RadLex: Building an Ontology for Radiology

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RadLex®
A Lexicon for Uniform Indexing and Retrieval of Radiology Information Resources

The Purposes of RadLex

- A successor to the ACR Index for retrieving online teaching files
- A set of terms for clinical reports in an electronic medical record
- Common data elements to improve clinical imaging research

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What is RadLex?

- >5,000 anatomic terms/"types"
- 26 participating organizations
- 9 committees
- 92 radiologist participants

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A Confession:

RadLex is not an ontology.

Yet.

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Status of RadLex Project

- Anatomy meetings were held this fall
- Draft anatomic terms available on RadLex web site (http://www.rsna.org/radlex) now
- Meetings winter/spring 2006 to consider findings and pathology terms
- Public comment summer/fall 2006
- Release of RadLex 1.0 at RSNA 2006

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Top 10 Reasons...

...building biomedical imaging ontologies is challenging.

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Top 10 Reasons...

10. It is tempting to reinvent the wheel

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Key Collaborating Organizations

- American College of Radiology (ACR)
- DICOM
- College of American Pathologists (CAP) / SNOMED)

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Top 10 Reasons…

9. The perfect can get in the way of the good
10. It is tempting to reinvent the wheel

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Avoiding "Perfection Fever"

- Conduct pilot projects
- Enable frequent feedback from others
- Allow temporary "messiness" and unsolved problems

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Top 10 Reasons…

8. The real world isn't always logical
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Cooperating Organizations

- American College of Radiology
- American Society of Functional Neuroradiology (ASFNR)
- American Society of Head and Neck Radiology (ASHNR)
- American Society of Neuroradiology (ASNR)
- American Society of Pediatric Neuroradiology (ASPNR)
- American Society of Spine Radiology (ASSR)
- Cardiovascular Radiology Council of the American Heart Association (AHA)
- College of American Pathologists
- DICOM
- Fleischner Society
- International Skeletal Society (ISS)
- International Society of Magnetic Resonance in Medicine (ISMRM)
- North American Society for Cardiac Imaging (NASCI)
- North American Spine Society (NASS)
- Society of Body Computed Tomography and Magnetic Resonance (SCBTMR)
- Society for Cardiovascular Computed Tomography (SCCT)
- Society for Cardiovascular Magnetic Resonance (SCMR)
- Society of Gastrointestinal Radiology (SGR)
- Society for Pediatric Radiology (SPR)
- Society of Radiologists in Ultrasound (SRU)
- Society of Skeletal Radiology (SSR)
- Society of Thoracic Radiology (STR)
- Society of Uroradiology (SUR)

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RadLex Content Delineation

1. ~~Patient identifiers~~
2. ~~Clinical history~~
3. Image acquisition, processing, and display
4. ✓ Location on the image
5. ✓ Image quality
6. Anatomic location
7. Findings
8. Relationships
9. ✓ Uncertainty
10. Conclusions
11. Recommendations
12. ✓ Teaching attributes

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Textbook Example

1. Diseases of the abdomen
   - A. Diseases of the genitourinary system
     - i. Diseases of the kidney
       - a. Kidney stones
       - b. pyelonephritis
     - ii. Diseases of the ureter
     - iii. Diseases of the bladder
   - B. Diseases of the gastrointestinal tract
     1. Diseases of the pharynx
     2. Diseases of the esophagus
     3. Diseases of the stomach

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Disease Organization

- V Vascular
- I Infectious / Inflammatory
- N Neoplasm
- D Drugs / Toxins
- I Intervention / Iatrogenic
- C Congenital / Developmental
- A Autoimmune
- T Trauma
- E Endocrine / Metabolic

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Top 10 Reasons...

7. Taxonomies are intuitive, but limiting
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Taxonomy Limitations

- Variants and competing anatomic subdivision methods (e.g., liver)
- Spectrum of findings
  - Visual features (e.g., round opacity)
  - Morphologic and physiologic processes (e.g., mass)
  - Diseases (e.g., adenocarcinoma)
- Vascular branching patterns

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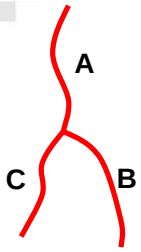
Vascular Branching Patterns



- A
  - B
  - C

(arises from)

(siblings have common origin)

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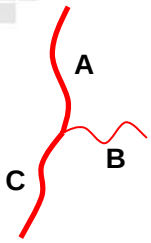
Vascular Branching Patterns



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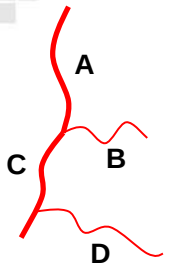
Vascular Branching Patterns



- A
  - B
  - C
    - D

(deep hierarchy)

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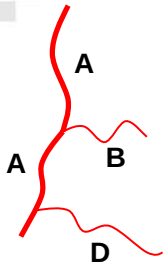
Vascular Branching Patterns



- A
  - B
  - D

(Does not preserve branch ordering)

(B and D are now siblings)

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Vessel Changes Name

- A
  - C

(deep hierarchy)

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Top 10 Reasons...

4. Deciding between single and multiple inheritance
5. Distinguishing radiographic and clinical disease
6. Good mapping tools are not available
7. Taxonomies are intuitive, but limiting
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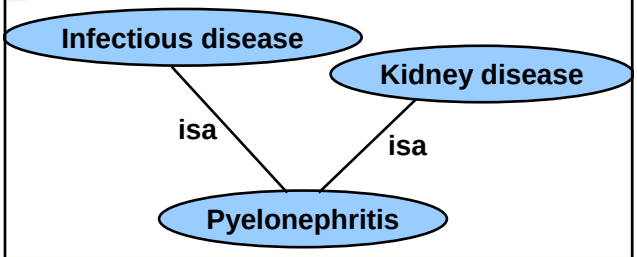
Multiple inheritance



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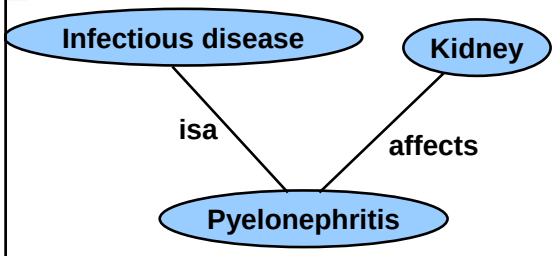
Multiple inheritance



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Top 10 Reasons...

3. Establishing consistent naming conventions
4. Deciding between single and multiple inheritance
5. Distinguishing radiographic and clinical disease
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Concept Naming Issues

- Latin vs. English words
  - Cardiomegaly vs. enlarged heart
  - Profunda femoris artery vs. deep femoral artery
- Adjectival vs nominal form
  - Uterine fundus vs. fundus of the uterus
  - Splenic capsule vs. capsule of spleen
- Eponyms
  - Uveomeningitic syndrome vs. Vogt-Koyanagi-Harada syndrome
  - Crohn's disease vs. inflammatory bowel disease
  - Hirschsprung's disease

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Top 10 Reasons...

2. Deciding between pre- and post-composition
3. Establishing consistent naming conventions
4. Deciding between single and multiple inheritance
5. Distinguishing radiographic and clinical disease
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Pre- vs. post-composition

- Superficial flexor muscle of 2nd digit
- Tendon of superficial flexor muscle of 2nd digit
- Sheath of tendon of superficial flexor muscle of 2nd digit

What about the other 4 digits?

What about synonyms (e.g., index finger)?

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"Modifiers"

- Anatomic modifiers
  - General anatomic modifiers
    - (e.g., medial, lateral, left, right)
  - Anatomy-specific modifiers
    - (e.g., diaphysis, metaphysis, epiphysis)
- Finding modifiers
  - General finding modifiers
    - (e.g., mild, moderate, severe, large, small)
  - Anatomy-specific modifiers
    - (e.g., monoarticular, polyarticular)

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Top 10 Reasons…

1. Finding support for curation and ontology development
2. Deciding between pre- and post-composition
3. Establishing consistent naming conventions
4. Deciding between single and multiple inheritance
5. Distinguishing radiographic and clinical disease
6. Good mapping tools are not available
7. Taxonomies are intuitive, but limiting
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