Improving Decision Making using Semantic Technology

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Tek Raj Chhetri
@TekRaj_14
tekraj.chhetri@sti2.at
With inputs from Anna Fensel
Outline

1) **Introduction Decision Making**

2) **Motivation**

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5) **Evaluation Plan**
Acknowledgements

• **smashHit**: Smart Dispatcher for Secure and Controlled Sharing of Distributed Personal and Industrial Data”, EU Horizon 2020 funded project, duration: 2020-2022,
  - [https://www.smashhit.eu](https://www.smashhit.eu)

• **KI-Net**: Building Blocks for AI-based Optimization in Industrial Production”, Interreg funded project, duration: 2020-2022,
  - [https://www.scch.at/de/das-projekte-details/KI-Net](https://www.scch.at/de/das-projekte-details/KI-Net)
1. Introduction to Decision Making

- Decision making is defined as a mental process, which involves judging multiple options or alternatives, in order to select one, so as to best fulfil the aims or goals of the decision-maker [1].
1. Introduction to Decision Making

- The main aim of this research is to improve machine-based automated decision making in a heterogeneous and distributed environment.

- Machine-based automated decision making in a heterogeneous and distributed environment refers to using a machine to decide in a distributed environment, such as smart cities, with complete or minimal human intervention.
2. Motivation

- Machine learning (ML) based systems have limited explainability, interpretability and are potentially biased in nature [2, 3, 4] and lack context.
  - E.g. Blacks were penalised more severely than nonblacks, even when the nonblacks had more severe crimes [4].

- Semantic Web technologies can help ML missing semantics (or contextual information), can make ML and further can make ML interpretable and explainable [5, 6, 7].

2. Motivation

- According to the World Economic Forum data is a new asset in this modern time\(^2\).
- The consequences can be both positive and negative based on how data is used.
  - E.g. The use of voter data in a political campaign to manipulate voters can endanger fundamental rights and undermine democracy [8].
- GDPR (General Data Protection Regulation)\(^3\) was implemented on May 25, 2018 and provides data owner control over their data.
- GDPR has introduced six legal bases; consent, contract, legal obligations, vital interests of the data subject, public interest and legitimate interest.
- We need a compliance verifier.


2. Motivation

• There is a growing use of connected things in healthcare, industry such as manufacturing and other mission-critical systems.

• The deployed systems in domains such as healthcare needs to be fail safe because failure can reduce productivity, increase downtime and even cost human lives.

• Maintenance yields 15 to 60% of total manufacturing operating costs [9].

• Market value of USD 21.20 Billion by 2027[^4].

Challenges

Knowledge representation and processing at scale, integration with techniques like modern ML methods, and data complexity [10].

Integration of reasoning techniques, such as embedding-based reasoning, logic-based and neural network-based reasoning techniques [11].
3. Main Research Question

**RQ:** To what extent we can leverage Semantic Web technologies to improve and automate decision making in a distributed and heterogeneous environment?

• *To what extent can we improve decision making by combining a knowledge-driven approach with a data-driven approach where knowledge is represented using Semantic Web technologies in the form of knowledge graphs?*

• *To what extent can we support the required decision while also dealing with complex interactions and maintaining the necessary scalability in dynamic and heterogeneous environments such as smart cities and manufacturing?*
4. Contributions

5. Development of an automatic contracting tool for GDPR compliance verification in smashHit⁵.

6. Predictive maintenance prototype in KI-NET⁶.
4.1 Automatic Contracting Tool

- The automatic contracting tool will be in charge of making (or supporting) the following decisions:
- Whether data exchange should be permitted?
- Performing verification to determine whether there is a breach of contract or a broken consent chain.
- Checking updated consent information to make a further decision, such as limiting data access to the data processor.
- Mahindrakar et al. [12], D’Aniello et al. [13], Panasiuk et al. [14] will be reused.
4.2 Predictive Maintenance Prototype

• The predictive maintenance prototype would assist in the following decisions:
  • Decision when to perform maintenance?
  • Decision about the type of action required, such as automatic or manual control action.
  • Performing the appropriate automatic control action or selecting the best possible solution and presenting it to the user (or operator) in the case of manual control action.
  • Zhou et al [15], D’Aniello et al. [13], Panigutti et al. [16] will be reused.
Two-stage evaluation, one before integrating and the other after integration. Evaluation will be carried out using metrics such as accuracy, Precision at N (Prec@N).

Mahindrakar et al. [12], Sun et al. [17], and Wang et al. [18] will be used as a reference studies.
Thank you for your attention!

Questions?

http://tekrajchhetri.com @TekRaj_14 @tekrajchhetri
References


References


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