GRAKN LABS

A Knowledge Graph for Autonomous Robotics Systems

TNO innovation for life

GRAKN LABS

AUTONOMOUS ROBOTICS SYSTEMS

> “The fact that Grakn Labs aims to add the state-of-the-art to its reasoner shows that they are ambitious and therefore a perfect partner for companies that want to be in the forefront of realising actual AI systems”
>
> Joris Sijs, Senior Scientist & Research Fellow, TNO

At TNO they are developing autonomous robots, for which numerous AI-solutions are integrated on remotely controlled robots. Some of the robots that they are using are aerial drones, small robotic cars and quadruped robots (SPOT). TNO uses the following to characterise autonomy:

"...a *single system, or a system of systems, that understands its goal and the situation, that is capable of reaching that goal largely independently from human intervention, yet in cooperation with human team members.*"

Use Case:
TNO has set out to build an autonomous robotics system, where the system has more capabilities than simply processing sensor measurements into actual information, they also expect them to:
"have a deeper understanding so that they can put that information in the larger context of their surroundings“ says Joris Sijs, Senior Scientist & Research Fellow

Industry:
Robotics

Use Case:
Autonomous Robotics Systems

Challenge:
To build a robotics systems that is able to make decisions about its configuration based on changing environmental scenarios

Solution:
A knowledge-base that stores, manages and reasons with the combination of actual information and general knowledge

Result:
SnowBoy: intelligence for autonomous robotic systems

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Challenge:

A robot that reaches its goals largely independent from human intervention, is generally solved by allowing the robot to make independent decisions on its behaviour and on the usage of its resources during operation. However, before the robot is able to make these decisions, it should understand the surrounding world in which it is operating. Further, autonomous robots are expected to operate in dynamic and unpredictable environments (the so-called open world assumption). This implies that a robot should complete its task(s) under changing, and sometimes novel, conditions - it cannot be expected that the engineer who designed the robot was able to prepare it for all edge cases. Hence, TNO's robots need to be able to do more than just processing sensor measurements into actual information. The goal is to facilitate the system's ability to put this information in the context of its ever changing enviornment.

Grakn allows us to adjust the ontology by which we represents the robot's knowledge online."

Joris Sijs, Senior Scientist & Research Fellow, TNO

Why Grakn:

Firstly, Grakn allows the team to adjust the ontology by which the robot's knowledge online is represented. Grakn's schema is flexible and extensible allowing, in this case, a robot to use the inbound sensor measurements to learn new aspects of its surroundings and store that piece of knowledge sensibly with the rest of its general knowledge.

Secondly, to model one's knowledge, Grakn natively implements the enhanced entity-relationship model, using a hypergraph data model as the formal foundation, which together make it easier to work with complex data. In TNO's experience, real-world phenomena, in which their robots are operating in, are often more naturally expressible in a hypergraph, and as such, could improve the interoperability between the robot and its human team-mate as well.

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Thirdly, Grakn's built-in reasoner; is on a development path to integrate new features over time. Grakn started, for example, by including typical inference-rules , i.e., if-then or when-then, to which a developer has the benefit of making inference-rules in the same language as the knowledge is modelled (Graql). TNO is also interested in Grakn's "start-of-the-art" reasoning as graph-based learning with KGCN (Knowledge Graph Convolutional Networks). Although using such new solutions require the attention from a developer, and there's work to be done, the fact that Grakn aims to add machine learning to its reasoner demonstrated to the TNO team, the ambitious plans ahead and "therefore are a perfect partner for companies that want to be in the forefront of realising actual AI systems."

About Grakn:
Grakn is a distributed knowledge graph: a logical database to organise large and complex networks of data as one body of knowledge. Grakn provides the knowledge engineering tools for developers to easily leverage the power of Knowledge Representation and Reasoning when building complex systems. Our enterprise product, Grakn Cluster, is available on any cloud provider and on premise.

Grakn is used in numerous applications from tax automation bots to complex use cases in drug discovery via protein pathways, a knowledge network of drones and robots, cybersecurity and financial services. Users include organisations such as AstraZeneca, Cisco, the French Intelligent Services, Bayer and Nestlé.