

Handwritten Chinese Character Recognition Using Deep Neural Networks

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Content

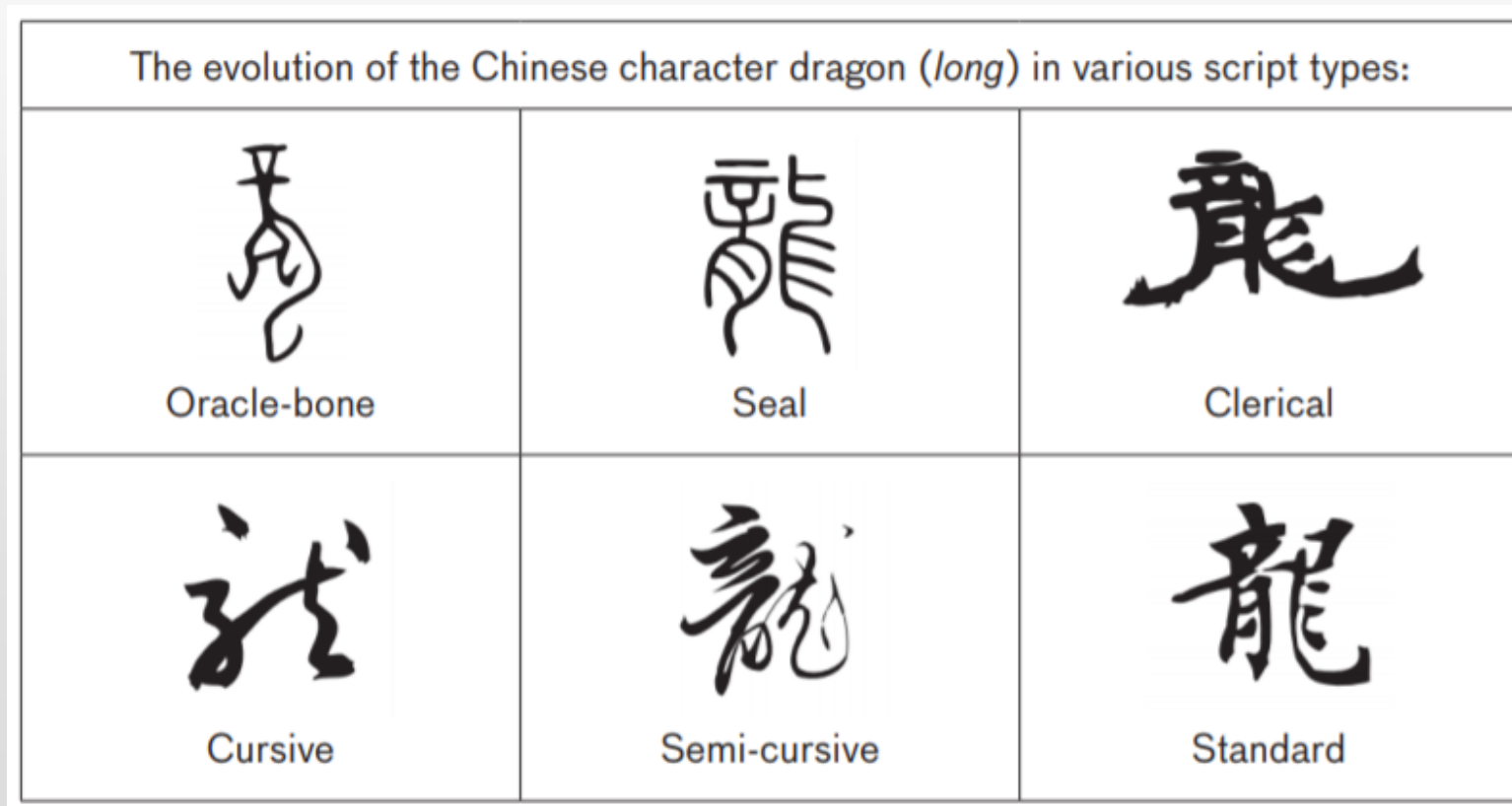
- Introduction
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Introduction

- Worldwide linguistic system
- Large categories problem (3755 classes)
- Challenging research topic

Background of Chinese script (1)

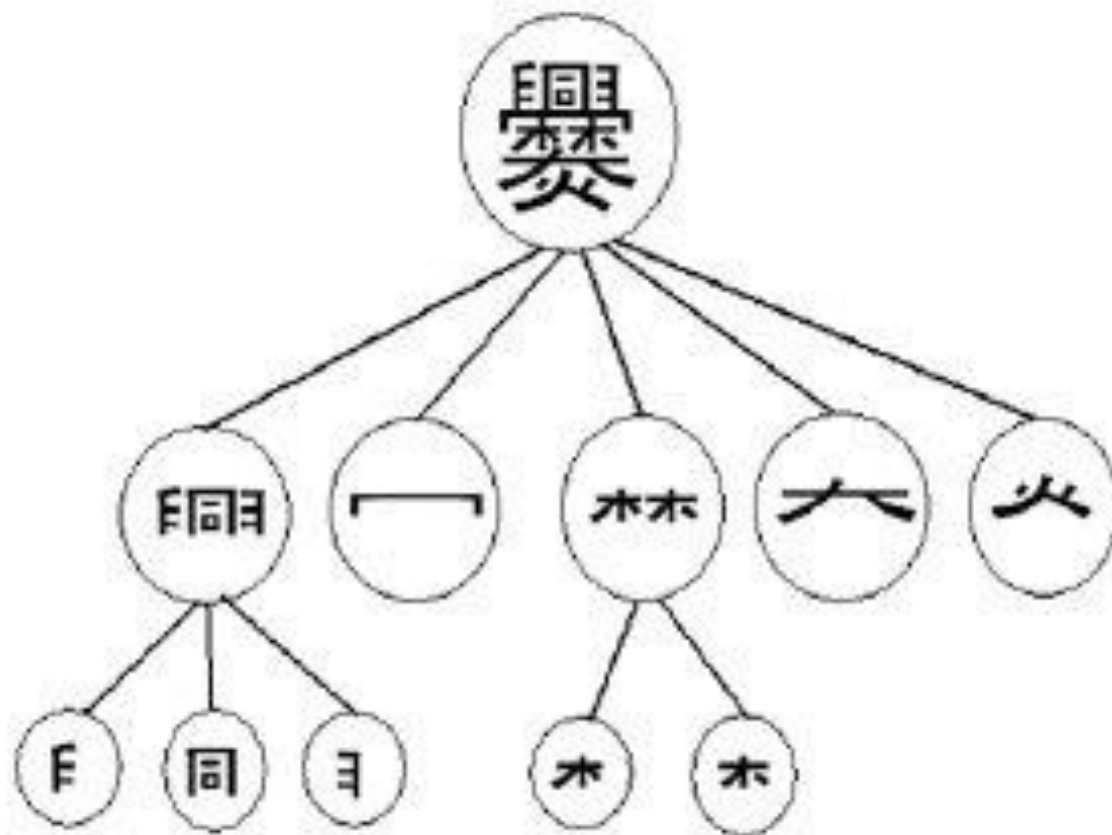
- 3,000-year history
- Diverse scripts



Background of Chinese script (2)

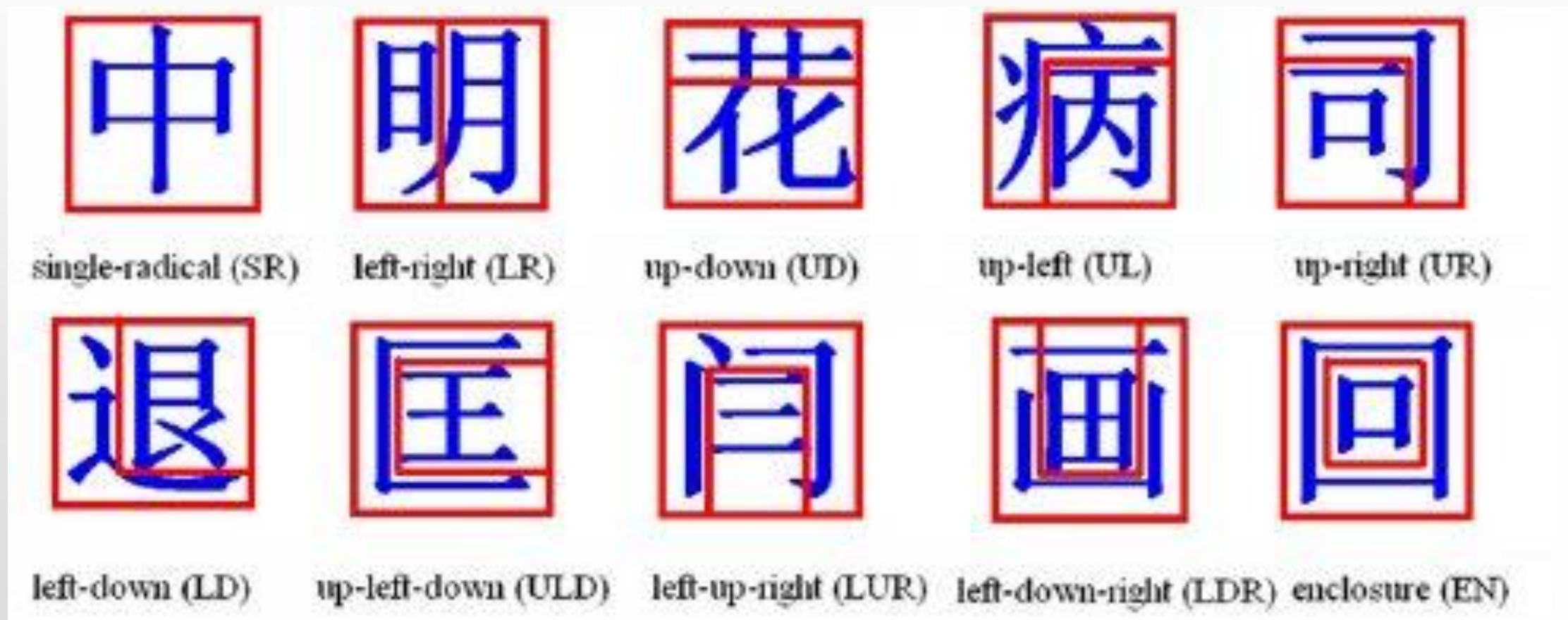
- Consisting of radicals and strokes

| | |
|-----------|---|
| 1-stroke | 一 |
| 1-radical | 乙 |
| 5-stroke | 冉 |
| 1-radical | 母 |
| 6-stroke | 匡 |
| 2-radical | 动 |
| 30-stroke | 爨 |
| 5-radical | |
| 36-stroke | 自 |
| 5-radical | 鼻 |



Background of Chinese script (3)

- Variant structures



Background of Chinese script (4)

- Similar shapes

涎涎
动劫
讽讯
根棍

荏若
待侍
敌故
旬甸

特持
王玉
袭龚
抑柳

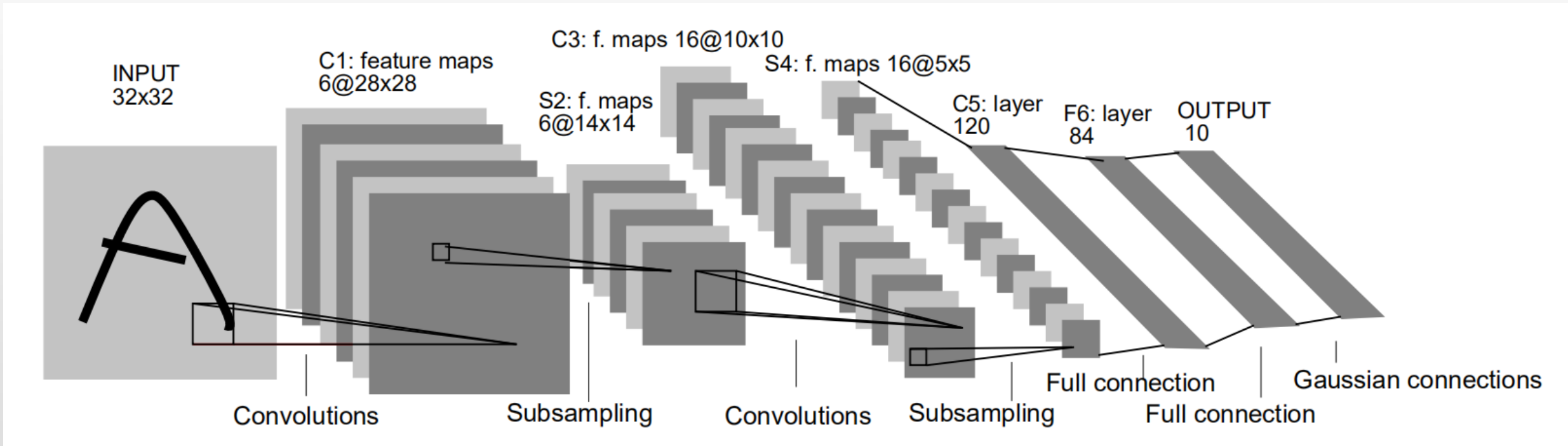
令今
鸟乌
鸣鸣
日日

天夫
又叉
爪瓜
酉西

宜宣
元亢
祝视
戌戌

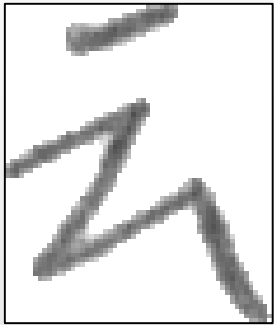
Related work

- An example of CNN, LeNet-5 [2]



Database

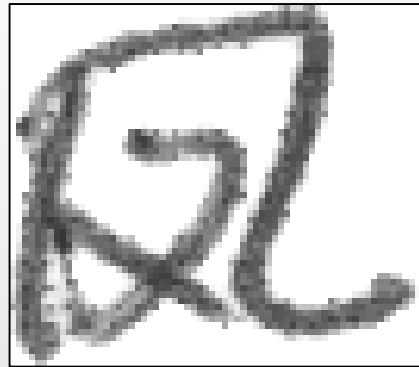
- CASIA HWDB1.1[4]



cloud



rabbit



phoenix



a last name



island

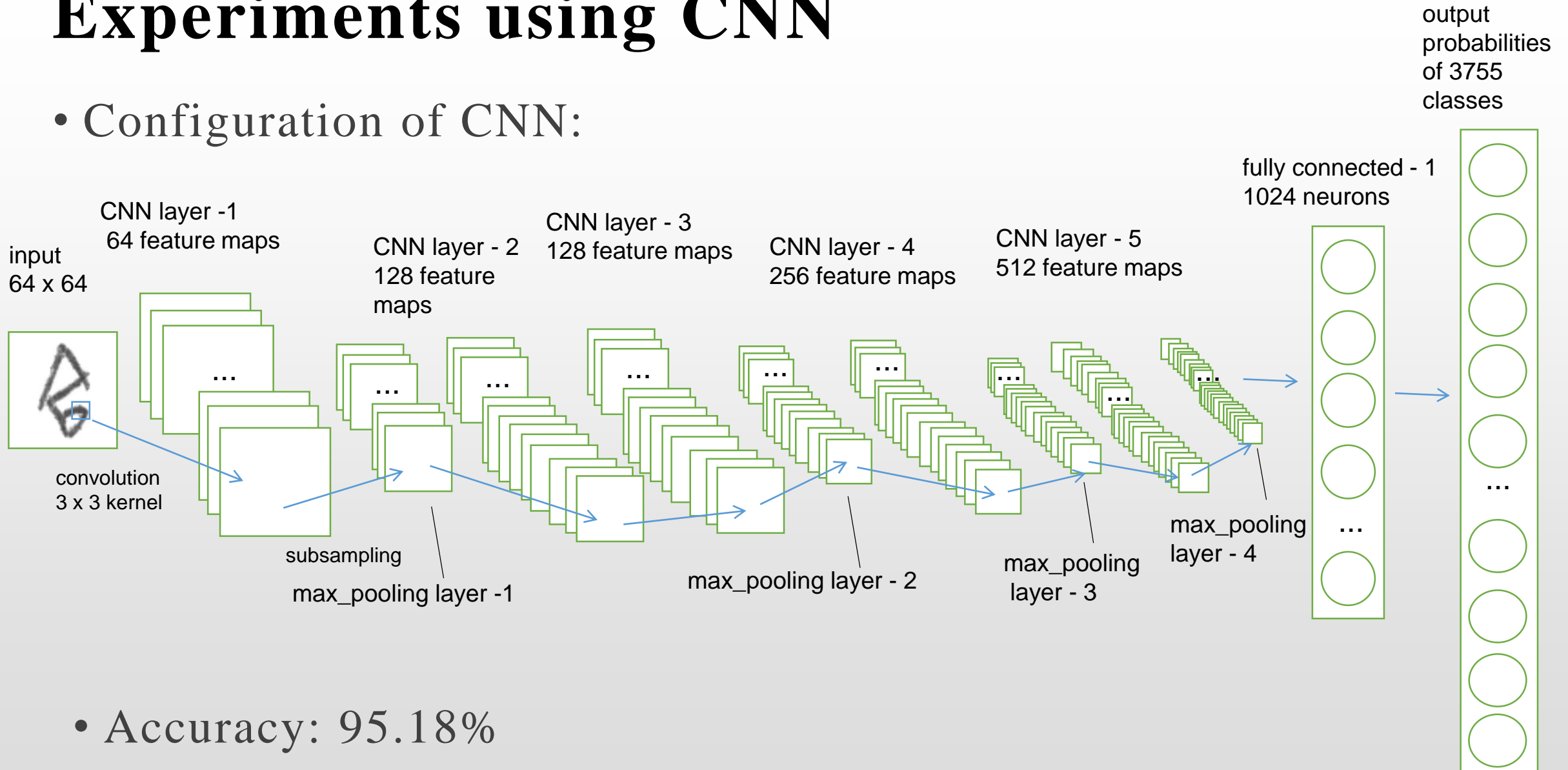


fan

| Database | No. of writers | Training | Test | No. of classes | No. of samples | Training | Test |
|---------------|----------------|----------|------|----------------|----------------|----------|---------|
| CASIA HWDB1.1 | 300 | 240 | 60 | 3755 | 1,121,749 | 897,758 | 223,991 |

Experiments using CNN

- Configuration of CNN:



- Accuracy: 95.18%

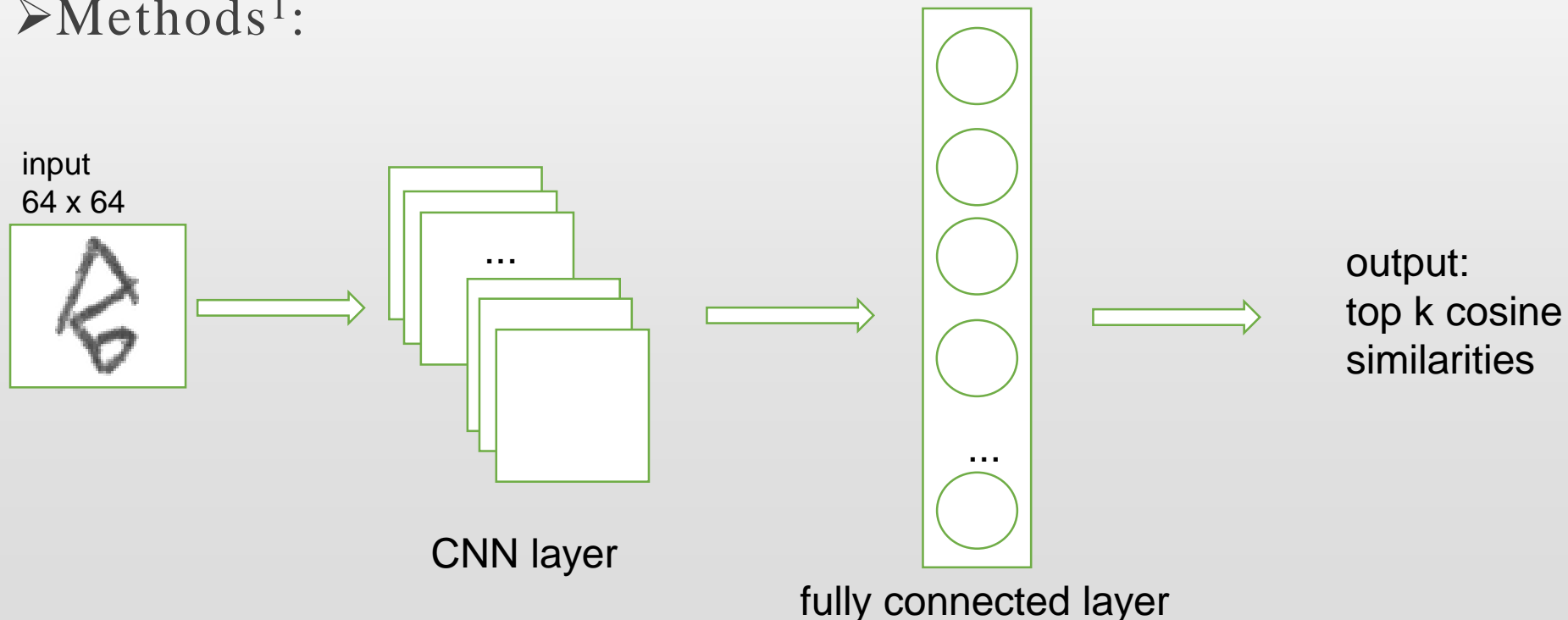
Experiments using KNN

- K-nearest neighbor (KNN) classification

➤ Cosine similarity: $\cos \langle a, b \rangle = \frac{a \cdot b}{|a||b|}$

➤ Results: 75.70% when $k = 21$

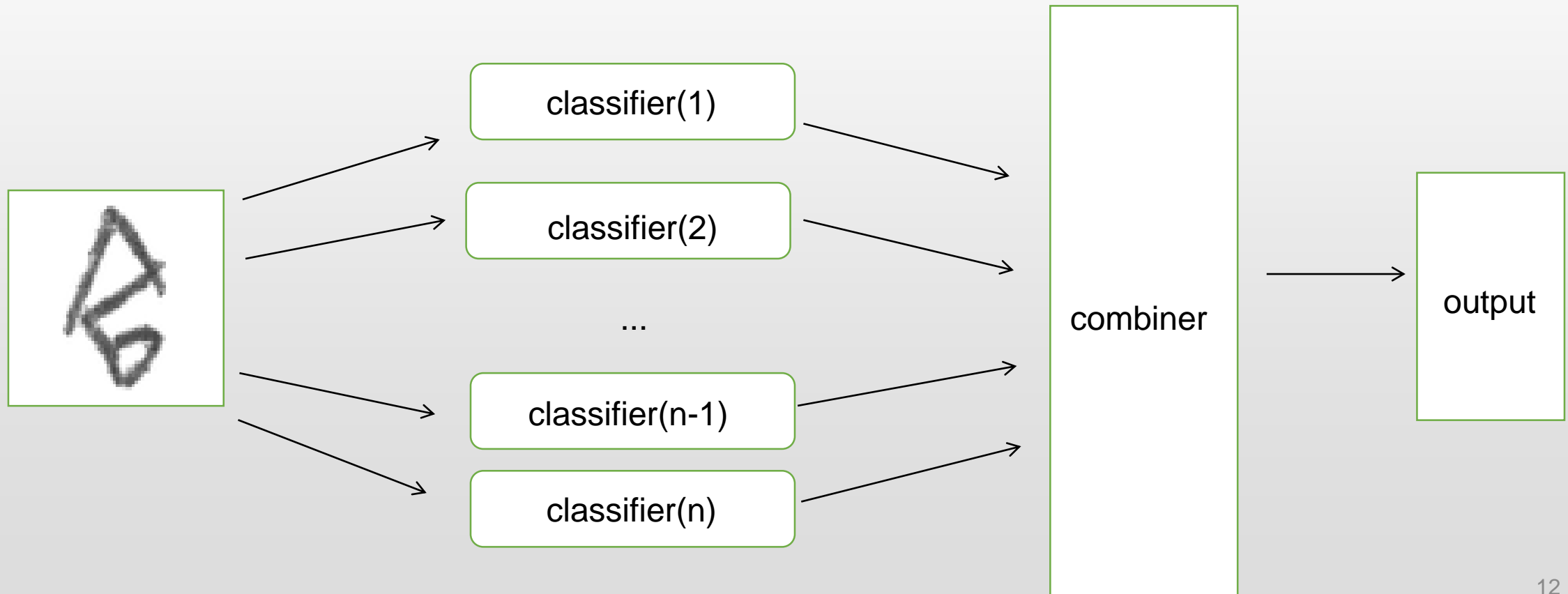
➤ Methods¹:



¹The method was inspired by a technical blog, Nearest Neighbors with Keras and CoreML, which is retrieved from <https://hackernoon.com/nearest-neighbors-with-keras-and-coreml-755e76fedf36>

Conclusion

- Limitation of a single classifier
- Multiple classifier system (MCS)



References

- [1]Dai, R., Liu, C., & Xiao, B. (2007). Chinese character recognition: history, status and prospects. *Frontiers of Computer Science in China*, 1, 126-136.
- [2]LeCun, Y. (1998). Gradient-based learning applied to document recognition.
- [3]Li, Z., Teng, N., Jin, M., & Lu, H. (2018). Building efficient CNN architecture for offline handwritten Chinese character recognition. *International Journal on Document Analysis and Recognition (IJDAR)*, 21, 233-240.
- [4]Liu, C., Yin, F., Wang, D., & Wang, Q. (2011). CASIA Online and Offline Chinese Handwriting Databases. *2011 International Conference on Document Analysis and Recognition*, 37-41.