

# Interactive Thesaurus Assessment for Automatic Document Annotation

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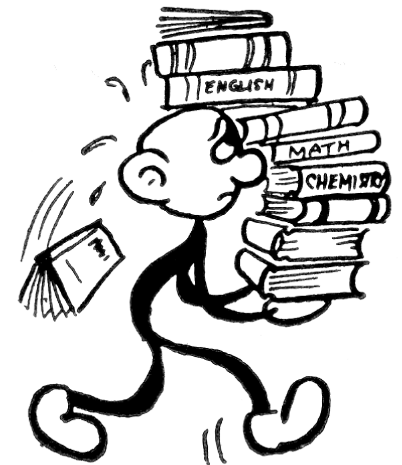
University Library  
University of Mannheim

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Knowledge Representation and Knowledge Management Research Group  
Prof. Dr. Heiner Stuckenschmidt

## Thesaurus-Based Document Annotation

- Manual vs. Automatic Document Annotation
- Manual: Small and bounded sets of documents.
- Automatic: Large and fast growing document sets.
  - News
  - Websites
  - Scientific Papers (especially brand new ones)



## Problems for Automatic Document Annotation

- Thesaurus:
  - Quality and Suitability
- Annotation System:
  - Pitfalls in Natural Language Processing
  - Quality of Normalizers
  - Performance of Disambiguation

**Revision by a Human Expert needed.**



## Performed Revisions

- Traditional
  - **Adaption** to reflect changes in the vocabulary
  - **Deletion** and/or **Merging** of rarely used concepts
  - **Splitting, extension** or **restriction** of extensively used concepts
  - **Review of the structure** to avoid extensive subclassing
- New
  - Identification of **problematic concepts** for the automatic annotation

## Intuitive selection of problematic concepts

- **Very high** occurrence:
  - Too common - should be split into subconcepts
  - Not significant
- **Very low** occurrence:
  - Too specialized – could be merged with other concepts
  - Missing synonymous terms
  - Not significant

## Considering the Hierarchy

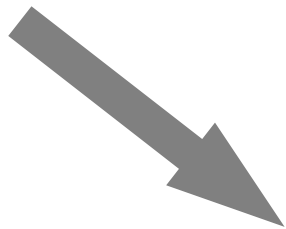
- **Higher** occurrence  **Higher** in the hierarchy
  - More common concepts
- **Lower** occurrence  **Lower** in the hierarchy
  - More specialized concepts

## IC Diff Analysis

### Information Content:

- Proposed by Resnik
- Depends on Frequency in Document Base

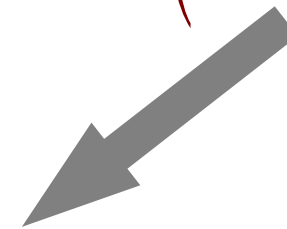
$$IC(c) = -\log P(c)$$



### Intrinsic Information Content:

- Proposed by Seco, Veale and Hayes
- Depends on Number of Subconcepts

$$IIC(c) = -\log \left( \frac{\mathit{hypo}(c) + 1}{\mathit{max}} \right)$$



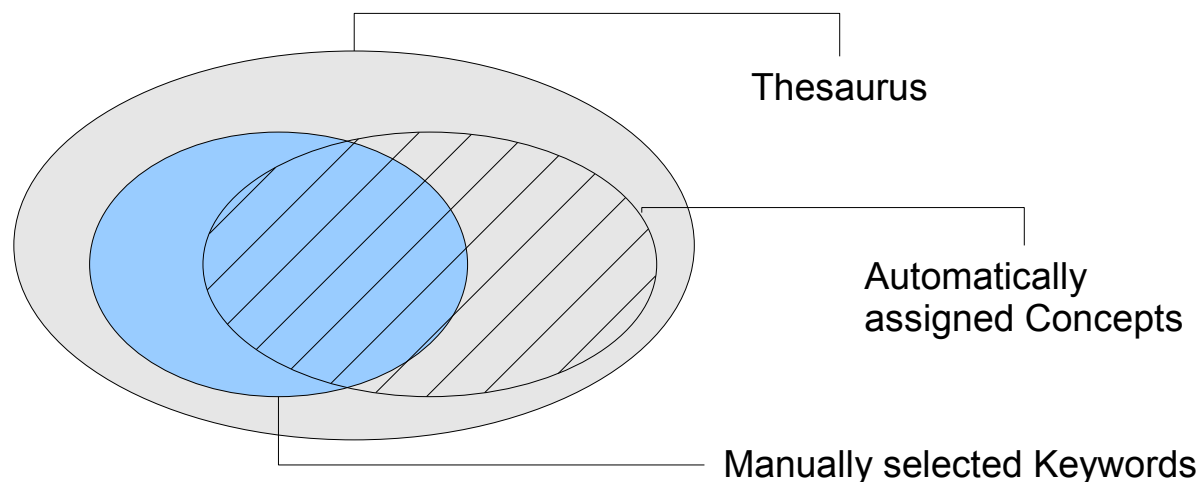
$$D_{IC}(c) = IC(c) - IIC(c)$$

Intuitive: A value between  $-1$  and  $1$  that says if a concept has a suspicious frequency regarding its position in the thesaurus.



## Evaluation of Automatic Annotation Results

- Calculation of **Precision** and **Recall**
- **Relevant**: Manually selected Keywords
- **Retrieved**: Automatically assigned Concepts



## Generalized Precision and Recall

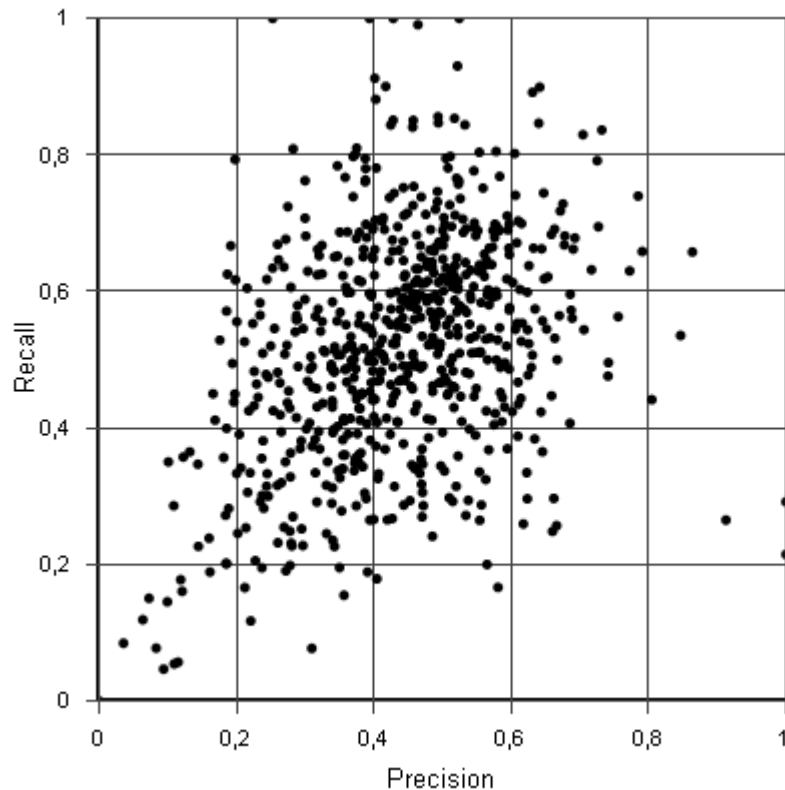
- Precision and Recall not sufficient for practical reasons
- How “wrong” are the assigned keywords?

$$Prec_{\omega}(C, K) = \frac{\omega(C, K)}{|C|} \qquad Rec_{\omega}(C, K) = \frac{\omega(K, C)}{|K|}$$

$$\omega(A, B) = \sum_{a \in A} \max_{b \in B} \textit{Similarity}(a, b)$$

## Results

Precision: 0.43  
Recall: 0.52



- Precision
  - Avoid „Equidae“, „Lead“, „Volition“: **+1,2%**
  - Avoid most problematic concept in German Economic Standard Thesaurus: **+4,8%**

## Further Steps

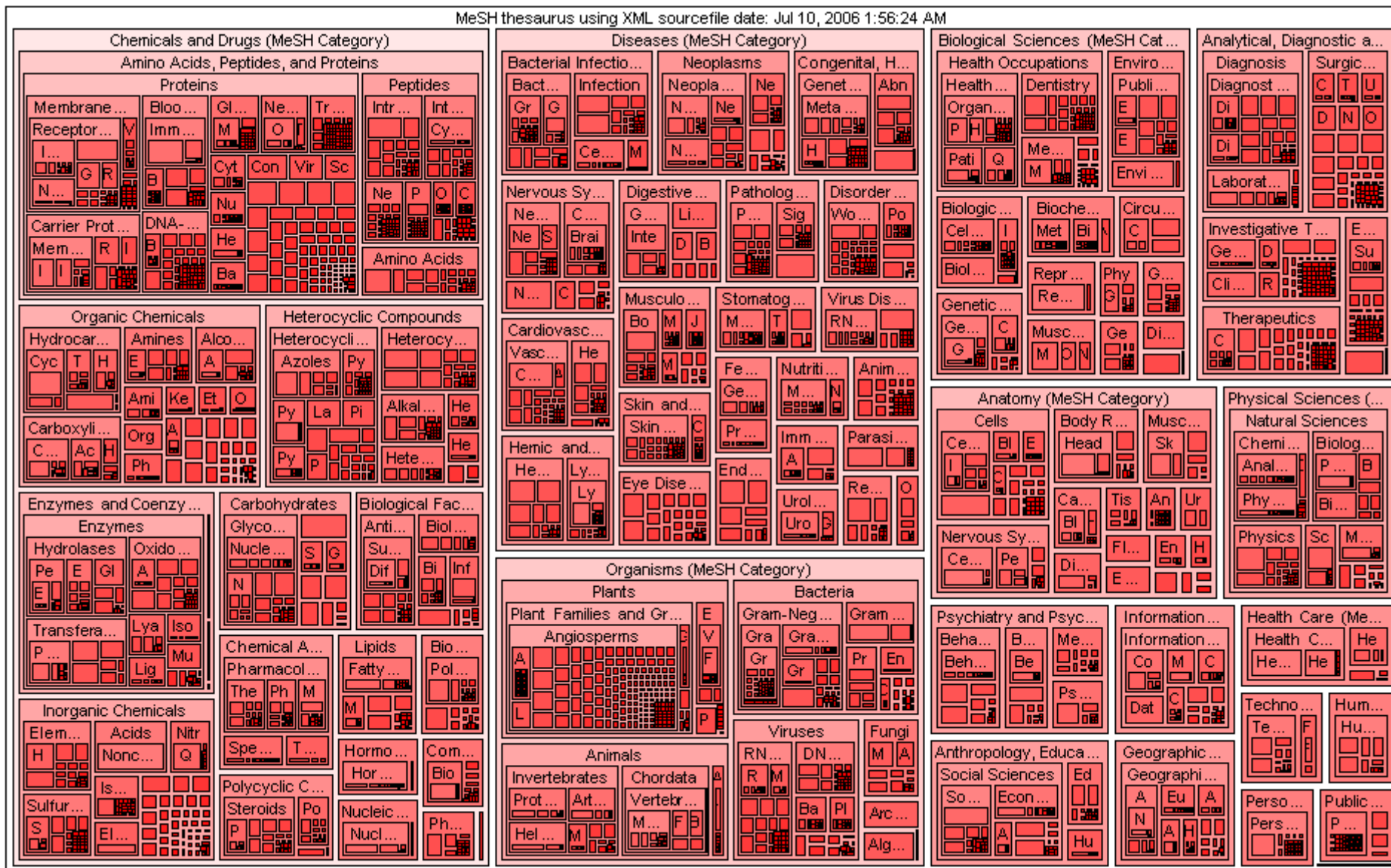
- Evaluation with human experts, would they use it?
- Evaluation of the impact on retrieval results
- Use as framework for other analysis methods

**Thank you for your attention.**

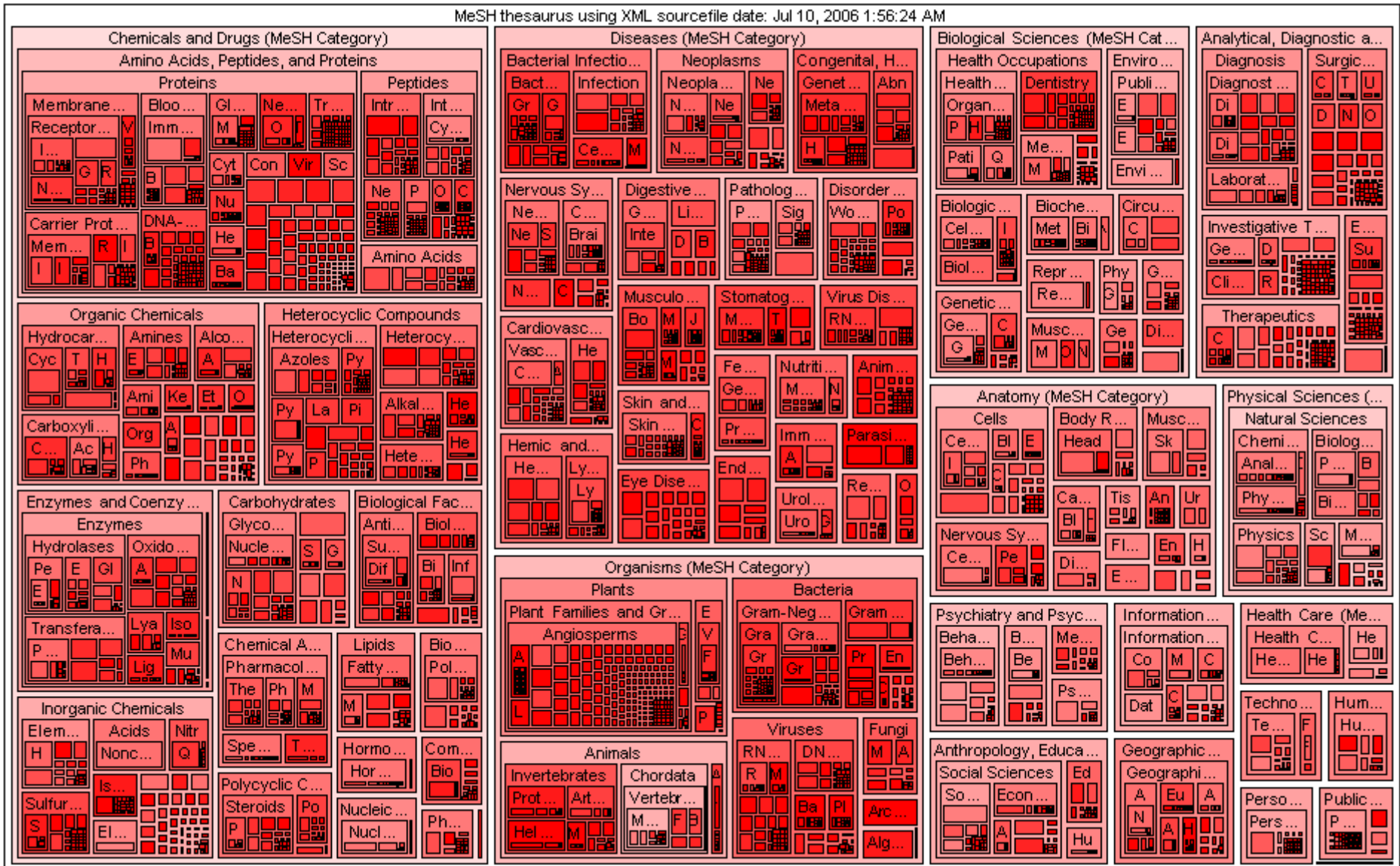
Questions or ideas?

[kai@informatik.uni-mannheim.de](mailto:kai@informatik.uni-mannheim.de)

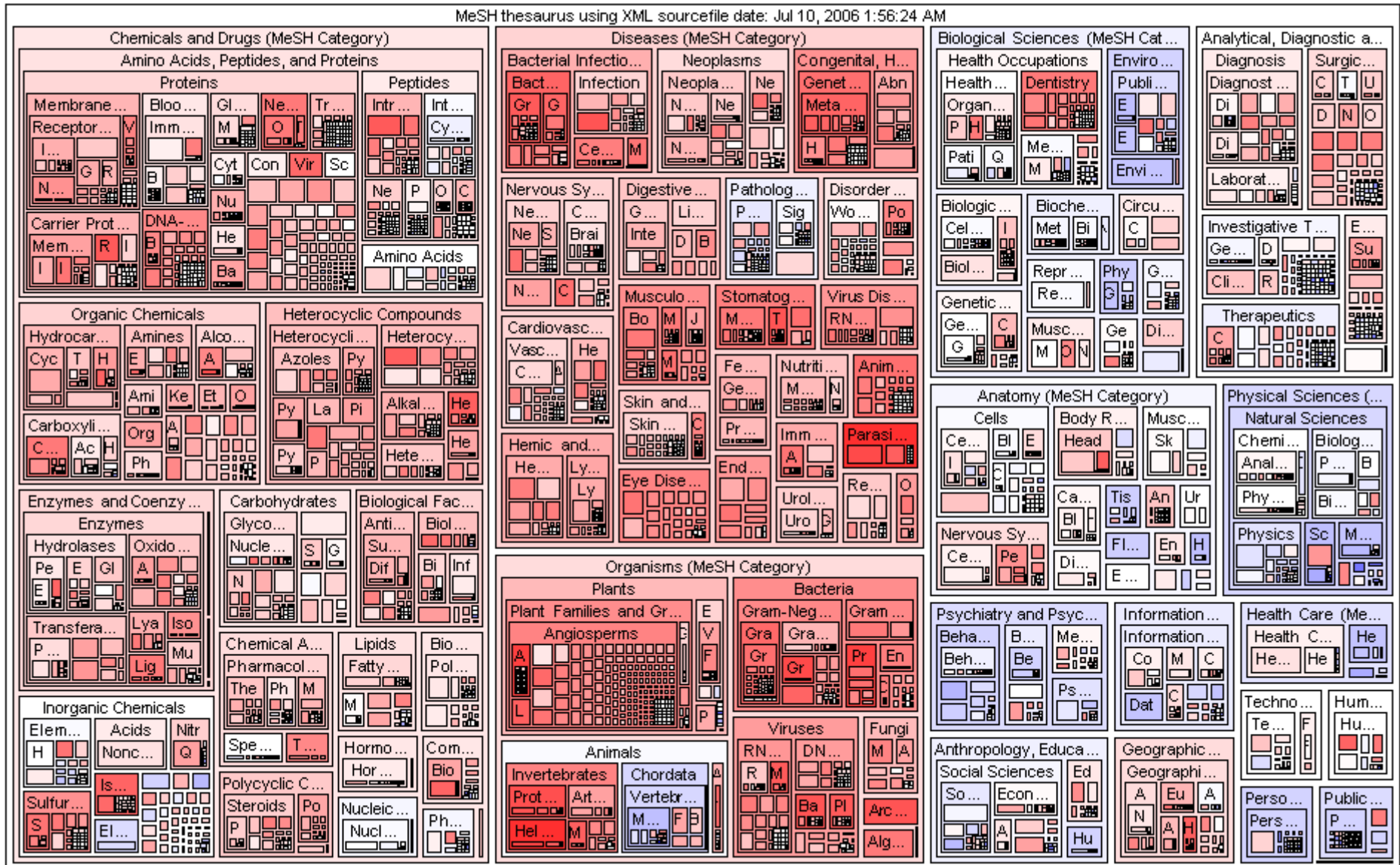
# Intrinsic Information Content



# Information Content



# IC Diff





# Organisms

Organisms (MeSH Category)

**Plants**

Plant Families and Groups

Angiosperms

Asteraceae    Lamiaceae    Poaceae

Liliaceae    Rosales    Apiaceae    Solana...

Ranun...    Brassi...    Scrop...    Rubi...    The...    Eup...

Apo...    Cuc...    Asc...    Ch...    My...    B...    C...    M...

Ver...    A...    M...    S...    P...    O...    C...    C...

Rut...    Ara...    Rh...    P...    On...    Ge...    Sa...    Tili...    Are...    Val...

Zin...    Sim...    Mis...    A...    Pr...    A...    B...    C...    B...    B...    St...    Vit...

Lau...    Alis...    Lyt...    Ur...    F...    W...    A...    C...    C...    Iri...    A...    D...    C...

Eric...    Zyg...    Br...    G...    Ar...    Le...

Ara...    Ber...    Ca...    P...    C...    S...    B...    N...    C...    U...    I...    N...    J...    T...

Gymnosperms    Ferns    B...    H...    L...    S...

Edible Plants

Vegetables

Fabaceae    A...    Agri...    Pla...    P...    Cer...    B...    I...    V...    N...

**Animals**

Invertebrates

Protozoa    Helminths

Sarcomastigophora    Nematoda

Mastigop...    Sar...    Secernentea    A...

Zoom...    Lo...    Spi...    Str...    Asc...    Sp...    R...    Platyhelminths

Apico...    Ciliop...    Trem...    Ce...

Co...    Oli...    Ha...    Sp...    M...

Arthropods    Mollusca

Insects    Arac...    Bivalvia    Ga...    C...

Diptera    Acari...    Echin...    Cnid...    An...    P...

He...    B...    Li...    Crust...    Porifera    No...    D...    An...    P...

Animal Population Groups

**Viruses**

RNA Viruses

Retroviridae    Picornavi...    Nidovira...

Ga...    Le...    E...    C...    Cor...    A...

De...    Si...    A...    B...    Buny...    Reo...    To...

Mononega...    Ortho...    Enc...    Cal...

Para...    Rh...    Flavi...    Are...    Bir...

DNA Viruses    Bacteriophages

Herp...    DNA...    C...    Ca...    I...    R...

Alph...    Pa...    G...    P...    Mo...    Br...    C...    C...    R...

Plant Viruses

Poxviri...    Pa...    Mo...    Br...    C...    C...    R...

Chor...    Par...    Hep...    Ve...    In...    H...    Def...    Ar...    U...    A...

**Bacteria**

Gram-Negative Bacteria

Gram-Negative Aerobic Bac...    Gram-Negati...

Gram-Negative Aerobic R...    Gram-Neg...

Nei...    R...    Bru...    Lep...    Rh...    Ba...    A...    D...    E...    Spi...    Mollicutes

Ps...    Ac...    C...    C...    Mycopla...    S...

Alc...    Xa...    R...    Anap...    Ric...    Proteobact...    Endospore-F...

Gram-Negative Facultativel...    Gammapr...    Alphaprot...

Enterobacter...    Pa...    Ca...    H...    Bar...    R...    Del...    C...    Ba...    Su...    F...    S...    C...    At...    Basidi...    Ye...    Z...    Micros...    F...    C...    Gre...    Br...    Re...    Oo...

**Fungi**

Mitospori...    Asco...    Euryar...    Cre...

Sa...    S...    H...    H...    T...    H...    T...    H...    T...

**Archaea**

Euryar...    Cre...

**Algae**

Gre...    Br...    Re...    Oo...

# Animals

Animals

Invertebrates	Chordata																																																																																																																																																																																																						
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P...</td> </tr> <tr> <td colspan="2" style="text-align: center;">Ciliophora</td> </tr> <tr> <td>Oligohy...</td> <td>Polym...</td> </tr> <tr> <td>Hymen...</td> <td>Hypot...</td> </tr> <tr> <td>P... Tet</td> <td>Kineto...</td> </tr> <tr> <td>Par... T</td> <td></td> </tr> <tr> <td colspan="2" style="text-align: center;">Spores</td> </tr> <tr> <td>P... B</td> <td>My... Ha</td> </tr> <tr> <td>P... Blo</td> <td>Phy</td> </tr> <tr> <td colspan="2" style="text-align: center;">Piroplasmia</td> </tr> <tr> <td colspan="2" style="text-align: center;">Arthropods</td> </tr> <tr> <th colspan="2" style="text-align: center;">Insects</th> </tr> <tr> <th colspan="2" style="text-align: center;">Diptera</th> </tr> <tr> <td>Culi... Dr... Glo... M...</td> <td></td> </tr> <tr> <td>An... C...</td> <td></td> </tr> <tr> <td>C... A... Te... Psy... Ch...</td> <td></td> </tr> <tr> <th colspan="2" style="text-align: center;">Hemiptera</th> </tr> <tr> <td>Heteroptera</td> <td>Mot... E...</td> </tr> <tr> <td>Redu... 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St...</td> <td></td> </tr> <tr> <th colspan="2" style="text-align: center;">Amphibia</th> </tr> <tr> <th colspan="2" style="text-align: center;">Anura</th> </tr> <tr> <td>Ranidae</td> <td>Salama...</td> </tr> <tr> <td>R... R... R... R... R... N... P... T... S... Buf... Pipi... A... Prot... A... Ne...</td> <td></td> </tr> <tr> <th colspan="2" style="text-align: center;">Reptiles</th> </tr> <tr> <th colspan="2" style="text-align: center;">Snakes</th> </tr> <tr> <td>Vipe... El... Hv... R... C... A... C... Rn... Di... T... T... A... Co... Ali...</td> <td></td> </tr> <tr> <th colspan="2" style="text-align: center;">Animal Population Groups</th> </tr> <tr> <th colspan="2" style="text-align: center;">Laboratory Animals</th> </tr> <tr> <td>Animals, Inbred Strains</td> <td>Org... Ch... Poi... A... S... N... Ani... F... T... P... Do... A... Z... W... il...</td> </tr> </table>	Vertebrates		Mammals		Primates	Carnivora	Haplorhini		Catarrhini	Platyrrhini	Cercopitheci...	Cebidae	Cercopith... H...	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# Persons

Persons (MeSH Category)																					
Occupational Groups										Persons											
Health Personnel										Age Groups				Patients							
Allied Health Personnel					Nurses			Physicians		Infant		Adult		Child		Survivors		Patient			
Dental Auxiliaries		Physician ...			Nurse Midwives	Male Nurses	Nurse Administrators	Women Physicians	Hospitalists	Newborn Infant		Aged		Preschool Child		HIV Long-Term Survivors		Hospitalized Adolescents			
Denturists	Dental Assistants	Pediatric Assistants								Infant, Low Birth Weight	Premature Infant	Frail Elderly	Aged, 80 and over			Inpatients		Hospitalized Child			
	Dental Hygienists	Ophthalmic Assistants			Nurse Practitioners	Nurse Anesthetists	Nurse Clinicians	Foreign Medical Graduates	Family Physicians	Infant, Small for Gestational	Postmature Infant	Middle Aged		Adolescent		Outpatients		Institutionalized Adolescents			
Medical Social Workers		Pharmacists		Home Health Aides	Medical Staff			Nursing ...		Disabled Persons		Tissue Donors		Men		Exceptional ...		Homeless ...			
Medical Receptionists		Pharmacists &apos;			Medical Staff, Hospitalists			Nursing Staff, Hospital		Mentally Disabled Persons		Living Donors		Blood Donors		Male Nurses		Homeless Youth			
Nurses & Assistants		Animal Technicians		Community Health Technician						Mentally Ill Persons		Hearing Impaired Persons									
Psychiatric Aides		Emergency Medical Technicians		Medical Record Administrator	Dental Staff, Hospital			Infection Control Practitioners		Amputees		Visually Impaired Persons		Volunteer Hospital Volunteers		Survivors		Child of Impaired Parents			
Hospital Personnel					Dental Staff, Hospital			Veterinarians		Pregnant Women		Women		Jehovah's Witnesses		Crime Victims		Terminally Ill		Medically Uninsured	
Hospital Volunteer Patient Escort Service		Hospital Auxiliary		Nursing Staff, Hospital		Dental Staff, Hospital		Nursing Faculty		Pharmacists		Dental Faculty		Research Subjects		Mentors		Abandoned Child		Abortion Applicants	
				Medical Staff, Hospital		Hospital Administrators		Pharmacists		Physician Executives		Battered Women		Working Women		Women Dentists		Legal Proxy		Research Subjects	
Administrative Personnel					Research Personnel			Librarians		Women Physicians		Pregnant Women		Legal Proxy		Research Subjects		Mentors		Abandoned Child	
Health Facility Administrator		Trustees		Nurse Administrators		Astronauts		Lawyers		Ethicists		Faculty		Clergy		Multiple Birth Offspring		Homebound Persons		Siblings	
Chief Executive Officers, Hospital						Foreign Professionals		Police		Missionaries and Missionaries		Military Personnel		Triplets		Quadruplets		Spouses		Friends	
		Physician Executives		Foreign Medical Graduates										Twins		Quintuplets		Parents		Students	
																				Refugees	
																				Sexual Partners	