Title: *An Interactive Digital Twin for Visual Querying and Process Mining*

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Short Bios

- **BSc** in *Computer Engineering and Informatics*

  (Cyprus University of Technology 2013 – 2017)

- **MSc** in *Data Science and Engineering*

  (Cyprus University of Technology 2017 - 2019)

- **Working Experience**

➢ Dossier Cloud – Twinning H2020 (2017 – 2019)

➢ Epirroi Greece – Cyprus Interreg Programme (2017 – 2019)

➢ Destini – Twinning H2020 (2019 – 2022)

➢ Digital Logic Lab in CUT (2019 – 2021) – Teaching Assistant

➢ VLSI Systems Design Lab in CUT (2019 – 2021) – Teaching Assistant

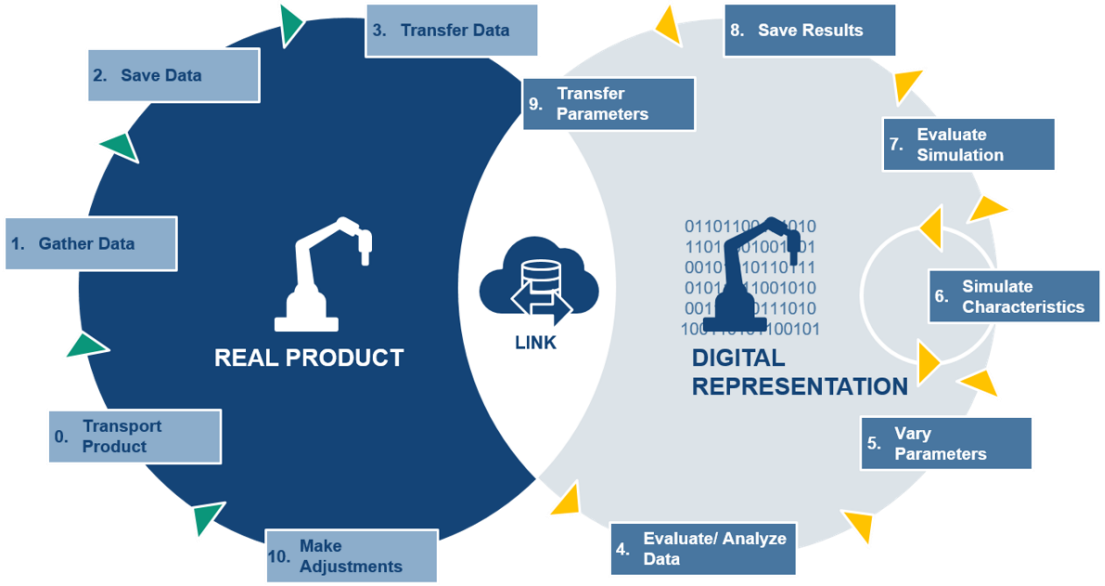
Contents

Introduction (1/4)

- Scientific Trends:
  - Internet of Things (IoT)
  - Big Data
  - Cloud Computing
  - Artificial Intelligence (AI)
- Large Volume of data (Structured, Semi-Structured and Unstructured)
- Data processing and Visualization
- Transform primary data to meaningful data

Introduction (2/4)

- Digital Twin
  - ➢ Virtual representation
  - ➢ Simulation
  - ➢ Support Decision Making
  - ➢ Predictions



Introduction (3/4)

- Process Mining
  - Technique relating the fields of data science and process management
  - Support the analysis of operational processes based on event logs
  - Turn event data into insights and actions
  - Use event data to show what people, machines, and organizations are really doing

Introduction (4/4)

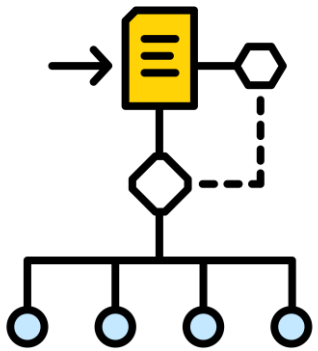
- Open Research Challenge
  - How Digital Twins may contribute to enhancing the applicability and efficiency of process models
  - Prevent costly failures in physical objects or activities
  - Improve quality and productivity, by using advanced analytical, monitoring and predictive capabilities, test processes and services

Technical Background (1/4)

- Data Processing

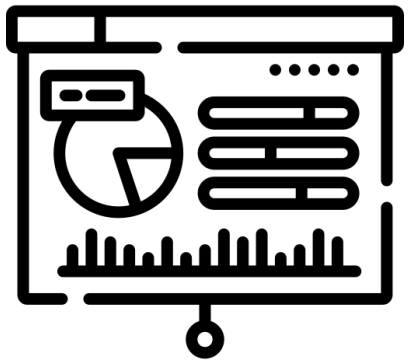
  - Smart Data Processing Systems for data ingestion, data aggregation of an enormous variety of structured, unstructured and semi-structured datasets

  - Knowledge-based meta-data representation techniques for the conversion of raw into smart data, data privacy and protection, and dynamic configuration.



Technical Background (2/4)

- Data Visualization
  - Graphical representation of information and data.
  - Data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data.
  - Visualization-based data discovery methods allow business users to mash up disparate data sources to create custom analytical views.



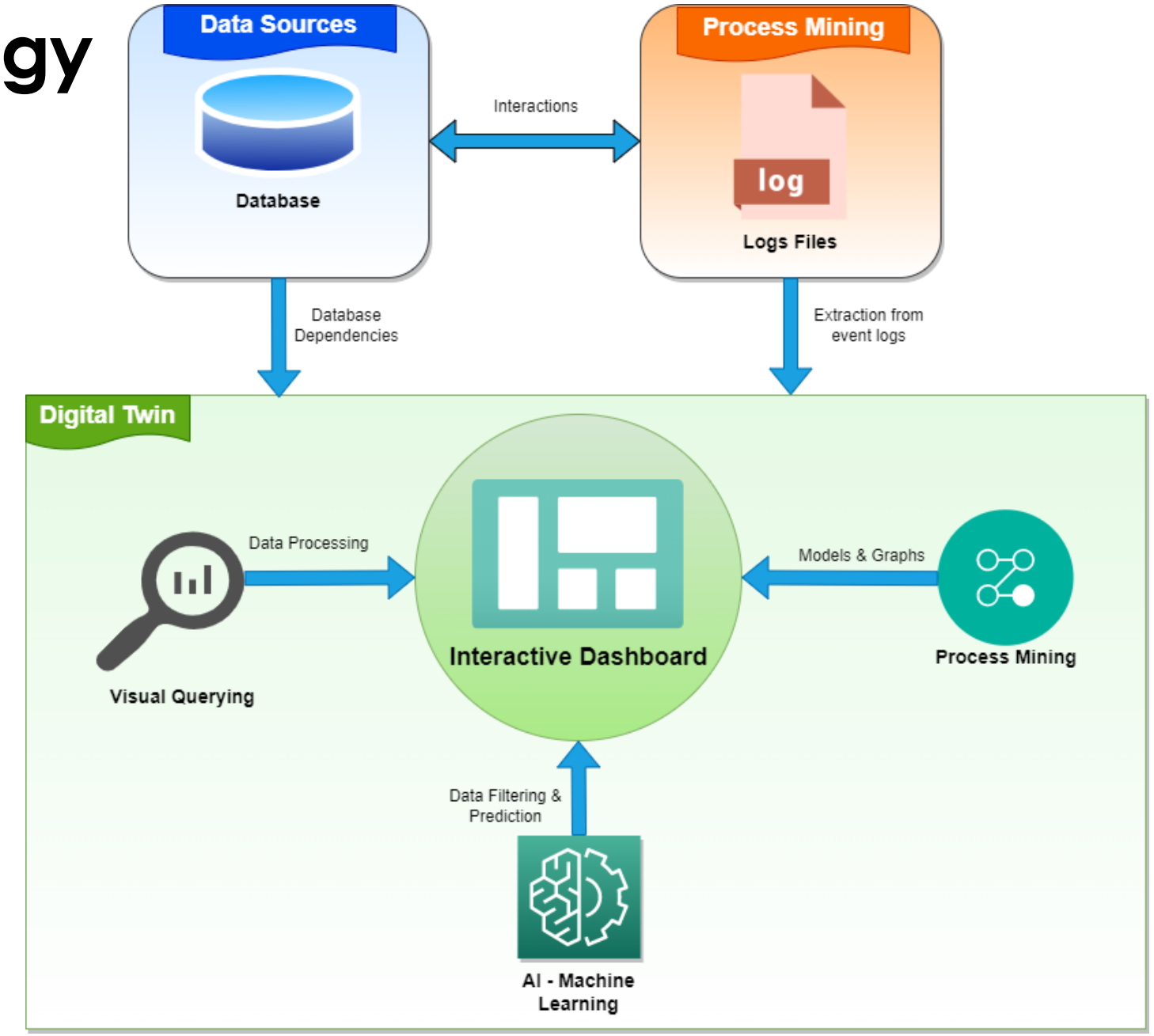
Technical Background (3/4)

- Digital Twin
  - Traditionally characterized by two-way interactions between the digital and the physical world
  - A DT offers error optimization to save money and time, reduces defects and manages the lifecycle of the Internet of things (IoT)
  - **Idea of DTs to graphically represent and interact with event data and process logs and applies this approach to industrial environments**

Technical Background (4/4)

- Process Mining
  - Technique designed to discover, monitor and improve real processes by extracting readily available knowledge from event logs stored in information systems
  - Use different algorithms to extract and organize data and business flows, with the top 5 mining algorithms being Alpha Miner, Fuzzy miner, Heuristic miner, Inductive Miner and Genetic miner
  - **Provide the means for a totally different user experience based on visual querying and process mining data-driven tasks, which is characterized by simplicity, self-explainability, ease of use and graphical ergonomics**

Methodology

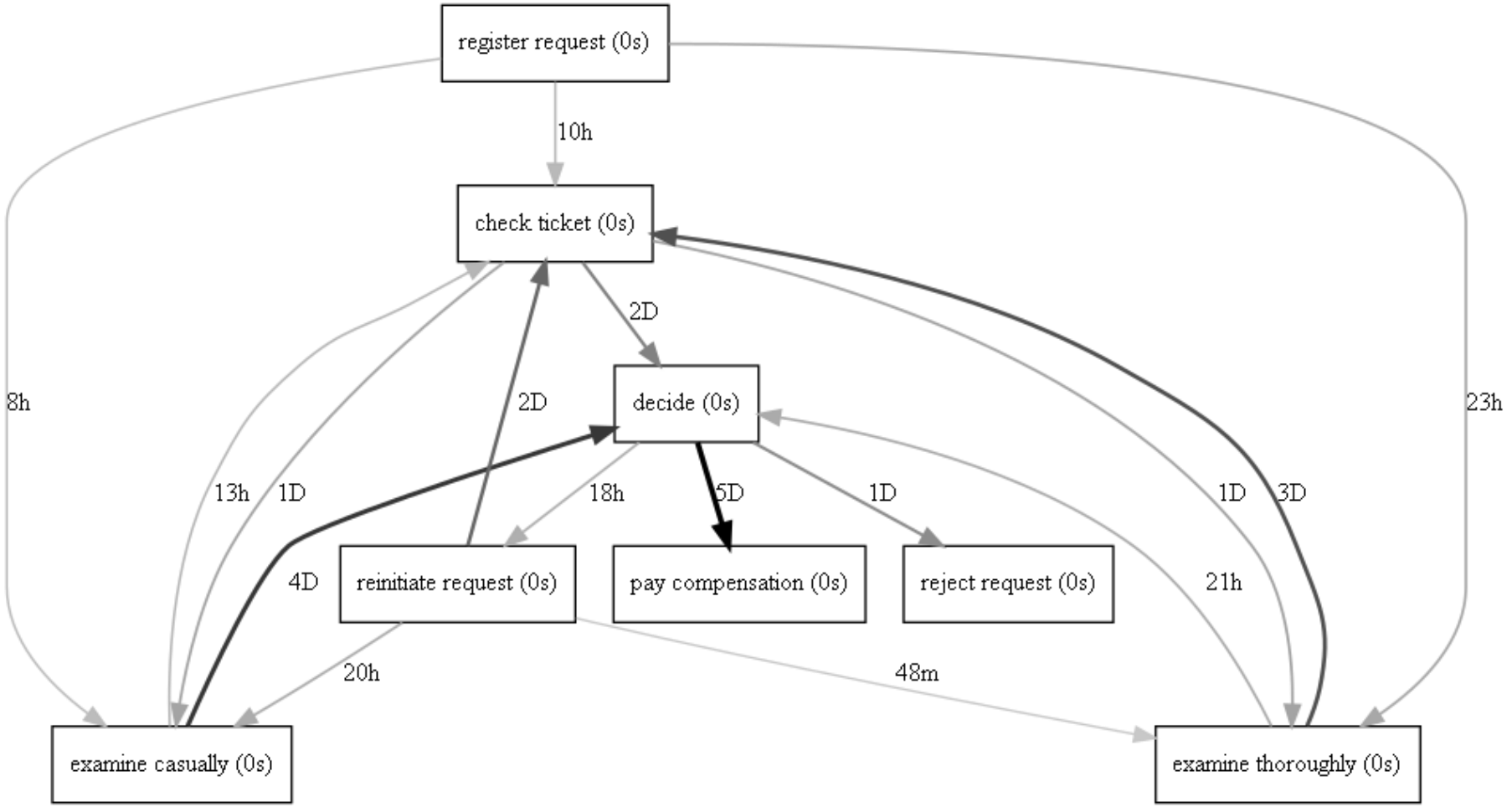


Methodology

- A dedicated software tool was developed to demonstrate the proposed framework
- Python, mainly using pm4py, pandas and Streamlit libraries
- Unity was the environment used to produce playful, aesthetically correct and user-friendly graphics for the presentation and interactive use of the dashboard

System Demonstration

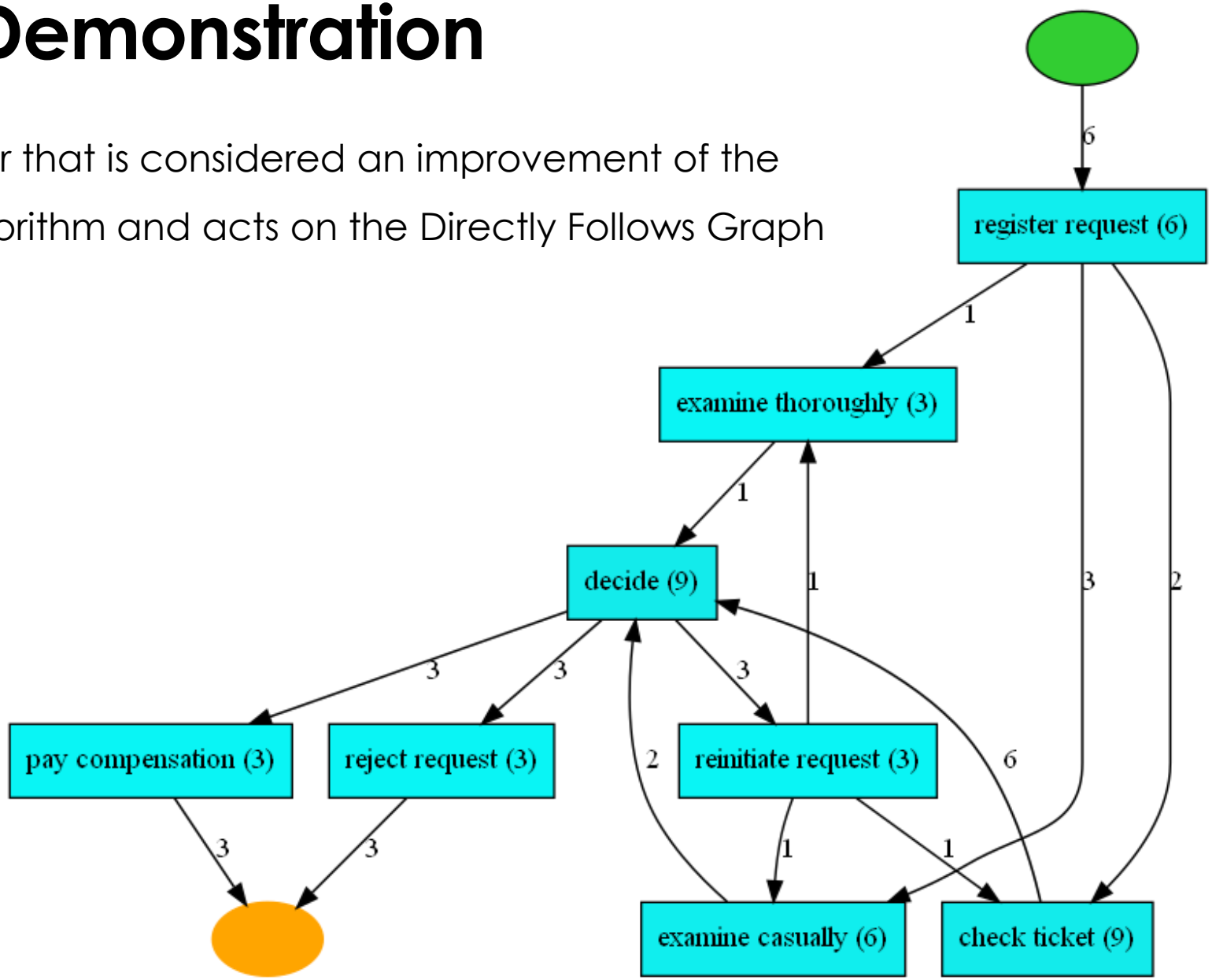
- Directly Follows Graph based on average time



System Demonstration

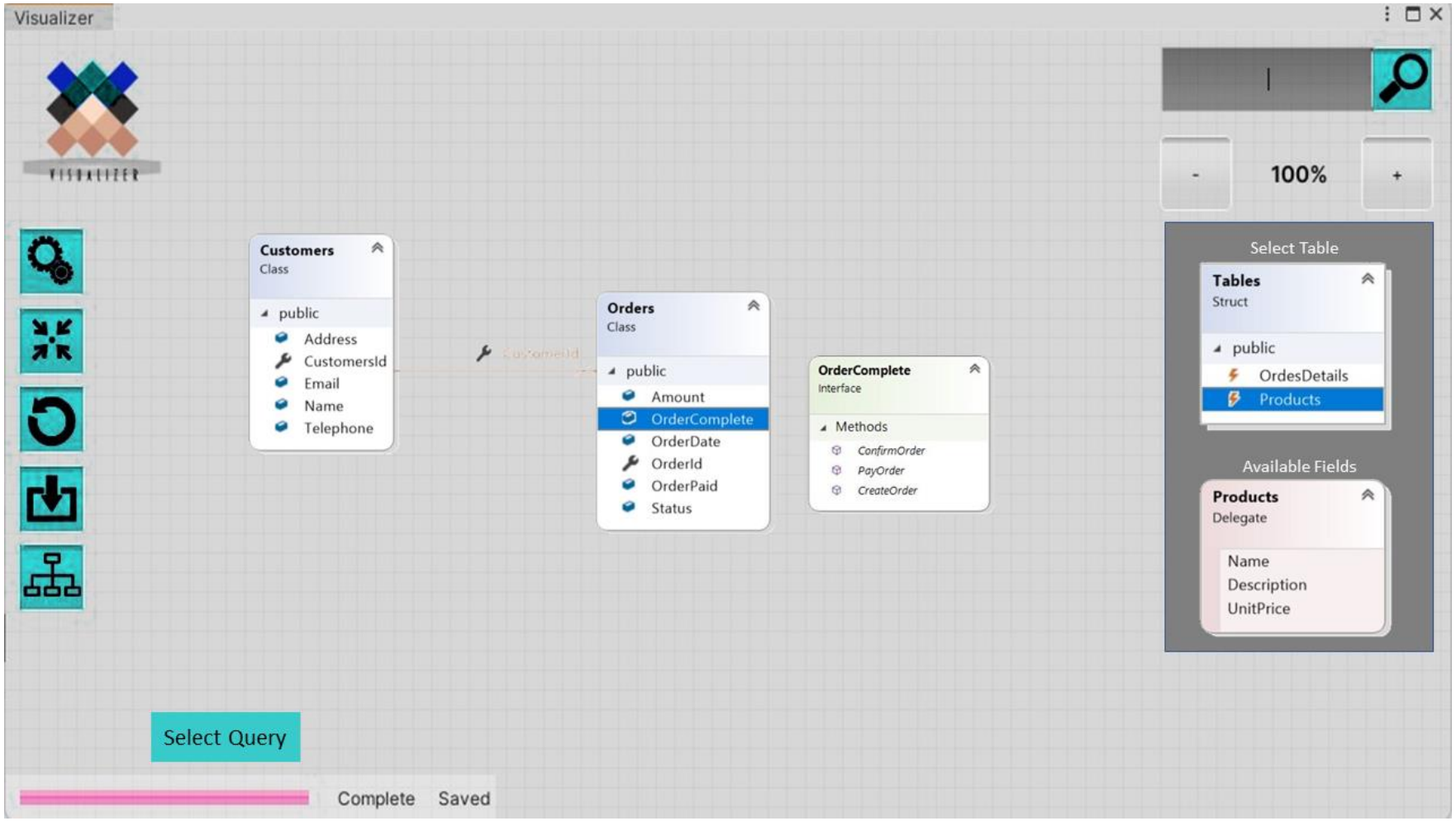
- Heuristic Miner that is considered an improvement of the

Alpha Miner algorithm and acts on the Directly Follows Graph



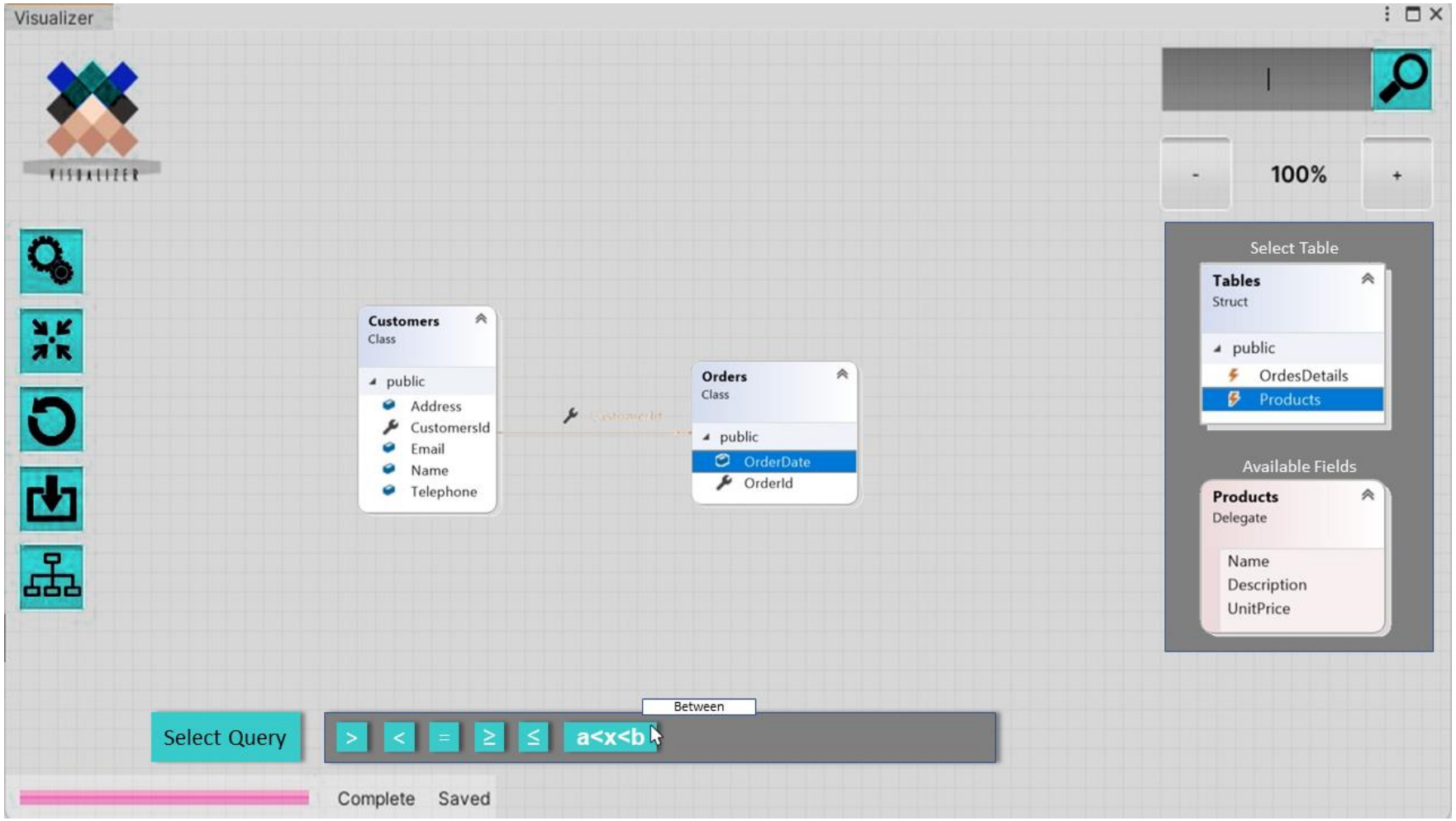
System Demonstration

- Selection of tables and attributes of interest



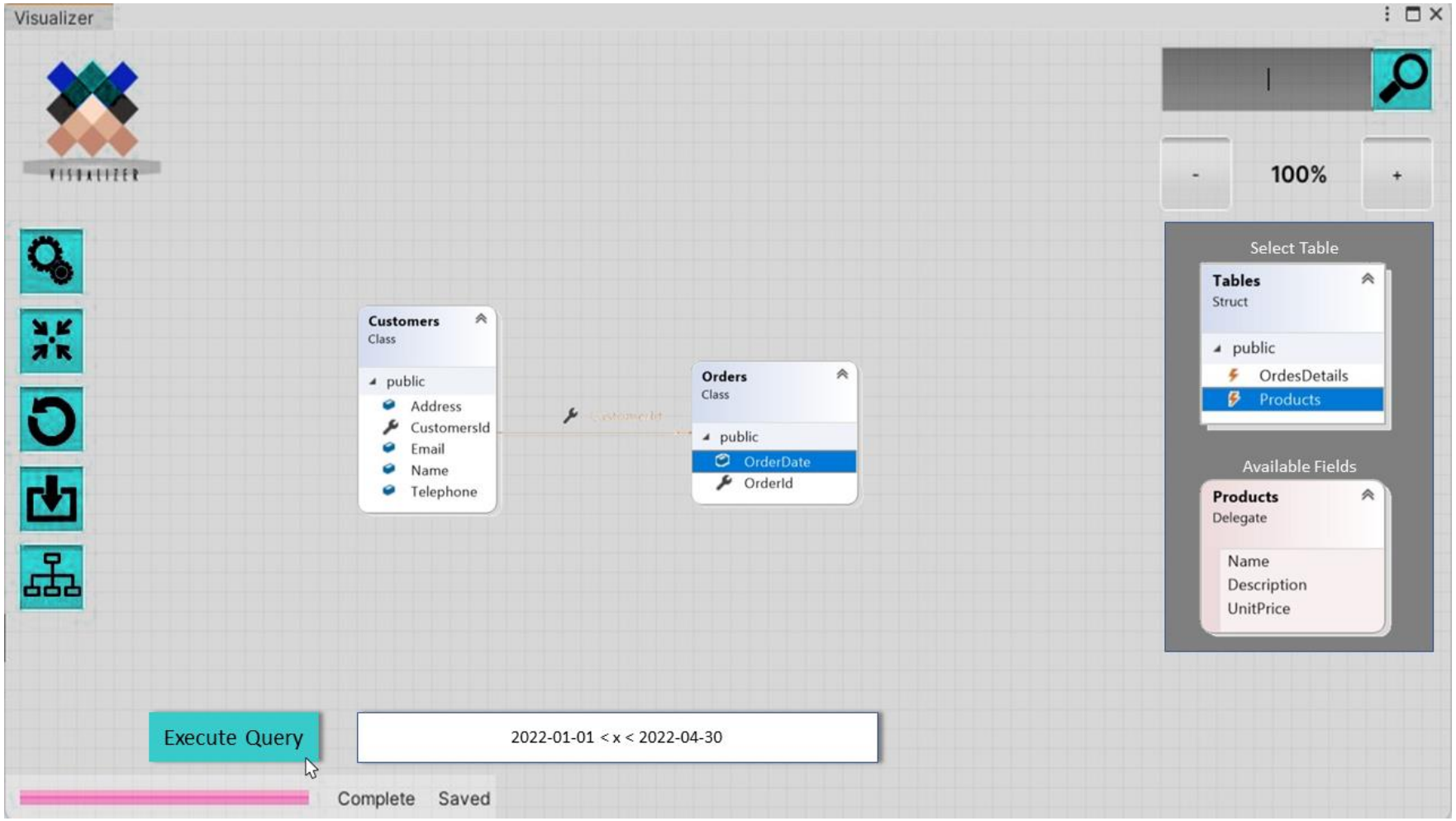
System Demonstration

- Selection of logical and arithmetic operators



System Demonstration

- Creation and execution of a visual query



System Demonstration

- Results obtained from a visual query

CustomersId	Name	Email	Address	Telephone	OrderId	OrderDate
1451	John	john@example.com	Steet no 1	99111111	147854	2022-01-05
1001	Andrew	Andrew@example.com	Street no 10	99101010	254114	2022-02-10
1018	Chris	chris@example.com	Street no 22	99221122	189588	2022-02-22
1451	John	john@example.com	Street no 1	99111111	156040	2022-04-03
1451	John	john@example.com	Street no 1	99111111	156065	2022-04-10
1991	Helen	jelen@example.com	Street no 9	99121314	221478	2022-04-28

Future Work

- Use of Data Lakes in which sorted and cleaned data will be hosted
- More sophisticated visualization features supporting predictive analytics
- Suggestion of business flow corrections to achieve better process results

THANK YOU

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