Thinking Lifecycle as an implementation of machine understanding in software maintenance domain

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Abstract. IT maintenance domain is wide and contains a lot of tools that helps to solve a lot of every-day problems. IT maintenance also has a lot of primitive incidents that seems to be easy to automate. However there is still the gap occupied by human specialist understanding and decision making as well as implementation even primitive incidents. But one of the key to understanding input request is the human being thinking processes: correlation, simulation, annotation. Using this model it is much easy to parse incoming request in natural language. In 2006 Marvin Minsky has published his book [1] which was our inspiration and the base of implementation described below.

Keywords: AI, machine understanding, it outsourcing

1 Introduction

This implementation contains machine understanding model based on thinking model because human understanding is also based on human thinking.
In 2006 year Marvin Minsky has published his book The Emotion Machine where he describes model of human thinking dividing all actions into 3 categories:

1. Critic
2. Selector
3. Way To Think

1.1 Critic

Critic could be understood as probabilistic predicate. In real world when human faces the problem several critics are activated. In ITSM model[4] there is Di-

[4] ITSM - IT Service Management - model of IT services

rect Instruction Critic (described below) that activates when direct instruction incident has been received. After activating critic returns Selector request.

Critic examples:

1. Learned Reactive Critics.
2. Deliberative Critics.
3. Reflective Critics.
4. Self-Reflective Critics.
5. Self-Conscious Critics.

1.2 Selector

Selector is capable of retrieving Resources (Critic or Way to think) from memory. Is the main component for memory(see below) processing.

1.3 Way to think

Worker components that actually changes the contents of short term memory(see below).

Way to think examples:

- Simulation
- Correlation
- Reformulation
- Thinking by analogy
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Practical example 1, If incident is an automatically generated system should process it using instruction book A. *Practical example 2*, If the problem symptoms already stored in the system knowledge base, use analogy to solve it.Way To Think in current implementation is a worker that modifies short term memory.

1.4 Thinking levels

Minsky indicates six thinking level. Every thinking level has its own major functionality. Every next level is a more complex than previous.

1. Instinctive
2. Learned
3. Deliberative
4. Reflective
5. Self-Reflective
6. Self-Conscious

First level is for inborn instincts and there are highest ideals and personal goals on the top level.

1.5 Facts and statistics

We have been inspired by the study of Incident Dump of Fujitsu GDC Russia Company[5]. Study indicates that there are at lest 60% of typical incidents that can be automated.

2 Emotion machine prototype

This implementation based on triple *Critic-Selector-Way to think*. There are several critics, way-to-think and selector has been created:

1. Natural language processing based on RelEx.
2. Incident classification critics.
3. Simulation.
4. Reformulation.
5. Correlation.
6. Solution search.

2.1 Implemented thinking levels

1. Learned
2. Deliberative
3. Reflective
4. Self Reflective
5. Self Conscious

Instinctive level is planned for future use as acceleration of automatically generated incidents.

3 Thinking life cycle

Thinking lifecycle is a main and central component of current implementation. It controls prototype thinking levels, short term memory, long term memory.

Typical workflow described in following steps:

- Incident processing starts
- Suitable critic activates and returns selector request
- According to selector request Selector retrieves suitable Way to think
- Way To Think modifies data in Short term memory
- Process repeats until all the goals(see below) are satisfied

Thinking Lifecycle(TLC) run different components simultaneously like a human thinking. This way, different thinking levels are activated in parallel.

[5] Russia, Kazan, Fujitsu GDC Russia, http://ru.fujitsu.com

3.1 Short Term Memory

Ways to think actively operate with common data that are stored in short term memory or a context. Short term memory contains a set of current processing data required for every component of the Selector -¿ Cricit -¿ Way to think triple: domain model, last processing result e.t.c.

3.2 Long Term Memory

In contrast of Short Term Memory Long Term Memory persists data in electrically independent storage. After several thinking cycles data from short term memory is merged with data in long term memory.

3.3 Domain model

Domain model is a set of current knowledge for specific scope: known problems, solutions, existing concepts, existing how-tos, critics, way to think.

4 Thinking Model

The picture below shows Thinking Model diagram

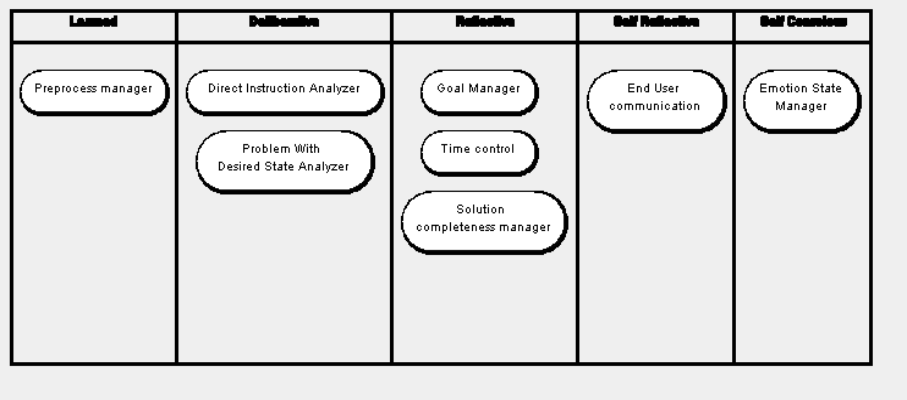

Fig. 1. Thinking Model Diagram

4.1 Learned

Process manager. This manager activates several Way To Think to perform initial incident processing. The goal of this critic is to produce semantic network of the incident. There are several Way To Think:

- Auto Correction of spelling
- Synonymic search
- Annotation finding existing concepts in Knowledge Base

4.2 Deliberative

Incident processing on the deliberative level main activities: select suitable analyzers from memory for learned level and search proper solutions.

Direct Instruction Analyzer. This Critic activates when direct instruction detected in incoming request. For example, Please install MS Office 2012 is a direct instruction for system.

Problem With Desired State Analyzer. Critic activates when problem with desired state detected by the system. For example, I have Internet Explorer 8 installed, but finance department requested Internet Explorer 7.

4.3 Reflective

System sets processing goals, performs time control, runs solution completeness manager.

Goal manager. Processing goals mechanism is used to increase performance of incident processing. Goals are links between critics and way to think. Main goal is to Help User. Other goals, that derived from it, for example:

- Resolve incident
- Understand incident type
- Model Direct Instruction

Goal manager links way to think with actions(critics or way to think) and finds required for current goal processing way to think.

Time control. Time control tracks time of a incident processing. (SLA[6] in terms of IS domain)

Solution completeness manager. This manager runs solution analysis to check if solution found is complete.

[6] SLA-Service Layer Agreement, the period of time while incident should be processed

4.4 Self-reflective

System controls actions of lower levels like: initialize short term memory or start time control. All communication with user is also managed on this level, for example by Do Not Understand Manager.
Practical example: System doesn't know concept "Opera software". Using the clarification request system learns new concept.

Dialog mode. Important part of prototype implementation is an ability to work in Dialog mode with end user. When system faces with problem (e.g. unknown concept) it solves this issue asking help from human specialist.

4.5 Self-conscious

This level is a top in hierarchy. On this level system tracks and sets the Emotional State. For example reacting for long incident processing system changes emotional state to anxious to allocate more resources for processing.

4.6 Training

System trains during operation via communication with human specialist. However, current prototype works in separate training mode. System perceives all input data as training requests in it.

5 Initial processing results

TBD

6 Conclusions

The main goal of described prototype is feasibility study of application of "Emotion Machine" [1] in IT Maintenance Domain in boundaries of the cycle from processing incident in natural language(English) up to machine understood request. In future: found and applied solution. Prototype is capable of evolving during the operation via training option.

References

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