Ubiquity Symposium

What is Computation?

Editor's Introduction

by Peter J. Denning and Peter Wegner

What is computation? This has always been the most fundamental question of our field. In the 1930s, as the field was starting, the answer was that computation was the action of people who operated calculator machines. By the late 1940s, the answer was that computation was steps carried out by automated computers to produce definite outputs. That definition did very well: it remained the standard for nearly fifty years. But it is now being challenged. People in many fields have accepted that computational thinking is a way of approaching science and engineering. The Internet is full of servers that provide nonstop computation endlessly. Researchers in biology and physics have claimed the discovery of natural computational processes that have nothing to do with computers. How must our definition evolve to answer the challenges of brains computing, algorithms never terminating by design, computation as a natural occurrence, and computation without computers?

All these definitions frame computation as the actions of an agent carrying out computational steps. New definitions will focus on new agents: their matches to real systems, their explanatory and predictive powers, and their ability to support new designs. There have been some real surprises about what can be a computational agent and more lie ahead.

To get some answers, we invited leading thinkers in computing to tell us what they see. This symposium is their forum. We will release one of their essays every week for the next fifteen weeks.

It is also your forum: You can add your thoughts in the comments area on the Ubiquity web site (http://ubiquity.acm.org/article.cfm?id=1870596), or on the Ubiquity blog (http://blog.acm.org/ubiquity/2010/10/symposia_on_ubiquity_1.html).

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