 Last edited Saturday, April 21, 2001

Haugeland on Digitality

I. Preliminaries

A. Review
   1. Last time, we started our analysis of the fifth construal: that of **digitality**
   2. We set up three groups of question that we wanted to ask:

> **Q1** What are digital (discrete) systems good for? What are continuous systems good for? What are the constitutive properties of each?
>
> **Q2** What are the consequences of (reasons for? reasons against?) implementing on a digital substrate?
>
> **Q3** What kinds of fixity—and what kinds of fluidity—does digitality confer?

B. Literature
   1. We started to talk about John Haugeland's characterisation, found in:
      a. Chapter 2 ("Automatic Formal Systems") of *Artificial Intelligence: The Very Idea*
      b. The paper: "Analog and Analog" (one of my all-time favourite 10-page papers)
   2. Next time (after Thanksgiving) we will look at Nelson Goodman:
      a. Chapter 4 ("The Theory of Notation") of *Languages of Art*

II. Haugeland's notion of digitality[1]

A. Haugeland defines:
   1. Computers to be ⇒ formal (specifically: interpreted automatic formal system)
   2. 'Formal' to mean ⇒ "finitely-playable digital token-manipulation"[2]
   3. Digital to mean ⇒ *positive read/write techniques*

B. First, note three characteristic properties
   1. **Copyability:** flawless copying is possible
      a. E.g., Shakespeare sonnets—as opposed to Rembrandt paintings
   2. **Complexity:** interesting cases are complex or composite
      a. Cf. numerals, words, poker chips, computers
   3. **Medium independence:** (exactly) equivalent structures in different media
      a. Cf. chess: can play with wood pieces, metal pieces, on the computer, with people (à la Lewis Carroll), etc.

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[1] The notes for this section (II only) duplicate the notes from section III in lecture 11a, which we didn't get to.

[2] This is his conceptual version of the negative ("independent of semantics") reading of the FSM construal.

C. Look at definition
   1. Four parts
      a. Set of types
      b. Set of feasible procedures for writing and reading tokens of those types
      c. Specification of suitable operating conditions
      d. Given those, then procedures for read-and-write cycle are *positive* and *reliable*
   2. Positivity
      a. Positive procedure is one that can succeed absolutely and without qualification
      b. I.e., no ambiguity, vagueness, indeterminacy
      c. Not just *almost* perfect, or *pretty much* but *absolutely perfectly*, *exactly*
      d. Examples
         i. Getting a basket in basketball
         ii. Moving the pawn to K4
         iii. Cutting a board between six feet and six feet and one inch.
         iv. Writing a letter 'A'
         v. Making a copy of a text, or poem, or musical score
      e. Non-examples
         i. Shots in billiards
         ii. Cutting a board exactly six feet long
         iii. A sigh or a smile
         iv. Making a copy of a painting, or a performance of a musical score
D. Metaphysics
   1. The physical world doesn't (H. claims—we will return to this) support digitality directly
   2. So how do we have it?
      a. There is always some slop, variation, inexactness
      b. So how is digitality achieved?
      c. By allowing a "margin for error," within which all performances are equivalent and success is total
      d. Cf. poker chips (as opposed to piles of blue, red, and white sand)
   3. Comment
      a. Cf. voltages in a computer
      b. Not just that there is a margin for error
      c. Engineering requirement: *error* (discrepancy from the ideal) *doesn't propagate*
      d. Ragged edges of a pulse on a line: discrepancy from the ideal square wave don't pile up, so as to push this pulse, or the next one, or whatever, into the other camp

III. Analysis

A. Positive
   1. Haugeland has an excellent grip (in my opinion) on the *why*s of digitality
   2. This is his most important contribution
   3. Cf. A&A, p. 217:

a. "*Digital*, like *accurate*, *economical*, or *heavy-duty*, is a mundane engineering notion, root and branch. It only makes sense as …

> **Digitality:** "… a practical means to cope with the vagaries and vicissitudes, the noise and drift, of earthly existence."
>
> — John Haugeland

b. However: this is not what digitality *is*; this is what it is *for*

B. Negative · I
   1. Read/write: are these metaphors useful?
   2. Seems to be borrowing a specific (semantical) notion to describe arbitrary interaction (pushing and shoving)
   3. Devolves into *positive (effective?) interaction*, full bore
   4. Not yet clear how important this critique is

C. Negative · II
   1. The limits of his analysis are the same as what is positive
   2. Think of basic intuition about digital systems: something like a square wave, with states having two properties
      a. Internally, they are all *identical*
      b. Externally, they are *separated* (so there is room between them)
   3. Neither property is captured in Haugeland's analysis
   4. More seriously
      a. We have an intuition that these properties of *internal non-variation* and *external separation* are *necessary*, in this world, in order to *achieve* the kind of positive reliability that he wants
      b. In fact surely the right way to put it is this: to be *positive* (in this world)—i.e., to meet his criterion—one needs to use a digital system
      c. In other words, his definition is not a definition of digitality at all
      d. Rather, it is a definition of *positivity* or *reliability*
      e. Underneath it is an interesting hypothesis

> **D1** The only way to be positive and reliable, in Haugeland's sense, (at least in this world) is to be a *digital system*.

      f. But if this is right, then *what it is to be digital* is still unanswered.

D. Negative · III
   1. Once put that way, it is not even clear that **D1** is correct.
      a. Imagine a perfect Newton-Maxwell world, in which there is no quantum indeterminacy.
      b. Why couldn't a *continuous* system meet Haugeland's positivity and reliability conditions?
      c. How to cut a board that is exactly 6' long: take a saw ¼" thick, center it 6'⅛"from one end, and cut.
      d. Etc.

2. Haugeland would of course say that we can't do any of those things. And of course there is a very evident and mundane sense in which he is surely right.
3. But it is not clear why not
4. Is it a claim that *metaphysically* it is impossible to use a saw that is of a determinate width, or that is determinately placed?
5. If so, then that fact had better be put on the table
6. If not, then the claim must be that we can't *type* systems so exactly
7. But then *that* fact should be put on the table.

E. Summary

1. All sorts of issue are brought up, here
2. First, it seems, on reflection, as if the Newton/Maxwell world *itself* supports a kind of ontological perfection: there is no ambiguity, inexactness, or anything of the sort that digitality seems to be proof against, in the world as described by the equations.
3. On the other hand, it also seems equally evident that there is a serious sense in which that kind of perfection isn't usable.
4. Two possible kinds of reason suggest themselves, as reasons why Newton/Maxwell perfection isn't usable (implying that we need digitality, as Haugeland assumes, in order to achieve perfection in the real world)
   a. An **epistemic** reason, having to do with the fact that although the Newton/Maxwell world has a kind of exactness, we couldn't *know* what that exactness is. This (intrinsic) failure of knowledge, in turn, could be caused by (at least) two independent kinds of limitations:
      i. Limitations of quantum mechanics—i.e., that our understanding of the powers and limitations of knowability are in fact suffused with limitations that come from the fact that knowing, as we know it, is a phenomenon in a quantum-mechanical world.
      ii. Limitations of computational complexity—i.e., for reasons of the (very real) limits of finite efficacy, of the sort that we talked about in the second critique.
   b. An **ontological** reason, having to do (again) with quantum mechanics—i.e., that some kind of quantum indeterminacy is what defeats perfection in our world, and therefore leads to the conditions that digitality is needed, in order to regain it.
5. Either way, we can say that at least two major questions remain unanswered:

> **1.** What is digitality, such that **D1**, in our world, does seem to be true?
>
> **2.** What is our world like, such that **D1** is true in it?

6. Next week, we will try to come to a better understanding of both of these issues.

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