DIGITÁLIS SZOLGÁLTATÁSOK

NAGY MEGBÍZHATÓSÁGÚ INFORMÁCIÓS RENDSZER SZOLGÁLTATÁSOK KIALAKÍTÁSÁNAK FORMÁLIS ÉS FÉLIG FORMÁLIS MEGKÖZELÍTÉSEI

MOLNÁR BÁLINT

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HUNGARY

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2022. 02. 20.

Esettanulmány – Alkalmazási lehetőségek

- A kutatási eredmények alkalmazásának lehetőségei alkalmazott (ipari) kutatás keretében:
  - Adatbázis séma leképezése kutatást támogató, nemzetközi, ipari szabvány adatbázis sémára
  - Adatok migrálása, szöveges attribútum értékek leképezése, számítógépes intelligencia természetes nyelvű feldolgozás módszereivel.
  - Szervezeti/intézményi információs rendszerek (vállalati, pénzügyi) estében:
    - A dinamikusan változó, változtatott folyamatok helyességének, megfelelőségének, konzisztenciájának, integráltsága megőrzésének ellenőrzése
  - Információs rendszerek munkafolyamataiba a blokklánc technológia alkalmazása mintázatainak kialakítása, esetek feldolgozása, modellből program generálási algoritmus/ -ok kialakítása.
    - A munkafolyamatokba szolgáltatásként beintegrált adatanalitikai algoritmusokkal kapcsolatban az átláthatóság, értelmezhetőség, megérthetőség vizsgálata. Támogatási lehetőségek kialakítása a folyamatok specifikálásban, mintázatok felhasználásában arra, hogy a végfelhasználók számára átláthatók, és megérthetők legyenek a döntések. .

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Data Science for Finance: Best-Suited Methods and Enterprise Architectures

- Áttekintő cikk
- Esettanulmányok feldolgozása
- További munkák előkészítése
- Ph.D. és MS.C. hallgatók számára témába bevezetése

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- [1]
- G. Pisoni, B. Molnár, and Á. Tarcsi, “Data science for finance: best-suited methods and enterprise architectures,” *Applied System Innovation*, vol. 4, no. 3, Art. no. 3, Sep. 2021, doi: 10.3390/asi4030069.

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Modellből program (M2P)

- Elfogadott, ipari szabványnak megfelelő jelölésrendszerekkel és módszerekkel elkészített tervekből közvetlenül programok előállítása
- A modellek helyességét és pontosságát logikai módszerekkel ellenőrizzük a generálás előtt
- A kutatás célja a szervezeti folyamatok és munkafolyamatok formális tervekből történő előállítása.

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Model to Program and Block-chain approaches for Business Processes and Workflows

Meriem Kherbouche, Galena Pisoni, Bálint Molnár

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Summary

- We investigate the utilization of Block-chain technology for model checking of Workflows, Business Processes to ensure consistency, integrity and security in dynamically changing business environment.
- We transform the block-chain to UML activity diagram followed by a verification using petri nets to guarantee a distributed computing system and scalable with mutable data.

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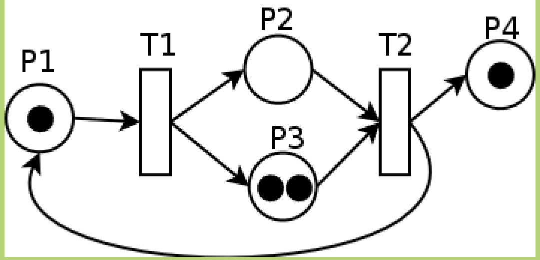
Summary



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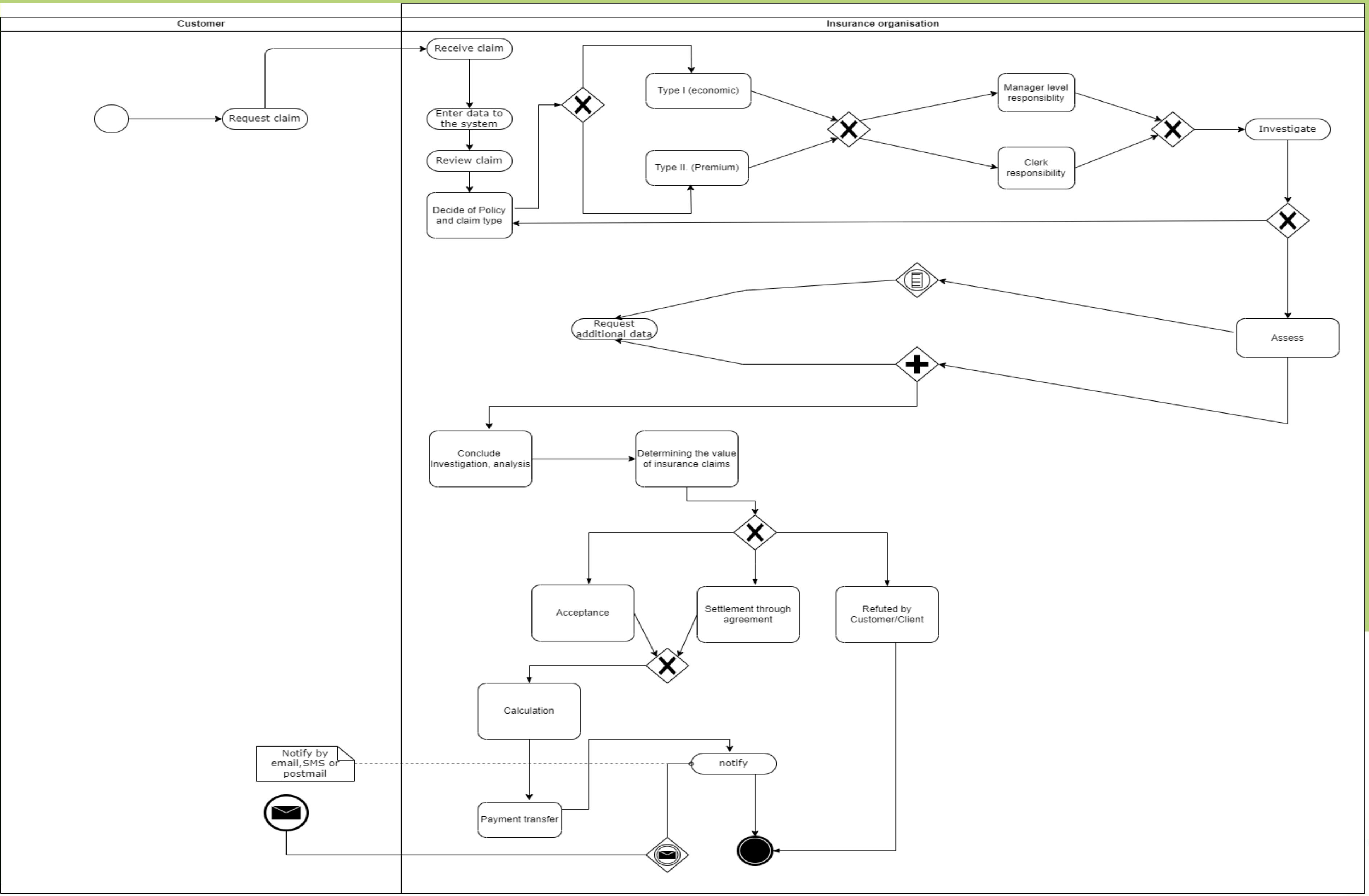
Insurance claim- Activity diagram



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UML profile for blockchain

- We propose to create a structured UML profile, a new meta-model, to lightweight extend the UML meta-model by adding the block-chain part to the Activity diagram.
- Profiles allow adaptation of the ***UML meta-model for platforms like Java platform, .NET Framework,*** etc... or domains such as our case business process modelling, insurance, medical applications, service-oriented architecture, etc.

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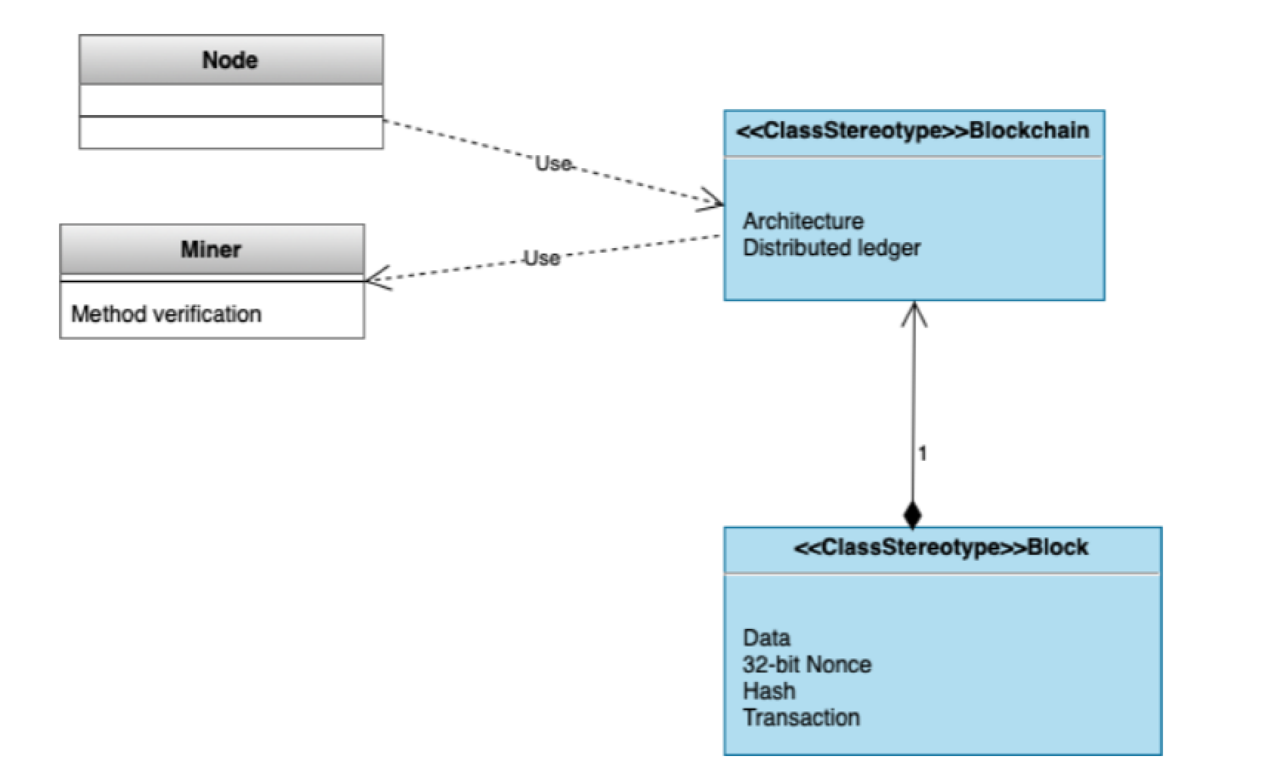
UML profile for blockchain



- It is composed of:
  - Node - In block-chain architecture, a node can be any user or computer (every node has an independent copy of the block-chain).
  - Block - a data structure used for keeping a set of transactions that is distributed to all nodes in the network.
  - Chain - a sequence of blocks in a specific order. Transaction - Contained in the block and contains information, records, etc...
  - Miners - specific nodes which perform the block verification process before adding anything to the block-chain structure.

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Conclusion and future work

- We discusses the power of modelling business processes using UML activity diagrams and model transformation M2P benefits from the strength of block-chain and UML profiles to facilitate insurance claims. Where, a UML profile was created to extend the UML activity diagram by adding a part that represent block-chain. Then we Transformed the whole extended diagram to Petri nets by respecting the generated rules of transformation.
- Block-chain integration in the insurance field can be a promising multi-actor research area.

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Conclusion and future work

- The application of block-chain technology can be perceived as web services or micro-services that are called by tasks of specific Business Processes.
- The patterns of Business Processes and web services initiate the review of workflow patterns. The *workflow patterns* are elementary building blocks that can be either extended or expanded by necessary constituents to take into account the specialty of ***Business Processes in Financial Services Technologies*** and the *application of block-chain* technologies.

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Publikáci

- [1] M. Kherbouche, G. Pisoni, and B. Molnár, "Model to Program and Block-chain approaches for Business Processes and Workflows," Applied Sciences Innovation, 2022.

Scopus: CiteScoreTracker 2021 2.7

Category	Rank	Percentile
Computer Science Information Systems	#200/329	39th

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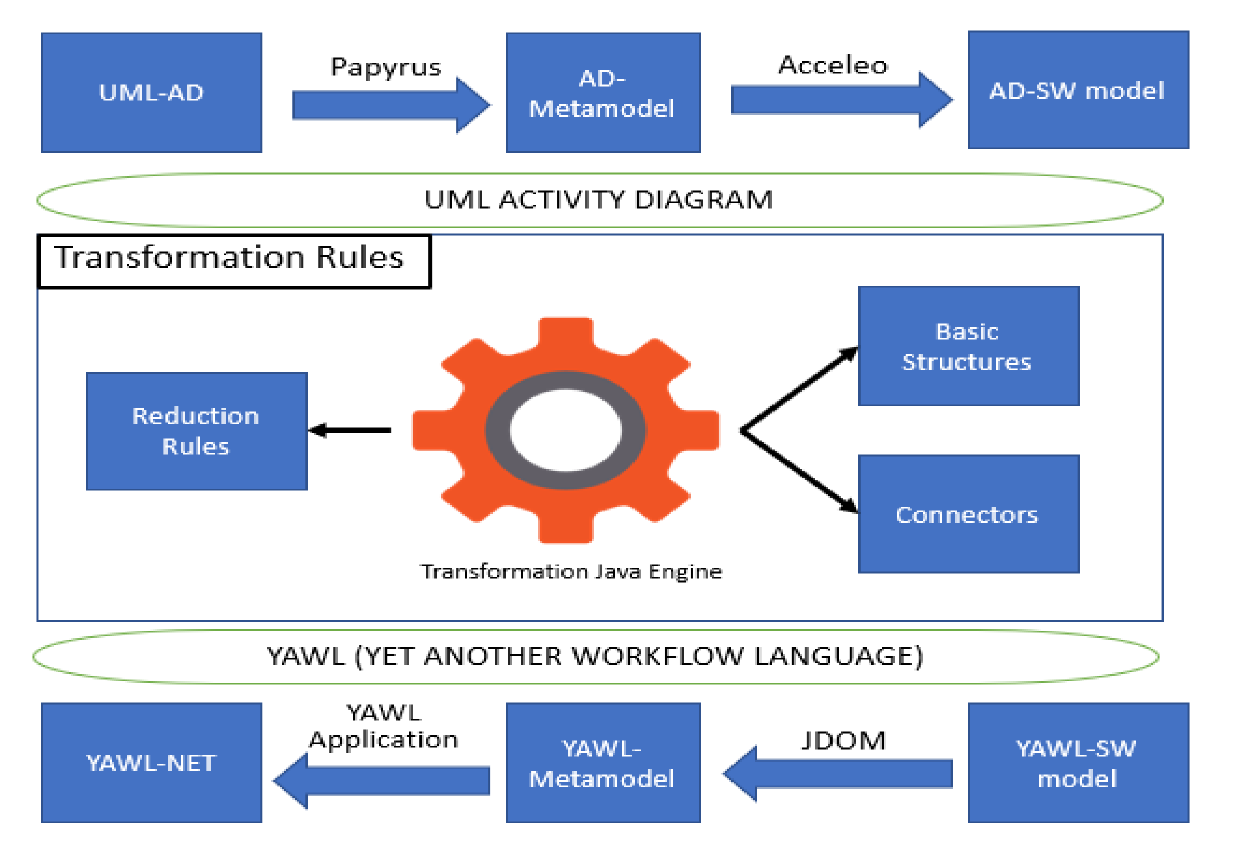
An Operationalized Transformationfor Activity Diagram into YAWL



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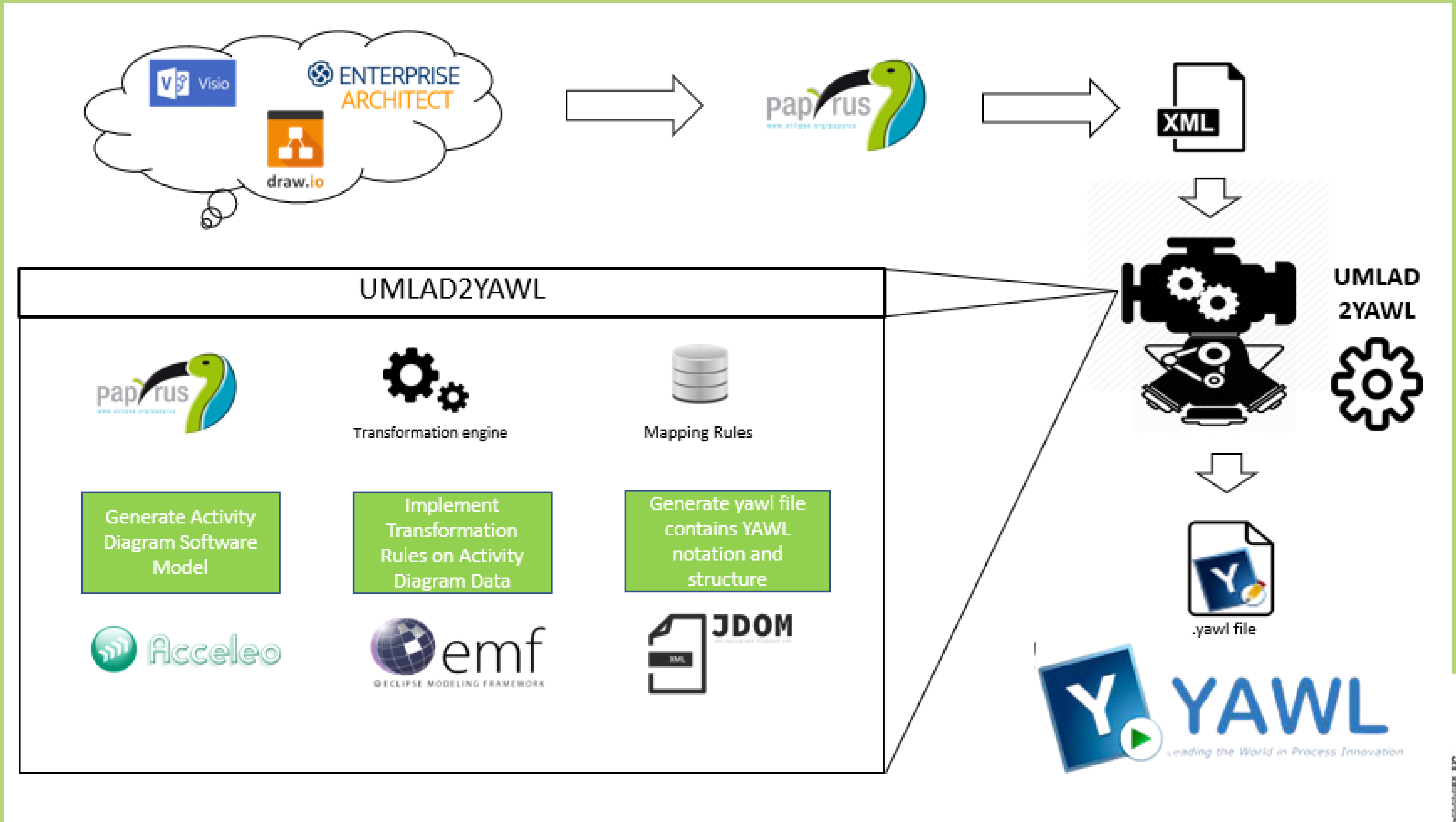
An Operationalized Transformationfor Activity Diagram into YAWL



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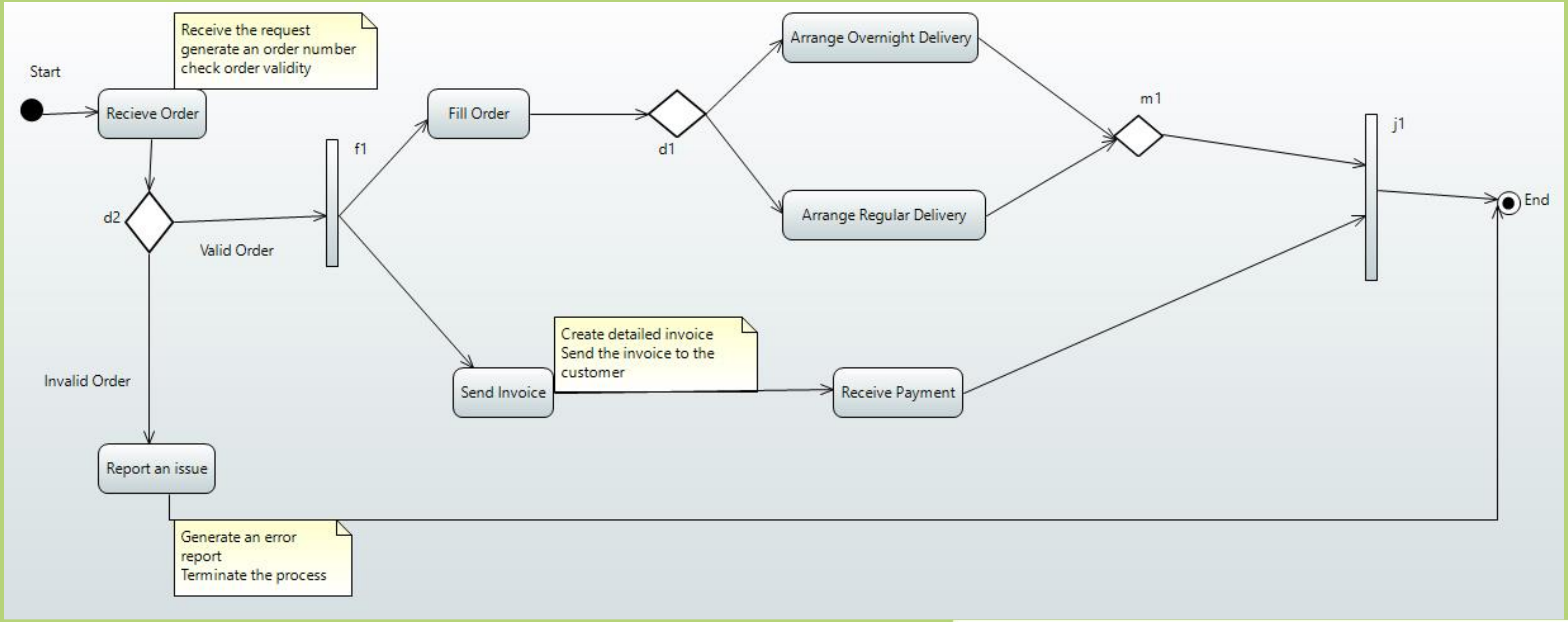
Online ordering system (Activity diagram)



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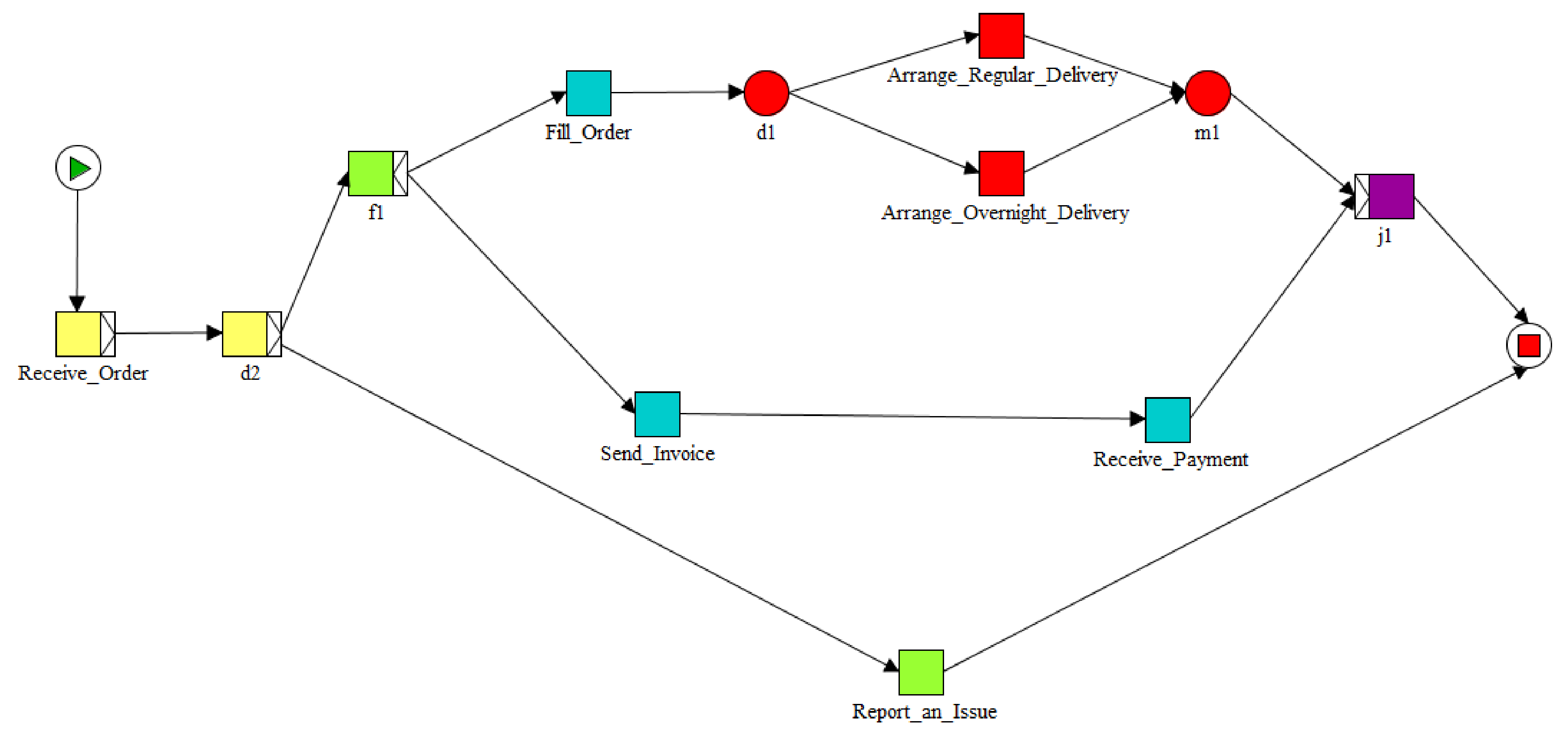
Online ordering system (YAWL)



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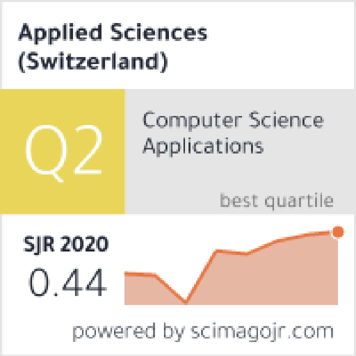
Publikáció előkészületben

Author	Title	Year	Journal/Proceedings	Reftype	DOI/URL
Kherbouche, M., Mukashaty, A. and Molnár, B.	Activity Diagram to Yawl	2022	MDPI Apllied Sciences	article	

Computer Science Computer Science Applications	**#300/ 693**	**56th**



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Knowledge-enriched schema matching and mapping
Introduction

- **Semantic heterogeneity** in various schemas brings some obstacles while establishing the correspondences between source schema and target schema.
- The performance of the matching algorithms depends on the characteristics of the datasets such as **abbreviated, synonym and combined words.**
- We are not address the pre-match, we focus on ***how to enrich and augment the initial mappings in the phase of post-match in this work.***

Research Questions:

How to analyze, parse, and represent the database schema at instance level and attribute level

How to enrich and augment the schema matching by using existing knowledge bases?

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Knowledge-enriched schema matching and mapping Introduction

- **Semantic schema matching based on the text embeddings.** Train an embedding model from the basic database schema elements (e.g., table name, fields, etc.) and their description.
- **Knowledge-enriched schema-level mapping based on graph embeddings.** Enrich the network model to obtain the semantic mapping by leveraging the existing domain knowledge bases (e.g., ontologies, knowledge graph) to enrich the schema matching.
- **Case Study. Mapping E-MedSolution into OMOP CDM schema:** Pre-process (translate, cleaning, annotation) the related database elements of source schema, train the neural network model and validate the flexibility of the designed method.

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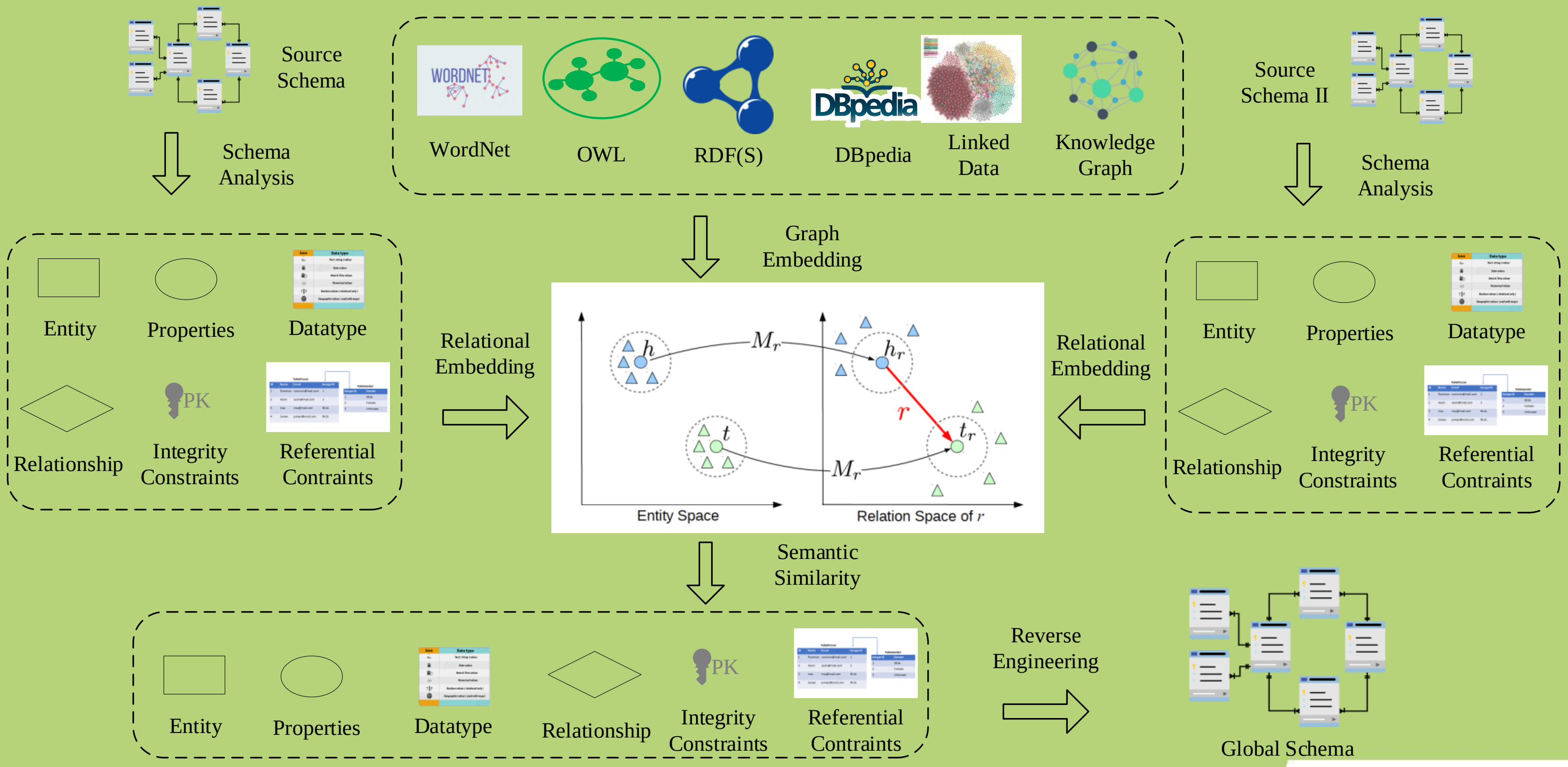
Knowledge-enriched schema matching and mapping: Proposed Framework



In the framework, we enrich the mappings by **combing the trained relational embeddings with external pre-training embeddings.**

The framework of knowledge-enriched schema matching and mapping

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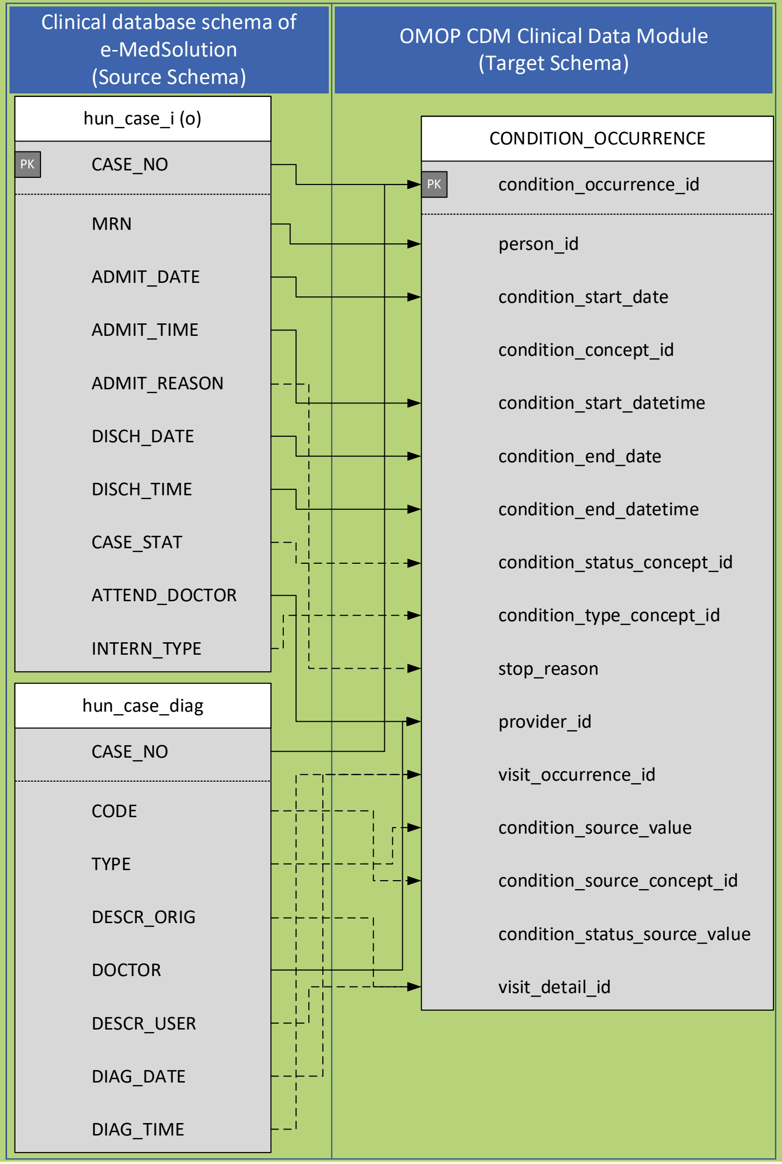
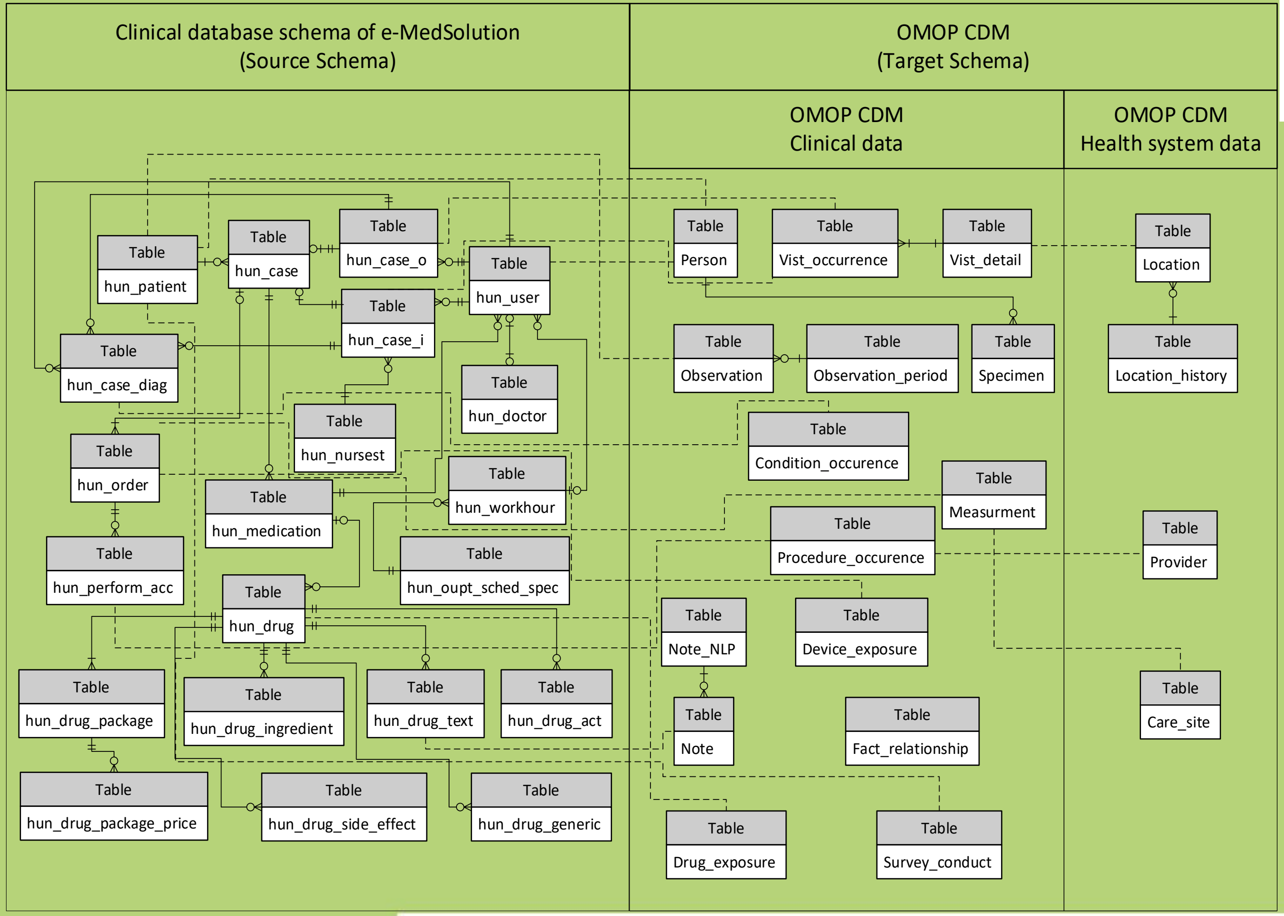
Knowledge-enriched schema matching and mapping: Preliminary Case Study





Map e-MedSolution database schema into OMOP CDM unified schema

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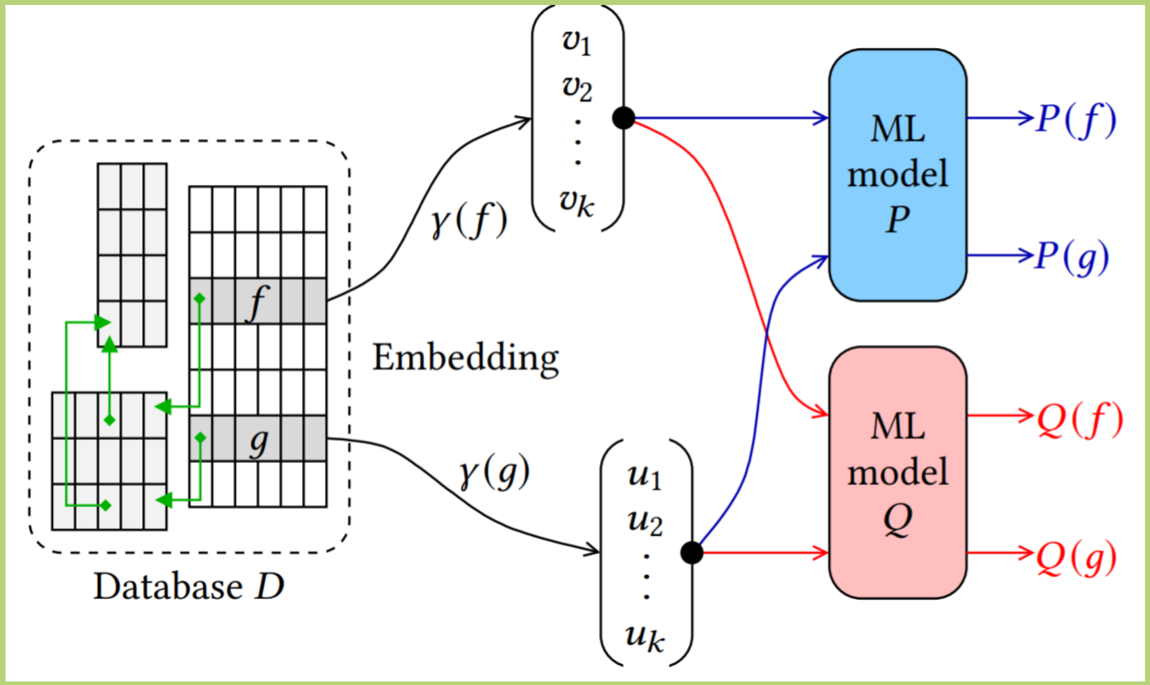
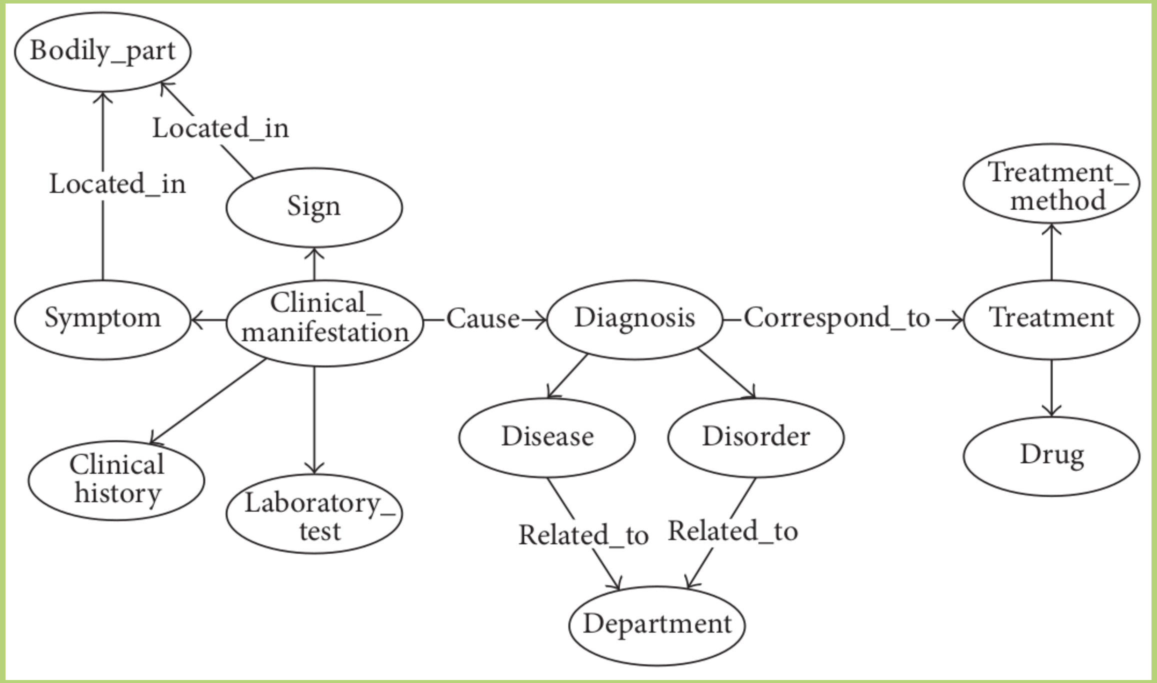
Knowledge-enriched schema matching and mapping: Preliminary Case Study





Train Relational embedding: entity embedding, properties embedding, constraints embedding.

Construction of heterogeneous knowledge graph

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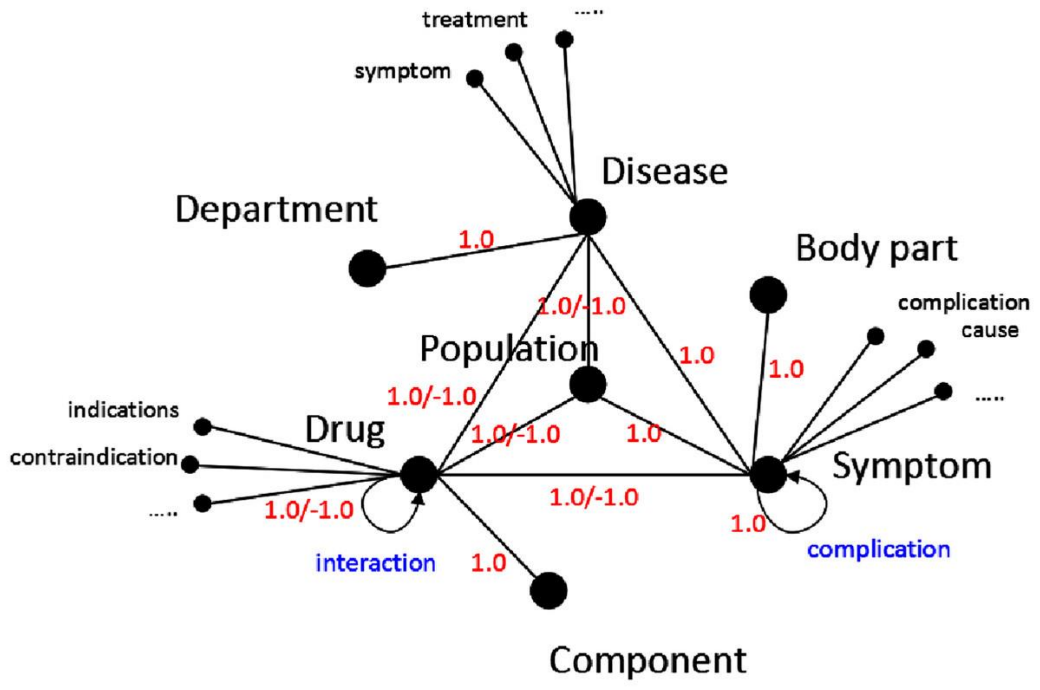
Knowledge-enriched schema matching and mapping: Preliminary Case Study



- In the vector space, these **embeddings could be used to calculate similarities** and find the similar items between columns.
- These potential mappings could be enriched by using **relational embeddings and knowledge embeddings** based on similarity.

Define a proximity measure from embedding to enrich schema matching

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Publikációk

- **Publication**

- C. Ma and B. Molnar, "Ontology Learning from Relational Database: Opportunities for Semantic Information Integration," *Vietnam Journal of Computer Science*, Dec. 2021, doi: 10.1142/s219688882150024x.
- C. Ma, B. Molnár, and A. Benczúr, "A Semi-automatic Semantic Consistency Checking Method for Learning Ontology from Relational Database," *Information*, April, 2021,12(5),188. doi:10.3390/info12050188 (Journal Rank: CiteScore - Q2 (Information Systems))

- **Publication in preparation**

- C, Ma, B, Molnár, A, Benczúr. A knowledge enriched model for semantic schema matching and mapping, 2022

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Hypergraph Application on BP Performance

Khawla Bouafia , Bálint Molnár.

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Introduction

- The modeling of graphical representation of Business Processes (BP) or workflows in Enterprise Information Systems (IS) is often to represent the various activities, entities, relations, functions, and how to communicate between them in an enterprise to get the major goal of the operational support.
- In this work, we decided to use *graph representation approaches,* especially <u>hypergraphs</u> to depict the complex relationships that exist among the artifacts and constituents of BP. for more efficient and accurate manipulations.

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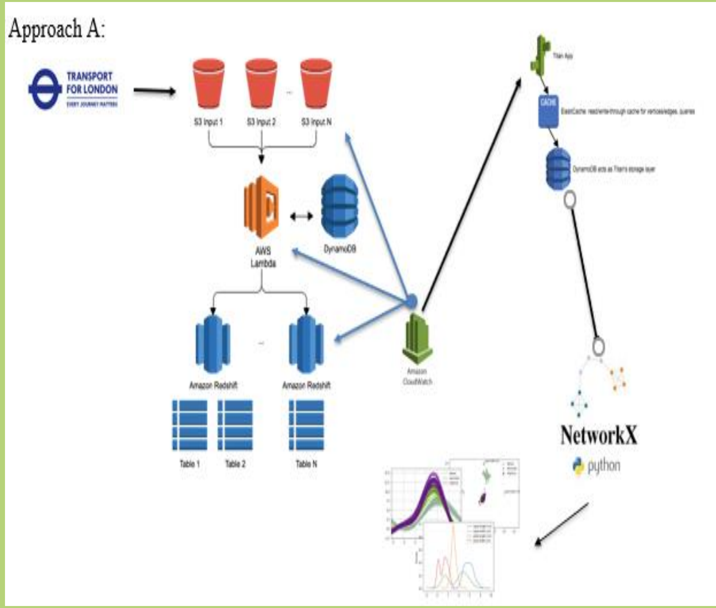
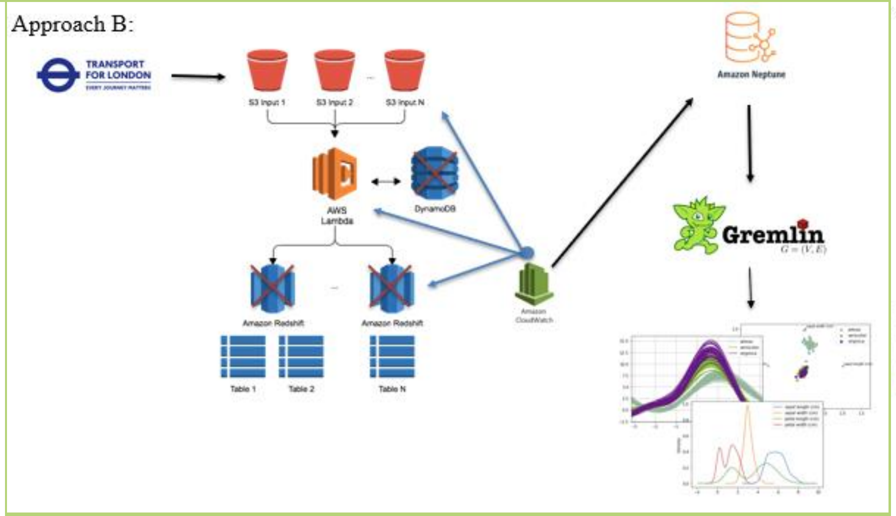
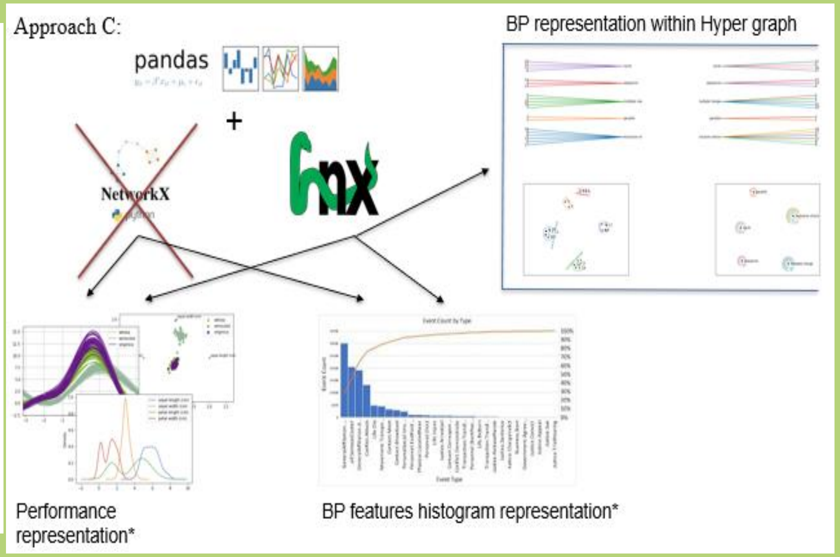
Approaches of BP

- We have experimented with different combinations of tools and manually generated data which represents Business Process
- We tried different ways of defining BP and on generating simulated data.







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Hypergraph based representation for BP

- We used the hypergraphs as a tool for describing IS from various viewpoints formal method to analyze the system, and to check the conformance, compliance, and consistency of the set of models.
- The BP representation can be based using transformation into FSM that is described in hypergraphs then perform Model Checking activities on the representation.

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Hypergraph based representation for BP

- A design problem of workflows and BP is to provide consistent and timely feedback about a ***case*** to the *involved citizens.*
- A formal model grounded in graph theory provides the chances to reconcile the various aspects in an integrated and consistent view.
- The systematic description of the complex relationships makes it possible to monitor, track, and manage the ***cases.***
- The formalized model can solve the above-mentioned problems with Case Management that appears in document-centric IS with special emphasis on BP.
- The BP description in hypergraphs is transformed into bipartite graphs and showcased in matrices according to the Smith Normal Form.
- The Smith Normal Form representation offers an opportunity to evaluate the dissimilarities between Business Processes, i.e. the violation of integrity and consistency in the case of dynamically changed Business Processes can be highlighted.

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- [1]K. Bouafia and B. Molnár, “Hypergraph Application on Dynamic Aspect of Business Process Performance Analysis,” *MDPI Information*, vol. 12, no. 9, Art. no. 9, Sep. 2021, doi: 10.3390/info12090370. (CiteScore - Q2 (Information Systems)
- Doktori dolgozat megvédése, január 28.

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KOGNITÍV INFORMÁCIÓS RENDSZEREK ÉS INTELLIGENS ADATELEMZÉSI ESZKÖZÖK

PUTNOKI ATTILA MÁRTON

MOLNÁR BÁLINT

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2022. 02. 20.

Bevezetés

- A Big Data elemzés mindig is fontos szerepet játszott a vállalatoknál. Multinacionális vállalatok nagy hangsúlyt fektetnek a gyors információszerzésre.
- A Gartner trendjeit szem előtt tartva a cél egy olyan AI és Business Intelligence (BI) által támogatott rendszer előkészítése, amely segítségével az üzleti Decision-Making (DM) jobban támogatható, vagy helyettesíthető automatizált intelligens robottal (intelligent bot) Intelligent Process Automation (IPA) által, ami kapcsolódik a Computer Vision (CV), Cognitive Automation (CA), Machine Learning (ML) és Robotic Process Automation (RPA) technológiákhoz is.
- E kihívások leküzdéséhez multidiszciplináris kutatásra van szükség, amely áthidalja a különböző tudományterületeket, ahol a folyamatelmélet és a rendszerelmélet megközelíti a DM-et, az információfeldolgozást, a rezonanciaadaptációt és a Carbon-Silicon ágens modellezését a Human-Computer Interaction (HCI)-ben, hogy egy bevált alapmodellt biztosítson a jövőbeli kutatások számára.
- A kutatás szükségességét alátámasztja az a tény is, hogy az üzleti döntéshozók olyan kihívásokkal szembesülnek, amelyeket a rendelkezésre álló idő alatt nem tudnak megoldani Cognitive Information Systems (CIS) nélkül.
- A CIS alapjainak lerakásával olyan rendszer alakítható ki, amely jobban támogatja az üzleti élet szereplőinek és vezetőinek döntéseit, optimalizálva a lehetséges döntési eredményeiket.

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Publikálási terv

Nemzetközi konferencián publikálás, prezentálás HCI-AI témakörben:

- MDPI,
- ACTA,
- CogInfo,
- CIST,
- ICEIS,
- egyéb

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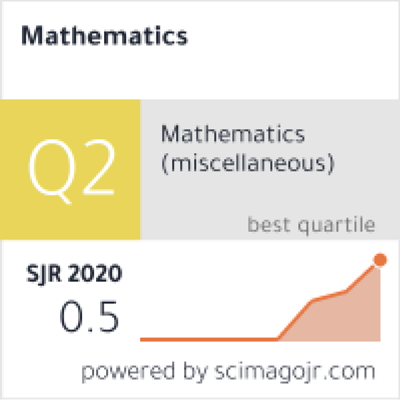
Előkészületben

- Application of Directed Hypergraphs for analysis of Models of Information Systems
- B. Molnár, A. Benczúr, “Application of Directed Hypergraphs for analysis of Models of InformationSystems,” *Mathematics*, 2022.



- **Journal Rank:** JCR - Q1 (*Mathematics*) / CiteScore - Q1 (*General Mathematics*)

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