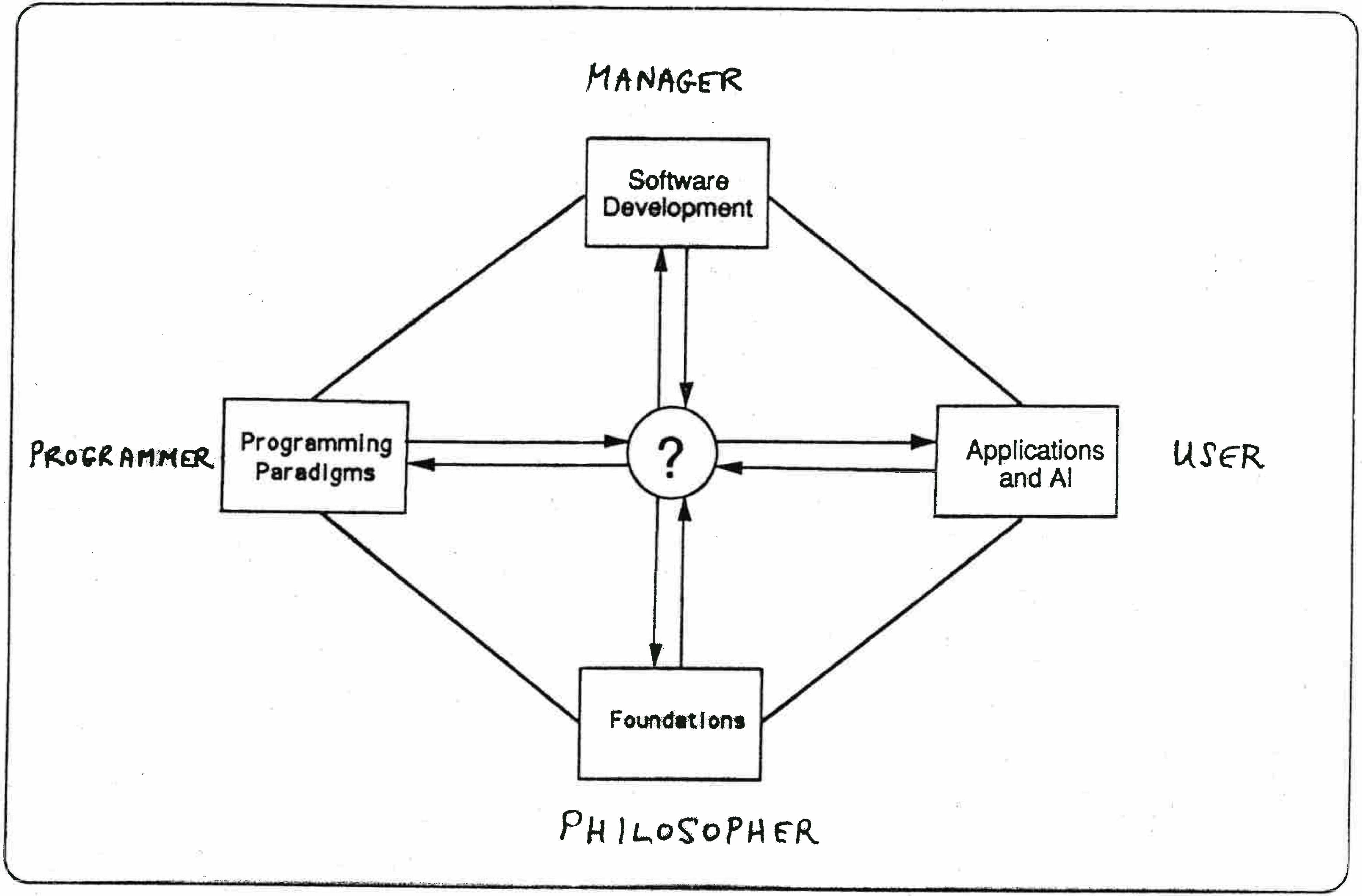

THE FOUR AGENT PERSPECTIVES

AI FOUNDATIONS
COMPUT. INTELL. Vol 3. 198

Brian Cantwell Smith: 2 lessons of logic

'First factor': what must be realised in a physical substrate if the system is to do any work

"proof theory" **form**

'Second factor': what the symbols are about

"model theory" **content**

First lesson: content can't be reduced to form

Second lesson:
first and second factors have to be related

"soundness and completeness"

- **Want** principles to connect content and form

- In computer science

semantics = unambiguous execution

BUT in this sense ...

2nd factor is "**semantics of the semantics**" !

cf McDERMOTT
"A CRITIQUE OF PURE REASON"

3 **tenets** of classical logic to be **reconstructed**

✓✓ **CONTEXT DEPENDENCE**

✗ use can be ignored. A sentence must represent its whole content explicitly. ✗

✓✓ **INTERACTION OF FIRST/SECOND FACTORS**

✗ locally first & second factors treated independently, ultimately globally related. ✗

CF Defn of **formal**
"From step to step, in a formal proof, the
first-factor inference procedure
can not depend on or affect
second-factor semantic interpretation" ✗

✓✓ **MORE DISCRIMINATE MODELLING**

language and modelling are treated as
distinct types of representation: ✗
✗ linguistic reference relation non-transitive,
but
modelling is transitive and "**free**":
can use a model of X in place of X.

✗ "**promiscuous modelling**" ✗

SOFTWARE

Harel: Biting the Silver Bullet - January 1992

Developments in **1-person prog** 1950-75
largely eliminated the problems

"No single reason: mix of factors that prevailed"

How about **reactive systems**? ...
.... Brooks, Parnas pessimistic

Harel's analysis:

Behavioural models with
good mathematical semantics
=> can **execute** models

Need to be **visual** ....

Can do extensive **testing** with prototypes ....

.. in 25 years problems will have gone away ...?

? is there a fundamental distinction between
1-person programming
and
reactive systems engineering

? is there fundamental distinction between
1-person programming
and
reactive systems engineering

NO - both involve
requirements analysis + program specification
2nd factor **1st factor**

YES - requirements analysis for
reactive systems involves

- design of computational devices
from first principles

- essential interaction between 1st/2nd factors

Much more is **preconceived** in 1-person prog:

- computational devices

- requirement described off-line

PROGRAMMING

≡ TRANSFORMATIONS OF STATE + HUMAN INTERPRETATION

PROGRAMMING

Object-oriented programming: a case study

1967 **Birtwistle et al: Simula**

- programming = system description
- Key abstraction - the object
- Idea: identify objects in the application
  build a model to reflect capabilities
  to act to change state in system

=> Problems:

- propagation of state-change via content

  non-computable relations:
  "doodling vs signing away my house"
- principles for constructing objects unclear
- parallelism badly modelled wrt indivisibility

Object-oriented programming: a case study

1972 - **Parnas et al**

- objects for information hiding: 1st factor
  => objects as a **programming device**

1980 - **Smalltalk**

class concept / inheritance

=> Principles of Simula obscured

- Powerful mix of 1st & 2nd factor concerns
- No clear basis for prescribing parallelism

1985 - **Pierre America:**
Semantics for Parallel OO Language

Theorists describe POOL formally ...

Formalising limits power to link 1st/2nd factor

APPLICATIONS

Motivation for linking 1st & 2nd factors

Need to know how to:

- write programs that are easy to interpret *
- write interactive programs to adapt to user
- integrate requirements analysis and spec
- model CAD, where
  user introduces knowledge incrementally
- program a robot to make correspondence:
  between **internal model** & **sensory input**

* AND DOES THIS MEAN ANYTHING

?

Conventions to link 1st and 2nd factor aspects:

descriptive identifiers
lazy evaluation
data structures to reflect the application
objects
etc

BUT
This is inadequate ... need new **principles**
to deal with 1st and 2nd factor interaction