Levels of Reality

Position paper— 1.316 words reference missing—V3—extended abstract

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Abstract: I argue that level of detail is determined by agents constructing a plan to achieve a specific goal. Influences relevant for the plan are included, others not. This is related to the observation that human decision making is done with imperfect information and the influence of processes are included as they significantly change the outcome. Processes can be classified by the space-time frequency regions they occupy. A goal determines a space-time frequency region and only processes in this regions are relevant. This determines the level of reality related to this goal.

The invitation for this meeting focuses immediately on one—if not the—crucial question; namely causation. I separate in my approach to ontology (Frank 2001; Frank 2003) into two realms—the material and the information realm—each with objects, processes, and causation. Information processes and information causation includes psychological and social dynamics, which must be differentiated later.

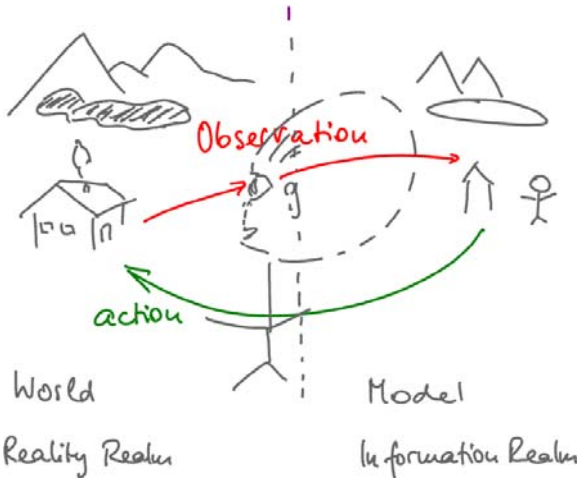

Figure 1

Properties of the reality realm can be observed, at a determined location and at the time now (point observation). Observations produce representations in the information realm of values of properties at a specific location and time. (This could be a conceptualization in the sense of Herre). At this ontological tier 1 values are describing point properties and physical processes and causations are describable by Partial Differential Equations (PDE). No level of detail concept applies (as little as in the reality realm tier 0). This view could correspond to West's 4-dimentional view.

It is an interesting question whether and how specific PDE correspond to a specific part of the space-time frequency spectrum. It seems intuitively clear that a disturbance of a water surface travels faster and further than a similar disturbance of a ground water table; but I do not see how to formalize this and how to characterize PDEs with respect to frequency [Hofer Frank AGIT 2007; habe ich keine bearbeitung gemacht, kein email gesandt bekommen und daher ist es auch nicht registriert.].

Level of reality is closely related to processes, even though objects and their size appear more salient. It is therefore necessary to characterize processes with respect to level of reality. I propose to consider the space and time frequency of a process and represent the region a process and time occupies with orders of magnitude; for example, a glacier's movement as "mm-year", moving a cup on my table as "m-sec".

Ontological tier 2 includes objects and actions as aggregates; objects and actions are regions in space-time that are uniform with respect to some property. The conversion from the point observations of tier 1 to objects and actions in tier 2 introduces levels of detail; the same space-time region can be part of multiple objects. For small table top objects physical coherence is the dominant principle for object formation: what moves together is an object (Frank 2007b; Frank 2007a)! Process in tabletop space (Montello 1997) occupy mostly the same space-time-frequency region (m-sec). For geographic space no such salient principle imposes itself and therefore problems of level of detail in geographic space are more prominent where there were addressed under the research initiative for multiple representation of the same part of geographic reality in different scales, thematic focus, etc. (NCGIA 1989). But what determines the level of detail? Object formation only explains that different level of objects are possible, but does not explain their use.

In the information realm not only an image of the reality realm (or past states of the reality realm) but also other future, possible or impossible states can be constructed. I concentrate here on "goal" states, which represent some desirable state the agent imagines. A series of actions (a "plan") can describe how such a desirable state can be achieved; an agent (individual) can decide if it wants to execute these actions and therewith translate the information causation to material causation.

Agents use theories and models to produce and assess their plans; these theories and models consist of predictive rules that describe the influence of inputs on outcomes, e.g., a concrete action—moving a cup on the table to my mouth—is influenced in principle by everything else existing, but it is only strongly influenced by nearby things. Waldo Tobler's first law of geography states: "Everything is related to everything else, but near things are more related than distant things" (Tobler 1970). From experience we know what is relevant. We have to consider processes in the same space-time-frequency region—other processes are

either too slow or too fast to influence our plan. From the object types these processes identify, only the individuals collocated in space-time are of interest. Actions much smaller or faster (the fly buzzing around the table (cm^3 – 10^{-1}s)) or much slower (the tectonic movement of the European plate (cm – year), are not relevant for me moving the cup (m-sec).

This restriction of what is relevant to achieve a goal and what detail must be considered when intending an action results from the simplification of decisions to a practical level of certainty. We do not select the absolute best course of action—because it would need complete information—we need only a *satisfying* decision (Simon 1997). Level of detail give us focus on what is relevant for to attain a goal (Grice 1989). We focus on first order, most likely, influences and leave out minor considerations. The first order influences, important and probable issues are included in the selected level of detail for this plan and sequence of action; others are ignored.

Conclusion

1. The level of reality is determined by the predictive theory used. As we change our theories, the level of reality for an action may change. The level of detail is introduced and determined by an agent that pursues some goal (human, animal, or robot); it is not present in the reality as such, independent of a cognitive, goal seeking agent. (This result may be similar to Bickhard's argument).
2. The level of detail is determined by the goal, action, and theory used to predict the outcome of the action. If my theory for weather prediction includes the color of the sunset, than sunset colors are included in the detail for prediction of tomorrow's weather. If I use a different theory (e.g., including atmospheric pressure) then the collected information at my level of detail is different. Gessler points out the important intermediation between scientists with different focus contributing to the "theories" (or rules of thumb) used for actual decision-making.
3. One might also consider how the level of reality changed into the change from alchemy to modern chemistry.

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