Modeling the behaviour of interactive 3D scenes and applications

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Outline : Presentation context

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Presentation in 2 parts

- Knowledge background (from Master thesis) : Statechart modelling of interactive gesture based applications
- PhD thesis proposal : Behaviour modeling and recognition of virtual 3D objects

Outline : Master thesis : problem statement

Master thesis : problem statement

Problem Statement

Challenge

Develop intuitive interactive applications that are easy to maintain

Why is it a challenge ?

- Complex behaviour of user interaction
- Nondeterministic user actions
- Same events lead to different actions

Contributions

- Gestural user interface for 3D object manipulation
- Modeling executable behaviour using a visual formalism
- Validation with an application framework

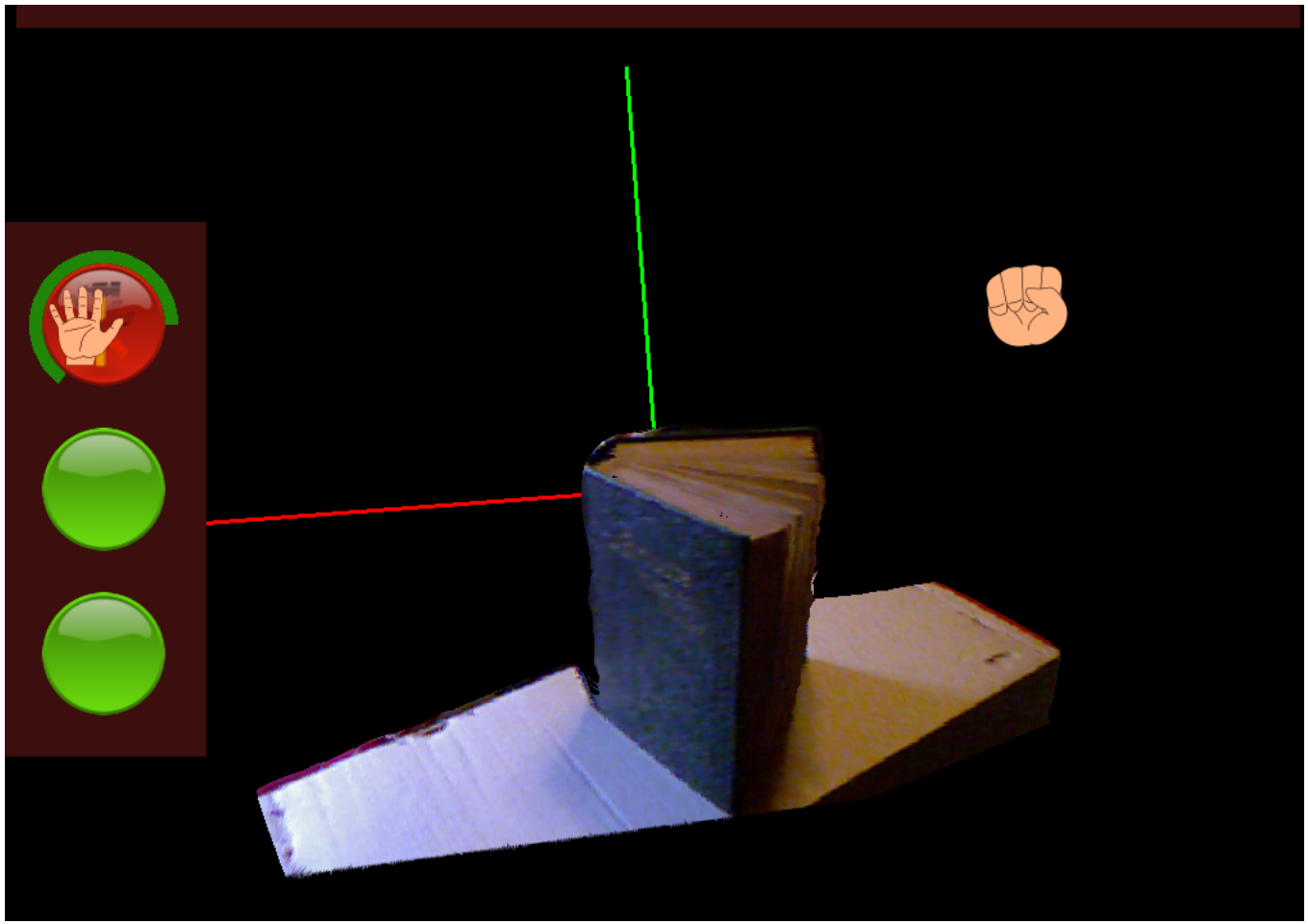
Outline : Proof-of-concept application

Proof-of-concept application

Proof-of-concept application

- 3D visual drawing tool
- Uses gestures to create and manipulate 3D objects
- OpenGL graphical library
- Microsoft Kinect + NITE

Small video



Outline : Modeling interactive behaviour

Modeling interactive behaviour

Modeling interactive behaviour

Context

- Highly reactive event-driven systems
- Gesture-based interaction

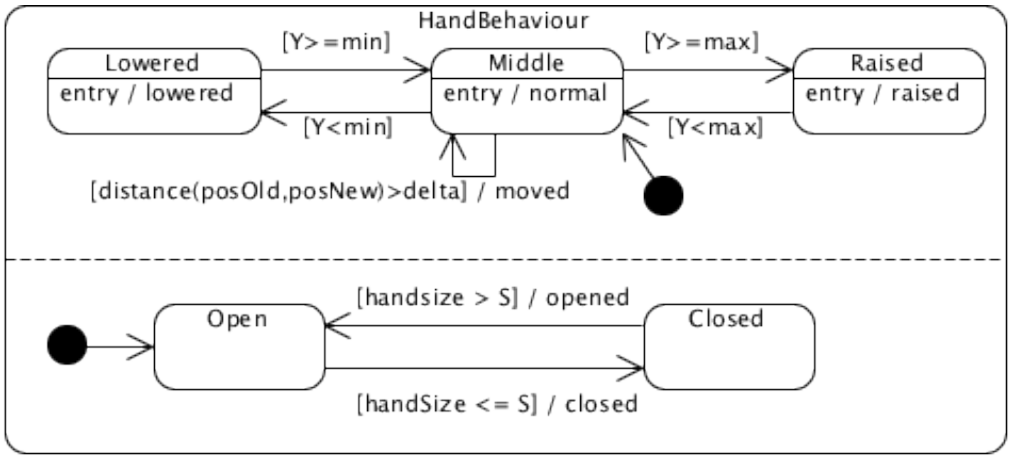
Proposed solutions

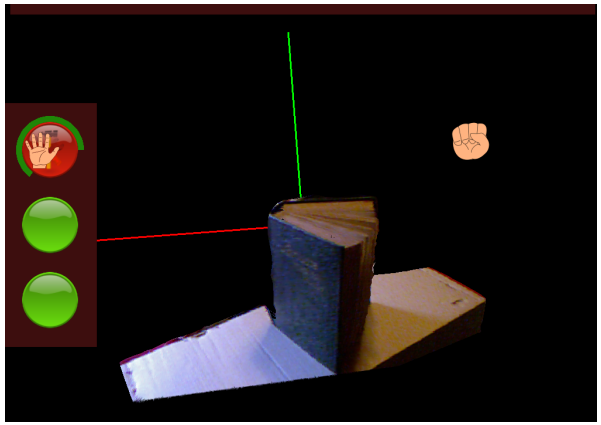
- Visual modeling language
  - Statecharts
  - Petri nets
  - Labelled Transition Systems
- Amenable to formal analysis
- Easier to evolve
- Reduced complexity

Outline : Statechart models

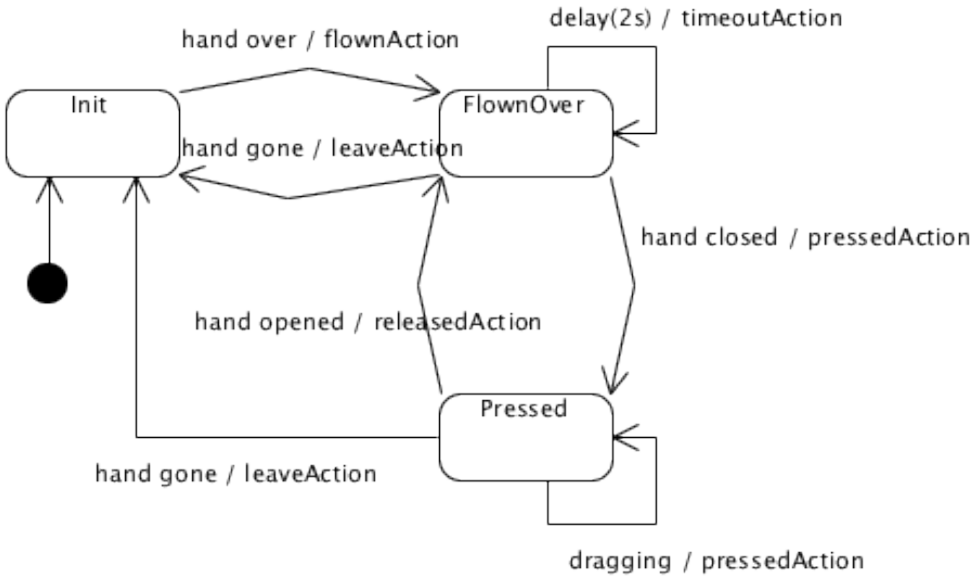
Statechart models

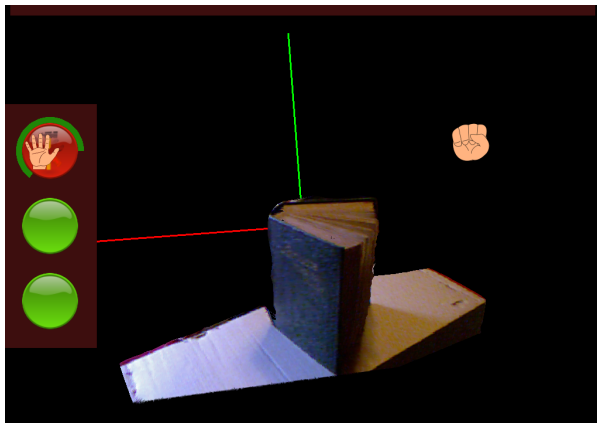
Statechart models - Hand



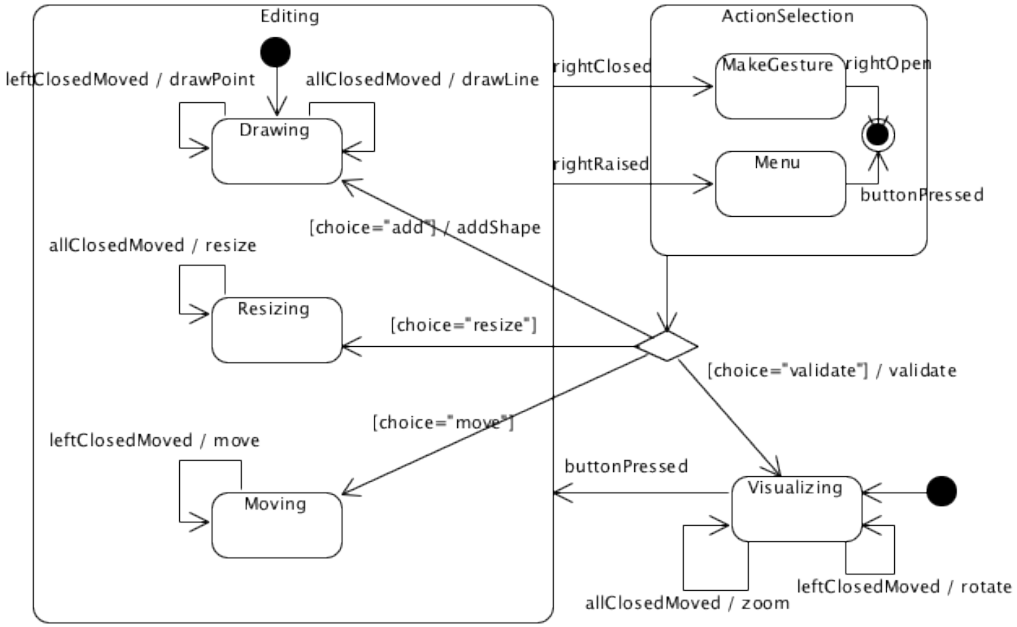


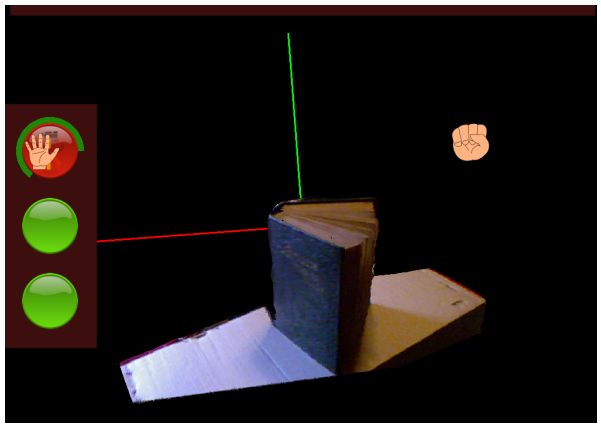
Statechart models - Component





Statechart models - Scene



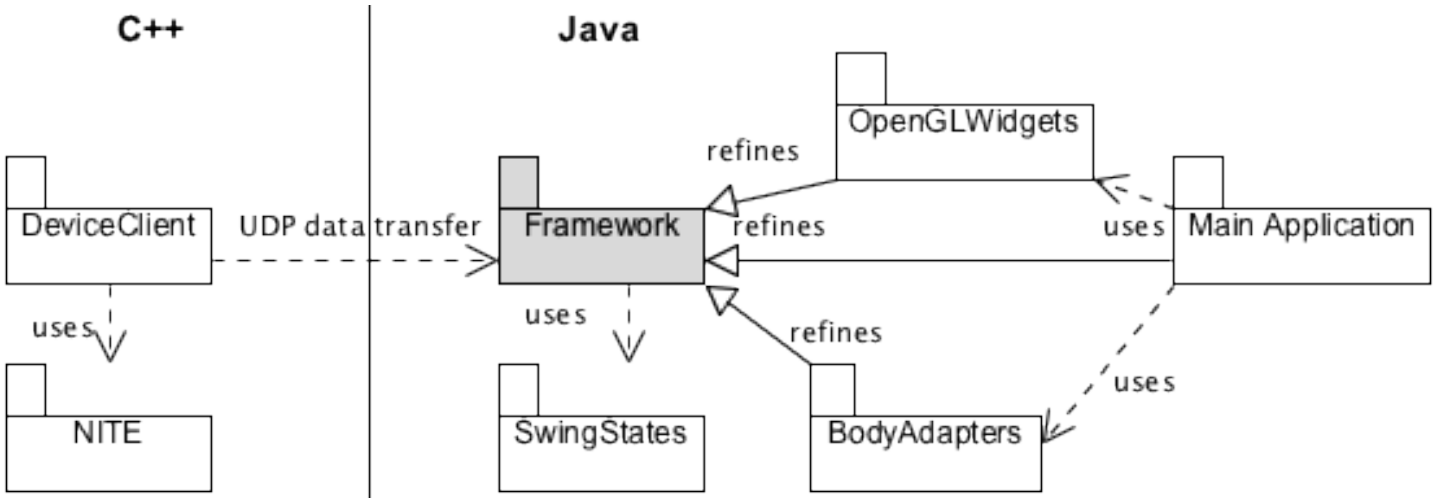


Outline : The application framework

The application framework

The application framework

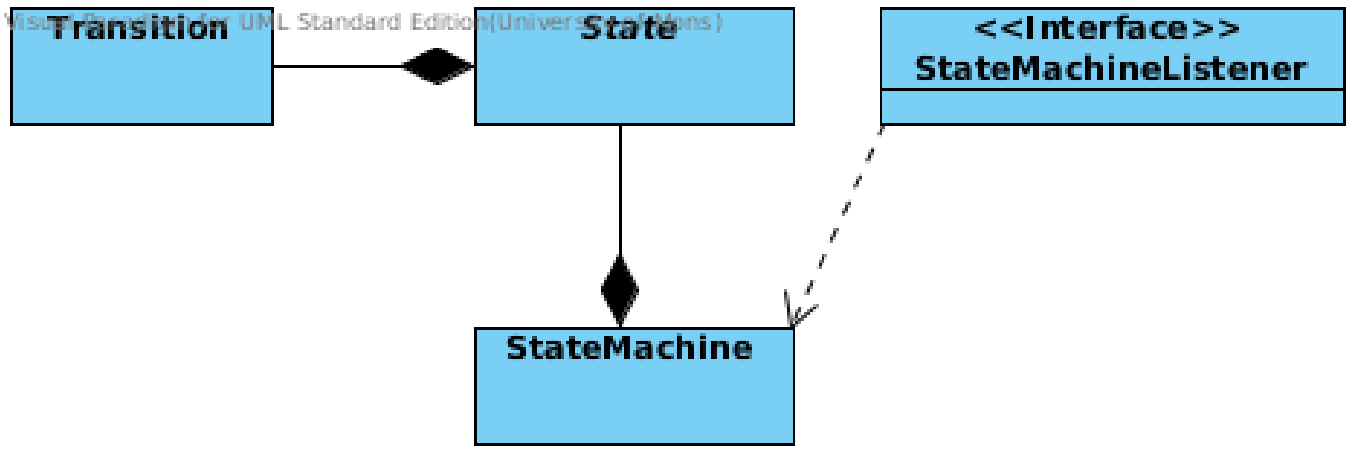
- Framework for developing interactive applications
- Executable behaviour specified using statecharts
- Client-server architecture



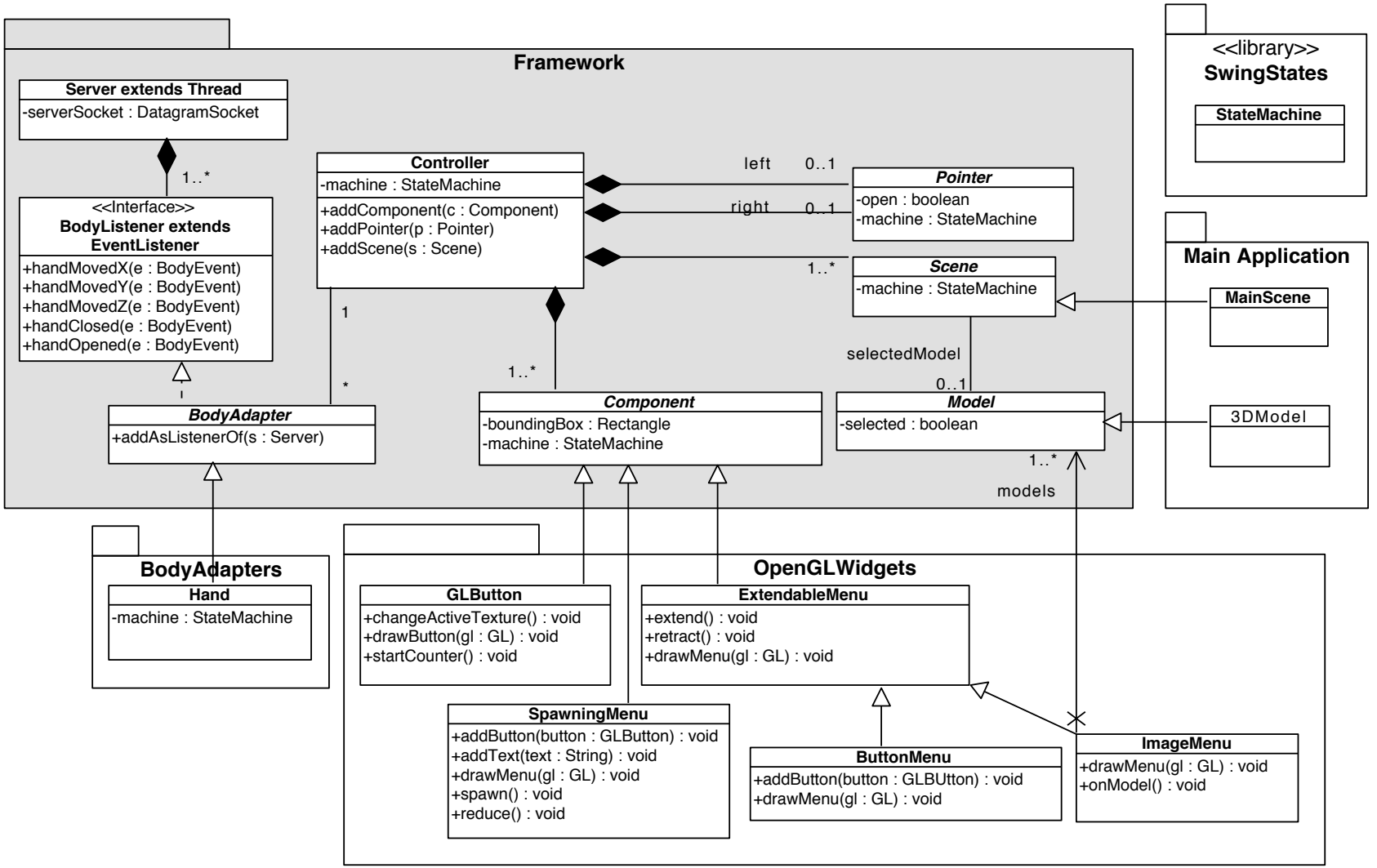
The application framework II

Features

- Generic
  - Abstract classes
  - Observer design pattern
- Communication between statecharts
- Uses Java SwingStates library



The application framework III



Outline : About statecharts

About statecharts

Statecharts for modeling executable gestural behaviour

Statecharts

- Appropriate and scalable formalism for modeling the interactive gesture-based behaviour ?

Future work

- Externalise/decouple statechart representation from framework
- Compare statecharts with Petri nets & LTS

Outline : PhD thesis proposal

PhD thesis proposal

Goal of the project

Two main scientific contributions :

- Generic solution to specify the behaviour of the interaction between 3d virtual objects
- Improvement of the robustness of the 3D recognition algorithms, using 3D sensors

Combining those two ideas will allow various applications in many domains such as augmented reality, video games or home automation (domotics)

Research Domain

Interface modeling

Many research focus on HMI modeling, but (to our knowledge) less are focused on modeling the *behaviour of the interaction* with virtual 3D objects

Potential formalisms to model behaviour of the interaction

- Statecharts [ABL08]
- Petri nets [NPLB09]
- Labelled Transition System [CP09]

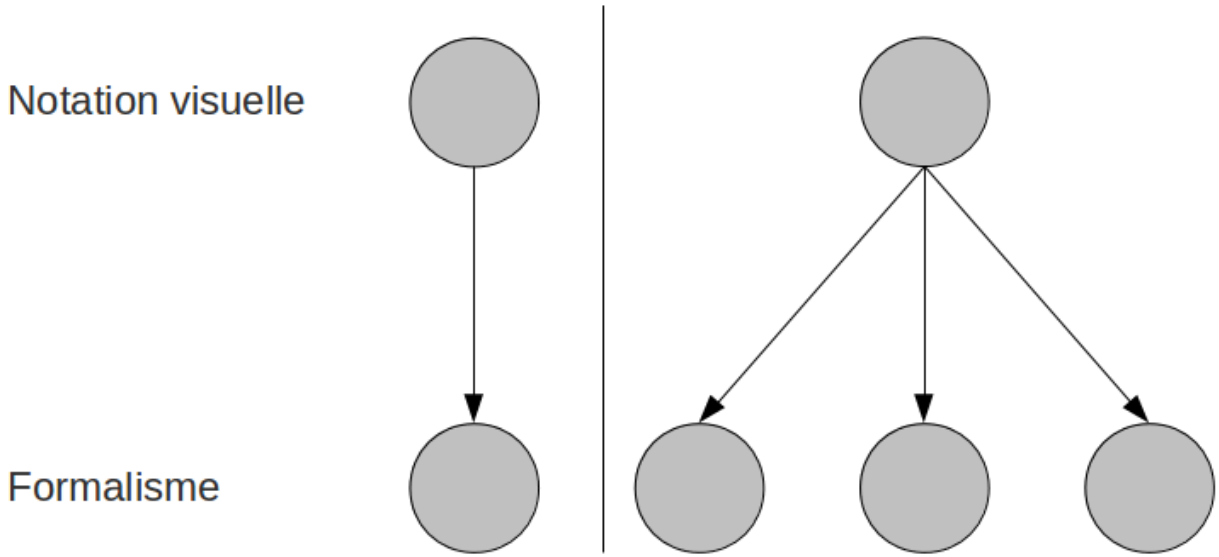
Each one has its advantages and limitations

→ Study and compare existing formalisms to see if they are suitable to solve our problem

Development of a Domain Specific Modeling Language

Two approaches to develop a new DSML :

- 1 visual notation $\wedge$ 1 formalism $= \cup$ studied formalisms (partial)
- 1 visual notation $\wedge$ 3 distinct formalisms



Research Domain

Computer Vision

Make use of geometric information to recognize more accurately 3D objects in a complex scene

- Using 3D sensors
- Partial 3D reconstruction of objects [Des11]
- Need new recognition algorithms [LBRF11]
- Interactive system
  - A training phase
  - A real-time recognition phase

Thank you

Thank you for your attention !

Questions, suggestions ?

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