Knowledge Assertions and Knowledge Organization Systems

Presented to the 16 July 2009 Joint DoD-IC Data Meeting

Office of the Director of National Intelligence
Chief Information Officer

Goals for Knowledge Management

- **Currently, the content of intel resources is buried in the form of the resource (text, image, video), and is not able to be processed directly**
- **Identifying and describing the content of intel resources, in a structured (unambiguously interpretable) way, with the meaning (semantics) explicitly stated, will improve intelligence analysis, correlation, fusion, discovery, and overall usability of those resources**
- **Developing standards for describing content will help the IC move towards interoperability so these goals are achieved**

Knowledge Assertion Defined

- **Knowledge Assertions (KAs) are the identification of entities in intel resources, such as:**
  - People
  - Organizations
  - Places
  - Weapons
- **KAs also are the identification of attributes of entities and relationships between entities**
- **“Intel resources” include documents, web pages, database records, images, audios, videos, and other digital forms of content**

Resource Segment

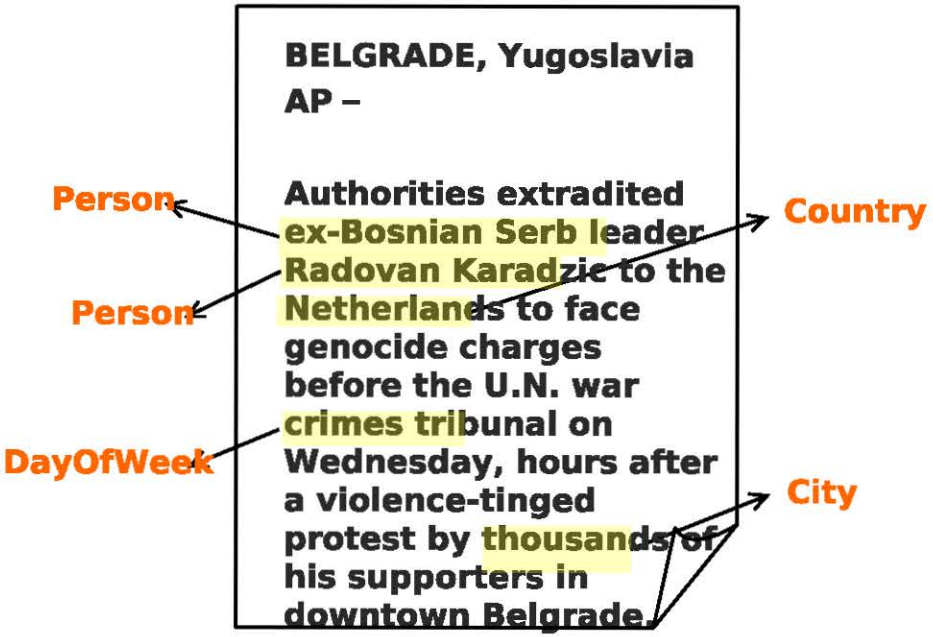
- **A specific, possibly non-contiguous, portion of an intel resource about which the *Knowledge Assertion* is being made**

BELGRADE, Yugoslavia
AP –

Authorities extradited ex-Bosnian Serb leader Radovan Karadzic to the Netherlands to face genocide charges before the U.N. war crimes tribunal on Wednesday, hours after a violence-tinged protest by thousands of his supporters in downtown Belgrade.

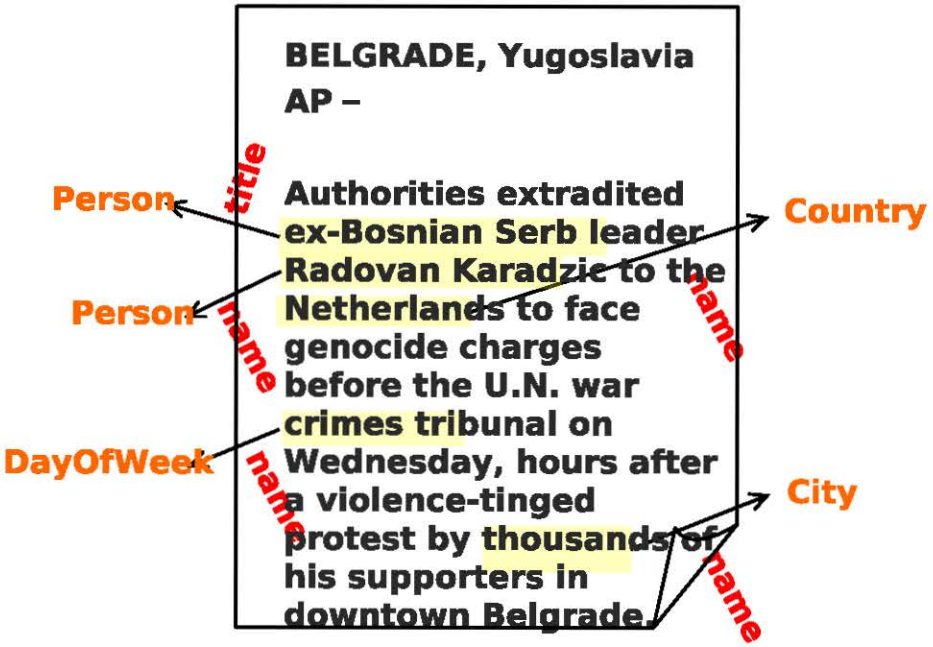
Entity Class

- ***Entity*** **= something that has a distinct, separate existence**
- ***Entity class*** **= the asserted type of the entity that is referred to by the *Resource Segment***



Entity Segment Attribute

- ***Entity Segment Attribute*** **= an asserted property of an entity whose value is the *Resource Segment***



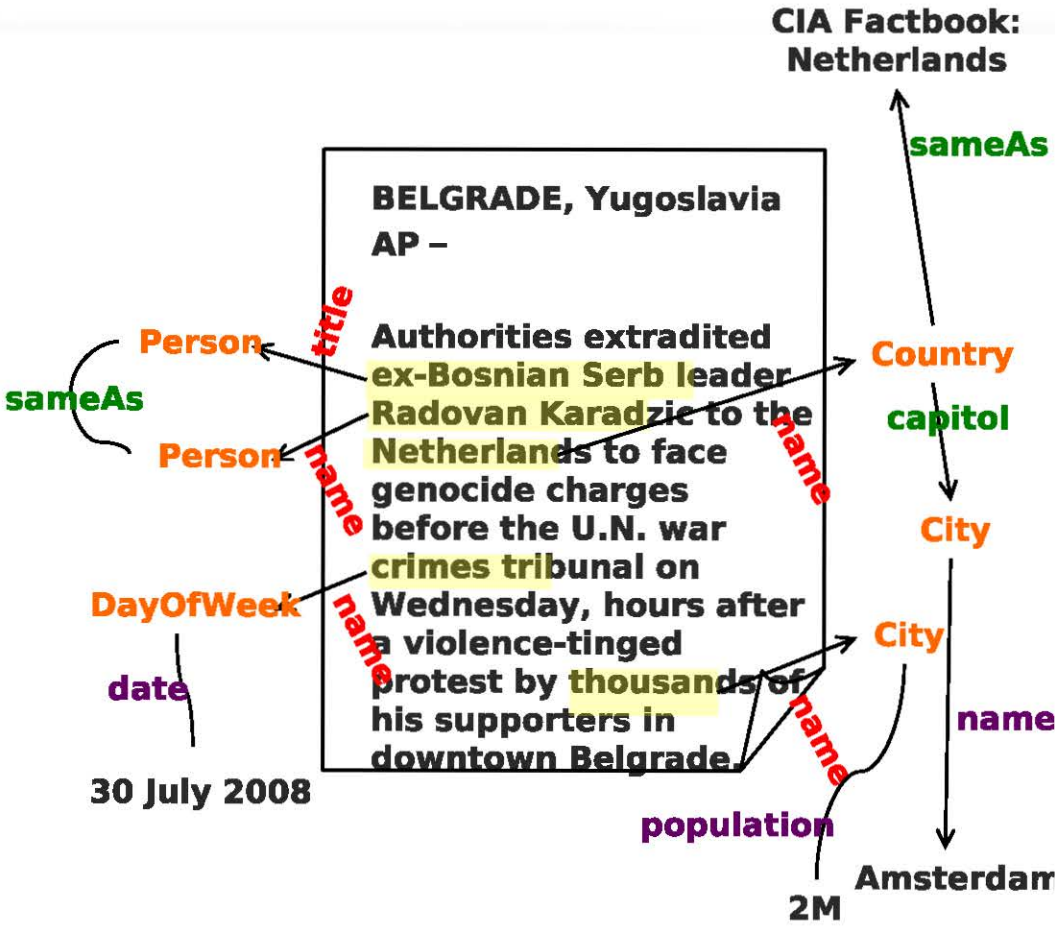
Entity Attribute

- ***Entity attribute*** **= any additional asserted property of the entity whose value is a quantitative or qualitative characteristic*, that is not a *Resource Segment***

A number, string, Boolean, quantity with units, etc.

Entity Relationship

- ***Entity Relationship*** **= an asserted property of an entity whose value is another entity**
- **Variants**
  - Identified by *Resource Segment*
  - Not identified by a *Resource Segment*
  - Identified external to the intelligence resource



Assertion Metadata

- **Information about a *KA*, but not what is being asserted**
- **Includes:**
  - Source
  - Creator
  - Contributor
  - Date
  - Confidence
  - Knowledge Organization System Reference
  - Encoding
  - Publisher
  - Knowledge Assertion Security Mark

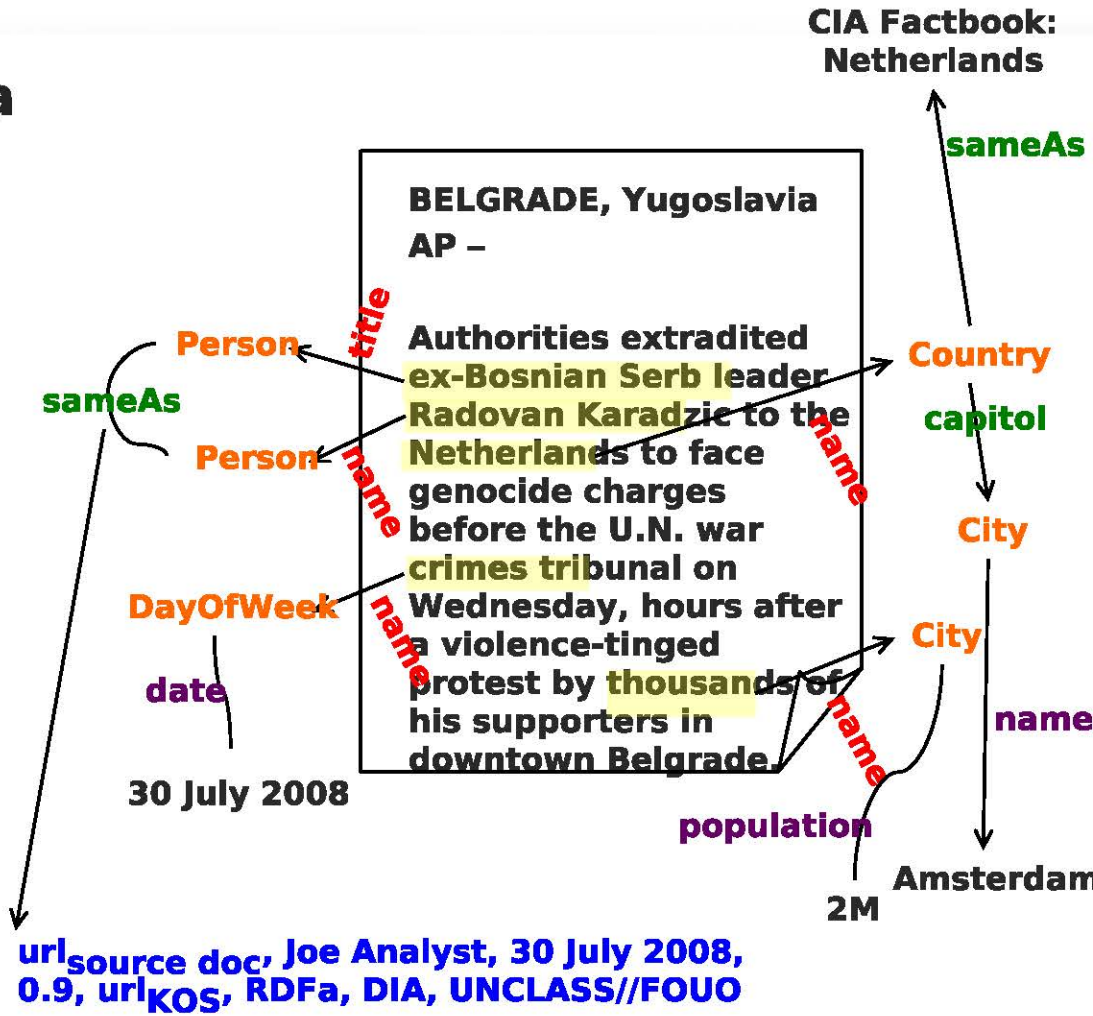


Image Example

Jane's "All the World's Aircraft": McDonnell Douglas DC-9

sameAs

E/OImage

Fixed-wingAircraft

MD DC-9 airframe

maxTake-off Weight

164,000 lbs

locatedAt

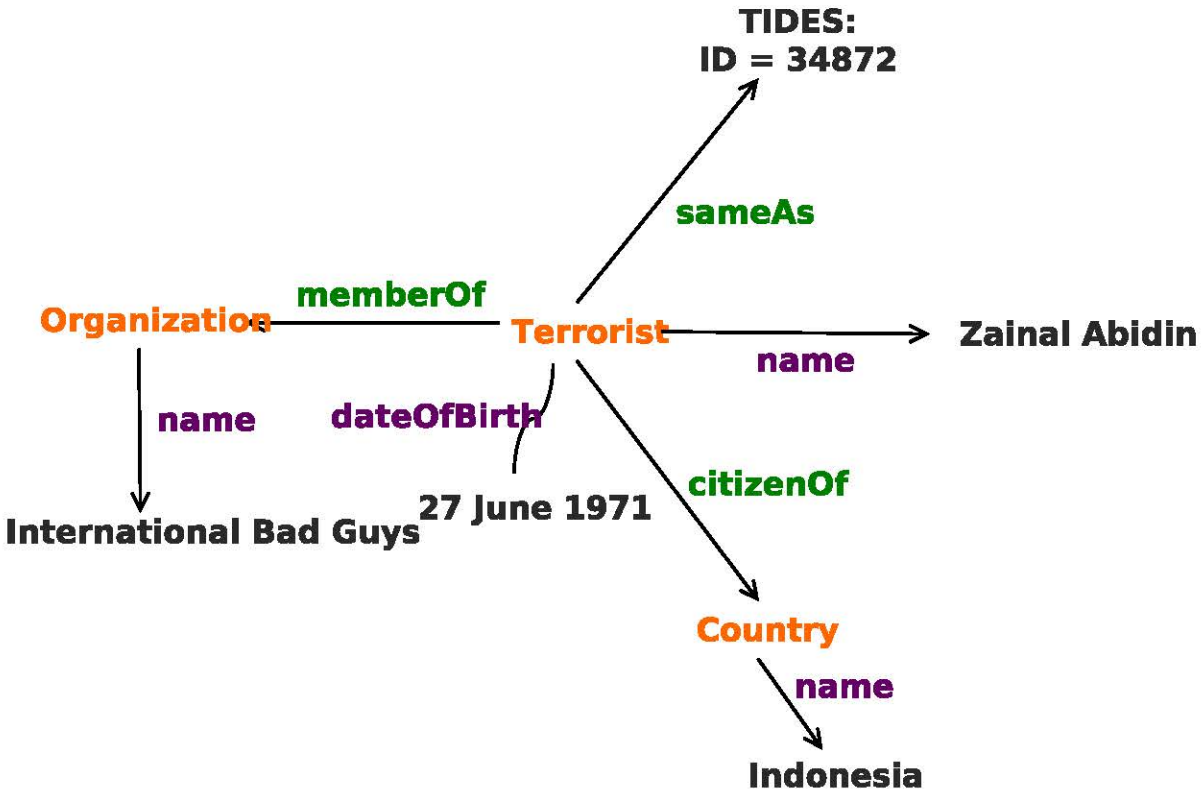
E/OImage

AirportTerminal

name

Ronald Reagan National Airport, Terminal B

Example with No Explicit Resource



Knowledge Organization System Defined

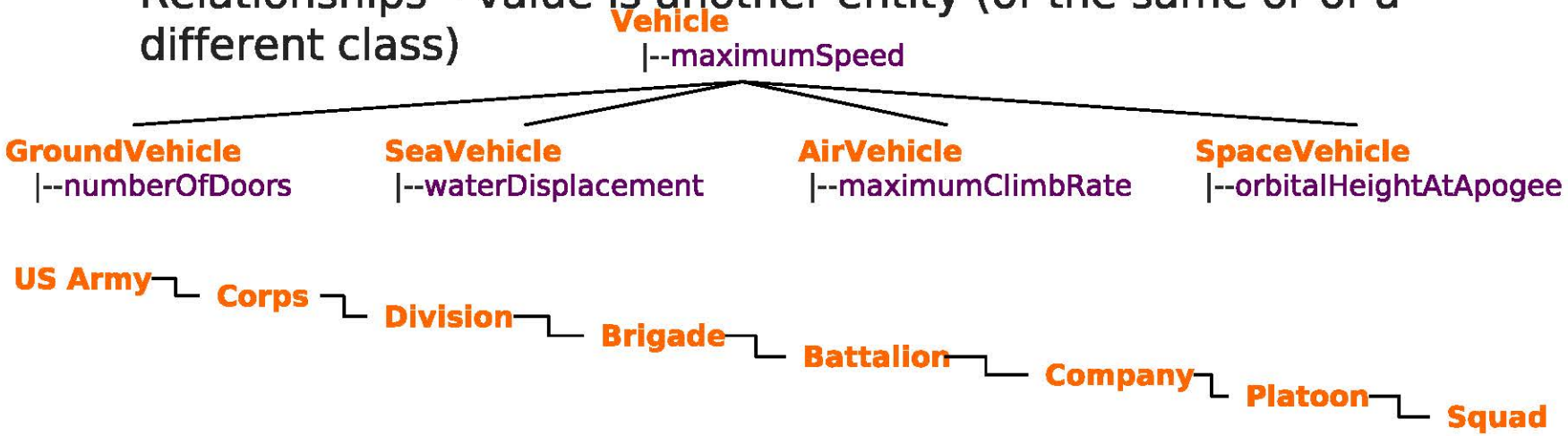
- **In previous examples, how did I know to use:**
  - Classes: Person, Country, City, Fixed-wingAircraft, Terrorist, Organization?
  - Attributes: name, title, population, E/OImage, airframe, dateOfBirth?
  - Relationships: capitol, locatedAt, citizenOf, memberOf, sameAs?
  - Controlled vocabulary: DayOfWeek name = Wednesday, Country name = Indonesia?
- **Maybe I should have asserted a different attribute?**
  - "Bosnian Serb leader" is role of Person, instead of title of Person?
- **Aren't classes related?**
  - Isn't a Terrorist a kind of Person?
- **Answer: a *Knowledge Organization System (KOS)* gives meaning (semantics) to the classes, properties, and controlled vocabulary values of the Knowledge Assertions**

Types of KOSs

- **One that deals with *concepts* in a domain**
  - Often called an *ontology*
  - An explicit and formal collection of concepts of interest in a specific intelligence domain
- **One that deals with *terms* in a domain**
  - Often called a *controlled vocabulary* (CV)
  - A collection of natural language (lexical) terms explicitly allowed to be used to refer to aspects of a specific intelligence domain

Ontology Elements

- **Class**
  - A grouping of a number *entities* regarded as forming this group by reason of specific properties, characteristics, qualities, or traits
- **Properties**
  - Attributes - value is qualitative or quantitative; attributes can be restricted to have values in a CV
  - Relationships – value is another entity (of the same or of a different class)



Controlled Vocabulary

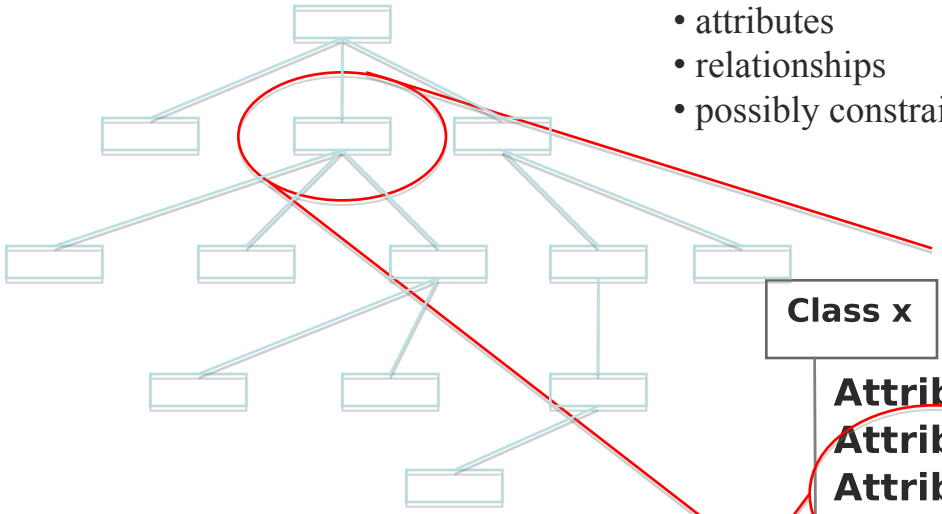
- **Controlled Vocabulary: a defined set of terms**
  - Uasge: Preferred term(s), alternate term(s), deprecated term(s)
  - Can include a natural language description of values
- **Common controlled vocabularies in IC**
  - Language Codes
  - Currency Codes
  - Units of Measure
  - Subject Area Taxonomy
  - Orgs and Alliances
  - Classification Markings
  - Dissemination Control Markings
  - Special Access Required Markings
  - Intelligence Disciplines
  - MIME Types
- **Enumeration**
  - A subset of the values of a *single* attribute of an entity class
  - Example: RELTO countries

Connection between Ontology and CV

- **CV: a list, where each entry in the list is a set of terms that are allowable values of some attributes of an entity class**
- **Example: a CV of country names and ISO trigraphs, with one entry:**
  - Afghanistan | Islamic Republic of Afghanistan, AFG
- **Although this definition of a CV is in the context of a ontology, the connection is often implicit**
  - But it wouldn't make sense to have the CV without stating what the terms mean, which can be done informally (e.g., in English) or formally (e.g., in a ontology)

Unified View of KOSs

Ontology
- class hierarchy
- attributes
- relationships
- possibly constraints, rules, etc.



Class x

Attribute x_1
Attribute x_2
Attribute x_3
Attribute x_4
Attribute x_5
⋮
Relationship x_1
⋮

Controlled Vocabulary
- allowed value sets for multiple attributes
- possibly relationships

(Attribute x_2, Attribute x_3, Attribute x_4) =
{ (a_2, a_3, a_4) | (b_2, b_3, b_4) |… | (z_2, z_3, z_4) }

Enumerated list

Attribute x_4 = { a_4 | b_4 |… | z_4 }
- allowed value subset for single attribute

KOS Metadata

- **Each class/property/term has metadata**
  - Contributor
  - Creator
  - Date
  - Description
  - Class/property/terms Security Mark
  - Source
  - Title
- **Entire KOS has metadata**
  - Contributor
  - Creator
  - Date
  - Description
  - Identifier
  - Encoding
  - Publisher
  - KOS Security Mark
  - Source
  - Title

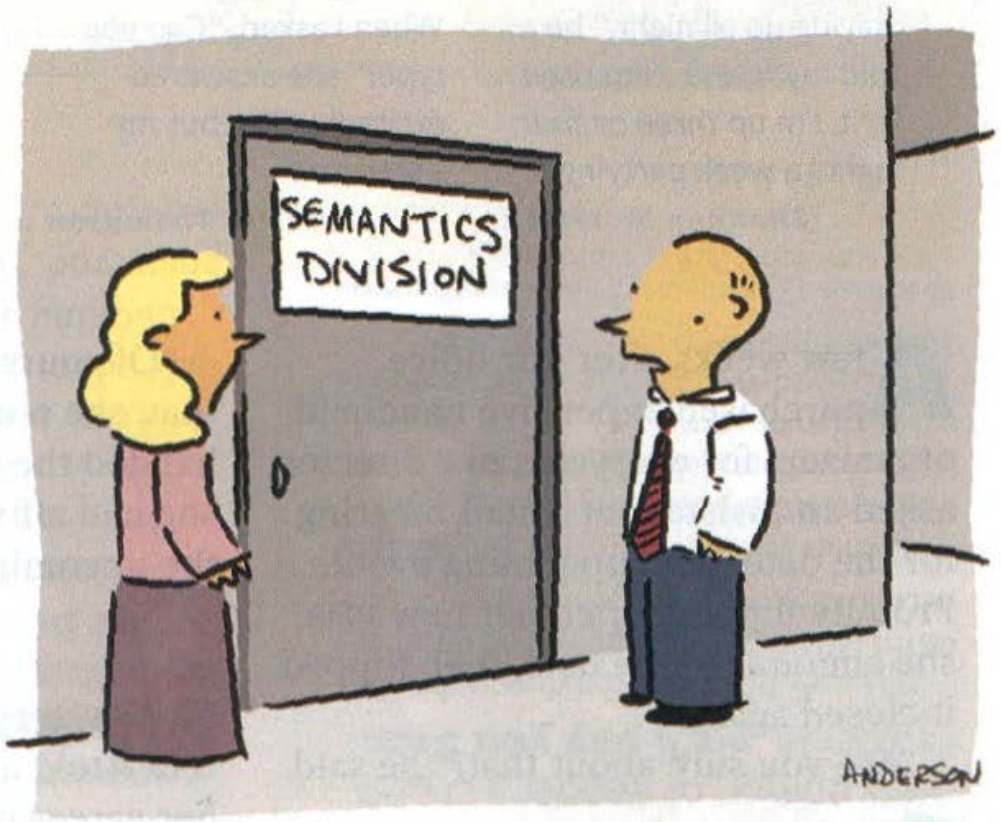
Knowledge Object Defined

- **A set of Knowledge Assertions all of which are "about" the same entity is a *Knowledge Object***
- **Formally, a KO is the set of assertions that defines the class of the entity plus all attributes and relationships of that entity, according to a unified ontology**
- **An important objective of intel collection and analysis is the integration of "everything" the IC knows about an entity, which can be represented as a KO**

Summary

- **A *Knowledge Assertion* is a means to express specific content of an intelligence product using a formal mechanism**
- **A *Knowledge Organization System* provides contextual meaning (semantics) to KAs**
- **A *Knowledge Object* is the set of KAs about a single entity, which taken together is what is known about that entity**

Questions?



"We're really more of a department."