Software Engineering for Economics:
Or what a Computer Scientist does in SCCER CREST

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Current status:
- 1 Prof.
- 1 Post Doc
- 2 PhD students
- 1 Assistant
SCCER

Future Energy Efficient Buildings & Districts

Efficiency of Industrial Processes

Future Swiss Electrical Infrastructure

Research in Energy, Society and Transition

Heat & Electricity Storage

Efficient Technologies and Systems for Mobility

Supply of Electricity

Biomass for Swiss Energy Future
CREST (new structure from 2017 onwards)

- WP 1: Energy, Innovation, Management
- WP 2: Change of Behavior
- WP 3: Energy Policy, Markets and Regulation
- WP 4: Energy Governance
CREST: And where is the Informatics?

- WP 1: Energy, Innovation, Management
- WP 2: Change of Behavior
- WP 3: Energy Policy, Markets and Regulation
- WP 4: Energy Governance
  - Management, …
  - Sociology, Psychology,…
  - Economists..
  - Law, Management, Investment…
CREST, a deeper look into WP 3
Energy Policy, Markets and Regulation

Task 3.1. Market and Policy Design
HSG (Frauendorfer), UniBas (Krysiak, Roux), UniGe (Romerio), ZHAW (Betz)

Task 3.2. Economic Modeling
ETHZ (Bretscher, Rausch), HES-SO (Schumann), UniBas (Weigt), UniGe (Patel)
Why Economic Modeling?

• Actually: We are interested in Multi-Agent System (MAS) Research

• Applying MAS for Multi-Agent based Simulation (MABS) / Agent-based Computational Economics (ACE)
What do we want to simulate?

• Demand: For Mobility

• Economists have a limited scope (so far):

• BUT: Price Curves cannot explain everything
  • (you have an iphone, right? So you violate that rule)

• BUT: Various researcher in different diciplines are investigate what drives energy demand apart from money (WP 2: Change of Behavior) for 8 years.
  • Should we ignore their findings?
Creating agent-based models for simulation

• Agents can simulate social behavior,
  • e.g. Agent-based Social Simulation

• BUT: Economics (who know what to model) cannot program…
Modeling

```java
public class BidirectionalConversationAutomata extends Automata implements Serializable {
    Map<String, ConversationState> states;
    ConversationState currentState;

    public BidirectionalConversationAutomata(String automataName) {
        this.name = automataName;
        this.dataStore = new HashMap<String, Object>();
        this.states = new HashMap<String, ConversationState>();
        this.states.put(initial.getStateID(), initial);
        this.currentState = initial;
    }

    public void addSenderState(boolean loop, String performative) {
        ConversationState state = null;
        if (loop) {
            state = findPredecessorState(currentState, "", performative);
        }
        if (state == null) {
            state = new ConversationState(this);
        }
        // input = none, output = performative
        Edge edge = new Edge(this.currentState.getStateID(), state.getStateID(), "", performative);
        registerEdge(state, edge);
    }

    public void addReceiverState(boolean loop, String performative) {
        ConversationState state = null;
        if (loop) {
            state = findPredecessorState(currentState, performative, ";");
        }
        if (state == null) {
            state = new ConversationState(this);
        }
        // input = performative, output = none
        Edge edge = new Edge(this.currentState.getStateID(), state.getStateID(), performative, ";");
        registerEdge(state, edge);
    }

    public void execute() {
        // Execute the conversation
    }

    public void send(String performative) {
        // Send a performative
    }

    public void receive(String performative) {
        // Receive a performative
    }
}
```
Ontology Model Driven Development
Idea

Conceptual Model Definition
- Domain Specific modelling language
- Metamodel modelling language
- RDF Model
- Domain specific language profile
- Conceptual Schema

Simulation design
- Transformation model
  - Wrapper model generator
    - (Object-oriented / Agent-oriented)
  - Data model template
    - (Object-oriented / Agent-oriented)
  - Code Generator
  - MABS model modifier
  - MABS model

Executable model
- Conceptual model modification / extension
- MABS model modification / extension

Ontology Model

Multi Agent System Framework (MASON)
An example Ontology
Creating code & instances (objects & instances)
Run the simulation

Agent container Main-Container@127.0.1.1 is ready.

prices to sell[2928.0, 90876.0, 45678.0]
prices to sell[2928.0, 90876.0, 45678.0]

Seller-agent seller0@127.0.1.1:1099/JADE: Trying to add one plan convetionalelectricity for 90876
prices to sell[2928.0, 90876.0, 45678.0]

Seller-agent seller0@127.0.1.1:1099/JADE: Trying to add one plan convetionalelectricity for 45678

Seller-agent seller0@127.0.1.1:1099/JADE: convictionalelectricity inserted into catalogue. Price = 45678

Seller-agent seller0@127.0.1.1:1099/JADE: Trying to add one plan convetionalelectricity for 90876

Seller-agent seller0@127.0.1.1:1099/JADE: convictionalelectricity inserted into catalogue. Price = 90876

Seller-agent seller0@127.0.1.1:1099/JADE: convictionalelectricity inserted into catalogue. Price = 90876

Hello! Buyer-agent buyer0@127.0.1.1:1099/JADE is ready.

Buyer-agent buyer0@127.0.1.1:1099/JADETarget plan is convictionalelectricity

Trying to buy convictionalelectricity

Buyer-agent buyer0@127.0.1.1:1099/JADE: Found the following seller agents:
seller0@127.0.1.1:1099/JADE

seller0@127.0.1.1:1099/JADE

seller0@127.0.1.1:1099/JADE

Seller-agent seller0@127.0.1.1:1099/JADE: convictionalelectricity sold to agent buyer0@127.0.1.1:1099/JADE

Buyer-agent buyer0@127.0.1.1:1099/JADE: convictionalelectricity successfully purchased from agent seller0@127.0.1.1:1099/JADE

Price = 45678

Buyer-agent buyer0@127.0.1.1:1099/JADE terminating.
Results obtained so far


• Nominated for the MATES Best Demo Award
Limitations?

• Are we that great already?
  
• Actually Ontology are limited in their expressive power.
  • Objects,
  • Attributes
  • Relations
  • Instances (what UML cannot do)

• BUT
  • No Logic… (at the moment it comes from templates)

• BUT
  • Next Iteration, we plan to integrate Rule-based System
    • (IF THEN ELSE)
Outlook in the Future (where the real work is comming)

- Task 3.2 SCCER CREST
- Joint Activity SCCER Mobility & CREST
  - Lead Workstream on Aggregated Scenarios
Questions