3D INTERACTION ASSISTANCE THROUGH CONTEXT-AWARENESS

A semantic reasoning engine for classic virtual environment

Yannick Dennemont

I. 3DI adaptation interests

- Advantages:
  - To speed up the interaction
  - To diminish the cognitive load
  - To tailor the interaction
  - To add or manage possibilities
- Examples:
  - Choose between techniques (specificities, Bowman2006)(Lee2004)(Octavia2010)
  - Make techniques variations (flavors, Bowman2006)(Octavia2010).
  - Automatically add/manage modalities (Lee2004) (Bouyer2007).
  - Automatically perform parts of the task (Celentano2004)

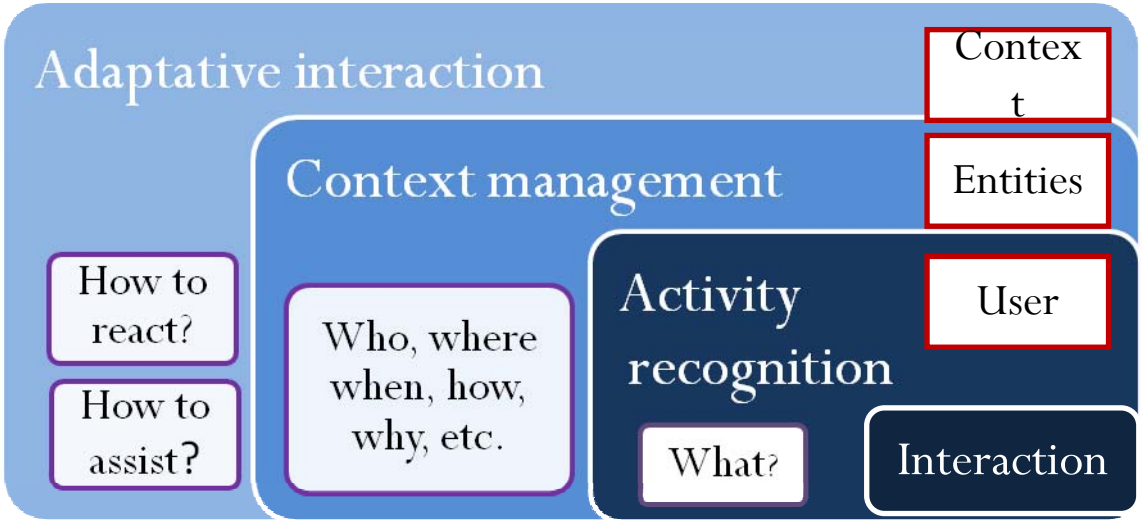
- Manage any adaptations?
- Achieve better adaptation?
- Apply adaptation automatically?

→ Use context !

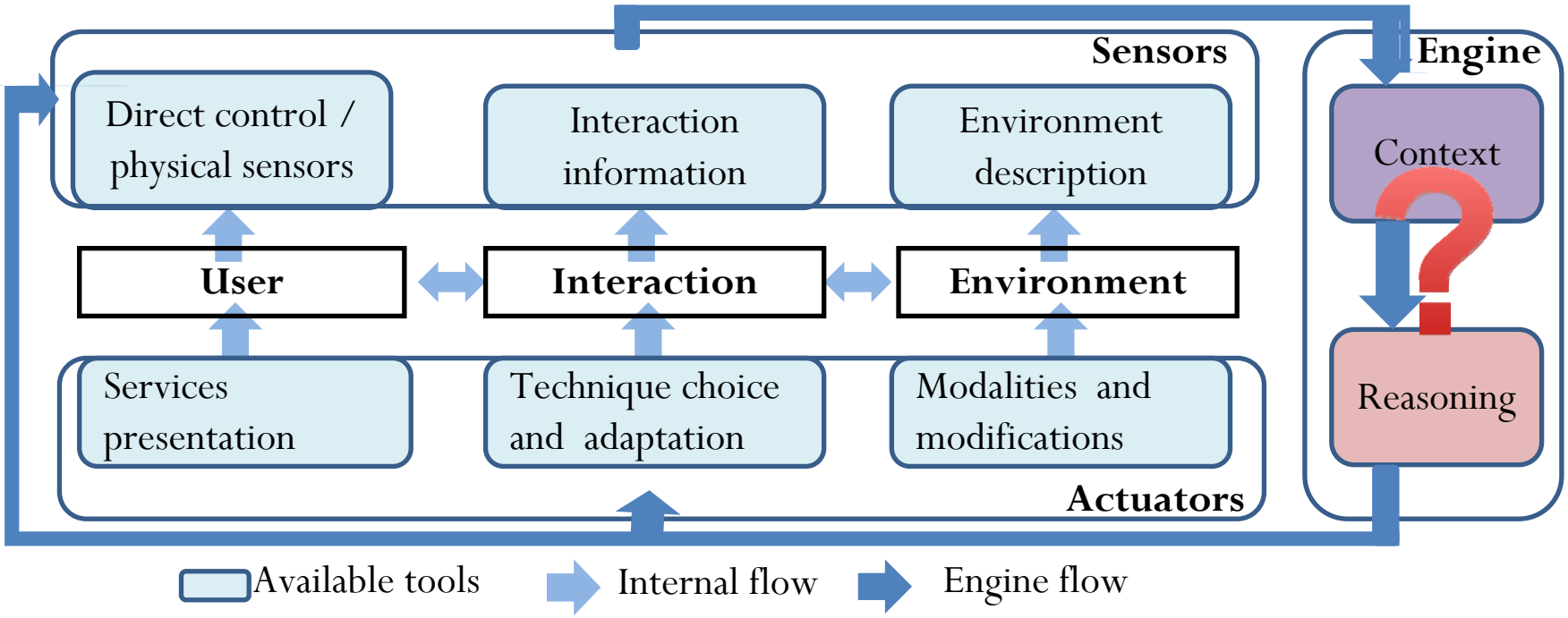
II Context-awareness

•Context : *any information that can be used to characterize the situation of an entity (person, place, object, user, applications etc.)*

• A context-aware system : *uses context to provide relevant information and/or services to the user.* (Dey 2000)



III. 1 Representation and reasoning choices



III. 1 Representation and reasoning choices

Methods	Representation	Information extraction	Reasonning	Interests
EAV CC/PP	☺			Efficiency
Markup Models	☺			Information presentation
Ontology	☺	😐		Reusability, interoperability
Conceptual graphs, Semantic net	☺	😐	☺	Functional knowledge representation
NN,HMM, MDP, DBN Learning		☺		Representation without semantic, Reasoning without rules
Fuzzy Logic/Belief Theory/ Probabilities	😐	☺	☺	Reasoning about uncertainty, imperfection etc.
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Petri's nets Contextual Graphs, FSM	☺		☺	Process representation

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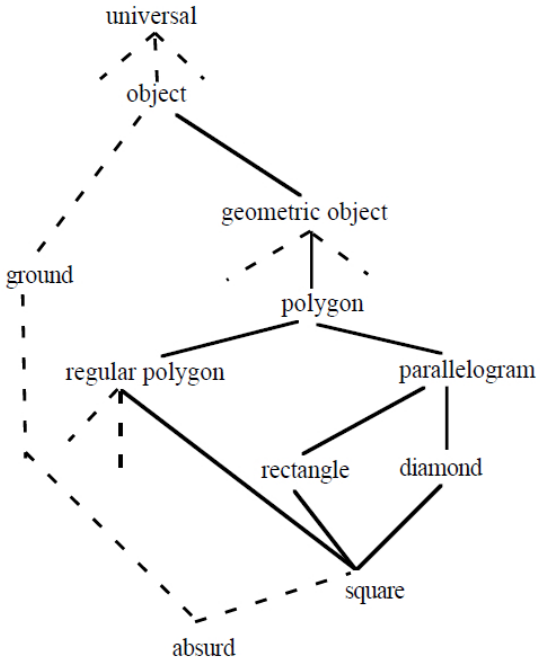
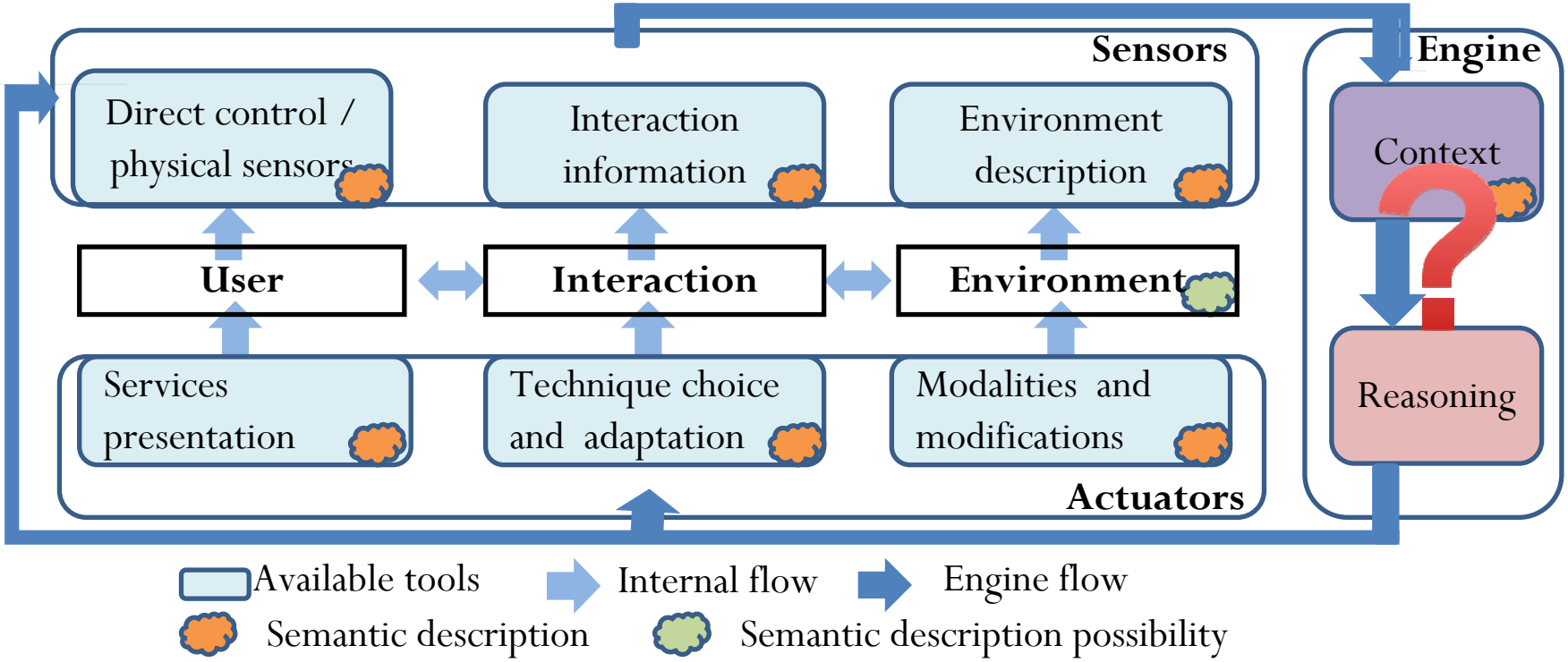
III.2 Ontology interests

Ontology : *explicit and formal specification of a shared conceptualization* (Gruber 1995)



- Ontology advantages:
  - Make the environment understandable by computers
  - Ease interoperability and reusability
  - Allow high level interpretation

III.2 Ontology interests



- Ontology classification: engine and applications separation
- Add semantic information in the environment.

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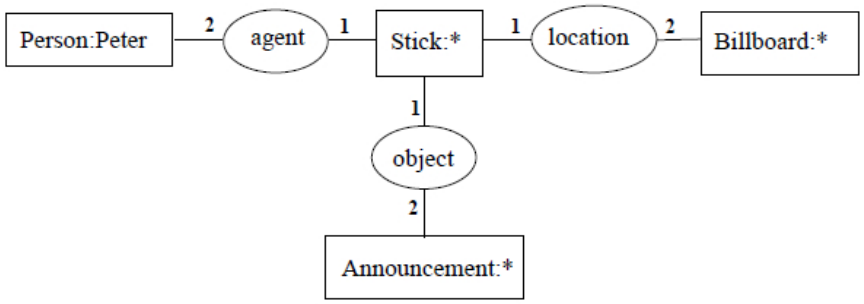
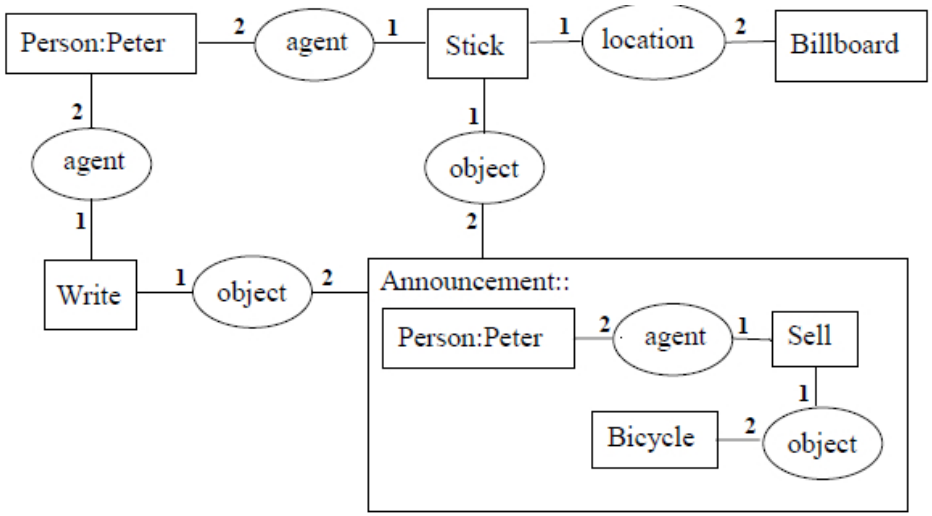
III.4 Conceptual graphs interests

- Based on an ontology
- Universal descriptors
- Usability : readable by humans and machines
- Nested graphs : context relativity
- Situation comparator

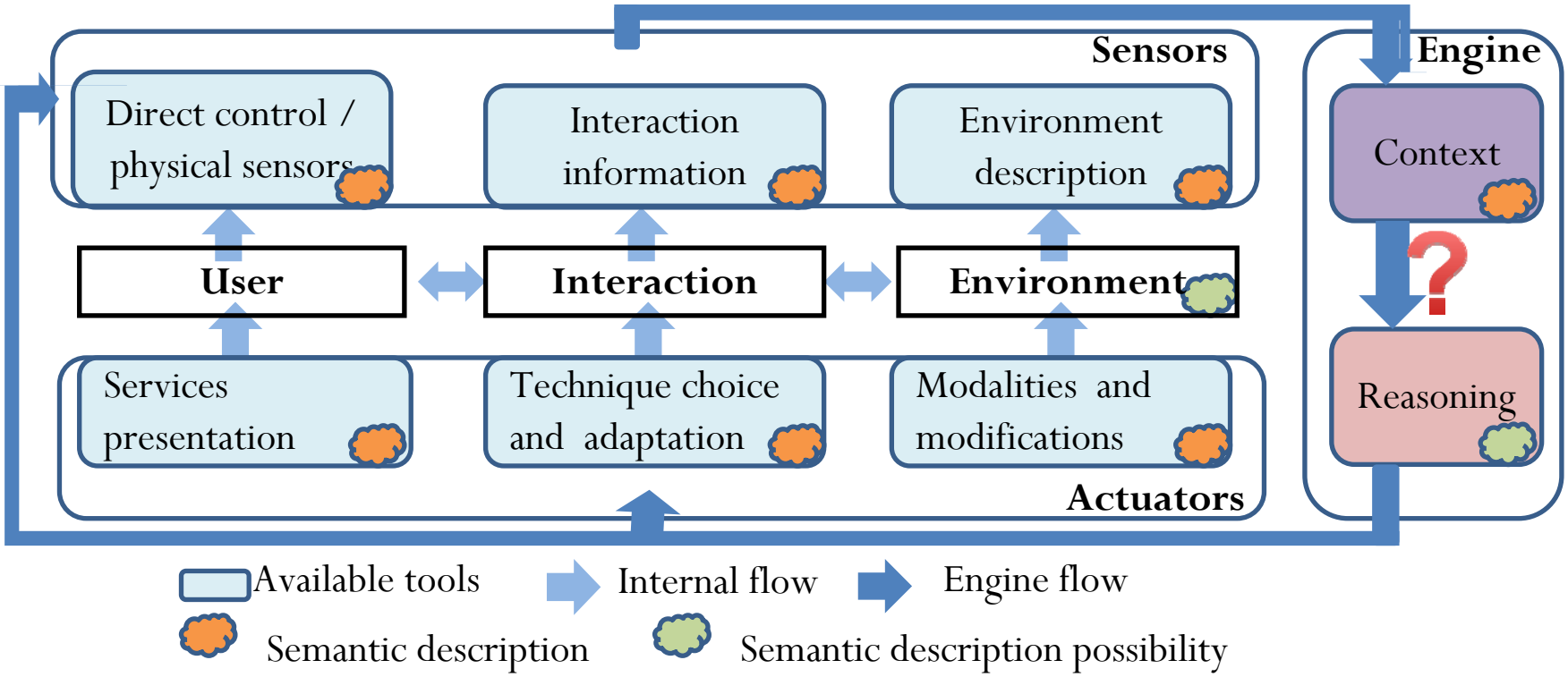




$$\Phi(G) = \exists y_2 y_3 y_4 (Person(Peter) \wedge Stick(y_2) \wedge Announcement(y_3) \wedge Billboard(y_4) \wedge agent(y_2, Peter) \wedge object(y_2, y_3) \wedge location(y_2, y_4)).$$

(M. Chein and M-L. Mugnier 2009)

III.4 Conceptual graphs interests



- Allows further description
- Allows rules and semantic description for the core's reasoning
- Allows the same representation for context and reasoning
- Other reasoning techniques can be nested in a CG

III.5 Representation and reasoning choices

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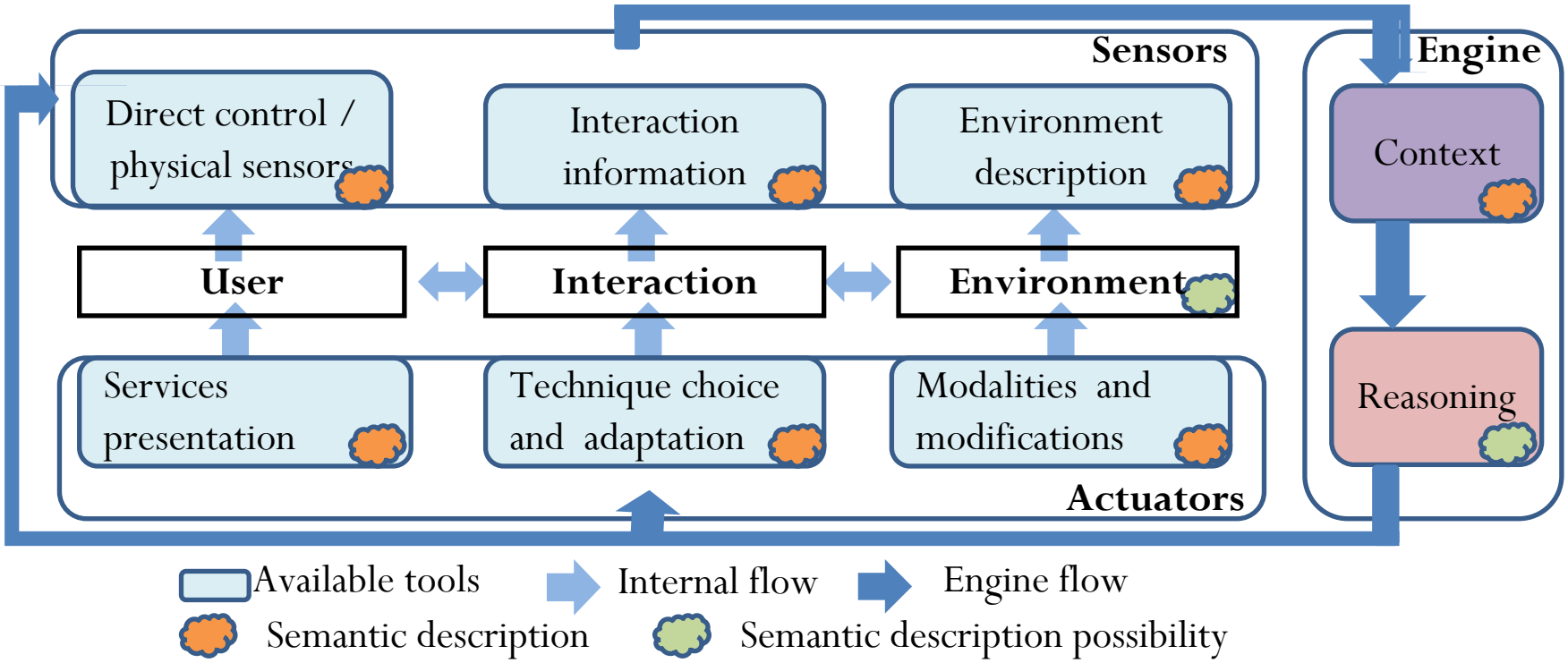

- Allows further description
- Allows rules and semantic description for the core's reasoning
- Allows the same representation for context and reasoning
- Other reasoning techniques can be nested in a CG
- Other reasoning techniques results can be expressed as a CG

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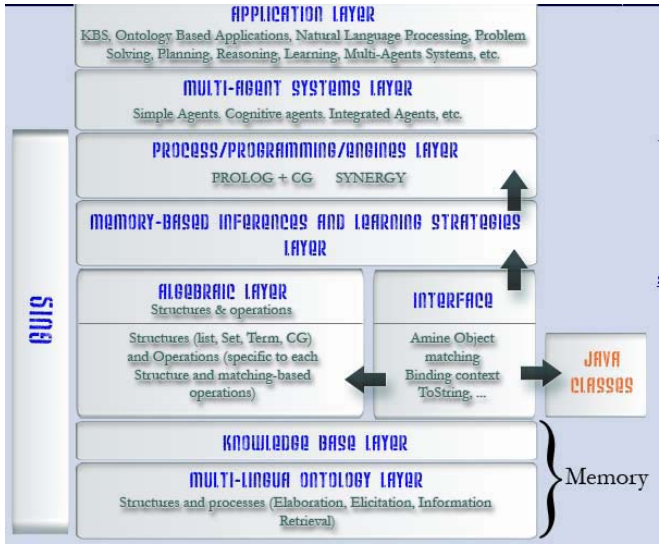
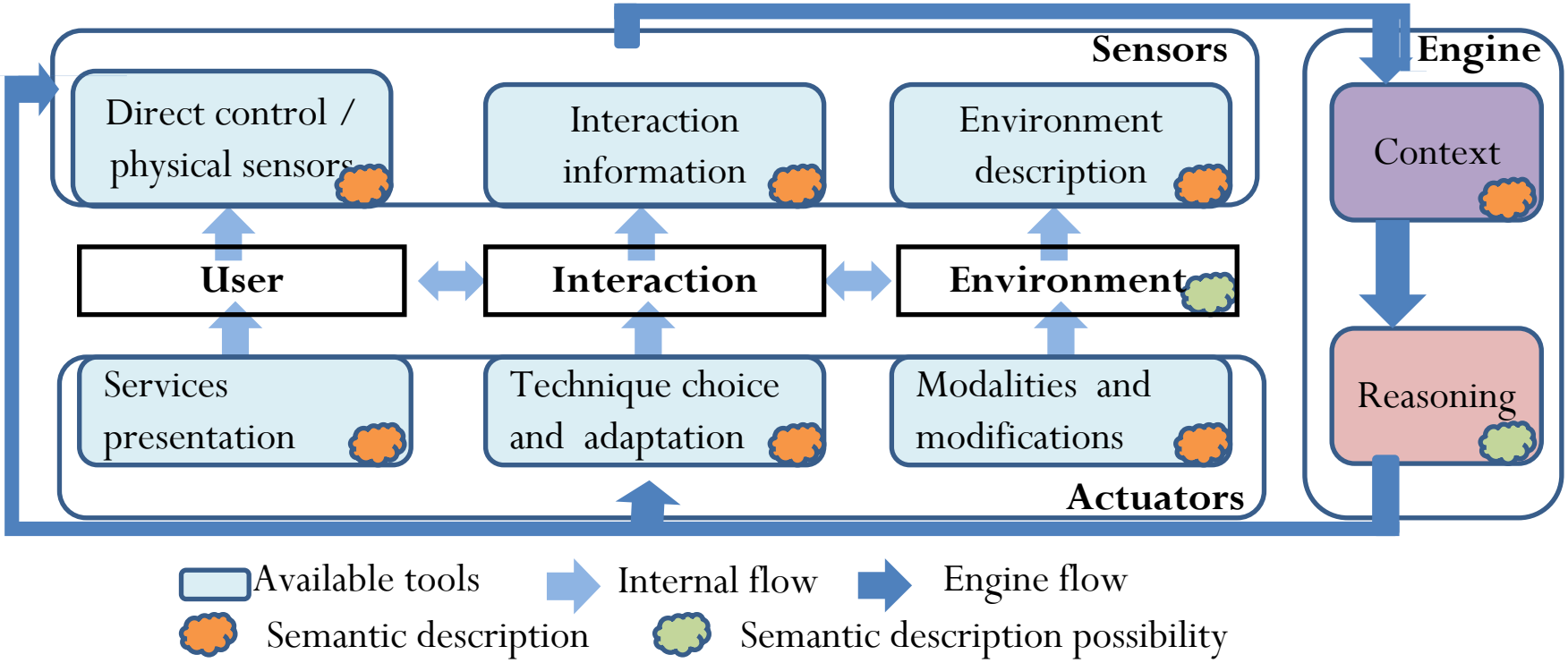
III.6 Implementation choices summary

- Engine advantages:
  - Independent semantic engine core.
  - Good expressiveness and usability.
  - Useable for any applications with their own tools.
- Methods advantages:
  - Ontology : reusability and interoperability.
  - Conceptual graphs: usability and expressiveness.
  - Logic programming: facts management and reasoning.



Amine Platform
(A.Kabbaj 2000,2006,2011)

IV. 1 A parallel engine



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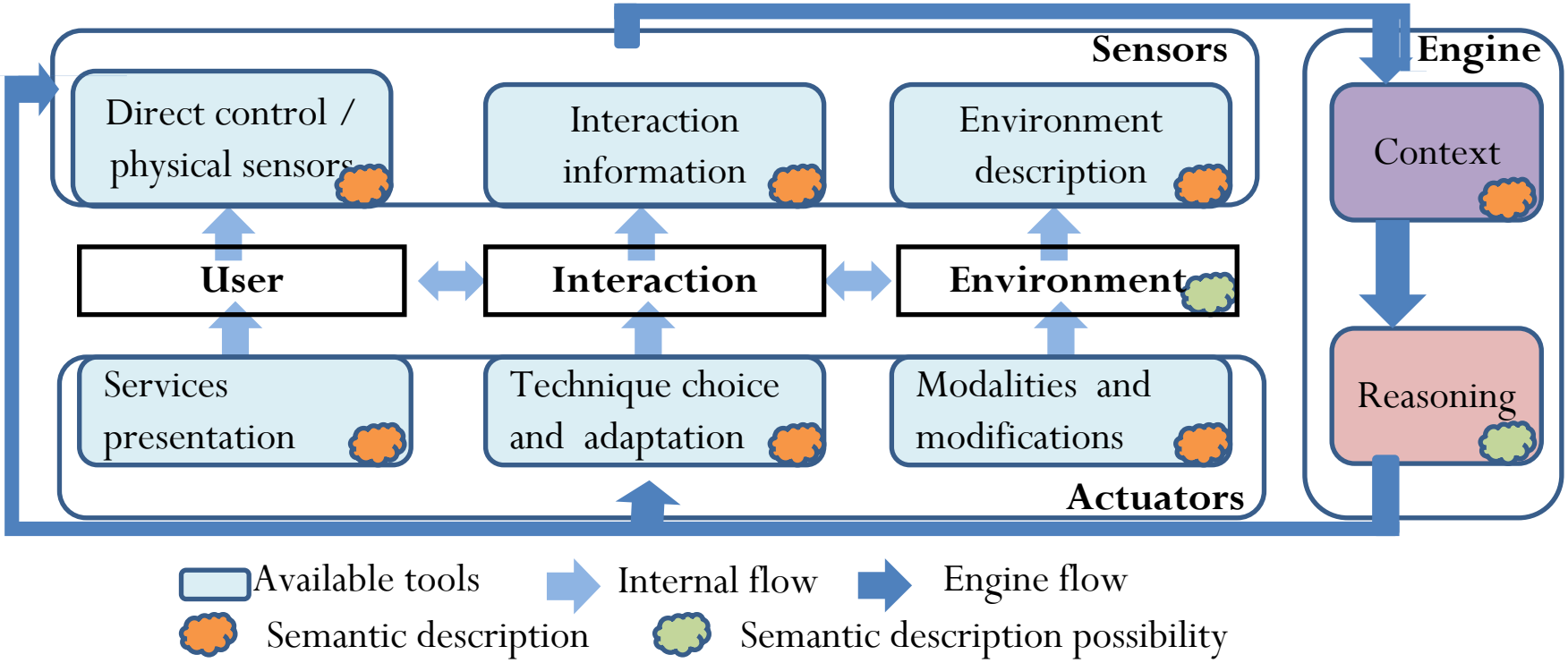
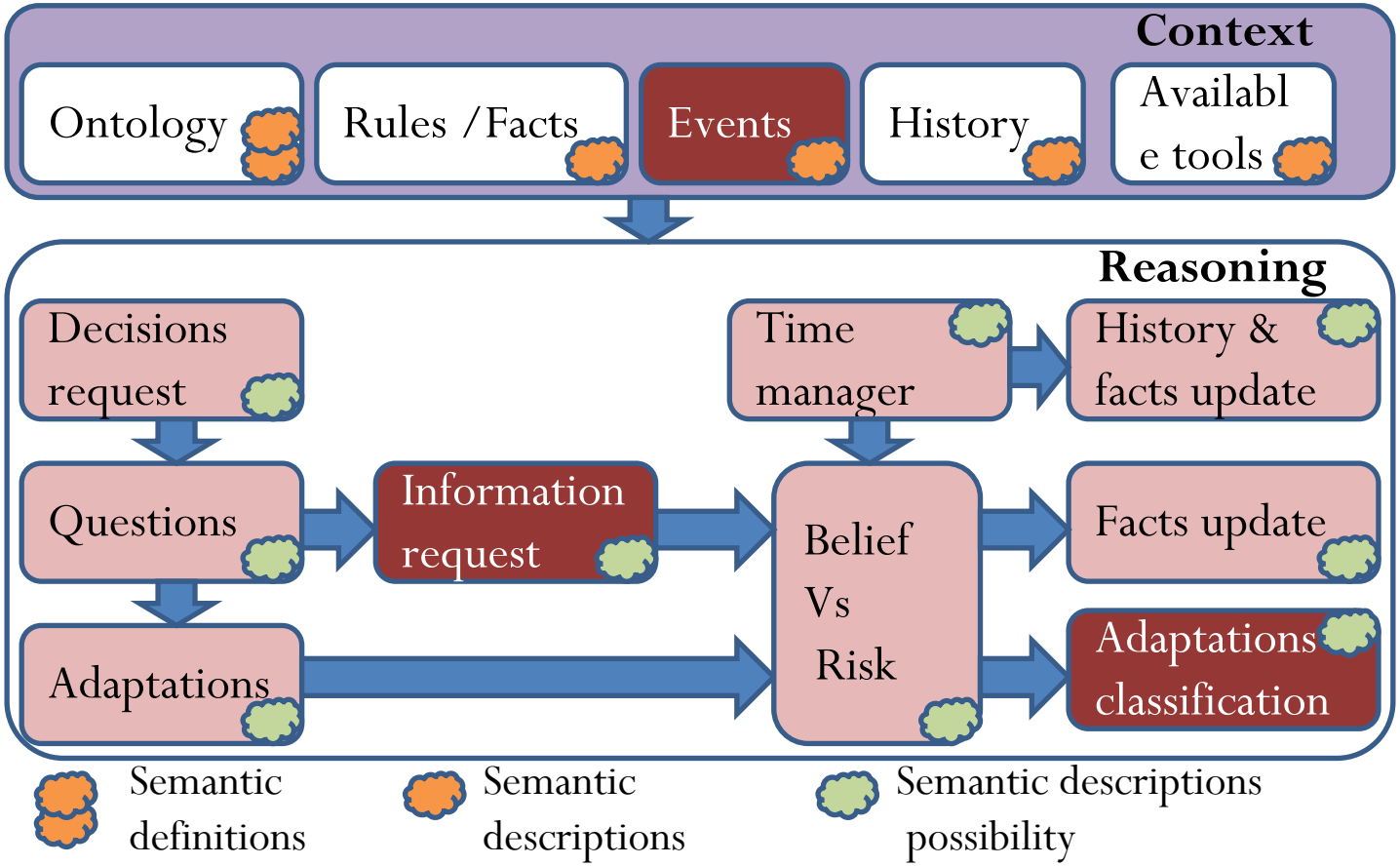
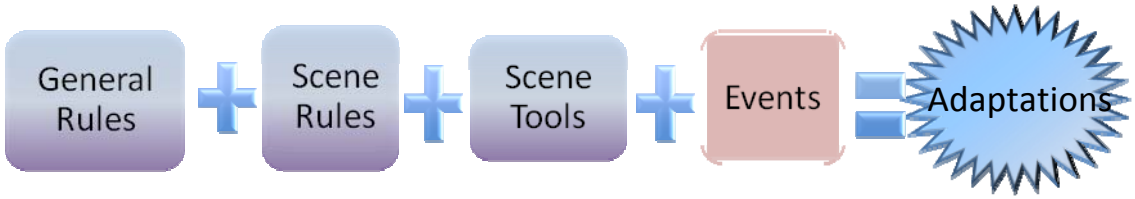


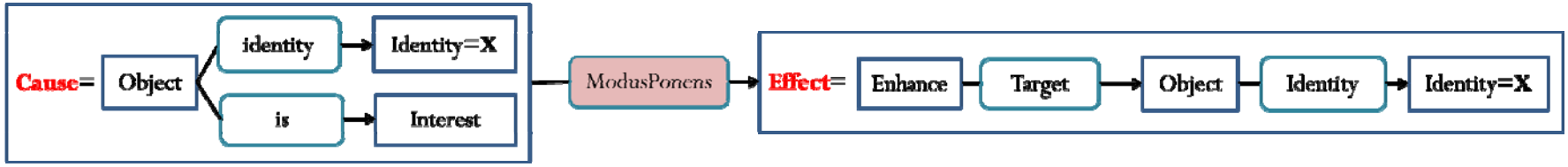
IV.2 The engine

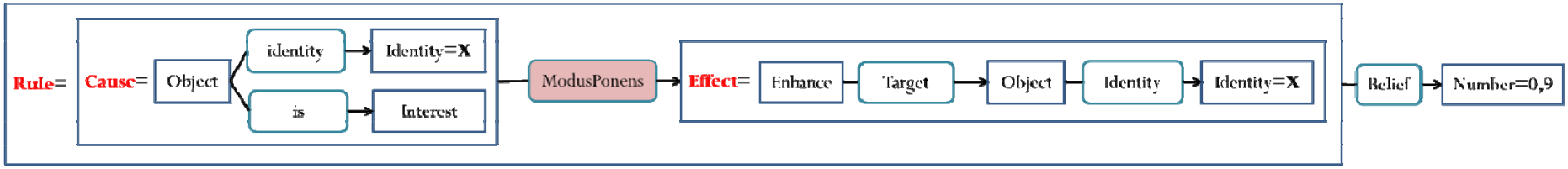


IV.4 Test scenario: acquire and enhance user's interests



- General Rules:
  - Define interests.
  - Define our will to enhance interests.





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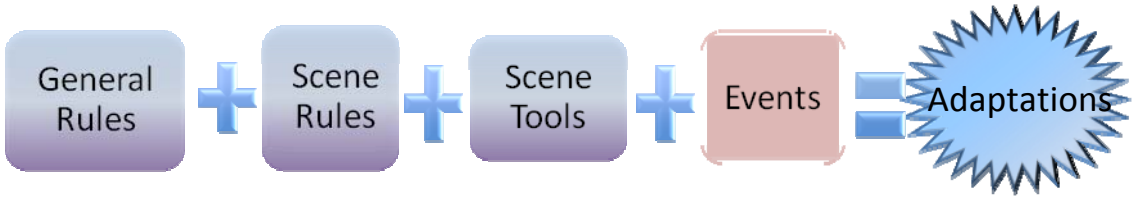
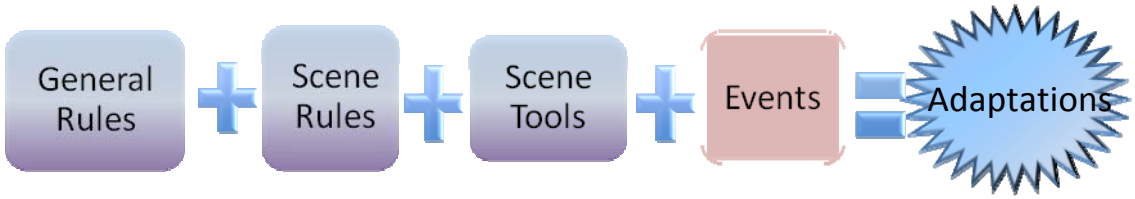


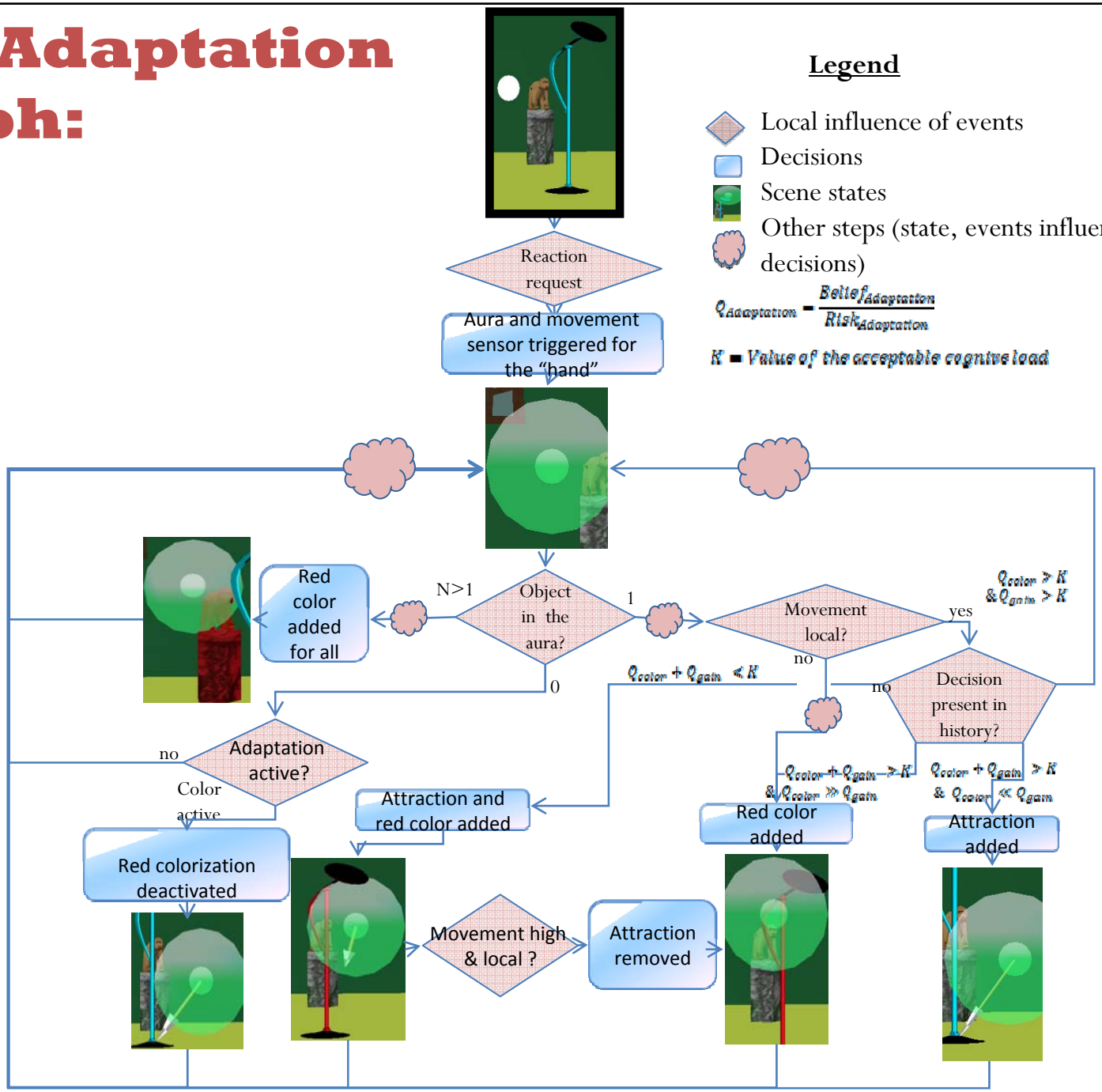
- General Rules:
  - Define interests.
  - Define our will to enhance interests.
  - Associate possible enhancements:
    - visual modifications through color change.
    - interaction modifications through gain (visual or haptic).
  - Manage adaptations states
    - remove added visual modification for previous interest.
    - remove added active gain if the movement is abnormal.
  - Increase some concepts' risk: haptic, gain etc.
  - Increase identical decision repetitions' risk.
  - Decrease interaction modifications ' risk for slow movements.

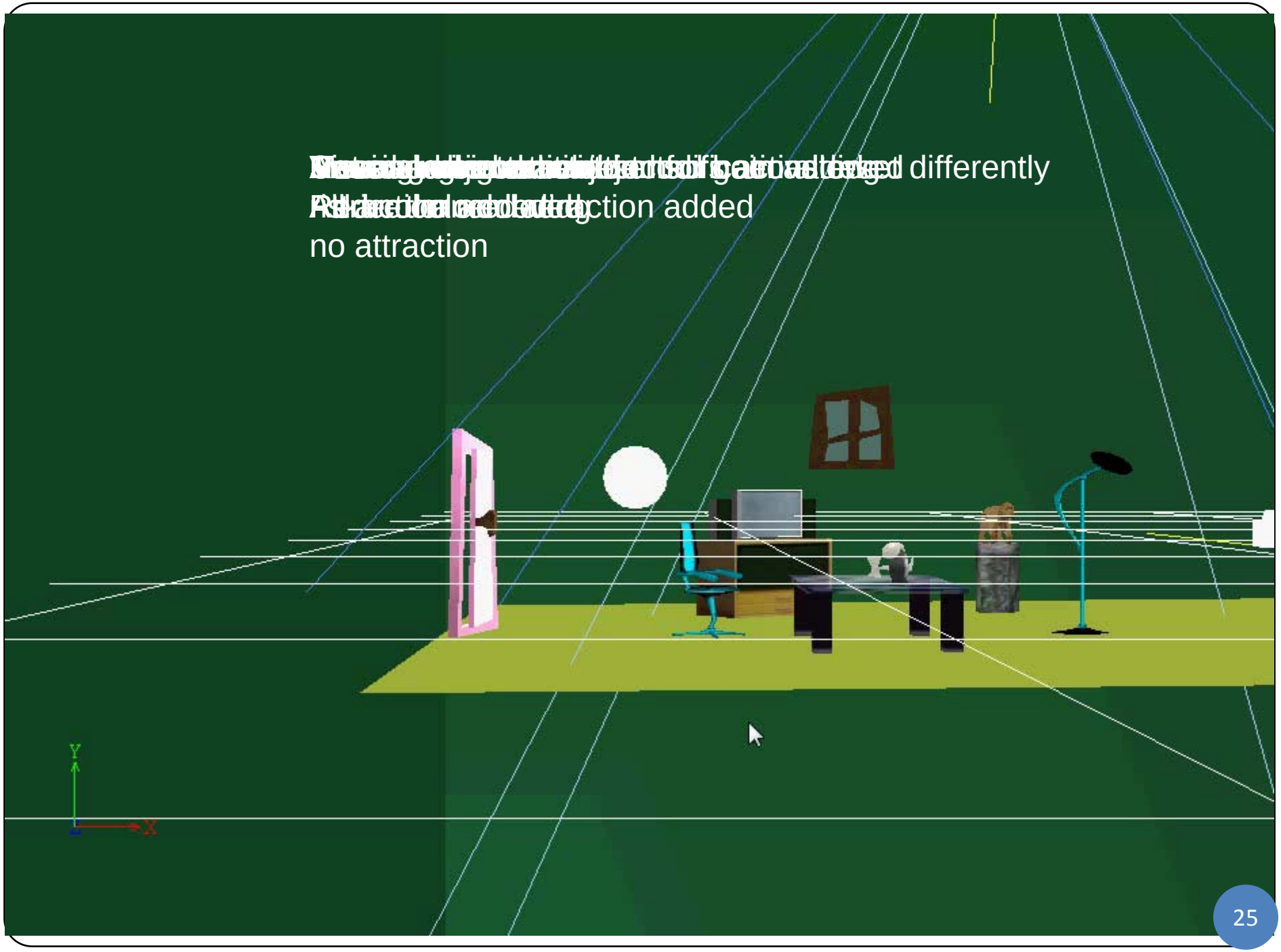
IV.4 Test scenario: acquire and enhance user's interests



- Scene rules:
  - Supply a specific cognitive load value
  - Monitor the hand
- Scene tools:
  - a Zones Of Interest (ZOI) sensor
  - an object's movement sensor
  - an actuator to change the color of an object
  - an actuator to add a haptic/visual gain to an object

IV.4 Adaptation graph:




differently
action added
no attraction

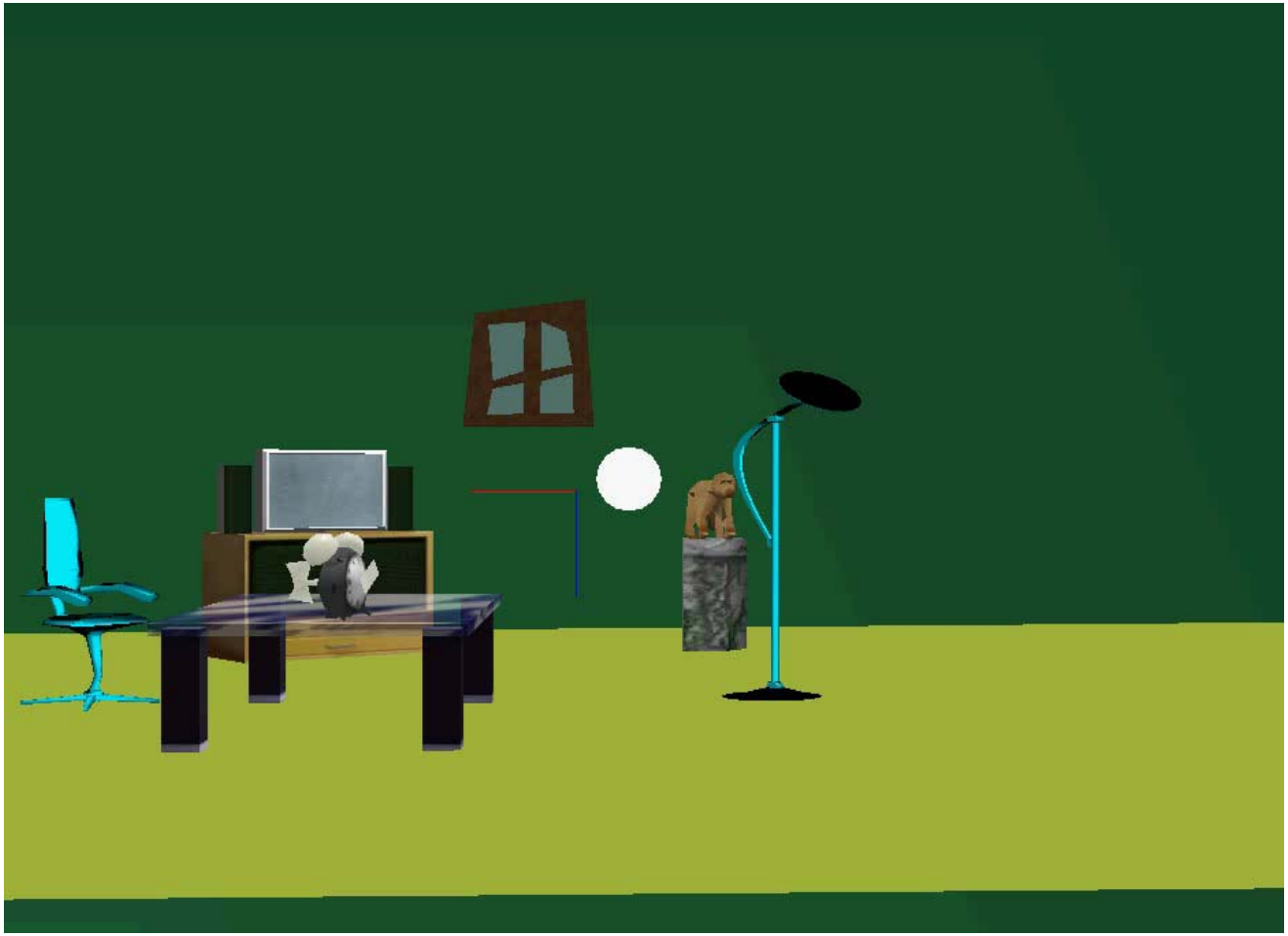
Conclusion

- Properties summary (Bettini 2010):

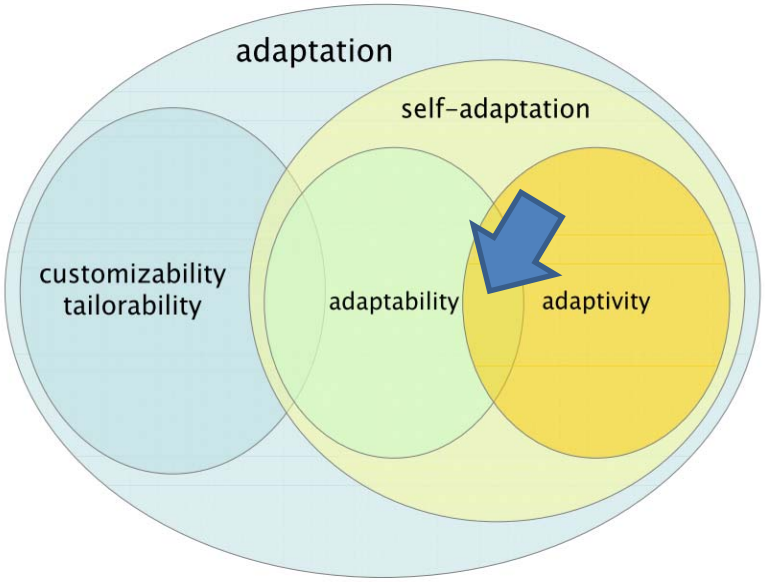
  ✓ Heterogeneity and mobility of context.
  ✓ Relationships and dependencies between context.
  ✓ Imperfection: data can be uncertain or incorrect.
  ✓ Reasoning: to decide or to derive information.
  ✓ Usability of modeling formalisms.
  ▪ Efficient context provisioning.
  ▪ Timeliness: access to past and future states.

- Next works:
  - Improve overall performances
  - Obtain better users intention hint.
  - Try more complex scenario

Questions?

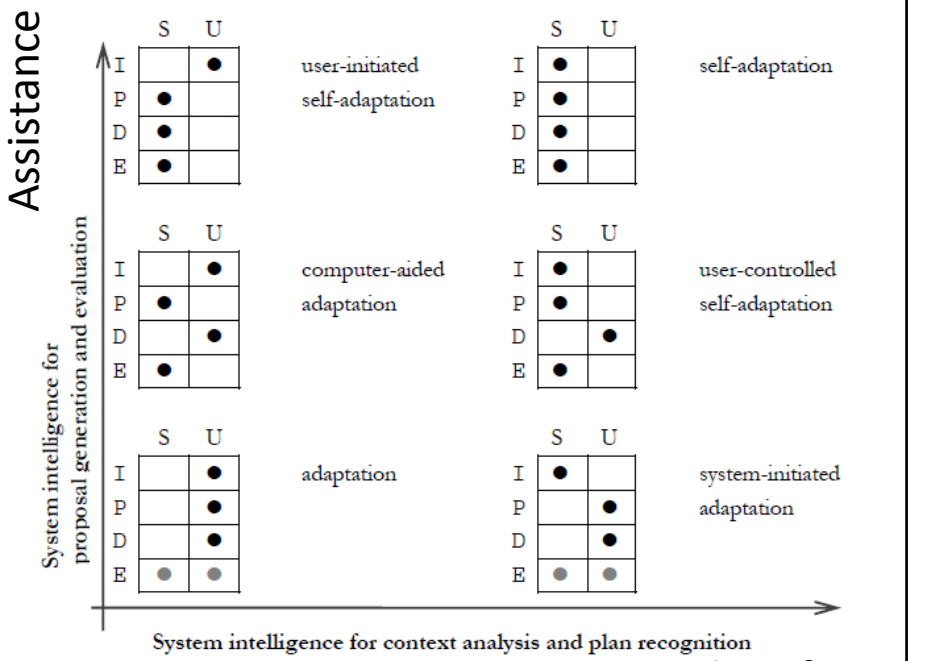


II.2 Context-aware systems are adaptive systems



Paramythis 2009

Adaptation steps:



Identificatior

Dieterich 1993

Adaptation creation:

- Modification
- Testing

Designer,
User,
System offline,
System online.

Adaptation steps:

- Initialisation
- Proposition
- Decision
- Execution

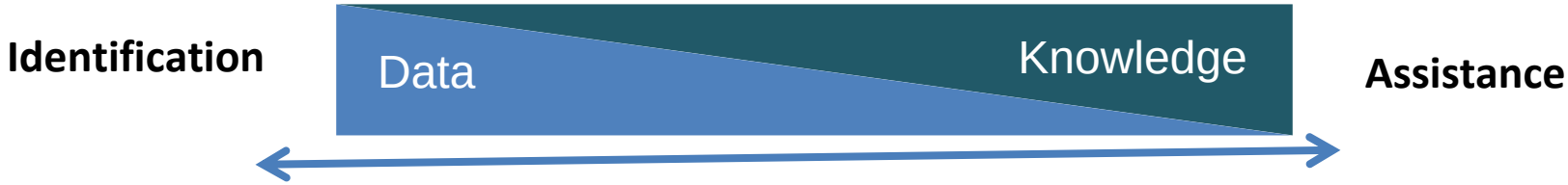
User,
System.

Adaptation steps timeline:

- Reactive
- Pro-active

II.2 Common properties

• Identification and/or assistance:



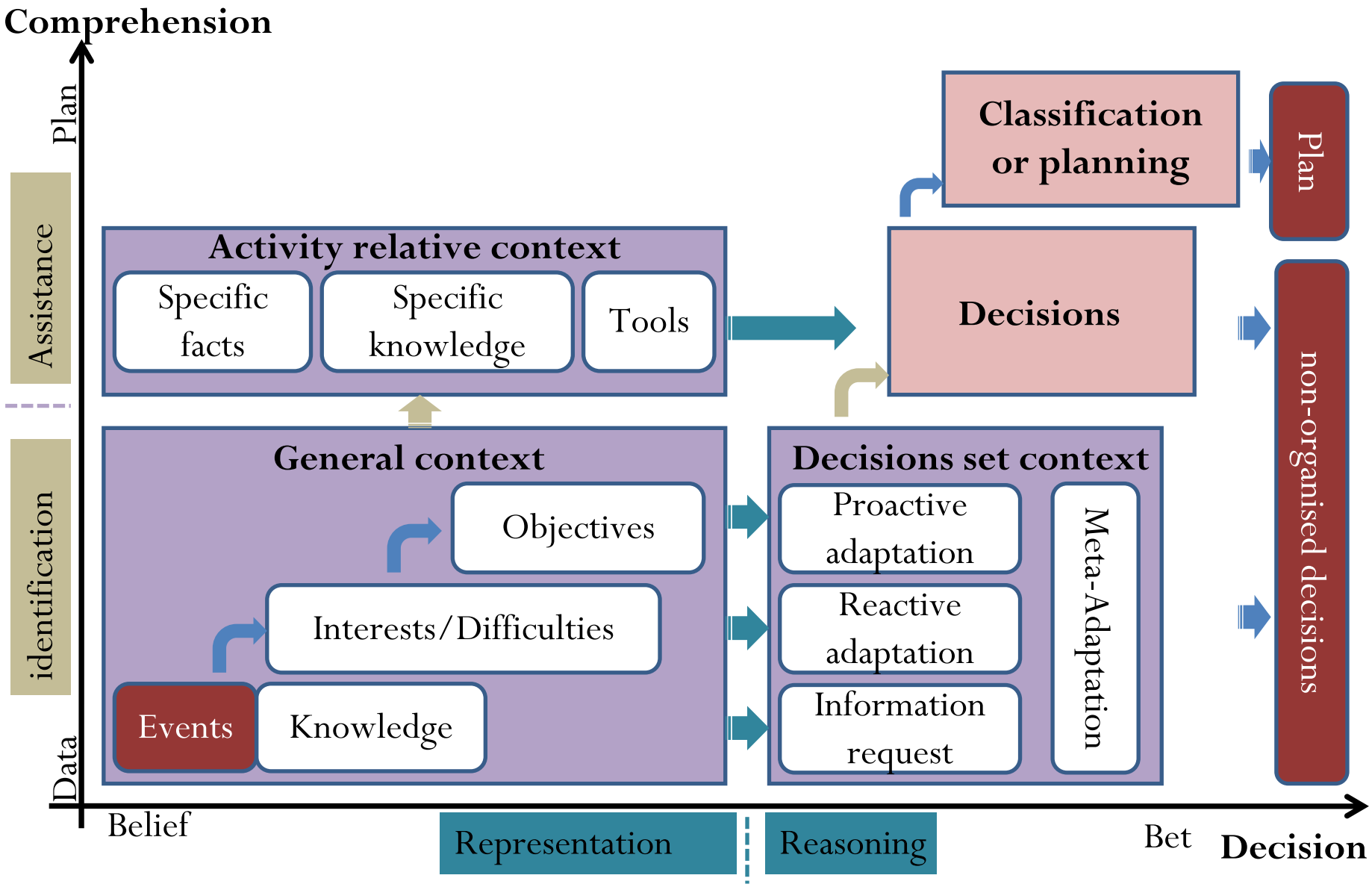
Intelligent Systems continuum (adapted from Brezillon 1999/2011)

•List of ideal properties for context-awareness(Bettini 2010):

- Heterogeneity and mobility of context.
- Relationships and dependencies between context.
- Timeliness: access to past and future states.
- Imperfection: data can be uncertain or incorrect.
- Reasoning: to decide or to derive information.
- Usability of modeling formalisms.
- Efficient context provisioning.

• Designers, system and users possible roles at each steps.

IV.3 Context hierarchy in the engine's core



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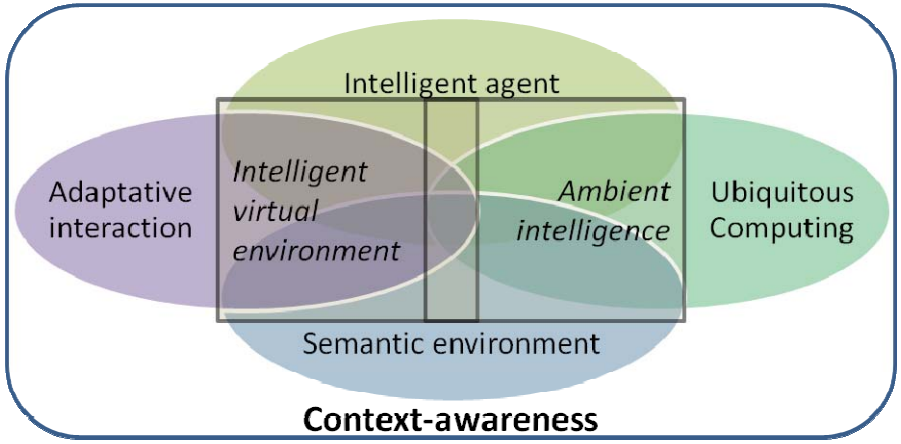
•Context(Dey 2000): *any information that can be used to characterize the situation of an entity. (person, place, or object, user and applications).*

• A context-aware system (Dey 2000) : *uses context to provide relevant information and/or services to the user.*

•Classification:



I.3 Travaux précédents

•Techniques embarquées ou implicites: Go-Go (Poupyrev1996),l'interaction continue FlyOver (Boudoin2008), Bubble Cursor et Depth Ray (2009).

•(Wingrave2002) tente de déterminer et de s'adapter aux préférences de l'utilisateur en vue d'une interaction. Idée d'une interaction à nuance. Repris en spécificité & « flavor » Bowman2006.

•Un salon d'exposition virtuel (Celentano2004) : identifie des schémas récurrents d'interaction.

•Un framework de gestion du contexte VR-UCAM (Lee2004) modèle conceptuel basé sur le W5H

•L'assistance utilisateur via une supervision de la tâche (Bouyer2007).

• (Octavia2010) : personnalisation de l'interaction d'un utilisateur à l'aide d'un moteur utilisant un modèle utilisateur générique, un modèle particulier et un ensemble de contexte.

• (Frees 2010) Association contexte/tâches