Towards a Semantic Model for Wise Systems

Graph Matching Algorithm

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Before you code, you have to think, in order to think, you must have a paradigm.

Experience

Ph.D Student Teacher — **France**
Polytech Annecy-Chambéry — *2020 - 2023*

Python, PHP/Symfony3.4 consultant — **Morocco, USA, France**
Amundi, Acensi, OCP-SA, RevoTrends, Vili — *2017 - 2020*

Education

Ph.D Student — **France**
Savoie Mont-Blanc university, — *2020 - 2023*
Computer Science.

Master degree — **Morocco**
Hassan I university, — *2015 - 2017*
Application Architecture and Development Engineering.

Bachelor degree — **Morocco**
Hassan I university, — *2011 - 2014*
Application Architecture and Development Engineering.

Languages

Arabic: Native

French: Fluent

English: Fluent

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Wise objects

To begin with

The first idea was to create an object that could learn by itself about itself to moderate attention from the end-users [8] [7] (Calm technology).

Currently, the wise object:

- Gets knowledge about its capabilities.
- Gets knowledge about its use.
- Analyses its knowledge to generate new one.
- Reacts according to its knowledge.

Wise objects

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Wise objects

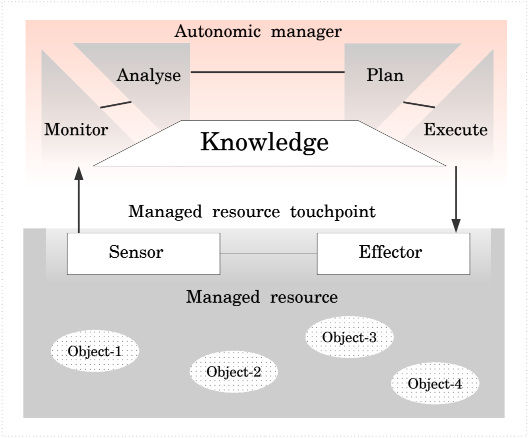


Figure 1: WO respects the notion of MAPE-K to ensure adaptability

Conceptual view [1]

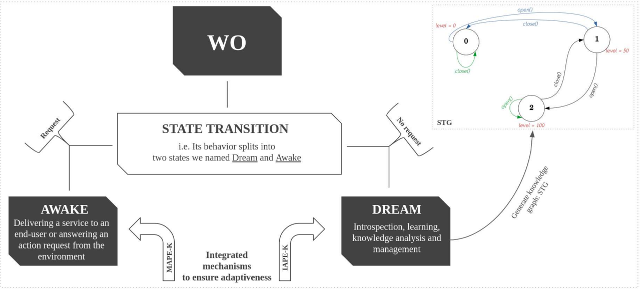
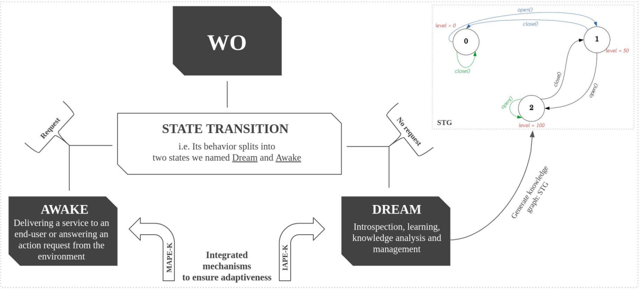


Figure 2: Different states of wise object

Lacks

- How to make a wise object able to communicate with humans?
- What are the limits of such an object?

Conceptual view [1]



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Why using an IOSTS?

In oracle or controller synthesis, IOSTS graphs are often used to model the behaviour of systems, and as this type of graph is conceptually understandable by humans, it has semantics.

Definition 1 (IOSTS).

An IOSTS automaton is a syntax that allows finite descriptions of infinite transition systems [4] [3].

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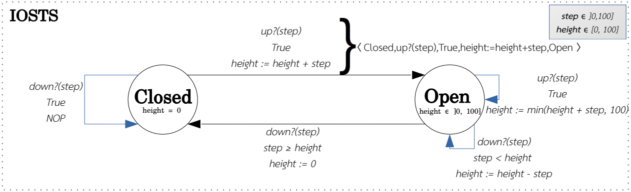

Figure 3: IOSTS representation of a roller shutter

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Problematic diagram

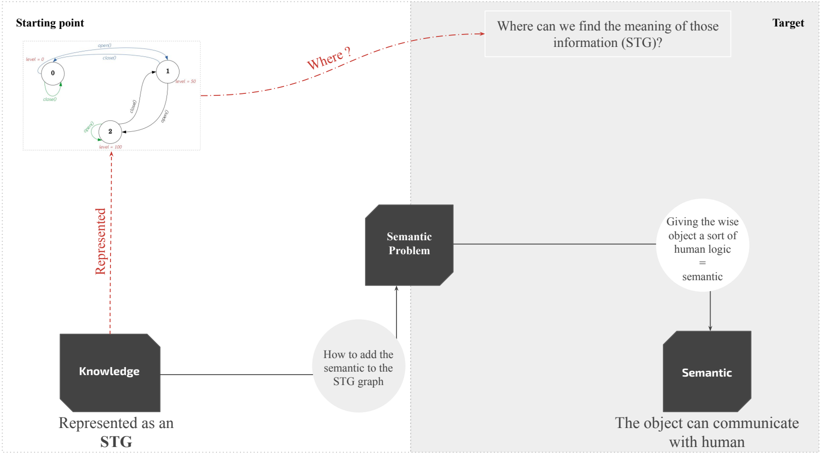
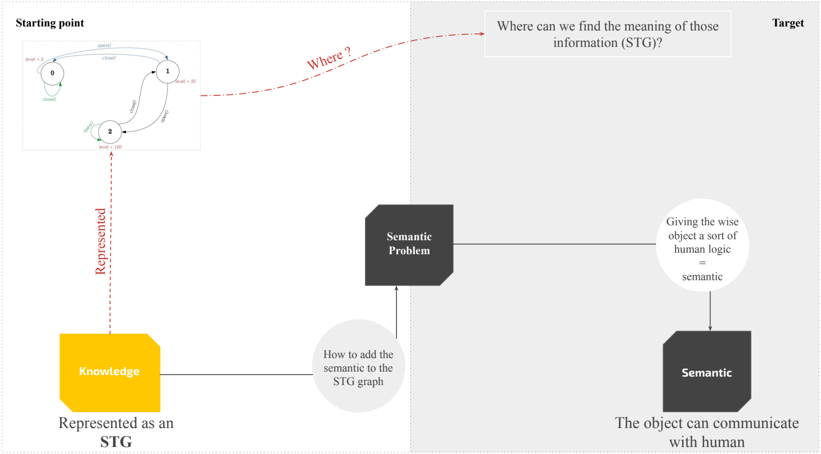


Figure 4: From wise object knowledge to human semantics[1].

[1] Semantic is the meaning given to something so that it can be understood by humans as mentioned in [2]. This definition also applies to objects/devices, as semantic is used to communicate with humans.

Problematic diagram



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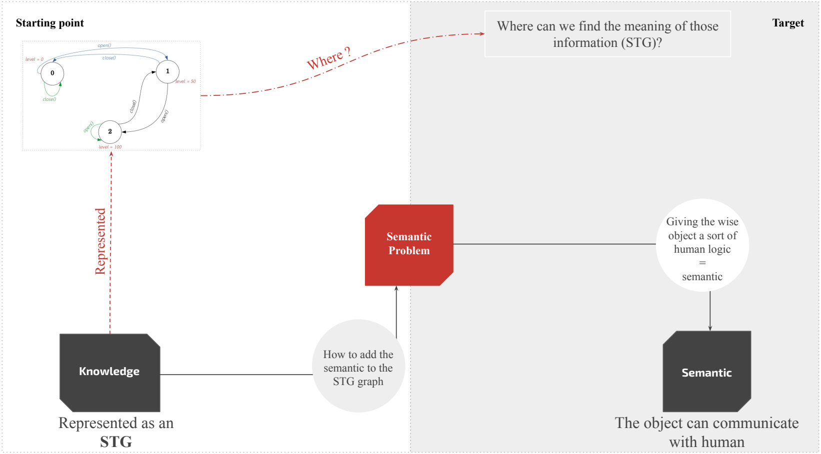

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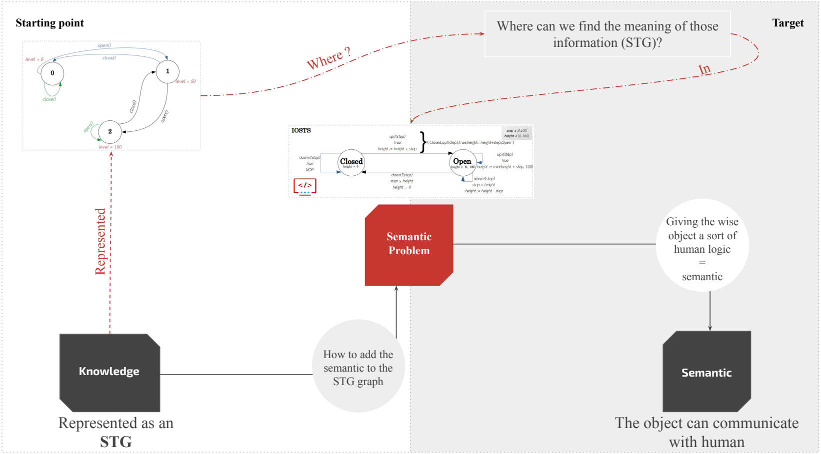

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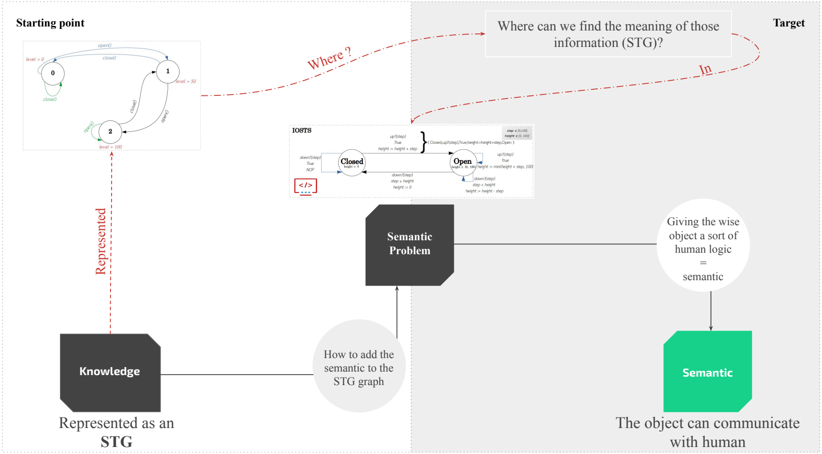

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How to link the two representations?

Proposal

Extend the generated knowledge (STG) with the conceptual knowledge (IOSTS) using a *matching algorithm based on graph morphism.*

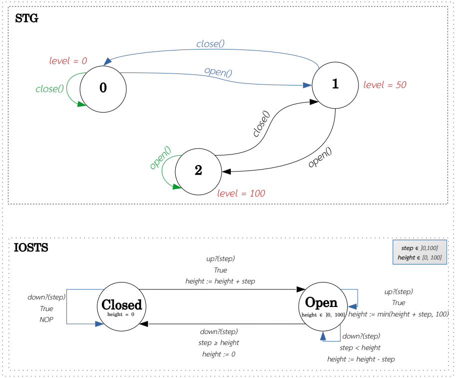


Figure 5: Two representations of knowledge

Algorithm: Based on the concept of graph morphism

Uniqueness of localities

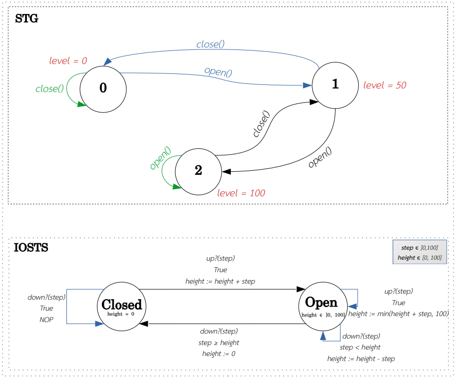
$$\forall q, q' \in Q, dom(q, x_e) \cap dom(q', x_e) = \emptyset.$$

Variable matching

$$\exists! x_e \in X, \exists! att_e \in A | x_e \equiv att_e,$$
$$x_e \equiv att_e \Leftrightarrow Dom(att_e) \subseteq Dom(x_e).$$

States matching

$$\forall v_i \in V, \exists! q_j \in Q$$
$$value_{i,e} \in dom(q_j, x_e) \Leftrightarrow v_i \implies q_j.$$



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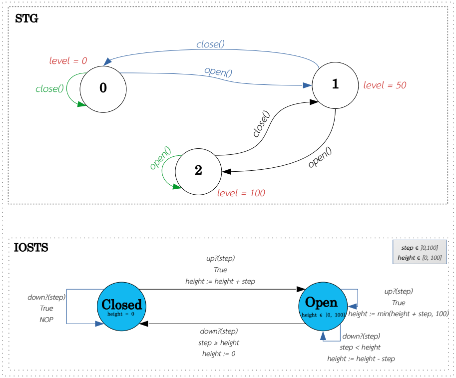

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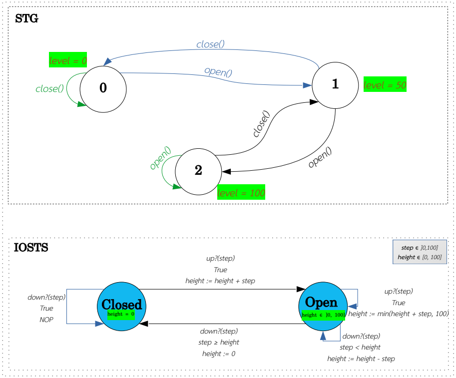

Figure 6: Algorithm result of the variable/attribute matching

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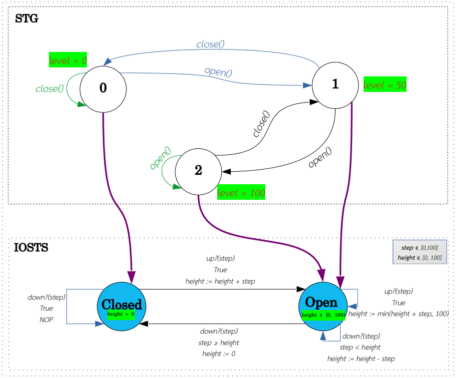

Figure 6: Algorithm result of the graph matching

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Current work: Many variables approach

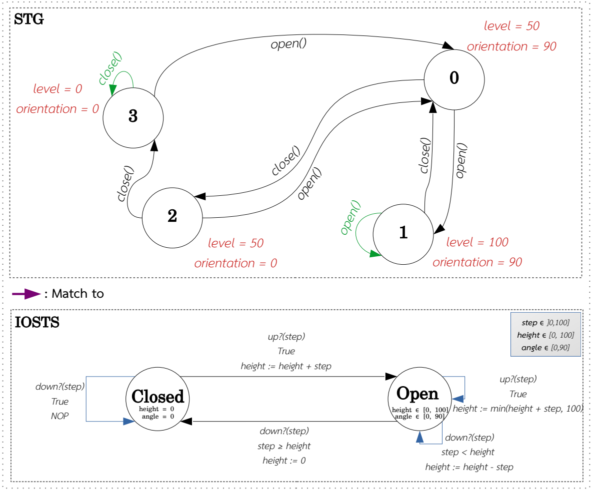

Figure 7: How can the matching algorithm be improved to take into account many variables?

Current work: Many variables approach

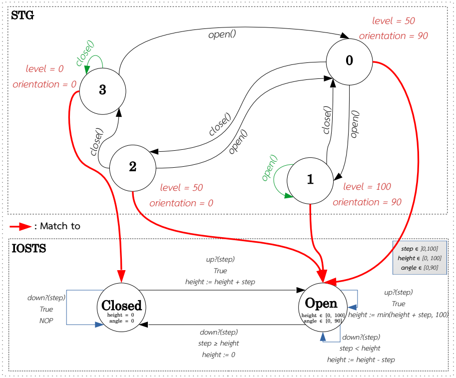

Figure 8: $level \equiv height; orientation \equiv angle$

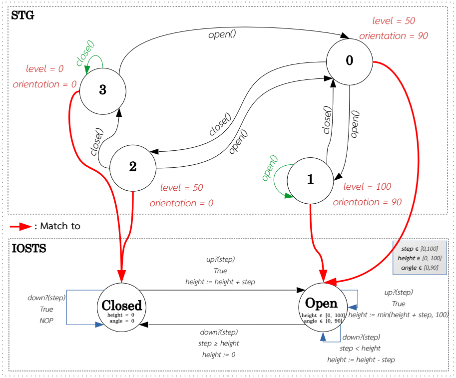

Figure 9: $orientation \equiv height$

Towards a Semantic Model for Wise Systems

Graph Matching Algorithm

Thank you

Future work: Ontology & Knowledge graph

I propose to link the graph matching result with one of the four generality level[2] of ontology[3] levels in order to contextualize the result.

Definition 2 (Ontology).

An ontology is an explicit specification of a conceptualization. The term is borrowed from philosophy, where an Ontology is a systematic account of Existence. For artificial intelligence systems, what exists is that which can be represented.

- *Thomas R. Gruber 1993* [5]

- How to link the result of the graph matching algorithm with the ontology to contextualize it?
- Which of the four generality levels of ontology should be used [6]?

[2] Four generality levels of ontologies: Domain ontologies, Generic ontologies, Application ontologies and Representational ontologies

[3] Definition 2

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