Notebook To Notepad

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Problem Statement

- Keyboarding remains the most common way of inputting data into computers. This is probably the most time consuming and labor intensive operation.
- **Notebook To Notepad** would enable the user to electronically search, store and edit data, which is in handwritten form originally.
- Handwritten notes, such as letters, school notes, diaries, meeting minutes, grocery lists, recipes etc. can be converted into text, available for use in any digital platform.

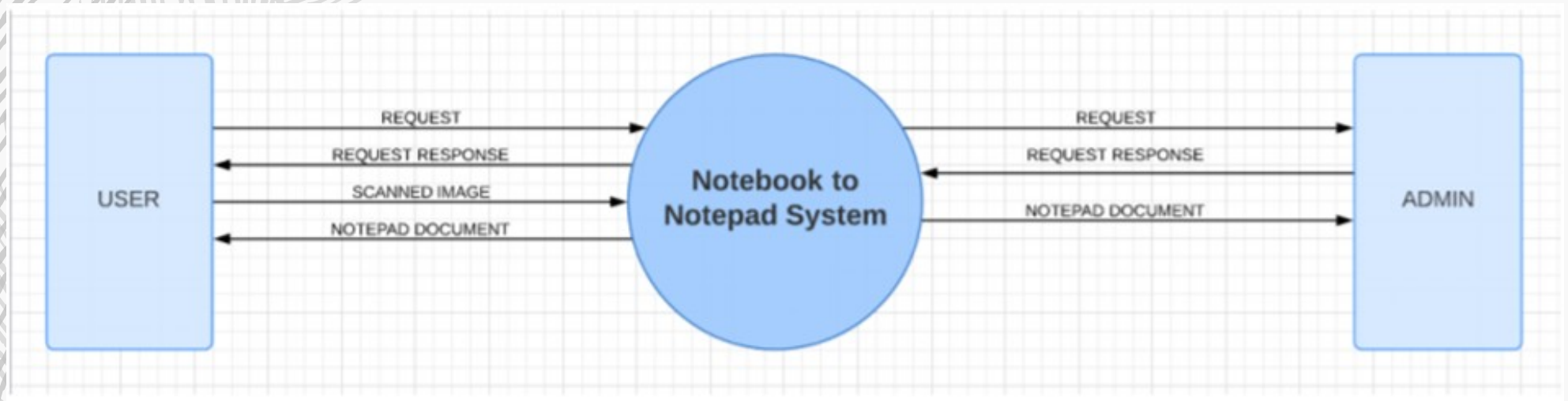
Our Contribution

- We have developed a model to input an image, read its contents, and return the most likely interpretation of that sentence.
- To avoid spelling errors we have used autocorrect, which is an inbuilt library in python.
- SCOPE: our current model is limited to reading a single line only. In the future, we aim to implement segmentation, to enable our model to read multiple lines.

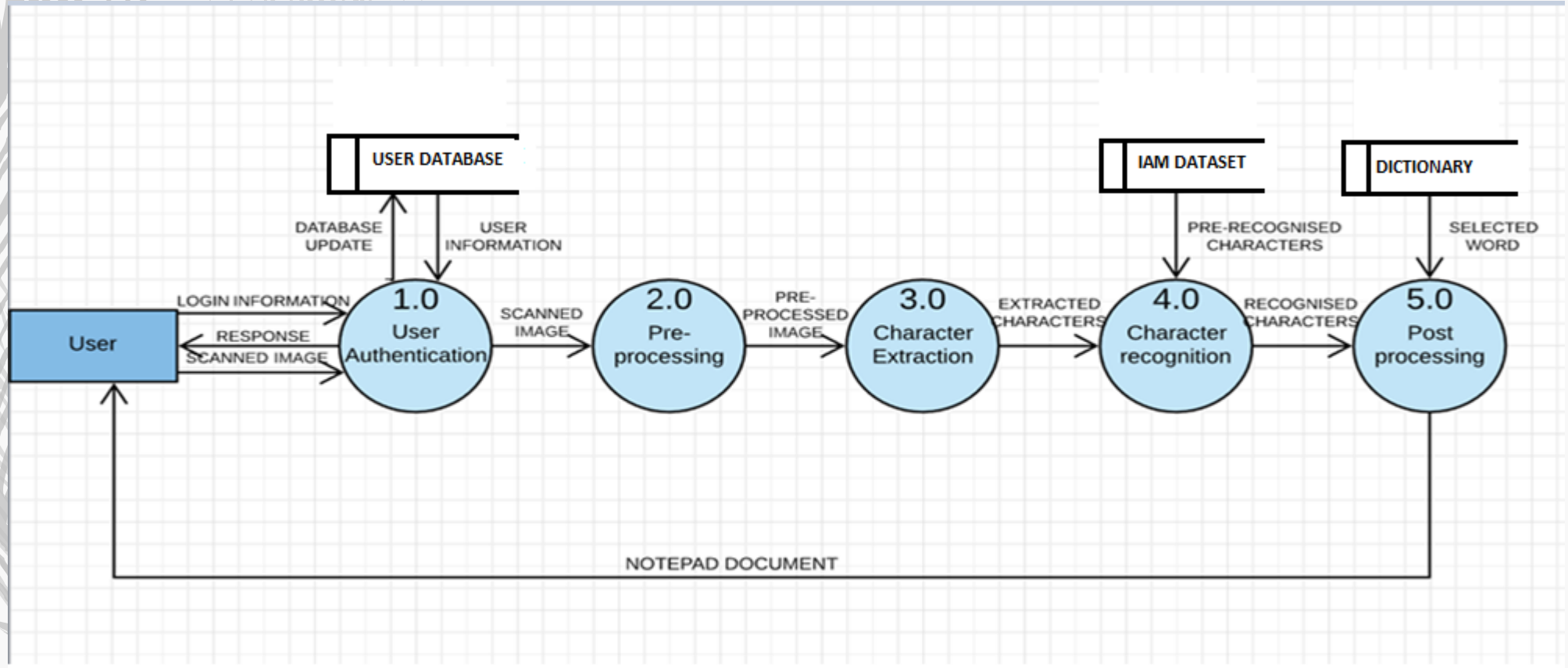
Technical Requirements

- The front-end is made using HTML and CSS.
- The login page and the corresponding database is made using Django and Postgres.
- The deep learning model is implemented using TensorFlow. It has 7 CNN layers and 2 RNN layers.
- Training has been done on the IAM Dataset.

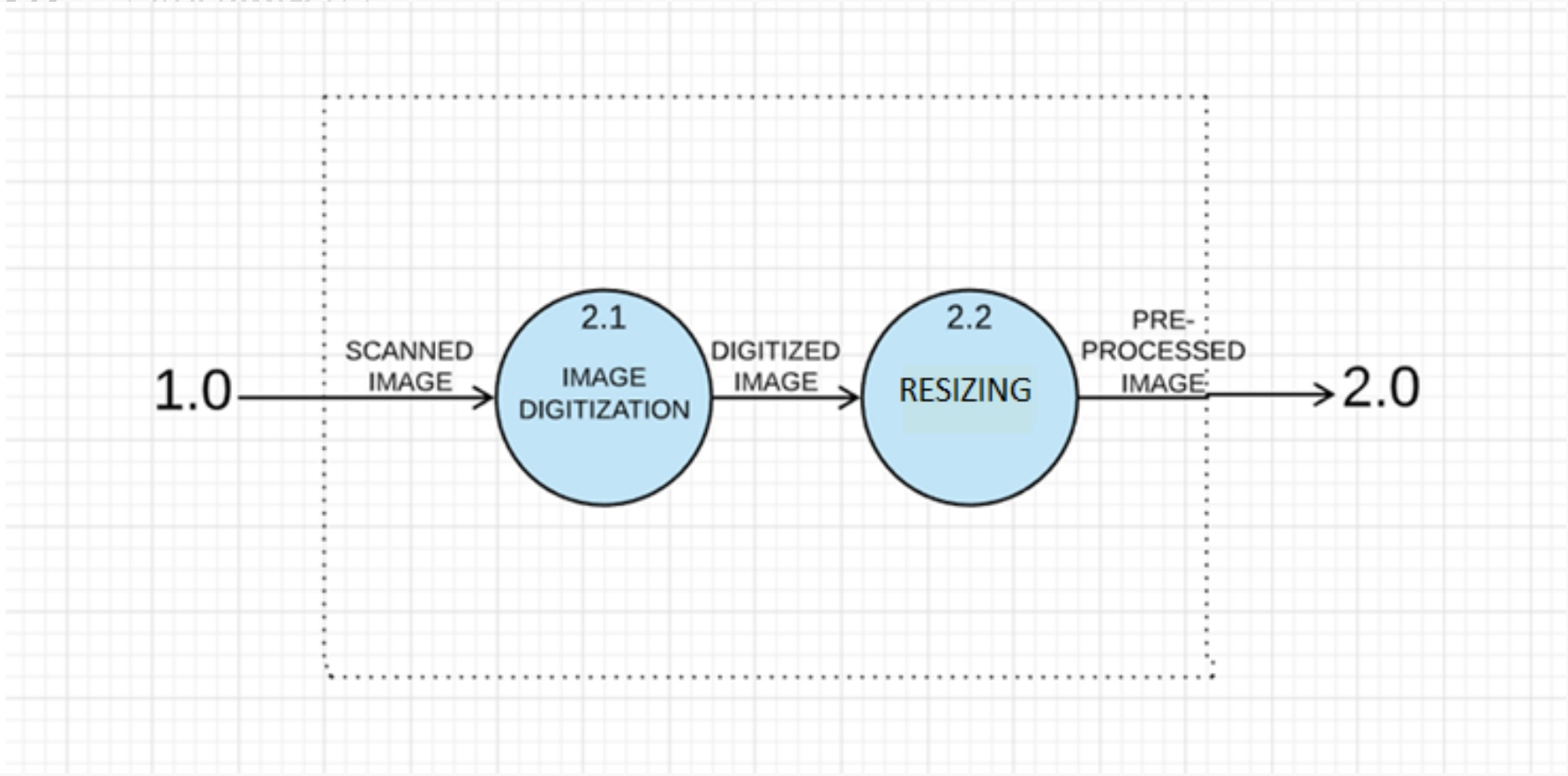
Data Flow Diagram Level - 0



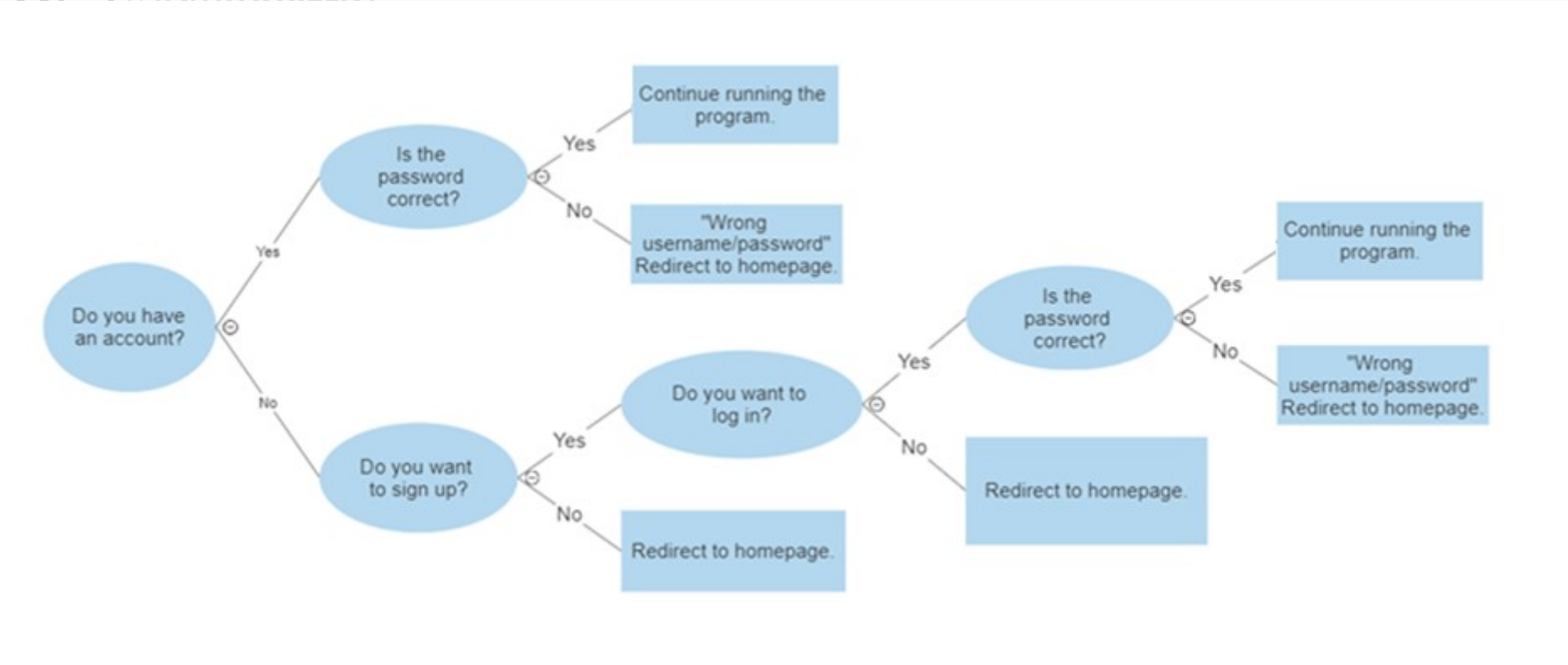
Data Flow Diagram Level - 1



Data Flow Diagram Level - 2



Decision Tree



Data Dictionary - Processes

- **LEVEL 0**

1. **Process Name:** Notebook To Notepad System

- **Description:** It takes a scanned image as the input, converts the text of this image to digitized form, stores it as a notepad file, and then gives the notepad document as the output.
- **Inbound Data Flow:** User request, scanned image, request response
- **Outbound Data Flow:** Request response, Notepad document

– **LEVEL 1**

2. **Process Name:** User Authentication (1.0)

– **Description:** It authenticates the login information of the user and updates the User database.

– **Inbound Data Flow:** Login information, scanned image, user information

– **Outbound Data Flow:** Response, Database update, Scanned image

3. **Process Name:** Pre-processing (2.0)

– **Description:** It pre-processes the scanned image. It removes noise and reduces size of the image.

– **Inbound Data Flow:** Scanned image

– **Outbound Data Flow:** Pre-processed image

4. **Process Name:** Character Extraction (3.0)

- **Description:** The pre-processed image serves as the input to this and each single character in the image is found out.
- **Inbound Data Flow:** Pre-processed image
- **Outbound Data Flow:** Extracted characters

5. **Process Name:** Character Recognition (4.0)

- **Description:** The image from the extraction stage is correlated with all the templates which are preloaded into the system. Once the correlation is completed, the template with the maximum correlated value is declared as the character present in the image.
- **Inbound Data Flow:** Extracted characters, pre-recognised characters
- **Outbound Data Flow:** Recognised characters

6. **Process Name:** Post-processing (5.0)

- **Description:** If there are some unrecognised characters found, those characters are given their meaning in the post-processing stage. Word beam search is applied to find the best fitting word.
- **Inbound Data Flow:** Recognised characters, selected word
- **Outbound Data Flow:** Notepad document

– **LEVEL 2**

1. **Process Name:** Image Digitisation (2.1)

– **Description:** Converts the scanned image to digitised form.

– **Inbound Data Flow:** Scanned image

– **Outbound Data Flow:** Digitised image

2. **Process Name:** Noise Removal (2.2)

– **Description:** It removes unwanted noise from the image, which would lead to better learning by the neural network.

– **Inbound Data Flow:** Digitized image

– **Outbound Data Flow:** Pre-processed image

Data Flows

1. **Data Flow Name:** Login information
   - **Description:** It contains the username and password of that user.
   - **From Process:** NA
   - **To Process:** 1.0 User Authentication
   - **Data Structure:** User details

2. **Data Flow Name:** Response

- **Description:** It tells whether the user has been granted access or not.
- **From Process:** 1.0 User Authentication
- **To Process:** NA
- **Data Structure:** Negative/Affirmative

3. **Data Flow Name:** Database Update

- **Description:** It updates the User Database whenever a new user creates an account.
- **From Process:** 1.0 User Authentication
- **To Process:** NA
- **Data Structure:** User details

4. **Data Flow Name:** User Information

- **Description:** It contains the actual password and details of said user. Its values is compared with Login Information to find out Response.
- **From Process:** NA
- **To Process:** 1.0 User Authentication
- **Data Structure:** User details

5. **Data Flow Name:** Scanned Image

- **Description:** It is the scanned image input by the user whose digitised form will be returned.
- **From Process:** 1.0 User Authentication
- **To Process:** 2.0 Pre-processing
- **Data Structure:** Location in system

6. **Data Flow Name:** Digitised Image

- **Description:** It converts the scanned imaged to digitised form.
- **From Process:** 2.1 Image Digitisation
- **To Process:** 2.2 Noise Removal
- **Data Structure:** Matrix of pixel values

7. **Data Flow Name:** Pre-processed Image

- **Description:** It is the pre-processed image, which has reduced size and removed noise.
- **From Process:** 2.0 Pre-processing
- **To Process:** 3.0 Character Extraction
- **Data Structure:** Matrix of pixel values

8. **Data Flow Name:** Extracted Characters

- **Description:** It is a list of all the characters that have been found in that image.
- **From Process:** 3.0 Character Extraction
- **To Process:** 4.0 Character Recognition
- **Data Structure:** List of characters

9. **Data Flow Name:** Pre-recognised Characters

- **Description:** These characters are from the IAM Dataset and were used to train the Neural Network model.
- **From Process:** NA
- **To Process:** 4.0 Character Recognition
- **Data Structure:** List of characters

10. **Data Flow Name:** Recognised Characters

- **Description:** These are the recognised characters of the image, obtained after comparing the pixel values of the image to the pre-recognised characters.
- **From Process:** 4.0 Character Recognition
- **To Process:** 5.0 Post-processing
- **Data Structure:** String of recognized words

11. **Data Flow Name:** Selected Word

- **Description:** This is the word selected from the dictionary after applying word beam search.
- **From Process:** NA
- **To Process:** 5.0 Post-processing
- **Data Structure:** String of words after autocorrect

12. **Data Flow Name:** Notepad Document

- **Description:** This is the final output which is returned to the user.
- **From Process:** 5.0 Post-processing
- **To Process:** NA
- **Data Structure:** Notepad file

DATA STORES

1. **Data Store Name:** User Database

– **Description:** It contains information about the user, including his name, username and password.

– **Inbound Data Flow:** Database Update

– **Outbound Data Flow:** User Information

– **Volume:** Growing

– **Access:** Can be accessed only by the admin

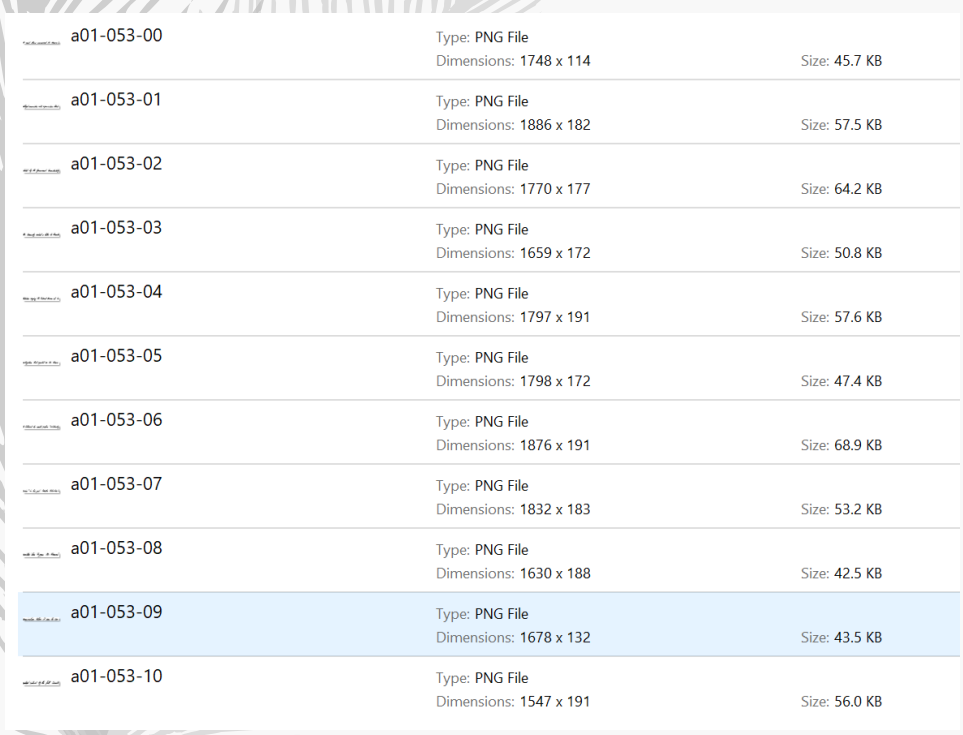
– **Data Description:**

- first_name varchar(100)
- last_name varchar(100)
- username varchar(100)
- password varchar(100)

2. **Data Store Name:** IAM Dataset

- **Description:** It contains a set of 115320 words, contributed by 657 writers. It has 1539 pages of scanned text, 5685 sentences and 13353 text lines. A mapping of these images with their corresponding text was created to train the Neural Network.
- **Inbound Data Flow:** NA
- **Outbound Data Flow:** Pre-recognised Characters
- **Volume:** Static
- **Access:** Read-only access while training the model. No access after that.

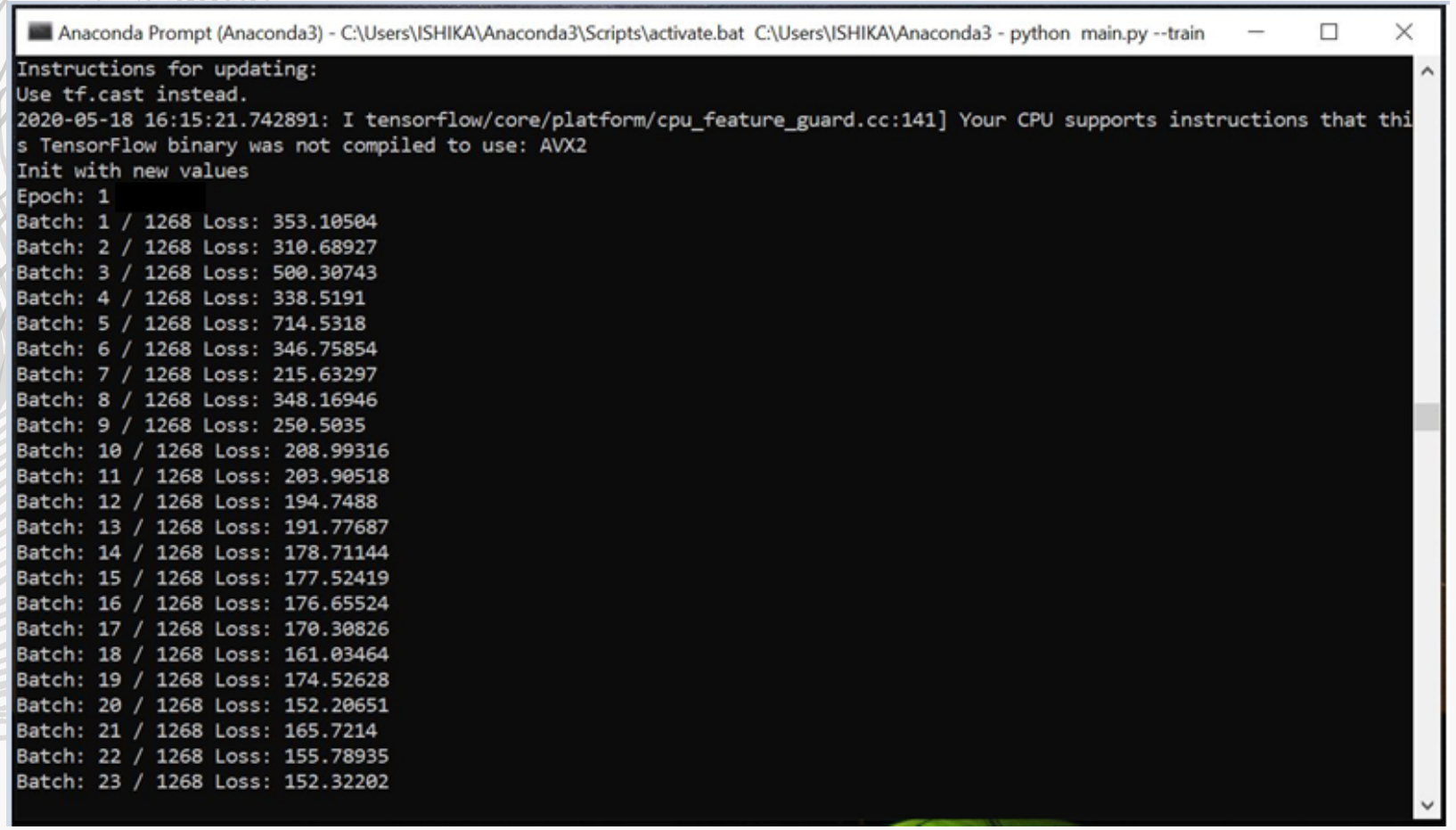
IAM Dataset



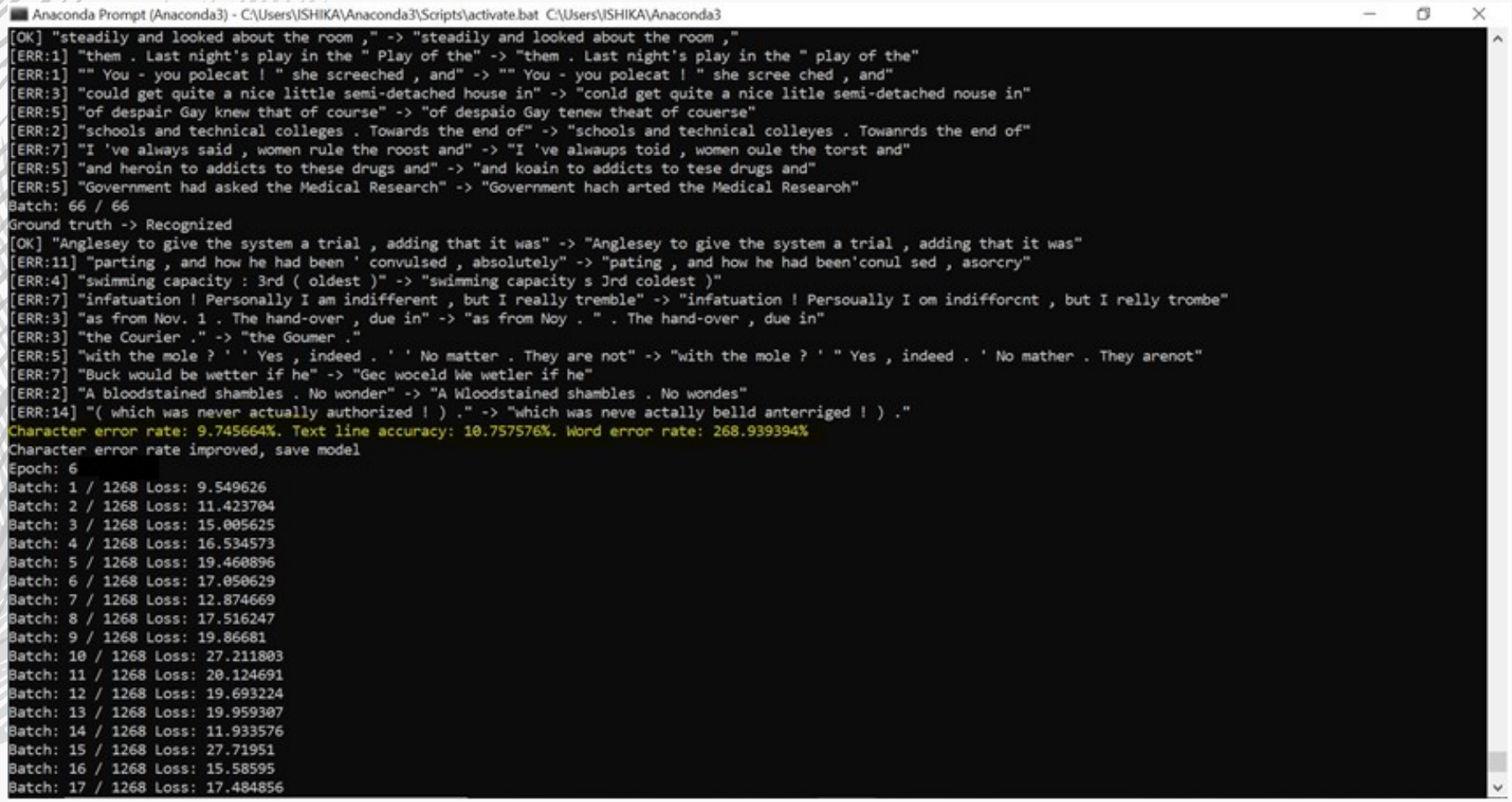
a01-053-00	Type: PNG File Dimensions: 1748 x 114	Size: 45.7 KB
a01-053-01	Type: PNG File Dimensions: 1886 x 182	Size: 57.5 KB
a01-053-02	Type: PNG File Dimensions: 1770 x 177	Size: 64.2 KB
a01-053-03	Type: PNG File Dimensions: 1659 x 172	Size: 50.8 KB
a01-053-04	Type: PNG File Dimensions: 1797 x 191	Size: 57.6 KB
a01-053-05	Type: PNG File Dimensions: 1798 x 172	Size: 47.4 KB
a01-053-06	Type: PNG File Dimensions: 1876 x 191	Size: 68.9 KB
a01-053-07	Type: PNG File Dimensions: 1832 x 183	Size: 53.2 KB
a01-053-08	Type: PNG File Dimensions: 1630 x 188	Size: 42.5 KB
a01-053-09	Type: PNG File Dimensions: 1678 x 132	Size: 43.5 KB
a01-053-10	Type: PNG File Dimensions: 1547 x 191	Size: 56.0 KB

```
a01-000u-00 ok 154 19 408 746 1661 89 A|MOVE|to|stop|Mr.|Gaitskell|from
a01-000u-01 ok 156 19 395 932 1850 105 nominating|any|more|Labour|life|Peers
a01-000u-02 ok 157 16 408 1106 1986 105 is|to|be|made|at|a|meeting|of|Labour
a01-000u-03 err 156 23 430 1290 1883 70 M Ps|tomorrow|.|Mr.|Michael|Foot|has
a01-000u-04 ok 157 20 395 1474 1830 94 put|down|a|resolution|on|the|subject
a01-000u-05 err 156 21 379 1643 1854 88 and|he|is|to|be|backed|by|Mr.|Will
a01-000u-06 ok 159 20 363 1825 2051 87 Griffiths|,|M P|for|Manchester|Exchange|.
a01-000x-00 ok 182 30 375 748 1561 148 A|MOVE|to|stop|Mr.|Gaitskell|from|nominating
a01-000x-01 ok 181 23 382 924 1595 148 any|more|Labour|life|Peers|is|to|be|made|at|a
a01-000x-02 ok 181 30 386 1110 1637 140 meeting|of|Labour|0M Ps|tomorrow|.|Mr.|Michael
a01-000x-03 ok 179 22 375 1276 1584 154 Foot|has|put|down|a|resolution|on|the|subject
a01-000x-04 ok 173 25 397 1458 1647 148 and|he|is|to|be|backed|by|Mr.|Will|Griffiths|,
a01-000x-05 ok 173 16 393 1635 1082 155 0M P|for|Manchester|Exchange|.
a01-003-00 ok 176 31 325 896 1807 139 Though|they|may|gather|some|Left-wing|support|,|a
a01-003-01 ok 176 29 319 1078 1787 126 large|majority|of|Labour|M Ps|are|likely|to
a01-003-02 ok 176 29 315 1259 1744 128 turn|down|the|Foot-Griffiths|resolution|.|Mr.
a01-003-03 ok 176 28 316 1441 1750 70 Foot's|line|will|be|that|as|Labour|M Ps
a01-003-04 ok 161 28 325 1619 1848 113 opposed|the|Government|Bill|which|brought
a01-003-05 ok 176 29 325 1779 1871 143 life|peers|into|existence|,|they|should|not
a01-003-06 ok 176 28 326 1980 1873 126 now|put|forward|nominees|.|He|believes
a01-003-07 ok 161 27 295 2147 1921 129 that|the|House|of|Lords|should|be|abolished
a01-003-08 ok 161 29 317 2318 1849 117 and|that|Labour|should|not|take|any|steps
a01-003-09 err 161 29 313 2509 1975 125 which|would|appear|to|"|prop|up|"|an|out-dated
a01-003-10 ok 161 11 322 2701 363 66 institution|.
a01-003u-00 ok 159 18 357 800 1938 106 Though|they|may|gather|some|Left-wing
a01-003u-01 ok 161 23 366 976 1837 103 support|,|a|large|majority|of|Labour
a01-003u-02 ok 161 21 356 1162 1908 96 M Ps|are|likely|to|turn|down|the|Foot-
a01-003u-03 err 162 24 348 1324 1868 96 Griffiths|resolution|.|Mr.|Foot's|line|will
a01-003u-04 ok 161 13 351 1515 1869 103 be|that|as|Labour|M Ps|opposed|the
a01-003u-05 ok 163 24 335 1693 2000 104 Government|Bill|which|brought|life|peers
a01-003u-06 ok 163 20 322 1878 1995 102 into|existence|,|they|should|not|now|put
```

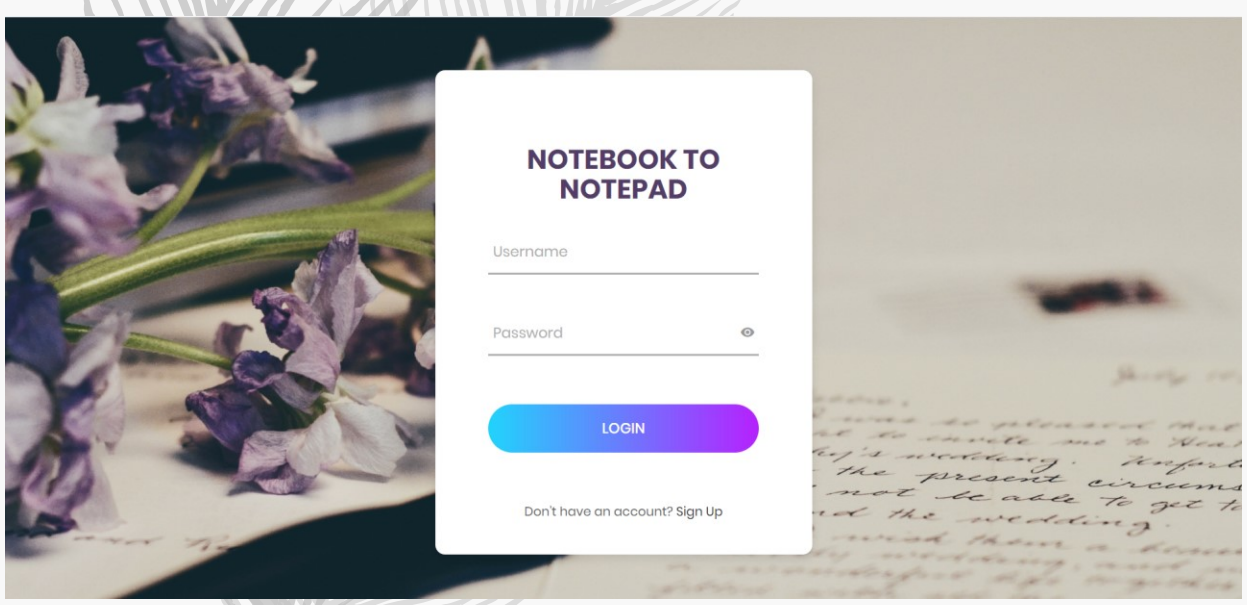
Execution of First Epoch

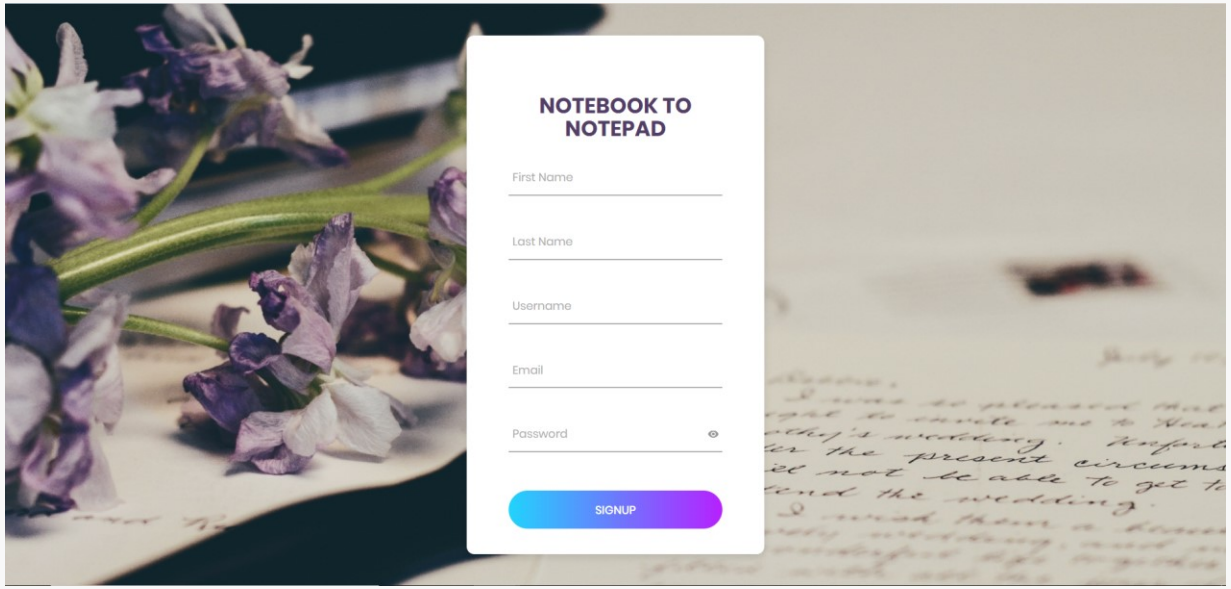


Final Epoch

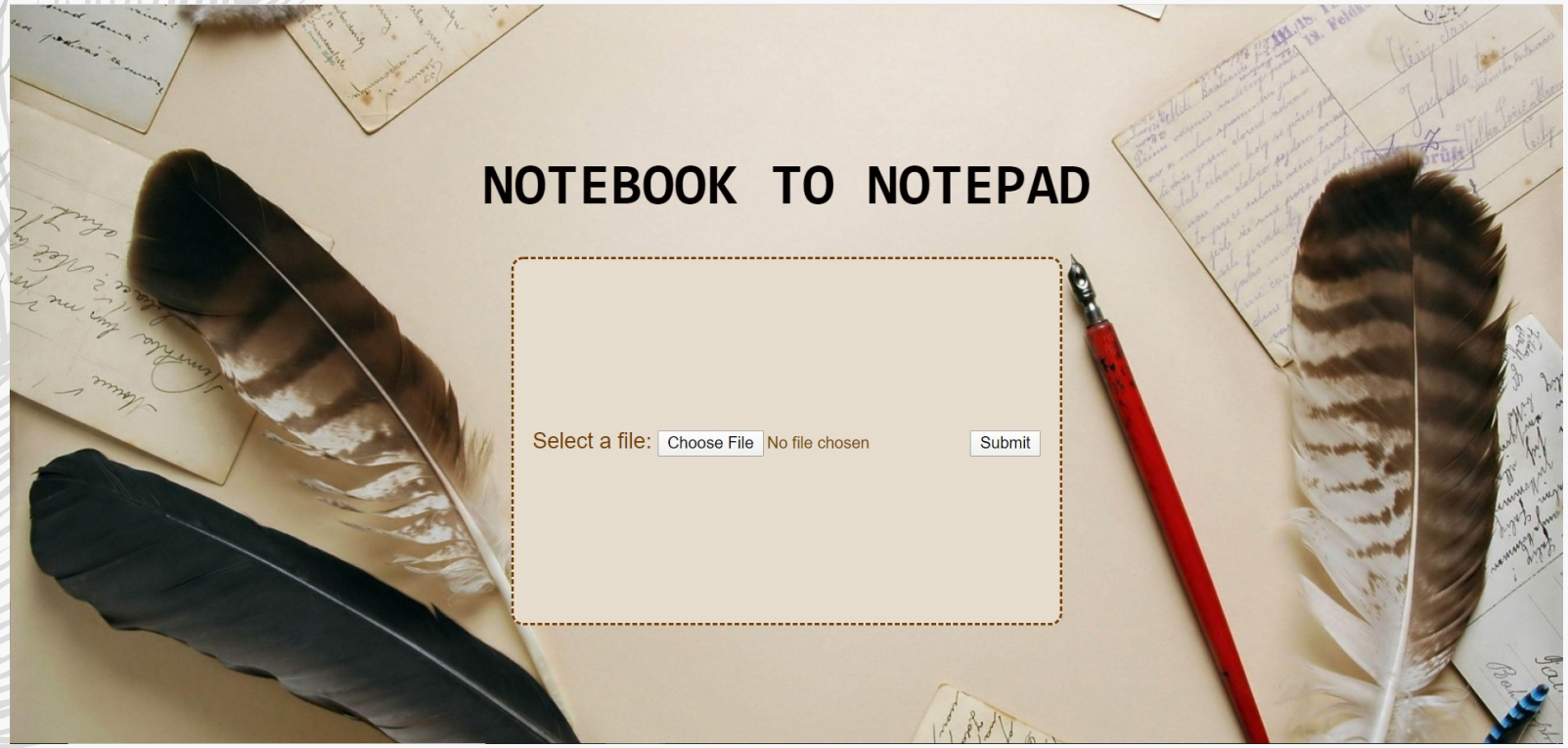

Anaconda Prompt (Anaconda3) - C:\Users\ISHIKA\Anaconda3\Scripts\activate.bat C:\Users\ISHIKA\Anaconda3
[OK] "steadily and looked about the room ," -> "steadily and looked about the room ,"
[ERR:1] "them . Last night's play in the " Play of the" -> "them . Last night's play in the " play of the"
[ERR:1] "" You - you polecat ! " she screeched , and" -> "" You - you polecat ! " she scree ched , and"
[ERR:3] "could get quite a nice little semi-detached house in" -> "conld get quite a nice litle semi-detached nouse in"
[ERR:5] "of despair Gay knew that of course" -> "of despaio Gay tenew theat of couerse"
[ERR:2] "schools and technical colleges . Towards the end of" -> "schools and technical colleyes . Towanrds the end of"
[ERR:7] "I 've always said , women rule the roost and" -> "I 've alwaups toid , women oule the torst and"
[ERR:5] "and heroin to addicts to these drugs and" -> "and koain to addicts to tese drugs and"
[ERR:5] "Government had asked the Medical Research" -> "Government hach arted the Medical Researoh"
Batch: 66 / 66
Ground truth -> Recognized
[OK] "Anglesey to give the system a trial , adding that it was" -> "Anglesey to give the system a trial , adding that it was"
[ERR:11] "parting , and how he had been ' convulsed , absolutely" -> "pating , and how he had been'conul sed , asorcry"
[ERR:4] "swimming capacity : 3rd (oldest)" -> "swimming capacity s Jrd coldest)"
[ERR:7] "infatuation ! Personally I am indifferent , but I really tremble" -> "infatuation ! Persoually I om indifforcnt , but I relly trombe"
[ERR:3] "as from Nov. 1 . The hand-over , due in" -> "as from Noy . " . The hand-over , due in"
[ERR:3] "the Courier ." -> "the Goumer ."
[ERR:5] "with the mole ? ' ' Yes , indeed . ' ' No matter . They are not" -> "with the mole ? ' " Yes , indeed . ' No mather . They arenot"
[ERR:7] "Buck would be wetter if he" -> "Gec woceld We wetler if he"
[ERR:2] "A bloodstained shambles . No wonder" -> "A Wloodstained shambles . No wondes"
[ERR:14] "(which was never actually authorized !) ." -> "which was neve actally belld anterriged !) ."
Character error rate: 9.745664%. Text line accuracy: 10.757576%. Word error rate: 268.939394%
Character error rate improved, save model
Epoch: 6
Batch: 1 / 1268 Loss: 9.549626
Batch: 2 / 1268 Loss: 11.423704
Batch: 3 / 1268 Loss: 15.005625
Batch: 4 / 1268 Loss: 16.534573
Batch: 5 / 1268 Loss: 19.460896
Batch: 6 / 1268 Loss: 17.050629
Batch: 7 / 1268 Loss: 12.874669
Batch: 8 / 1268 Loss: 17.516247
Batch: 9 / 1268 Loss: 19.86681
Batch: 10 / 1268 Loss: 27.211803
Batch: 11 / 1268 Loss: 20.124691
Batch: 12 / 1268 Loss: 19.693224
Batch: 13 / 1268 Loss: 19.959307
Batch: 14 / 1268 Loss: 11.933576
Batch: 15 / 1268 Loss: 27.71951
Batch: 16 / 1268 Loss: 15.58595
Batch: 17 / 1268 Loss: 17.484856

Login/Signup Page





Upload Page


NOTEBOOK TO NOTEPAD
Select a file:
Choose File
No file chosen
Submit

THANK YOU.