I. Coding Challenge

Problem Overview:

As a research scientist, you are working on the solving the problem of identifying 5 different objects: **"bed", "chair", "desk", "monitor",** and **"table"** from a given set of 3D point cloud data collected from an indoor environment.

You are asked to work with an available dataset, ModelNet10, which contains all these objects. You are tasked with building a predictive model to differentiate between the objects. The following instructions in the form of subtasks are available to you as a guide for succeeding in the overall task.

SubTask 1.
Download the ModelNet10 dataset using the following '**wget'** command such as below:

```
wget http://3dvision.princeton.edu/projects/2014/3DShapeNets/ModelNet10.zip
```

The above will download a zipped file, you will need to unzip it using the '**unzip'** command.

Implement a function **read_files()** to read the required data from the downloaded 'ModelNet10' dataset folder, which may take filename as input argument.

SubTask 2:
Implement a function **sample_uniform()** to uniformly sample 1024 data points from the point cloud objects. Also, implement a method **pc_transforms()** that takes the original point cloud samples and returns normalized and randomly rotated tensors as its output.

SubTask 3:

Define the **model** that you are using to solve the task. The model needs to be able to process the 3D data format. You may implement any appropriate **loss function** and **optimizer** for your model training.

Write function **train()** to load and train the data that you obtained after completing the Subtask 2 above. The train() method may take the model, train data loader, number of epochs as input arguments. A **sample** function definition is as provided below:

```
def train(model, train_loader, val_loader=None,  epochs=5, save=True)
      # run training and validation loop
      # save trained model
```

Finally, implement a method **evaluate()** to return the value of an evaluation metric when evaluating the trained model on the validation data. You may choose any appropriate metric for evaluation.

You are welcome to use Python classes, objects and methods in any manner as well as the following libraries in your submission:

```
os
numpy
glob
math
itertools
random
path
torch
torchvision
sklearn
opencv
tensorflow
keras
```

NOTE: You are free to use any other Python libraries **for your own purposes** while solving the problem, such as for visualizing the data. If for any reason, you do need any other library *outside* of the above listed in your submission, **please provide a brief explanation**.

II. Discussion

Question 1.
Please discuss the results you obtained. In what way could you **improve** your final results?

Question 2.
Imagine a scenario where you are asked to identify some other objects, not present within the 5 categories you have trained your model on. What **metrics** would you use to decide whether the object belongs to a novel category, outside of those in your training data?

III. Submission Guidelines

You are required to create a **private Github repository** to host your code, and add the following ids: **erikchwang, tanmana5** to have access. You may use Google colaboratory to run/test your code.

Please make sure you add a **requirements file** to your repository, with the package requirements. Additionally, please provide a brief **README** file in the repo, that explains how to run your code. You may also provide your answers to the questions in the "**Discussion**" section in the README file.

In case you have any questions, please contact us through email:

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Wish you good luck! ☺