MSc Individual Project Progress Report

Michael Song (02405765) on 07 August

Progress before last meeting

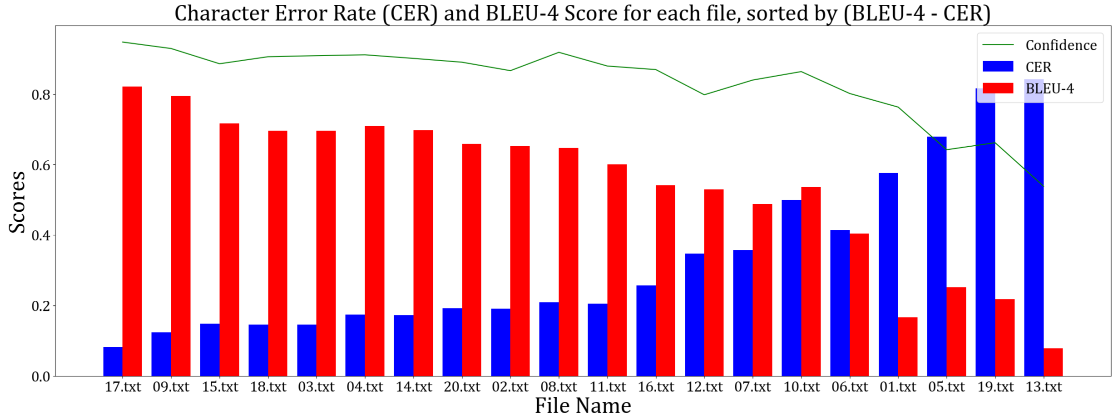
- Background and progress report
- Data collection (journal images with labels)
- Synthetic datasets for training
- Trained following models:
  - Text Line Detector (LD), based on Faster-RCNN
  - Text Line Recognizer (LR), based on CRNN
  - Character Detector (CD), based on Faster-RCNN
  - Character Recognizer (CR), based on Faster-RCNN
  - Character Classifier (CC), based on ResNet
- Compared the performance with following methods:
  - CR
  - CD + CC
  - LD + CR
  - LD + CD + CC
  - LD + LR
- **LD + LR** is better and chosen for further improvement
  - LD performs well on the most common layout.
  - LR only performs well on train/validation set, **but not** on target images.
    - The synthetic training set may not fully matches the target data.
  - Both LD and LR are only trained on vertical text images.
- Manual text extraction performed on 20 images as **testing set**.
- **LD** Model Training:
  - Synthetic dataset with random layouts and icon integration.
  - Extensive data augmentation techniques used.
- **LR** Model Training:
  - Combined vertical and horizontal text, frequency-based character selection.
  - Typeface variety increased from 1 to 4.
  - Extensive data augmentation applied.
- Results:
  - LD and LR can handle diverse text layouts.
  - LD is better at ignoring non-text areas.
  - LR shows reduced over-fitting.
- Metrics:
  - Inference speed: **0.8** sec/image.
  - CER: **0.44**
  - BLEU-4: **0.41**
- Comparison with Baseline:
  - Outperforms Apple's OCR engine in CER and BLEU-4.
- Processed textual data from 35,851 journal images.
- Training pipeline improvement:
  - Typeface variety increased from 4 to 12
  - Wider range of data augmentation
  - LR model architecture adjustment
  - Introduce **word-based** character selection in training data
- Improved result:
  - Average CER improved to **0.33** for 20 images

        - **0.28** for 17 common layout images
        - Less than **0.2** on half of the images
    - Average BLEU-4 improved to **0.55** for 20 images
        - **0.62** for 17 common layout images
- User interface:
    - Load and display image locally
    - Zoom and shift the image
    - Perform OCR on the image
    - Show the results of both detection and recognition
    - Switch between traditional and simplified Chinese

Progress since last meeting

Confidence Scores

- **Idea**: the average output value from the **recognition** model for each character
    - For example, the output text for a file is "ABCD",
    - assuming there are only 4 characters in the database,
    - the raw output from the recognition model may be:
    - [[0.1, 0.2, **0.4**, 0.3], [**0.4**, 0.2, 0.1, 0.3], [0.1, **0.4**, 0.2, 0.3], [0.1, 0.2, 0.3, **0.4**]],
    - the index of the item with the highest **value** will be decoded to character,
    - the average of these **values** will be used as confidence score, which in this case is 0.4
- The prediction with a higher confidence score is theoretically more accurate.
- Relation to other metrics:



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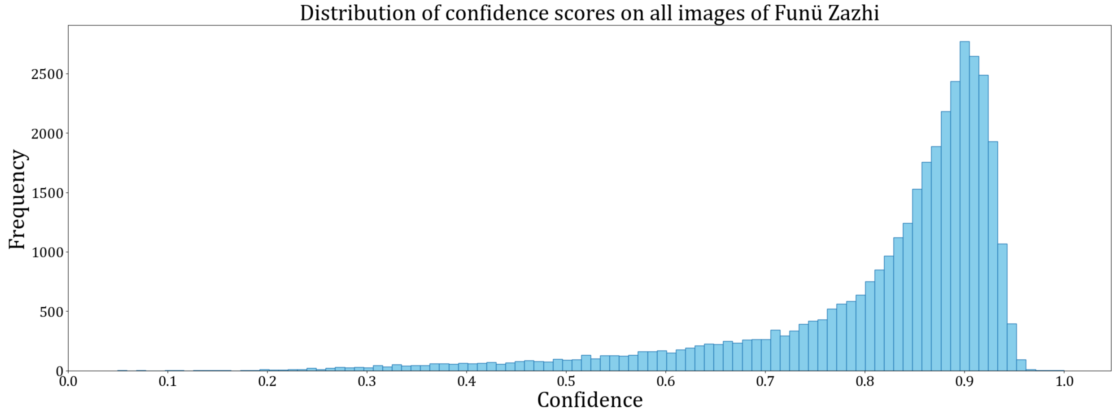
- Distribution of confidence scores on all 36,101 journal pages:



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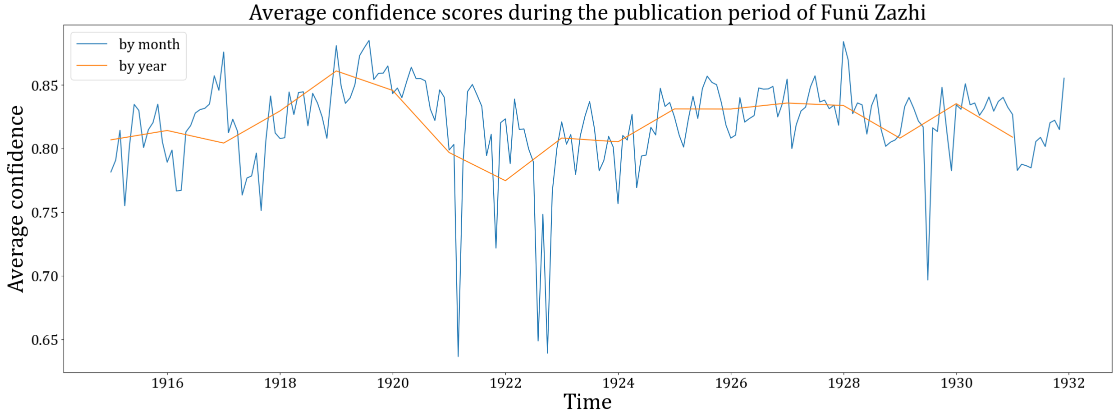
    - Around 30% have a confidence score higher than 0.9 (CER $<$ 0.15 in general)

  - Around 70% have a confidence score higher than 0.8 (CER $<$ 0.20 in general)
- Average confidence scores during the publication period:


Average confidence scores during the publication period of Funü Zazhi

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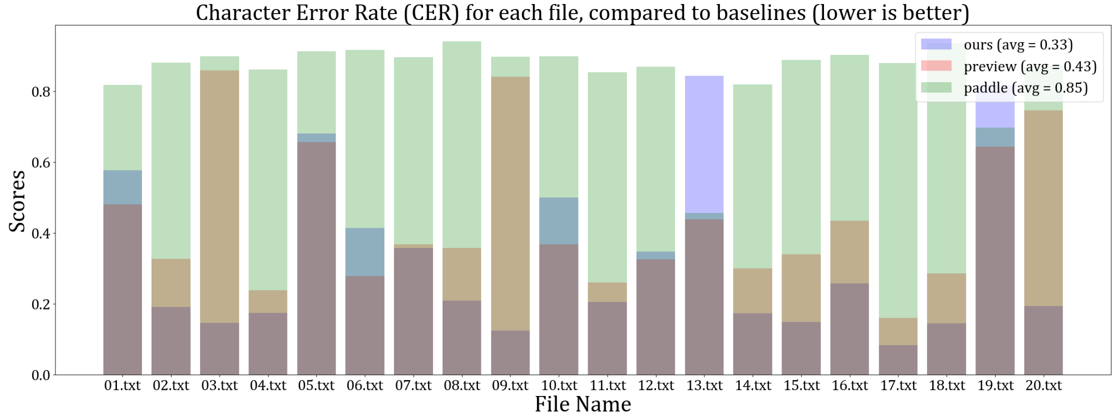
Baseline Comparison

- Apple Preview and PaddleOCR (v4)


Character Error Rate (CER) for each file, compared to baselines (lower is better)

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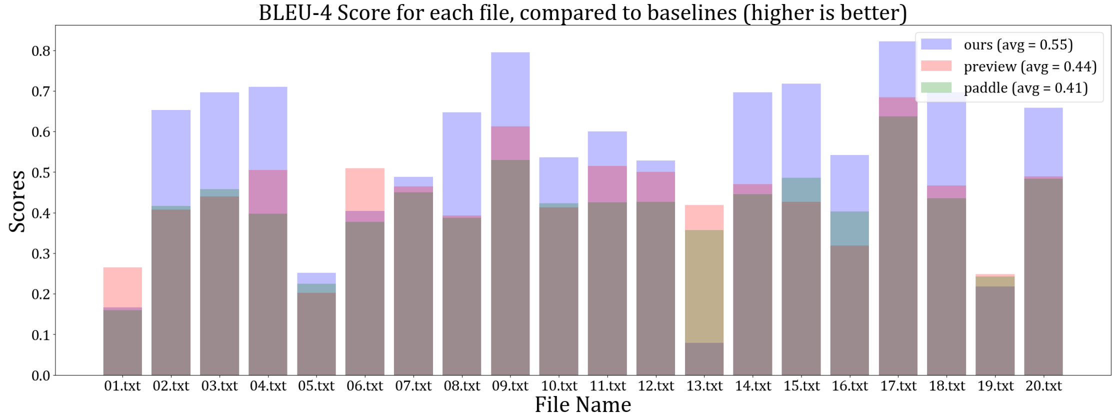
BLEU-4 Score for each file, compared to baselines (higher is better)

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- CER of PaddleOCR is very high as it orders the textlines from left to right
- Our models still lack performance on horizontal text, as the training data is designed to have much more **vertical text** to match the distribution of target data.

Future work

- Final report

Questions

- Report structure