Handwritten Digit Classification (MNIST)

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Introduction

In our digital age, handwritten documents still hold a significant place in our lives. Our daily lives are filled with handwritten letters, legal documents, shopping lists and mathematical equations.

Through the marvels of optical character recognition (OCR), handwritten content has become seamless to convert into various electronic formats. With a simple picture of from our notebook, many of our phones are able to convert our notes into a text file. As our world becomes increasingly connected, the demand for rapid and accurate analysis of physical documents have increased. For Instance, millions of transactions via check are automatically processed via OCR to ensure their accuracy.

Within this project, we explore the seminal paper: "Gradient-Based Learning Applied to Document Recognition", in order to apply various classification methods to recognize handwritten digits (Lecun et al., 1998).

Background Context

"Real-life document recognition systems are composed of multiple modules including field extraction, segmentation, recognition, and language modeling" (Lecun et al., 1998). Our project will focus mainly on the recognition part of the process. Within the realm of recognition, specifically handwriting recognition (HWR), there are two methods: online and offline.
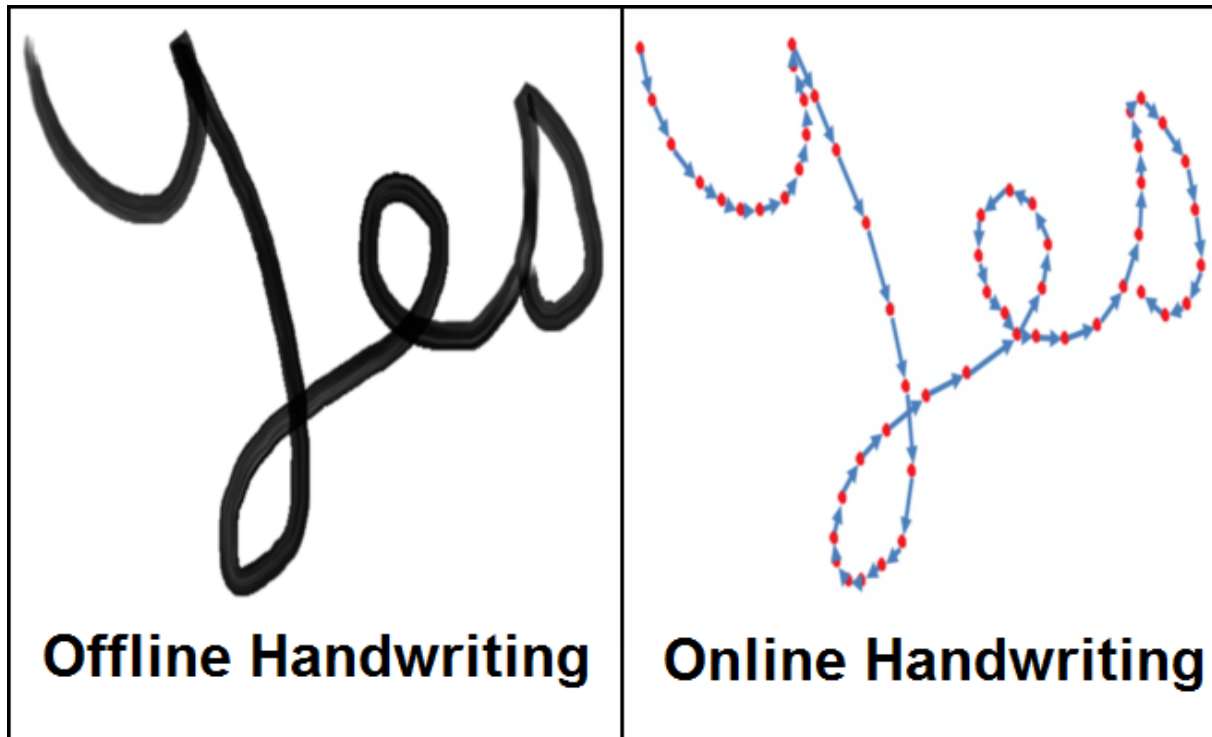
Figure 1: Showcasing offline vs online methodologies of HWR (Matcha, 2022)

1. **Online methods** - "Online methods involve a digital pen/stylus and have access to the stroke information, pen location while text is being written as shown in the figure. Since they tend to have a lot of information in regard to the flow of text being written they can be classified at a pretty high accuracy and the demarcation between different characters in the text becomes much more clear" (Matcha, 2022).

2. **Offline methods** - Offline methods involve recognizing text once it's written down and thus won't have information to the strokes/directions involved during writing, however, it will also have the addition of some background noise such as paper and shadows. (Matcha, 2022).

This project will focus on following the applications mentioned in the seminal paper, where we will build an identification/recognition module to read a bank check. All the processes within document recognition must occur to read a bank check's various components: date, payee, amount (in word form), amount (in numeric form), and signature. Due to time constraints, we will focus only building the module to classify the handwritten digits within the amount specified field of a check, and leave the rest of the implementation to our readers as our approach can be extended to the other fields as well.

Problem Statement

References

Lecun, Y., Bottou, L., Bengio, Y., & Haffner, P. (1998). Gradient-based learning applied to document recognition. *Proceedings of the IEEE*, *86*(11), 2278–2324. https://doi.org/10.1109/5.726791

Matcha, A. C. N. (2022). How to easily do handwriting recognition using machine learning. In *Handwriting Recognition with ML (An In-Depth Guide)*. Nanonets. https://nanonets.com/blog/handwritten-character-recognition/