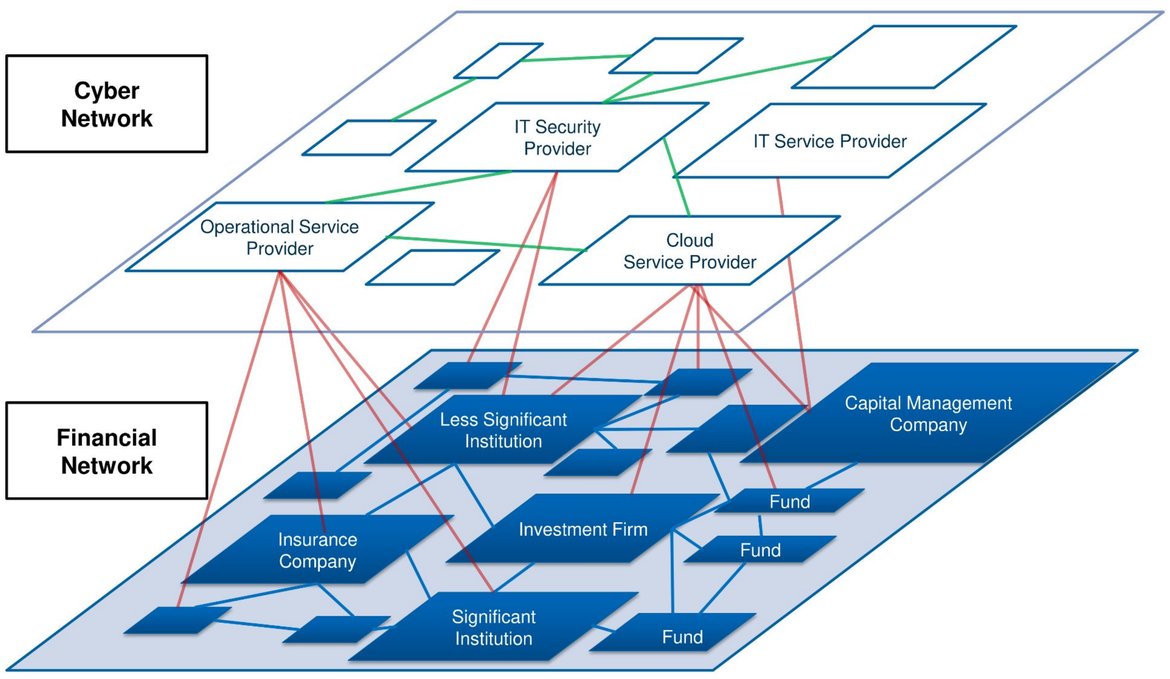
dfki ai Deutsches Forschungszentrum für Künstliche Intelligenz
*German Research Center for Artificial Intelligence*

# CO-Fun: A German Dataset on Company Outsourcing in Fund Prospectuses for Named Entity Recognition and Relation Extraction

***Neda Foroutan, Markus Schröder, Andreas Dengel***

## I. Motivation

- Banks and other institutes are increasingly outsourcing critical processes and services to third-party information and communication technology (ICT) providers.
- This outsourcing trend introduces potential risks to cyber incidents and financial stability.
- Discovering cyber risks requires “cyber mapping” giving insights in relationships among financial entities and service providers.
- Accurate recognition of entities and their relationships in financial documents necessitates the use of advanced NLP models trained on a dataset with ground truth labels.
- Lack of annotated datasets focused on outsourced services in the financial domain.
- No dataset links companies with the services they outsource.




## II. Data Collection

- 1,054 publicly available fund prospectuses (PDFs) were collected from websites of 37 well-known Capital Management Companies (CMCs) in Germany.
- Converting PDFs into plain texts.
- Sentences were splitted and preprocessed.
- 1,267 sentences could be collected.
- Roughly half of them assemble bullet point lists.
- Three subject-matter experts of the Deutsche Bundesbank annotated the corpus with named entities and relations.
- Named entity types: *‘Auslagerung’ [Outsourcing], ‘Unternehmen’ [Company], ‘Ort’ [Location]* and *Software*.
- Relationships types: *Outsourcing–Company* and *Company–Location*.

**Example:**

***‘Die Gesellschaft hat Rechenzentrumsleistungen auf die Mercurtainment & CO KGaA ausgelagert.’***

***‘The company has outsourced data center services to Mercurtainment & CO KGaA.’-***

**Named Entities:**

**Outsourcing: “data center services” and Company: “Mercurtainment & CO KGaA”**

**Relations:**

**Outsourcing-Company**

## III. CO-Fun Dataset

- The raw data of CO-Fun consists of records formatted in JSON.
- Each entry has the following properties:
  - “entities”: Lists of Named Entities with their type.
  - “text”: the annotated text is present in HTML Format.
  - “relations”: Lists of source and target entities with their relation type.

***** Anonymization of all companies by randomly swapping their names with other companies with the same postfix e.g. GmbH.

**CO-Fun Dataset**
https://zenodo.org/records/12745116


```
"entities":[
  {
    "text":"Fondsadministration",
    "type":"Auslagerung"
  },
  …
],
"text":"<html><head><\/head><body>Die Gesellschaft hat die folgend…
"relations":[
  {
    "src":{
      "text":"Fondsadministration",
      "type":"Auslagerung"
    },
    "trg":{
      "text":"OPEX Corporation",
      "type":"Unternehmen"
    },
    "type":"Auslagerung-Unternehmen"
  },
```


| | | | |
|---|---|---|---|
| **# Sentences** | 984 (900 unique) | | |
| **Sentences average length** | 314.8 ± 393.76 characters (w/o markup tags) | | |
| | 44.9 ± 53.5 tokens | | |
| **Sentences contain on average** | 6.3 ± 9 annotations | | |
| **# Named Entity annotations** | 5,969 | | |
| | # Outsourcing Services | 2,340 (W) | 270 (O) |
| | # Companies | 2,024 (W) | 323 (O) |
| | # Locations | 1,594 (W) | 84 (O) |
| | # Software | 11 (W) | 1 (O) |
| **# Relations annotations** | 4,102 | | |
| | # Outsourcing-Company | 2,573 | |
| | # Companies-Locations | 1,529 | |

(W): With duplicates (O): Without duplicates

## IV. Results

- Data was randomly split to training, development and test sets with 80%, 10% and 10% ratio.
- Applying Named Entity Recognition (NER) and Relation Extraction (RE) models on CO-Fun.
- CO-Fun is a NER and RE dataset on company outsourcing in fund prospectuses.

| Models | | Train | | | Test | | |
|---|---|---|---|---|---|---|---|
| | | P | R | F1 | P | R | F1 |
| NER | CRF | 96.7 | 95.1 | 95.9 | 95.7 | 93.0 | 94.3 |
| | BERT | 99.8 | 94.2 | 97.0 | 92.9 | 91.5 | 92.2 |
| RE | RoBERTa | 89.4 | 81.7 | 85.3 | 86.5 | 86.1 | 86.3 |

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## Limitations

- No inter-annotator agreement: As the expert annotators had limited time.
- Small size of the Co-Fun dataset:
  - The collaborating partner could not provide more documents since other regulatory data is usually confidential.
  - Our corpus was the small set of the provided documents and only a few pages contain some sentences about outsourcing statements due to our special language, domain and selection constraints.

**Towards Cyber Mapping the German Financial System with Knowledge Graphs**
https://link.springer.com/chapter/10.1007/978-3-031-60626-7_15