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Novel Technologies for
High Performance Computing

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PERCEPTION AND COMPUTING

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Progress in computing depends on its being brought closer to the natural way in which humans interact with the world. Properly accounting for the full range of decision-making activity which computing is meant to serve, and molding developments around proper intended usage, is the correct means by which to provide guidance for and incorporate future developments: from ground level architecture all the way up to the interface exposed to the user. Binary decisions currently form the basis of computing, with appeals to perception taking the form of end products, or interfaces to a world which is at core language-oriented. Binary decisions are appropriate in a linguistic setting. A perceptual setting, however, calls for a different class of decision-making: the base notion of a perceptual space is a determination of more, less, or the same. This suggests that the natural basis for decisions of a perceptual sort is not binary. It is ternary.

True art-level activity, in its definition as perceptual problem-solving in full dimensionality and at full speed, has reached a level of maturity recently with currently available tools of computing. However, it is problematic. While computing has made much progress in allowing art-level activity, allowing a degree of continuous feedback, the nature of interaction remains problematic and far less natural than basic acts which constitute art activity. The core issue is a fundamental problem: a sequence of yes or no responses is required to answer to a single perceptual query. While it may be possible now to emulate the true decision-making style through overwhelming speed, the differential will continue to be unmasked in top level work, and necessarily so, since it is the nature of art activity to explore the limits of technological capabilities. The message here is that computing, improperly constructed, will never keep pace with the speed of decision-making necessary for perceptual work.

1. Problem-solving

The direction that computing should take depends on what we wish to do with it. The purpose of computation is to assist with problem-solving. Knowing what is meant by problem-solving is a step towards knowing how to proceed.

Problem-solving begins with the identification of a perceptual phenomenon requiring investigation. This is captured and described in multiple ways: as collections of elements which can be counted or measured, thus susceptible to linguistic approaches, and as the array of relationships among them, the space of which is processed through perception. Observations in the form of combinations of these suggest a set of invariants, a characterization in compact form. The invariants are acted on by linguistic and algebraic means to derive similarity to previously described phenomena. These are then combined in multiple ways to compute a result in the full dimensional space, which can be verified against the initial phenomenon, through combination with perceptual information.

The progression suggests the weakness of the current approach of focusing on linguistic manipulation: Doing so only addresses a portion of the full range of problem-solving activity. Linguistic manipulation is valid in the space of one-to-one mappings, but much less natural in dealing with the initial many-to-one characterizations, or in constructing and validating one-to-many mappings, which require fluency in making valid determinations over a much larger space. The focus on language-based techniques suggests certain types of problems: poor quality initial characterizations, and inability to make valid decisions on verification of results. As well, the manipulations required to allow computing to be of use for perceptual activities introduces distortions and inaccuracies which lie at the heart of a variety of contemporary issues.

2. Trust

A central problematic issue in computing currently is the inability to determine trustworthiness in a natural way. The basis for trust is the ability to provide a solution to a difficult problem. In having made easy a class of problem that was once difficult, computing has seemingly made determinations of trust less straightforward. Yet what constitutes trust in a perceptual sense is relatively well-defined: talent in any given setting implies that effort has been put forth. Dealing effectively with unexpected input and functioning at full speed and to full-dimensionality is by definition difficult. Knowing the characteristics of good art in a contemporary setting may give an alternate and more natural class of a hard problem. Notions of weight and history, the provenance of objects being apparent in their appearance, are of primary importance. Perhaps this viewpoint combined with incorporation of perception in computing will offer improved methods for determining trustworthiness.

3. Conclusion

In order to make valid decisions, it is advantageous to know how those decisions are made. Allowing a correct base-level decision, rather than forcing translation at each step, will offer significant improvements. A strategy combining decisions of two possible outcomes with those of three, will correctly reflect the way in which humans make decisions, and allow for a far more robust and natural form of computing.