Automatic Knowledge Revision in a Generalisation System

ACI Workshop 2007

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- 4. Case study : the housing estates
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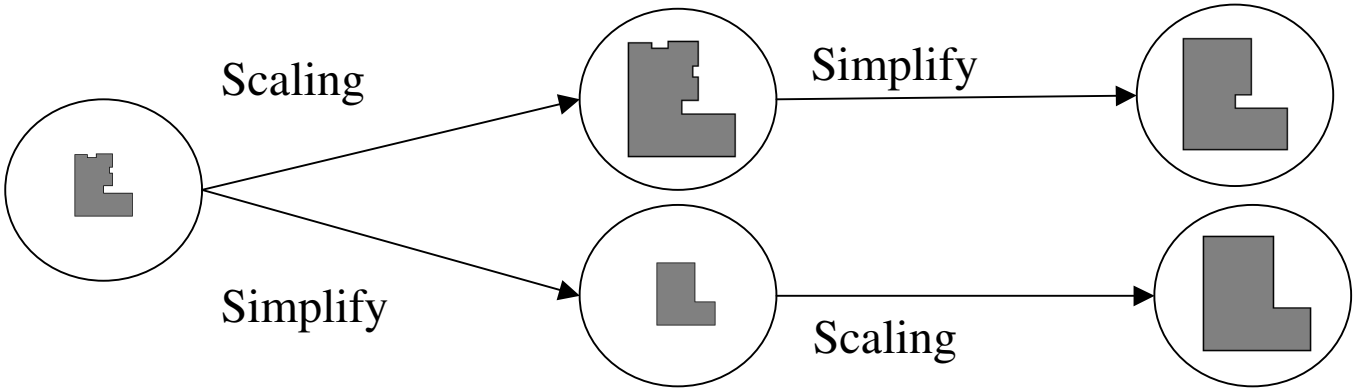
1. Introduction :

Generalisation automation

- Lot of existing approaches
- Agent based approach :
  - Geographical objects are modelled by agents
  - Agents generalise themselves by applying generalisation algorithms (actions) on themselves
  - Much knowledge is included in the process



1. Introduction :

Procedural knowledge revision

- Knowledge is good but not perfect
- Knowledge improvement => Generalisation system could be :
  - More effective (cartographic quality of the result)
  - More efficient (to get the result faster)
- Knowledge evolution is complex

Objective : Propose a procedural knowledge revision approach, without experts interventions

2.1 The AGENT model :

General presentation

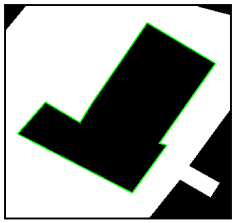
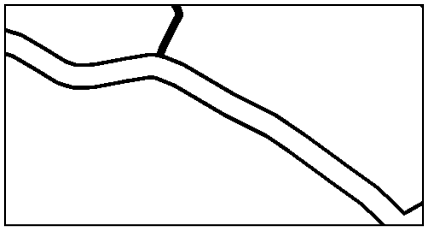
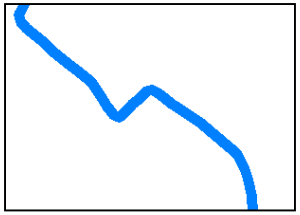
- Conceptual model developed by Anne Ruas (1999), then improved during the European project AGENT

- Geographical Objects = geographical agents

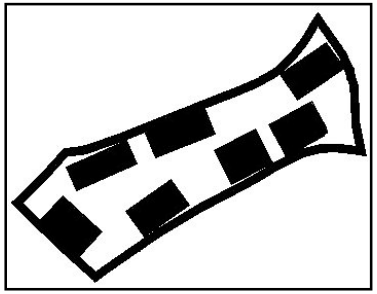
2.1 The AGENT model :

General presentation

- Two kinds of agents :
  - ***Micro*** : individual geographical object

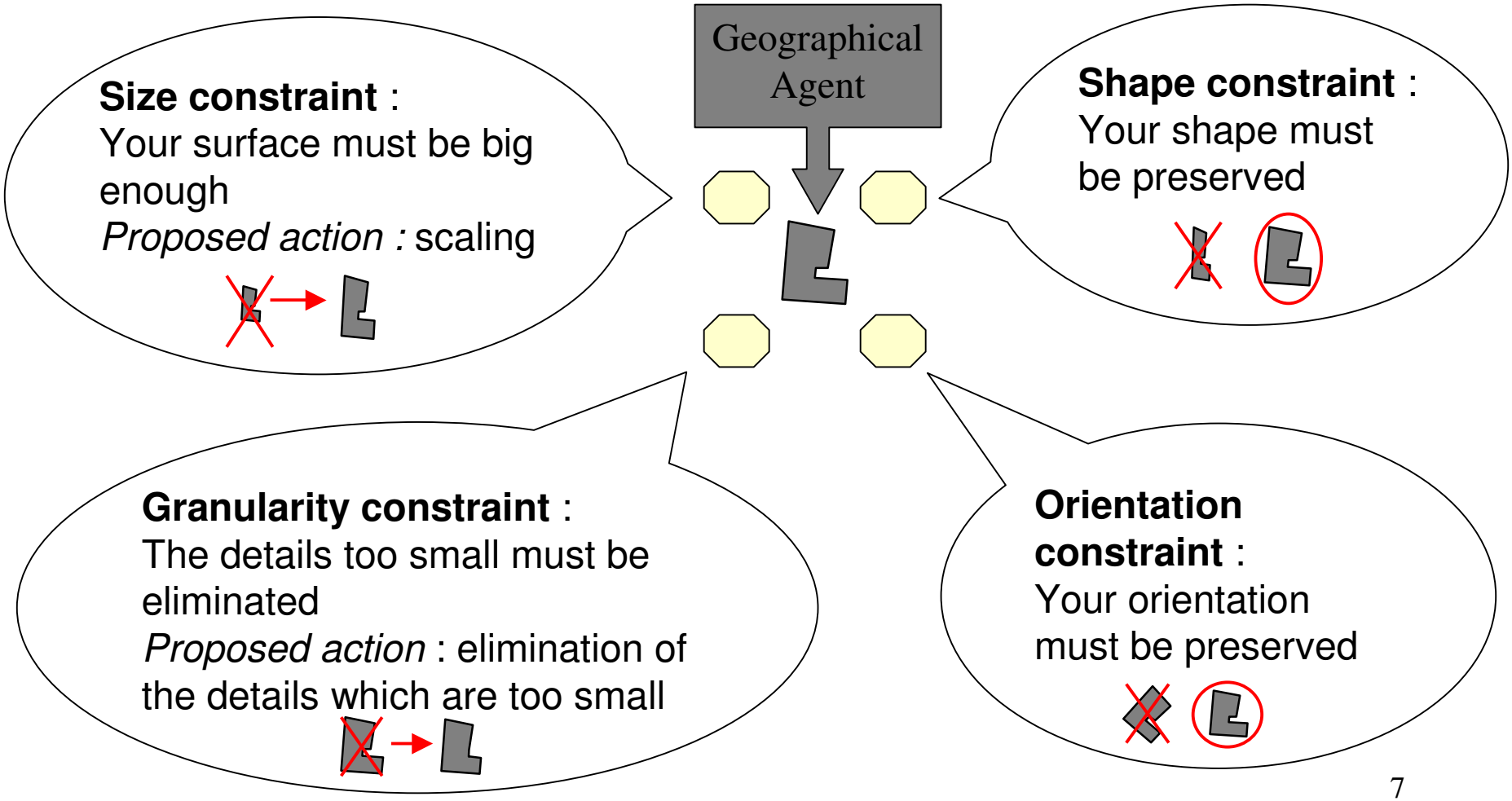




  - ***Meso*** : set of organised objects



2.2 The AGENT model :

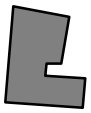
The constraints



2.2 The AGENT model :

The constraints

- Each constraint has :
  - ***A goal value*** : value to reach. Computed according to the users specifications
  - ***A current value*** : value which represents the current state
  - ***A satisfaction*** : computed from the current value and the goal value for a given state. Marked between 1 and 10.
  - ***A priority*** : the constraint treatment urgency. Marked between 1 and 5.
  - ***An importance*** : importance to satisfy the constraint for the cartographic result. Marked between 1 and 5.

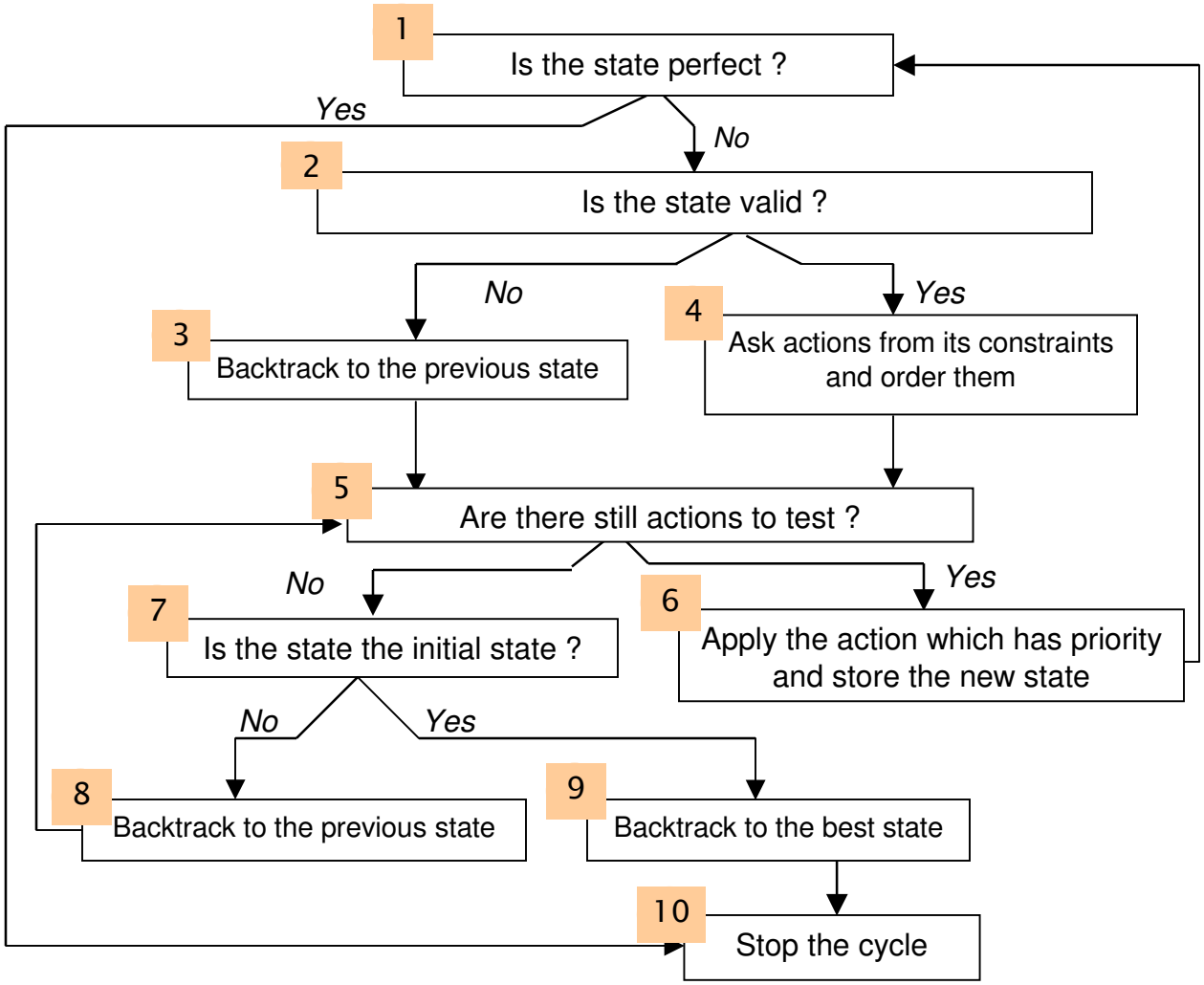


Size constraint

Goal value : > 300 m^2 Current value : 240 m^2 Satisfaction : 8

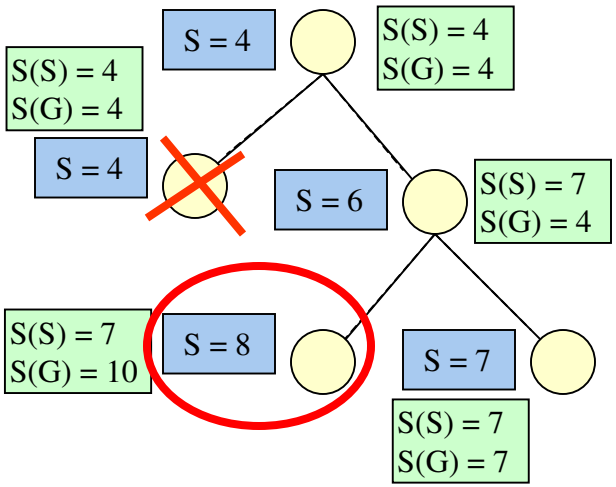
Priority : 3 Importance : 4

2.3 The AGENT model : *the actions cycle*



2 constraints :

- **Size** (S): priority = 1
  importance = 4
- **Granularity** (G) : priority = 3
  importance = 2



2.4 The AGENT model :

Procedural knowledge of the model

- Procedural knowledge :
  - Application order for the actions proposed by the constraints
  - State validity criterion
  - Actions cycle stopping criterion

3.1 Our knowledge revision approach :

General approach

- Approach based on 3 steps :
  - Log the system when generalising
  - Acquire new knowledge from the logs
  - Integrate new knowledge in the system

3.2 Our knowledge revision approach :
Constraints priority rules learning

- Objective : Learn for each constraint, a base of priority rules
  - Rule example :
    - **If** the size constraint satisfaction > 5 and the granularity constraint satisfaction < 4

      Then *the size constraint has priority with a confidence rate of 80%*

3.2 Our knowledge revision approach :

Constraints priority rules learning

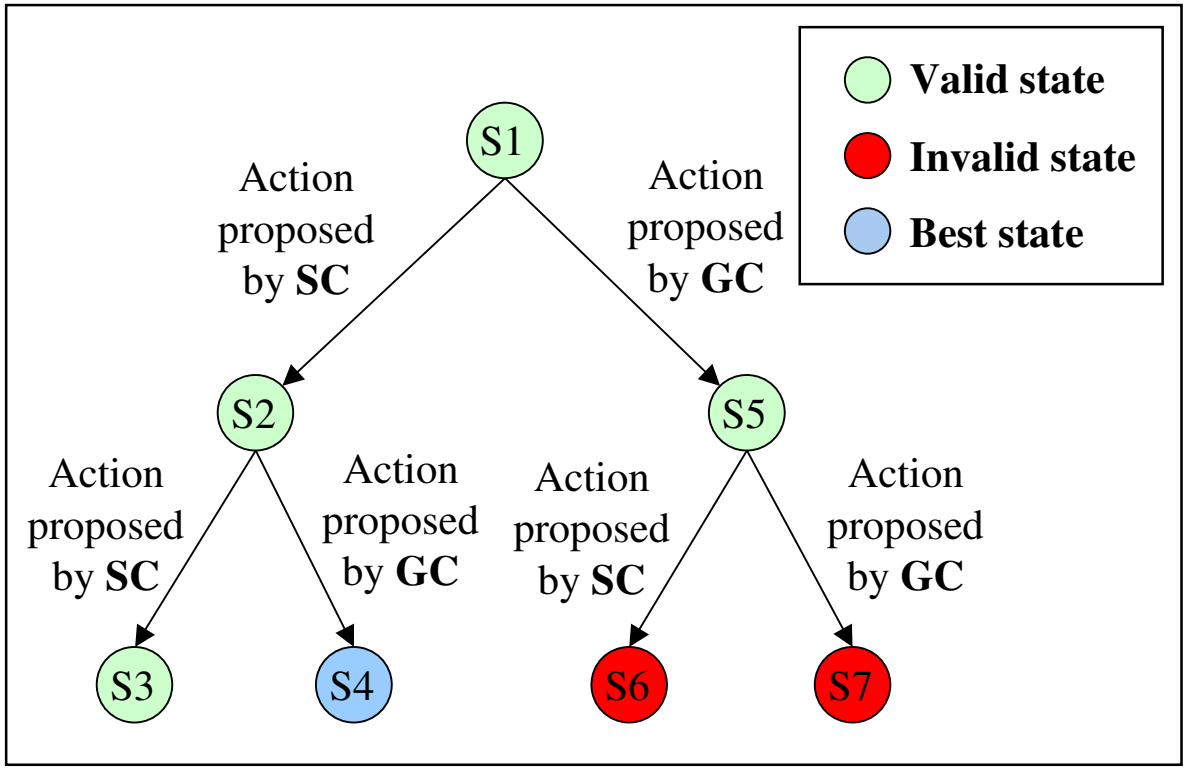
- Example : 2 constraints : a size constraint (SC) and a granularity constraint (GC)
  - Learnt rules :
    - Rules for SC : **if** SC's satisfaction (SSC) > 4 and GC's satisfaction (SGC) < 3 **then** SC has priority with a confidence rate : CR = 80%
    - Rules for GC : **if** SGC < 10 **then** GC has priority with CR = 75%
  - States example :
    - SSC = 7, SGC = 8 : GC has priority with CR = 75%

      → GC's actions will be tested in priority
    - SSC = 8, SGC = 2 : SC has priority avec CR = 80% and GC has priority with CR = 75%

      → SC's actions will be tested in priority

3.2 Our knowledge revision approach :

Constraints priority rules learning



Learning set :

For SC :

State 1, Priority

State 2, Non priority

Pour GC :

State 1, Non priority

State 2, Priority

3.3 Our knowledge revision approach :
States validity rules learning

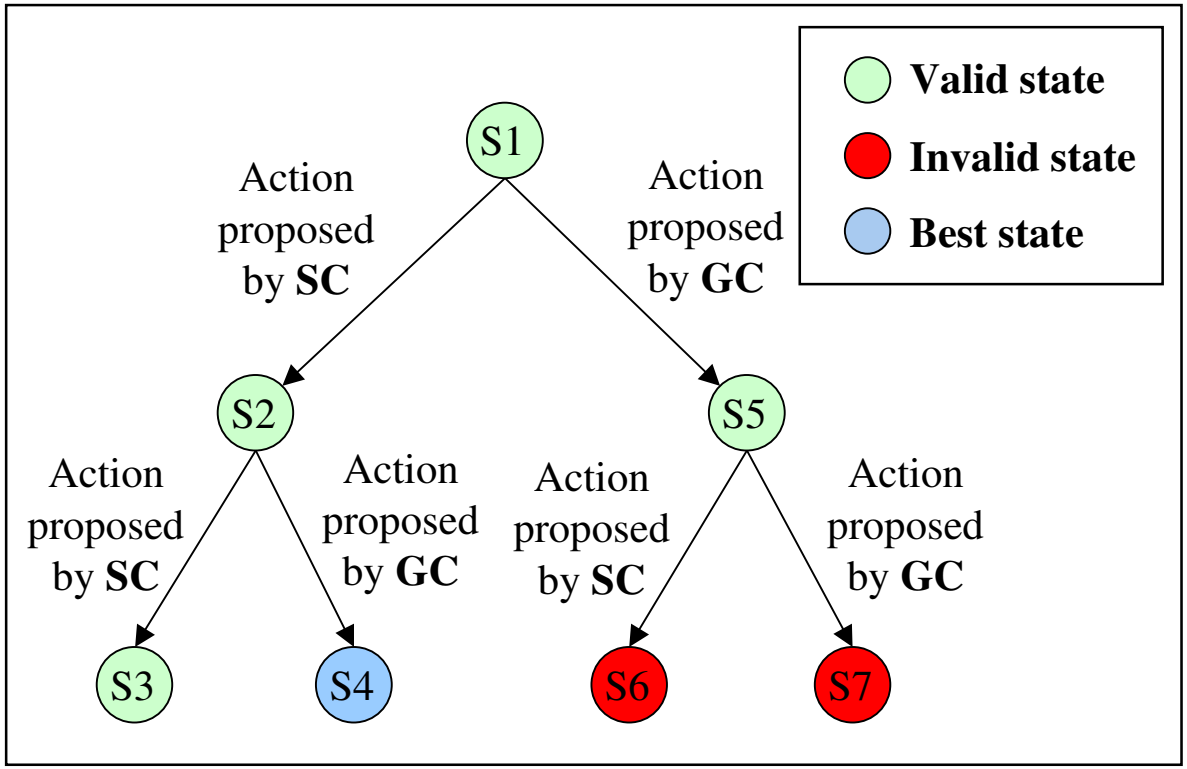
- Objective : Learn **rules** allowing the system to determine the **validity** of a given state

  - Rule example :
    - **If** the size constraint satisfaction > 9 and the granularity constraint satisfaction < 2

      then *the state is invalid*

3.3 Our knowledge revision approach :

States validity rules learning



Learning set :

State 1, Valid

State 2, Valid

State 3, Invalid

State 4, Valid

State 5, Invalid

3.4 Our knowledge revision approach :
Actions cycle stopping rules learning

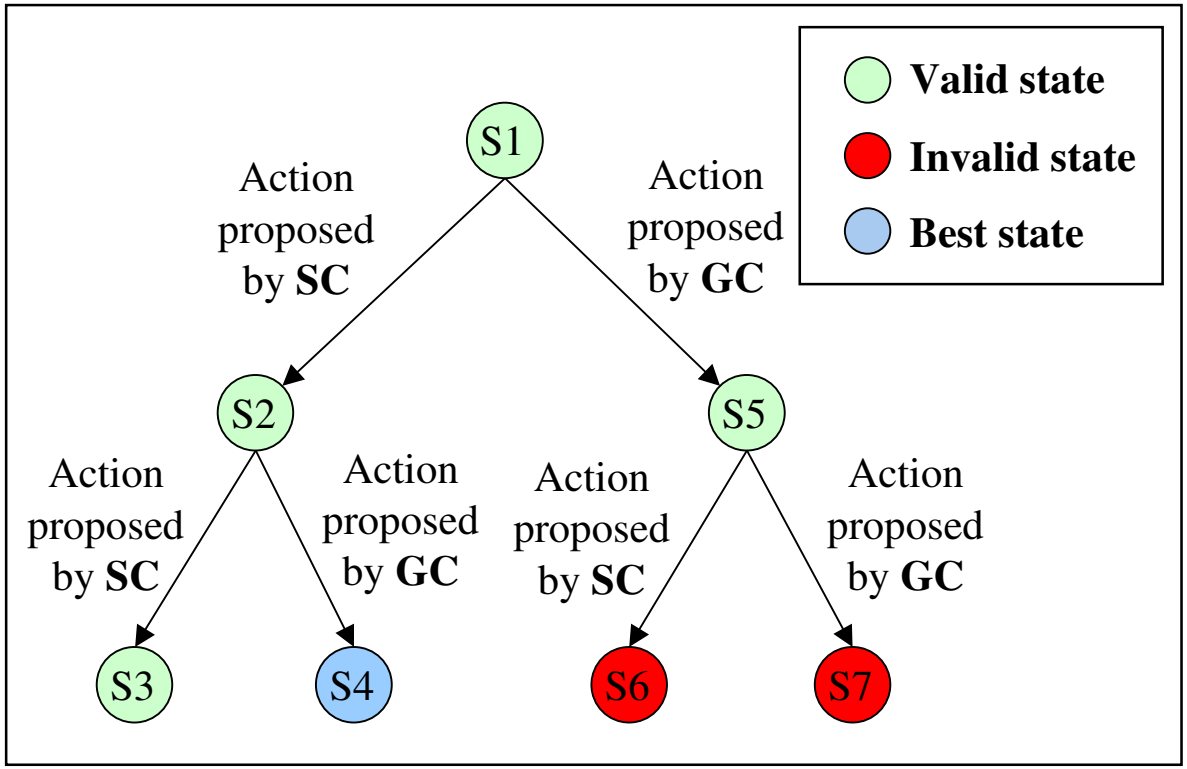
- Objective : Learn **rules** allowing the system to determine if the **actions cycle** must be **stopped** or not for given state

  - Rule example :
    - **If** the size constraint satisfaction > 9 and the granularity constraint satisfaction > 7

      then *the actions cycle must be stopped*

3.4 Our knowledge revision approach :

Actions cycle stopping rules learning



Learning set :

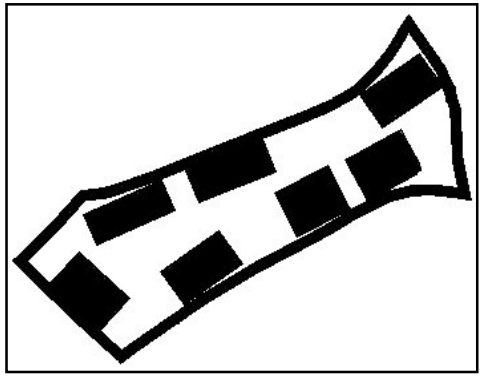
State 1, Continue

State 2, Continue

State 4, Stop

4.1 Case study : the housing estates

Context



Constraints :

- ***Buildings satisfaction***
  - **Action** : buildings generalisation
  - Priority = 5 , Importance = 5
- ***Proximity between buildings***
  - **Action** : buildings aggregation
  - Priority = 5 , Importance = 4
- ***Proximity between buildings and between roads and buildings***
  - **Action** : displacement and removal of buildings
  - Priority = 5 , Importance = 4
- ***Preservation of a buildings minimum number***
  - **No action**
  - Priority = 5 , Importance = 4

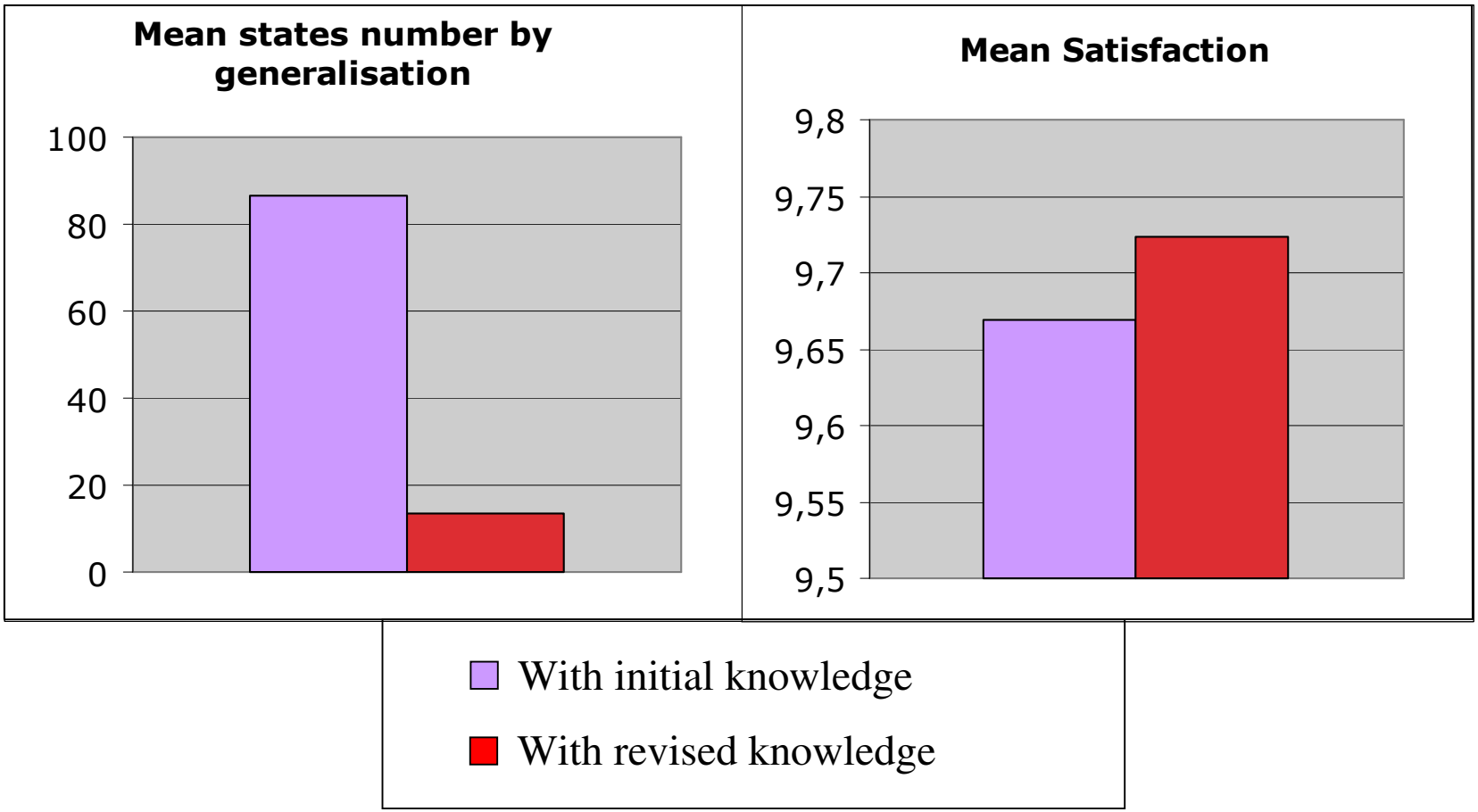
4.1 Case study : the housing estates

Context

- Learning set : built from the generalisation of 40 pieces of housing estates
- Machine learning algorithm : c4.5
- Test phase : system tested on 40 pieces of housing estates

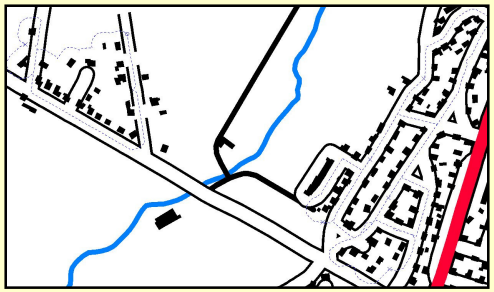
4.2 Case study : the housing estates

Results

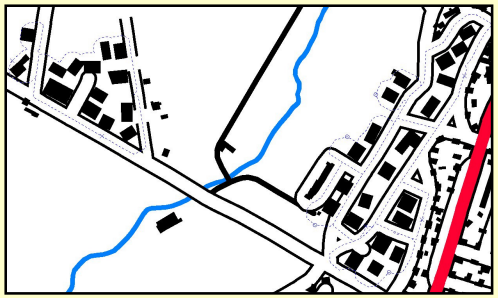


4.2 Case study : the housing estates

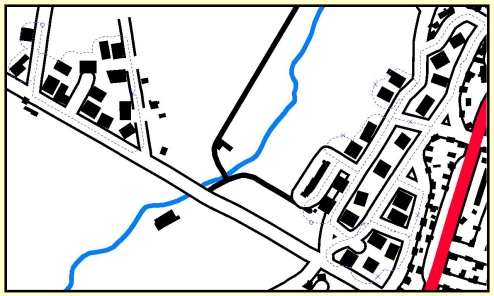
Results



Before generalisation



Generalisation with initial knowledge



Generalisation with revised knowledge

5. Conclusion

- Summary
  - Development of a procedural knowledge revision approach which does not need experts interventions
  - Validation of the approach by a case study on the housing estates

5. Conclusion

- Perspectives :
  - Actions choice revision
  - Development of methods to better take into account the system initial knowledge

THANK YOU FOR YOUR ATTENTION