Report Date: 06/24/2022
To:

- ematson@purdue.edu
- ahsmith@purdue.edu
- lhiday@purdue.edu
- lee3450@purdue.edu
- wang4070@purdue.edu

From: TN

- Eunyoung Bang (yeong35@kangwon.ac.kr)
- Yeongmin Seo (dudals1003@cu.ac.kr)
- Jeongyoun Seo (201810773@sangmyung.kr)
- Raymond Zeng (zeng172@purdue.edu)
- Aminata Niang(aminata.niang@telecom-sudparis.eu)

Summary

- The training code for CNN will be finished.
- The methodology is finished to write.

What TN completed this week

- The training code for CNN will be finished.

```
34  # CNN example
35  class ClassifireCNN(nn.Module):
36      def __init__(self, drop_out=0.0):
37          super(ClassifireCNN, self).__init__()
38          self.cnn1 = nn.Conv1d(in_channels=20, out_channels=8, kernel_size=5, padding=2)
39          self.cnn2 = nn.Conv1d(in_channels=8, out_channels=4, kernel_size=5, padding=2)
40          self.cnn3 = nn.Conv1d(in_channels=4, out_channels= 1, kernel_size=5, padding=2)
41
```

Fig 1. Example code of CNN model

- Train.py is added to argparse code.

```
def parse_args():
    parser = argparse.ArgumentParser()

    parser.add_argument('-lr', dest='lr', help='learning rate value', default=0.0001, type=float)
    parser.add_argument('-dropout', dest='dropout', help='drop out', default=0.3, type=float)
    parser.add_argument('-epochs', dest='epochs', help='epochs', default=100, type=int)
    parser.add_argument('-batch', dest='batch', help='batch', default=16, type=int)
    parser.add_argument('-dataset', dest='dataset', help='dataset', default="./dataset", type=str)
    parser.add_argument("--test", dest='test',action="store_true", help="Use model test")
    parser.add_argument('-model_weights', dest='model_weights', help='model path', default='./models/cnn_model_1.0.h5')
    args = parser.parse_args()
    return args
```

Fig 2. argparse function.

- The methodology is finished.

- Audio Split code is written.
    - Cut all of the yellow lines in a fast velocity sound dataset.

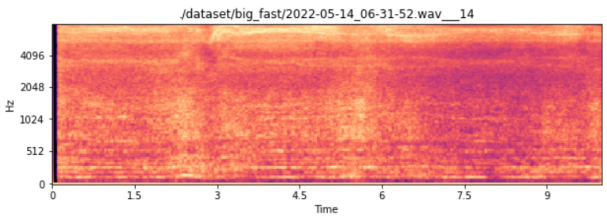

Fig 3. Before cutting yellow lines.

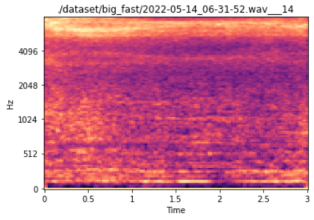

Fig 4. After cutting yellow lines.

- Learn about Machine Learning and Git [1], [2], [3], [4]
    - The recommendation system is a type of information filtering (IF), and is a system that recommends information that a specific user will be interested in. There are algorithms such as collaborative filtering (CF), content-based filtering (CB), and knowledge-based filtering (KB). CF is a method of analyzing users' consumption patterns and recommending the tastes of consumers in the group. Since consumers are classified and recommended in groups, there is an advantage that individual consumers do not need to explain reviews of all products.
    - Stochastic gradient descent, and Map Reduce for viewing with large dataset sets are efficient to proceed with machine learning using large dataset. The existing gradient descent becomes too high in cost when turning a large dataset. Therefore, the use of gradient descent for some randomly extracted data rather than the entire data is called stoichiometric gradient descent.
      Map Reduce is a distributed programming model for processing large dataset, which is divided into MAPs that combine related data into a set and reduce that removes duplication from the set and extracts the desired data.
    - Large-scale machine learning setting can be called online learning. Online learning trains the system by dividing the data into small batches called mini-batch. Therefore, it is suitable for systems that require continuous data acceptance and rapid adaptation due to fast learning steps and low cost.
    - The basic functions and basic terms about deep learning algorithms, such as Perceptron Algorithm, NN (Neural Network), Sigmoid function, Step function, Matrix multiplication, 3-layer NN, etc.
        - Perceptron Algorithm
            - The Origin of Neural Network (deep learning algorithm), If the above is changed to a function format, it is as follows.

$$y = \begin{cases} 0 & (w_1x_1 + w_2x_2 \leq \theta) \\ 1 & (w_1x_1 + w_2x_2 > \theta) \end{cases}$$

        - Neural Network (NN)
            - NN has the ability to automatically learn appropriate values of weight parameters from data (or datasets).
            - If the above is changed to a function format, it is as follows.

$$y = h(b + w_1x_1 + w_2x_2)$$

$$h(x) = \begin{cases} 0 & (x \leq 0) \\ 1 & (x > 1) \end{cases}$$

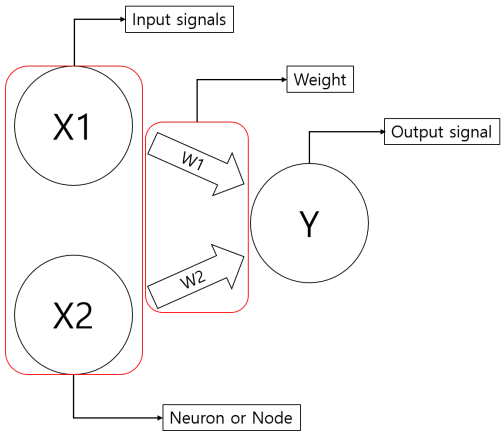

Fig 5. Perceptron Algorithm

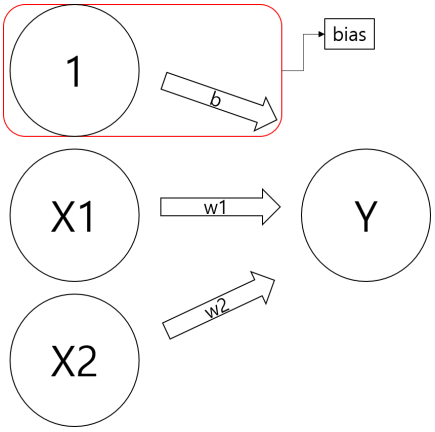

Fig 6. Neural Network

- Activation function
  - This function has the role of determining whether the sum of the input signals causes the activation.
  - If the above is changed to a function format, it is as follows.

    $$y = h(a), a = b + w_1x_1 + w_2x_2$$
- Sigmoid function
  - Nonlinear function, Curved function.
  - Output changes to integers (0.xx ~ 0.xx) with zero boundaries.
  - This function is usually used at NN.

    $$h(x) = \frac{1}{1 + \exp(-x)}$$
- Step function
  - Nonlinear function, Straight line function.
  - Output changes to integers (0, 1) with zero boundaries.

```
def step_function(x):
    y = x > 0
    return y.astype(np.int)
```

- Rectified Linear Unit (ReLU) function
  - A function that outputs as it is as a real number if the input value is greater than zero; if the input value is less than or equal to zero, output zero

    $$h(x) = \begin{cases} 0 & (x \leq 0) \\ x & (x > 1) \end{cases}$$

```
def ReLU:
    return np.maximum(0, x)
```

- 3-layer neural network
  - 3 types of layers: Input layer — initial data for the neural network. Hidden layers — intermediate layer between input and output layer and place where all the computation is done. Output layer — produce the result for given inputs.
  - In Neural Network, using the sigmoid function as an activation function to translate the signals, and transport that signals to the next neuron.

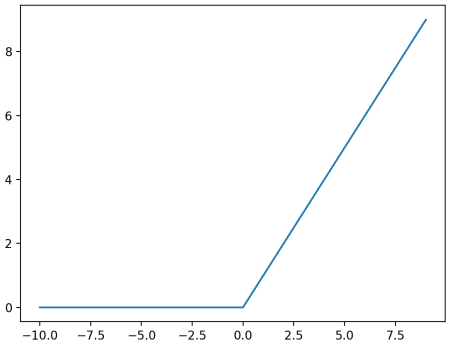

Fig 7. ReLU function graph

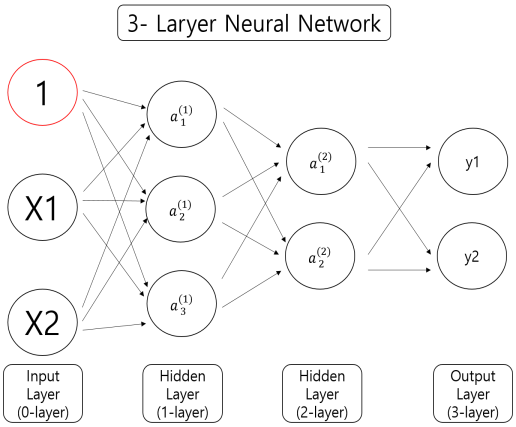

Fig 8. 3-layer Neural Network

Things to do by next week

- Compare the difference between the slow and fast velocity sound.
- Show results of the Machine Learning models.

Problems or challenges:

- ‘X5SW’ drone can’t fly faster than 10mph at a stable altitude, ‘X8SW’ drone charger has not arrived yet. Therefore, TN struggled with collecting datasets
- After cutting the yellow lines (an obvious feature that ML can classify easily), re-experiment results were still 100% of accuracy.
  - Have to check the Machine Learning code that may contain some error.

References

[1] holehouse, “Stanford Machine Learning”, holehouse.org. http://www.holehouse.org/mlclass/ (accessed June. 02, 2022)

[2] Coding Everybody, “지옥에서 온 Git (새 수업으로 대체)”, opentutorials.org. https://opentutorials.org/course/2708 (accessed June. 16, 2022)

[3] Deep Learning from scratch 1, 13t ed., Hanbit Publishing Netw., Seodaemun-gu, Seoul, Korea, 2021, pp.25-

[4] oreilly-japan, “deep-learning-from-scratch”, github.com. https://github.com/oreilly-japan/deep-learning-from-scratch (accessed June. 24, 2022)