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Problem #1: Document key information extraction

A recent visual document understanding (VDU) research shows that the process of document understanding can be done by an OCR-free model and still achieve state-of-the-art performances on various VDU tasks in terms of speed, accuracy, and model size efficiency [1]. Also, there are some research which shows the efficiency of graph neural networks (GNNs) in key information extraction due to their power in presenting the non-Euclidean data [2]. In this project, you will investigate the potential of OCR-free VDU and GNNs based models for reading parcel labels. The labels contain non-standard structured tables containing values and tags. The goal of the project is using the visual and semantic information extracted from the form, and tweaking the available approaches extract the pairs of tag and values.

You will be supervised by the Prime Vision deep learning engineers and would achieve a good understanding of the Transformer-based language models like BERT which are valuable in developing your future career. You are allowed to come up with your innovative ideas and publish scientific papers at the end.

[1] Kim, et al., "Donut : Document Understanding Transformer"
[2] Wenwen Yu, et al., "PICK: Processing Key Information Extraction from Documents using Improved Graph Learning-Convolutional Networks"

Work environment

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Expectations

- Self-motivated, eager to innovate and make a change to existing algorithms
- Affinity with Python and one of the deep learning libraries (Pytorch, Tensorflow, etc.)
- Affinity with deep neural networks.

Contact info

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Problem #2: Fuzzy name matching

Do these pairs of names match?

- "Den Haag" "The Hague"
- "Geoffrey Everest Hinton" "Prof. G.E. Hinton"
- "Muhammad Ali" "Magomamed Ali"

In the process of reading parcel labels, we would like to find the correct addresses. At Prime Vision we have a large, structured dataset of addresses to find the correct address by name matching. Name matching is a uniquely challenging task due to the name's variability and complexity. Nicknames, misspellings, multiple spellings of the same name, and more all can result in missed matches. There are many ways to match names, but no one is a universal solution. Fuzzy name matching is one of the popular solutions. A main concern in such applications is scalability, as it involves comparing many millions of names against millions of others. Besides optimizing systems for matching performance, the latency and scalability requirements play a central role in developing name matching applications. The research question is "what form of representation and algorithm provide name matching capabilities which can operate under low latency, and high scalability?"

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Proposal #3: Predicting the care plan goals using a knowledge graph-based recommender system

The Dutch government and health insurance companies are jointly responsible for long-term care of patients. People who need help to give them their medication or shower and dress are supported by this program.

Initially a care plan is conceived the first time a client enters the care system. In this plan the area's (Omaha*) are defined. For each area a goal is defined for the next 6 months. We would like to have a system which can predict the achievable care plan goals which one patient can obtain in every 6 months.

To solve this, collaborative filtering (CF) approaches can help in building a model from the patient's history as well as the goals that have been defined for the similar patients [1]. However, CF-based approaches suffer from data sparsity and cold start problems. In recent years, knowledge graphs (KGs) have been attracting lots of attention due to their strong ability to represent knowledge in a sparse way. Knowledge Graphs have been used to formalize information as a directed, labeled graph. The research question in this project could be: "how a knowledge graph-based recommender system can provide context for predicting the care plan goals?". Another question of this project would be "to what extent an unsupervised approach of making the KG, described in [2], can be successful?"

[1] https://arxiv.org/pdf/2003.00911.pdf

[2] https://arxiv.org/pdf/2010.11967.pdf

* Please check this page http://www.healthconnectionspress.com/book2005.html for the definition of Omaha system.

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Expectations

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- Proficiency in Dutch
- Affinity with Python and one of the deep learning libraries (Pytorch, Tensorflow, etc.)
- Affinity with natural language processing (Transformer and BERTmodels).

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Proposal #4: Forecasting liability insurance

The Dutch government and health insurance companies are jointly responsible for long-term care of patients. One of the goals of the healthcare system is to keep clients living at home and as independently as possible. Sometimes though people cannot live on their own anymore and need to be institutionalized. This proposal is about care inside an institution.

When a client (patient) comes in the first time an estimation is made about the care and attention the client needs. This zzp (=Zorg Zwaarte Pakket) indication is used for communicating with the health insurance company, so the care organization gets paid. During their stay a client indication may change (most clients need more care the longer their stay). For example, the zzp indication goes from zzp5 to zzp7.

The problem is that this change in zzp indication is noticed too late and therefore the health insurance company is notified too late. This causes a substantial financial loss for the care organization. We are trying to assist the care organization by predicting which clients will be needing more care in the near future.

To solve this, collaborative filtering (CF) approaches can help in building a model from the patient's history as well as the goa liability insurance level ls that has been defined for the similar patients [1]. However, CF-based approaches suffer from data sparsity and cold start problems. In recent years, knowledge graphs (KGs) have been attracting lots of attention due to their strong ability to represent knowledge in a sparse way. Knowledge Graphs have been used to formalize information as a directed, labeled graph. The research question in this project could be: "how a knowledge graph-based recommender system can provide context for predicting the liability insurance level?". Another question of this project would be "to what extent an unsupervised approach of making the KG, described in [2], can be successful?"

[1] https://arxiv.org/pdf/2003.00911.pdf

[2] https://arxiv.org/pdf/2010.11967.pdf

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Problem #5: Dutch paraphraser for care domain

Care organizations giving care to people at home are obliged to write a report after each visit about the status of the client. Family of the client read these reports so the can follow along with the situation. The reports are also used to assess the situation of the client and to plan for future care. Quality of reports is important!

Writing the Dutch language can be challenging for a care professional. To assist and help the care professional a tool is needed that paraphrases the reports of the care professional but keeps the semantic meaning of the original report. This helps the care system to make the reports more readable and understandable and, ultimately, improves the quality of service.

The objective of this project is to research the best end-to-end paraphraser model based on deep learning to assist care workers. For this goal you will be supervised by the Prime Vision deep learning engineers and would achieve a good understanding of the Transformer-based language models like BERTje, GPT3, and BART Paraphrase Models which are valuable in developing your future career. You are allowed to come up with your innovative ideas and publish scientific papers at the end.

[1] Colin Raffel, et al., "Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer".

[2] Swadheen Shukla, et al., "Conversation Learner – A Machine Teaching Tool for Building Dialog Managers for Task-Oriented Dialog Systems".

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