KOMEGA REQUIREMENTS No.1, Version 2
Basic Application Scenario
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Abstract

This text describes the basic requirements for the komega software project, which is part of a larger project in the domain of an applied cultural anthropology. This is version 2 of the basic requirements due to intensive discussions in the INM project team.

1 Basic Application Scenario

Before starting any kind of programming one has to consider, which *application scenario* is the context of the software and what are the detailed *functional and non-functional requirements* which have to be fulfilled to match the intended case. Figure 1 gives a first starting point for the intended application scenario.

Main Actors: The main actors in the intended application scenario are some *experts* working as a *group* with the *common intention* to solve a *given problem* P (a task, a question, ...).

How to Proceed: At the *beginning* of the process every *expert* A_i (with 'i' as an index in the range of the number 'n' of experts) has its own *experience*, therein embedded the individual *knowledge*. These experiences are usually mostly *unconscious*. Thus it is needed to start a *process of common communication* to *activate* as much experience as possible from the unconsciousness

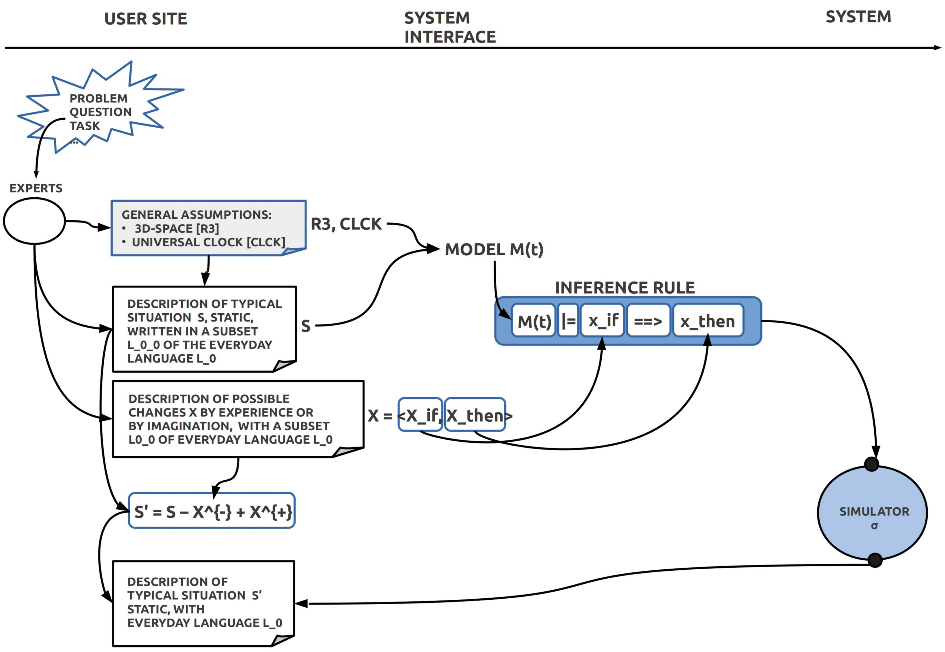

Figure 1: Basic requirements for the komega SW project, version 2

which is *related* to the problem P in question. Clearly, this 'hosted' knowledge can be extended with *actual knowledge* from external sources.

Target: This activation process of available knowledge *reaches* its first *end* if the experts could *write down* two *texts* in a subset $L_{0.0}$ of the used *everyday language* L_0:

1. A description of at least one *static state* S which is a typical part of the intended *problem* P.
2. A collection of *change-rules* X representing a set of *known* possible changes related to this static state as well as – in some cases – a collection of rules representing a set of *new possible* changes enabling new static states related to the problem P.

These two texts are close to the understanding of the experts measured in the light of the used everyday language $L_{0.0}$.

Implicit Knowledge: In this text it is assumed[1] that the *meaning* of language expressions is located *inside* an actor as his individual *meaning function* π which

[1] Based on knowledge from the empirical sciences especially biology, psychology and brain sciences.

maps internal neural structures M_{nn} – which are representing in some sense experience from the outside world and the body – to other neural structures E_{nn} – which are representing structures of a language – in a way that the M-structures are functioning as the *meaning* for the E-structures, and E-structures are possible pointers to M-structures. The M- and E-structures are mostly unconscious and are very dynamic in nature; they can continuously change. An *actor* α is in this perspective a kind of a *translator* from properties of the *real world* RW into some *internal states*IS of his body and then from the internal states again to the *outside world*.

$$\alpha_{perc} \quad : \quad RW \longmapsto IS \tag{1}$$
$$M_{nn} \cup E_{nn.L_0} \quad \subseteq \quad IS \tag{2}$$
$$\pi_{\alpha} \quad : \quad E_{nn.L_0} \longleftrightarrow M_{nn} \tag{3}$$
$$\alpha_{com} \quad : \quad IS \longmapsto E_{L_0} \tag{4}$$

These basic facts are important for to understand that the actors are the only *carrier of the knowledge* encoded in the written text. Thus the actors can decide what these texts mean, and they are able to decide, whether these expressions in the text do really *refer* to something in the state S assumed as a *static* state. If expressions *do refer* then these expressions are assumed to be *true* in this context, otherwise it is unclear, what the case is. If an expression refers to the scenario and that, what the expression *means* in the light of the knowledge of the actor, is somehow the *complete opposite* to that what is *given*, then such an expression can be classified as *false* in this context.

It is further assumed with the sciences that the internal knowledge of the actors is *biased* by the fact that all experience is organized in a way which resembles a *3D-like space* as well as an implicit timely ordering. All actors are able to organize parts of their internal knowledge as if these can be *ordered in a time-line* and they can perceive events as happening before, simultaneously or after some other events.

Change Rules X: Change rules X have the basic structure $X_{if} \Rightarrow X_E$. The condition X_{if} represents expressions of the used language $L_{0.0}$ which have to be *true* in the assumed static state S, and if this is the case, then the action X_E has to be executed. The action is very straight forward: there are either some expressions E^- which are part of S which have to be *deleted* in the follow-up state S', and/ or there are some expressions E^+ which have to be *newly introduced* in the follow-up state S', written as:

$$
\begin{aligned}
X &= X_{if} + X_E && (5)\\
X_E &= E^-, E^+ && (6)
\end{aligned}
$$

Thus to generate a follow-up state S' from a given state S one has to proceed according to the following schema:

$$
S' = S - E^- + E^+ \quad (7)
$$

Because there can be more than one change rule X_i which can be activated one has to consider more than one action part:

$$
S' = S - \bigcup E_i^- + \bigcup E_i^+ \quad (8)
$$

Semantic Dependency: While the processing of the action part of a change rule X_i is *meaning free* the test of the condition part of a change rule has nevertheless some semantic 'flavor'. The structure here resembles the case of *model theory*,[2] written as:

$$
\begin{aligned}
M_t(x) &\quad iff \quad x = \langle R3, T, S \rangle && (9)\\
x &\models X_{if} && (10)
\end{aligned}
$$

'x' is here a model which can *satisfy* the X_{if} part of a change rules. Different to classical model theory the model in this case is not a mathematical structure but the state description S enhanced with the assumptions about $R3, T$, encoded by the meaning functions π_j of the writing actors. Thus while every participating actor is assumed to be able to decide by himself whether the model x satisfies the if-parts of the change rules X, it is not yet completely clarified how one can make the *implicit* knowledge in a way *explicit*, that a purely *mechanical* decision would be possible. Because we want to use a computer to do these mechanical decisions automatically we will need this clarification.

Inference Rule: Putting all pieces together we have the following *inference rule* allowing to *infer new true situations* having already a true situation and having change rules:

$$
\begin{aligned}
Given &: M_t(x), S, X && (11)\\
x &\models X_{if} \Rightarrow S' = S - \bigcup E_i^- + \bigcup E_i^+ && (12)
\end{aligned}
$$

[2]See e.g. Chang & Keisler (1978) [CK78], or more fundamentally Tarski (1936) [Tar36]

Simulator σ: The intended simulator σ must be able to realize the inference rule purely automatically. Thus we assume:

$$\sigma : \quad S \times X \times INF \longmapsto S' \tag{13}$$

References

[CK78] C.C. Chang and Jerome H. Keisler. *Model Theory*. Noth-Holland, Amsterdam - Oxford - New York, 2 edition, 1978. 1st editioin 1973.

[Tar36] A. Tarski. Über den Begriff der logischen Folgerung. *Actes du Congrès de Philosophie Scientifique*, VII, ASI 394:1–11, 1936. The Congress took place 1935.