

# Taxonomies and Ontologies for Development of Lexicon

Steven Jenkins  
Principal Engineer



**Jet Propulsion Laboratory**  
California Institute of Technology

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# Overview/ Background

- I was asked to speak on “taxonomies and ontologies for development of lexicon”.
- With characteristic immodesty, I don’t think that’s the best way to look at it.
- In particular, a lexicon plays a very limited (albeit essential) role in information exchange.
- Instead I’d like to focus on some thoughts about how to develop ontologies to support digital engineering information exchange.
- A lexicon is a by-product of such an endeavor.
- And to make it fun, I’m calling it...

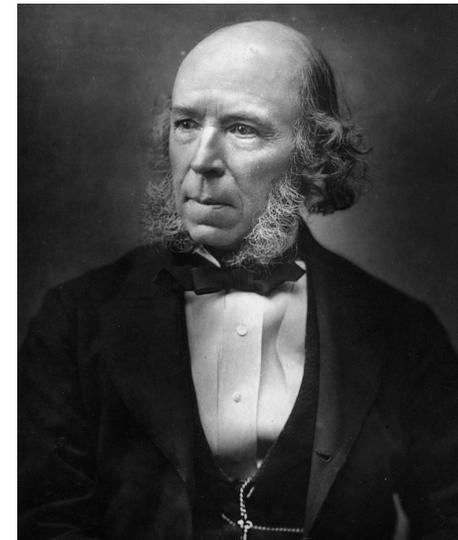
# Ontology Advice from Dead Philosophers

## Who Said It?

A preliminary conception, indefinite but comprehensive, is needful as an introduction to a definite conception. A complex idea is not communicable directly, by giving one after another their component parts in their finished forms; since if no outline pre-exists in the mind of the recipient those component parts will not be rightly combined. Much labor has to be gone through which would have been saved had a general notion, however cloudy, been conveyed before the distinct and detailed delineation was commenced.

Herbert Spencer, English philosopher, biologist, anthropologist, sociologist, and prominent classical liberal political theorist

*First Principles, 1867*



# The Takeaway

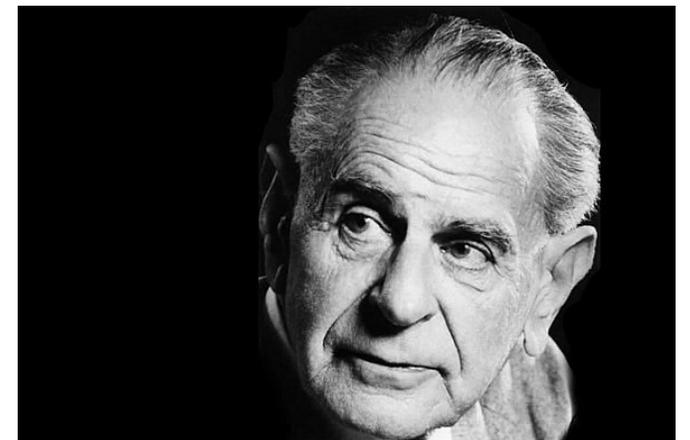
- We should not begin by attempting to define words precisely.
- We need to develop *ideas* first.
- Complex ideas require successive refinement after examination from multiple points of view.
- But don't we need definitions?

## Who Said It?

While we may say that the essentialist interpretation reads a definition 'normally', that is to say, from *the left to the right*, we can say that a *definition*, as it is *normally used in modern science*, *must be read back to front, or from the right to the left*; for it starts with the defining formula, and asks for a short label for it. Thus the scientific view of the definition 'A puppy is a young dog' would be that it is an answer to the question '*What shall we call a young dog?*' rather than an answer to the question '*What is a puppy?*'

Karl Popper, Austrian-British philosopher and professor, generally regarded as one of the 20th century's greatest philosophers of science

*Two Kinds of Definitions*, 1945

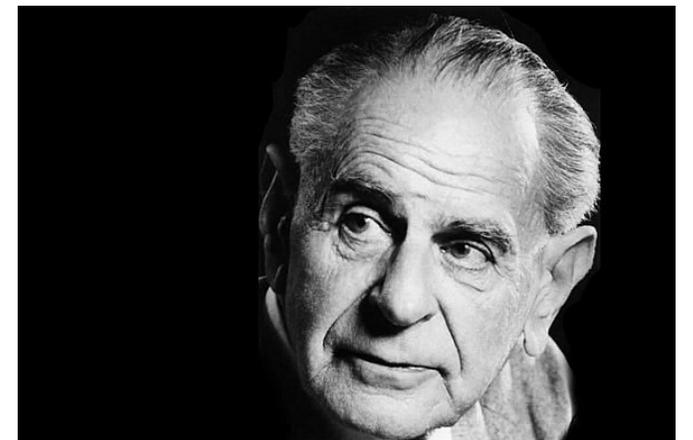


# More Popper

[A] definition cannot establish the meaning of a term any more than a logical derivation can establish the truth of a statement; both can only shift this problem back. The derivation shifts the problem of truth back to the premises, the definition shifts the problem of meaning back to the defining terms (i.e., the terms that make the defining formula). But these, for many reasons, are likely to be just as vague and confusing as the terms we started with; and in any case, we should have to go on to define them in turn; which leads to new terms which too must be defined. And so on, to infinity. One sees that the demand that all our terms should be defined is just as untenable as the demand that all our statements should be proved.

Karl Popper, Austrian-British philosopher and professor, generally regarded as one of the 20th century's greatest philosophers of science

*Two Kinds of Definitions, 1945*



# The Takeaway

- An *essentialist* definition answers “What does this word mean?”
- A *nominalist* definition answers “What shall we call this useful concept?”
- All the useful definitions in science are nominalist.
- The utility of a concept depends on its *meaning*, not its name.
- Insisting on “defining one’s terms” is a bad way to start.
- OK, but how do we find useful, meaningful concepts?



# The Takeaway

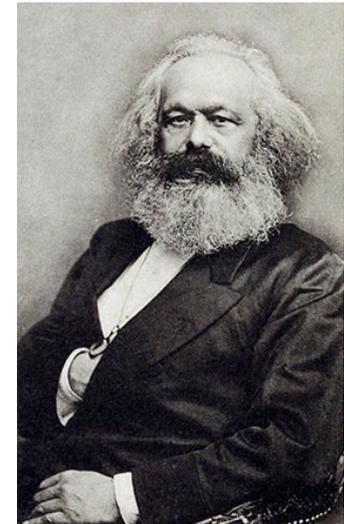
- When Feynman said “[W]e have no knowledge of what energy *is*” [his emphasis], he was rejecting the essentialist viewpoint.
  - *esse* is Latin for “to be”
- The important idea is the numerical quantity that appears to be conserved.
- In this case, it’s  $\mathcal{H} = T + V$ , the so-called total energy of a system.
- The concept  $\mathcal{H}$  is important *because  $T + V$  is conserved*.
- The key is to find the concepts that appear to be important.
- That works for science, but are we doing science?

# Who Said It?

The philosophers have only interpreted the world in various ways;  
the point is to change it.

Karl Marx, German philosopher, economist,  
historian, political theorist, sociologist, journalist  
and revolutionary socialist

*Theses on Feuerbach, 1845*

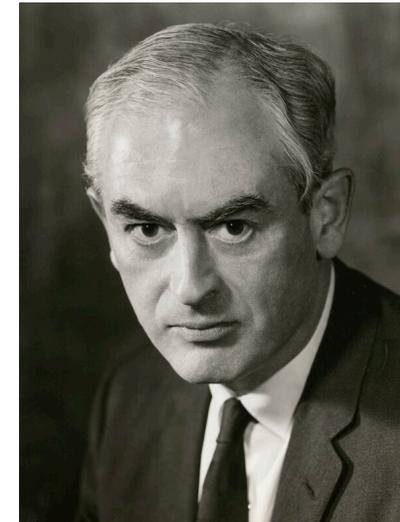


## Who Said It?

The general tone of my Presidential Address to the British Association [for the Advancement of Science] may give the impression that I am an 'optimist', but indeed I am no such thing, though I admit to a sanguine temperament. I prefer to describe myself as a 'meliorist' — one who believes the world can be improved by finding out what is wrong with it and then taking steps to put it right.

Peter Medawar, British biologist, Nobel laureate

*Pluto's Republic, 1845*



# The Takeaway

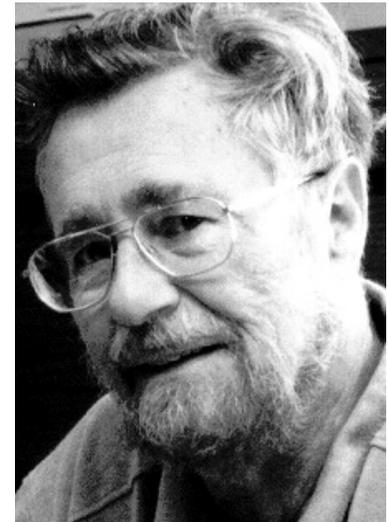
- Our job is not to be ethnographers, filling our notebooks with detailed descriptions of the wide variety of usages, conventions, interpretations, etc., in engineering information exchange.
- We're not interpreting the world.
- The reason we're here is that there isn't any real consensus practice for digital engineering information exchange.
- That's what's wrong with the world; our job is to take steps to set it right.
- We should not struggle to find a consensus that doesn't exist.
- Instead, we should develop useful ideas and build consensus for them *because they're useful*.
- Which brings up one more thought....

## Who Said It?

The proper technique is clearly to postpone the concerns for general acceptance until you have reached a result of such a quality that it deserves acceptance. It is the significance of your message that should justify the care that you give to its presentation, it may be its "unusualness" that makes extra care necessary. And, secondly, what is "general"? Has Albert Einstein failed because the Theory of Relativity is too difficult for the average high school student?

Edsger Dijkstra, Dutch systems scientist, programmer, software engineer, science essayist, and early pioneer in computing science

*On the role of scientific thought, 1974*



# The Takeaway

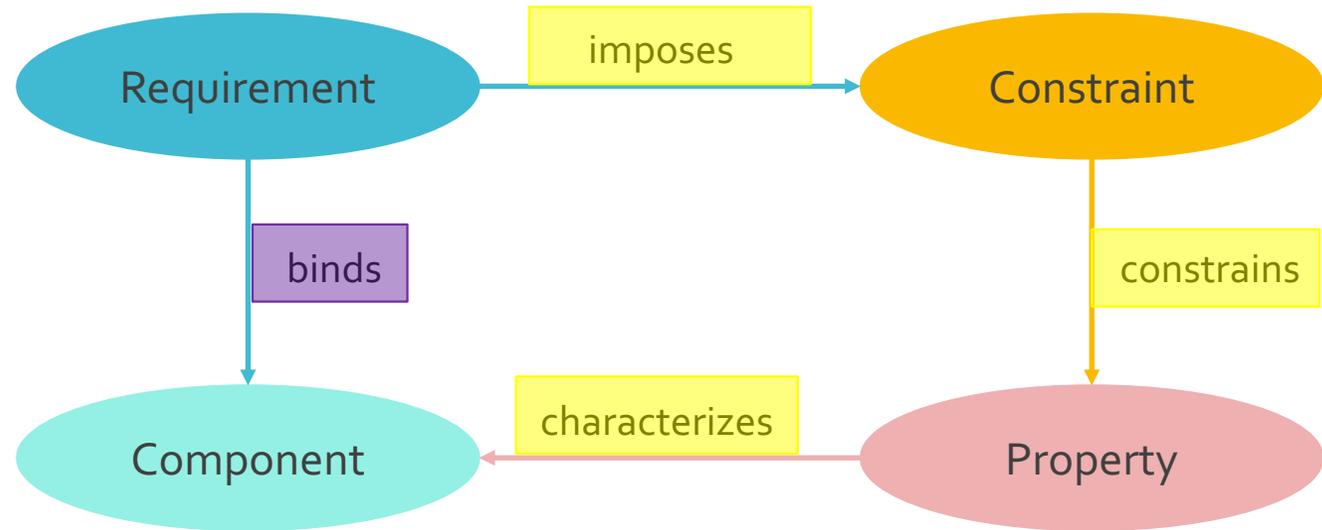
- Our job is to create useful things that *work*.
- It's easy to get broad agreement on things that *don't work*:
  - Convene in tropical resorts every January.
  - Accept everyone's favorite input.
  - Ignore gaps and inconsistencies.
  - Issue "Valued Participant" trophies to all involved.
- But what does it mean to *work* in this context?
- It means the concepts, properties, and rules we agree to must help us *reason* about engineered systems:
  - answering questions,
  - checking invariants,
  - creating products.
- Let's make it work *first*, then try to sell it *because it works*.

# A Quick Example

# A Requirement

- Consider a simple text requirement such as “The flight system mass shall not exceed 200 kg”.
- There’s a constraint in there:  $m_f \leq 200$  kg.
- And the word “shall” indicates some sort of imperative.
- Let’s try to structure that a little.

# A Simple Requirement Pattern



Rule:  $\text{imposes} \circ \text{constrains} \circ \text{characterizes} \rightarrow \text{binds}$

# What Did We Just Do?

- In just a few minutes of informal thinking, we
  - identified four concepts that appear to be useful,
    - which we're calling *Requirement, Constraint, Property, Component,*
  - identified three relationships that appear to be useful,
    - which we're calling *imposes, constrains, characterizes, binds*
  - and identified a rule that relates three relationships to the fourth.
- We began to define a little language to exchange information about Requirements...
  - and Constraints and Properties and Components.
- That is, we started building an *ontology* for engineering information exchange.
  - You're welcome!
- There are obvious directions for further work (e.g., Constraint)
- And we didn't have to define a single term.

# Of Course There Will Be A Lexicon

- When we're finished, our ontology will prescribe everything that we agree it's meaningful to say about a Requirement.
- That is, the ontology will enumerate those commitments to which we've agreed about the concept of a Requirement.
  - And Constraint, and Property, and ....
- It will be useful to summarize those commitments in a few sentences (i.e., for the lexicon).
- But it's just a summary—the real meaning is the ontology.
- There's no point in trying to summarize the commitments before we've made them
- So let's get on with building ontologies.

# Questions?

[sjenkins@jpl.nasa.gov](mailto:sjenkins@jpl.nasa.gov)