Team 06 DUMBO Final Report

Topic: Digit recognition

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Digit recognition is a prominent topic in computer vision. Initially, we planned to create a program that recognizes different fruits by looking at pictures. However, we encountered difficulties in selecting distinguishing features for each fruit. As a result, to differentiate ourselves from others, we decided to pursue a new approach of our own. Rather than creating a program that recognizes numbers in images, we opted to create a program where we personally write the numbers in real-time and then have the system recognize and interpret those handwritten digits.

**Outline of program**

**1. User Interface:** The program utilizes Pygame to create a graphical user interface (GUI). It initializes a Pygame window where users can draw numbers using their mouse cursor in real-time.

**2. Functionality:**

* **Drawing Numbers:** Users can draw numbers on the Pygame window by clicking and dragging the mouse cursor.
* **Recognition:** The program includes a recognition feature that identifies handwritten numbers in real-time. Upon clicking the "check" button, the drawn number is captured, saved as an image ("drawing.png"), and then passed through a pre-trained Convolutional Neural Network (CNN) model for recognition.
* **Buttons:**
  + "check": Initiates the recognition process.
  + "reset": Clears the drawing area and resets the recognized number.
  + "X" (Quit): Closes the Pygame window and exits the program.

**3. Machine Learning Model:**

* The main program **ia.py** includes the definition and training of a complex CNN model using PyTorch. The trained model is used for digit recognition.
* The **load\_and\_recognize\_digit** function preprocesses the drawn image, loads the pre-trained CNN model, and predicts the handwritten digit.

**Design of program**

**1. Pygame Setup:**

* The Pygame window is set up with a drawing area for users to input numbers, along with buttons ("check," "reset," and "X" for quitting).

**2. Interface Features:**

* The drawing area allows users to draw numbers using the mouse cursor.
* Button functionalities are implemented using event handling:
  + "check" button: Captures the drawn number, initiates recognition, and displays the recognized digit.
  + "reset" button: Clears the drawing area and resets the recognized digit.
  + "X" button: Closes the Pygame window and exits the program.

**3. Machine Learning Integration:**

* Utilizes a pre-trained complex CNN model (defined and trained in **ia.py**) for digit recognition.
* Recognition process:
  + Captures the drawing as an image ("drawing.png").
  + Processes the image using OpenCV and transforms it into a format suitable for the CNN model.
  + Uses the pre-trained model to predict and recognize the handwritten digit.

**4. Overall Flow:**

* Initialize Pygame window and drawing area.
* User draws a number on the drawing area.
* Upon clicking the "check" button, the drawn number is captured, saved, processed, and recognized using the pre-trained CNN model.
* The recognized digit is displayed on the screen.

The program effectively combines graphical user interface development (Pygame), real-time drawing functionalities, and integration with a machine learning model for digit recognition.

**The project timeline**

Nov.3~ Nov.15: We discussed about topic

Nov.16: We splitted the work

Yosra – implement the CNN Class

Brice – implement the training function

Seokhyun – implement digit recognition function

Joel – implement the Pygame(main function)

Nov17~Nov.30: We studied autonomously and coded within part we was assigned to  
Dec.01~Dec.02: We merged our code, and optimized it.

**Design process of group discussion(Picture and Capture image of Kakao Talk, etc.)**

텍스트, 스크린샷, 소프트웨어, 웹사이트이(가) 표시된 사진

자동 생성된 설명 텍스트, 전자제품, 스크린샷, 소프트웨어이(가) 표시된 사진

자동 생성된 설명

**Team’s thoughts on this project**

Joel- I thoroughly enjoyed the project, particularly its profound exploration of deep learning and the adept handling of images to transform them into data for artificial intelligence

Yosra - I really enjoyed working on this project for its freedom to choose a topic. We had to find a subject that is interesting and useful, bridging theory and practice. Working with friends added a dynamic and enjoyable dimension to the experience.

Brice - The start of the project was difficult because we took a long time to find a theme that we would all like, but after different meetings we all decided to go on the subject of digit recognition.

This project was very interesting because in comparison of what we did during the semester we were able to use a deep learning framework, which was Pytorch, in addition of using the knowledge that we built during the semester.

I really enjoyed working on it thanks to the project idea that I found interesting and also because of all I could learn about deep learning.

In addition, I'm really happy about the fact that we were able to implement our digit recognition code in a little game using Pygame.

I thoroughly enjoyed the experience and the insight of deep learning that it gave me.

Seokhyun – At first, as a global team, we struggled with communication. However, fueled by our passion for the project, we communicated with each other in limited English, determined a topic, and diligently performed coding tasks within our respective areas. We felt proud witnessing our trained program accurately recognizing digits upon the completion of the project