Philosophy 395 Computer Science 228 Symbolic Systems 210	**Lecture 4 — Formal Symbol Manipulation**	Philosophy of AI Stanford University Winter Quarter, 1989–90

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I. Review

A. Btw
   1. First problem set due today!
   2. If have, take after class
   3. If not, into envelope by midnight
   4. Talk about next Tuesday evening, during question period.

B. So done with introduction

C. Trust the people have some sense of
   1. What the AI project is:
      a. strong & weak
      b. computational notions to explain intelligence (emphasis on intentionality)
   2. What intentionality is like
      a. Reach & registration
      b. Disconnection
   3. Some computational issues

D. Turn for the next 3 weeks to look at (ϕ of computation)
   1. three candidate theories
      a. Start, today with **Formal Symbol Manipulation**
         i. Not the order in the syllabus
      b. Next time: **Digital State Machines**
         i. Tuesday evening (2/20)at 7:00
         ii. Three handouts
      c. Third (2/26): **Recursive Function Theory**
   2. Ask, of each of them, two questions:
         a. Is it true of computation?
         i. Is it a plausible account of mind?

II. Introduction

A. Today's lecture in 3 parts
   1. Introduction to the notion
   2. Conceptual critique
   3. Factual critique

B. Start with some general comments
   1. Have been interested in "formality" for more than 10 years
   2. Even interviewed people as to what it means
   3. Lots of different things
      a. Not a technical notion (like mass, energy, or tail-recursion)
      b. Still: virtual consensus
      c. As such, betrays many of the deepest assumptions …
   4. To do it justice, would have to go back in history
      a. Through Turing, Carnap, Russell, and Frege, with a considerable side trip to Brauwer & the intuitionists, Herbrand school, etc.
      b. Not only that; Galileo, etc.
      c. Role in plays in other fields: math (perjorative), physics, etc.
      d. Even back to Platonic forms.
   5. That book should be written, but not my topic here
   6. So look at the present case.

C. Two methodological problem
   1. Have two notions under review
      a. To ask whether computation is formal, have to know what computation is, so as to assess its formality
      b. But don't know
      c. So: cliffs, two cases.
         — conservative tactics
   2. In a given case, if I challenge something's being "formal symbol manipulation", and you say that it's obviously formal, answer may be yes or no, but what I want you to answer is the following question:
      — Under what construal of "formal" is it so obviously formal, and is that notion on that is adequate to serve as a foundational predicate on what it is to be a computer?

D. Basic idea
   1. **Independent of semantics**
      a. examples: logic, etc.
      b. Mathematics: Martin-Löf
   2. Change the semantics without changing the syntax
      — see this in lots of discussions
      — Not just Dretske, Searle, (critics), but positive adherents as well

E. Couple of immediate comments
   1. To distinguish it from other readings, call it **antisemantical**
      a. So, claim is that computation is antisemantical symbol manipulation (ASM).
   2. AI, not c.s., primarily (will come back to this)

   a. Hint: c.s. more interested in formal methods than formality of computation.
3. Relates to disconnection
   a. Talked about non-effectiveness of semantic reach
   b. Hypotheticals, didn't have to drag tectonic plates with you
   c. On the other hand:
      i. Is obvious that people are disconnected (all examples taken from simple human introspection)
      ii. Is ¬obvious that people are formal (in fact many people would shy away from that claim)
   d. Raises a question: how does formal relate to disconnected?
      i. If same, should say so
      ii. If different, how?
   e. Won't answer now, but will expect an answer before we're through.
4. Predicate on the internals of the machine
   a. Cf. las t week's discussion
5. Requires semantics
   a. I.e., assumes that symbols have a meaning, or semantic value
   b. Don't call cutting eggplants (when making mousaka) a formal operation
   c. I.e., semantics is banishes to the wings.
   d. Remember talk about metaphysical stripe? That all there is to meaning is what happens to the symbols inside the machine?
      i. These people cannot accept a formal (antismenatical) symbol manipulation construal of computation
      ii. This is important, because there are lots of idealists, solipsists, and other forms of irrealism in AI and c.s.
      iii. Don't be misled into identifying those who think there aren't other semantical properties, and those would think that the machine proceeds dindependently of them.
      iv. Extremely important!

F. Given these remarks, turn to parts II and III
   1. First, problems of internal coherence, methodological status, etc. (so what? what would follow if it were true).
   2. Problems of factual adequacy (is it true?)

III. Conceptual critique

A. Why is antisemantical reading so popular?
B. Seems to offer naturalist (define) dream on a silver platter
   1. Semantics is recalcitrant
   2. So: seems to have set it aside

3. So: ASM view of mind would solve all of ϕ's problems!

C. But not so fast
   1. This hope is based on a fundamental confusion!
   2. Somethink like a **use/mention error**.
      a. What naturalism needs is what I'll call notional independence
      b. What antisemantical formality offers is phenomenal (ontic) independence.
   3. If you blur your eyes, can think they are the same thing.
   4. But in fact it isn't so.
   5. Conclusion: even if computation were formal symbol manipulation, that wouldn't advance intellectual inquiry one iota towards its goal of providing a naturalistic theory of intentionality!
   6. So see how this goes

D. First the two notions
   1. Notional independence
      a. Two simple examples
         i. Hopskotch and Lawrencium-236.
         ii. More relevant: temperature and mean molecular velocity
      b. Note something about the latter: directed
         i. molecular velocity is independent of temperature, qua notion
         ii. That's why an explanation of temperature as mean molecular velocity is intellectually satisfying
      c. It's not that there isn't temperature
      d. Rather, the converse: that mean molecular velocity is what temperature is.
   2. Phenomenal (ontic) independence
      a. Length and width.
      b. Useful ontological categories, exactly because they are independent.
      c. But notions are dependent. Couldn't have length without having width.

E. So now can see what's going on:
   1. A naturalistic reconstruction of intentionality requires notional independence
   2. Antisemantical formality offers phenoemenal independence.
   3. ASM doesn't offer notional.
      a. Easy: first, symbol manipulation
      b. Second: independent of semantics $\Leftarrow$ also intentionally defined!
         i. Not like red, or <$1000, or something else.

F. Conclusion:
   1. Claim that entire theoretical allure of ASM is founded on this mistake.
      a. ASM is like Temperance Union's banishing of alcohol

   b. Not like physicists banishment of the luminiferous ether (or, perhaps more relevantly, their elimination of weight, or their reduction of temperature).
2. So much the worse for it.
3. Turn to second question: whether, these conceptual failings notwithstanding, ASM claim about computation is true.

IV. Factual critique

A. Intro
   1. Claim that it is false
      a. Specifically, too narrow
      b. Would have to exclude all kinds of machines currentl;y marketed.
   2. Four categories
      a. Internal
      b. External
      c. Universal
      d. Boundaries (transducers)
B. Internal
   1. Examples
      a. Quotation
      b. CAR, CDR (cf. English discourse)
      c. Strings
      d. Data structures in general
      e. EQ ("A" = "B")
      f. E-mail
      g. compilers, linkers, etc.
   2. Conclusion: full of internal reference
   3. Possible reconstructions
      a. Formality/1a: independent of the semantics of meta-level designators.
      b. Still catches original intuitions
      c. But won't work!
      d. More later!
C. Universal
   1. Examples
      a. Length
      b. ERCC
      c. Lots of properties of internal structures
   2. Conclusion: computers actually manifest, don't just represent, lots of comlpex mathematical properties.
D. External

1. Churchland's Roger the Crab
2. Possible replies
   a. ¬computational
   b. transducers ¬computational
      — Dennett: "transducer overcoats"
3. Don't work: where does causal flow end?
4. Data-driven machine, by causal flow.

E. Boundaries (transducers)
F. Conculsion: **silicon valley doesn't care about the formality police**

V. ...

A. Conceptual coöccurrence (Maine, NE)

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