INFS3101/7100 Ontology and the Semantic Web

Module 4 Some Examples

Assignment

- due Monday, 8 May, 4:00 pm, in assignment box
  - Value 40%
- Purpose: Gain an understanding of the main principles of ontology in a practical situation
- This assignment is to be done in groups of up to three. Unless a strong case is made to the contrary, all students in a group will receive the same mark. (Note that a student may do the assignment as a group of one, but that no allowance will be made in the marking for doing so.)

Assignment

- Find a published ontology of some kind. No two groups should have the same ontology, so your ontology choice should be registered with the lecturer as soon as possible. It will be published anonymously on the course web site.
- Identify three distinct players who interoperate using this ontology, and three distinct roles that can be taken in the interoperation. Briefly describe what each role does and how the players interact using the ontology.

  Show three concrete actions taken by players as they interoperate. Include details of players and roles involved, and the contents of the messages. (3 marks)

Assignment

- Briefly describe the ontology, giving enough detail to understand the elements of the ontology involved in the actions of 2. You should include enough concepts to get an idea of the scope and content of the whole ontology. Include some instances of all classes, including all instances used in the actions of 2. Your description should be supported by a diagram in the representation language of Chapter 4, with between 25 and 50 classes. (5 marks)
- Describe three institutional facts created in this network, including brute fact and context. What roles are responsible for creation of each fact? Who is responsible for keeping the definitive record of the fact? You may use the actions of 2. (3 marks)
- Describe two shared complex objects. What are their parts? What are their identifying and unifying relations? (4 marks)

Assignment

- Describe a bulk class in the ontology, showing how it satisfies the criteria to be a bulk class. If there is none, propose a plausible addition. (3 marks)
- Describe the three classes in the ontology from 5 and 6. Give their rigid properties, indicating whether the rigid properties are lexical or logical. Show a system of subclasses for each class, inventing a plausible system if necessary. Each subclass is either defined or declared. If it is defined, give the defining predicates. If it is declared, tell how objects are classified into the subclass and by which role (5 marks)
- Describe a property (relationship, association) involving at least one of the classes from 7. This property should have a subproperty structure. Invent a plausible structure if necessary. Show a population of property instances, including at least one instance of each subproperty. (3 Marks)

Assignment

- Describe in detail two endurants and two perdurants in the ontology. (If there are no perdurants, invent two plausible ones). What endurants participate in the perdurants? How are the histories of the endurants represented in the ontology? (4 marks)

Assignment

- Criticise the ontology in terms of the five principles of Gruber (6 marks).
  - Clarity: suggest a plausible unintended interpretation of one of the concepts. How does (or could) the ontology prevent that unintended interpretation?
  - Coherence: suggest a plausible inference that an agent could be expected to draw from the ontology. How does (or could) the ontology support the reasoning necessary to make the inference?
  - Extendibility: suggest a plausible extension to the ontology. Show what changes would need to be made. Are any of the changes redundant? If so, show how. If not, show how the ontology design anticipated the extension.
  - Encoding bias: Show how one of the actions of 2 is implemented. Does it make sense for it to be implemented in a different way? If not, why not? If so, does the ontology make the different implementation difficult? Consider each element of the implementation of the action.
  - Ontological commitment: Describe the particular system of interoperations the ontology is intended to be used for (this could be a class of systems, with multiple separate instances). Is there a different system of interoperations in which the ontology could be reused? If so briefly describe the different system and how the ontology could be adapted to the re-use. If not, why are there no similar systems?
  - In each quality dimension, indicate whether in your judgment the quality is high or low.

Assignment

- Propose an improvement to the ontology. Argue why this improvement is a good idea in terms of at least one of Gruber's principles. Show a cost of the change. On balance, is the improvement a good idea? Take a position and justify it. (4 marks)

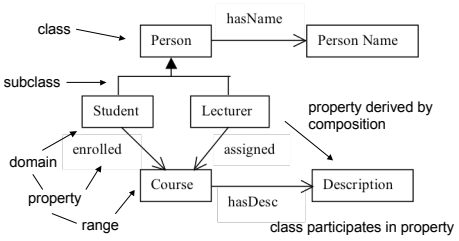
Assignment

- The object of the exercise is to demonstrate your understanding of the concepts and principles of ontology as contained in the course material. Since engagement with the detail is essential for understanding, descriptions should be detailed enough to see what is going on. For example a simple create(object) is not sufficient. The description should include under what conditions the create is possible, who sends the message to whom, and what information is contained in the message.

Last lecture: Key Terms

- **Bottom-up approach** to building an ontology fails, due to **semantic heterogeneity**.To interoperate, organisations need to align their business practices, implemented as systems of speech acts. Requires integrating contexts, including background.
- The ontology is a record of agreement created prior to the interoperation. Participating organisations must **commit** to the ontology. Approach is **top-down**.
- A system of interoperating agents operates within a single system of speech acts.

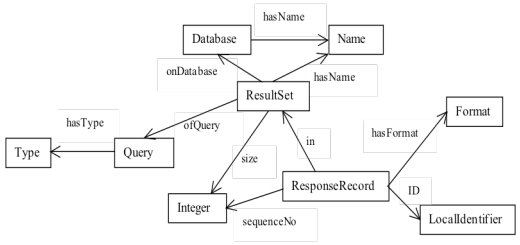
Representation Language



Z39.50

- Information retrieval protocol. Used in libraries etc.
- Players libraries, people
- Roles
  - information provider (service)
  - Information seeker (user)
- (Informative) speech acts
  - Initialization Facility: establish a connection
  - Search Facility: enables the user to submit a query
  - Retrieval Facility: enables the client to ask for records
- Each informative consists of two performatives, messages request and response

Z39.50



Z39.50

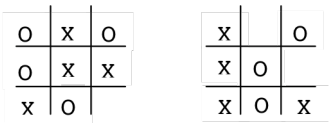
- World of Z39.50 includes database only. Independent of content
- Libraries, museums, government information describe their content by a set of class names called use attributes.
- Library set called Bib-1, museums CIMI, government GILS

Bib-1 World

Personal name	Dewey classification	MESH subject
Corporate name	UDC classification	PA subject
Conference name	Bliss classification	LC subject heading
Title	LC call number	RVM subject heading
Title series	NLM call number	Local subject index
Title uniform	NAL call number	Date
ISBN	MOS call number	Date of publication
ISSN	Local classification	Date of acquisition

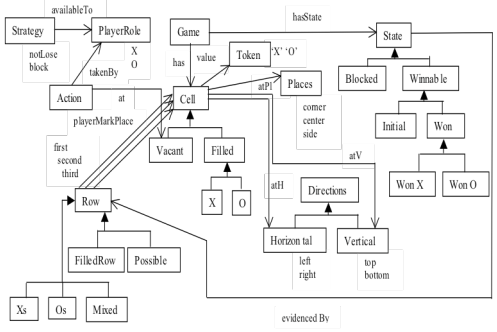
- Each of these classes has conventions for instances maintained as standards by the library community

Game: Tic Tac Toe



- Players: collection of people (agents), game space
- Roles: X, O, game space
- Performatives: Place X, Place O, X wins, Y wins, Blocked

Tic Tac Toe



Tic Tac Toe

- Ontology allows us to represent games and describe strategy
- Does not forbid nonsense statements
- Includes messages for all performatives
- But not for describing the contexts
- Nor a mechanism for recording a game, nor a tournament

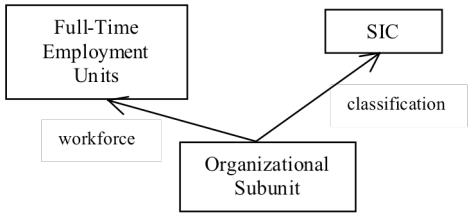
Standard Industrial Classification

- Division A: Agriculture, Forestry, And Fishing
- Division B: Mining
- Division C: Construction
- Division D: Manufacturing
- Division E: Transportation, Communications, Electric, Gas, etc
- Division F: Wholesale Trade
- Division G: Retail Trade
- Division H: Finance, Insurance, And Real Estate
- Division I: Services
  - Major Group 70: Hotels, Rooming Houses, Camps, etc
  - Major Group 72: Personal Services
  - Major Group 73: Business Services
- Division J: Public Administration

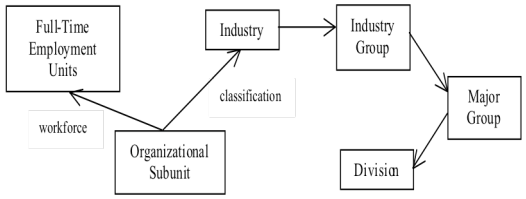
Standard Industrial Classification

- Major Group 73: Business Services
  - Industry Group 731: Advertising
  - Industry Group 732: Consumer Credit Reporting Agencies, Mercantile
  - Industry Group 733: Mailing, Reproduction, Commercial Art And
  - Industry Group 734: Services to Dwellings and Other Buildings
  - Industry Group 735: Miscellaneous Equipment Rental and Leasing
  - Industry Group 736: Personnel Supply Services
  - Industry Group 737: Computer Programming, Data Processing,
    - 7371 Computer Programming Services
    - 7372 Prepackaged Software
    - 7373 Computer Integrated Systems Design
    - 7374 Computer Processing and Data Preparation and Processing Services
    - 7375 Information Retrieval Services
    - 7376 Computer Facilities Management Services
    - 7377 Computer Rental and Leasing
    - 7378 Computer Maintenance and Repair
    - 7379 Computer Related Services, Not Elsewhere Classified

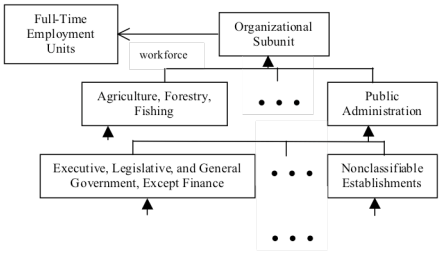
Using SIC as a classifier



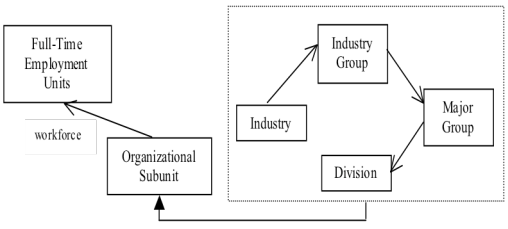
SIC Showing Hierarchical Structure



SIC as subclass structure



SIC shown as subclasses grouped



One ontology - many representations

- SIC example shows that a single simple ontology can be represented in many ways
- An ontology is designed, not discovered
- If the representations are faithful, we have structural semantic heterogeneity
- In this case, multiple representations can co-exist

SNOMED

- Used for classifying medical treatment incidents
- For insurance reimbursement, health statistics
- Like SIC, but much much larger
- Based on multiple semantic dimensions. SIC has one only
- A single incident can be classified in each dimension
- Dimension called facet or axis

SNOMED - Size of Facets

Topography (Anatomy)	13,165
Morphology	5898
Diagnoses	41,494
Procedures	30,796
Functions, symptoms, etc.	19,355
Living organisms	24,821
Chemicals and drugs	14,859
Physical agents, forces	1,601
Social context	1,070
Occupations	1,949
General modifiers	1,594
Total	156,602

SNOMED Issues

- System is huge. How to represent?
- Facets not exhaustive (some incidents not classified by some facets). Makes individual incidents independent of classes
- Very few combinations actually used
- Specificity varies among incidents (deep in hierarchy more specific than shallow). Introduces semantic heterogeneity

Periodic Table

Period	Group** 1 IA 1A							18 VIIIA 8A
	1	2	13	14	15	16	17	2
1	H	IIA 2A	IIIA 3A	IVA 4A	VA 5A	VIA 6A	VIIA 7A	He
	1.008							4.003
	3	4	5	6	7	8	9	10
2	Li	Be	B	C	N	O	F	Ne
	6.941	9.012	10.81	12.01	14.01	16.00	19.00	20.18
	11	12	13	14	15	16	17	18
3	Na	Mg	Al	Si	P	S	Cl	Ar
	22.99	24.31	26.98	28.09	30.97	32.07	35.45	39.95

Periodic Table

- Small system (109 elements), with complex system of subclasses
- Facets include period, group, several others
- Classes in group include alkali metals, alkaline earths, halogens, noble gasses etc.
- Properties include atomic number, weight, many others.
- Instances are important
- Widely used in science and engineering

Dimension

- Small systems complex in a different way
- Fundamental dimensions: length, mass, time
- Derived dimensions: area, energy, speed
- Units of measure come in systems
  - Kilogram-metre-second
  - Gram-centimetre-second
  - Foot-pound-second
- Units can be converted one to another by formula
- Not all arithmetic operations valid for all dimensions

Dimension

- Rules are important
- Widely used in science, engineering, many other fields
- Value is a dimension, measured in currency units
- All sorts of specific derived dimensions and units
  - burn rate, measured in million US Dollars per month, used in the venture capital industry

Summary: Key Terms

- To represent an ontology need an **ontology representation language**
- Ontologies can be packaged in modules.
- A given ontology can be represented in many ways
- Some ontologies are huge and complex
- Some ontologies include individuals
- Some ontologies need complex rules in their representation

Resources

- Essential
  - Notes chapter 4 Some Examples
- Further
  - Colomb and Finnigan (1997) "Protocol Support for Commercial Access to Complex Database Applications" (About Z39.50)
  - Gruber and Olsen (1994) "An Ontology for Engineering Mathematics" (about dimensions)
  - Both on course web site.
  - Look up SIC, SNOMED, Periodic Table using a search engine.