
Iteration 37000, Loss: 0.5793662949998848
Iteration 38000, Loss: 0.49209665537590797
Iteration 39000, Loss: 0.44267654749704377
Iteration 40000, Loss: 0.5361011450982778
Iteration 41000, Loss: 0.4094669280335508
Iteration 42000, Loss: 0.4561052949446892
Iteration 43000, Loss: 0.6394853233101367
Iteration 44000, Loss: 0.4103212917257898
Iteration 45000, Loss: 0.4763262913374649
Iteration 46000, Loss: 0.6624023464674029
Iteration 47000, Loss: 0.4112084595638294
Iteration 48000, Loss: 0.47527048198146205
Iteration 49000, Loss: 0.5955736751801554
Iteration 50000, Loss: 0.39291119184745227
Iteration 51000, Loss: 0.442582332672094
Iteration 52000, Loss: 0.4969590479266905
Iteration 53000, Loss: 0.41277811135767123
Iteration 54000, Loss: 0.4745695445182499
Iteration 55000, Loss: 0.5221382688548287
```

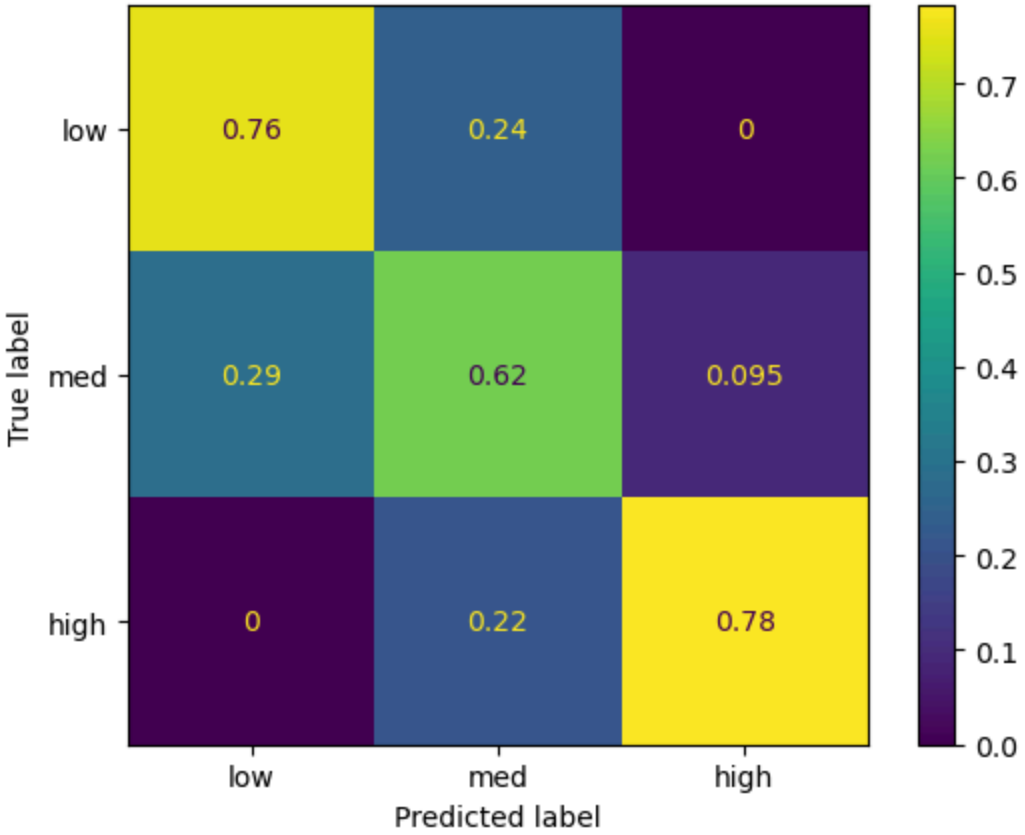
```
Iteration 56000, Loss: 0.4209877374254116
Iteration 57000, Loss: 0.4325816574285274
Iteration 58000, Loss: 0.6385345171395895
Iteration 59000, Loss: 0.4504900733292504
```

In [ ]:
```python
# Plot training loss
fig = plt.plot(np.array(nn.loss).squeeze())
plt.title(f"Training: {nn.neural_net_type}")
plt.xlabel("Epoch (1000)")
plt.ylabel("Loss")
plt.show()
```




```
[codecarbon INFO @ 04:16:39] Energy consumed for RAM : 0.006064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:39] Energy consumed for all CPUs : 0.010109 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:39] 0.016174 kWh of electricity used since the begi
nning.
```

In [ ]:
```python
# Plot confusion matrix
y_true = np.argmax(y_test, axis=1)
y_pred = nn.predict(x_test)
display_labels = ["low", "med", "high"]
ConfusionMatrixDisplay.from_predictions(
    y_true, y_pred, normalize="true", display_labels=display_labels
)
plt.show()
```




In [ ]:
```
# Total loss
y_hat = nn.forward(x_test, use_dropout=False)
print("Cross entropy loss:", round(nn.cross_entropy_loss(y_test, y_hat), 3))
```

```
Cross entropy loss: 0.811
[codecarbon INFO @ 04:16:42] Energy consumed for RAM : 0.006114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:42] Energy consumed for all CPUs : 0.010192 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:42] 0.016306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:16:42] Energy consumed for all CPUs : 0.010192 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:42] 0.016306 kWh of electricity used since the begi
nning.
```

## 1.4 Loss plot and CE value for NN with Gradient Descent with Momentum [5pts Grad / 0.6% Bonus for Undergrad] [W]

Train your neural net implementation with gradient descent with momentum and print out the loss at every 1000th iteration (starting at iteration 0). The following cells will plot the loss vs epoch graph and calculate the final test CE.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
```

```
##############################
from NN import NeuralNet
from sklearn.metrics import ConfusionMatrixDisplay, confusion_matrix

x_train, y_train, x_test, y_test = get_housing_dataset()

nn = NeuralNet(
    y_train, lr=0.01, use_dropout=False, use_momentum=True
)  # initalize neural net class
nn.gradient_descent(x_train, y_train, iter=60000, use_momentum=True)  # trai
```

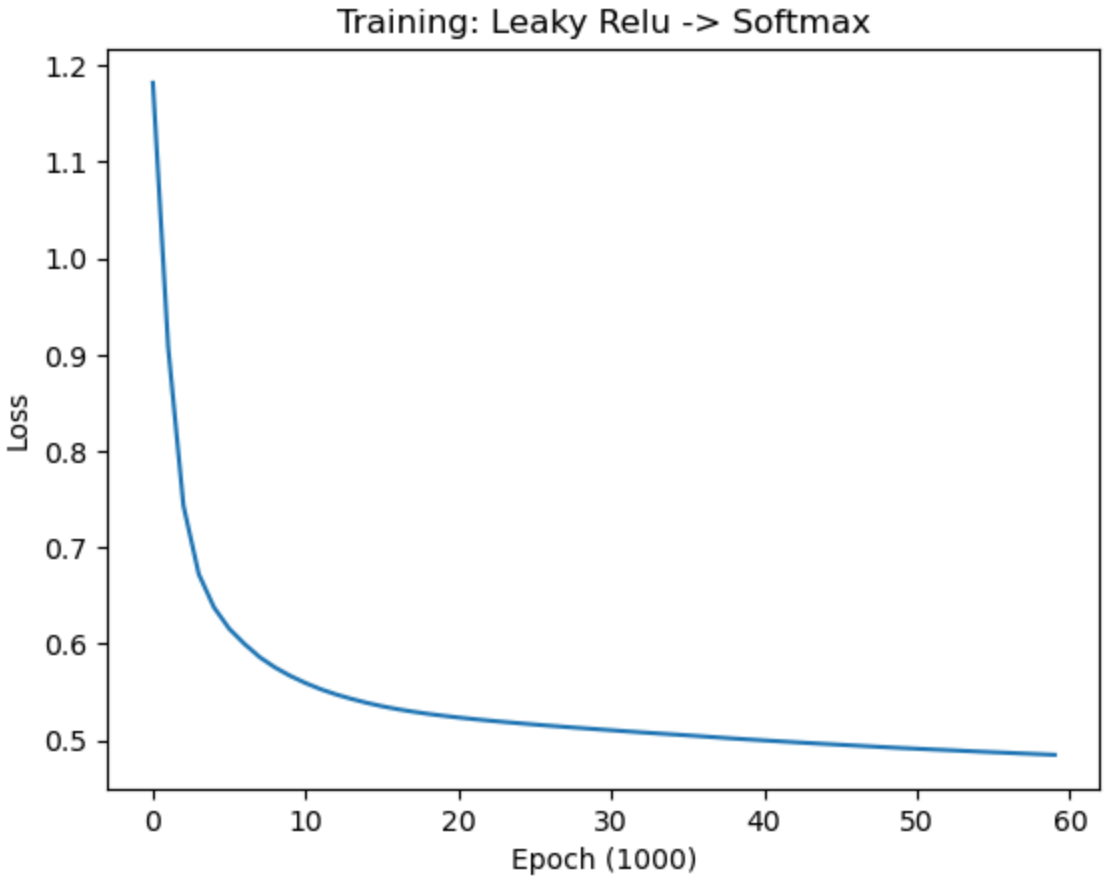
```
Iteration 0: Loss = 1.1821349083552721
Iteration 1000: Loss = 0.9077666931281345
Iteration 2000: Loss = 0.7433410309285499
Iteration 3000: Loss = 0.6724075081131817
Iteration 4000: Loss = 0.6376986066001584
Iteration 5000: Loss = 0.6155546570274347
Iteration 6000: Loss = 0.5997609445971269
Iteration 7000: Loss = 0.586001566762959
Iteration 8000: Loss = 0.5753810571099479
Iteration 9000: Loss = 0.5665987565512002
Iteration 10000: Loss = 0.5591968099853745
Iteration 11000: Loss = 0.5527579029654528
Iteration 12000: Loss = 0.5473890700088094
Iteration 13000: Loss = 0.5428157858850438
Iteration 14000: Loss = 0.5387271689534832
Iteration 15000: Loss = 0.5351987197021071
Iteration 16000: Loss = 0.5321723641262808
Iteration 17000: Loss = 0.5295890892726565
Iteration 18000: Loss = 0.5273250705616637
Iteration 19000: Loss = 0.5253213342533336
Iteration 20000: Loss = 0.523505413813381
Iteration 21000: Loss = 0.5218510529509272
Iteration 22000: Loss = 0.5203193792742086
Iteration 23000: Loss = 0.5188787231365
Iteration 24000: Loss = 0.517513700415503
Iteration 25000: Loss = 0.5162101744761436
Iteration 26000: Loss = 0.5149581147625224
Iteration 27000: Loss = 0.5137422538217254
Iteration 28000: Loss = 0.5125704638730091
Iteration 29000: Loss = 0.5114315063564134
Iteration 30000: Loss = 0.5103137082791849
Iteration 31000: Loss = 0.5091824465973809
Iteration 32000: Loss = 0.5080791444474151
Iteration 33000: Loss = 0.5070295335176728
Iteration 34000: Loss = 0.5060168639938373
Iteration 35000: Loss = 0.504997019666275
```

```
[codecarbon INFO @ 04:16:54] Energy consumed for RAM : 0.006077 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:54] Energy consumed for all CPUs : 0.010130 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:54] 0.016207 kWh of electricity used since the begi
nning.
```

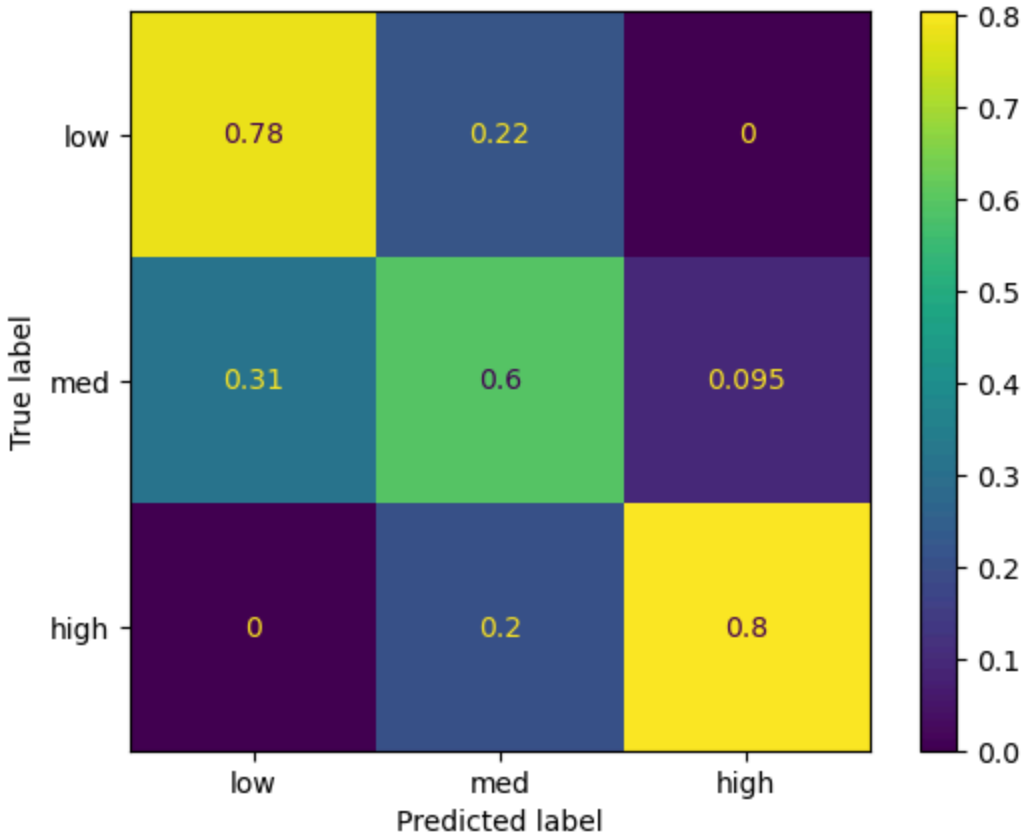
```
Iteration 36000: Loss = 0.5039010255894524
Iteration 37000: Loss = 0.5028118218294261
Iteration 38000: Loss = 0.5017228388730883
Iteration 39000: Loss = 0.5007173866303233
Iteration 40000: Loss = 0.4997637037965427
Iteration 41000: Loss = 0.4988244262901487
Iteration 42000: Loss = 0.49787118990851786
Iteration 43000: Loss = 0.49695546001483726
Iteration 44000: Loss = 0.4960848878340883
Iteration 45000: Loss = 0.49523025379671104
Iteration 46000: Loss = 0.4943876918803919
Iteration 47000: Loss = 0.4934877878029714
Iteration 48000: Loss = 0.49263216867464205
Iteration 49000: Loss = 0.4918436771245543
Iteration 50000: Loss = 0.49109613778031613
Iteration 51000: Loss = 0.49036417736072707
Iteration 52000: Loss = 0.489667183588438
Iteration 53000: Loss = 0.4889457043825784
Iteration 54000: Loss = 0.48818902043288076
Iteration 55000: Loss = 0.48749126050865077
Iteration 56000: Loss = 0.4868029248830703
Iteration 57000: Loss = 0.486133277257346
Iteration 58000: Loss = 0.4854766236260259
Iteration 59000: Loss = 0.48478026719297757
[codecarbon INFO @ 04:16:57] Energy consumed for RAM : 0.006126 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:16:57] Energy consumed for all CPUs : 0.010213 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:16:57] 0.016339 kWh of electricity used since the begi
nning.
```

In [ ]:

```
# Plot training loss
fig = plt.plot(np.array(nn.loss).squeeze())
plt.title(f"Training: {nn.neural_net_type}")
plt.xlabel("Epoch (1000)")
plt.ylabel("Loss")
plt.show()
```




In [ ]:
```
# Plot confusion matrix
y_true = np.argmax(y_test, axis=1)
y_pred = nn.predict(x_test)
display_labels = ["low", "med", "high"]
ConfusionMatrixDisplay.from_predictions(
    y_true, y_pred, normalize="true", display_labels=display_labels
)
plt.show()
```




In [ ]:
```
# Total loss
y_hat = nn.forward(x_test, use_dropout=False)
print("Cross entropy loss:", round(nn.cross_entropy_loss(y_test, y_hat), 3))
```

```
Cross entropy loss: 0.733
```

```
[codecarbon INFO @ 04:17:09] Energy consumed for RAM : 0.006089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:09] Energy consumed for all CPUs : 0.010151 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:09] 0.016240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:17:12] Energy consumed for RAM : 0.006139 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:12] Energy consumed for all CPUs : 0.010233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:12] 0.016372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:17:24] Energy consumed for RAM : 0.006102 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:24] Energy consumed for all CPUs : 0.010172 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:24] 0.016274 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:17:27] Energy consumed for RAM : 0.006151 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:27] Energy consumed for all CPUs : 0.010254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:27] 0.016406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:17:39] Energy consumed for RAM : 0.006114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:39] Energy consumed for all CPUs : 0.010193 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:39] 0.016307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:17:42] Energy consumed for RAM : 0.006164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:42] Energy consumed for all CPUs : 0.010275 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:42] 0.016439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:17:54] Energy consumed for RAM : 0.006127 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:54] Energy consumed for all CPUs : 0.010214 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:54] 0.016340 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:17:57] Energy consumed for RAM : 0.006176 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:17:57] Energy consumed for all CPUs : 0.010296 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:17:57] 0.016472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:09] Energy consumed for RAM : 0.006139 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:18:09] Energy consumed for all CPUs : 0.010235 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:09] 0.016374 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:12] Energy consumed for RAM : 0.006189 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:18:12] Energy consumed for all CPUs : 0.010317 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:12] 0.016506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:24] Energy consumed for RAM : 0.006152 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:18:24] Energy consumed for all CPUs : 0.010255 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:24] 0.016407 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:27] Energy consumed for RAM : 0.006201 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:18:27] Energy consumed for all CPUs : 0.010338 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:27] 0.016539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:39] Energy consumed for RAM : 0.006164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:18:39] Energy consumed for all CPUs : 0.010276 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:39] 0.016440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:42] Energy consumed for RAM : 0.006214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:18:42] Energy consumed for all CPUs : 0.010358 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:42] 0.016572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:54] Energy consumed for RAM : 0.006177 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:18:54] Energy consumed for all CPUs : 0.010297 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:54] 0.016474 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:18:57] Energy consumed for RAM : 0.006226 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:18:57] Energy consumed for all CPUs : 0.010379 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:18:57] 0.016606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:09] Energy consumed for RAM : 0.006189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:09] Energy consumed for all CPUs : 0.010318 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:19:09] 0.016507 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:12] Energy consumed for RAM : 0.006239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:12] Energy consumed for all CPUs : 0.010400 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:19:12] 0.016639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:24] Energy consumed for RAM : 0.006202 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:24] Energy consumed for all CPUs : 0.010339 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:19:24] 0.016540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:27] Energy consumed for RAM : 0.006251 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:27] Energy consumed for all CPUs : 0.010421 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:19:27] 0.016672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:39] Energy consumed for RAM : 0.006214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:39] Energy consumed for all CPUs : 0.010360 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:19:39] 0.016574 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:42] Energy consumed for RAM : 0.006264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:42] Energy consumed for all CPUs : 0.010442 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:19:42] 0.016706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:54] Energy consumed for RAM : 0.006227 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:54] Energy consumed for all CPUs : 0.010380 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:19:54] 0.016607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:19:57] Energy consumed for RAM : 0.006276 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:19:57] Energy consumed for all CPUs : 0.010463 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:19:57] 0.016739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:20:09] Energy consumed for RAM : 0.006239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:09] Energy consumed for all CPUs : 0.010401 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:09] 0.016640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:20:12] Energy consumed for RAM : 0.006289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:12] Energy consumed for all CPUs : 0.010483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:12] 0.016772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:20:24] Energy consumed for RAM : 0.006252 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:24] Energy consumed for all CPUs : 0.010422 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:24] 0.016674 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:20:27] Energy consumed for RAM : 0.006301 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:27] Energy consumed for all CPUs : 0.010504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:27] 0.016806 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:20:39] Energy consumed for RAM : 0.006264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:39] Energy consumed for all CPUs : 0.010443 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:39] 0.016707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:20:42] Energy consumed for RAM : 0.006314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:42] Energy consumed for all CPUs : 0.010525 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:42] 0.016839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:20:54] Energy consumed for RAM : 0.006277 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:54] Energy consumed for all CPUs : 0.010464 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:54] 0.016740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:20:57] Energy consumed for RAM : 0.006326 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:20:57] Energy consumed for all CPUs : 0.010546 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:20:57] 0.016872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:09] Energy consumed for RAM : 0.006289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:21:09] Energy consumed for all CPUs : 0.010485 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:09] 0.016774 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:12] Energy consumed for RAM : 0.006339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:21:12] Energy consumed for all CPUs : 0.010567 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:12] 0.016906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:24] Energy consumed for RAM : 0.006302 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:21:24] Energy consumed for all CPUs : 0.010505 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:24] 0.016807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:27] Energy consumed for RAM : 0.006351 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:21:28] Energy consumed for all CPUs : 0.010588 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:28] 0.016939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:39] Energy consumed for RAM : 0.006314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:21:39] Energy consumed for all CPUs : 0.010526 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:39] 0.016840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:42] Energy consumed for RAM : 0.006364 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:21:42] Energy consumed for all CPUs : 0.010609 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:42] 0.016972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:54] Energy consumed for RAM : 0.006327 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:21:54] Energy consumed for all CPUs : 0.010547 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:54] 0.016874 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:21:57] Energy consumed for RAM : 0.006376 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:21:58] Energy consumed for all CPUs : 0.010629 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:21:58] 0.017006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:09] Energy consumed for RAM : 0.006339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:09] Energy consumed for all CPUs : 0.010568 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:22:09] 0.016907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:12] Energy consumed for RAM : 0.006389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:13] Energy consumed for all CPUs : 0.010650 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:22:13] 0.017039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:24] Energy consumed for RAM : 0.006352 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:24] Energy consumed for all CPUs : 0.010589 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:22:24] 0.016940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:28] Energy consumed for RAM : 0.006401 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:28] Energy consumed for all CPUs : 0.010671 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:22:28] 0.017072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:39] Energy consumed for RAM : 0.006364 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:39] Energy consumed for all CPUs : 0.010610 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:22:39] 0.016974 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:43] Energy consumed for RAM : 0.006414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:43] Energy consumed for all CPUs : 0.010692 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:22:43] 0.017106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:54] Energy consumed for RAM : 0.006377 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:54] Energy consumed for all CPUs : 0.010630 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:22:54] 0.017007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:22:58] Energy consumed for RAM : 0.006426 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:22:58] Energy consumed for all CPUs : 0.010713 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:22:58] 0.017139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:09] Energy consumed for RAM : 0.006389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:09] Energy consumed for all CPUs : 0.010651 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:09] 0.017040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:13] Energy consumed for RAM : 0.006439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:13] Energy consumed for all CPUs : 0.010734 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:13] 0.017172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:24] Energy consumed for RAM : 0.006402 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:24] Energy consumed for all CPUs : 0.010672 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:24] 0.017074 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:28] Energy consumed for RAM : 0.006451 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:28] Energy consumed for all CPUs : 0.010754 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:28] 0.017206 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:39] Energy consumed for RAM : 0.006414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:39] Energy consumed for all CPUs : 0.010693 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:39] 0.017107 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:43] Energy consumed for RAM : 0.006464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:43] Energy consumed for all CPUs : 0.010775 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:43] 0.017239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:54] Energy consumed for RAM : 0.006427 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:54] Energy consumed for all CPUs : 0.010714 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:54] 0.017140 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:23:58] Energy consumed for RAM : 0.006476 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:23:58] Energy consumed for all CPUs : 0.010796 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:23:58] 0.017272 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:24:09] Energy consumed for RAM : 0.006439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:09] Energy consumed for all CPUs : 0.010735 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:09] 0.017174 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:24:13] Energy consumed for RAM : 0.006489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:13] Energy consumed for all CPUs : 0.010817 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:13] 0.017306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:24:24] Energy consumed for RAM : 0.006452 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:24] Energy consumed for all CPUs : 0.010755 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:24] 0.017207 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:24:28] Energy consumed for RAM : 0.006501 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:28] Energy consumed for all CPUs : 0.010838 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:28] 0.017339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:24:39] Energy consumed for RAM : 0.006464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:39] Energy consumed for all CPUs : 0.010776 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:39] 0.017240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:24:43] Energy consumed for RAM : 0.006514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:43] Energy consumed for all CPUs : 0.010859 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:43] 0.017372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:24:54] Energy consumed for RAM : 0.006477 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:54] Energy consumed for all CPUs : 0.010797 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:54] 0.017274 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:24:58] Energy consumed for RAM : 0.006526 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:24:58] Energy consumed for all CPUs : 0.010879 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:24:58] 0.017406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:09] Energy consumed for RAM : 0.006489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:25:09] Energy consumed for all CPUs : 0.010818 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:09] 0.017307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:13] Energy consumed for RAM : 0.006539 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:25:13] Energy consumed for all CPUs : 0.010900 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:13] 0.017439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:24] Energy consumed for RAM : 0.006502 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:25:24] Energy consumed for all CPUs : 0.010839 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:24] 0.017340 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:28] Energy consumed for RAM : 0.006551 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:25:28] Energy consumed for all CPUs : 0.010921 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:28] 0.017472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:39] Energy consumed for RAM : 0.006514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:25:39] Energy consumed for all CPUs : 0.010860 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:39] 0.017374 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:43] Energy consumed for RAM : 0.006564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:25:43] Energy consumed for all CPUs : 0.010942 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:43] 0.017506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:54] Energy consumed for RAM : 0.006527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:25:54] Energy consumed for all CPUs : 0.010880 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:54] 0.017407 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:25:58] Energy consumed for RAM : 0.006576 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:25:58] Energy consumed for all CPUs : 0.010963 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:25:58] 0.017539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:09] Energy consumed for RAM : 0.006539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:09] Energy consumed for all CPUs : 0.010901 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:26:09] 0.017440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:13] Energy consumed for RAM : 0.006589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:13] Energy consumed for all CPUs : 0.010984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:26:13] 0.017572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:24] Energy consumed for RAM : 0.006552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:24] Energy consumed for all CPUs : 0.010922 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:26:24] 0.017474 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:28] Energy consumed for RAM : 0.006601 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:28] Energy consumed for all CPUs : 0.011004 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:26:28] 0.017606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:39] Energy consumed for RAM : 0.006564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:39] Energy consumed for all CPUs : 0.010943 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:26:39] 0.017507 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:43] Energy consumed for RAM : 0.006614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:43] Energy consumed for all CPUs : 0.011025 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:26:43] 0.017639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:54] Energy consumed for RAM : 0.006577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:54] Energy consumed for all CPUs : 0.010964 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:26:54] 0.017540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:26:58] Energy consumed for RAM : 0.006626 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:26:58] Energy consumed for all CPUs : 0.011046 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:26:58] 0.017672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:27:09] Energy consumed for RAM : 0.006589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:09] Energy consumed for all CPUs : 0.010985 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:09] 0.017574 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:27:13] Energy consumed for RAM : 0.006639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:13] Energy consumed for all CPUs : 0.011067 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:13] 0.017706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:27:24] Energy consumed for RAM : 0.006602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:24] Energy consumed for all CPUs : 0.011006 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:24] 0.017607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:27:28] Energy consumed for RAM : 0.006651 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:28] Energy consumed for all CPUs : 0.011088 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:28] 0.017739 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:27:39] Energy consumed for RAM : 0.006614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:39] Energy consumed for all CPUs : 0.011026 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:39] 0.017640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:27:43] Energy consumed for RAM : 0.006664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:43] Energy consumed for all CPUs : 0.011109 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:43] 0.017772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:27:54] Energy consumed for RAM : 0.006627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:54] Energy consumed for all CPUs : 0.011047 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:54] 0.017674 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:27:58] Energy consumed for RAM : 0.006676 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:27:58] Energy consumed for all CPUs : 0.011129 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:27:58] 0.017806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:09] Energy consumed for RAM : 0.006639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:28:09] Energy consumed for all CPUs : 0.011068 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:09] 0.017707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:13] Energy consumed for RAM : 0.006689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:28:13] Energy consumed for all CPUs : 0.011150 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:13] 0.017839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:24] Energy consumed for RAM : 0.006651 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:28:24] Energy consumed for all CPUs : 0.011089 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:24] 0.017740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:28] Energy consumed for RAM : 0.006701 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:28:28] Energy consumed for all CPUs : 0.011171 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:28] 0.017872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:39] Energy consumed for RAM : 0.006664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:28:39] Energy consumed for all CPUs : 0.011110 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:39] 0.017774 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:43] Energy consumed for RAM : 0.006714 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:28:43] Energy consumed for all CPUs : 0.011192 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:43] 0.017906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:54] Energy consumed for RAM : 0.006676 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:28:54] Energy consumed for all CPUs : 0.011131 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:54] 0.017807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:28:58] Energy consumed for RAM : 0.006726 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:28:58] Energy consumed for all CPUs : 0.011213 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:28:58] 0.017939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:09] Energy consumed for RAM : 0.006689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:09] Energy consumed for all CPUs : 0.011151 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:29:09] 0.017840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:13] Energy consumed for RAM : 0.006739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:13] Energy consumed for all CPUs : 0.011234 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:29:13] 0.017972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:24] Energy consumed for RAM : 0.006701 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:24] Energy consumed for all CPUs : 0.011172 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:29:24] 0.017874 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:28] Energy consumed for RAM : 0.006751 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:28] Energy consumed for all CPUs : 0.011254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:29:28] 0.018006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:39] Energy consumed for RAM : 0.006714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:39] Energy consumed for all CPUs : 0.011193 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:29:39] 0.017907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:43] Energy consumed for RAM : 0.006764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:43] Energy consumed for all CPUs : 0.011275 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:29:43] 0.018039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:54] Energy consumed for RAM : 0.006726 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:54] Energy consumed for all CPUs : 0.011214 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:29:54] 0.017940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:29:58] Energy consumed for RAM : 0.006776 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:29:58] Energy consumed for all CPUs : 0.011296 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:29:58] 0.018072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:09] Energy consumed for RAM : 0.006739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:09] Energy consumed for all CPUs : 0.011235 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:09] 0.017974 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:13] Energy consumed for RAM : 0.006789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:13] Energy consumed for all CPUs : 0.011317 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:13] 0.018106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:24] Energy consumed for RAM : 0.006751 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:24] Energy consumed for all CPUs : 0.011256 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:24] 0.018007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:28] Energy consumed for RAM : 0.006801 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:28] Energy consumed for all CPUs : 0.011338 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:28] 0.018139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:39] Energy consumed for RAM : 0.006764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:39] Energy consumed for all CPUs : 0.011276 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:39] 0.018040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:43] Energy consumed for RAM : 0.006814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:43] Energy consumed for all CPUs : 0.011359 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:43] 0.018172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:54] Energy consumed for RAM : 0.006776 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:54] Energy consumed for all CPUs : 0.011297 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:54] 0.018074 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:30:58] Energy consumed for RAM : 0.006826 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:30:58] Energy consumed for all CPUs : 0.011379 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:30:58] 0.018206 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:31:09] Energy consumed for RAM : 0.006789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:09] Energy consumed for all CPUs : 0.011318 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:09] 0.018107 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:31:13] Energy consumed for RAM : 0.006839 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:13] Energy consumed for all CPUs : 0.011400 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:13] 0.018239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:31:24] Energy consumed for RAM : 0.006801 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:24] Energy consumed for all CPUs : 0.011339 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:24] 0.018140 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:31:28] Energy consumed for RAM : 0.006851 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:28] Energy consumed for all CPUs : 0.011421 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:28] 0.018272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:31:39] Energy consumed for RAM : 0.006814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:39] Energy consumed for all CPUs : 0.011360 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:39] 0.018174 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:31:43] Energy consumed for RAM : 0.006864 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:43] Energy consumed for all CPUs : 0.011442 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:43] 0.018306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:31:54] Energy consumed for RAM : 0.006826 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:54] Energy consumed for all CPUs : 0.011381 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:54] 0.018207 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:31:58] Energy consumed for RAM : 0.006876 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:31:58] Energy consumed for all CPUs : 0.011463 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:31:58] 0.018339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:32:09] Energy consumed for RAM : 0.006839 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:32:10] Energy consumed for all CPUs : 0.011401 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:32:10] 0.018240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:32:13] Energy consumed for RAM : 0.006889 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:32:13] Energy consumed for all CPUs : 0.011484 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:32:13] 0.018372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:32:24] Energy consumed for RAM : 0.006851 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:32:25] Energy consumed for all CPUs : 0.011422 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:32:25] 0.018274 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:32:28] Energy consumed for RAM : 0.006901 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:32:28] Energy consumed for all CPUs : 0.011504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:32:28] 0.018406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:32:39] Energy consumed for RAM : 0.006864 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:32:40] Energy consumed for all CPUs : 0.011443 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:32:40] 0.018307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:32:43] Energy consumed for RAM : 0.006914 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:32:43] Energy consumed for all CPUs : 0.011525 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:32:43] 0.018439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:32:55] Energy consumed for RAM : 0.006876 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:32:55] Energy consumed for all CPUs : 0.011464 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:32:55] 0.018340 kWh of electricity used since the begi
nning.
```

# 2: Image Classification based on Convolutional Neural Networks [25pts; 20pts Grad / 2.7% Bonus for Undergrad + 1.1% Bonus for all] [P][W]

## 2.1 Image Classification using Pytorch and CNN

- Pytorch is a popular platform for machine learning.

**Pytorch Description**

PyTorch is a Machine Learning/Deep Learning tensor library based on Python and Torch. It uses dynamic computation graphs and is completely Pythonic. Pytorch is used for applications using GPUs and CPUs.

### Helpful Links

- Install Pytorch
- Pytorch Quickstart Tutorial

### Setup Pytorch

Make sure you installed pytorch and torchvision (directions here).

Please also see Pytorch Quickstart Tutorial to see how to load a data set, build a training loop, and test the model. Another good resource for building CNNs using Pytorch is here.

## Environment Setup

In [ ]:
```
import torch
import torchvision
from torch.utils.data import non_deterministic
from torchvision.transforms import v2

%load_ext autoreload
%autoreload 2
%reload_ext autoreload
```

```
[codecarbon INFO @ 02:18:20] Energy consumed for RAM : 0.000151 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:20] Energy consumed for all CPUs : 0.000251 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:20] 0.000402 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:18:22] Energy consumed for RAM : 0.000075 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:22] Energy consumed for all CPUs : 0.000125 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:22] 0.000201 kWh of electricity used since the begi
nning.
The autoreload extension is already loaded. To reload it, use:
  %reload_ext autoreload
```

```
[codecarbon INFO @ 02:18:24] Energy consumed for RAM : 0.000200 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:24] Energy consumed for all CPUs : 0.000333 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:24] 0.000533 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:18:35] Energy consumed for RAM : 0.000163 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:35] Energy consumed for all CPUs : 0.000272 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:35] 0.000435 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:18:37] Energy consumed for RAM : 0.000088 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:37] Energy consumed for all CPUs : 0.000146 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:37] 0.000234 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:18:39] Energy consumed for RAM : 0.000212 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:39] Energy consumed for all CPUs : 0.000354 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:39] 0.000567 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:18:50] Energy consumed for RAM : 0.000176 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:50] Energy consumed for all CPUs : 0.000293 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:50] 0.000469 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:18:52] Energy consumed for RAM : 0.000100 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:52] Energy consumed for all CPUs : 0.000167 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:52] 0.000267 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:18:54] Energy consumed for RAM : 0.000225 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:18:54] Energy consumed for all CPUs : 0.000375 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:18:54] 0.000600 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:19:05] Energy consumed for RAM : 0.000188 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:19:05] Energy consumed for all CPUs : 0.000314 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:19:05] 0.000502 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:19:07] Energy consumed for RAM : 0.000113 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:19:07] Energy consumed for all CPUs : 0.000188 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:19:07] 0.000301 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:19:09] Energy consumed for RAM : 0.000237 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 02:19:09] Energy consumed for all CPUs : 0.000396 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:19:09] 0.000633 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:19:20] Energy consumed for RAM : 0.000201 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:19:20] Energy consumed for all CPUs : 0.000335 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:19:20] 0.000535 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:19:22] Energy consumed for RAM : 0.000125 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:19:22] Energy consumed for all CPUs : 0.000209 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:19:22] 0.000334 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:19:24] Energy consumed for RAM : 0.000250 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:19:24] Energy consumed for all CPUs : 0.000417 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:19:24] 0.000667 kWh of electricity used since the begi
nning.
```

### 2.1.1 Load FashionMNIST Dataset and Data Augmentation [5pts - Bonus for Undergrad] [P]

We use Fashion-MNIST dataset to train our model. This is a dataset of 70,000 28x28 grayscale images in 10 classes. There are 60,000 training images and 10,000 test images. We provide code for you to download Fashion-MNIST dataset below.

#### Data Augmentation [5pts]

Data augmentation is a technique to increase the diversity of your training set by applying random (but realistic) transformations such as image rotation and flipping the image around an axis. If the dataset in a machine learning model is rich and sufficient, the model performs better and more accurately. We will preprocess the training and testing set, but only the training set will undergo augmentation.

Go through the Pytorch torchvision.transforms.v2 documentation to see how to apply multiple transformations at once.

In the **cnn_image_transformations.py** file, complete the following functions to understand the common practices used for preprocessing and augmenting the image data:

- **create_training_transformations**
    - In this function, you are going to preprocess and augment training data.
        - PREPROCESS: Convert the given PIL Images to Tensors

        - AUGMENTATION: Apply Random Horizontal Flip and Random Rotation
- **create_testing_transformations**
    - In this function, you are going to only preprocess testing data.
        - PREPROCESS: Convert the given PIL Images to Tensors

Please note that the Gradescope only checks if expected preprocessing layers are existent.

**References**

v2.Compose()

v2.ToTensor() (Hint: Look at the warning)

v2.RandomHorizontalFlip()

v2.RandomApply()

v2.RandomRotation()

Article about performance regarding transformations

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################

from cnn_image_transformations import (
    create_testing_transformations,
    create_training_transformations,
)

# Create Transformations
training_transformations = create_training_transformations()
testing_transformation = create_testing_transformations()

# Load data
trainset = torchvision.datasets.FashionMNIST(
    root="./data", train=True, download=True, transform=training_transformat
)
testset = torchvision.datasets.FashionMNIST(
    root="./data", train=False, download=True, transform=testing_transformat
)

classes = (
    "Top",
    "Trouser",
    "Pullover",
    "Dress",
    "Coat",
    "Sandal",
    "Shirt",
```

```
    "Sneaker",
    "Bag",
    "Ankle boot",
)

print(trainset.data.shape)
print(testset.data.shape)
```

```
/Users/viditpokharna/anaconda3/envs/ml_hw4/lib/python3.11/site-packages/torchvision/transforms/v2/_deprecated.py:41: UserWarning: The transform `ToTensor()` is deprecated and will be removed in a future release. Instead, please use `v2.Compose([v2.ToImage(), v2.ToDtype(torch.float32, scale=True)])`.
  warnings.warn(
Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/train-images-idx3-ubyte.gz
Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/train-images-idx3-ubyte.gz to ./data/FashionMNIST/raw/train-images-idx3-ubyte.gz
[codecarbon INFO @ 02:20:24] Energy consumed for RAM : 0.000300 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:20:24] Energy consumed for all CPUs : 0.000500 kWh. Total CPU Power : 5.0 W
[codecarbon INFO @ 02:20:24] 0.000800 kWh of electricity used since the beginning.
 93%|█████████▎ | 24510464/26421880 [00:11<00:00, 2899370.50it/s][codecarbon INFO @ 02:20:36] Energy consumed for RAM : 0.000263 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:20:36] Energy consumed for all CPUs : 0.000439 kWh. Total CPU Power : 5.0 W
[codecarbon INFO @ 02:20:36] 0.000702 kWh of electricity used since the beginning.
100%|██████████| 26421880/26421880 [00:12<00:00, 2164988.04it/s]
Extracting ./data/FashionMNIST/raw/train-images-idx3-ubyte.gz to ./data/FashionMNIST/raw

Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/train-labels-idx1-ubyte.gz
Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/train-labels-idx1-ubyte.gz to ./data/FashionMNIST/raw/train-labels-idx1-ubyte.gz
100%|██████████| 29515/29515 [00:00<00:00, 268037.84it/s]
[codecarbon INFO @ 02:20:37] Energy consumed for RAM : 0.000188 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:20:37] Energy consumed for all CPUs : 0.000313 kWh. Total CPU Power : 5.0 W
[codecarbon INFO @ 02:20:37] 0.000501 kWh of electricity used since the beginning.
Extracting ./data/FashionMNIST/raw/train-labels-idx1-ubyte.gz to ./data/FashionMNIST/raw

Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/t10k-images-idx3-ubyte.gz
Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/t10k-images-idx3-ubyte.gz to ./data/FashionMNIST/raw/t10k-images-idx3-ubyte.gz
```

```
 34%|███       | 1507328/4422102 [00:01<00:01, 1659021.74it/s][codecarbon IN
FO @ 02:20:39] Energy consumed for RAM : 0.000313 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:20:39] Energy consumed for all CPUs : 0.000521 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:20:39] 0.000834 kWh of electricity used since the begi
nning.
100%|██████████| 4422102/4422102 [00:02<00:00, 1702273.66it/s]
Extracting ./data/FashionMNIST/raw/t10k-images-idx3-ubyte.gz to ./data/Fashi
onMNIST/raw

Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/t10k-
labels-idx1-ubyte.gz
Downloading http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/t10k-
labels-idx1-ubyte.gz to ./data/FashionMNIST/raw/t10k-labels-idx1-ubyte.gz
100%|██████████| 5148/5148 [00:00<00:00, 10954985.79it/s]
Extracting ./data/FashionMNIST/raw/t10k-labels-idx1-ubyte.gz to ./data/Fashi
onMNIST/raw

torch.Size([60000, 28, 28])
torch.Size([10000, 28, 28])
```

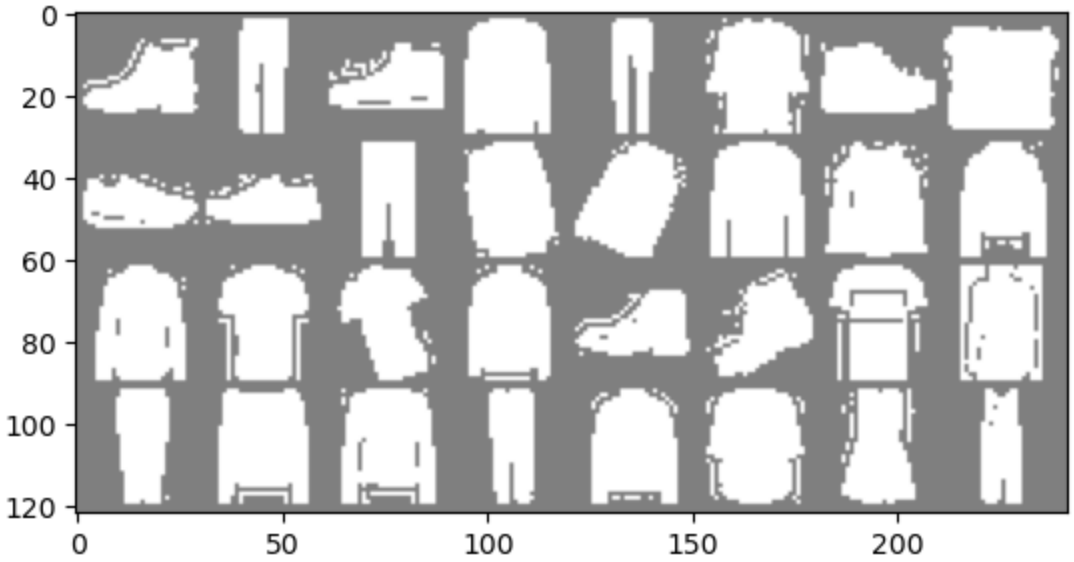
## 2.1.2 Load some sample images from Fashion-MNIST [Setup - No points]

In [ ]:

```
################################
### DO NOT CHANGE THIS CELL ###
################################

import matplotlib.pyplot as plt
import numpy as np

trainloader = torch.utils.data.DataLoader(
    trainset, batch_size=32, shuffle=True, num_workers=2
)
testloader = torch.utils.data.DataLoader(
    testset, batch_size=32, shuffle=False, num_workers=2
)

# functions to show an image


def imshow(img):
    img = img / 2 + 0.5  # unnormalize
    npimg = img.numpy()
    plt.imshow(np.transpose(npimg, (1, 2, 0)))
    plt.show()


# get some random training images
dataiter = iter(trainloader)
images, labels = next(dataiter)

print("Image size")
print(v2.functional.get_size(images[0]))
```

```
# show images
imshow(torchvision.utils.make_grid(images))
```

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for floats or [0..255] for integers).
Image size
[28, 28]
```



```
[codecarbon INFO @ 02:20:51] Energy consumed for RAM : 0.000276 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:20:51] Energy consumed for all CPUs : 0.000460 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:20:51] 0.000735 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:20:52] Energy consumed for RAM : 0.000200 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:20:52] Energy consumed for all CPUs : 0.000334 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:20:52] 0.000534 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:20:54] Energy consumed for RAM : 0.000325 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:20:54] Energy consumed for all CPUs : 0.000542 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:20:54] 0.000867 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:06] Energy consumed for RAM : 0.000288 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:06] Energy consumed for all CPUs : 0.000480 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:06] 0.000769 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:07] Energy consumed for RAM : 0.000213 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:07] Energy consumed for all CPUs : 0.000355 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:07] 0.000567 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:09] Energy consumed for RAM : 0.000338 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:09] Energy consumed for all CPUs : 0.000563 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:09] 0.000900 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:21] Energy consumed for RAM : 0.000301 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:21] Energy consumed for all CPUs : 0.000501 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:21] 0.000802 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:22] Energy consumed for RAM : 0.000225 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:22] Energy consumed for all CPUs : 0.000376 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:22] 0.000601 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:24] Energy consumed for RAM : 0.000350 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:24] Energy consumed for all CPUs : 0.000584 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:24] 0.000934 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:36] Energy consumed for RAM : 0.000313 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 02:21:36] Energy consumed for all CPUs : 0.000522 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:36] 0.000835 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:37] Energy consumed for RAM : 0.000238 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:37] Energy consumed for all CPUs : 0.000396 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:37] 0.000634 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:39] Energy consumed for RAM : 0.000363 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:39] Energy consumed for all CPUs : 0.000605 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:39] 0.000967 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:51] Energy consumed for RAM : 0.000326 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:51] Energy consumed for all CPUs : 0.000543 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:51] 0.000869 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:52] Energy consumed for RAM : 0.000250 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:52] Energy consumed for all CPUs : 0.000417 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:52] 0.000667 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:21:54] Energy consumed for RAM : 0.000375 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:21:54] Energy consumed for all CPUs : 0.000625 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:21:54] 0.001000 kWh of electricity used since the begi
nning.
```

As you can see from above, the FashionMNIST dataset contains different types of objects. The images have been size-normalized and objects remain centered in fixed-size images.

### 2.1.3 Build convolutional neural network model [5pts Grad / 0.7% Bonus for Undergrad] [W]

In this part, you need to build a convolutional neural network as described below. The architecture of the model is outlined.

In the **cnn.py** file, complete the following functions:

- **__init__**: See Defining Variables section
- **forward**: See Defining Model section

**[INPUT - CONV - CONV - MAXPOOL - DROPOUT - CONV - CONV - MAXPOOL - DROPOUT - AVERAGEPOOL - FC1 - DROPOUT - FC2 - DROPOUT - FC3]**

> INPUT: $[28 \times 28 \times 1]$ will hold the raw pixel values of the image, in this case, an image of width 28, height 28. This layer should give 8 filters and have appropriate padding to maintain shape.

> CONV: Conv. layer will compute the output of neurons that are connected to local regions in the input, each computing a dot product between their weights and a small region they are connected to the input volume. In our example architecture, we decide to set the kernel_size to be $3 \times 3$. For example, the output of the Conv. layer may look like $[28 \times 28 \times 8]$ if we set out_channels to be 8 and use appropriate paddings to maintain shape.

> CONV: Additional Conv. layer take outputs from above layers and applies more filters. We set the kernel_size to be $3 \times 3$ and out_channels to be 32.

> MAXPOOL: MAXPOOL layer will perform a downsampling operation along the spatial dimensions (width, height). With pool size of $2 \times 2$, resulting shape takes form $16 \times 16$.

> DROPOUT: DROPOUT layer with the dropout rate of 0.2 to prevent overfitting.

> CONV: Additonal Conv. layer takes outputs from above layers and applies more filters. We set the kernel_size to be $3 \times 3$ and out_channels to be 32. Appropriate paddings are used to maintain shape.

> CONV: Additonal Conv. layer takes outputs from above layers and applies more filters. We set the kernel_size to be $3 \times 3$ and out_channels to be 64. Appropriate paddings are used to maintain shape.

> MAXPOOL: MAXPOOL layer will perform a downsampling operation along the spatial dimensions (width, height).

> DROPOUT: Dropout layer with the dropout rate of 0.2 to prevent overfitting.

> AVERAGEPOOL: AVERAGEPOOL layer will perform a downsampling operation along the spatial dimension (width, height). Checkout AdaptiveAvgPool2d below.

> FC1: Dense layer which takes output from above layers, and has 256 neurons. Flatten() operations may be useful.

> DROPOUT: Dropout layer with the dropout rate of 0.2 to prevent overfitting.

> FC2： Dense layer which takes output from above layers, and has 128 neurons.

> DROPOUT: Dropout layer with the dropout rate of 0.2 to prevent overfitting.

> FC3: Dense layer with 10 neurons, and Softmax activation, is the final layer. The dimension of the output space is the number of classes.

**Activation function**: Use LeakyReLU with negative_slope 0.01 as the activation function for Conv. layers and Dense layers unless otherwise indicated to build you model architecture

Note that while this is a suggested model design, you may use other architectures and experiment with different layers for better results.

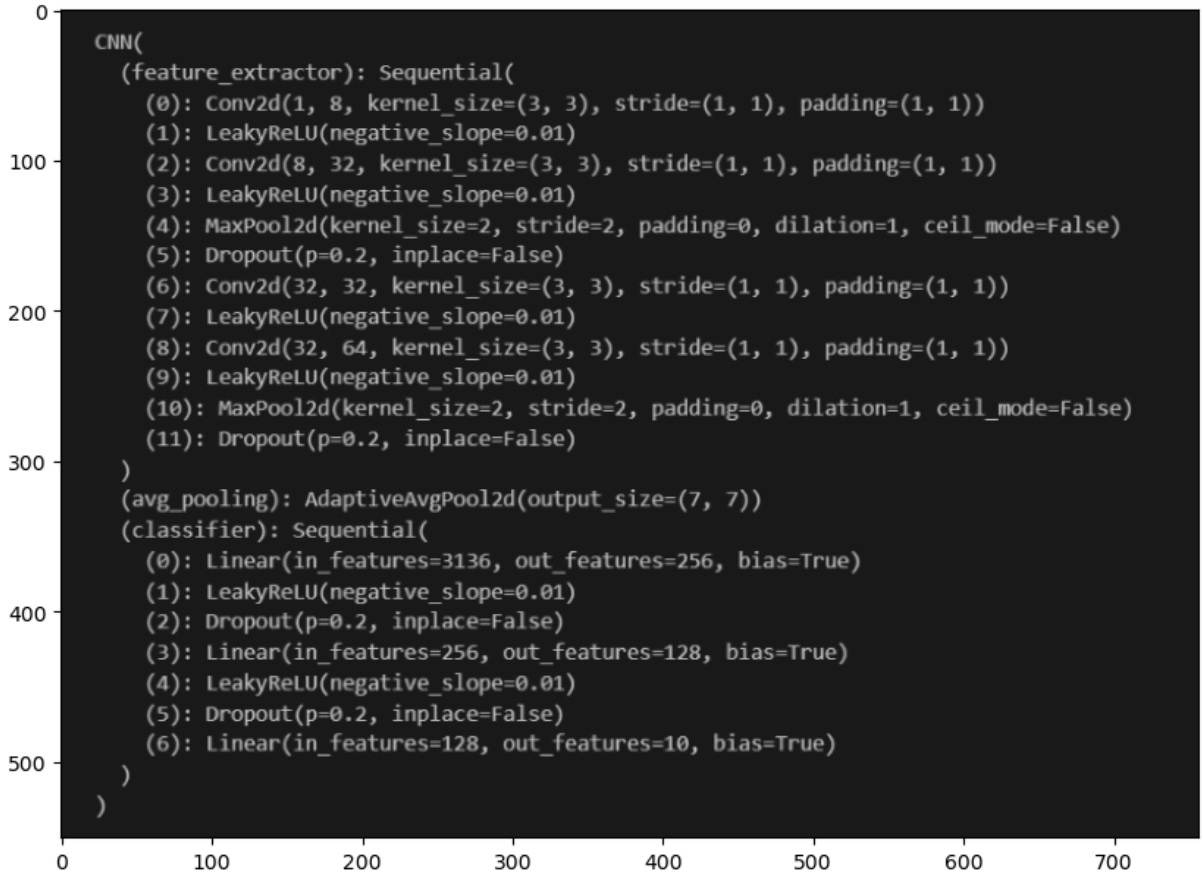
The following links are Pytorch documentation for the layers you are going to use to build the CNN.

- Conv2d
- Dense
- MaxPool
- AdaptiveAvgPool2d
- Dropout
- LeakyReLU
- Flatten

Lastly, if you would like to experiment with additional layers, explore the torch.nn api.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################

# Show the architecture of the model
achi = plt.imread("./data/images/Architecture.png")
fig = plt.figure(figsize=(10, 10))
plt.imshow(achi)
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x176ed3e90>
```




```
[codecarbon INFO @ 02:22:06] Energy consumed for RAM : 0.000338 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:22:06] Energy consumed for all CPUs : 0.000564 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:22:06] 0.000902 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:22:07] Energy consumed for RAM : 0.000263 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:22:07] Energy consumed for all CPUs : 0.000438 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:22:07] 0.000701 kWh of electricity used since the begi
nning.
```

## Defining model [5pts Grad / 0.7% Bonus for Undergrad][W]

You now need to complete the `__init__()` function and the `forward()` function in **cnn.py** to define your model structure.

Your model is required to have at least 2 convolutional layers and at least 2 dense layers. Ensuring that these requirements are met will earn you 5pts.

Once you have defined a model structure you may use the cell below to examine your architecture.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
```

```
# You can compare your architecture with the 'Architecture.png'

from cnn import CNN

net = CNN()
print(net)
```

```
CNN(
  (feature_extractor): Sequential(
    (0): Conv2d(1, 8, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (1): LeakyReLU(negative_slope=0.01)
    (2): Conv2d(8, 32, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (3): LeakyReLU(negative_slope=0.01)
    (4): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mode
=False)
    (5): Dropout(p=0.2, inplace=False)
    (6): Conv2d(32, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (7): LeakyReLU(negative_slope=0.01)
    (8): Conv2d(64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1))
    (9): LeakyReLU(negative_slope=0.01)
    (10): MaxPool2d(kernel_size=2, stride=2, padding=0, dilation=1, ceil_mod
e=False)
    (11): Dropout(p=0.2, inplace=False)
  )
  (avg_pooling): AdaptiveAvgPool2d(output_size=(7, 7))
  (classifier): Sequential(
    (0): Linear(in_features=3136, out_features=256, bias=True)
    (1): Dropout(p=0.2, inplace=False)
    (2): LeakyReLU(negative_slope=0.01)
    (3): Linear(in_features=256, out_features=128, bias=True)
    (4): Dropout(p=0.2, inplace=False)
    (5): LeakyReLU(negative_slope=0.01)
    (6): Linear(in_features=128, out_features=10, bias=True)
  )
)
```

```
[codecarbon INFO @ 02:39:21] Energy consumed for RAM : 0.001201 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:39:21] Energy consumed for all CPUs : 0.002002 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:21] 0.003202 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:39:22] Energy consumed for RAM : 0.001125 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:39:22] Energy consumed for all CPUs : 0.001876 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:22] 0.003001 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:39:24] Energy consumed for RAM : 0.001250 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:39:24] Energy consumed for all CPUs : 0.002084 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:24] 0.003334 kWh of electricity used since the begi
nning.
```

## 2.1.4 Train the network [8pts Grad / 1% Bonus for Undergrad (3pts, 3pts, 2pts) Bonus for Undergrad] [W]

**Tuning:** Training the network is the next thing to try. You can set the hyperparameters in the cell below. If your hyperparameters are set properly, you should see the loss of the validation set decreased and the value of accuracy increased. **It may take more than 15 minutes to train your model.**

- Recommended Batch Sizes fall in the range 32-512 (use powers of 2)
- Recommended Epoch Counts fall in the range 5-20
- Recommended Learning Rates fall in the range .0001-.01

**Expected Result:** You should be able to achieve more than $90\%$ accuracy on the test set to get full points. If you achieve accuracy between $75\%$ to $84\%$, you will only get 3 points. An accuracy between $84\%$ to $90\%$ will earn an additional 3pts.

Note: If you would like to automate the tuning process, you can use a nested for loop to search for the hyperparameter that achieves the accuracy. You could also look into grid search for hyperparameter optimization.

- $75\%$ to $84\%$ earns 3pts
- $84\%$ to $90\%$ earns 3pts more (6pts total)
- $90\%$+ earns 2pts more (8pts total)

### Train your own CNN model

In [ ]:
```
from cnn import CNN
from cnn_trainer import Trainer

net = CNN()

# TODO: Change hyperparameters here
num_epochs = 20
batch_size = 32
init_lr = 5e-3

# Choose best device to speed up training
if torch.cuda.is_available():
    device = "cuda"
elif torch.backends.mps.is_available():
    device = "mps"
else:
    device = "cpu"
print(f"Using {device} device")

trainer = Trainer(
    net,
    trainset,
```

```
    testset,
    num_epochs=num_epochs,
    batch_size=batch_size,
    init_lr=init_lr,
    device=device,
)
trainer.train()
```

```
Using mps device
```

```
Epoch 1/20:   0%|          | 0/1875 [00:00<?, ?batch/s]Epoch 1/20:  20%|██
| 366/1875 [00:11<00:29, 51.47batch/s, accuracy=0.663, loss=0.958][codecarbo
n INFO @ 02:39:36] Energy consumed for RAM : 0.001213 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:39:36] Energy consumed for all CPUs : 0.002022 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:36] 0.003236 kWh of electricity used since the begi
nning.
Epoch 1/20:  24%|██        | 444/1875 [00:12<00:26, 53.16batch/s, accuracy=
0.685, loss=0.892][codecarbon INFO @ 02:39:37] Energy consumed for RAM : 0.0
01138 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:39:37] Energy consumed for all CPUs : 0.001897 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:37] 0.003035 kWh of electricity used since the begi
nning.
Epoch 1/20:  29%|███       | 538/1875 [00:14<00:27, 49.23batch/s, accuracy=
0.702, loss=0.841][codecarbon INFO @ 02:39:39] Energy consumed for RAM : 0.0
01263 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:39:39] Energy consumed for all CPUs : 0.002105 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:39] 0.003368 kWh of electricity used since the begi
nning.
Epoch 1/20:  60%|██████    | 1125/1875 [00:26<00:13, 54.58batch/s, accuracy=
0.755, loss=0.685][codecarbon INFO @ 02:39:51] Energy consumed for RAM : 0.0
01226 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:39:51] Energy consumed for all CPUs : 0.002043 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:51] 0.003269 kWh of electricity used since the begi
nning.
Epoch 1/20:  64%|██████    | 1209/1875 [00:27<00:12, 55.39batch/s, accuracy=
0.759, loss=0.673][codecarbon INFO @ 02:39:52] Energy consumed for RAM : 0.0
01150 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:39:52] Energy consumed for all CPUs : 0.001917 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:52] 0.003068 kWh of electricity used since the begi
nning.
Epoch 1/20:  70%|███████   | 1311/1875 [00:29<00:10, 55.30batch/s, accuracy=
0.764, loss=0.661][codecarbon INFO @ 02:39:54] Energy consumed for RAM : 0.0
01275 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:39:54] Energy consumed for all CPUs : 0.002126 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:39:54] 0.003401 kWh of electricity used since the begi
nning.
Epoch 1/20: 100%|██████████| 1875/1875 [00:40<00:00, 46.10batch/s, accuracy=
0.782, loss=0.606]
[codecarbon INFO @ 02:40:06] Energy consumed for RAM : 0.001238 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:40:06] Energy consumed for all CPUs : 0.002064 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:06] 0.003302 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:40:07] Energy consumed for RAM : 0.001163 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:40:07] Energy consumed for all CPUs : 0.001938 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:07] 0.003101 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 02:40:09] Energy consumed for RAM : 0.001288 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:40:09] Energy consumed for all CPUs : 0.002146 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:09] 0.003434 kWh of electricity used since the begi
nning.
```

Epoch 1: Validation Loss: 0.37, Validation Accuracy: 0.865

```
Epoch 2/20:  29%|███       | 535/1875 [00:11<00:25, 51.91batch/s, accuracy=
0.839, loss=0.437][codecarbon INFO @ 02:40:21] Energy consumed for RAM : 0.0
01251 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:21] Energy consumed for all CPUs : 0.002085 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:21] 0.003336 kWh of electricity used since the begi
nning.
Epoch 2/20:  33%|███       | 619/1875 [00:12<00:23, 54.10batch/s, accuracy=
0.839, loss=0.434][codecarbon INFO @ 02:40:22] Energy consumed for RAM : 0.0
01175 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:22] Energy consumed for all CPUs : 0.001959 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:22] 0.003135 kWh of electricity used since the begi
nning.
Epoch 2/20:  38%|███       | 715/1875 [00:14<00:22, 52.71batch/s, accuracy=
0.839, loss=0.434][codecarbon INFO @ 02:40:24] Energy consumed for RAM : 0.0
01300 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:24] Energy consumed for all CPUs : 0.002167 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:24] 0.003468 kWh of electricity used since the begi
nning.
Epoch 2/20:  71%|██████    | 1339/1875 [00:26<00:10, 52.11batch/s, accuracy=
0.844, loss=0.425][codecarbon INFO @ 02:40:36] Energy consumed for RAM : 0.0
01263 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:36] Energy consumed for all CPUs : 0.002106 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:36] 0.003369 kWh of electricity used since the begi
nning.
Epoch 2/20:  76%|███████   | 1423/1875 [00:27<00:08, 53.96batch/s, accuracy=
0.845, loss=0.424][codecarbon INFO @ 02:40:37] Energy consumed for RAM : 0.0
01188 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:37] Energy consumed for all CPUs : 0.001980 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:37] 0.003168 kWh of electricity used since the begi
nning.
Epoch 2/20:  81%|███████   | 1519/1875 [00:29<00:06, 53.11batch/s, accuracy=
0.845, loss=0.423][codecarbon INFO @ 02:40:39] Energy consumed for RAM : 0.0
01313 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:39] Energy consumed for all CPUs : 0.002188 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:39] 0.003501 kWh of electricity used since the begi
nning.
Epoch 2/20: 100%|██████████| 1875/1875 [00:36<00:00, 50.92batch/s, accuracy=
0.847, loss=0.418]
```

Epoch 2: Validation Loss: 0.33, Validation Accuracy: 0.883

```
Epoch 3/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:40:51] Energy consumed for RAM : 0.001276 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:51] Energy consumed for all CPUs : 0.002127 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:51] 0.003402 kWh of electricity used since the begi
nning.
Epoch 3/20:   3%|▏         | 49/1875 [00:02<00:42, 42.96batch/s, accuracy=0.
869, loss=0.385][codecarbon INFO @ 02:40:52] Energy consumed for RAM : 0.001
200 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:52] Energy consumed for all CPUs : 0.002001 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:52] 0.003201 kWh of electricity used since the begi
nning.
Epoch 3/20:   8%|▊         | 145/1875 [00:04<00:31, 54.18batch/s, accuracy=
0.865, loss=0.382][codecarbon INFO @ 02:40:54] Energy consumed for RAM : 0.0
01325 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:40:54] Energy consumed for all CPUs : 0.002209 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:40:54] 0.003534 kWh of electricity used since the begi
nning.
Epoch 3/20:  41%|████      | 763/1875 [00:15<00:20, 53.81batch/s, accuracy=
0.864, loss=0.369][codecarbon INFO @ 02:41:06] Energy consumed for RAM : 0.0
01288 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:06] Energy consumed for all CPUs : 0.002147 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:06] 0.003436 kWh of electricity used since the begi
nning.
Epoch 3/20:  45%|████▌     | 847/1875 [00:17<00:18, 54.26batch/s, accuracy=
0.864, loss=0.369][codecarbon INFO @ 02:41:07] Energy consumed for RAM : 0.0
01213 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:07] Energy consumed for all CPUs : 0.002022 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:07] 0.003235 kWh of electricity used since the begi
nning.
Epoch 3/20:  50%|█████     | 943/1875 [00:19<00:17, 53.27batch/s, accuracy=
0.864, loss=0.371][codecarbon INFO @ 02:41:09] Energy consumed for RAM : 0.0
01338 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:09] Energy consumed for all CPUs : 0.002230 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:09] 0.003568 kWh of electricity used since the begi
nning.
Epoch 3/20:  83%|████████▎ | 1555/1875 [00:30<00:06, 51.75batch/s, accuracy=
0.866, loss=0.363][codecarbon INFO @ 02:41:21] Energy consumed for RAM : 0.0
01301 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:21] Energy consumed for all CPUs : 0.002168 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:21] 0.003469 kWh of electricity used since the begi
nning.
Epoch 3/20:  87%|████████▋ | 1639/1875 [00:32<00:04, 52.92batch/s, accuracy=
0.866, loss=0.363][codecarbon INFO @ 02:41:22] Energy consumed for RAM : 0.0
01225 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:22] Energy consumed for all CPUs : 0.002042 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:22] 0.003268 kWh of electricity used since the begi
nning.
Epoch 3/20:  92%|█████████▏| 1729/1875 [00:34<00:02, 52.20batch/s, accuracy=
```

```
0.867, loss=0.362][codecarbon INFO @ 02:41:24] Energy consumed for RAM : 0.0
01350 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:24] Energy consumed for all CPUs : 0.002251 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:24] 0.003601 kWh of electricity used since the begi
nning.
Epoch 3/20: 100%|██████████| 1875/1875 [00:37<00:00, 50.33batch/s, accuracy=
0.867, loss=0.36]
Epoch 3: Validation Loss: 0.31, Validation Accuracy: 0.885
```

```
Epoch 4/20:  10%|▉         | 182/1875 [00:05<00:35, 48.16batch/s, accuracy=
0.878, loss=0.324][codecarbon INFO @ 02:41:36] Energy consumed for RAM : 0.0
01313 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:36] Energy consumed for all CPUs : 0.002189 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:36] 0.003502 kWh of electricity used since the begi
nning.
Epoch 4/20:  14%|█         | 265/1875 [00:06<00:30, 52.66batch/s, accuracy=
0.879, loss=0.324][codecarbon INFO @ 02:41:38] Energy consumed for RAM : 0.0
01238 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:38] Energy consumed for all CPUs : 0.002063 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:38] 0.003301 kWh of electricity used since the begi
nning.
Epoch 4/20:  19%|██        | 355/1875 [00:08<00:30, 49.95batch/s, accuracy=
0.879, loss=0.33] [codecarbon INFO @ 02:41:39] Energy consumed for RAM : 0.0
01363 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:39] Energy consumed for all CPUs : 0.002272 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:39] 0.003634 kWh of electricity used since the begi
nning.
Epoch 4/20:  51%|████▉     | 962/1875 [00:20<00:18, 48.14batch/s, accuracy=
0.879, loss=0.333][codecarbon INFO @ 02:41:51] Energy consumed for RAM : 0.0
01326 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:51] Energy consumed for all CPUs : 0.002210 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:51] 0.003536 kWh of electricity used since the begi
nning.
Epoch 4/20:  55%|█████     | 1039/1875 [00:21<00:16, 50.58batch/s, accuracy=
0.879, loss=0.334][codecarbon INFO @ 02:41:53] Energy consumed for RAM : 0.0
01250 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:53] Energy consumed for all CPUs : 0.002084 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:53] 0.003335 kWh of electricity used since the begi
nning.
Epoch 4/20:  60%|█████▉    | 1128/1875 [00:23<00:14, 52.73batch/s, accuracy=
0.879, loss=0.333][codecarbon INFO @ 02:41:54] Energy consumed for RAM : 0.0
01375 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:41:54] Energy consumed for all CPUs : 0.002292 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:41:54] 0.003668 kWh of electricity used since the begi
nning.
Epoch 4/20:  93%|█████████▎| 1740/1875 [00:35<00:02, 51.51batch/s, accuracy=
0.881, loss=0.326][codecarbon INFO @ 02:42:06] Energy consumed for RAM : 0.0
01338 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:06] Energy consumed for all CPUs : 0.002231 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:06] 0.003569 kWh of electricity used since the begi
nning.
Epoch 4/20:  97%|█████████▋| 1818/1875 [00:36<00:01, 52.65batch/s, accuracy=
0.882, loss=0.325][codecarbon INFO @ 02:42:08] Energy consumed for RAM : 0.0
01263 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:08] Energy consumed for all CPUs : 0.002105 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:08] 0.003368 kWh of electricity used since the begi
nning.
```

```
Epoch 4/20: 100%|██████████| 1875/1875 [00:38<00:00, 49.31batch/s, accuracy=
0.882, loss=0.326]
[codecarbon INFO @ 02:42:09] Energy consumed for RAM : 0.001388 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:42:09] Energy consumed for all CPUs : 0.002313 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:09] 0.003701 kWh of electricity used since the begi
nning.
Epoch 4: Validation Loss: 0.26, Validation Accuracy: 0.904
```

```
Epoch 5/20:  19%|██        | 359/1875 [00:08<00:28, 53.29batch/s, accuracy=
0.882, loss=0.314][codecarbon INFO @ 02:42:21] Energy consumed for RAM : 0.0
01351 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:21] Energy consumed for all CPUs : 0.002252 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:21] 0.003603 kWh of electricity used since the begi
nning.
Epoch 5/20:  23%|██        | 437/1875 [00:09<00:27, 52.67batch/s, accuracy=
0.884, loss=0.312][codecarbon INFO @ 02:42:23] Energy consumed for RAM : 0.0
01275 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:23] Energy consumed for all CPUs : 0.002126 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:23] 0.003401 kWh of electricity used since the begi
nning.
Epoch 5/20:  28%|██        | 533/1875 [00:11<00:25, 53.27batch/s, accuracy=
0.885, loss=0.31] [codecarbon INFO @ 02:42:24] Energy consumed for RAM : 0.0
01400 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:24] Energy consumed for all CPUs : 0.002334 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:24] 0.003734 kWh of electricity used since the begi
nning.
Epoch 5/20:  61%|██████    | 1145/1875 [00:23<00:13, 52.87batch/s, accuracy=
0.887, loss=0.305][codecarbon INFO @ 02:42:36] Energy consumed for RAM : 0.0
01363 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:36] Energy consumed for all CPUs : 0.002273 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:36] 0.003636 kWh of electricity used since the begi
nning.
Epoch 5/20:  65%|██████    | 1223/1875 [00:24<00:12, 52.69batch/s, accuracy=
0.888, loss=0.305][codecarbon INFO @ 02:42:38] Energy consumed for RAM : 0.0
01288 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:38] Energy consumed for all CPUs : 0.002147 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:38] 0.003435 kWh of electricity used since the begi
nning.
Epoch 5/20:  70%|███████   | 1319/1875 [00:26<00:10, 52.96batch/s, accuracy=
0.889, loss=0.302][codecarbon INFO @ 02:42:39] Energy consumed for RAM : 0.0
01413 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:39] Energy consumed for all CPUs : 0.002355 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:39] 0.003768 kWh of electricity used since the begi
nning.
Epoch 5/20: 100%|██████████| 1875/1875 [00:37<00:00, 49.70batch/s, accuracy=
0.89, loss=0.301]
[codecarbon INFO @ 02:42:51] Energy consumed for RAM : 0.001376 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:42:51] Energy consumed for all CPUs : 0.002293 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:51] 0.003669 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:42:53] Energy consumed for RAM : 0.001300 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:42:53] Energy consumed for all CPUs : 0.002168 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:53] 0.003468 kWh of electricity used since the begi
nning.
```

```
Epoch 5: Validation Loss: 0.25, Validation Accuracy: 0.908
Epoch 6/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:42:54] Energy consumed for RAM : 0.001425 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:42:54] Energy consumed for all CPUs : 0.002376 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:42:54] 0.003801 kWh of electricity used since the begi
nning.
Epoch 6/20:  29%|███       | 547/1875 [00:11<00:27, 48.23batch/s, accuracy=
0.896, loss=0.28] [codecarbon INFO @ 02:43:06] Energy consumed for RAM : 0.0
01388 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:06] Energy consumed for all CPUs : 0.002314 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:06] 0.003703 kWh of electricity used since the begi
nning.
Epoch 6/20:  33%|███       | 625/1875 [00:13<00:23, 52.57batch/s, accuracy=
0.896, loss=0.281][codecarbon INFO @ 02:43:08] Energy consumed for RAM : 0.0
01313 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:08] Energy consumed for all CPUs : 0.002189 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:08] 0.003501 kWh of electricity used since the begi
nning.
Epoch 6/20:  38%|████      | 721/1875 [00:15<00:22, 50.51batch/s, accuracy=
0.896, loss=0.281][codecarbon INFO @ 02:43:09] Energy consumed for RAM : 0.0
01438 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:09] Energy consumed for all CPUs : 0.002397 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:09] 0.003835 kWh of electricity used since the begi
nning.
Epoch 6/20:  71%|███████   | 1327/1875 [00:26<00:10, 53.07batch/s, accuracy=
0.897, loss=0.281][codecarbon INFO @ 02:43:21] Energy consumed for RAM : 0.0
01401 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:21] Energy consumed for all CPUs : 0.002335 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:21] 0.003736 kWh of electricity used since the begi
nning.
Epoch 6/20:  75%|████████  | 1411/1875 [00:28<00:09, 50.60batch/s, accuracy=
0.897, loss=0.281][codecarbon INFO @ 02:43:23] Energy consumed for RAM : 0.0
01325 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:23] Energy consumed for all CPUs : 0.002209 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:23] 0.003535 kWh of electricity used since the begi
nning.
Epoch 6/20:  80%|████████  | 1507/1875 [00:30<00:06, 52.91batch/s, accuracy=
0.896, loss=0.282][codecarbon INFO @ 02:43:24] Energy consumed for RAM : 0.0
01450 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:24] Energy consumed for all CPUs : 0.002418 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:24] 0.003868 kWh of electricity used since the begi
nning.
Epoch 6/20: 100%|██████████| 1875/1875 [00:37<00:00, 49.77batch/s, accuracy=
0.897, loss=0.28]
Epoch 6: Validation Loss: 0.25, Validation Accuracy: 0.906
```

```
Epoch 7/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:43:36] Energy consumed for RAM : 0.001413 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:36] Energy consumed for all CPUs : 0.002356 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:36] 0.003769 kWh of electricity used since the begi
nning.
Epoch 7/20:   2%||         | 36/1875 [00:02<00:52, 34.76batch/s, accuracy=0.
914, loss=0.233][codecarbon INFO @ 02:43:38] Energy consumed for RAM : 0.001
338 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:38] Energy consumed for all CPUs : 0.002230 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:38] 0.003568 kWh of electricity used since the begi
nning.
Epoch 7/20:   7%|▌         | 132/1875 [00:03<00:33, 52.18batch/s, accuracy=
0.901, loss=0.264][codecarbon INFO @ 02:43:39] Energy consumed for RAM : 0.0
01463 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:39] Energy consumed for all CPUs : 0.002438 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:39] 0.003901 kWh of electricity used since the begi
nning.
Epoch 7/20:  38%|███▊      | 719/1875 [00:15<00:22, 52.27batch/s, accuracy=
0.902, loss=0.264][codecarbon INFO @ 02:43:51] Energy consumed for RAM : 0.0
01426 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:51] Energy consumed for all CPUs : 0.002377 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:51] 0.003803 kWh of electricity used since the begi
nning.
Epoch 7/20:  43%|████      | 797/1875 [00:17<00:20, 52.41batch/s, accuracy=
0.903, loss=0.263][codecarbon INFO @ 02:43:53] Energy consumed for RAM : 0.0
01350 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:53] Energy consumed for all CPUs : 0.002251 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:53] 0.003601 kWh of electricity used since the begi
nning.
Epoch 7/20:  48%|████▊     | 892/1875 [00:19<00:18, 52.47batch/s, accuracy=
0.902, loss=0.265][codecarbon INFO @ 02:43:54] Energy consumed for RAM : 0.0
01475 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:43:54] Energy consumed for all CPUs : 0.002459 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:43:54] 0.003935 kWh of electricity used since the begi
nning.
Epoch 7/20:  79%|███████▉  | 1490/1875 [00:30<00:07, 52.82batch/s, accuracy=
0.903, loss=0.264][codecarbon INFO @ 02:44:06] Energy consumed for RAM : 0.0
01438 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:06] Energy consumed for all CPUs : 0.002398 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:06] 0.003836 kWh of electricity used since the begi
nning.
Epoch 7/20:  84%|████████▍ | 1574/1875 [00:32<00:05, 51.73batch/s, accuracy=
0.903, loss=0.264][codecarbon INFO @ 02:44:08] Energy consumed for RAM : 0.0
01363 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:08] Energy consumed for all CPUs : 0.002272 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:08] 0.003635 kWh of electricity used since the begi
nning.
Epoch 7/20:  89%|████████▉ | 1663/1875 [00:34<00:04, 51.77batch/s, accuracy=
```

```
0.903, loss=0.264][codecarbon INFO @ 02:44:09] Energy consumed for RAM : 0.0
01488 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:09] Energy consumed for all CPUs : 0.002480 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:09] 0.003968 kWh of electricity used since the begi
nning.
Epoch 7/20: 100%|██████████| 1875/1875 [00:38<00:00, 48.81batch/s, accuracy=
0.903, loss=0.262]
Epoch 7: Validation Loss: 0.23, Validation Accuracy: 0.917
```

```
Epoch 8/20:   5%|▌         | 103/1875 [00:03<00:34, 52.11batch/s, accuracy=
0.905, loss=0.255][codecarbon INFO @ 02:44:21] Energy consumed for RAM : 0.0
01451 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:21] Energy consumed for all CPUs : 0.002418 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:21] 0.003869 kWh of electricity used since the begi
nning.
Epoch 8/20:  10%|▉         | 180/1875 [00:04<00:32, 51.77batch/s, accuracy=
0.907, loss=0.252][codecarbon INFO @ 02:44:23] Energy consumed for RAM : 0.0
01375 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:23] Energy consumed for all CPUs : 0.002293 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:23] 0.003668 kWh of electricity used since the begi
nning.
Epoch 8/20:  15%|█▍        | 276/1875 [00:06<00:30, 52.44batch/s, accuracy=
0.91, loss=0.243] [codecarbon INFO @ 02:44:24] Energy consumed for RAM : 0.0
01500 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:24] Energy consumed for all CPUs : 0.002501 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:24] 0.004001 kWh of electricity used since the begi
nning.
Epoch 8/20:  47%|████▋     | 882/1875 [00:18<00:19, 52.25batch/s, accuracy=
0.911, loss=0.245][codecarbon INFO @ 02:44:36] Energy consumed for RAM : 0.0
01463 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:36] Energy consumed for all CPUs : 0.002439 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:36] 0.003903 kWh of electricity used since the begi
nning.
Epoch 8/20:  52%|█████▏    | 966/1875 [00:19<00:17, 53.32batch/s, accuracy=
0.912, loss=0.243][codecarbon INFO @ 02:44:38] Energy consumed for RAM : 0.0
01388 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:38] Energy consumed for all CPUs : 0.002314 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:38] 0.003702 kWh of electricity used since the begi
nning.
Epoch 8/20:  56%|█████▌    | 1054/1875 [00:21<00:18, 43.36batch/s, accuracy=
0.911, loss=0.243][codecarbon INFO @ 02:44:39] Energy consumed for RAM : 0.0
01513 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:39] Energy consumed for all CPUs : 0.002522 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:39] 0.004035 kWh of electricity used since the begi
nning.
Epoch 8/20:  85%|████████▌ | 1600/1875 [00:33<00:05, 49.10batch/s, accuracy=
0.911, loss=0.245][codecarbon INFO @ 02:44:51] Energy consumed for RAM : 0.0
01476 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:51] Energy consumed for all CPUs : 0.002460 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:51] 0.003936 kWh of electricity used since the begi
nning.
Epoch 8/20:  89%|████████▉ | 1673/1875 [00:34<00:04, 47.18batch/s, accuracy=
0.91, loss=0.246] [codecarbon INFO @ 02:44:53] Energy consumed for RAM : 0.0
01400 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:53] Energy consumed for all CPUs : 0.002334 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:53] 0.003735 kWh of electricity used since the begi
nning.
```

```
Epoch 8/20:  94%|█████████ | 1763/1875 [00:36<00:02, 49.91batch/s, accuracy=
0.909, loss=0.248][codecarbon INFO @ 02:44:54] Energy consumed for RAM : 0.0
01525 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:44:54] Energy consumed for all CPUs : 0.002543 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:44:54] 0.004068 kWh of electricity used since the begi
nning.
Epoch 8/20: 100%|██████████| 1875/1875 [00:39<00:00, 47.54batch/s, accuracy=
0.91, loss=0.247]
Epoch 8: Validation Loss: 0.23, Validation Accuracy: 0.915
```

```
Epoch 9/20:   9%|▉         | 178/1875 [00:05<00:34, 49.44batch/s, accuracy=
0.915, loss=0.233][codecarbon INFO @ 02:45:06] Energy consumed for RAM : 0.0
01488 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:06] Energy consumed for all CPUs : 0.002481 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:06] 0.003969 kWh of electricity used since the begi
nning.
Epoch 9/20:  14%|▉         | 254/1875 [00:06<00:32, 49.57batch/s, accuracy=
0.915, loss=0.234][codecarbon INFO @ 02:45:08] Energy consumed for RAM : 0.0
01413 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:08] Energy consumed for all CPUs : 0.002355 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:08] 0.003768 kWh of electricity used since the begi
nning.
Epoch 9/20:  18%|█▊        | 340/1875 [00:08<00:33, 46.26batch/s, accuracy=
0.916, loss=0.229][codecarbon INFO @ 02:45:09] Energy consumed for RAM : 0.0
01538 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:09] Energy consumed for all CPUs : 0.002563 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:09] 0.004101 kWh of electricity used since the begi
nning.
Epoch 9/20:  48%|████▊     | 904/1875 [00:20<00:19, 49.54batch/s, accuracy=
0.915, loss=0.233][codecarbon INFO @ 02:45:21] Energy consumed for RAM : 0.0
01501 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:21] Energy consumed for all CPUs : 0.002502 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:21] 0.004003 kWh of electricity used since the begi
nning.
Epoch 9/20:  52%|█████▏    | 975/1875 [00:21<00:18, 47.64batch/s, accuracy=
0.916, loss=0.229][codecarbon INFO @ 02:45:23] Energy consumed for RAM : 0.0
01426 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:23] Energy consumed for all CPUs : 0.002376 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:23] 0.003802 kWh of electricity used since the begi
nning.
Epoch 9/20:  57%|█████▋    | 1063/1875 [00:23<00:16, 49.61batch/s, accuracy=
0.916, loss=0.231][codecarbon INFO @ 02:45:24] Energy consumed for RAM : 0.0
01550 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:24] Energy consumed for all CPUs : 0.002584 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:24] 0.004135 kWh of electricity used since the begi
nning.
Epoch 9/20:  86%|████████▌ | 1605/1875 [00:35<00:05, 46.88batch/s, accuracy=
0.914, loss=0.234][codecarbon INFO @ 02:45:36] Energy consumed for RAM : 0.0
01513 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:36] Energy consumed for all CPUs : 0.002523 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:36] 0.004036 kWh of electricity used since the begi
nning.
Epoch 9/20:  89%|████████▉ | 1677/1875 [00:36<00:04, 44.59batch/s, accuracy=
0.914, loss=0.236][codecarbon INFO @ 02:45:38] Energy consumed for RAM : 0.0
01438 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:38] Energy consumed for all CPUs : 0.002397 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:38] 0.003835 kWh of electricity used since the begi
nning.
```

```
Epoch 9/20:  94%|█████████ | 1763/1875 [00:38<00:02, 48.01batch/s, accuracy=
0.913, loss=0.237][codecarbon INFO @ 02:45:39] Energy consumed for RAM : 0.0
01563 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:39] Energy consumed for all CPUs : 0.002605 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:39] 0.004168 kWh of electricity used since the begi
nning.
Epoch 9/20: 100%|██████████| 1875/1875 [00:41<00:00, 45.02batch/s, accuracy=
0.914, loss=0.237]
Epoch 9: Validation Loss: 0.22, Validation Accuracy: 0.922
```

```
Epoch 10/20:   7%|▉         | 130/1875 [00:04<00:35, 49.62batch/s, accuracy=
0.921, loss=0.23] [codecarbon INFO @ 02:45:51] Energy consumed for RAM : 0.0
01526 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:51] Energy consumed for all CPUs : 0.002543 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:51] 0.004069 kWh of electricity used since the begi
nning.
Epoch 10/20:  11%|▉         | 204/1875 [00:06<00:36, 46.15batch/s, accuracy=
0.924, loss=0.221][codecarbon INFO @ 02:45:53] Energy consumed for RAM : 0.0
01451 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:53] Energy consumed for all CPUs : 0.002418 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:53] 0.003868 kWh of electricity used since the begi
nning.
Epoch 10/20:  16%|█▍        | 291/1875 [00:07<00:31, 49.55batch/s, accuracy=
0.923, loss=0.226][codecarbon INFO @ 02:45:54] Energy consumed for RAM : 0.0
01575 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:45:54] Energy consumed for all CPUs : 0.002626 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:45:54] 0.004201 kWh of electricity used since the begi
nning.
Epoch 10/20:  45%|████▍     | 848/1875 [00:19<00:22, 46.63batch/s, accuracy=
0.92, loss=0.225][codecarbon INFO @ 02:46:06] Energy consumed for RAM : 0.00
1538 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:06] Energy consumed for all CPUs : 0.002564 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:06] 0.004103 kWh of electricity used since the begi
nning.
Epoch 10/20:  49%|████▉     | 920/1875 [00:21<00:19, 49.55batch/s, accuracy=
0.92, loss=0.224] [codecarbon INFO @ 02:46:08] Energy consumed for RAM : 0.0
01463 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:08] Energy consumed for all CPUs : 0.002439 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:08] 0.003902 kWh of electricity used since the begi
nning.
Epoch 10/20:  54%|█████▍    | 1008/1875 [00:22<00:19, 44.88batch/s, accuracy
=0.919, loss=0.226][codecarbon INFO @ 02:46:09] Energy consumed for RAM : 0.
001588 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:09] Energy consumed for all CPUs : 0.002647 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:09] 0.004235 kWh of electricity used since the begi
nning.
Epoch 10/20:  82%|████████▏ | 1546/1875 [00:34<00:06, 48.01batch/s, accuracy
=0.918, loss=0.227][codecarbon INFO @ 02:46:21] Energy consumed for RAM : 0.
001551 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:21] Energy consumed for all CPUs : 0.002585 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:21] 0.004136 kWh of electricity used since the begi
nning.
Epoch 10/20:  87%|████████▋ | 1622/1875 [00:36<00:05, 48.51batch/s, accuracy
=0.918, loss=0.227][codecarbon INFO @ 02:46:23] Energy consumed for RAM : 0.
001476 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:23] Energy consumed for all CPUs : 0.002459 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:23] 0.003935 kWh of electricity used since the begi
nning.
```

```
Epoch 10/20:  91%|█████████ | 1709/1875 [00:37<00:03, 48.70batch/s, accuracy
=0.918, loss=0.227][codecarbon INFO @ 02:46:24] Energy consumed for RAM : 0.
001600 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:24] Energy consumed for all CPUs : 0.002668 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:24] 0.004268 kWh of electricity used since the begi
nning.
Epoch 10/20: 100%|██████████| 1875/1875 [00:41<00:00, 44.83batch/s, accuracy
=0.918, loss=0.226]
Epoch 10: Validation Loss: 0.22, Validation Accuracy: 0.921
```

```
Epoch 11/20:   5%|▌         | 90/1875 [00:03<00:38, 46.91batch/s, accuracy=
0.919, loss=0.229][codecarbon INFO @ 02:46:36] Energy consumed for RAM : 0.0
01563 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:36] Energy consumed for all CPUs : 0.002606 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:36] 0.004169 kWh of electricity used since the begi
nning.
Epoch 11/20:   9%|▉         | 164/1875 [00:04<00:35, 47.63batch/s, accuracy=
0.918, loss=0.228][codecarbon INFO @ 02:46:38] Energy consumed for RAM : 0.0
01488 kWh. RAM Power : 3.0 W
Epoch 11/20:   9%|▉         | 164/1875 [00:05<00:35, 47.63batch/s, accuracy=
0.919, loss=0.227][codecarbon INFO @ 02:46:38] Energy consumed for all CPUs
: 0.002480 kWh. Total CPU Power : 5.0 W
[codecarbon INFO @ 02:46:38] 0.003968 kWh of electricity used since the begi
nning.
Epoch 11/20:  13%|█▎        | 251/1875 [00:06<00:33, 48.61batch/s, accuracy=
0.916, loss=0.227][codecarbon INFO @ 02:46:39] Energy consumed for RAM : 0.0
01613 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:39] Energy consumed for all CPUs : 0.002688 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:39] 0.004301 kWh of electricity used since the begi
nning.
Epoch 11/20:  43%|████▎     | 803/1875 [00:18<00:22, 47.67batch/s, accuracy=
0.918, loss=0.226][codecarbon INFO @ 02:46:51] Energy consumed for RAM : 0.0
01576 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:51] Energy consumed for all CPUs : 0.002627 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:51] 0.004203 kWh of electricity used since the begi
nning.
Epoch 11/20:  47%|████▋     | 874/1875 [00:20<00:20, 47.88batch/s, accuracy=
0.918, loss=0.226][codecarbon INFO @ 02:46:53] Energy consumed for RAM : 0.0
01501 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:53] Energy consumed for all CPUs : 0.002501 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:53] 0.004002 kWh of electricity used since the begi
nning.
Epoch 11/20:  51%|█████     | 961/1875 [00:21<00:18, 48.86batch/s, accuracy=
0.919, loss=0.223][codecarbon INFO @ 02:46:54] Energy consumed for RAM : 0.0
01625 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:46:54] Energy consumed for all CPUs : 0.002709 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:46:54] 0.004335 kWh of electricity used since the begi
nning.
Epoch 11/20:  79%|███████▉  | 1489/1875 [00:33<00:08, 47.23batch/s, accuracy
=0.919, loss=0.224][codecarbon INFO @ 02:47:06] Energy consumed for RAM : 0.
001588 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:06] Energy consumed for all CPUs : 0.002648 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:06] 0.004236 kWh of electricity used since the begi
nning.
Epoch 11/20:  83%|████████▎ | 1565/1875 [00:34<00:06, 47.92batch/s, accuracy
=0.919, loss=0.223][codecarbon INFO @ 02:47:08] Energy consumed for RAM : 0.
001513 kWh. RAM Power : 3.0 W
Epoch 11/20:  83%|████████▎ | 1565/1875 [00:35<00:06, 47.92batch/s, accuracy
=0.919, loss=0.223][codecarbon INFO @ 02:47:08] Energy consumed for all CPUs
: 0.002522 kWh. Total CPU Power : 5.0 W
```

```
[codecarbon INFO @ 02:47:08] 0.004035 kWh of electricity used since the begi
nning.
Epoch 11/20:  88%|████████▊ | 1645/1875 [00:36<00:05, 45.34batch/s, accuracy
=0.919, loss=0.223][codecarbon INFO @ 02:47:09] Energy consumed for RAM : 0.
001638 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:09] Energy consumed for all CPUs : 0.002730 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:09] 0.004368 kWh of electricity used since the begi
nning.
Epoch 11/20: 100%|██████████| 1875/1875 [00:42<00:00, 44.34batch/s, accuracy
=0.919, loss=0.222]
Epoch 11: Validation Loss: 0.21, Validation Accuracy: 0.924
```

```
Epoch 12/20:   0%|          | 1/1875 [00:01<53:12,  1.70s/batch, accuracy=0.
925, loss=0.179][codecarbon INFO @ 02:47:21] Energy consumed for RAM : 0.001
601 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:21] Energy consumed for all CPUs : 0.002669 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:21] 0.004269 kWh of electricity used since the begi
nning.
Epoch 12/20:   4%|▍         | 73/1875 [00:03<00:37, 47.97batch/s, accuracy=
0.93, loss=0.195] [codecarbon INFO @ 02:47:23] Energy consumed for RAM : 0.0
01526 kWh. RAM Power : 3.0 W
Epoch 12/20:   4%|▍         | 78/1875 [00:03<00:37, 48.06batch/s, accuracy=
0.93, loss=0.195][codecarbon INFO @ 02:47:23] Energy consumed for all CPUs :
0.002543 kWh. Total CPU Power : 5.0 W
[codecarbon INFO @ 02:47:23] 0.004068 kWh of electricity used since the begi
nning.
Epoch 12/20:   9%|▉         | 160/1875 [00:05<00:35, 48.12batch/s, accuracy=
0.924, loss=0.207][codecarbon INFO @ 02:47:24] Energy consumed for RAM : 0.0
01650 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:24] Energy consumed for all CPUs : 0.002751 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:24] 0.004401 kWh of electricity used since the begi
nning.
Epoch 12/20:  38%|███▊      | 715/1875 [00:16<00:24, 47.72batch/s, accuracy=
0.925, loss=0.207][codecarbon INFO @ 02:47:36] Energy consumed for RAM : 0.0
01613 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:36] Energy consumed for all CPUs : 0.002689 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:36] 0.004303 kWh of electricity used since the begi
nning.
Epoch 12/20:  42%|████      | 793/1875 [00:18<00:22, 48.09batch/s, accuracy=
0.925, loss=0.207][codecarbon INFO @ 02:47:38] Energy consumed for RAM : 0.0
01538 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:38] Energy consumed for all CPUs : 0.002564 kWh. To
tal CPU Power : 5.0 W
Epoch 12/20:  42%|████      | 793/1875 [00:18<00:22, 48.09batch/s, accuracy=
0.925, loss=0.207][codecarbon INFO @ 02:47:38] 0.004102 kWh of electricity u
sed since the beginning.
Epoch 12/20:  47%|████▋     | 877/1875 [00:20<00:20, 48.38batch/s, accuracy=
0.925, loss=0.208][codecarbon INFO @ 02:47:39] Energy consumed for RAM : 0.0
01663 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:39] Energy consumed for all CPUs : 0.002772 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:39] 0.004435 kWh of electricity used since the begi
nning.
Epoch 12/20:  76%|███████▌  | 1424/1875 [00:31<00:09, 47.78batch/s, accuracy
=0.924, loss=0.209][codecarbon INFO @ 02:47:51] Energy consumed for RAM : 0.
001626 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:51] Energy consumed for all CPUs : 0.002710 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:51] 0.004336 kWh of electricity used since the begi
nning.
Epoch 12/20:  80%|███████▉  | 1499/1875 [00:33<00:08, 46.36batch/s, accuracy
=0.924, loss=0.209][codecarbon INFO @ 02:47:53] Energy consumed for RAM : 0.
001551 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:53] Energy consumed for all CPUs : 0.002584 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 02:47:53] 0.004135 kWh of electricity used since the begi
nning.
Epoch 12/20:  85%|████████▌  | 1585/1875 [00:35<00:06, 47.71batch/s, accuracy
=0.924, loss=0.209][codecarbon INFO @ 02:47:54] Energy consumed for RAM : 0.
001675 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:47:54] Energy consumed for all CPUs : 0.002793 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:47:54] 0.004468 kWh of electricity used since the begi
nning.
Epoch 12/20: 100%|██████████| 1875/1875 [00:41<00:00, 44.65batch/s, accuracy
=0.924, loss=0.21]
Epoch 12: Validation Loss: 0.20, Validation Accuracy: 0.929
```

```
Epoch 13/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:48:06] Energy consumed for RAM : 0.001638 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:06] Energy consumed for all CPUs : 0.002731 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:06] 0.004369 kWh of electricity used since the begi
nning.
Epoch 13/20:   3%|▌         | 51/1875 [00:02<00:43, 41.72batch/s, accuracy=
0.926, loss=0.202][codecarbon INFO @ 02:48:08] Energy consumed for RAM : 0.0
01563 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:08] Energy consumed for all CPUs : 0.002605 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:08] 0.004168 kWh of electricity used since the begi
nning.
Epoch 13/20:   7%|▋         | 136/1875 [00:04<00:38, 44.85batch/s, accuracy=
0.928, loss=0.2]  [codecarbon INFO @ 02:48:09] Energy consumed for RAM : 0.0
01688 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:09] Energy consumed for all CPUs : 0.002813 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:09] 0.004501 kWh of electricity used since the begi
nning.
Epoch 13/20:  37%|███▋      | 691/1875 [00:16<00:24, 48.78batch/s, accuracy=
0.928, loss=0.201][codecarbon INFO @ 02:48:21] Energy consumed for RAM : 0.0
01651 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:21] Energy consumed for all CPUs : 0.002752 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:21] 0.004403 kWh of electricity used since the begi
nning.
Epoch 13/20:  41%|████      | 767/1875 [00:17<00:23, 48.11batch/s, accuracy=
0.928, loss=0.2]  [codecarbon INFO @ 02:48:23] Energy consumed for RAM : 0.0
01576 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:23] Energy consumed for all CPUs : 0.002626 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:23] 0.004202 kWh of electricity used since the begi
nning.
Epoch 13/20:  45%|████▍     | 848/1875 [00:19<00:22, 46.32batch/s, accuracy=
0.928, loss=0.201][codecarbon INFO @ 02:48:24] Energy consumed for RAM : 0.0
01700 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:24] Energy consumed for all CPUs : 0.002834 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:24] 0.004535 kWh of electricity used since the begi
nning.
Epoch 13/20:  75%|███████▍  | 1402/1875 [00:31<00:09, 48.41batch/s, accuracy
=0.926, loss=0.202][codecarbon INFO @ 02:48:36] Energy consumed for RAM : 0.
001663 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:36] Energy consumed for all CPUs : 0.002773 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:36] 0.004436 kWh of electricity used since the begi
nning.
Epoch 13/20:  79%|███████▊  | 1477/1875 [00:32<00:08, 47.67batch/s, accuracy
=0.925, loss=0.204][codecarbon INFO @ 02:48:38] Energy consumed for RAM : 0.
001588 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:38] Energy consumed for all CPUs : 0.002647 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:38] 0.004235 kWh of electricity used since the begi
nning.
Epoch 13/20:  83%|████████▎ | 1559/1875 [00:34<00:06, 48.14batch/s, accuracy
```

```
=0.926, loss=0.203][codecarbon INFO @ 02:48:39] Energy consumed for RAM : 0.
001713 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:39] Energy consumed for all CPUs : 0.002855 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:39] 0.004568 kWh of electricity used since the begi
nning.
Epoch 13/20: 100%|██████████| 1875/1875 [00:41<00:00, 45.15batch/s, accuracy
=0.925, loss=0.204]
Epoch 13: Validation Loss: 0.20, Validation Accuracy: 0.928
```

```
Epoch 14/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:48:51] Energy consumed for RAM : 0.001676 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:51] Energy consumed for all CPUs : 0.002794 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:51] 0.004469 kWh of electricity used since the begi
nning.
Epoch 14/20:   2%||         | 29/1875 [00:02<01:08, 26.87batch/s, accuracy=
0.925, loss=0.217][codecarbon INFO @ 02:48:53] Energy consumed for RAM : 0.0
01601 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:53] Energy consumed for all CPUs : 0.002668 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:53] 0.004268 kWh of electricity used since the begi
nning.
Epoch 14/20:   6%|▌         | 107/1875 [00:04<00:43, 40.30batch/s, accuracy=
0.927, loss=0.215][codecarbon INFO @ 02:48:54] Energy consumed for RAM : 0.0
01725 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:48:54] Energy consumed for all CPUs : 0.002876 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:48:54] 0.004601 kWh of electricity used since the begi
nning.
Epoch 14/20:  35%|███       | 663/1875 [00:15<00:24, 48.49batch/s, accuracy=
0.927, loss=0.202][codecarbon INFO @ 02:49:06] Energy consumed for RAM : 0.0
01688 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:06] Energy consumed for all CPUs : 0.002814 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:06] 0.004503 kWh of electricity used since the begi
nning.
Epoch 14/20:  39%|███▉      | 739/1875 [00:17<00:23, 47.48batch/s, accuracy=
0.926, loss=0.201][codecarbon INFO @ 02:49:08] Energy consumed for RAM : 0.0
01613 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:08] Energy consumed for all CPUs : 0.002689 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:08] 0.004302 kWh of electricity used since the begi
nning.
Epoch 14/20:  44%|████      | 820/1875 [00:19<00:21, 48.31batch/s, accuracy=
0.926, loss=0.203][codecarbon INFO @ 02:49:09] Energy consumed for RAM : 0.0
01738 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:09] Energy consumed for all CPUs : 0.002897 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:09] 0.004635 kWh of electricity used since the begi
nning.
Epoch 14/20:  74%|███████   | 1390/1875 [00:30<00:09, 49.55batch/s, accuracy
=0.927, loss=0.199][codecarbon INFO @ 02:49:21] Energy consumed for RAM : 0.
001701 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:21] Energy consumed for all CPUs : 0.002835 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:21] 0.004536 kWh of electricity used since the begi
nning.
Epoch 14/20:  78%|███████▊  | 1465/1875 [00:32<00:08, 47.52batch/s, accuracy
=0.927, loss=0.2]  [codecarbon INFO @ 02:49:23] Energy consumed for RAM : 0.
001626 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:23] Energy consumed for all CPUs : 0.002710 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:23] 0.004335 kWh of electricity used since the begi
nning.
Epoch 14/20:  82%|████████▏ | 1545/1875 [00:34<00:07, 46.90batch/s, accuracy
```

```
=0.927, loss=0.201][codecarbon INFO @ 02:49:24] Energy consumed for RAM : 0.
001750 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:24] Energy consumed for all CPUs : 0.002918 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:24] 0.004668 kWh of electricity used since the begi
nning.
Epoch 14/20: 100%|██████████| 1875/1875 [00:41<00:00, 45.03batch/s, accuracy
=0.927, loss=0.2]
[codecarbon INFO @ 02:49:36] Energy consumed for RAM : 0.001713 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:49:36] Energy consumed for all CPUs : 0.002856 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:36] 0.004570 kWh of electricity used since the begi
nning.
Epoch 14: Validation Loss: 0.20, Validation Accuracy: 0.931
```

```
Epoch 15/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:49:38] Energy consumed for RAM : 0.001638 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:38] Energy consumed for all CPUs : 0.002730 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:38] 0.004368 kWh of electricity used since the begi
nning.
Epoch 15/20:   4%|▌         | 70/1875 [00:03<00:48, 36.96batch/s, accuracy=
0.929, loss=0.202][codecarbon INFO @ 02:49:39] Energy consumed for RAM : 0.0
01763 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:39] Energy consumed for all CPUs : 0.002939 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:39] 0.004701 kWh of electricity used since the begi
nning.
Epoch 15/20:  33%|███       | 615/1875 [00:14<00:25, 50.17batch/s, accuracy=
0.931, loss=0.189][codecarbon INFO @ 02:49:51] Energy consumed for RAM : 0.0
01726 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:51] Energy consumed for all CPUs : 0.002877 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:51] 0.004603 kWh of electricity used since the begi
nning.
Epoch 15/20:  37%|███       | 690/1875 [00:16<00:23, 50.53batch/s, accuracy=
0.93, loss=0.19]  [codecarbon INFO @ 02:49:53] Energy consumed for RAM : 0.0
01651 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:53] Energy consumed for all CPUs : 0.002751 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:53] 0.004402 kWh of electricity used since the begi
nning.
Epoch 15/20:  42%|████      | 781/1875 [00:18<00:21, 50.84batch/s, accuracy=
0.93, loss=0.19]  [codecarbon INFO @ 02:49:54] Energy consumed for RAM : 0.0
01775 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:49:54] Energy consumed for all CPUs : 0.002959 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:49:54] 0.004735 kWh of electricity used since the begi
nning.
Epoch 15/20:  72%|███████   | 1358/1875 [00:29<00:09, 51.76batch/s, accuracy
=0.929, loss=0.192][codecarbon INFO @ 02:50:06] Energy consumed for RAM : 0.
001738 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:06] Energy consumed for all CPUs : 0.002898 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:06] 0.004636 kWh of electricity used since the begi
nning.
Epoch 15/20:  77%|███████▋  | 1436/1875 [00:31<00:08, 50.42batch/s, accuracy
=0.929, loss=0.192][codecarbon INFO @ 02:50:08] Energy consumed for RAM : 0.
001663 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:08] Energy consumed for all CPUs : 0.002772 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:08] 0.004435 kWh of electricity used since the begi
nning.
Epoch 15/20:  81%|████████  | 1524/1875 [00:33<00:07, 47.03batch/s, accuracy
=0.929, loss=0.191][codecarbon INFO @ 02:50:09] Energy consumed for RAM : 0.
001788 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:09] Energy consumed for all CPUs : 0.002980 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:09] 0.004768 kWh of electricity used since the begi
nning.
Epoch 15/20: 100%|██████████| 1875/1875 [00:44<00:00, 42.14batch/s, accuracy
```

```
=0.93, loss=0.191]
[codecarbon INFO @ 02:50:21] Energy consumed for RAM : 0.001751 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:50:21] Energy consumed for all CPUs : 0.002919 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:21] 0.004670 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:50:23] Energy consumed for RAM : 0.001676 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:50:23] Energy consumed for all CPUs : 0.002793 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:23] 0.004468 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:50:25] Energy consumed for RAM : 0.001800 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:50:25] Energy consumed for all CPUs : 0.003001 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:25] 0.004801 kWh of electricity used since the begi
nning.
Epoch 15: Validation Loss: 0.20, Validation Accuracy: 0.928
```

```
Epoch 16/20:  21%|██        | 399/1875 [00:10<00:28, 52.22batch/s, accuracy=
0.932, loss=0.185][codecarbon INFO @ 02:50:36] Energy consumed for RAM : 0.0
01763 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:36] Energy consumed for all CPUs : 0.002939 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:36] 0.004703 kWh of electricity used since the begi
nning.
Epoch 16/20:  25%|██        | 470/1875 [00:11<00:30, 45.90batch/s, accuracy=
0.931, loss=0.189][codecarbon INFO @ 02:50:38] Energy consumed for RAM : 0.0
01688 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:38] Energy consumed for all CPUs : 0.002814 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:38] 0.004502 kWh of electricity used since the begi
nning.
Epoch 16/20:  29%|██        | 549/1875 [00:13<00:28, 47.01batch/s, accuracy=
0.93, loss=0.189] [codecarbon INFO @ 02:50:40] Energy consumed for RAM : 0.0
01813 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:40] Energy consumed for all CPUs : 0.003022 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:40] 0.004835 kWh of electricity used since the begi
nning.
Epoch 16/20:  62%|██████    | 1166/1875 [00:25<00:13, 54.12batch/s, accuracy
=0.931, loss=0.19] [codecarbon INFO @ 02:50:51] Energy consumed for RAM : 0.
001776 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:51] Energy consumed for all CPUs : 0.002960 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:51] 0.004736 kWh of electricity used since the begi
nning.
Epoch 16/20:  66%|██████    | 1244/1875 [00:26<00:12, 50.67batch/s, accuracy
=0.931, loss=0.19][codecarbon INFO @ 02:50:53] Energy consumed for RAM : 0.0
01701 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:53] Energy consumed for all CPUs : 0.002835 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:53] 0.004535 kWh of electricity used since the begi
nning.
Epoch 16/20:  71%|███████   | 1340/1875 [00:28<00:09, 55.09batch/s, accuracy
=0.931, loss=0.19] [codecarbon INFO @ 02:50:55] Energy consumed for RAM : 0.
001825 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:50:55] Energy consumed for all CPUs : 0.003043 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:50:55] 0.004868 kWh of electricity used since the begi
nning.
Epoch 16/20: 100%|██████████| 1875/1875 [00:38<00:00, 48.38batch/s, accuracy
=0.93, loss=0.189]
[codecarbon INFO @ 02:51:06] Energy consumed for RAM : 0.001788 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:51:06] Energy consumed for all CPUs : 0.002981 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:06] 0.004770 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:51:08] Energy consumed for RAM : 0.001713 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:51:08] Energy consumed for all CPUs : 0.002855 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:08] 0.004569 kWh of electricity used since the begi
nning.
```

```
Epoch 16: Validation Loss: 0.20, Validation Accuracy: 0.931
Epoch 17/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:51:10] Energy consumed for RAM : 0.001838 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:10] Energy consumed for all CPUs : 0.003064 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:10] 0.004902 kWh of electricity used since the begi
nning.
Epoch 17/20:  32%|███       | 604/1875 [00:12<00:24, 50.98batch/s, accuracy=
0.933, loss=0.183][codecarbon INFO @ 02:51:21] Energy consumed for RAM : 0.0
01801 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:21] Energy consumed for all CPUs : 0.003002 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:21] 0.004803 kWh of electricity used since the begi
nning.
Epoch 17/20:  37%|███       | 688/1875 [00:14<00:21, 55.01batch/s, accuracy=
0.932, loss=0.184][codecarbon INFO @ 02:51:23] Energy consumed for RAM : 0.0
01726 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:23] Energy consumed for all CPUs : 0.002876 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:23] 0.004602 kWh of electricity used since the begi
nning.
Epoch 17/20:  42%|████      | 784/1875 [00:16<00:20, 53.16batch/s, accuracy=
0.932, loss=0.185][codecarbon INFO @ 02:51:25] Energy consumed for RAM : 0.0
01850 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:25] Energy consumed for all CPUs : 0.003084 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:25] 0.004935 kWh of electricity used since the begi
nning.
Epoch 17/20:  75%|███████   | 1414/1875 [00:27<00:08, 53.83batch/s, accuracy
=0.934, loss=0.181][codecarbon INFO @ 02:51:36] Energy consumed for RAM : 0.
001813 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:36] Energy consumed for all CPUs : 0.003023 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:36] 0.004836 kWh of electricity used since the begi
nning.
Epoch 17/20:  80%|████████  | 1498/1875 [00:29<00:06, 55.23batch/s, accuracy
=0.934, loss=0.182][codecarbon INFO @ 02:51:38] Energy consumed for RAM : 0.
001738 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:38] Energy consumed for all CPUs : 0.002897 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:38] 0.004635 kWh of electricity used since the begi
nning.
Epoch 17/20:  85%|████████  | 1594/1875 [00:31<00:05, 53.97batch/s, accuracy
=0.933, loss=0.183][codecarbon INFO @ 02:51:40] Energy consumed for RAM : 0.
001863 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:40] Energy consumed for all CPUs : 0.003105 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:40] 0.004968 kWh of electricity used since the begi
nning.
Epoch 17/20: 100%|██████████| 1875/1875 [00:36<00:00, 51.17batch/s, accuracy
=0.933, loss=0.184]
Epoch 17: Validation Loss: 0.21, Validation Accuracy: 0.930
```

```
Epoch 18/20:   4%|▌         | 66/1875 [00:02<00:35, 51.25batch/s, accuracy=
0.937, loss=0.168][codecarbon INFO @ 02:51:51] Energy consumed for RAM : 0.0
01826 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:51] Energy consumed for all CPUs : 0.003044 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:51] 0.004870 kWh of electricity used since the begi
nning.
Epoch 18/20:   8%|▊         | 150/1875 [00:04<00:31, 55.07batch/s, accuracy=
0.933, loss=0.174][codecarbon INFO @ 02:51:53] Energy consumed for RAM : 0.0
01751 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:53] Energy consumed for all CPUs : 0.002918 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:53] 0.004669 kWh of electricity used since the begi
nning.
Epoch 18/20:  13%|█▎        | 246/1875 [00:06<00:29, 54.95batch/s, accuracy=
0.933, loss=0.176][codecarbon INFO @ 02:51:55] Energy consumed for RAM : 0.0
01875 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:51:55] Energy consumed for all CPUs : 0.003126 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:51:55] 0.005002 kWh of electricity used since the begi
nning.
Epoch 18/20:  47%|████▋     | 882/1875 [00:17<00:17, 55.63batch/s, accuracy=
0.935, loss=0.176][codecarbon INFO @ 02:52:06] Energy consumed for RAM : 0.0
01838 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:06] Energy consumed for all CPUs : 0.003065 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:06] 0.004903 kWh of electricity used since the begi
nning.
Epoch 18/20:  52%|█████▏    | 966/1875 [00:19<00:16, 54.46batch/s, accuracy=
0.936, loss=0.176][codecarbon INFO @ 02:52:08] Energy consumed for RAM : 0.0
01763 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:08] Energy consumed for all CPUs : 0.002939 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:08] 0.004702 kWh of electricity used since the begi
nning.
Epoch 18/20:  57%|█████▋    | 1062/1875 [00:21<00:14, 55.11batch/s, accuracy
=0.935, loss=0.178][codecarbon INFO @ 02:52:10] Energy consumed for RAM : 0.
001888 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:10] Energy consumed for all CPUs : 0.003147 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:10] 0.005035 kWh of electricity used since the begi
nning.
Epoch 18/20:  91%|█████████ | 1698/1875 [00:32<00:03, 55.14batch/s, accuracy
=0.935, loss=0.178][codecarbon INFO @ 02:52:21] Energy consumed for RAM : 0.
001851 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:21] Energy consumed for all CPUs : 0.003085 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:21] 0.004936 kWh of electricity used since the begi
nning.
Epoch 18/20:  95%|█████████▍| 1782/1875 [00:34<00:01, 55.08batch/s, accuracy
=0.935, loss=0.178][codecarbon INFO @ 02:52:23] Energy consumed for RAM : 0.
001776 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:23] Energy consumed for all CPUs : 0.002960 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:23] 0.004735 kWh of electricity used since the begi
nning.
```

```
Epoch 18/20: 100%|██████████| 1872/1875 [00:35<00:00, 54.89batch/s, accuracy
=0.935, loss=0.179][codecarbon INFO @ 02:52:25] Energy consumed for RAM : 0.
001900 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:25] Energy consumed for all CPUs : 0.003168 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:25] 0.005068 kWh of electricity used since the begi
nning.
Epoch 18/20: 100%|██████████| 1875/1875 [00:36<00:00, 51.63batch/s, accuracy
=0.935, loss=0.179]
Epoch 18: Validation Loss: 0.20, Validation Accuracy: 0.931
```

```
Epoch 19/20:  19%|██        | 349/1875 [00:07<00:27, 55.51batch/s, accuracy=
0.938, loss=0.173][codecarbon INFO @ 02:52:36] Energy consumed for RAM : 0.0
01863 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:36] Energy consumed for all CPUs : 0.003106 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:36] 0.004970 kWh of electricity used since the begi
nning.
Epoch 19/20:  23%|██        | 433/1875 [00:09<00:26, 55.07batch/s, accuracy=
0.937, loss=0.175][codecarbon INFO @ 02:52:38] Energy consumed for RAM : 0.0
01788 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:38] Energy consumed for all CPUs : 0.002980 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:38] 0.004769 kWh of electricity used since the begi
nning.
Epoch 19/20:  28%|██        | 529/1875 [00:11<00:24, 55.41batch/s, accuracy=
0.936, loss=0.178][codecarbon INFO @ 02:52:40] Energy consumed for RAM : 0.0
01913 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:40] Energy consumed for all CPUs : 0.003189 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:40] 0.005102 kWh of electricity used since the begi
nning.
Epoch 19/20:  61%|██████    | 1153/1875 [00:22<00:13, 53.43batch/s, accuracy
=0.936, loss=0.173][codecarbon INFO @ 02:52:51] Energy consumed for RAM : 0.
001876 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:51] Energy consumed for all CPUs : 0.003127 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:51] 0.005003 kWh of electricity used since the begi
nning.
Epoch 19/20:  66%|██████    | 1237/1875 [00:24<00:11, 53.91batch/s, accuracy
=0.936, loss=0.174][codecarbon INFO @ 02:52:53] Energy consumed for RAM : 0.
001801 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:53] Energy consumed for all CPUs : 0.003001 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:53] 0.004802 kWh of electricity used since the begi
nning.
Epoch 19/20:  71%|███████   | 1333/1875 [00:26<00:09, 54.64batch/s, accuracy
=0.936, loss=0.172][codecarbon INFO @ 02:52:55] Energy consumed for RAM : 0.
001925 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:52:55] Energy consumed for all CPUs : 0.003209 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:52:55] 0.005135 kWh of electricity used since the begi
nning.
Epoch 19/20: 100%|██████████| 1875/1875 [00:36<00:00, 51.34batch/s, accuracy
=0.936, loss=0.175]
[codecarbon INFO @ 02:53:06] Energy consumed for RAM : 0.001888 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:53:06] Energy consumed for all CPUs : 0.003148 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:06] 0.005036 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:53:08] Energy consumed for RAM : 0.001813 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:53:08] Energy consumed for all CPUs : 0.003022 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:08] 0.004835 kWh of electricity used since the begi
nning.
```

```
Epoch 19: Validation Loss: 0.19, Validation Accuracy: 0.931
Epoch 20/20:   0%|          | 0/1875 [00:00<?, ?batch/s][codecarbon INFO @ 0
2:53:10] Energy consumed for RAM : 0.001938 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:53:10] Energy consumed for all CPUs : 0.003230 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:10] 0.005168 kWh of electricity used since the begi
nning.
Epoch 20/20:  33%|███       | 625/1875 [00:12<00:22, 56.34batch/s, accuracy=
0.936, loss=0.171][codecarbon INFO @ 02:53:21] Energy consumed for RAM : 0.0
01901 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:53:21] Energy consumed for all CPUs : 0.003169 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:21] 0.005070 kWh of electricity used since the begi
nning.
Epoch 20/20:  37%|███       | 703/1875 [00:14<00:25, 45.27batch/s, accuracy=
0.936, loss=0.171][codecarbon INFO @ 02:53:23] Energy consumed for RAM : 0.0
01826 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:53:23] Energy consumed for all CPUs : 0.003043 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:23] 0.004869 kWh of electricity used since the begi
nning.
Epoch 20/20:  43%|████      | 805/1875 [00:16<00:19, 54.86batch/s, accuracy=
0.936, loss=0.171][codecarbon INFO @ 02:53:25] Energy consumed for RAM : 0.0
01950 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:53:25] Energy consumed for all CPUs : 0.003251 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:25] 0.005202 kWh of electricity used since the begi
nning.
Epoch 20/20:  77%|███████   | 1435/1875 [00:27<00:08, 54.75batch/s, accuracy
=0.936, loss=0.174][codecarbon INFO @ 02:53:36] Energy consumed for RAM : 0.
001913 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:53:36] Energy consumed for all CPUs : 0.003190 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:36] 0.005103 kWh of electricity used since the begi
nning.
Epoch 20/20:  81%|████████  | 1513/1875 [00:29<00:07, 50.40batch/s, accuracy
=0.936, loss=0.173][codecarbon INFO @ 02:53:38] Energy consumed for RAM : 0.
001838 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:53:38] Energy consumed for all CPUs : 0.003064 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:38] 0.004902 kWh of electricity used since the begi
nning.
Epoch 20/20:  86%|████████  | 1609/1875 [00:31<00:04, 56.14batch/s, accuracy
=0.936, loss=0.172][codecarbon INFO @ 02:53:40] Energy consumed for RAM : 0.
001963 kWh. RAM Power : 3.0 W
[codecarbon INFO @ 02:53:40] Energy consumed for all CPUs : 0.003272 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:40] 0.005235 kWh of electricity used since the begi
nning.
Epoch 20/20: 100%|██████████| 1875/1875 [00:36<00:00, 51.73batch/s, accuracy
=0.936, loss=0.173]
Epoch 20: Validation Loss: 0.20, Validation Accuracy: 0.933
```

```
[codecarbon INFO @ 02:53:51] Energy consumed for RAM : 0.001926 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:53:51] Energy consumed for all CPUs : 0.003210 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:51] 0.005136 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:53:53] Energy consumed for RAM : 0.001851 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:53:53] Energy consumed for all CPUs : 0.003085 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:53] 0.004935 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:53:55] Energy consumed for RAM : 0.001975 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:53:55] Energy consumed for all CPUs : 0.003293 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:53:55] 0.005268 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:06] Energy consumed for RAM : 0.001938 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:06] Energy consumed for all CPUs : 0.003231 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:06] 0.005170 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:08] Energy consumed for RAM : 0.001863 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:08] Energy consumed for all CPUs : 0.003105 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:08] 0.004969 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:10] Energy consumed for RAM : 0.001988 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:10] Energy consumed for all CPUs : 0.003314 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:10] 0.005302 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:21] Energy consumed for RAM : 0.001951 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:21] Energy consumed for all CPUs : 0.003252 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:21] 0.005203 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:23] Energy consumed for RAM : 0.001876 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:23] Energy consumed for all CPUs : 0.003126 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:23] 0.005002 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:25] Energy consumed for RAM : 0.002000 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:25] Energy consumed for all CPUs : 0.003334 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:25] 0.005335 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:36] Energy consumed for RAM : 0.001963 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 02:54:36] Energy consumed for all CPUs : 0.003273 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:36] 0.005236 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:38] Energy consumed for RAM : 0.001888 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:38] Energy consumed for all CPUs : 0.003147 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:38] 0.005035 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:40] Energy consumed for RAM : 0.002013 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:40] Energy consumed for all CPUs : 0.003355 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:40] 0.005368 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:51] Energy consumed for RAM : 0.001976 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:51] Energy consumed for all CPUs : 0.003294 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:51] 0.005270 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:53] Energy consumed for RAM : 0.001901 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:53] Energy consumed for all CPUs : 0.003168 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:53] 0.005069 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:54:55] Energy consumed for RAM : 0.002025 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:54:55] Energy consumed for all CPUs : 0.003376 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:54:55] 0.005402 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:06] Energy consumed for RAM : 0.001988 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:06] Energy consumed for all CPUs : 0.003315 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:06] 0.005303 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:08] Energy consumed for RAM : 0.001913 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:08] Energy consumed for all CPUs : 0.003189 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:08] 0.005102 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:10] Energy consumed for RAM : 0.002038 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:10] Energy consumed for all CPUs : 0.003397 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:10] 0.005435 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:21] Energy consumed for RAM : 0.002001 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:21] Energy consumed for all CPUs : 0.003335 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 02:55:21] 0.005336 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:23] Energy consumed for RAM : 0.001926 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:23] Energy consumed for all CPUs : 0.003210 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:23] 0.005135 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:25] Energy consumed for RAM : 0.002050 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:25] Energy consumed for all CPUs : 0.003418 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:25] 0.005468 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:36] Energy consumed for RAM : 0.002013 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:36] Energy consumed for all CPUs : 0.003356 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:36] 0.005370 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:38] Energy consumed for RAM : 0.001938 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:38] Energy consumed for all CPUs : 0.003230 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:38] 0.005169 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:40] Energy consumed for RAM : 0.002063 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:40] Energy consumed for all CPUs : 0.003439 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:40] 0.005502 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:51] Energy consumed for RAM : 0.002026 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:51] Energy consumed for all CPUs : 0.003377 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:51] 0.005403 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:53] Energy consumed for RAM : 0.001951 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:53] Energy consumed for all CPUs : 0.003251 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:53] 0.005202 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:55:55] Energy consumed for RAM : 0.002075 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:55:55] Energy consumed for all CPUs : 0.003459 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:55:55] 0.005535 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:06] Energy consumed for RAM : 0.002038 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:06] Energy consumed for all CPUs : 0.003398 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:06] 0.005436 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 02:56:08] Energy consumed for RAM : 0.001963 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:08] Energy consumed for all CPUs : 0.003272 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:08] 0.005235 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:10] Energy consumed for RAM : 0.002088 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:10] Energy consumed for all CPUs : 0.003480 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:10] 0.005568 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:21] Energy consumed for RAM : 0.002051 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:21] Energy consumed for all CPUs : 0.003419 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:21] 0.005470 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:23] Energy consumed for RAM : 0.001976 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:23] Energy consumed for all CPUs : 0.003293 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:23] 0.005269 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:25] Energy consumed for RAM : 0.002100 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:25] Energy consumed for all CPUs : 0.003501 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:25] 0.005602 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:36] Energy consumed for RAM : 0.002063 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:36] Energy consumed for all CPUs : 0.003440 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:36] 0.005503 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:38] Energy consumed for RAM : 0.001988 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:38] Energy consumed for all CPUs : 0.003314 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:38] 0.005302 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:40] Energy consumed for RAM : 0.002113 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:40] Energy consumed for all CPUs : 0.003522 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:40] 0.005635 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:51] Energy consumed for RAM : 0.002076 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:51] Energy consumed for all CPUs : 0.003460 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:51] 0.005536 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:53] Energy consumed for RAM : 0.002001 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 02:56:53] Energy consumed for all CPUs : 0.003335 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:53] 0.005335 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:56:55] Energy consumed for RAM : 0.002125 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:56:55] Energy consumed for all CPUs : 0.003543 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:56:55] 0.005668 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:06] Energy consumed for RAM : 0.002088 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:06] Energy consumed for all CPUs : 0.003481 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:06] 0.005570 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:08] Energy consumed for RAM : 0.002013 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:08] Energy consumed for all CPUs : 0.003355 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:08] 0.005369 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:10] Energy consumed for RAM : 0.002138 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:10] Energy consumed for all CPUs : 0.003564 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:10] 0.005702 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:21] Energy consumed for RAM : 0.002101 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:21] Energy consumed for all CPUs : 0.003502 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:21] 0.005603 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:23] Energy consumed for RAM : 0.002026 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:23] Energy consumed for all CPUs : 0.003376 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:23] 0.005402 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:25] Energy consumed for RAM : 0.002150 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:25] Energy consumed for all CPUs : 0.003585 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:25] 0.005735 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:36] Energy consumed for RAM : 0.002113 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:36] Energy consumed for all CPUs : 0.003523 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:36] 0.005636 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:38] Energy consumed for RAM : 0.002038 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:38] Energy consumed for all CPUs : 0.003397 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 02:57:38] 0.005435 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:40] Energy consumed for RAM : 0.002163 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:40] Energy consumed for all CPUs : 0.003605 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:40] 0.005768 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:51] Energy consumed for RAM : 0.002126 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:51] Energy consumed for all CPUs : 0.003544 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:51] 0.005670 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:53] Energy consumed for RAM : 0.002051 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:53] Energy consumed for all CPUs : 0.003418 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:53] 0.005469 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:57:55] Energy consumed for RAM : 0.002175 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:57:55] Energy consumed for all CPUs : 0.003626 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:57:55] 0.005802 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:06] Energy consumed for RAM : 0.002138 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:06] Energy consumed for all CPUs : 0.003565 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:06] 0.005703 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:08] Energy consumed for RAM : 0.002063 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:08] Energy consumed for all CPUs : 0.003439 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:08] 0.005502 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:10] Energy consumed for RAM : 0.002188 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:10] Energy consumed for all CPUs : 0.003647 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:10] 0.005835 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:21] Energy consumed for RAM : 0.002151 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:21] Energy consumed for all CPUs : 0.003586 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:21] 0.005736 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:23] Energy consumed for RAM : 0.002076 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:23] Energy consumed for all CPUs : 0.003460 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:23] 0.005535 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 02:58:25] Energy consumed for RAM : 0.002200 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:25] Energy consumed for all CPUs : 0.003668 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:25] 0.005868 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:36] Energy consumed for RAM : 0.002163 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:36] Energy consumed for all CPUs : 0.003606 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:36] 0.005770 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:38] Energy consumed for RAM : 0.002088 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:38] Energy consumed for all CPUs : 0.003481 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:38] 0.005569 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:40] Energy consumed for RAM : 0.002213 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:40] Energy consumed for all CPUs : 0.003689 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:40] 0.005902 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:51] Energy consumed for RAM : 0.002176 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:51] Energy consumed for all CPUs : 0.003627 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:51] 0.005803 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:53] Energy consumed for RAM : 0.002101 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:53] Energy consumed for all CPUs : 0.003501 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:53] 0.005602 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:58:55] Energy consumed for RAM : 0.002226 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:58:55] Energy consumed for all CPUs : 0.003710 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:58:55] 0.005935 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:06] Energy consumed for RAM : 0.002188 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:06] Energy consumed for all CPUs : 0.003648 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:06] 0.005837 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:08] Energy consumed for RAM : 0.002113 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:08] Energy consumed for all CPUs : 0.003522 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:08] 0.005635 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:10] Energy consumed for RAM : 0.002238 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 02:59:10] Energy consumed for all CPUs : 0.003730 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:10] 0.005968 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:21] Energy consumed for RAM : 0.002201 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:21] Energy consumed for all CPUs : 0.003669 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:21] 0.005870 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:23] Energy consumed for RAM : 0.002126 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:23] Energy consumed for all CPUs : 0.003543 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:23] 0.005669 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:25] Energy consumed for RAM : 0.002251 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:25] Energy consumed for all CPUs : 0.003751 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:25] 0.006002 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:36] Energy consumed for RAM : 0.002213 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:36] Energy consumed for all CPUs : 0.003690 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:36] 0.005903 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:38] Energy consumed for RAM : 0.002138 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:38] Energy consumed for all CPUs : 0.003564 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:38] 0.005702 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:40] Energy consumed for RAM : 0.002263 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:40] Energy consumed for all CPUs : 0.003772 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:40] 0.006035 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:51] Energy consumed for RAM : 0.002226 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:51] Energy consumed for all CPUs : 0.003711 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:51] 0.005937 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:53] Energy consumed for RAM : 0.002151 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:53] Energy consumed for all CPUs : 0.003585 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 02:59:53] 0.005735 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 02:59:55] Energy consumed for RAM : 0.002276 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 02:59:55] Energy consumed for all CPUs : 0.003793 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 02:59:55] 0.006068 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:06] Energy consumed for RAM : 0.002238 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:06] Energy consumed for all CPUs : 0.003731 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:06] 0.005970 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:08] Energy consumed for RAM : 0.002163 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:08] Energy consumed for all CPUs : 0.003606 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:08] 0.005769 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:10] Energy consumed for RAM : 0.002288 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:10] Energy consumed for all CPUs : 0.003814 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:10] 0.006102 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:21] Energy consumed for RAM : 0.002251 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:21] Energy consumed for all CPUs : 0.003752 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:21] 0.006003 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:23] Energy consumed for RAM : 0.002176 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:23] Energy consumed for all CPUs : 0.003626 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:23] 0.005802 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:25] Energy consumed for RAM : 0.002301 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:25] Energy consumed for all CPUs : 0.003835 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:25] 0.006135 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:36] Energy consumed for RAM : 0.002263 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:36] Energy consumed for all CPUs : 0.003773 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:36] 0.006037 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:38] Energy consumed for RAM : 0.002188 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:38] Energy consumed for all CPUs : 0.003647 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:38] 0.005835 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:40] Energy consumed for RAM : 0.002313 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:40] Energy consumed for all CPUs : 0.003855 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:40] 0.006169 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:00:51] Energy consumed for RAM : 0.002276 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:51] Energy consumed for all CPUs : 0.003794 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:51] 0.006070 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:53] Energy consumed for RAM : 0.002201 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:53] Energy consumed for all CPUs : 0.003668 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:53] 0.005869 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:00:55] Energy consumed for RAM : 0.002326 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:00:55] Energy consumed for all CPUs : 0.003876 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:00:55] 0.006202 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:06] Energy consumed for RAM : 0.002289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:06] Energy consumed for all CPUs : 0.003815 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:06] 0.006103 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:08] Energy consumed for RAM : 0.002213 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:08] Energy consumed for all CPUs : 0.003689 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:08] 0.005902 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:10] Energy consumed for RAM : 0.002338 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:10] Energy consumed for all CPUs : 0.003897 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:10] 0.006235 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:21] Energy consumed for RAM : 0.002301 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:21] Energy consumed for all CPUs : 0.003836 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:21] 0.006137 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:23] Energy consumed for RAM : 0.002226 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:23] Energy consumed for all CPUs : 0.003710 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:23] 0.005935 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:25] Energy consumed for RAM : 0.002351 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:25] Energy consumed for all CPUs : 0.003918 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:25] 0.006268 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:36] Energy consumed for RAM : 0.002314 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:01:36] Energy consumed for all CPUs : 0.003856 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:36] 0.006170 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:38] Energy consumed for RAM : 0.002238 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:38] Energy consumed for all CPUs : 0.003731 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:38] 0.005969 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:40] Energy consumed for RAM : 0.002363 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:40] Energy consumed for all CPUs : 0.003939 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:40] 0.006302 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:51] Energy consumed for RAM : 0.002326 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:51] Energy consumed for all CPUs : 0.003877 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:51] 0.006203 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:53] Energy consumed for RAM : 0.002251 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:53] Energy consumed for all CPUs : 0.003751 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:53] 0.006002 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:01:55] Energy consumed for RAM : 0.002376 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:01:55] Energy consumed for all CPUs : 0.003960 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:01:55] 0.006335 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:06] Energy consumed for RAM : 0.002339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:06] Energy consumed for all CPUs : 0.003898 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:06] 0.006237 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:08] Energy consumed for RAM : 0.002263 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:08] Energy consumed for all CPUs : 0.003772 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:08] 0.006036 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:10] Energy consumed for RAM : 0.002388 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:10] Energy consumed for all CPUs : 0.003981 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:10] 0.006369 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:21] Energy consumed for RAM : 0.002351 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:21] Energy consumed for all CPUs : 0.003919 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:02:21] 0.006270 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:23] Energy consumed for RAM : 0.002276 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:23] Energy consumed for all CPUs : 0.003793 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:23] 0.006069 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:25] Energy consumed for RAM : 0.002401 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:25] Energy consumed for all CPUs : 0.004001 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:25] 0.006402 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:36] Energy consumed for RAM : 0.002364 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:36] Energy consumed for all CPUs : 0.003940 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:36] 0.006303 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:38] Energy consumed for RAM : 0.002288 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:38] Energy consumed for all CPUs : 0.003814 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:38] 0.006102 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:40] Energy consumed for RAM : 0.002413 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:40] Energy consumed for all CPUs : 0.004022 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:40] 0.006435 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:52] Energy consumed for RAM : 0.002376 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:52] Energy consumed for all CPUs : 0.003961 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:52] 0.006337 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:53] Energy consumed for RAM : 0.002301 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:53] Energy consumed for all CPUs : 0.003835 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:53] 0.006136 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:02:55] Energy consumed for RAM : 0.002426 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:02:55] Energy consumed for all CPUs : 0.004043 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:02:55] 0.006469 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:06] Energy consumed for RAM : 0.002389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:06] Energy consumed for all CPUs : 0.003981 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:07] 0.006370 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:03:08] Energy consumed for RAM : 0.002313 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:08] Energy consumed for all CPUs : 0.003856 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:08] 0.006169 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:10] Energy consumed for RAM : 0.002438 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:10] Energy consumed for all CPUs : 0.004064 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:10] 0.006502 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:22] Energy consumed for RAM : 0.002401 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:22] Energy consumed for all CPUs : 0.004002 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:22] 0.006403 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:23] Energy consumed for RAM : 0.002326 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:23] Energy consumed for all CPUs : 0.003877 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:23] 0.006202 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:25] Energy consumed for RAM : 0.002451 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:25] Energy consumed for all CPUs : 0.004085 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:25] 0.006535 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:37] Energy consumed for RAM : 0.002414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:37] Energy consumed for all CPUs : 0.004023 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:37] 0.006437 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:38] Energy consumed for RAM : 0.002338 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:38] Energy consumed for all CPUs : 0.003897 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:38] 0.006236 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:40] Energy consumed for RAM : 0.002463 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:40] Energy consumed for all CPUs : 0.004106 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:40] 0.006569 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:52] Energy consumed for RAM : 0.002426 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:52] Energy consumed for all CPUs : 0.004044 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:52] 0.006470 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:53] Energy consumed for RAM : 0.002351 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:03:53] Energy consumed for all CPUs : 0.003918 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:53] 0.006269 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:03:55] Energy consumed for RAM : 0.002476 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:03:55] Energy consumed for all CPUs : 0.004126 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:03:55] 0.006602 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:07] Energy consumed for RAM : 0.002439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:07] Energy consumed for all CPUs : 0.004065 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:07] 0.006503 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:08] Energy consumed for RAM : 0.002363 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:08] Energy consumed for all CPUs : 0.003939 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:08] 0.006302 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:10] Energy consumed for RAM : 0.002488 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:10] Energy consumed for all CPUs : 0.004147 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:10] 0.006635 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:22] Energy consumed for RAM : 0.002451 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:22] Energy consumed for all CPUs : 0.004086 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:22] 0.006537 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:23] Energy consumed for RAM : 0.002376 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:23] Energy consumed for all CPUs : 0.003960 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:23] 0.006336 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:25] Energy consumed for RAM : 0.002501 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:25] Energy consumed for all CPUs : 0.004168 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:25] 0.006669 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:37] Energy consumed for RAM : 0.002464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:37] Energy consumed for all CPUs : 0.004107 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:37] 0.006570 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:38] Energy consumed for RAM : 0.002388 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:38] Energy consumed for all CPUs : 0.003981 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:04:38] 0.006369 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:40] Energy consumed for RAM : 0.002513 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:40] Energy consumed for all CPUs : 0.004189 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:40] 0.006702 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:52] Energy consumed for RAM : 0.002476 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:52] Energy consumed for all CPUs : 0.004127 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:52] 0.006603 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:53] Energy consumed for RAM : 0.002401 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:53] Energy consumed for all CPUs : 0.004002 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:53] 0.006402 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:04:55] Energy consumed for RAM : 0.002526 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:04:55] Energy consumed for all CPUs : 0.004210 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:04:55] 0.006735 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:07] Energy consumed for RAM : 0.002489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:07] Energy consumed for all CPUs : 0.004148 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:07] 0.006637 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:08] Energy consumed for RAM : 0.002413 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:08] Energy consumed for all CPUs : 0.004022 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:08] 0.006436 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:10] Energy consumed for RAM : 0.002538 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:10] Energy consumed for all CPUs : 0.004231 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:10] 0.006769 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:22] Energy consumed for RAM : 0.002501 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:22] Energy consumed for all CPUs : 0.004169 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:22] 0.006670 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:23] Energy consumed for RAM : 0.002426 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:23] Energy consumed for all CPUs : 0.004043 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:23] 0.006469 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:05:25] Energy consumed for RAM : 0.002551 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:25] Energy consumed for all CPUs : 0.004251 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:25] 0.006802 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:37] Energy consumed for RAM : 0.002514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:37] Energy consumed for all CPUs : 0.004190 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:37] 0.006703 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:38] Energy consumed for RAM : 0.002438 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:38] Energy consumed for all CPUs : 0.004064 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:38] 0.006502 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:40] Energy consumed for RAM : 0.002563 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:40] Energy consumed for all CPUs : 0.004272 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:40] 0.006835 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:52] Energy consumed for RAM : 0.002526 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:52] Energy consumed for all CPUs : 0.004211 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:52] 0.006737 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:53] Energy consumed for RAM : 0.002451 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:53] Energy consumed for all CPUs : 0.004085 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:53] 0.006536 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:05:55] Energy consumed for RAM : 0.002576 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:05:55] Energy consumed for all CPUs : 0.004293 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:05:55] 0.006869 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:07] Energy consumed for RAM : 0.002539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:07] Energy consumed for all CPUs : 0.004232 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:07] 0.006770 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:08] Energy consumed for RAM : 0.002463 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:08] Energy consumed for all CPUs : 0.004106 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:08] 0.006569 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:10] Energy consumed for RAM : 0.002588 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:06:10] Energy consumed for all CPUs : 0.004314 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:10] 0.006902 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:22] Energy consumed for RAM : 0.002551 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:22] Energy consumed for all CPUs : 0.004252 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:22] 0.006804 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:23] Energy consumed for RAM : 0.002476 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:23] Energy consumed for all CPUs : 0.004127 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:23] 0.006602 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:25] Energy consumed for RAM : 0.002601 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:25] Energy consumed for all CPUs : 0.004335 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:25] 0.006935 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:37] Energy consumed for RAM : 0.002564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:37] Energy consumed for all CPUs : 0.004273 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:37] 0.006837 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:38] Energy consumed for RAM : 0.002488 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:38] Energy consumed for all CPUs : 0.004147 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:38] 0.006636 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:06:40] Energy consumed for RAM : 0.002613 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:06:40] Energy consumed for all CPUs : 0.004356 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:06:40] 0.006969 kWh of electricity used since the begi
nning.
[codecarbon WARNING @ 03:17:53] Background scheduler didn't run for a long p
eriod (676s), results might be inaccurate
[codecarbon INFO @ 03:17:53] Energy consumed for RAM : 0.003127 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:17:53] Energy consumed for all CPUs : 0.005213 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:17:53] 0.008340 kWh of electricity used since the begi
nning.
[codecarbon WARNING @ 03:17:54] Background scheduler didn't run for a long p
eriod (676s), results might be inaccurate
[codecarbon INFO @ 03:17:54] Energy consumed for RAM : 0.003052 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:17:54] Energy consumed for all CPUs : 0.005087 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:17:54] 0.008139 kWh of electricity used since the begi
nning.
```

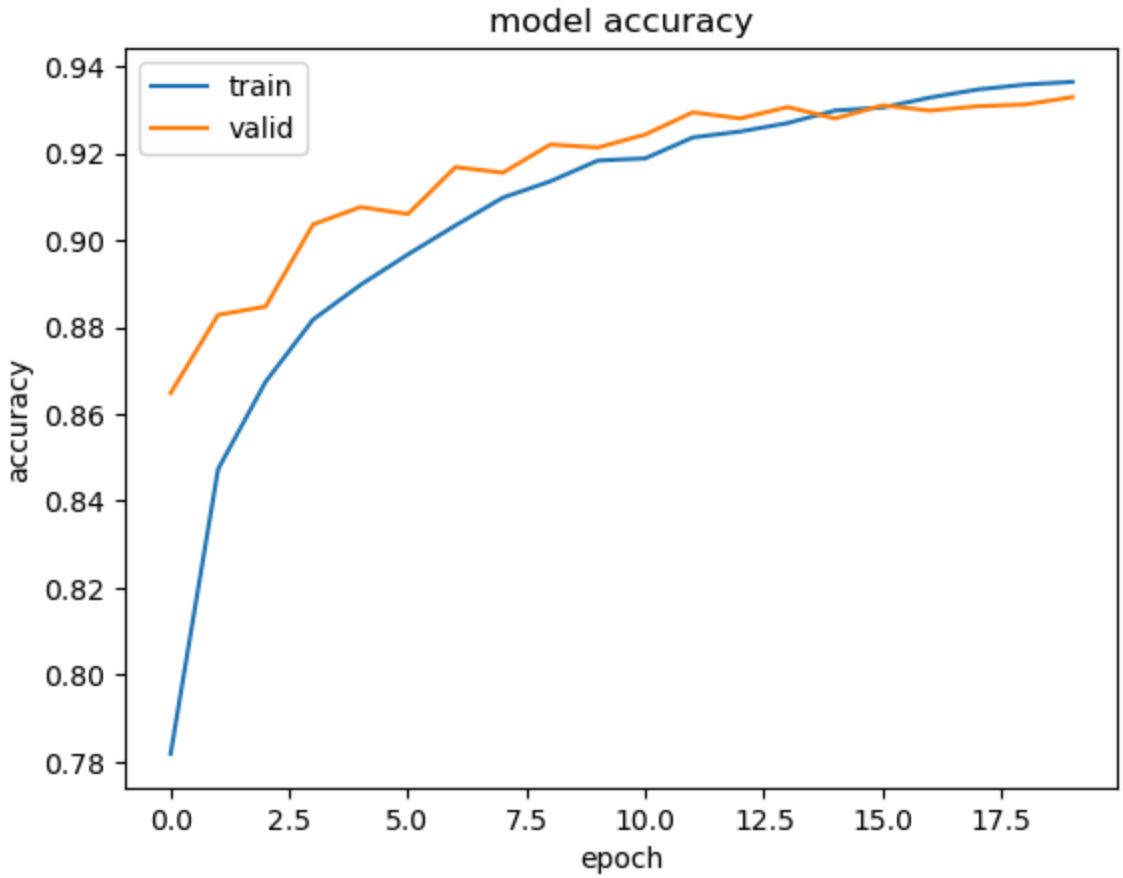
```
[codecarbon WARNING @ 03:17:56] Background scheduler didn't run for a long p
eriod (676s), results might be inaccurate
[codecarbon INFO @ 03:17:56] Energy consumed for RAM : 0.003177 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:17:56] Energy consumed for all CPUs : 0.005295 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:17:56] 0.008472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:08] Energy consumed for RAM : 0.003140 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:08] Energy consumed for all CPUs : 0.005233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:08] 0.008373 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:09] Energy consumed for RAM : 0.003064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:09] Energy consumed for all CPUs : 0.005108 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:09] 0.008172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:11] Energy consumed for RAM : 0.003189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:11] Energy consumed for all CPUs : 0.005316 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:11] 0.008505 kWh of electricity used since the begi
nning.
```

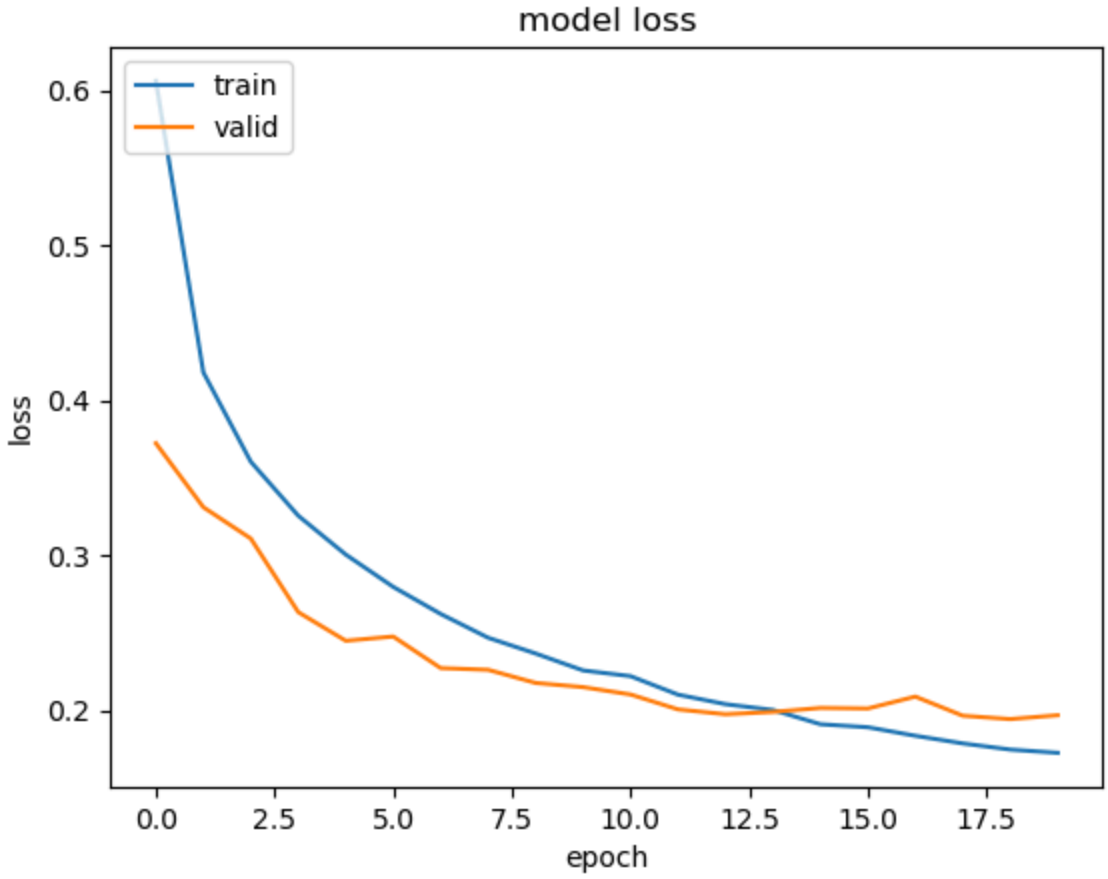
### 2.1.5 Examine accuracy and loss [2pts Grad / 0.3% Bonus for Undergrad] [W]

You should expect to see gradually decreasing loss and gradually increasing accuracy. Examine loss and accuracy by running the cell below, no editing is necessary. Having appropriate looking loss and accuracy plots will earn you the last 2pts for your convolutional neural net.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################

# list all data in history
train_loss, train_accuracy, valid_loss, valid_accuracy = trainer.get_trainir

# summarize history for accuracy and loss
plt.plot(train_accuracy)
plt.plot(valid_accuracy)
plt.title("model accuracy")
plt.ylabel("accuracy")
plt.xlabel("epoch")
plt.legend(["train", "valid"], loc="upper left")
plt.show()

plt.plot(train_loss)
plt.plot(valid_loss)
plt.title("model loss")
```

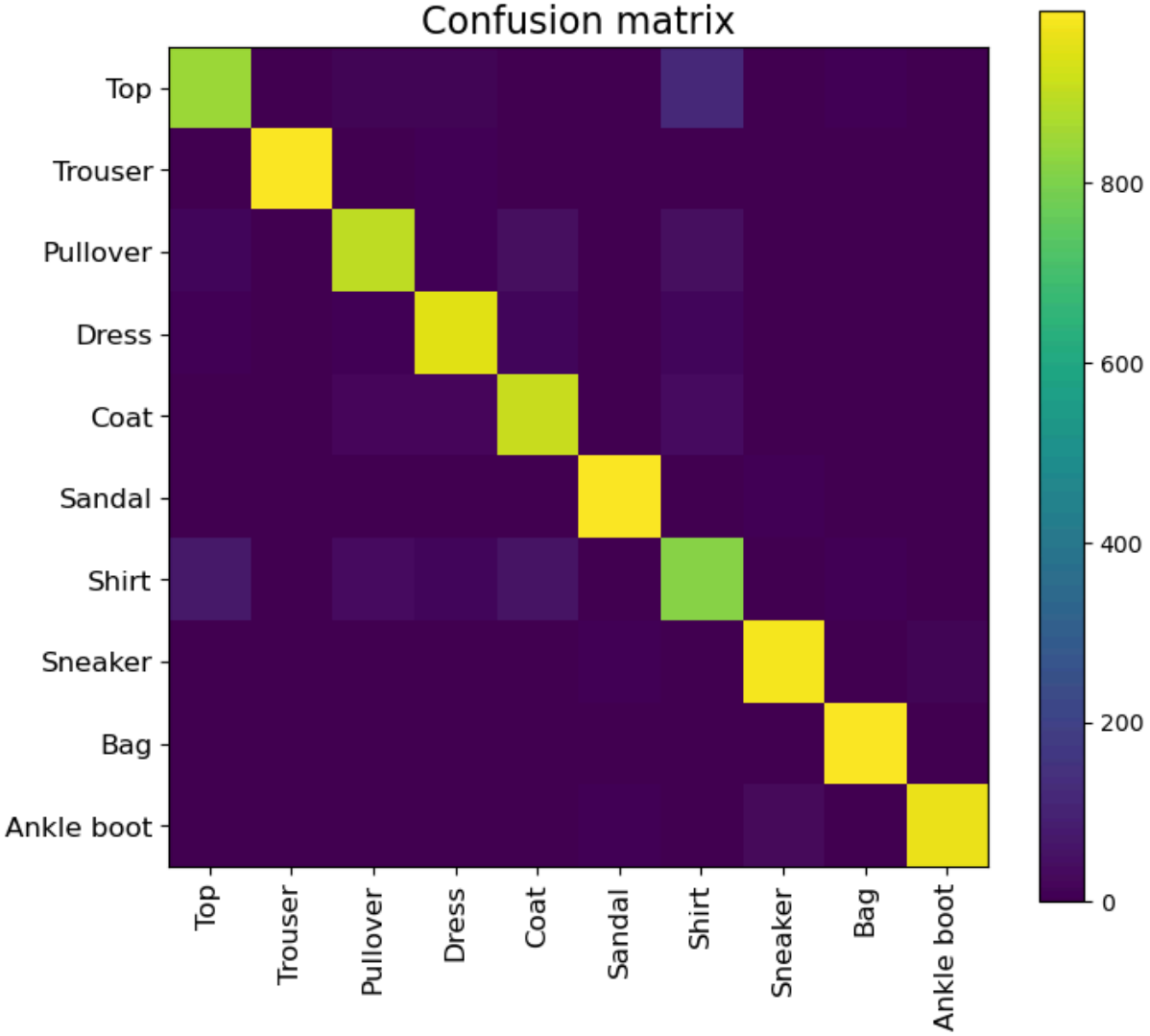
```
plt.ylabel("loss")
plt.xlabel("epoch")
plt.legend(["train", "valid"], loc="upper left")
plt.show()
```






In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################

# make predictions
y_pred, y_pred_classes, y_gt_classes = trainer.predict(testloader)
y_pred_prob = torch.max(y_pred, dim=1).values

from sklearn.metrics import accuracy_score, confusion_matrix

plt.figure(figsize=(8, 7))
plt.imshow(confusion_matrix(y_gt_classes, y_pred_classes))
plt.title("Confusion matrix", fontsize=16)
plt.xticks(np.arange(10), classes, rotation=90, fontsize=12)
plt.yticks(np.arange(10), classes, fontsize=12)
plt.colorbar()
plt.show()
```

```
[codecarbon INFO @ 03:18:23] Energy consumed for RAM : 0.003152 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:23] Energy consumed for all CPUs : 0.005254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:23] 0.008406 kWh of electricity used since the begi
nning.
```


Confusion matrix
Top
Trouser
Pullover
Dress
Coat
Sandal
Shirt
Sneaker
Bag
Ankle boot
800
600
400
200
0

```
[codecarbon INFO @ 03:18:24] Energy consumed for RAM : 0.003077 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:24] Energy consumed for all CPUs : 0.005128 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:24] 0.008205 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:26] Energy consumed for RAM : 0.003202 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:26] Energy consumed for all CPUs : 0.005337 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:26] 0.008538 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:38] Energy consumed for RAM : 0.003165 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:38] Energy consumed for all CPUs : 0.005275 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:38] 0.008440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:39] Energy consumed for RAM : 0.003089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:39] Energy consumed for all CPUs : 0.005149 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:39] 0.008239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:41] Energy consumed for RAM : 0.003214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:41] Energy consumed for all CPUs : 0.005357 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:41] 0.008572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:53] Energy consumed for RAM : 0.003177 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:53] Energy consumed for all CPUs : 0.005296 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:53] 0.008473 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:54] Energy consumed for RAM : 0.003102 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:54] Energy consumed for all CPUs : 0.005170 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:54] 0.008272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:18:56] Energy consumed for RAM : 0.003227 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:18:56] Energy consumed for all CPUs : 0.005378 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:18:56] 0.008605 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:08] Energy consumed for RAM : 0.003190 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:08] Energy consumed for all CPUs : 0.005317 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:08] 0.008506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:09] Energy consumed for RAM : 0.003114 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:19:09] Energy consumed for all CPUs : 0.005191 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:09] 0.008305 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:11] Energy consumed for RAM : 0.003239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:11] Energy consumed for all CPUs : 0.005399 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:11] 0.008638 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:23] Energy consumed for RAM : 0.003202 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:23] Energy consumed for all CPUs : 0.005338 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:23] 0.008540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:24] Energy consumed for RAM : 0.003127 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:24] Energy consumed for all CPUs : 0.005212 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:24] 0.008339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:26] Energy consumed for RAM : 0.003252 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:26] Energy consumed for all CPUs : 0.005420 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:26] 0.008672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:38] Energy consumed for RAM : 0.003215 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:38] Energy consumed for all CPUs : 0.005358 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:38] 0.008573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:39] Energy consumed for RAM : 0.003139 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:39] Energy consumed for all CPUs : 0.005233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:39] 0.008372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:41] Energy consumed for RAM : 0.003264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:41] Energy consumed for all CPUs : 0.005441 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:41] 0.008705 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:53] Energy consumed for RAM : 0.003227 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:53] Energy consumed for all CPUs : 0.005379 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:53] 0.008606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:54] Energy consumed for RAM : 0.003152 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:54] Energy consumed for all CPUs : 0.005253 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:19:54] 0.008405 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:19:56] Energy consumed for RAM : 0.003277 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:19:56] Energy consumed for all CPUs : 0.005462 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:19:56] 0.008738 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:08] Energy consumed for RAM : 0.003240 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:08] Energy consumed for all CPUs : 0.005400 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:08] 0.008640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:09] Energy consumed for RAM : 0.003164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:09] Energy consumed for all CPUs : 0.005274 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:09] 0.008439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:11] Energy consumed for RAM : 0.003289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:11] Energy consumed for all CPUs : 0.005482 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:11] 0.008772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:23] Energy consumed for RAM : 0.003252 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:23] Energy consumed for all CPUs : 0.005421 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:23] 0.008673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:24] Energy consumed for RAM : 0.003177 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:24] Energy consumed for all CPUs : 0.005295 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:24] 0.008472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:26] Energy consumed for RAM : 0.003302 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:26] Energy consumed for all CPUs : 0.005503 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:26] 0.008805 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:38] Energy consumed for RAM : 0.003265 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:38] Energy consumed for all CPUs : 0.005442 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:38] 0.008706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:39] Energy consumed for RAM : 0.003189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:39] Energy consumed for all CPUs : 0.005316 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:39] 0.008505 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:20:41] Energy consumed for RAM : 0.003314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:41] Energy consumed for all CPUs : 0.005524 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:41] 0.008838 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:53] Energy consumed for RAM : 0.003277 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:53] Energy consumed for all CPUs : 0.005463 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:53] 0.008740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:54] Energy consumed for RAM : 0.003202 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:54] Energy consumed for all CPUs : 0.005337 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:54] 0.008539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:20:56] Energy consumed for RAM : 0.003327 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:20:56] Energy consumed for all CPUs : 0.005545 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:20:56] 0.008872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:08] Energy consumed for RAM : 0.003290 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:08] Energy consumed for all CPUs : 0.005483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:08] 0.008773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:09] Energy consumed for RAM : 0.003214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:09] Energy consumed for all CPUs : 0.005358 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:09] 0.008572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:11] Energy consumed for RAM : 0.003339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:11] Energy consumed for all CPUs : 0.005566 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:11] 0.008905 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:23] Energy consumed for RAM : 0.003302 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:23] Energy consumed for all CPUs : 0.005504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:23] 0.008806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:24] Energy consumed for RAM : 0.003227 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:24] Energy consumed for all CPUs : 0.005378 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:24] 0.008605 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:26] Energy consumed for RAM : 0.003352 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:21:26] Energy consumed for all CPUs : 0.005587 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:26] 0.008938 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:38] Energy consumed for RAM : 0.003315 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:38] Energy consumed for all CPUs : 0.005525 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:38] 0.008840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:39] Energy consumed for RAM : 0.003239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:39] Energy consumed for all CPUs : 0.005399 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:39] 0.008639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:41] Energy consumed for RAM : 0.003364 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:41] Energy consumed for all CPUs : 0.005607 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:41] 0.008972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:53] Energy consumed for RAM : 0.003327 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:53] Energy consumed for all CPUs : 0.005546 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:53] 0.008873 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:54] Energy consumed for RAM : 0.003252 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:54] Energy consumed for all CPUs : 0.005420 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:54] 0.008672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:21:56] Energy consumed for RAM : 0.003377 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:21:56] Energy consumed for all CPUs : 0.005628 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:21:56] 0.009005 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:08] Energy consumed for RAM : 0.003340 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:08] Energy consumed for all CPUs : 0.005567 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:08] 0.008906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:09] Energy consumed for RAM : 0.003264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:09] Energy consumed for all CPUs : 0.005441 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:09] 0.008705 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:11] Energy consumed for RAM : 0.003389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:11] Energy consumed for all CPUs : 0.005649 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:22:11] 0.009038 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:23] Energy consumed for RAM : 0.003352 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:23] Energy consumed for all CPUs : 0.005588 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:23] 0.008940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:24] Energy consumed for RAM : 0.003277 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:24] Energy consumed for all CPUs : 0.005462 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:24] 0.008739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:26] Energy consumed for RAM : 0.003402 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:26] Energy consumed for all CPUs : 0.005670 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:26] 0.009072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:38] Energy consumed for RAM : 0.003365 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:38] Energy consumed for all CPUs : 0.005609 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:38] 0.008973 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:39] Energy consumed for RAM : 0.003289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:39] Energy consumed for all CPUs : 0.005483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:39] 0.008772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:41] Energy consumed for RAM : 0.003414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:41] Energy consumed for all CPUs : 0.005691 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:41] 0.009105 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:53] Energy consumed for RAM : 0.003377 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:53] Energy consumed for all CPUs : 0.005629 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:53] 0.009006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:54] Energy consumed for RAM : 0.003302 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:54] Energy consumed for all CPUs : 0.005503 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:54] 0.008805 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:22:56] Energy consumed for RAM : 0.003427 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:22:56] Energy consumed for all CPUs : 0.005712 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:22:56] 0.009138 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:23:08] Energy consumed for RAM : 0.003390 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:23:08] Energy consumed for all CPUs : 0.005650 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:23:08] 0.009040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:23:09] Energy consumed for RAM : 0.003314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:23:09] Energy consumed for all CPUs : 0.005524 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:23:09] 0.008839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:23:11] Energy consumed for RAM : 0.003439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:23:11] Energy consumed for all CPUs : 0.005733 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:23:11] 0.009172 kWh of electricity used since the begi
nning.
```

## 2.2 Exploring Deep CNN Architectures [1.1% Bonus for All] [W]

The network you have produced is rather simple relative to many of those used in industry and research. Researchers have worked to make CNN models deeper and deeper over the past years in an effort to gain higher accuracy in predictions. While your model is only a handful of layers deep, some state of the art deep architectures may include up to 150 layers. However, this process has not been without challenges.

One such problem is the problem of the vanishing gradient. The weights of a neural network are updated using the backpropagation algorithm. The backpropagation algorithm makes a small change to each weight in such a way that the loss of the model decreases. Using the chain rule, we can find this gradient for each weight. But, as this gradient keeps flowing backwards to the initial layers, this value keeps getting multiplied by each local gradient. Hence, the gradient becomes smaller and smaller, making the updates to the initial layers very small, increasing the training time considerably.

Many tactics have been used in an effort to solve this problem. One architecture, named ResNet, solves the vanishing gradient problem in a unique way. ResNet was developed at Microsoft Research to find better ways to train deep networks. Take a moment to explore how ResNet tackles the vanishing gradient problem by reading the original research paper here: https://arxiv.org/pdf/1512.03385.pdf (also included as PDF in papers directory).

**Question:** In your own words, explain how ResNet addresses the vanishing gradient problem in 1-2 sentences below: (Please type answers directly in the cell below.)

ResNet addresses the vanishing gradient problem by introducing skip connections that allow the gradient to bypass some layers during backpropagation. These connections

enable the direct flow of the gradient to earlier layers, in turn preserving the gradient's strength and preventing it from diminishing exponentially as it passes through many layers, which facilitates training deeper networks effectively.

# 3: Random Forests [45pts; 40pts + 1.1% Bonus for All] [P] [W]

**NOTE**: Please use sklearn's ExtraTreeClassifier in your Random Forest implementation. You can find more details about this classifier here.

For context, the general difference between an extra tree and decision tree classifier is that the decision tree optimizes which feature to reduce entropy on and at what value to split, while an extra tree randomly splits on the features given.

## 3.1 Random Forest Implementation [35pts] [P]

The decision boundaries drawn by decision or extra trees are very sharp, and fitting a tree of unbounded depth to a list of examples almost inevitably leads to **overfitting**. In an attempt to decrease the variance of an extra tree, we're going to use a technique called 'Bootstrap Aggregating' (often abbreviated 'bagging'). This stems from the idea that a collection of weak learners can learn decision boundaries as well as a strong learner. This is commonly called a Random Forest.

We can build a Random Forest as a collection of extra trees, as follows:

1. For every tree in the random forest, we're going to

   a) Subsample the examples with replacement. Note that in this question, the size of the subsample data is equal to the original dataset.

   b) From the subsamples in part a, choose attributes at random without replacement to learn on in accordance with a provided attribute subsampling rate. Based on what it was mentioned in the class, we randomly pick features in each split. We use a more general approach here to make the programming part easier. Let's randomly pick some features (65% percent of features) and grow the tree based on the pre-determined randomly selected features. Therefore, there is no need to find random features in each split.

   c) Fit an extra tree to the subsample of data we've chosen to a certain depth.

You can refresh your understanding with the lecture notes.

Classification for a random forest is then done by taking a majority vote of the classifications yielded by each tree in the forest after it classifies an example.

In the **random_forest.py** file, complete the following functions:

- **_bootstrapping**: this function will be used in `bootstrapping()`
- **fit**: Fit the extra trees initialized in `__init__` with the datasets created in `bootstrapping()`. You will need to call `bootstrapping()`.

**NOTES:**

1. In the Random Forest Class, X is assumed to be a matrix with num_training rows and num_features columns where num_training is the number of total records and num_features is the number of features of each record. y is assumed to be a vector of labels of length num_training.
2. Look out for TODO's for the parts that need to be implemented
3. If you receive any `SettingWithCopyWarning` warnings from the Pandas library, you can safely ignore them.
4. Hint: when bootstrapping, set replace = False while creating col_idx

# 3.2 Hyperparameter Tuning with a Random Forest [5pts] [P]

In machine learning, hyperparameters are parameters that are set before the learning process begins. The max_depth, num_estimators, or max_features variables from 3.1 are examples of different hyperparameters for a random forest model. Let's first review the dataset in a bit more detail.

## Dataset Objective

Imagine that we are a team of researchers working to track and document various information related to dry beans for a machine learning model that predicts what type of bean is represented. We know that there are multiple things to keep track of, such as the shapes and sizes that differentiate different types of beans. We will use the information we track and document in order to publish it for the general public.

After much reflection within the research team, we come to the conclusion that we can use past observations on bean images to create a model.

We will use our random forest algorithm from Q3.1 to predict the bean type.

You can find more information on the dataset here.

*The barbunya bean, also known as the cranberry bean, was first bred in Colombia.*

## Loading the dataset

The dataset that the company has collected has the following features:

There were 16 features used in this dataset.

Inputs:

1. Area The area of a bean zone and the number of pixels within its boundaries
2. Perimeter: Bean circumference is defined as the length of its border
3. MajorAxisLength: The distance between the ends of the longest line that can be drawn from a bean
4. MinorAxisLength: The longest line that can be drawn from the bean while standing perpendicular to the main axis
5. AspectRatio: Defines the relationship between MajorAxisLength and MinorAxisLength
6. Eccentricity: Eccentricity of the ellipse having the same moments as the region
7. ConvexArea: Number of pixels in the smallest convex polygon that can contain the area of a bean seed
8. EquivDiameter Equivalent diameter, the diameter of a circle having the same area as a bean seed area
9. Extent Feature: The ratio of the pixels in the bounding box to the bean area
10. Solidity: Also known as convexity. The ratio of the pixels in the convex shell to those found in beans.
11. Roundness: Calculated with the following formula: (4piA)/(P^2)
12. Compactness: Measures the roundness of an object

13. ShapeFactor1
14. ShapeFactor2
15. ShapeFactor3
16. ShapeFactor4

Output:

17. Target value:
    - Seker
    - Barbunya
    - Bombay
    - Cali
    - Dermosan
    - Horoz
    - Sira

Your random forest model will try to predict this variable.

In [ ]:
```
import numpy as np
import pandas as pd

################################
### DO NOT CHANGE THIS CELL ###
################################
from sklearn import preprocessing

dry_bean_dataset = "./data/Dry_Bean_Dataset.csv"
df = pd.read_csv(dry_bean_dataset)

label_encoder = preprocessing.LabelEncoder()

X = df.drop(["Class"], axis=1)
y = label_encoder.fit_transform(df["Class"])

X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.33, random_state=42
)
X_test = np.array(X_test)
X_train, y_train, X_test, y_test = (
    np.array(X_train),
    np.array(y_train),
    np.array(X_test),
    np.array(y_test),
)
```

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
print(X_train.shape, y_train.shape, X_test.shape, y_test.shape)
assert X_train.shape == (9119, 16)
assert y_train.shape == (9119,)
```

```
assert X_test.shape == (4492, 16)
assert y_test.shape == (4492,)
```

```
(9119, 16) (9119,) (4492, 16) (4492,)
```

In the following codeblock, train your random forest model with different values for max_depth, n_estimators, or max_features and evaluate each model on the held-out test set. Try to choose a combination of hyperparameters that maximizes your prediction accuracy on the test set (aim for 85%+).

In **random_forest.py**, once you are satisfied with your chosen parameters, update the following function:

- **select_hyperparameters**: change the values for `max_depth`, `n_estimators`, and `max_features` to your chosen values

Submit this file to Gradescope. You must achieve at least a **85% accuracy** against the test set in Gradescope to receive full credit for this section.

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
from utilities.localtests import TestRandomForest

"""
Once you have implemented Random forest, you can run this cell. If you imple
then this cell should execute without any errors.
"""
TestRandomForest("test_bootstrapping").test_bootstrapping()
```

```
[codecarbon INFO @ 03:25:38] Energy consumed for RAM : 0.003515 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:25:38] Energy consumed for all CPUs : 0.005859 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:25:38] 0.009373 kWh of electricity used since the begi
nning.
test_bootstrapping passed!
[codecarbon INFO @ 03:25:40] Energy consumed for RAM : 0.003439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:25:40] Energy consumed for all CPUs : 0.005733 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:25:40] 0.009172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:25:41] Energy consumed for RAM : 0.003564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:25:41] Energy consumed for all CPUs : 0.005941 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:25:41] 0.009505 kWh of electricity used since the begi
nning.
```

In [ ]:
```
"""
TODO:
n_estimators defines how many Extra trees are fitted for the random forest.
max_depth defines a stop condition when the tree reaches to a certain depth.
```

```
max_features controls the percentage of features that are used to fit each e

Tune these three parameters to achieve a better accuracy. n_estimators and m
be at least 3 in value for moderately reliable answers. While you can use th
to evaluate your implementation, you will need to obtain 85% on the test set
credit for this section.
"""

import sklearn.ensemble
from random_forest import RandomForest
from sklearn import preprocessing

################## DO NOT CHANGE THIS RANDOM SEED ####################
student_random_seed = 4641 + 7641
######################################################################

################## CHANGE THESE VALUES ################################
### Default Student Values
# n_estimators = 3  # Hint: Consider values between 3-15.
# max_depth = 3  # Hint: Consider values betweeen 3-15.
# max_features = 0.1  # Hint: Consider values betweeen 0.3-1.0.

### Tuned Solution Values
n_estimators = 5  # Hint: Consider values between 3-15.
max_depth = 15  # Hint: Consider values betweeen 3-15.
max_features = 0.9  # Hint: Consider values betweeen 0.3-1.0.
######################################################################
random_forest = RandomForest(
    n_estimators, max_depth, max_features, random_seed=student_random_seed
)
random_forest.fit(X_train, y_train)
accuracy = random_forest.OOB_score(X_test, y_test)
print("accuracy: %.4f" % accuracy)
```

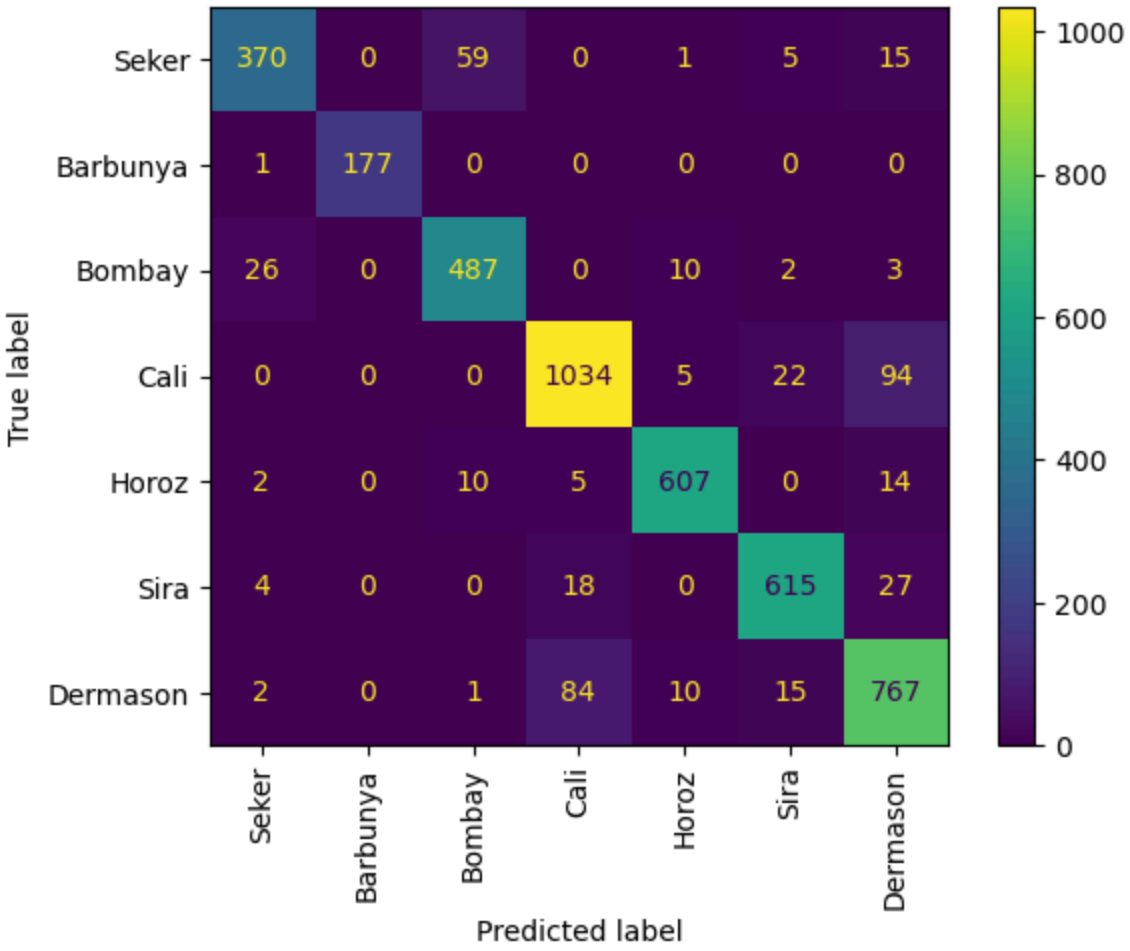
```
accuracy: 0.8740
```

```
[codecarbon INFO @ 03:25:53] Energy consumed for RAM : 0.003527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:25:53] Energy consumed for all CPUs : 0.005879 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:25:53] 0.009406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:25:55] Energy consumed for RAM : 0.003452 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:25:55] Energy consumed for all CPUs : 0.005754 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:25:55] 0.009205 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:25:56] Energy consumed for RAM : 0.003577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:25:56] Energy consumed for all CPUs : 0.005962 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:25:56] 0.009538 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:08] Energy consumed for RAM : 0.003540 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:08] Energy consumed for all CPUs : 0.005900 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:08] 0.009440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:09] Energy consumed for RAM : 0.003464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:10] Energy consumed for all CPUs : 0.005774 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:10] 0.009239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:11] Energy consumed for RAM : 0.003589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:11] Energy consumed for all CPUs : 0.005983 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:11] 0.009572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:23] Energy consumed for RAM : 0.003552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:23] Energy consumed for all CPUs : 0.005921 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:23] 0.009473 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:24] Energy consumed for RAM : 0.003477 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:24] Energy consumed for all CPUs : 0.005795 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:24] 0.009272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:26] Energy consumed for RAM : 0.003602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:26] Energy consumed for all CPUs : 0.006003 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:26] 0.009605 kWh of electricity used since the begi
nning.
```

**DON'T FORGET**: Once you are satisfied with your chosen parameters, change the values for `max_depth`, `n_estimators`, and `max_features` in the `select_hyperparameters()` function of your RandomForest class in `random_forest.py` to your chosen values, and then submit this file to Gradescope. You must achieve at least a **85% accuracy** against the test set in Gradescope to receive full credit for this section.

Below is a code block that plots a confusion matrix for the classifier's predictions on the test set. A few things to think about: What are some trends seen in the matrix? Why do they happen?

In [ ]:
```
from sklearn.metrics import ConfusionMatrixDisplay

pred = random_forest.predict(X_test)
labels = ["Seker", "Barbunya", "Bombay", "Cali", "Horoz", "Sira", "Dermason"
ConfusionMatrixDisplay.from_predictions(
    y_test, pred, display_labels=labels, xticks_rotation="vertical"
)
plt.show()
```



```
[codecarbon INFO @ 03:26:38] Energy consumed for RAM : 0.003565 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:38] Energy consumed for all CPUs : 0.005942 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:38] 0.009506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:39] Energy consumed for RAM : 0.003489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:39] Energy consumed for all CPUs : 0.005816 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:39] 0.009305 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:41] Energy consumed for RAM : 0.003614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:41] Energy consumed for all CPUs : 0.006024 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:41] 0.009638 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:53] Energy consumed for RAM : 0.003577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:53] Energy consumed for all CPUs : 0.005963 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:53] 0.009540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:54] Energy consumed for RAM : 0.003502 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:54] Energy consumed for all CPUs : 0.005837 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:55] 0.009339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:26:56] Energy consumed for RAM : 0.003627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:26:56] Energy consumed for all CPUs : 0.006045 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:26:56] 0.009672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:08] Energy consumed for RAM : 0.003590 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:08] Energy consumed for all CPUs : 0.005984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:08] 0.009573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:09] Energy consumed for RAM : 0.003514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:09] Energy consumed for all CPUs : 0.005858 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:09] 0.009372 kWh of electricity used since the begi
nning.
```

## 3.3 Plotting Feature Importance [1.1% Bonus for All] [W]

While building tree-based models, it's common to quantify how well splitting on a particular feature in an extra tree helps with predicting the target label in a dataset.

Machine learning practicioners typically use "Gini importance", or the (normalized) total reduction in entropy brought by that feature to evaluate how important that feature is for predicting the target variable.

Gini importance is typically calculated as the reduction in entropy from reaching a split in an extra tree weighted by the probability of reaching that split in the extra tree. Sklearn internally computes the probability for reaching a split by finding the total number of samples that reaches it during the training phase divided by the total number of samples in the dataset. This weighted value is our feature importance.

Let's think about what this metric means with an example. A high probabiity of reaching a split on feature A in an extra tree trained on a dataset (many samples will reach this split for a decision) and a large reduction in entropy from splitting on feature A will result in a high feature importance value for feature A. This could mean feature A is a very important feature for predicting the probability of the target label. On the other hand, a low probability of reaching a split on feature B in an extra tree and a low reduction in entropy from splitting on feature B will result in a low feature importance value. This could mean feature B is not a very informative feature for predicting the target label. **Thus, the higher the feature importance value, the more important the feature is to predicting the target label.**

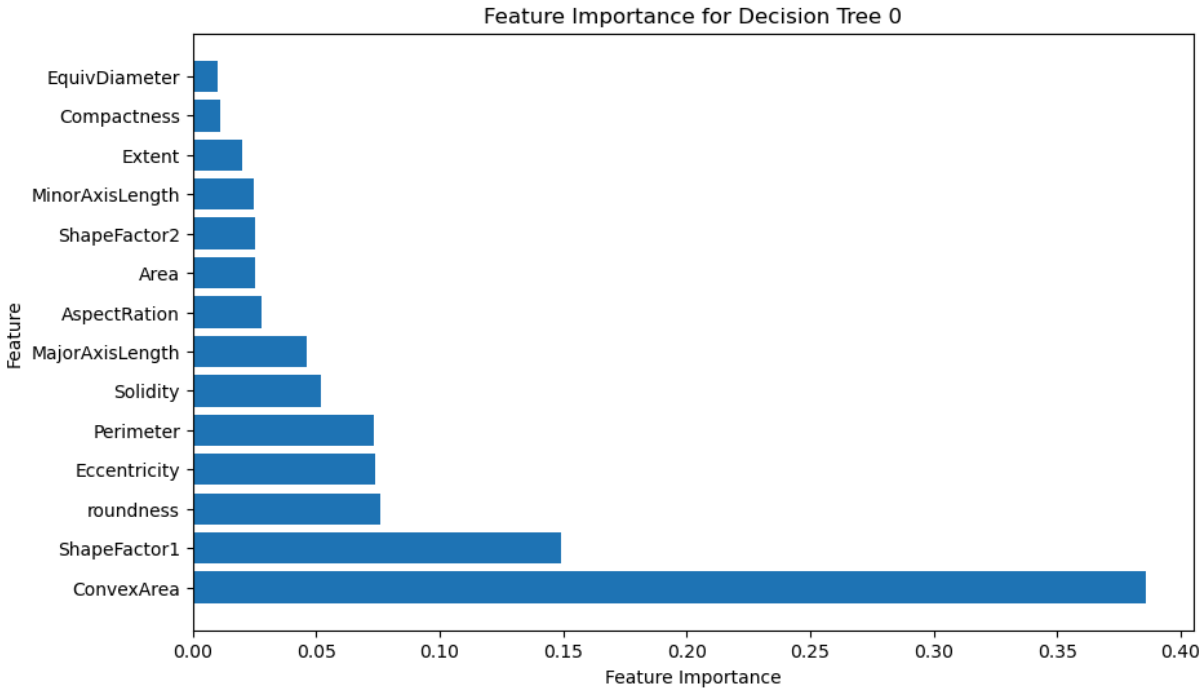
Fortunately for us, fitting a sklearn.ExtraTreeClassifier to a dataset automatically computes the Gini importance for every feature in the extra tree and stores these values in a **feature_importances_** variable. Review the docs for more details on how to access this variable

In the **random_forest.py** file, complete the following function:

- **plot_feature_importance**: Make sure to sort the bars in descending order and remove any features with feature importance of 0

In the cell below, call your implementation of `plot_feature_importance()` and display a bar plot that shows the feature importance values for at least one extra tree in your tuned random forest from Q3.2.

In [ ]:
```
# TODO: Complete plot_feature_importance() in random_forest.py

random_forest.plot_feature_importance(X)
```


Feature Importance for Decision Tree 0
EquivDiameter
Compactness
Extent
MinorAxisLength
ShapeFactor2
Area
AspectRation
MajorAxisLength
Solidity
Perimeter
Eccentricity
roundness
ShapeFactor1
ConvexArea
Feature
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Feature Importance

```
[codecarbon INFO @ 03:27:11] Energy consumed for RAM : 0.003639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:11] Energy consumed for all CPUs : 0.006066 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:11] 0.009705 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:23] Energy consumed for RAM : 0.003602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:23] Energy consumed for all CPUs : 0.006004 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:23] 0.009606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:25] Energy consumed for RAM : 0.003527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:25] Energy consumed for all CPUs : 0.005879 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:25] 0.009405 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:26] Energy consumed for RAM : 0.003652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:26] Energy consumed for all CPUs : 0.006087 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:26] 0.009738 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:38] Energy consumed for RAM : 0.003615 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:38] Energy consumed for all CPUs : 0.006025 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:38] 0.009640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:40] Energy consumed for RAM : 0.003539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:40] Energy consumed for all CPUs : 0.005899 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:40] 0.009439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:41] Energy consumed for RAM : 0.003664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:41] Energy consumed for all CPUs : 0.006108 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:41] 0.009772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:53] Energy consumed for RAM : 0.003627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:53] Energy consumed for all CPUs : 0.006046 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:53] 0.009673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:55] Energy consumed for RAM : 0.003552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:27:55] Energy consumed for all CPUs : 0.005920 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:55] 0.009472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:27:56] Energy consumed for RAM : 0.003677 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:27:56] Energy consumed for all CPUs : 0.006128 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:27:56] 0.009805 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:08] Energy consumed for RAM : 0.003640 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:08] Energy consumed for all CPUs : 0.006067 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:08] 0.009706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:10] Energy consumed for RAM : 0.003564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:10] Energy consumed for all CPUs : 0.005941 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:10] 0.009505 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:11] Energy consumed for RAM : 0.003689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:11] Energy consumed for all CPUs : 0.006149 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:11] 0.009838 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:23] Energy consumed for RAM : 0.003652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:23] Energy consumed for all CPUs : 0.006088 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:23] 0.009740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:25] Energy consumed for RAM : 0.003577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:25] Energy consumed for all CPUs : 0.005962 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:25] 0.009539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:26] Energy consumed for RAM : 0.003702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:26] Energy consumed for all CPUs : 0.006170 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:26] 0.009872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:38] Energy consumed for RAM : 0.003665 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:38] Energy consumed for all CPUs : 0.006109 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:38] 0.009773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:40] Energy consumed for RAM : 0.003589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:40] Energy consumed for all CPUs : 0.005983 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:40] 0.009572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:41] Energy consumed for RAM : 0.003714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:41] Energy consumed for all CPUs : 0.006191 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:28:41] 0.009905 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:53] Energy consumed for RAM : 0.003677 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:53] Energy consumed for all CPUs : 0.006129 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:53] 0.009806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:55] Energy consumed for RAM : 0.003602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:55] Energy consumed for all CPUs : 0.006004 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:55] 0.009605 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:28:56] Energy consumed for RAM : 0.003727 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:28:56] Energy consumed for all CPUs : 0.006212 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:28:56] 0.009938 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:08] Energy consumed for RAM : 0.003690 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:08] Energy consumed for all CPUs : 0.006150 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:08] 0.009840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:10] Energy consumed for RAM : 0.003614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:10] Energy consumed for all CPUs : 0.006024 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:10] 0.009639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:11] Energy consumed for RAM : 0.003739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:11] Energy consumed for all CPUs : 0.006233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:11] 0.009972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:23] Energy consumed for RAM : 0.003702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:23] Energy consumed for all CPUs : 0.006171 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:23] 0.009873 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:25] Energy consumed for RAM : 0.003627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:25] Energy consumed for all CPUs : 0.006045 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:25] 0.009672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:26] Energy consumed for RAM : 0.003752 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:26] Energy consumed for all CPUs : 0.006253 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:26] 0.010005 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:29:38] Energy consumed for RAM : 0.003715 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:38] Energy consumed for all CPUs : 0.006192 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:38] 0.009906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:40] Energy consumed for RAM : 0.003639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:40] Energy consumed for all CPUs : 0.006066 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:40] 0.009705 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:41] Energy consumed for RAM : 0.003764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:41] Energy consumed for all CPUs : 0.006274 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:41] 0.010038 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:53] Energy consumed for RAM : 0.003727 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:53] Energy consumed for all CPUs : 0.006213 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:53] 0.009940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:55] Energy consumed for RAM : 0.003652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:55] Energy consumed for all CPUs : 0.006087 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:55] 0.009739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:29:56] Energy consumed for RAM : 0.003777 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:29:56] Energy consumed for all CPUs : 0.006295 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:29:56] 0.010072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:08] Energy consumed for RAM : 0.003740 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:08] Energy consumed for all CPUs : 0.006234 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:08] 0.009973 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:10] Energy consumed for RAM : 0.003664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:10] Energy consumed for all CPUs : 0.006108 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:10] 0.009772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:11] Energy consumed for RAM : 0.003789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:11] Energy consumed for all CPUs : 0.006316 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:11] 0.010105 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:23] Energy consumed for RAM : 0.003752 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:30:23] Energy consumed for all CPUs : 0.006254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:23] 0.010006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:25] Energy consumed for RAM : 0.003677 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:25] Energy consumed for all CPUs : 0.006129 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:25] 0.009805 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:26] Energy consumed for RAM : 0.003802 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:26] Energy consumed for all CPUs : 0.006337 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:26] 0.010138 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:38] Energy consumed for RAM : 0.003765 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:38] Energy consumed for all CPUs : 0.006275 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:38] 0.010040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:40] Energy consumed for RAM : 0.003689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:40] Energy consumed for all CPUs : 0.006149 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:40] 0.009839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:41] Energy consumed for RAM : 0.003814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:41] Energy consumed for all CPUs : 0.006358 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:41] 0.010172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:53] Energy consumed for RAM : 0.003777 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:53] Energy consumed for all CPUs : 0.006296 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:53] 0.010073 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:55] Energy consumed for RAM : 0.003702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:55] Energy consumed for all CPUs : 0.006170 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:55] 0.009872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:30:56] Energy consumed for RAM : 0.003827 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:30:56] Energy consumed for all CPUs : 0.006378 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:30:56] 0.010205 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:08] Energy consumed for RAM : 0.003790 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:08] Energy consumed for all CPUs : 0.006317 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:31:08] 0.010106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:10] Energy consumed for RAM : 0.003714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:10] Energy consumed for all CPUs : 0.006191 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:10] 0.009905 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:11] Energy consumed for RAM : 0.003839 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:11] Energy consumed for all CPUs : 0.006399 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:11] 0.010238 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:23] Energy consumed for RAM : 0.003802 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:23] Energy consumed for all CPUs : 0.006338 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:23] 0.010140 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:25] Energy consumed for RAM : 0.003727 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:25] Energy consumed for all CPUs : 0.006212 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:25] 0.009939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:26] Energy consumed for RAM : 0.003852 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:26] Energy consumed for all CPUs : 0.006420 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:26] 0.010272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:38] Energy consumed for RAM : 0.003815 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:38] Energy consumed for all CPUs : 0.006359 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:38] 0.010173 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:40] Energy consumed for RAM : 0.003739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:40] Energy consumed for all CPUs : 0.006233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:40] 0.009972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:41] Energy consumed for RAM : 0.003864 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:41] Energy consumed for all CPUs : 0.006441 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:41] 0.010305 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:53] Energy consumed for RAM : 0.003827 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:53] Energy consumed for all CPUs : 0.006379 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:53] 0.010206 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:31:55] Energy consumed for RAM : 0.003752 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:55] Energy consumed for all CPUs : 0.006254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:55] 0.010005 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:31:56] Energy consumed for RAM : 0.003877 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:31:56] Energy consumed for all CPUs : 0.006462 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:31:56] 0.010338 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:08] Energy consumed for RAM : 0.003840 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:08] Energy consumed for all CPUs : 0.006400 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:08] 0.010240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:10] Energy consumed for RAM : 0.003764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:10] Energy consumed for all CPUs : 0.006274 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:10] 0.010039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:11] Energy consumed for RAM : 0.003889 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:11] Energy consumed for all CPUs : 0.006483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:11] 0.010372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:23] Energy consumed for RAM : 0.003852 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:23] Energy consumed for all CPUs : 0.006421 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:23] 0.010273 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:25] Energy consumed for RAM : 0.003777 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:25] Energy consumed for all CPUs : 0.006295 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:25] 0.010072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:26] Energy consumed for RAM : 0.003902 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:26] Energy consumed for all CPUs : 0.006503 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:26] 0.010405 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:38] Energy consumed for RAM : 0.003865 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:38] Energy consumed for all CPUs : 0.006442 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:38] 0.010306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:40] Energy consumed for RAM : 0.003789 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:32:40] Energy consumed for all CPUs : 0.006316 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:40] 0.010105 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:41] Energy consumed for RAM : 0.003914 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:41] Energy consumed for all CPUs : 0.006524 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:41] 0.010438 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:53] Energy consumed for RAM : 0.003877 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:53] Energy consumed for all CPUs : 0.006463 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:53] 0.010340 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:55] Energy consumed for RAM : 0.003802 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:55] Energy consumed for all CPUs : 0.006337 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:55] 0.010139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:32:56] Energy consumed for RAM : 0.003927 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:32:56] Energy consumed for all CPUs : 0.006545 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:32:56] 0.010472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:08] Energy consumed for RAM : 0.003890 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:08] Energy consumed for all CPUs : 0.006484 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:08] 0.010373 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:10] Energy consumed for RAM : 0.003814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:10] Energy consumed for all CPUs : 0.006358 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:10] 0.010172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:11] Energy consumed for RAM : 0.003939 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:11] Energy consumed for all CPUs : 0.006566 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:11] 0.010505 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:23] Energy consumed for RAM : 0.003902 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:23] Energy consumed for all CPUs : 0.006504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:23] 0.010406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:25] Energy consumed for RAM : 0.003827 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:25] Energy consumed for all CPUs : 0.006379 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:33:25] 0.010205 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:26] Energy consumed for RAM : 0.003952 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:26] Energy consumed for all CPUs : 0.006587 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:26] 0.010538 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:38] Energy consumed for RAM : 0.003915 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:38] Energy consumed for all CPUs : 0.006525 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:38] 0.010440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:40] Energy consumed for RAM : 0.003839 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:40] Energy consumed for all CPUs : 0.006399 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:40] 0.010239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:41] Energy consumed for RAM : 0.003964 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:41] Energy consumed for all CPUs : 0.006608 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:41] 0.010572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:53] Energy consumed for RAM : 0.003927 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:53] Energy consumed for all CPUs : 0.006546 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:53] 0.010473 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:55] Energy consumed for RAM : 0.003852 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:55] Energy consumed for all CPUs : 0.006420 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:55] 0.010272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:33:56] Energy consumed for RAM : 0.003977 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:33:56] Energy consumed for all CPUs : 0.006628 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:33:56] 0.010605 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:08] Energy consumed for RAM : 0.003940 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:08] Energy consumed for all CPUs : 0.006567 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:08] 0.010506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:10] Energy consumed for RAM : 0.003864 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:10] Energy consumed for all CPUs : 0.006441 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:10] 0.010305 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:34:11] Energy consumed for RAM : 0.003989 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:11] Energy consumed for all CPUs : 0.006649 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:11] 0.010639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:23] Energy consumed for RAM : 0.003952 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:23] Energy consumed for all CPUs : 0.006588 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:23] 0.010540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:25] Energy consumed for RAM : 0.003877 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:25] Energy consumed for all CPUs : 0.006462 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:25] 0.010339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:26] Energy consumed for RAM : 0.004002 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:26] Energy consumed for all CPUs : 0.006670 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:26] 0.010672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:38] Energy consumed for RAM : 0.003965 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:38] Energy consumed for all CPUs : 0.006609 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:38] 0.010573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:40] Energy consumed for RAM : 0.003889 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:40] Energy consumed for all CPUs : 0.006483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:40] 0.010372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:41] Energy consumed for RAM : 0.004014 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:41] Energy consumed for all CPUs : 0.006691 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:41] 0.010705 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:53] Energy consumed for RAM : 0.003977 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:53] Energy consumed for all CPUs : 0.006630 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:53] 0.010607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:55] Energy consumed for RAM : 0.003902 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:34:55] Energy consumed for all CPUs : 0.006504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:55] 0.010406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:34:56] Energy consumed for RAM : 0.004027 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:34:56] Energy consumed for all CPUs : 0.006712 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:34:56] 0.010739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:08] Energy consumed for RAM : 0.003990 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:08] Energy consumed for all CPUs : 0.006650 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:08] 0.010640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:10] Energy consumed for RAM : 0.003914 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:10] Energy consumed for all CPUs : 0.006524 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:10] 0.010439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:11] Energy consumed for RAM : 0.004039 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:11] Energy consumed for all CPUs : 0.006733 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:11] 0.010772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:23] Energy consumed for RAM : 0.004002 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:23] Energy consumed for all CPUs : 0.006671 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:23] 0.010673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:25] Energy consumed for RAM : 0.003927 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:25] Energy consumed for all CPUs : 0.006545 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:25] 0.010472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:26] Energy consumed for RAM : 0.004052 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:26] Energy consumed for all CPUs : 0.006754 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:26] 0.010805 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:38] Energy consumed for RAM : 0.004014 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:38] Energy consumed for all CPUs : 0.006692 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:38] 0.010707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:40] Energy consumed for RAM : 0.003939 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:40] Energy consumed for all CPUs : 0.006566 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:40] 0.010505 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:41] Energy consumed for RAM : 0.004064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:41] Energy consumed for all CPUs : 0.006774 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:35:41] 0.010839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:53] Energy consumed for RAM : 0.004027 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:53] Energy consumed for all CPUs : 0.006713 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:53] 0.010740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:55] Energy consumed for RAM : 0.003952 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:55] Energy consumed for all CPUs : 0.006587 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:55] 0.010539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:35:56] Energy consumed for RAM : 0.004077 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:35:56] Energy consumed for all CPUs : 0.006795 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:35:56] 0.010872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:08] Energy consumed for RAM : 0.004039 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:08] Energy consumed for all CPUs : 0.006734 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:08] 0.010773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:10] Energy consumed for RAM : 0.003964 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:10] Energy consumed for all CPUs : 0.006608 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:10] 0.010572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:11] Energy consumed for RAM : 0.004089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:11] Energy consumed for all CPUs : 0.006816 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:11] 0.010905 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:23] Energy consumed for RAM : 0.004052 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:23] Energy consumed for all CPUs : 0.006755 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:23] 0.010807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:25] Energy consumed for RAM : 0.003977 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:25] Energy consumed for all CPUs : 0.006629 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:25] 0.010605 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:26] Energy consumed for RAM : 0.004102 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:26] Energy consumed for all CPUs : 0.006837 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:26] 0.010939 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:36:38] Energy consumed for RAM : 0.004064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:38] Energy consumed for all CPUs : 0.006775 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:38] 0.010840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:40] Energy consumed for RAM : 0.003989 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:40] Energy consumed for all CPUs : 0.006649 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:40] 0.010639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:41] Energy consumed for RAM : 0.004114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:41] Energy consumed for all CPUs : 0.006858 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:41] 0.010972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:53] Energy consumed for RAM : 0.004077 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:53] Energy consumed for all CPUs : 0.006796 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:53] 0.010873 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:55] Energy consumed for RAM : 0.004002 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:55] Energy consumed for all CPUs : 0.006670 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:55] 0.010672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:36:57] Energy consumed for RAM : 0.004127 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:36:57] Energy consumed for all CPUs : 0.006879 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:36:57] 0.011005 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:08] Energy consumed for RAM : 0.004089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:08] Energy consumed for all CPUs : 0.006817 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:08] 0.010907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:10] Energy consumed for RAM : 0.004014 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:10] Energy consumed for all CPUs : 0.006691 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:10] 0.010706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:12] Energy consumed for RAM : 0.004139 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:12] Energy consumed for all CPUs : 0.006899 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:12] 0.011039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:23] Energy consumed for RAM : 0.004102 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:37:23] Energy consumed for all CPUs : 0.006838 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:23] 0.010940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:25] Energy consumed for RAM : 0.004027 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:25] Energy consumed for all CPUs : 0.006712 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:25] 0.010739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:27] Energy consumed for RAM : 0.004152 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:27] Energy consumed for all CPUs : 0.006920 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:27] 0.011072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:38] Energy consumed for RAM : 0.004114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:38] Energy consumed for all CPUs : 0.006859 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:38] 0.010973 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:40] Energy consumed for RAM : 0.004039 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:40] Energy consumed for all CPUs : 0.006733 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:40] 0.010772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:42] Energy consumed for RAM : 0.004164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:42] Energy consumed for all CPUs : 0.006941 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:42] 0.011105 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:53] Energy consumed for RAM : 0.004127 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:53] Energy consumed for all CPUs : 0.006880 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:53] 0.011007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:55] Energy consumed for RAM : 0.004052 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:55] Energy consumed for all CPUs : 0.006754 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:55] 0.010806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:37:57] Energy consumed for RAM : 0.004177 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:37:57] Energy consumed for all CPUs : 0.006962 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:37:57] 0.011139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:08] Energy consumed for RAM : 0.004139 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:08] Energy consumed for all CPUs : 0.006900 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:38:08] 0.011040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:10] Energy consumed for RAM : 0.004064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:10] Energy consumed for all CPUs : 0.006775 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:10] 0.010839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:12] Energy consumed for RAM : 0.004189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:12] Energy consumed for all CPUs : 0.006983 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:12] 0.011172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:23] Energy consumed for RAM : 0.004152 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:23] Energy consumed for all CPUs : 0.006921 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:23] 0.011073 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:25] Energy consumed for RAM : 0.004077 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:25] Energy consumed for all CPUs : 0.006795 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:25] 0.010872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:27] Energy consumed for RAM : 0.004202 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:27] Energy consumed for all CPUs : 0.007004 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:27] 0.011205 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:38] Energy consumed for RAM : 0.004164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:38] Energy consumed for all CPUs : 0.006942 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:38] 0.011107 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:40] Energy consumed for RAM : 0.004089 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:40] Energy consumed for all CPUs : 0.006816 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:40] 0.010906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:42] Energy consumed for RAM : 0.004214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:42] Energy consumed for all CPUs : 0.007024 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:42] 0.011239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:53] Energy consumed for RAM : 0.004177 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:53] Energy consumed for all CPUs : 0.006963 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:53] 0.011140 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:38:55] Energy consumed for RAM : 0.004102 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:55] Energy consumed for all CPUs : 0.006837 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:55] 0.010939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:38:57] Energy consumed for RAM : 0.004227 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:38:57] Energy consumed for all CPUs : 0.007045 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:38:57] 0.011272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:08] Energy consumed for RAM : 0.004189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:08] Energy consumed for all CPUs : 0.006984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:08] 0.011173 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:10] Energy consumed for RAM : 0.004114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:10] Energy consumed for all CPUs : 0.006858 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:10] 0.010972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:12] Energy consumed for RAM : 0.004239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:12] Energy consumed for all CPUs : 0.007066 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:12] 0.011305 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:23] Energy consumed for RAM : 0.004202 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:23] Energy consumed for all CPUs : 0.007005 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:23] 0.011207 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:25] Energy consumed for RAM : 0.004127 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:25] Energy consumed for all CPUs : 0.006879 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:25] 0.011006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:27] Energy consumed for RAM : 0.004252 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:27] Energy consumed for all CPUs : 0.007087 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:27] 0.011339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:38] Energy consumed for RAM : 0.004214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:38] Energy consumed for all CPUs : 0.007025 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:38] 0.011240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:40] Energy consumed for RAM : 0.004139 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:39:40] Energy consumed for all CPUs : 0.006900 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:40] 0.011039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:42] Energy consumed for RAM : 0.004264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:42] Energy consumed for all CPUs : 0.007108 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:42] 0.011372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:53] Energy consumed for RAM : 0.004227 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:53] Energy consumed for all CPUs : 0.007046 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:53] 0.011273 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:55] Energy consumed for RAM : 0.004152 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:55] Energy consumed for all CPUs : 0.006920 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:55] 0.011072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:39:57] Energy consumed for RAM : 0.004277 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:39:57] Energy consumed for all CPUs : 0.007129 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:39:57] 0.011405 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:08] Energy consumed for RAM : 0.004239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:08] Energy consumed for all CPUs : 0.007067 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:08] 0.011307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:10] Energy consumed for RAM : 0.004164 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:10] Energy consumed for all CPUs : 0.006941 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:10] 0.011106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:12] Energy consumed for RAM : 0.004289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:12] Energy consumed for all CPUs : 0.007149 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:12] 0.011439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:23] Energy consumed for RAM : 0.004252 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:23] Energy consumed for all CPUs : 0.007088 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:23] 0.011340 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:25] Energy consumed for RAM : 0.004177 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:25] Energy consumed for all CPUs : 0.006962 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:40:25] 0.011139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:27] Energy consumed for RAM : 0.004302 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:27] Energy consumed for all CPUs : 0.007170 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:27] 0.011472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:38] Energy consumed for RAM : 0.004264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:38] Energy consumed for all CPUs : 0.007109 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:38] 0.011373 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:40] Energy consumed for RAM : 0.004189 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:40] Energy consumed for all CPUs : 0.006983 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:40] 0.011172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:42] Energy consumed for RAM : 0.004314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:42] Energy consumed for all CPUs : 0.007191 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:42] 0.011505 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:53] Energy consumed for RAM : 0.004277 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:53] Energy consumed for all CPUs : 0.007130 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:53] 0.011407 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:55] Energy consumed for RAM : 0.004202 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:55] Energy consumed for all CPUs : 0.007004 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:55] 0.011206 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:40:57] Energy consumed for RAM : 0.004327 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:40:57] Energy consumed for all CPUs : 0.007212 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:40:57] 0.011539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:08] Energy consumed for RAM : 0.004289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:08] Energy consumed for all CPUs : 0.007150 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:08] 0.011440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:10] Energy consumed for RAM : 0.004214 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:10] Energy consumed for all CPUs : 0.007025 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:10] 0.011239 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:41:12] Energy consumed for RAM : 0.004339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:12] Energy consumed for all CPUs : 0.007233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:12] 0.011572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:23] Energy consumed for RAM : 0.004302 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:23] Energy consumed for all CPUs : 0.007171 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:23] 0.011473 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:25] Energy consumed for RAM : 0.004227 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:25] Energy consumed for all CPUs : 0.007045 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:25] 0.011272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:27] Energy consumed for RAM : 0.004352 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:27] Energy consumed for all CPUs : 0.007254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:27] 0.011605 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:38] Energy consumed for RAM : 0.004314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:38] Energy consumed for all CPUs : 0.007192 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:38] 0.011507 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:40] Energy consumed for RAM : 0.004239 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:40] Energy consumed for all CPUs : 0.007066 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:40] 0.011306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:42] Energy consumed for RAM : 0.004364 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:42] Energy consumed for all CPUs : 0.007274 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:42] 0.011639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:53] Energy consumed for RAM : 0.004327 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:53] Energy consumed for all CPUs : 0.007213 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:53] 0.011540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:55] Energy consumed for RAM : 0.004252 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:41:55] Energy consumed for all CPUs : 0.007087 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:55] 0.011339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:41:57] Energy consumed for RAM : 0.004377 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:41:57] Energy consumed for all CPUs : 0.007295 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:41:57] 0.011672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:08] Energy consumed for RAM : 0.004339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:08] Energy consumed for all CPUs : 0.007234 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:08] 0.011573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:10] Energy consumed for RAM : 0.004264 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:10] Energy consumed for all CPUs : 0.007108 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:10] 0.011372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:12] Energy consumed for RAM : 0.004389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:12] Energy consumed for all CPUs : 0.007316 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:12] 0.011705 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:23] Energy consumed for RAM : 0.004352 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:23] Energy consumed for all CPUs : 0.007255 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:23] 0.011607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:25] Energy consumed for RAM : 0.004277 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:25] Energy consumed for all CPUs : 0.007129 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:25] 0.011406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:27] Energy consumed for RAM : 0.004402 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:27] Energy consumed for all CPUs : 0.007337 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:27] 0.011739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:38] Energy consumed for RAM : 0.004364 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:38] Energy consumed for all CPUs : 0.007275 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:38] 0.011640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:40] Energy consumed for RAM : 0.004289 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:40] Energy consumed for all CPUs : 0.007150 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:40] 0.011439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:42] Energy consumed for RAM : 0.004414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:42] Energy consumed for all CPUs : 0.007358 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:42:42] 0.011772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:53] Energy consumed for RAM : 0.004377 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:53] Energy consumed for all CPUs : 0.007296 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:53] 0.011673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:55] Energy consumed for RAM : 0.004302 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:55] Energy consumed for all CPUs : 0.007170 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:55] 0.011472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:42:57] Energy consumed for RAM : 0.004427 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:42:57] Energy consumed for all CPUs : 0.007379 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:42:57] 0.011805 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:08] Energy consumed for RAM : 0.004389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:08] Energy consumed for all CPUs : 0.007317 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:08] 0.011707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:10] Energy consumed for RAM : 0.004314 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:10] Energy consumed for all CPUs : 0.007191 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:10] 0.011506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:12] Energy consumed for RAM : 0.004439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:12] Energy consumed for all CPUs : 0.007399 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:12] 0.011839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:23] Energy consumed for RAM : 0.004402 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:23] Energy consumed for all CPUs : 0.007338 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:23] 0.011740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:25] Energy consumed for RAM : 0.004327 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:25] Energy consumed for all CPUs : 0.007212 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:25] 0.011539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:27] Energy consumed for RAM : 0.004452 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:27] Energy consumed for all CPUs : 0.007420 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:27] 0.011872 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:43:38] Energy consumed for RAM : 0.004414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:38] Energy consumed for all CPUs : 0.007359 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:38] 0.011773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:40] Energy consumed for RAM : 0.004339 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:40] Energy consumed for all CPUs : 0.007233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:40] 0.011572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:42] Energy consumed for RAM : 0.004464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:42] Energy consumed for all CPUs : 0.007441 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:42] 0.011905 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:53] Energy consumed for RAM : 0.004427 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:53] Energy consumed for all CPUs : 0.007380 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:53] 0.011807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:55] Energy consumed for RAM : 0.004352 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:55] Energy consumed for all CPUs : 0.007254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:55] 0.011606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:43:57] Energy consumed for RAM : 0.004477 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:43:57] Energy consumed for all CPUs : 0.007462 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:43:57] 0.011939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:08] Energy consumed for RAM : 0.004439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:08] Energy consumed for all CPUs : 0.007401 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:08] 0.011840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:10] Energy consumed for RAM : 0.004364 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:10] Energy consumed for all CPUs : 0.007275 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:10] 0.011639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:12] Energy consumed for RAM : 0.004489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:12] Energy consumed for all CPUs : 0.007483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:12] 0.011972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:23] Energy consumed for RAM : 0.004452 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:44:23] Energy consumed for all CPUs : 0.007421 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:23] 0.011873 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:25] Energy consumed for RAM : 0.004377 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:25] Energy consumed for all CPUs : 0.007295 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:25] 0.011672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:27] Energy consumed for RAM : 0.004502 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:27] Energy consumed for all CPUs : 0.007504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:27] 0.012005 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:38] Energy consumed for RAM : 0.004464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:38] Energy consumed for all CPUs : 0.007442 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:38] 0.011907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:40] Energy consumed for RAM : 0.004389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:40] Energy consumed for all CPUs : 0.007316 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:40] 0.011706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:42] Energy consumed for RAM : 0.004514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:42] Energy consumed for all CPUs : 0.007525 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:42] 0.012039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:53] Energy consumed for RAM : 0.004477 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:53] Energy consumed for all CPUs : 0.007463 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:53] 0.011940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:55] Energy consumed for RAM : 0.004402 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:55] Energy consumed for all CPUs : 0.007337 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:55] 0.011739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:44:57] Energy consumed for RAM : 0.004527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:44:57] Energy consumed for all CPUs : 0.007545 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:44:57] 0.012072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:08] Energy consumed for RAM : 0.004489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:08] Energy consumed for all CPUs : 0.007484 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:45:08] 0.011973 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:10] Energy consumed for RAM : 0.004414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:10] Energy consumed for all CPUs : 0.007358 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:10] 0.011772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:12] Energy consumed for RAM : 0.004539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:12] Energy consumed for all CPUs : 0.007566 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:12] 0.012105 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:23] Energy consumed for RAM : 0.004502 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:23] Energy consumed for all CPUs : 0.007505 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:23] 0.012007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:25] Energy consumed for RAM : 0.004427 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:25] Energy consumed for all CPUs : 0.007379 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:25] 0.011806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:27] Energy consumed for RAM : 0.004552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:27] Energy consumed for all CPUs : 0.007587 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:27] 0.012139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:38] Energy consumed for RAM : 0.004514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:38] Energy consumed for all CPUs : 0.007526 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:38] 0.012040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:40] Energy consumed for RAM : 0.004439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:40] Energy consumed for all CPUs : 0.007400 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:40] 0.011839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:42] Energy consumed for RAM : 0.004564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:42] Energy consumed for all CPUs : 0.007608 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:42] 0.012172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:53] Energy consumed for RAM : 0.004527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:53] Energy consumed for all CPUs : 0.007546 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:53] 0.012073 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:45:55] Energy consumed for RAM : 0.004452 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:55] Energy consumed for all CPUs : 0.007420 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:55] 0.011872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:45:57] Energy consumed for RAM : 0.004577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:45:57] Energy consumed for all CPUs : 0.007629 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:45:57] 0.012205 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:08] Energy consumed for RAM : 0.004539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:08] Energy consumed for all CPUs : 0.007567 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:08] 0.012107 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:10] Energy consumed for RAM : 0.004464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:10] Energy consumed for all CPUs : 0.007441 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:10] 0.011906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:12] Energy consumed for RAM : 0.004589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:12] Energy consumed for all CPUs : 0.007650 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:12] 0.012239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:23] Energy consumed for RAM : 0.004552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:23] Energy consumed for all CPUs : 0.007588 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:23] 0.012140 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:25] Energy consumed for RAM : 0.004477 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:25] Energy consumed for all CPUs : 0.007462 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:25] 0.011939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:27] Energy consumed for RAM : 0.004602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:27] Energy consumed for all CPUs : 0.007670 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:27] 0.012272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:38] Energy consumed for RAM : 0.004564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:38] Energy consumed for all CPUs : 0.007609 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:39] 0.012173 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:40] Energy consumed for RAM : 0.004489 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:46:40] Energy consumed for all CPUs : 0.007483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:40] 0.011972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:42] Energy consumed for RAM : 0.004614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:42] Energy consumed for all CPUs : 0.007691 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:42] 0.012305 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:53] Energy consumed for RAM : 0.004577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:53] Energy consumed for all CPUs : 0.007630 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:53] 0.012207 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:55] Energy consumed for RAM : 0.004502 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:55] Energy consumed for all CPUs : 0.007504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:55] 0.012006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:46:57] Energy consumed for RAM : 0.004627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:46:57] Energy consumed for all CPUs : 0.007712 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:46:57] 0.012339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:08] Energy consumed for RAM : 0.004589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:09] Energy consumed for all CPUs : 0.007651 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:09] 0.012240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:10] Energy consumed for RAM : 0.004514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:10] Energy consumed for all CPUs : 0.007525 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:10] 0.012039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:12] Energy consumed for RAM : 0.004639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:12] Energy consumed for all CPUs : 0.007733 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:12] 0.012372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:24] Energy consumed for RAM : 0.004602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:24] Energy consumed for all CPUs : 0.007671 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:24] 0.012273 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:25] Energy consumed for RAM : 0.004527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:25] Energy consumed for all CPUs : 0.007546 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:47:25] 0.012072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:27] Energy consumed for RAM : 0.004652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:27] Energy consumed for all CPUs : 0.007754 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:27] 0.012405 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:39] Energy consumed for RAM : 0.004614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:39] Energy consumed for all CPUs : 0.007692 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:39] 0.012307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:40] Energy consumed for RAM : 0.004539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:40] Energy consumed for all CPUs : 0.007566 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:40] 0.012106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:42] Energy consumed for RAM : 0.004664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:42] Energy consumed for all CPUs : 0.007775 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:42] 0.012439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:54] Energy consumed for RAM : 0.004627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:54] Energy consumed for all CPUs : 0.007713 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:54] 0.012340 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:55] Energy consumed for RAM : 0.004552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:55] Energy consumed for all CPUs : 0.007587 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:55] 0.012139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:47:57] Energy consumed for RAM : 0.004677 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:47:57] Energy consumed for all CPUs : 0.007795 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:47:57] 0.012472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:09] Energy consumed for RAM : 0.004639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:09] Energy consumed for all CPUs : 0.007734 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:09] 0.012373 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:10] Energy consumed for RAM : 0.004564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:10] Energy consumed for all CPUs : 0.007608 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:10] 0.012172 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:48:12] Energy consumed for RAM : 0.004689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:12] Energy consumed for all CPUs : 0.007816 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:12] 0.012505 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:24] Energy consumed for RAM : 0.004652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:24] Energy consumed for all CPUs : 0.007755 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:24] 0.012407 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:25] Energy consumed for RAM : 0.004577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:25] Energy consumed for all CPUs : 0.007629 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:25] 0.012206 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:27] Energy consumed for RAM : 0.004702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:27] Energy consumed for all CPUs : 0.007837 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:27] 0.012539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:39] Energy consumed for RAM : 0.004664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:39] Energy consumed for all CPUs : 0.007776 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:39] 0.012440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:40] Energy consumed for RAM : 0.004589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:40] Energy consumed for all CPUs : 0.007650 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:40] 0.012239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:42] Energy consumed for RAM : 0.004714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:42] Energy consumed for all CPUs : 0.007858 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:42] 0.012572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:54] Energy consumed for RAM : 0.004677 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:54] Energy consumed for all CPUs : 0.007796 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:54] 0.012473 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:55] Energy consumed for RAM : 0.004602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:48:55] Energy consumed for all CPUs : 0.007671 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:55] 0.012272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:48:57] Energy consumed for RAM : 0.004727 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:48:57] Energy consumed for all CPUs : 0.007879 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:48:57] 0.012605 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:09] Energy consumed for RAM : 0.004689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:09] Energy consumed for all CPUs : 0.007817 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:09] 0.012507 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:10] Energy consumed for RAM : 0.004614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:10] Energy consumed for all CPUs : 0.007691 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:10] 0.012306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:12] Energy consumed for RAM : 0.004739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:12] Energy consumed for all CPUs : 0.007900 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:12] 0.012639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:24] Energy consumed for RAM : 0.004702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:24] Energy consumed for all CPUs : 0.007838 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:24] 0.012540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:25] Energy consumed for RAM : 0.004627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:25] Energy consumed for all CPUs : 0.007712 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:25] 0.012339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:27] Energy consumed for RAM : 0.004752 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:27] Energy consumed for all CPUs : 0.007920 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:27] 0.012672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:39] Energy consumed for RAM : 0.004714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:39] Energy consumed for all CPUs : 0.007859 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:39] 0.012573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:40] Energy consumed for RAM : 0.004639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:40] Energy consumed for all CPUs : 0.007733 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:40] 0.012372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:42] Energy consumed for RAM : 0.004764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:42] Energy consumed for all CPUs : 0.007941 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 03:49:42] 0.012705 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:54] Energy consumed for RAM : 0.004727 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:54] Energy consumed for all CPUs : 0.007880 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:54] 0.012607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:55] Energy consumed for RAM : 0.004652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:55] Energy consumed for all CPUs : 0.007754 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:55] 0.012406 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:49:57] Energy consumed for RAM : 0.004777 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:49:57] Energy consumed for all CPUs : 0.007962 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:49:57] 0.012739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:09] Energy consumed for RAM : 0.004739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:09] Energy consumed for all CPUs : 0.007901 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:09] 0.012640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:10] Energy consumed for RAM : 0.004664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:10] Energy consumed for all CPUs : 0.007775 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:10] 0.012439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:12] Energy consumed for RAM : 0.004789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:12] Energy consumed for all CPUs : 0.007983 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:12] 0.012772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:24] Energy consumed for RAM : 0.004752 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:24] Energy consumed for all CPUs : 0.007921 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:24] 0.012673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:25] Energy consumed for RAM : 0.004677 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:25] Energy consumed for all CPUs : 0.007796 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:25] 0.012472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:27] Energy consumed for RAM : 0.004802 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:27] Energy consumed for all CPUs : 0.008004 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:27] 0.012806 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 03:50:39] Energy consumed for RAM : 0.004764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:39] Energy consumed for all CPUs : 0.007942 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:39] 0.012707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:40] Energy consumed for RAM : 0.004689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:40] Energy consumed for all CPUs : 0.007816 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:40] 0.012506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:42] Energy consumed for RAM : 0.004814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:42] Energy consumed for all CPUs : 0.008025 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:42] 0.012839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:54] Energy consumed for RAM : 0.004777 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:54] Energy consumed for all CPUs : 0.007963 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:54] 0.012740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:55] Energy consumed for RAM : 0.004702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:55] Energy consumed for all CPUs : 0.007837 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:55] 0.012539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:50:57] Energy consumed for RAM : 0.004827 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:50:57] Energy consumed for all CPUs : 0.008045 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:50:57] 0.012872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:09] Energy consumed for RAM : 0.004789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:09] Energy consumed for all CPUs : 0.007984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:09] 0.012773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:10] Energy consumed for RAM : 0.004714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:10] Energy consumed for all CPUs : 0.007858 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:10] 0.012572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:12] Energy consumed for RAM : 0.004839 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:12] Energy consumed for all CPUs : 0.008066 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:12] 0.012906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:24] Energy consumed for RAM : 0.004802 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 03:51:24] Energy consumed for all CPUs : 0.008005 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:24] 0.012807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:25] Energy consumed for RAM : 0.004727 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:25] Energy consumed for all CPUs : 0.007879 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:25] 0.012606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:27] Energy consumed for RAM : 0.004852 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:27] Energy consumed for all CPUs : 0.008087 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:27] 0.012939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:39] Energy consumed for RAM : 0.004814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:39] Energy consumed for all CPUs : 0.008026 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:39] 0.012840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:40] Energy consumed for RAM : 0.004739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:40] Energy consumed for all CPUs : 0.007900 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:40] 0.012639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 03:51:42] Energy consumed for RAM : 0.004864 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 03:51:42] Energy consumed for all CPUs : 0.008108 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 03:51:42] 0.012972 kWh of electricity used since the begi
nning.
```

Note that there isn't one "correct" answer here. We simply want you to investigate how different features in your random forest contribute to predicting the target variable.

Also note that: the number of features can be different if you change max_features value since it ends up changing the number of features considered in bootstrapped datasets.

# 4: (Bonus for All) SVM [7.8%] [W] [P]

## 4.1 Fitting an SVM classifier by hand [5.5%] [W]

Consider a dataset with the following points in 2-dimensional space:

| $x_1$ | $x_2$ | $y$ |
|---|---|---|
| -2 | -2 | -1 |

| $x_1$ | $x_2$ | $y$ |
|---|---|---|
| -2 | -3 | -1 |
| -1 | -3 | -1 |
| 1 | -1 | 1 |
| 2 | -1 | 1 |
| 2 | -2 | 1 |

Here, $x_1$ and $x_2$ are features and $y$ is the label.

The max margin classifier has the formulation,

$$\min ||\theta||^2$$

$$s.t.\ y_i(\mathbf{x_i}\theta + b) \geq 1 \quad \forall\, i$$

**Hint:** $\mathbf{x_i}$ are the suppport vectors. Margin is equal to $\frac{1}{||\theta||}$ and full margin is equal to $\frac{2}{||\theta||}$. You might find it useful to plot the points in a 2D plane. When calculating the $\theta$ you don't need to consider the bias term.

(1) Are the points linearly separable? Does adding the point $\mathbf{x} = (1, -2)$, $y = 1$ change the separability? (2 pts)

(2) According to the max-margin formulation, find the separating hyperplane. Do not consider the new point from part 1 in your calculations for this current question or subsequent parts. (You should give some kind of explanation or calculation on how you found the hyperplane, you may solve this question graphically.) (4 pts)

(3) Find a vector parallel to the optimal vector $\theta$. (Hint: Recall whether the optimal vector is parallel or perpendicular to the separating hyperplane.) (4 pts)

(4) Calculate the value of the margin (single-sided) achieved by this $\theta$? (4 pts)

(5) Solve for $\theta$, given that the margin is equal to $1/||\theta||$. (4 pts)

(6) If we remove one of the points from the original data the SVM solution might change. Find all such points which change the solution. (2 pts)

(7) Consider the optimization formulation stated above. Why do we want to optimzie $||\theta||^2$ instead of $||\theta||$? (2 pts)

(8) Plot the features $x_1$ and $x_2$, based on label $y$ (use different color for different label), ignoring the hypothetical point mentioned in part (1). Please also included the separating hyperplane in the plot (4 pts)

(1) These points are linearly separable as a line can be drawn that separates the two classes without any points of one class lying on the side of the other class. Adding the point $(1, -2)$ with $y = 1$ does not affect separability, as it lies on the same side as the other positive points relative to any conceivable separating line between the given negative and positive points.

(2) The simplest hyperplane separating the data can be assumed to be almost parallel to the vector visually separating the two sets of points. Such a hyperplane is $x_1 + x_2 = -1$.

(3) The optimal vector $\theta$ is perpendicular to the separating hyperplane. For the hyperplane $x_1 + x_2 = -1$, a normal vector (hence $\theta$) could be $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$ since any scalar multiple of this vector would still be normal to the hyperplane.

(4) The margin is the distance from the closest data points (support vectors) to the hyperplane. We calculate this distance using the formula for the distance from a point to a line:

$$\text{Distance} = \frac{|ax_1 + bx_2 + c|}{\sqrt{a^2 + b^2}}$$

For the hyperplane $x_1 + x_2 = -1$ (or $x_1 + x_2 + 1 = 0$):

- Calculate using $a = 1$, $b = 1$, and $c = 1$.

Picking a point such as (-2, -2) for label -1:

$$\text{Distance} = \frac{|1(-2) + 1(-2) + 1|}{\sqrt{1^2 + 1^2}} = \frac{3}{\sqrt{2}} \approx 2.12$$

This distance indicates the single-sided margin from the hyperplane to this point, which is a support vector.

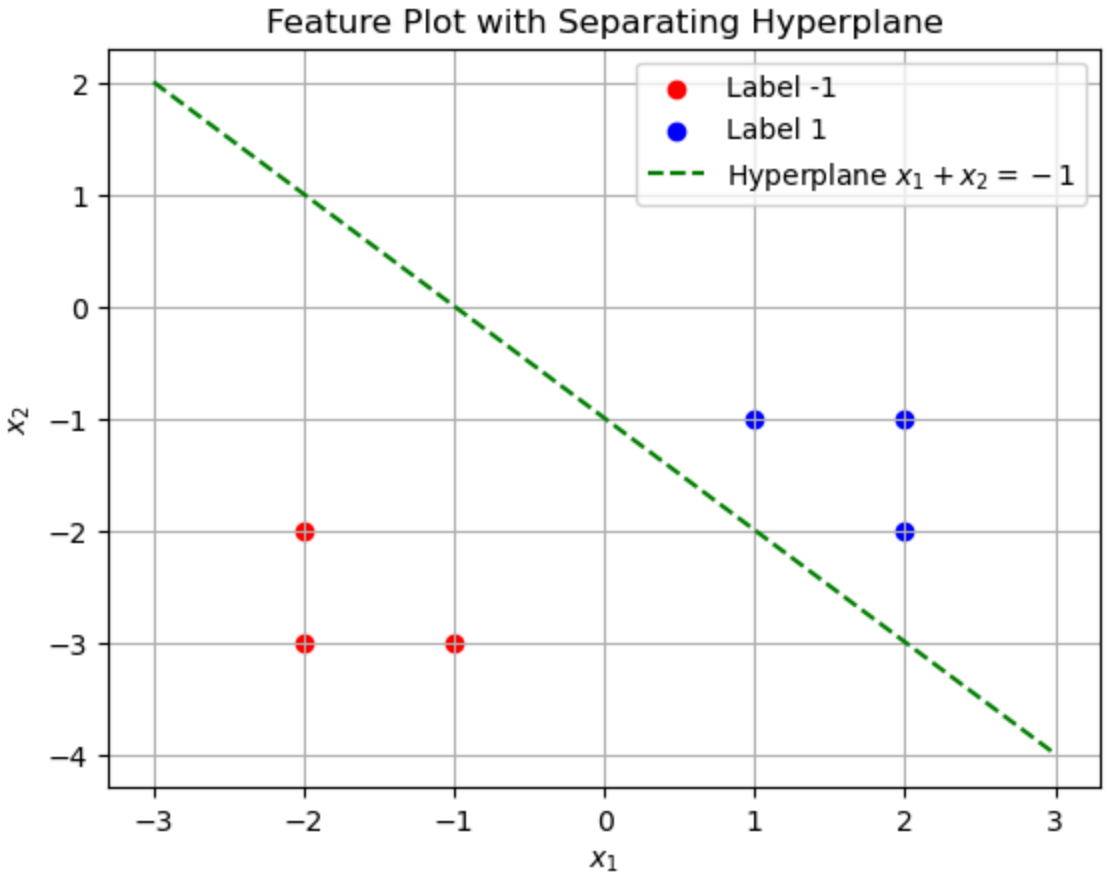
(5) The margin is $1/||\theta||$, which relates to the distance calculated above:

- Setting $||\theta|| = \sqrt{2}$ aligns with the unit vector $\theta = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$.
- To ensure a unit margin, we have $||\theta|| = \sqrt{2}$, hence $\theta = \begin{pmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \end{pmatrix}$.

(6) Points that are exactly at the margin's distance from the hyperplane are the support vectors. For this dataset, these would likely be the closest points to the hyperplane.

(7) Optimizing $||\theta||^2$ rather than $||\theta||$ provides computational simplicity in the optimization algorithms, particularly because the derivative of $||\theta||^2$ is more straightforward and well-behaved than $||\theta||$.

In [ ]:
```
import matplotlib.pyplot as plt
import numpy as np

x = np.array([[-2, -2], [-2, -3], [-1, -3], [1, -1], [2, -1], [2, -2]])
y = np.array([-1, -1, -1, 1, 1, 1])

plt.scatter(x[y == -1][:, 0], x[y == -1][:, 1], color='red', label='Label -1
plt.scatter(x[y == 1][:, 0], x[y == 1][:, 1], color='blue', label='Label 1')

x_values = np.linspace(-3, 3, 400)
y_values = -x_values - 1
plt.plot(x_values, y_values, 'green', linestyle='--', label='Hyperplane $x_1
plt.xlabel('$x_1$')
plt.ylabel('$x_2$')
plt.title('Feature Plot with Separating Hyperplane')
plt.legend()
plt.grid(True)
plt.show()
```



```
[codecarbon INFO @ 04:03:09] Energy consumed for RAM : 0.005389 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:09] Energy consumed for all CPUs : 0.008984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:09] 0.014373 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:03:12] Energy consumed for RAM : 0.005439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:12] Energy consumed for all CPUs : 0.009067 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:12] 0.014506 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:03:24] Energy consumed for RAM : 0.005402 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:24] Energy consumed for all CPUs : 0.009005 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:24] 0.014407 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:03:27] Energy consumed for RAM : 0.005452 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:27] Energy consumed for all CPUs : 0.009087 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:27] 0.014539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:03:39] Energy consumed for RAM : 0.005414 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:39] Energy consumed for all CPUs : 0.009026 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:39] 0.014440 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:03:42] Energy consumed for RAM : 0.005464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:42] Energy consumed for all CPUs : 0.009108 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:42] 0.014572 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:03:54] Energy consumed for RAM : 0.005427 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:54] Energy consumed for all CPUs : 0.009047 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:54] 0.014473 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:03:57] Energy consumed for RAM : 0.005477 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:03:57] Energy consumed for all CPUs : 0.009129 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:03:57] 0.014606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:09] Energy consumed for RAM : 0.005439 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:04:09] Energy consumed for all CPUs : 0.009068 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:09] 0.014507 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:12] Energy consumed for RAM : 0.005489 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:04:12] Energy consumed for all CPUs : 0.009150 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:12] 0.014639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:24] Energy consumed for RAM : 0.005452 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:04:24] Energy consumed for all CPUs : 0.009088 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:24] 0.014540 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:27] Energy consumed for RAM : 0.005502 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:04:27] Energy consumed for all CPUs : 0.009171 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:27] 0.014672 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:39] Energy consumed for RAM : 0.005464 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:04:39] Energy consumed for all CPUs : 0.009109 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:39] 0.014573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:42] Energy consumed for RAM : 0.005514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:04:42] Energy consumed for all CPUs : 0.009192 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:42] 0.014706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:54] Energy consumed for RAM : 0.005477 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:04:54] Energy consumed for all CPUs : 0.009130 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:54] 0.014607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:04:57] Energy consumed for RAM : 0.005527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:04:57] Energy consumed for all CPUs : 0.009212 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:04:57] 0.014739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:09] Energy consumed for RAM : 0.005489 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:09] Energy consumed for all CPUs : 0.009151 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:05:09] 0.014640 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:12] Energy consumed for RAM : 0.005539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:12] Energy consumed for all CPUs : 0.009233 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:05:12] 0.014772 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:24] Energy consumed for RAM : 0.005502 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:24] Energy consumed for all CPUs : 0.009172 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:05:24] 0.014673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:27] Energy consumed for RAM : 0.005552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:27] Energy consumed for all CPUs : 0.009254 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:05:27] 0.014806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:39] Energy consumed for RAM : 0.005514 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:39] Energy consumed for all CPUs : 0.009193 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:05:39] 0.014707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:42] Energy consumed for RAM : 0.005564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:42] Energy consumed for all CPUs : 0.009275 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:05:42] 0.014839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:54] Energy consumed for RAM : 0.005527 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:54] Energy consumed for all CPUs : 0.009213 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:05:54] 0.014740 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:05:57] Energy consumed for RAM : 0.005577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:05:57] Energy consumed for all CPUs : 0.009296 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:05:57] 0.014872 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:06:09] Energy consumed for RAM : 0.005539 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:09] Energy consumed for all CPUs : 0.009234 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:09] 0.014773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:06:12] Energy consumed for RAM : 0.005589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:12] Energy consumed for all CPUs : 0.009317 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:12] 0.014906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:06:24] Energy consumed for RAM : 0.005552 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:24] Energy consumed for all CPUs : 0.009255 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:24] 0.014807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:06:27] Energy consumed for RAM : 0.005602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:27] Energy consumed for all CPUs : 0.009337 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:27] 0.014939 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:06:39] Energy consumed for RAM : 0.005564 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:39] Energy consumed for all CPUs : 0.009276 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:39] 0.014840 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:06:42] Energy consumed for RAM : 0.005614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:42] Energy consumed for all CPUs : 0.009358 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:42] 0.014972 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:06:54] Energy consumed for RAM : 0.005577 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:54] Energy consumed for all CPUs : 0.009297 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:54] 0.014874 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:06:57] Energy consumed for RAM : 0.005627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:06:57] Energy consumed for all CPUs : 0.009379 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:06:57] 0.015006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:09] Energy consumed for RAM : 0.005589 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:07:09] Energy consumed for all CPUs : 0.009318 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:09] 0.014907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:12] Energy consumed for RAM : 0.005639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:07:12] Energy consumed for all CPUs : 0.009400 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:12] 0.015039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:24] Energy consumed for RAM : 0.005602 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:07:24] Energy consumed for all CPUs : 0.009338 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:24] 0.014940 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:27] Energy consumed for RAM : 0.005652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:07:27] Energy consumed for all CPUs : 0.009421 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:27] 0.015072 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:39] Energy consumed for RAM : 0.005614 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:07:39] Energy consumed for all CPUs : 0.009359 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:39] 0.014974 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:42] Energy consumed for RAM : 0.005664 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:07:42] Energy consumed for all CPUs : 0.009442 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:42] 0.015106 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:54] Energy consumed for RAM : 0.005627 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:07:54] Energy consumed for all CPUs : 0.009380 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:54] 0.015007 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:07:57] Energy consumed for RAM : 0.005677 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:07:57] Energy consumed for all CPUs : 0.009462 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:07:57] 0.015139 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:09] Energy consumed for RAM : 0.005639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:09] Energy consumed for all CPUs : 0.009401 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:08:09] 0.015040 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:12] Energy consumed for RAM : 0.005689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:12] Energy consumed for all CPUs : 0.009483 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:08:12] 0.015172 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:24] Energy consumed for RAM : 0.005652 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:24] Energy consumed for all CPUs : 0.009422 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:08:24] 0.015074 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:27] Energy consumed for RAM : 0.005702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:27] Energy consumed for all CPUs : 0.009504 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:08:27] 0.015206 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:39] Energy consumed for RAM : 0.005664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:39] Energy consumed for all CPUs : 0.009443 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:08:39] 0.015107 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:42] Energy consumed for RAM : 0.005714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:42] Energy consumed for all CPUs : 0.009525 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:08:42] 0.015239 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:54] Energy consumed for RAM : 0.005677 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:54] Energy consumed for all CPUs : 0.009463 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:08:54] 0.015140 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:08:57] Energy consumed for RAM : 0.005727 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:08:57] Energy consumed for all CPUs : 0.009546 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:08:57] 0.015272 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:09] Energy consumed for RAM : 0.005689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:09] Energy consumed for all CPUs : 0.009484 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:09] 0.015174 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:12] Energy consumed for RAM : 0.005739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:12] Energy consumed for all CPUs : 0.009567 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:12] 0.015306 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:24] Energy consumed for RAM : 0.005702 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:24] Energy consumed for all CPUs : 0.009505 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:24] 0.015207 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:27] Energy consumed for RAM : 0.005752 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:27] Energy consumed for all CPUs : 0.009587 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:27] 0.015339 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:39] Energy consumed for RAM : 0.005714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:39] Energy consumed for all CPUs : 0.009526 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:39] 0.015240 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:42] Energy consumed for RAM : 0.005764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:42] Energy consumed for all CPUs : 0.009608 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:42] 0.015372 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:54] Energy consumed for RAM : 0.005727 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:54] Energy consumed for all CPUs : 0.009547 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:54] 0.015274 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:09:57] Energy consumed for RAM : 0.005777 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:09:57] Energy consumed for all CPUs : 0.009629 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:09:57] 0.015406 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:10:09] Energy consumed for RAM : 0.005739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:10:09] Energy consumed for all CPUs : 0.009568 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:10:09] 0.015307 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:10:12] Energy consumed for RAM : 0.005789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:10:12] Energy consumed for all CPUs : 0.009650 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:10:12] 0.015439 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:10:24] Energy consumed for RAM : 0.005752 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:10:24] Energy consumed for all CPUs : 0.009589 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:10:24] 0.015340 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:10:27] Energy consumed for RAM : 0.005802 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:10:27] Energy consumed for all CPUs : 0.009671 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:10:27] 0.015472 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:10:39] Energy consumed for RAM : 0.005764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:10:39] Energy consumed for all CPUs : 0.009609 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:10:39] 0.015374 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:10:42] Energy consumed for RAM : 0.005814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:10:42] Energy consumed for all CPUs : 0.009692 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:10:42] 0.015506 kWh of electricity used since the begi
nning.
```

## 4.2 Feature Mapping [2.3%] [P]

Let's look at a dataset where the datapoint can't be classified with a good accuracy using a linear classifier. Run the below cell to generate the dataset.

We will also see what happens when we try to fit a linear classifier to the dataset.

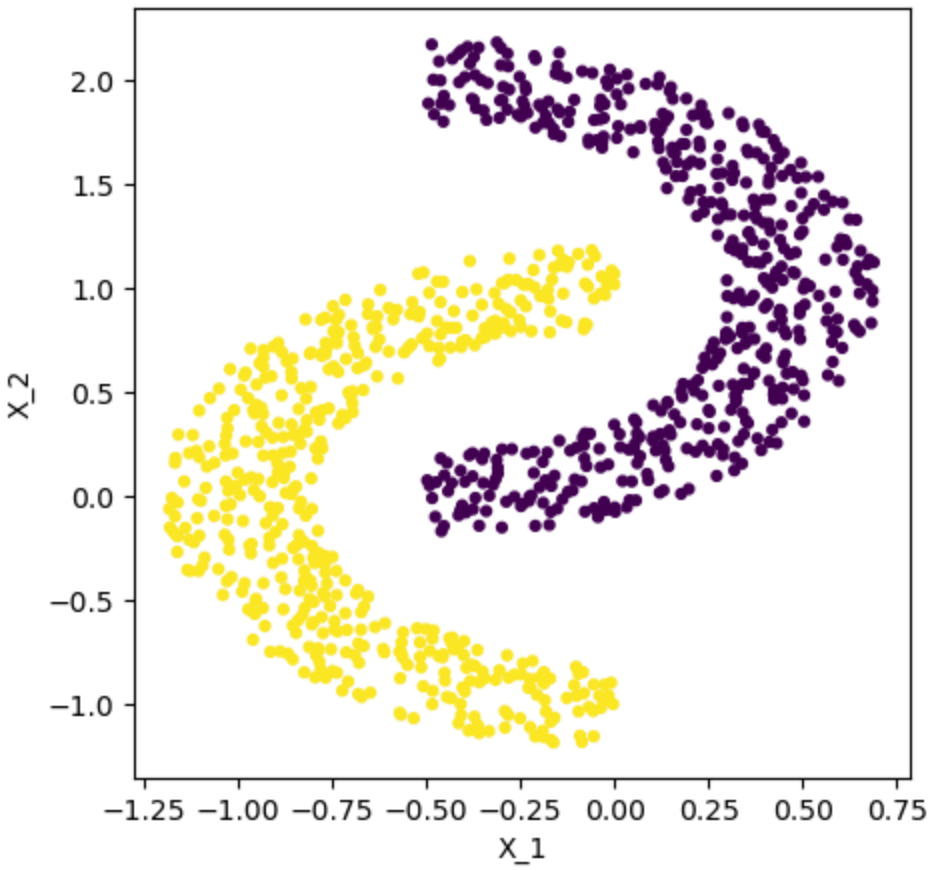
there are some suggestion readings:

https://see.stanford.edu/materials/aimlcs229/cs229-notes3.pdf

https://web.mit.edu/6.034/wwwbob/svm-notes-long-08.pdf

https://www.sjsu.edu/faculty/guangliang.chen/Math251F18/lec6svm.pdf

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
# Generate dataset

random_state = 1

np.random.seed(0)
theta = np.linspace(0, 2 * np.pi, 1000)
r = np.random.uniform(0.8, 1.2, 1000)
X = np.column_stack([r * np.cos(theta), r * np.sin(theta)])
y = np.logical_or(theta < np.pi, theta >= 2 * np.pi)
X[y == 0, 0] += 1
X[y == 0, 1] += 0.5

R = np.array([[0, -1], [1, 0]])

X_rotated = X.dot(R.T)

X_train, X_test, y_train, y_test = train_test_split(
    X_rotated, y, test_size=0.20, random_state=random_state
)

f, ax = plt.subplots(nrows=1, ncols=1, figsize=(5, 5))
plt.scatter(X_rotated[:, 0], X_rotated[:, 1], c=y, marker="o", s=12)
plt.xlabel("X_1")
plt.ylabel("X_2")
plt.show()
```



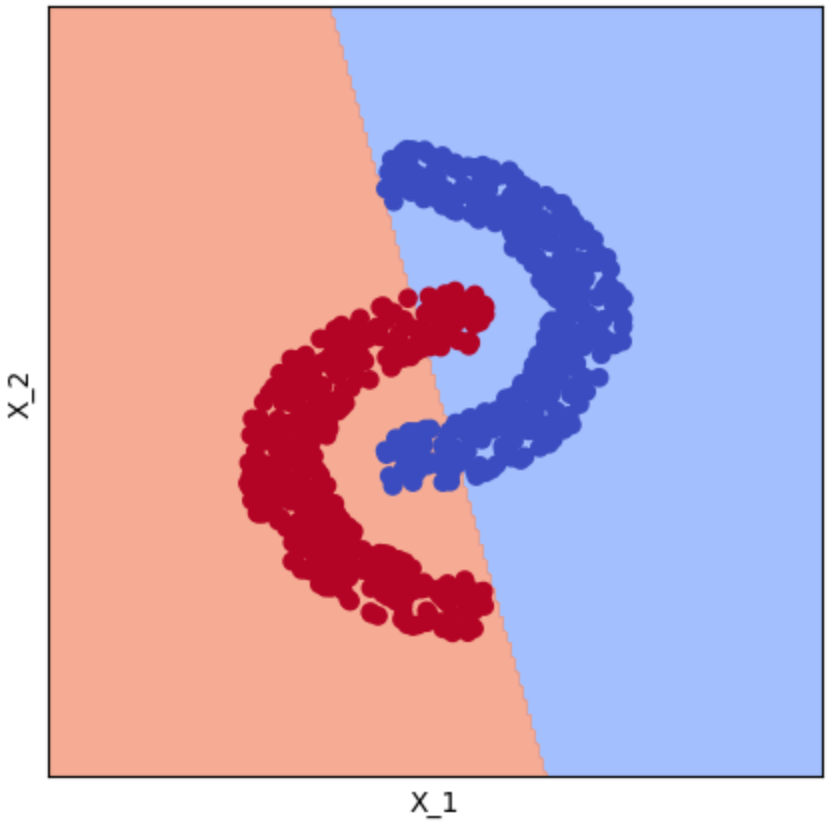
In [ ]:
```
##############################
### DO NOT CHANGE THIS CELL ###
##############################


def visualize_decision_boundary(X, y, feature_new=None, h=0.02):
    """
    You don't have to modify this function

    Function to vizualize decision boundary

    feature_new is a function to get X with additional features
    """
    x1_min, x1_max = X[:, 0].min() - 1, X[:, 0].max() + 1
    x2_min, x2_max = X[:, 1].min() - 1, X[:, 1].max() + 1
    xx_1, xx_2 = np.meshgrid(np.arange(x1_min, x1_max, h), np.arange(x2_min,

    if X.shape[1] == 2:
        Z = svm_cls.predict(np.c_[xx_1.ravel(), xx_2.ravel()])
    else:
        X_conc = np.c_[xx_1.ravel(), xx_2.ravel()]
        X_new = feature_new(X_conc)
        Z = svm_cls.predict(X_new)
    Z = Z.reshape(xx_1.shape)

    f, ax = plt.subplots(nrows=1, ncols=1, figsize=(5, 5))
    plt.contourf(xx_1, xx_2, Z, cmap=plt.cm.coolwarm, alpha=0.8)
    plt.scatter(X[:, 0], X[:, 1], c=y, cmap=plt.cm.coolwarm)
    plt.xlabel("X_1")
    plt.ylabel("X_2")
    plt.xlim(xx_1.min(), xx_1.max())
    plt.ylim(xx_2.min(), xx_2.max())
    plt.xticks(())
    plt.yticks(())

    plt.show()
```

```
[codecarbon INFO @ 04:36:40] Energy consumed for RAM : 0.007064 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:36:40] Energy consumed for all CPUs : 0.011777 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:36:40] 0.018840 kWh of electricity used since the begi
nning.
```

In [ ]:
```
##############################
### DO NOT CHANGE THIS CELL ###
##############################
# Try to fit a linear classifier to the dataset


svm_cls = svm.LinearSVC()
svm_cls.fit(X_train, y_train)
y_test_predicted = svm_cls.predict(X_test)

print("Accuracy on test dataset: {}".format(accuracy_score(y_test, y_test_pr
```

```
visualize_decision_boundary(X_train, y_train)
```

```
Accuracy on test dataset: 0.865
```




```
[codecarbon INFO @ 04:36:43] Energy consumed for RAM : 0.007114 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:36:43] Energy consumed for all CPUs : 0.011859 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:36:43] 0.018972 kWh of electricity used since the begi
nning.
```

We can see that we need a non-linear boundary to be able to successfully classify data in this dataset. By mapping the current feature x to a higher space with more features, linear SVM could be performed on the features in the higher space to learn a non-linear decision boundary. In feature.py, modify create_nl_feature() to add additional features which can help classify in the above dataset. After creating the additional features use code in the further cells to see how well the features perform on the test set.

**Note:** You should get a test accuracy above 85%

**Hint:** Think of the shape of the decision boundary that would best separate the above points. What additional features could help map the linear boundary to the non-linear one? Look at this for a detailed analysis of doing the same for points separable with a circular boundary

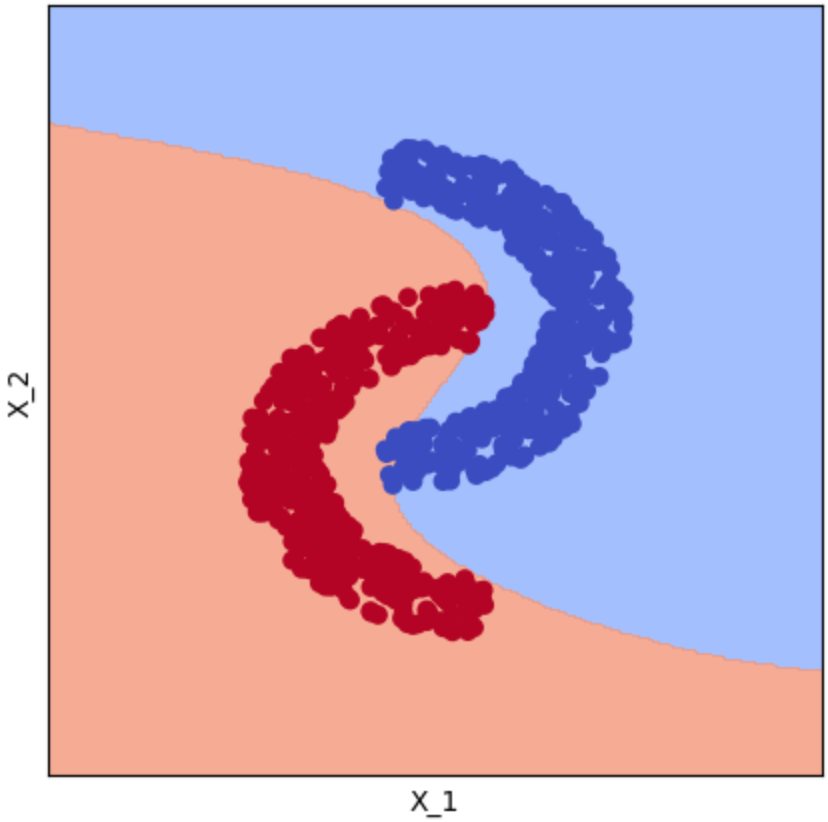
**TODO:** Implement the **create_nl_feature** function in **feature.py**. There are many possible solutions to producing a decision boundary; think creatively!

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
from feature import create_nl_feature

X_new = create_nl_feature(X_rotated)
X_train, X_test, y_train, y_test = train_test_split(
    X_new, y, test_size=0.20, random_state=random_state
)
```

```
[codecarbon INFO @ 04:48:10] Energy consumed for RAM : 0.007639 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:10] Energy consumed for all CPUs : 0.012735 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:10] 0.020374 kWh of electricity used since the begi
nning.
```

In [ ]:
```
################################
### DO NOT CHANGE THIS CELL ###
################################
# Fit to the new features and vizualize the decision boundary
# You should get more than 90% accuracy on test set

svm_cls = svm.LinearSVC(dual=True)
svm_cls.fit(X_train, y_train)
y_test_predicted = svm_cls.predict(X_test)

print("Accuracy on test dataset: {}".format(accuracy_score(y_test, y_test_pr

visualize_decision_boundary(X_train, y_train, create_nl_feature)
```

```
Accuracy on test dataset: 0.99
```




```
[codecarbon INFO @ 04:48:13] Energy consumed for RAM : 0.007689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:13] Energy consumed for all CPUs : 0.012817 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:13] 0.020506 kWh of electricity used since the begi
nning.
```

In [ ]:
```
tracker.stop()
```

```
[codecarbon WARNING @ 04:48:15] Tracker already stopped !
[codecarbon WARNING @ 04:48:15] Background scheduler didn't run for a long p
eriod (682s), results might be inaccurate
[codecarbon INFO @ 04:48:15] Energy consumed for RAM : 0.007568 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:15] Energy consumed for all CPUs : 0.012615 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:15] 0.020183 kWh of electricity used since the begi
nning.
```

Out[ ]:
```
0.009171023399815 66
```

```
[codecarbon INFO @ 04:48:25] Energy consumed for RAM : 0.007651 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:25] Energy consumed for all CPUs : 0.012756 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:25] 0.020407 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:48:28] Energy consumed for RAM : 0.007701 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:28] Energy consumed for all CPUs : 0.012838 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:28] 0.020539 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:48:40] Energy consumed for RAM : 0.007664 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:40] Energy consumed for all CPUs : 0.012777 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:40] 0.020441 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:48:43] Energy consumed for RAM : 0.007714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:43] Energy consumed for all CPUs : 0.012859 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:43] 0.020573 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:48:55] Energy consumed for RAM : 0.007676 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:55] Energy consumed for all CPUs : 0.012798 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:55] 0.020474 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:48:58] Energy consumed for RAM : 0.007726 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:48:58] Energy consumed for all CPUs : 0.012880 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:48:58] 0.020606 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:10] Energy consumed for RAM : 0.007689 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:49:10] Energy consumed for all CPUs : 0.012818 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:10] 0.020507 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:13] Energy consumed for RAM : 0.007739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:49:13] Energy consumed for all CPUs : 0.012901 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:13] 0.020639 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:25] Energy consumed for RAM : 0.007701 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:49:25] Energy consumed for all CPUs : 0.012839 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:25] 0.020541 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:28] Energy consumed for RAM : 0.007751 kWh. RAM Pow
er : 3.0 W
```

```
[codecarbon INFO @ 04:49:28] Energy consumed for all CPUs : 0.012921 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:28] 0.020673 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:40] Energy consumed for RAM : 0.007714 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:49:40] Energy consumed for all CPUs : 0.012860 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:40] 0.020574 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:43] Energy consumed for RAM : 0.007764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:49:43] Energy consumed for all CPUs : 0.012942 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:43] 0.020706 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:55] Energy consumed for RAM : 0.007726 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:49:55] Energy consumed for all CPUs : 0.012881 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:55] 0.020607 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:49:58] Energy consumed for RAM : 0.007776 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:49:58] Energy consumed for all CPUs : 0.012963 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:49:58] 0.020739 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:10] Energy consumed for RAM : 0.007739 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:10] Energy consumed for all CPUs : 0.012902 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:50:10] 0.020641 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:13] Energy consumed for RAM : 0.007789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:13] Energy consumed for all CPUs : 0.012984 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:50:13] 0.020773 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:25] Energy consumed for RAM : 0.007751 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:25] Energy consumed for all CPUs : 0.012923 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:50:25] 0.020674 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:28] Energy consumed for RAM : 0.007801 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:28] Energy consumed for all CPUs : 0.013005 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:50:28] 0.020806 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:40] Energy consumed for RAM : 0.007764 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:40] Energy consumed for all CPUs : 0.012943 kWh. To
tal CPU Power : 5.0 W
```

```
[codecarbon INFO @ 04:50:40] 0.020707 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:43] Energy consumed for RAM : 0.007814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:43] Energy consumed for all CPUs : 0.013026 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:50:43] 0.020839 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:55] Energy consumed for RAM : 0.007776 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:55] Energy consumed for all CPUs : 0.012964 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:50:55] 0.020741 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:50:58] Energy consumed for RAM : 0.007826 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:50:58] Energy consumed for all CPUs : 0.013047 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:50:58] 0.020873 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:51:10] Energy consumed for RAM : 0.007789 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:10] Energy consumed for all CPUs : 0.012985 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:10] 0.020774 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:51:13] Energy consumed for RAM : 0.007839 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:13] Energy consumed for all CPUs : 0.013067 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:13] 0.020906 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:51:25] Energy consumed for RAM : 0.007801 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:25] Energy consumed for all CPUs : 0.013006 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:25] 0.020807 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:51:28] Energy consumed for RAM : 0.007851 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:28] Energy consumed for all CPUs : 0.013088 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:28] 0.020939 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:51:40] Energy consumed for RAM : 0.007814 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:40] Energy consumed for all CPUs : 0.013027 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:40] 0.020841 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:51:43] Energy consumed for RAM : 0.007864 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:43] Energy consumed for all CPUs : 0.013109 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:43] 0.020973 kWh of electricity used since the begi
nning.
```

```
[codecarbon INFO @ 04:51:55] Energy consumed for RAM : 0.007826 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:55] Energy consumed for all CPUs : 0.013048 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:55] 0.020874 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:51:58] Energy consumed for RAM : 0.007876 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:51:58] Energy consumed for all CPUs : 0.013130 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:51:58] 0.021006 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:52:10] Energy consumed for RAM : 0.007839 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:52:10] Energy consumed for all CPUs : 0.013068 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:52:10] 0.020907 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:52:13] Energy consumed for RAM : 0.007889 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:52:13] Energy consumed for all CPUs : 0.013151 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:52:13] 0.021039 kWh of electricity used since the begi
nning.
[codecarbon INFO @ 04:52:25] Energy consumed for RAM : 0.007851 kWh. RAM Pow
er : 3.0 W
[codecarbon INFO @ 04:52:25] Energy consumed for all CPUs : 0.013089 kWh. To
tal CPU Power : 5.0 W
[codecarbon INFO @ 04:52:25] 0.020941 kWh of electricity used since the begi
nning.
```