Response to John Sowa

Ontology Summit 2018

Barry Smith

May 1, 2018

ISO/IEC 21838

- Part 1: Top-Level Ontology *Requirements*
- Part 2: Basic Formal Ontology

UNIVERSITÄT DES SAARLANDES

IFOMIS

Institute for Formal Ontology and Medical Information Science (IFOMIS)

Home
History
People
Partners
Activities
Projects
Contact

The Institute for Formal Ontology and Medical Information Science (IFOMIS) is a research group at the Philosophy Institute of Saarland University. Its main research and development activities are:

1. the investigation of the philosophical and logical foundations of formal ontologies in information science, in particular the Basic Formal Ontology;
2. the development and refinement of domain ontologies especially for the biomedical area, in particular a middle-layer ontology for the biomedical domain, the so-called Health-data Ontology Trunk (HDOT);
3. the development of ontology-based data integration strategies for ensuring semantic interoperability, combining a middle-layer ontology and a semi-automated ontology aggregator tool.

Historically, IFOMIS originated in April 2002 utilizing the Wolfgang Paul Award of the Alexander von Humboldt Foundation to Prof. Barry Smith. Substantial funding was provided also by the Volkswagen Foundation and by the European Commission.

Email to Graham Shutt on Barry Smith's Wolfgang Paul Award (2002)

John F. Sowa cg@cs.uah.edu to Graham Shutt
Tue, 02 Jul 2002 21:28:01 -0400
•Previous message: CG: Barry Smith's Wolfgang Paul Award
•Next message: CG: Barry Smith's work in ontology research

Graham,
Barry Smith is not someone that I would recommend as an expert on ontology, and certainly not on its applications to IT (information technology). He has published a lot of nonsense on the subject which seems to have misled many people (including the people who gave him the money). But I seriously doubt that anything useful will come of it.
John

http://mars.virtual-earth.de/pipermail; CG = Conceptual Graphs

Background

1996 release of yeast genome reference sequence

1998 release of nematode work reference sequence

1999 Gene Ontology (GO)

2000 release of fly genome reference sequence

2001 release human genome reference sequence

NCBI Resources How To

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed

Advanced

Send to

Science. 2000 Mar 24;287(5461):2185-95.

The genome sequence of Drosophila melanogaster.

Adams MD[1], Celniker SE, Holt RA, Evans CA, Gocayne JD, Amanatides PG, Scherer SE, Li PW, Hoskins RA, Galle RF, George RA, Lewis SE, Richards S, Ashburner M, Henderson SN, Sutton GG, Wortman JR, Yandell MD, Zhang Q, Chen LX, Brandon RC, Rogers YH, Blazej RG, Champe M, Pfeiffer BD, Wan KH, Doyle C, Baxter EG, Helt G, Nelson CR, Gabor GL, Abril JF, Agbayani A, An HJ, Andrews-Pfannkoch C, Baldwin D, Ballew RM, Basu A, Baxendale J, Bayraktaroglu L, Beasley EM, Beeson KY, Benos PV, Berman BP, Bhandari D, Bolshakov S, Borkova D, Botchan MR, Bouck J, Brokstein P, Brottier P, Burtis KC, Busam DA, Butler H, Cadieu E, Center A, Chandra I, Cherry JM, Cawley S, Dahlke C, Davenport LB, Davies P, de Pablos B, Delcher A, Deng Z, Mays AD, Dew I, Dietz SM, Dodson K, Doup LE, Downes M, Dugan-Rocha S, Dunkov BC, Dunn P, Durbin KJ, Evangelista CC, Ferraz C, Ferriera S, Fleischmann W, Fosler C, Gabrielian AE, Garg NS, Gelbart WM, Glasser K, Glodek A, Gong F, Gorrell JH, Gu Z, Guan P, Harris M, Harris NL, Harvey D, Heiman TJ, Hernandez JR, Houck J, Hostin D, Houston KA, Howland TJ, Wei MH, Ibegwam C, Jalali M, Kalush F, Karpen GH, Ke Z, Kennison JA, Ketchum KA, Kimmel BE, Kodira CD, Kraft C, Kravitz S, Kulp D, Lai Z, Lasko P, Lei Y, Levitsky AA, Li J, Li Z, Liang Y, Lin X, Liu X, Mattei B, McIntosh TC, McLeod MP, McPherson D, Merkulov G, Milshina NV, Mobarry C, Morris J, Moshrefi A, Mount SM, Moy M, Murphy B, Murphy L, Muzny DM, Nelson DL, Nelson DR, Nelson KA, Nixon K, Nusskern DR, Pacleb JM, Palazzolo M, Pittman GS, Pan S, Pollard J, Puri V, Reese MG, Reinert K, Remington K, Saunders RD, Scheeler F, Shen H, Shue BC, Sidén-Kiamos I, Simpson M, Skupski MP, Smith T, Spier E, Spradling AC, Stapleton M, Strong R, Sun E, Svirskas R, Tector C, Turner R, Venter E, Wang AH, Wang X, Wang ZY, Wassarman DA, Weinstock GM, Weissenbach J, Williams SM, WoodageT, Worley KC, Wu D, Yang S, Yao QA, Ye J, Yeh RF, Zaveri JS, Zhan M, Zhang G, Zhao Q, Zheng L, Zheng XH, Zhong FN, Zhong W, Zhou X, Zhu S, Zhu X, Smith HO, Gibbs RA, Myers EW, Rubin GM, Venter JC.

Author information

1 Celera Genomics, 45 West Gude Drive, Rockville, MD 20850, USA.

NCBI Resources How To

PubMed.gov
US National Library of Medicine
National Institutes of Health

PubMed

Advanced

Send to

Science. 2000 Mar 24;287(5461):2185-95.

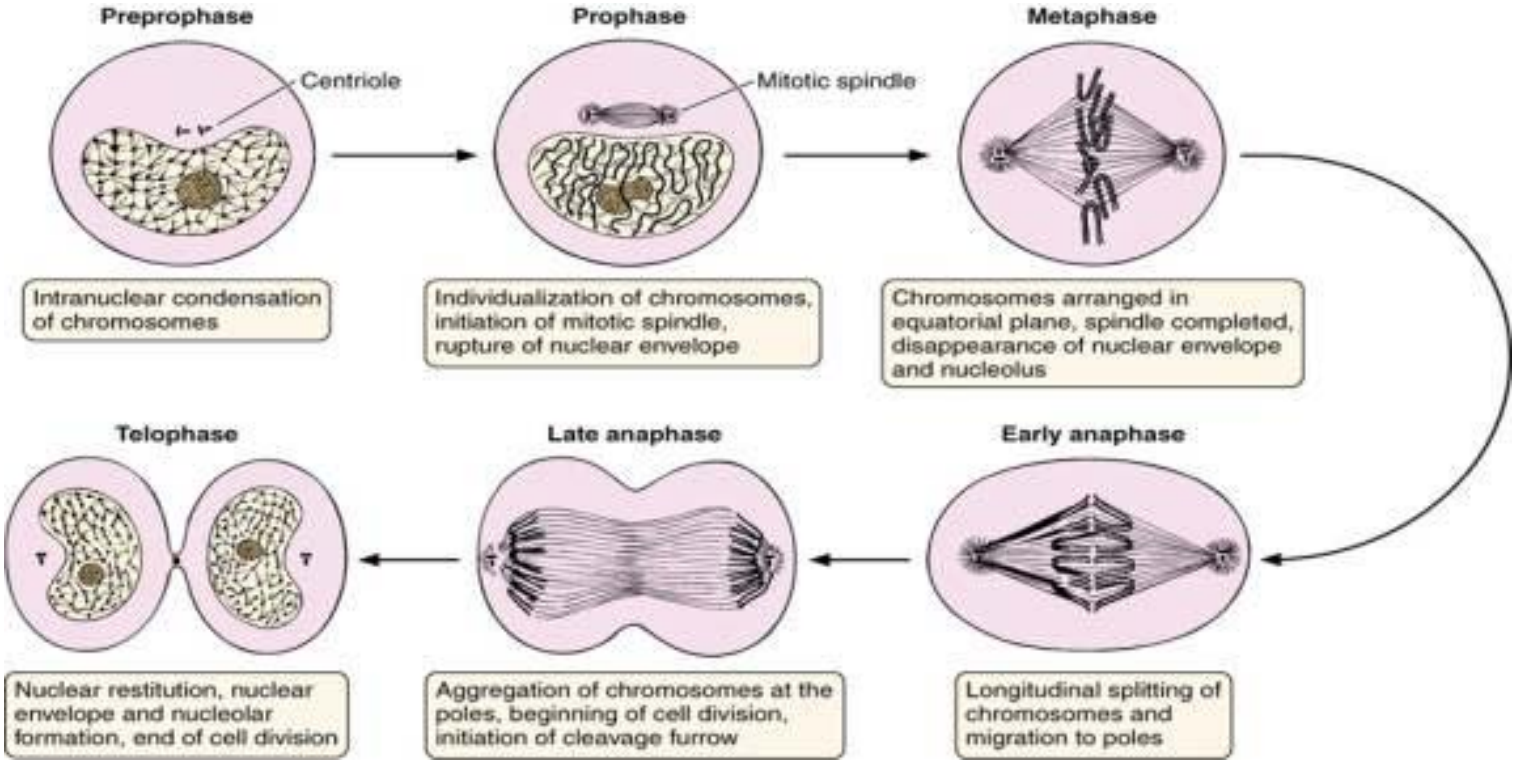
The genome sequence of Drosophila melanogaster.

Adams MD[1], Celniker SE, Holt RA, Evans CA, C
Ashburner M, Henderson SN, Sutton GG, Wortm
Howland TJ, Wei MH, Ibegwam C, Jalali M, Kalush F, Karpen GH, Ke Z, Kennison JA, Ketchum KA, Kimmel BE, Kodira CD, Kraft C, Kravitz S, Kulp D, Lai Z, Lasko P, Lei Y, Levitsky AA, Li J, Li Z, Liang Y, Lin X, Liu X, Mattei B, McIntosh TC, McLeod MP, McPherson D, Merkulov G, Milshina NV, Mobarry C, Morris J, Moshrefi A, Mount SM, Moy M, Murphy B, Murphy L, Muzny DM, Nelson DL, Nelson DR, Nelson KA, Nixon K, Nusskern DR, Pacleb JM, Palazzolo M, Pittman GS, Pan S, Pollard J, Puri V, Reese MG, Reinert K, Remington K, Saunders RD, Scheeler F, Shen H, Shue BC, Sidén-Kiamos I, Simpson M, Skupski MP, Smith T, Spier E, Spradling AC, Stapleton M, Strong R, Sun E, Svirskas R, Tector C, Turner R, Venter E, Wang AH, Wang X, Wang ZY, Wassarman DA, Weinstock GM, Weissenbach J, Williams SM, WoodageT, Worley KC, Wu D, Yang S, Yao QA, Ye J, Yeh RF, Zaveri JS, Zhan M, Zhang G, Zhao Q, Zheng L, Zheng XH, Zhong FN, Zhong W, Zhou X, Zhu S, Zhu X, Smith HO, Gibbs RA, Myers EW, Rubin GM, Venter JC.

Author information

1 Celera Genomics, 45 West Gude Drive, Rockville, MD 20850, USA.

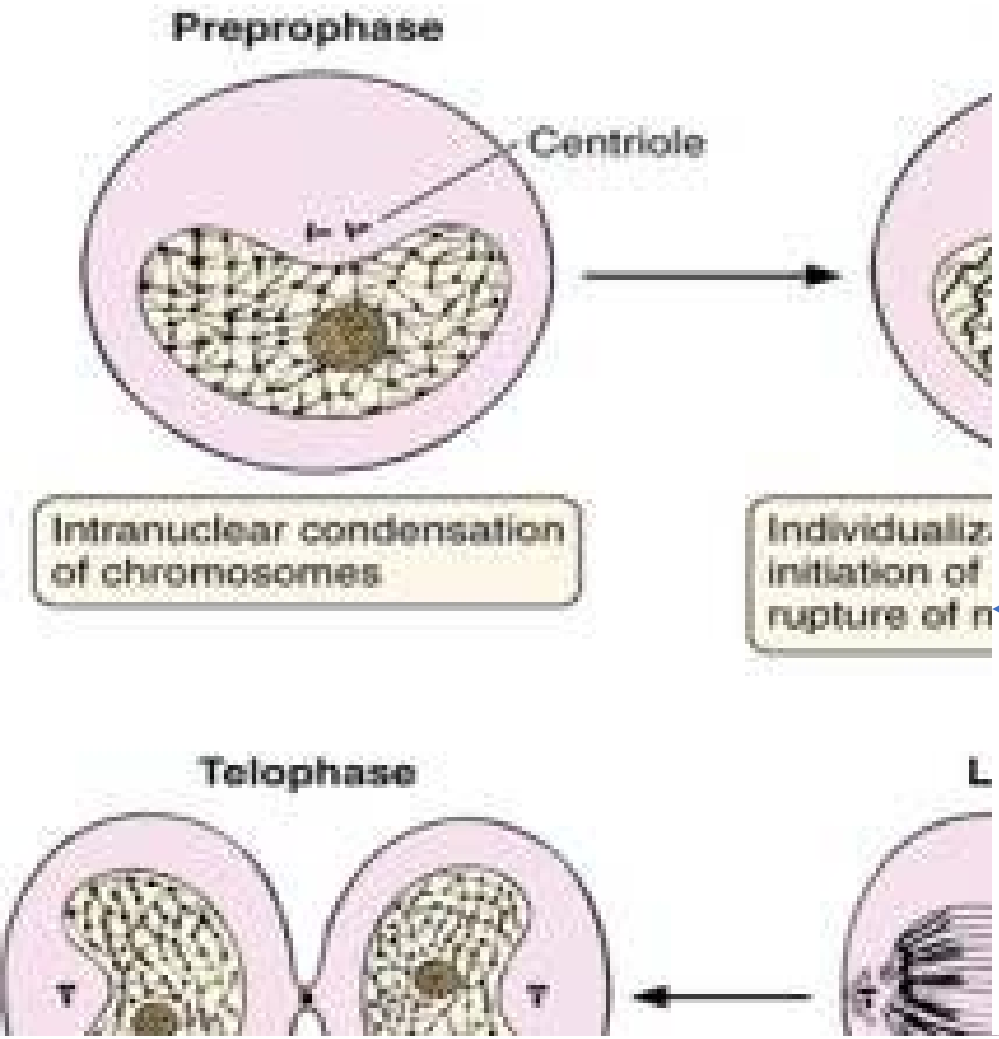
Old biology data



New biology data

MKVSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRKRSFEKVVISVMVGKNVKKFLTF
EDEPDFQGGPISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLFYLNRGYYNELSFRVLERCHEIASARPNDSSTMRTFTDFVSGAPIV
RSLQKSTIRKYGYNLAPYMFLLLHVDELSIFSAYQASLPGEKKVDTERLKRDLCPRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALN
GAGPRGGAGDEEDRSITNEEPIIPSVDEHGLKVCKLRSPNTPRRLRKTLDAVKALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEV
QETTLKDSYRITLVPSSDGISLLAFAGPQRNVYVDDTTRRIQLYTDYNKNGSSEPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAFI
HDPWMDVVGFEDPNQVTNRDISRIVLYSYMFLNTAKGCLVEYATFRQYMRELPKNAPQKLNFREMRQGLIALGRHCVGSRFETDLYE
ATSELMANHSVQTGRNIYGVDFSLTSVSGTTATLLQERASERWIQWLGLESDYHCSFSSTRNAEDVMKVSDRRKFEKANFDEFESALN
KNDLVHCPSITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRKRSFEKVVISVMVGKNVKKFLTFVEDEPDFQGGPISKYLIPKKINLMV
YTLFQVHTLKFNRKDYDTLSLFYLNRGYYNELSFRVLERCHEIASARPNDSSTMRTFTDFVSGAPIVRSLQKSTIRKYGYNLAPYMFLLLH
DELSIFSAYQASLPGEKKVDTERLKRDLCPRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALNFGAGPRGGAGDEEDRSITNEEPIIP
VDEHGLKVCKLRSPNTPRRLRKTLDAVKALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEVAQETTLKDSYRITLVPSSDGISLLAFA
GPQRNVYVDDTTRRIQLYTDYNKNGSSEPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAFNHDPWMDVVGFEDPNQVTNRD
RIVLYSYMFLNTAKGCLVEYATFRQYMRELPKNAPQKLNFREMRQGLIALGRHCVGSRFETDLYESATSELMANHSVQTGRNIYGVDFS
TSVSGTTATLLQERASERWIQWLGLESDYHCSFSSTRNAEDVMKVSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYE
EKSGLIKVVKFRTGAMDRKRSFEKVVISVMVGKNVKKFLTFVEDEPDFQGGPISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLFYLI
RGYYNELSFRVLERCHEIASARPNDSSTMRTFTDFVSGAPIVRSLQKSTIRKYGYNLAPYMFLLLHVDELSIFSAYQASLPGEKKVDTERL
RDLCPRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALNFGAGPRGGAGDEEDRSITNEEPIIPSVDEHGLKVCKLRSPNTPRRLRKT
DAVKALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEVAQETTLKDSYRITLVPSSDGISLLAFAGPQRNVYVDDTTRRIQLYTDYNH
NGSSEPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAFNHDPWMDVVGFEDPNQVTNRDISRIVLYSYMFLNTAKGCLVEYATFR
QYMRELPKNAPQKLNFREMRQGLIALGRHCVGSRFETDLYESATSELMANHSVQTGRNIYGVDFSLTSVSGTTATLLQERASERWIQW
LGLESDYHCSFSSTRNAEDVMKVSDRRKFEKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRKRS
EKVVISVMVGKNVKKFLTFVEDEPDFQGGPISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLFYLNRGYYNELSFRVLERCHEIASAR

How to link these two kinds of data





LIKVVKFRTGAMDRKRSFEKVVISVMVGKNVKKFLTF
NELSFRVLERCHEIASARPNDSSTMRTFTDFVSGAPIV
PRKPIEIKYFSQICNDMMNKKDRLGDILHIILRACALN
KALLVSSCACTARDLDIFDDNNGVAMWKWIKILYHEV
EPRLKTLDGLTSDYVFYFVTVLRQMQICALGNSYDAF
ELPKNAPQKLNFREMRQGLIALGRHCVGSRFETDLYE
YHCSFSSTRNAEDVMKVSDRRKFEKANFDEFESALN
VMVGKNVKKFLTFVEDEPDFQGGPISKYLIPKKINLM
MRTFTDFVSGAPIVRSLQKSTIRKYGYNLAPYMFLLLH
GDILHIILRACALNFGAGPRGGAGDEEDRSITNEEPIIP
MWKWIKILYHEVAQETTLKDSYRITLVPSSDGISLLAF
MQICALGNSYDAFNHDPWMDVVGFEDPNQVTNRD
HCVGSRFETDLYESATSELMANHSVQTGRNIYGVDFS
EKANFDEFESALNNKNDLVHCPSITLFESIPTEVRSFYE
PISKYLIPKKINLMVYTLFQVHTLKFNRKDYDTLSLFYL
GYNLAPYMFLLLHVDELSIFSAYQASLPGEKKVDTERL
DEEDRSITNEEPIIPSVDEHGLKVCKLRSPNTPRRLRKT
ITLVPSSDGISLLAFAGPQRNVYVDDTTRRIQLYTDYNH
VGFEDPNQVTNRDISRIVLYSYMFLNTAKGCLVEYATFR
HSVQTGRNIYGVDFSLTSVSGTTATLLQERASERWIQV
SITLFESIPTEVRSFYEDEKSGLIKVVKFRTGAMDRKRS

Answer

1. create the Gene Ontology (GO) = a controlled logically structured species-neutral consensus representation of the types biological entities

2. bring about a situation in which thousands of biologists **use the GO**, aggressively, to tag their data

Google Scholar

gene ontology

Articles

About 39,600 results (**0.24** sec)

Any time
Since 2018
Since 2017
Since 2014
Custom range...

Sort by relevance
Sort by date

include patents
include citations

Create alert

Gene Ontology: **tool** for the **unification** of biology

M Ashburner, CA Ball, JA Blake, D Botstein, H Butler... - Nature ..., 2000 - nature.com

1FlyBase (http://www. flybase. bio. indiana. edu). 2Berkeley Drosophila Genome Project (http://fruitfly. bdgp. berkeley. edu). 3Saccharomyces Genome Database (http://genome-www. stanford. edu). 4Mouse Genome Database and **Gene** Expression Database ...

★ Cited by 21201 Related articles All 45 versions

[PDF] **Gene Ontology**: **tool** for the **unification** of biology

D Botstein, JM Cherry, M Ashburner, CA Ball... - Nat Genet, 2000 - researchgate.net

Genomic sequencing has made it clear that a large fraction of the **genes** specifying the core biological functions are shared by all eukaryotes. Knowledge of the biological role of such shared proteins in one organism can often be transferred to other organisms. The goal of the ...

★ Cited by 3195 Related articles All 6 versions

BiNGO: a Cytoscape plugin to assess overrepresentation of **Gene Ontology** categories in Biological Networks

S Maere, K Heymans, M Kuiper - Bioinformatics, 2005 - academic.oup.com

... A comprehensive list can be found at http://www.**geneontology**.org/GO.**tools**.shtml ... BMC Bioinformatics. 4. 2. Beißbarth, T. and Speed, TP 2004. GOstat: find statistically overrepresented **Gene Ontologies** within a group of **genes** ...

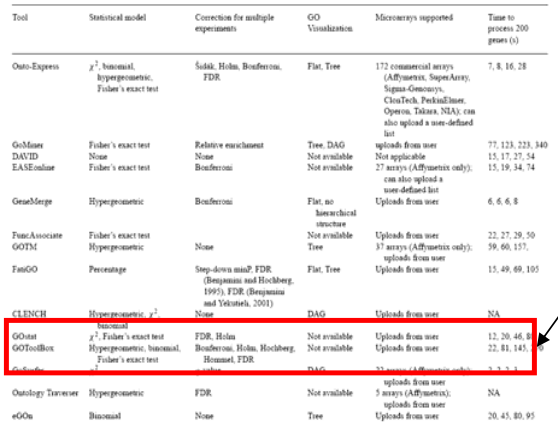
☆ Cited by 2536 Related articles All 20 versions

GO provides a controlled system of terms for use in tagging experimental data

- multi-species, multi-disciplinary, open source
- compare: use of kilograms, meters, seconds … in formulating experimental results

annotation using Gene Ontology (GO) terms allows navigation between databases

MouseEcotope



Tool	Statistical model	Correction for multiple experiments	GO Visualization	Microarrays supported	Time to process 200 genes (s)
Onto-Express	χ^2, binomial, hypergeometric, Fisher's exact test	Šidák, Holm, Bonferroni, FDR	Flat, Tree	172 commercial arrays (Affymetrix, SuperArray, Sigma-Genomics, ClouTech, PerkinElmer, Operon, Takara, NIA); can also upload a user-defined list	7, 8, 16, 28
GoMiner	Fisher's exact test	Relative enrichment	Tree, DAG	uploads from user	77, 123, 223, 340
DAVID	None	None	Not available	Not applicable	15, 17, 27, 54
EASEonline	Fisher's exact test	Bonferroni	Not available	27 arrays (Affymetrix only); can also upload a user-defined list	15, 19, 34, 74
GeneMerge	Hypergeometric	Bonferroni	Flat, no hierarchical structure	Uploads from user	6, 6, 6, 8
FuncAssociate	Fisher's exact test		Not available	Uploads from user	22, 27, 29, 50
GOTM	Hypergeometric	None	Tree	37 arrays (Affymetrix only); uploads from user	59, 60, 157,
FatiGO	Percentage	Step-down minP, FDR (Benjamini and Hochberg, 1995), FDR (Benjamini and Yekutieli, 2001)	Flat, Tree	Uploads from user	15, 49, 69, 105
CLENCH	Hypergeometric, χ^2, binomial	None	DAG	Uploads from user	NA
GOstat	χ^2, Fisher's exact test	FDR, Holm	Not available	Uploads from user	12, 20, 46, 8
GOToolBox	Hypergeometric, binomial, Fisher's exact test	Bonferroni, Holm, Hochberg, Hommel, FDR	Not available	Uploads from user	22, 81, 145,
Ontology Traverser	Hypergeometric	FDR	Not available	5 arrays (Affymetrix); uploads from user	NA
eGOn	Binomial	None	Tree	Uploads from user	20, 45, 80, 95

sphingolipid transporter activity

GlyProt

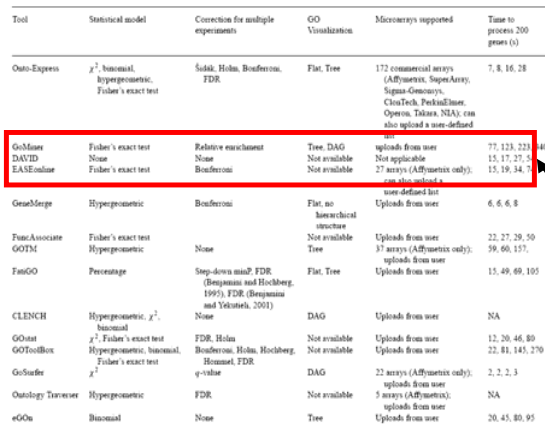
GLUL Glutamate-ammonia ligase
HMOX2 Heme oxygenase (decycling) 2
Ahnak-A Nucleoprotein Ahnak-A
Erythrocyte membrane 50kd glycoprotein
CA2 Carbonic anhydrase II
NFIX Nuclear factor I/X
HOMEOBOX PROTEIN HOX-A5
Homeotic Protein C6, Class I
KIAA0246 gene, partial cds
ELA2 Elastase 2, neutrophil
MPO Myeloperoxidase
CST3 Cystatin C
ARH9 Ras homolog, member G (rho G)
ANX1 Annexin I (lipocortin I)
CSF3R
SET1 integration oncogene
D component of complement
MF-IL6-beta
MAN2 Alpha mannosidase II isozyme
Homolog suppressor-of-white-apricot
CD2 antigen (p50)
Myosin VIIA (UBH1B)
SPRR1B Small proline-rich protein 1B
ACTN2 Actinin alpha 2
KIAA0080 gene, partial cds
DTDMK Deoxythymidylate kinase
Carcinoembryonic antigen precursor
LTE Lymphotoxin-beta
GATA3 GATA-binding protein 3
HB DEF = Escherichia coli unknown
SUARYLATE CYCLASE, BETA-1
Spinal Muscular Atrophy 4
KIAA0239 gene, partial cds
Butyrophilin (BTF4)
MHC-encoded proteasome LAMP7-E1
RPA1 Replication protein A1
Clone 22 mRNA
CTPS CTP synthetase
UBIQUITIN-LIKE PROTEIN GDX
(AP1c) mRNA
S100 calcium-binding protein A13
BLK Protein-tyrosine kinase blk
IGB (B29)
ORF-1
TCL1
CD19 antigen
Skeletal muscle abundant protein

DiabetInGene

GluChem

annotation using Gene Ontology (GO) terms allows navigation between databases

MouseEcotope



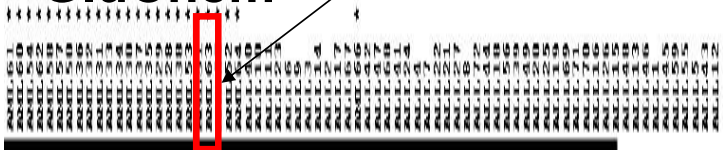
Tool	Statistical model	Correction for multiple experiments	GO Visualization	Microarrays supported	Time to process 200 genes (s)
Onto-Express	χ^2, binomial, hypergeometric, Fisher's exact test	Šidák, Holm, Bonferroni, FDR	Flat, Tree	172 commercial arrays (Affymetrix, SuperArray, Sigma-Genomics, CloneTech, PerkinElmer, Operon, Takara, NIA); can also upload a user-defined list	7, 8, 16, 28
GoMiner	Fisher's exact test	Relative enrichment	Tree, DAG	uploads from user	77, 123, 221, 340
DAVID	None	None	Not available	Not applicable	15, 17, 27, 3
EASEonline	Fisher's exact test	Bonferroni	Not available	27 arrays (Affymetrix only); can also upload a user-defined list	15, 19, 34, 7
GeneMerge	Hypergeometric	Bonferroni	Flat, no hierarchical structure	Uploads from user	6, 6, 6, 8
FuncAssociate	Fisher's exact test		Not available	Uploads from user	22, 27, 29, 50
GOTM	Hypergeometric	None	Tree	37 arrays (Affymetrix only); uploads from user	59, 60, 157,
FatiGO	Percentage	Step-down minP, FDR (Benjamini and Hochberg, 1995), FDR (Benjamini and Yekutieli, 2001)	Flat, Tree	Uploads from user	15, 49, 69, 105
CLENCH	Hypergeometric, χ^2, binomial	None	DAG	Uploads from user	NA
GOstat	χ^2, Fisher's exact test	FDR, Holm	Not available	Uploads from user	12, 20, 46, 80
GOToolBox	Hypergeometric, binomial, Fisher's exact test	Bonferroni, Holm, Hochberg, Hommel, FDR	Not available	Uploads from user	22, 81, 145, 270
GoSurfer	χ^2	q-value	DAG	22 arrays (Affymetrix only); uploads from user	2, 2, 2, 3
Ontology Traverser	Hypergeometric	FDR	Not available	5 arrays (Affymetrix); uploads from user	NA
eGOn	Binomial	None	Tree	Uploads from user	20, 45, 80, 95

Holliday junction helicase complex

DiabetInGene



GluChem



GlyProt

GLUL Glutamate-ammonia ligase
HMOX2 Heme oxygenase (decycling) 2
Ahnak-A Nucleoprotein Ahnak-A
Erythrocyte membrane 50kd glycoprotein
CA2 Carbonic anhydrase II
NFIX Nuclear factor I/X
HOMEOBOX PROTEIN HOX-A5
Homeotic Protein C6, Class I
KIAA0246 gene, partial cds
ELA2 Elastase 2, neutrophil
MPO Myeloperoxidase
CST3 Cystatin C
ARH9 Ras homolog, member G (rho G)
ANX1 Annexin I (lipocortin I)
CSF3R
SET1 integration oncogene
D component of complement
MF-IL6-beta
Ahnak-Related Sequence
MAN2 Alpha mannosidase II isozyme
HOX2 oncogene
Homolog suppressor-of-white-apricot
CD2 antigen (p50)
SPRR1B Small proline-rich protein IE
KIAA0080 gene, partial cds
DTDMK Deoxythymidylate kinase
Carcinoembryonic antigen precursor
LTE Lymphotoxin-beta
GATA3 GATA-binding protein 3
HB DEF = Escherichia coli unknown
GUANYLATE CYCLASE BETA-1
Spinal Muscular Atrophy 4
KIAA0239 gene, partial cds
Butyrophilin (BTF4)
MHC-encoded proteasome LAMP7-E1
RPA1 Replication protein A1
Clone 22 mRNA
CTP6 CTP synthetase
UBIQUITIN-LIKE PROTEIN GDX
(AP1c) mRNA
S100 calcium-binding protein A13
BLK Protein-tyrosine kinase blk
IGB (B29)
ORF-1
TCL1
CD19 antigen
Skeletal muscle abundant protein

Email to Graham Shutt on Barry Smith's Wolfgang Paul Award (2002)

Graham,
Barry Smith is not someone that I would recommend as an expert on ontology, and certainly not on its applications to IT (information technology). He has published a lot of nonsense on the subject which seems to have misled many people (including the people who gave him the money). But I seriously doubt that anything useful will come of it.
John

Background

1996 release of yeast genome reference sequence

1998 release of nematode work reference sequence

1999 Gene Ontology (GO)

2000 release of fly genome reference sequence

2001 release human genome reference sequence

2004 “The Formal Architecture of the Gene Ontology”

Institute for Formal Ontology and Medical Information Science
Faculty of Medicine
University of Leipzig

2004

The Formal Architecture of the Gene Ontology

An Informal Workshop

sponsored by the

- Institute for Formal Ontology and Medical Information Science

in conjunction with:

- Department of Genetics, Faculty of Biological Science, Pharmacy and Psychology, University of Leipzig,
- Max Planck Institute for Evolutionary Anthropology, and
- Network of Excellence on Medical Informatics and Semantic Data mining

STOP!

Smart Terminologies via Ontological Principles

Barry Smith
IFOMIS, Leipzig, 2004

e.g. problems with circularity

- ***cell fate commitment***

  =def. The commitment of cells to specific cell fates **and** their capacity to differentiate into particular kinds of cells.

This definition has the form:

x is an A =def. *x* is an A & x is a B

e.g. problems with circularity

- ***hemolysis***

  =def. The processes that cause hemolysis …

e.g. problems with constituents, components, parts, …

What is the relation between

structural constituent of ribosome

and

large ribosomal subunit?

e.g. problems with ‘within’

- *lytic vacuole within a protein storage vacuole*

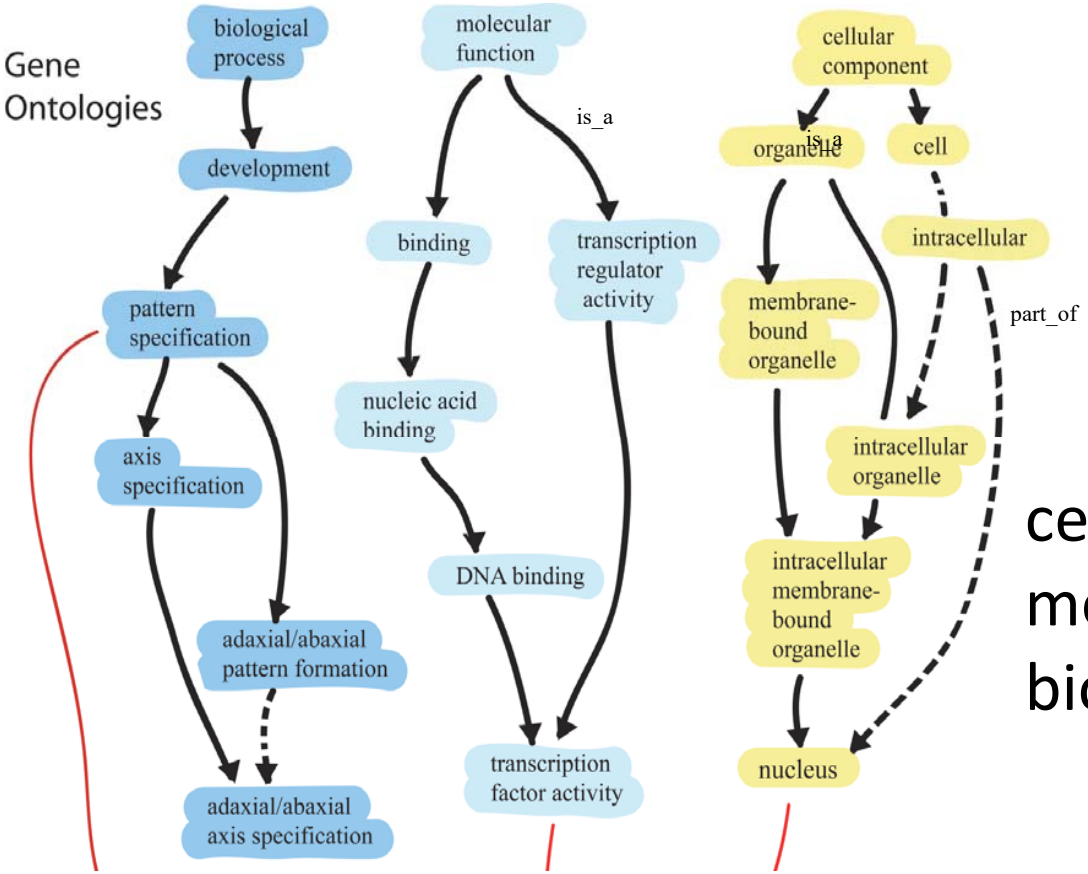
e.g. problems with ‘within’

- *lytic vacuole within a protein storage vacuole*
- *lytic vacuole within a protein storage vacuole* ***is-a*** *protein storage vacuole*
- *embryo within a uterus* ***is-a*** *uterus*
- *car within a tunnel* ***is-a*** *car*

Michael Ashburner, Professor of Genetics, Cambridge

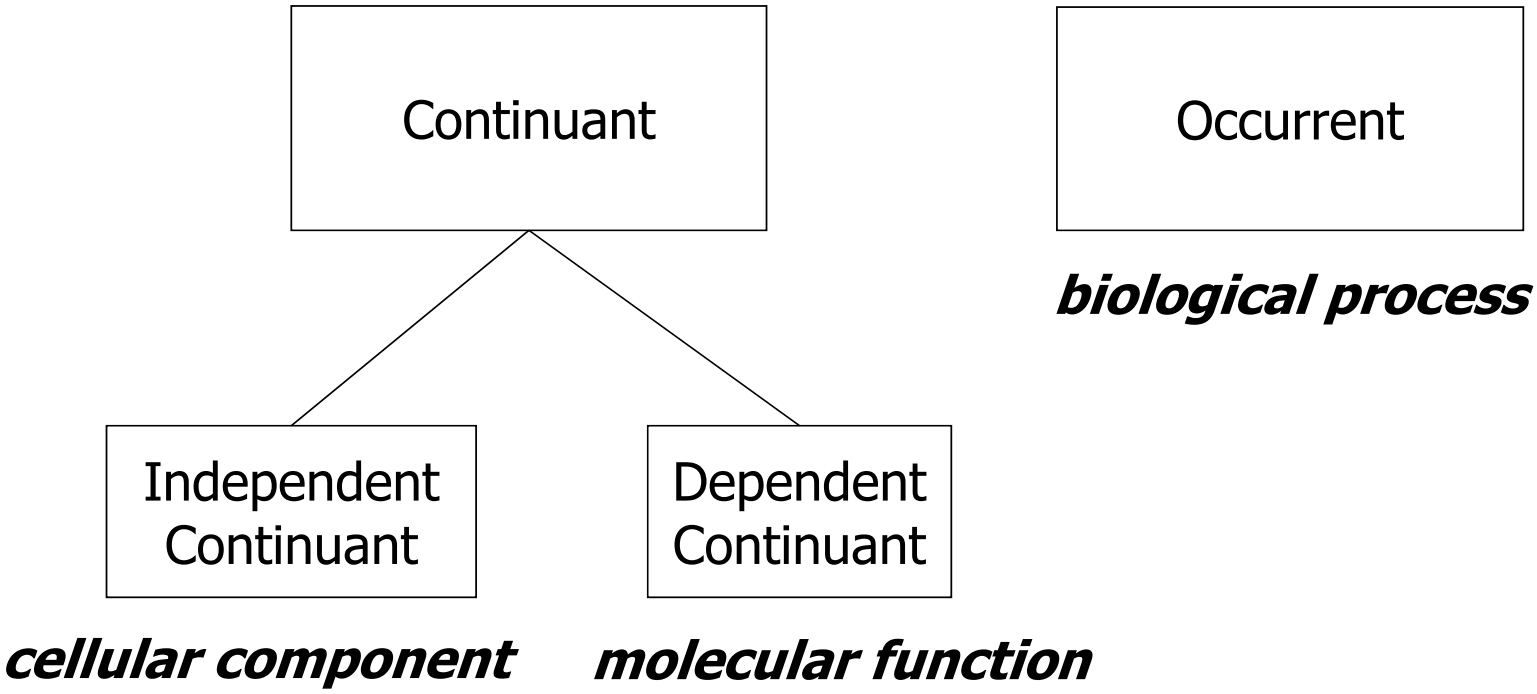


GO's three sub-ontologies

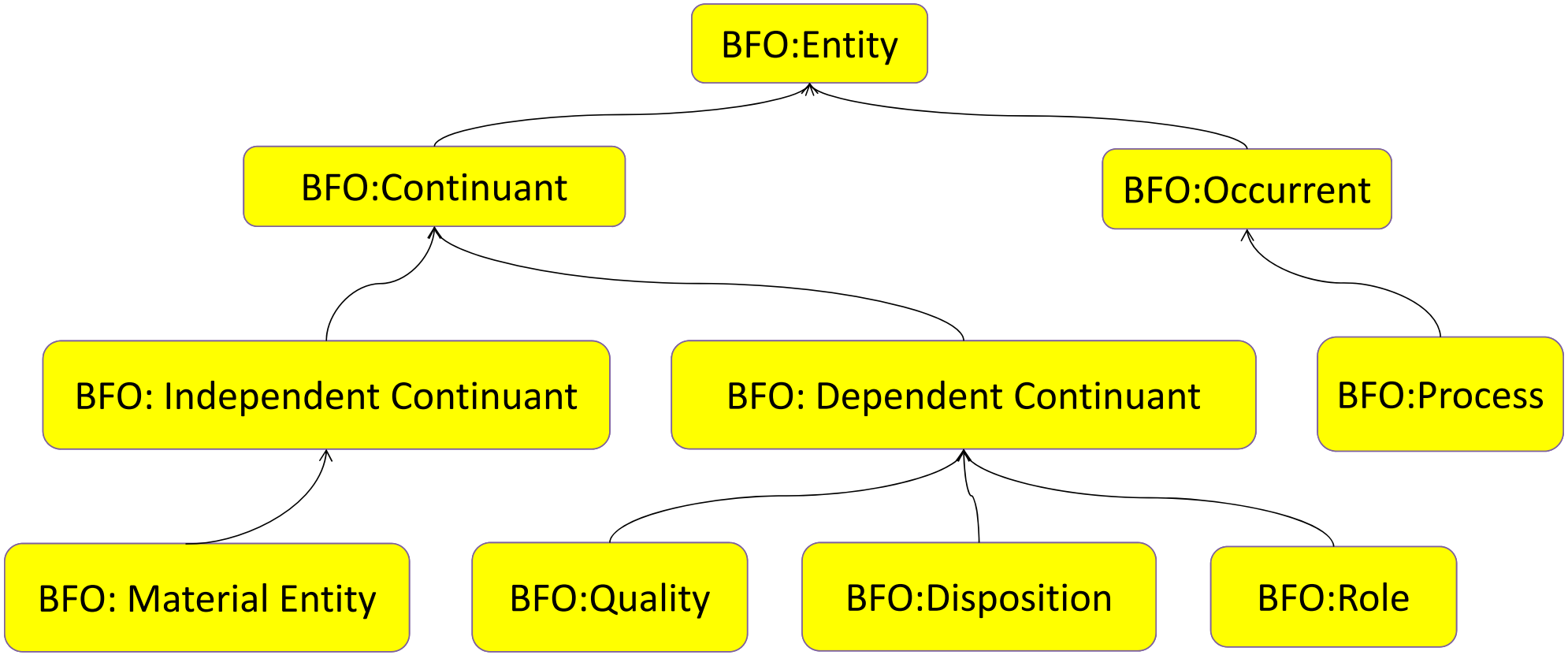


cellular component
molecular function
biological process

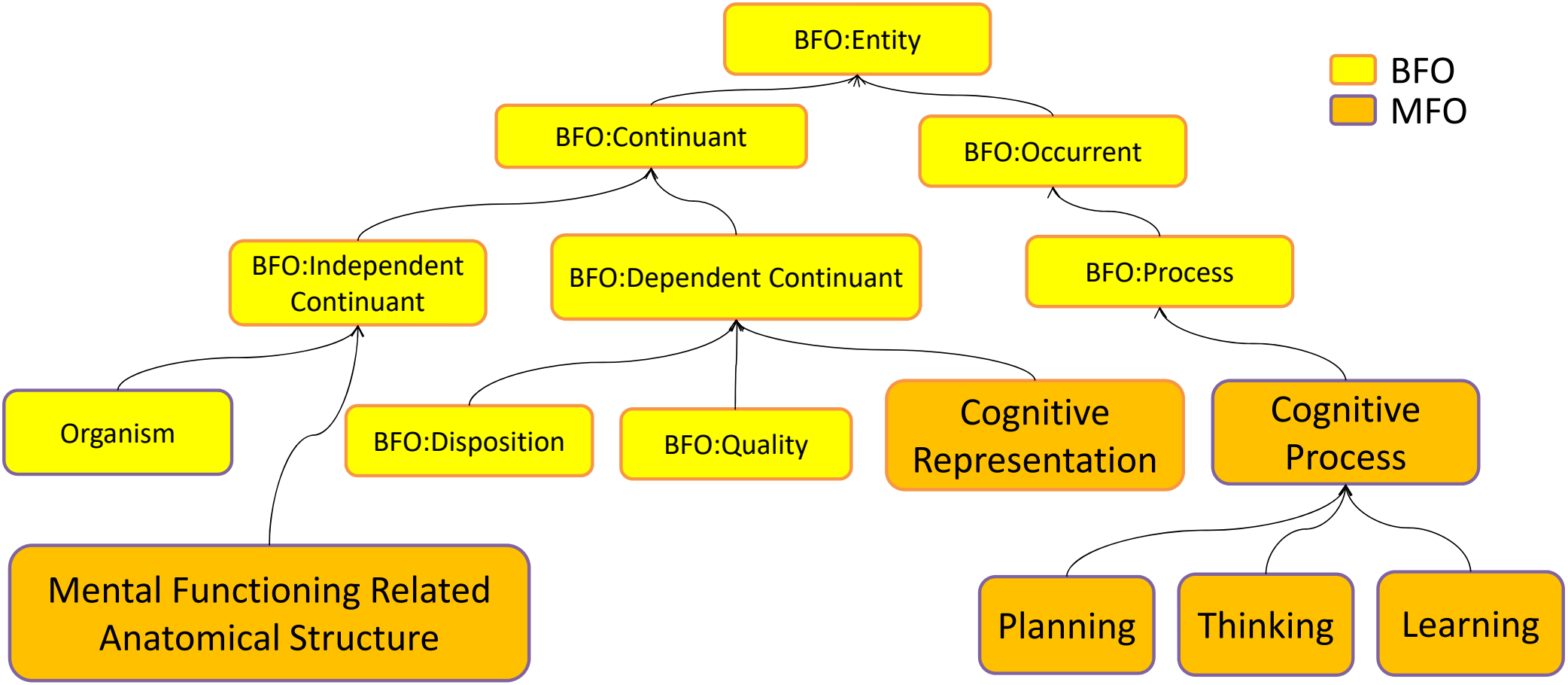
BFO generalizes GO



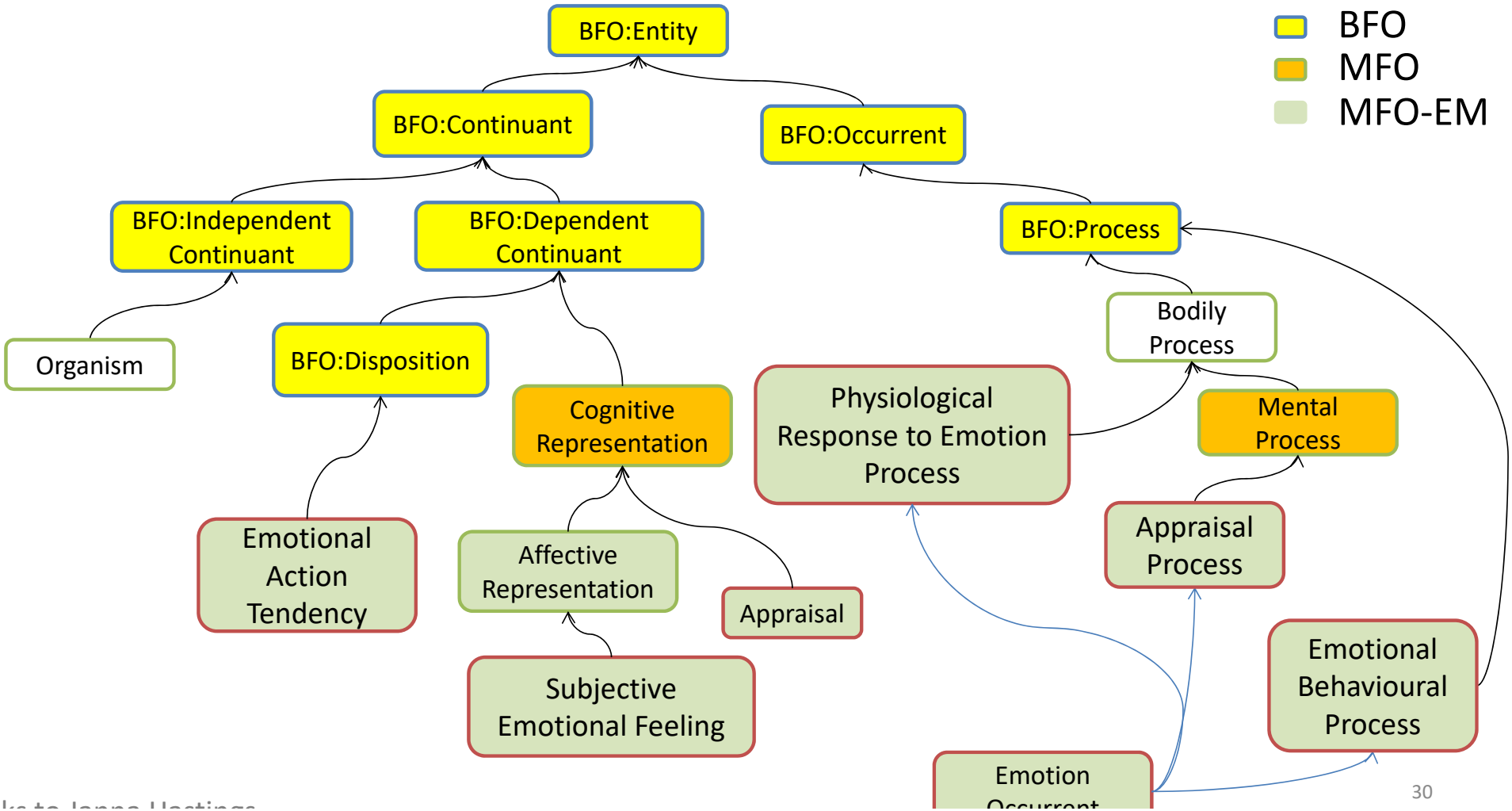
BFO = Basic Formal Ontology



Mental Functioning Ontology (MFO) extends BFO

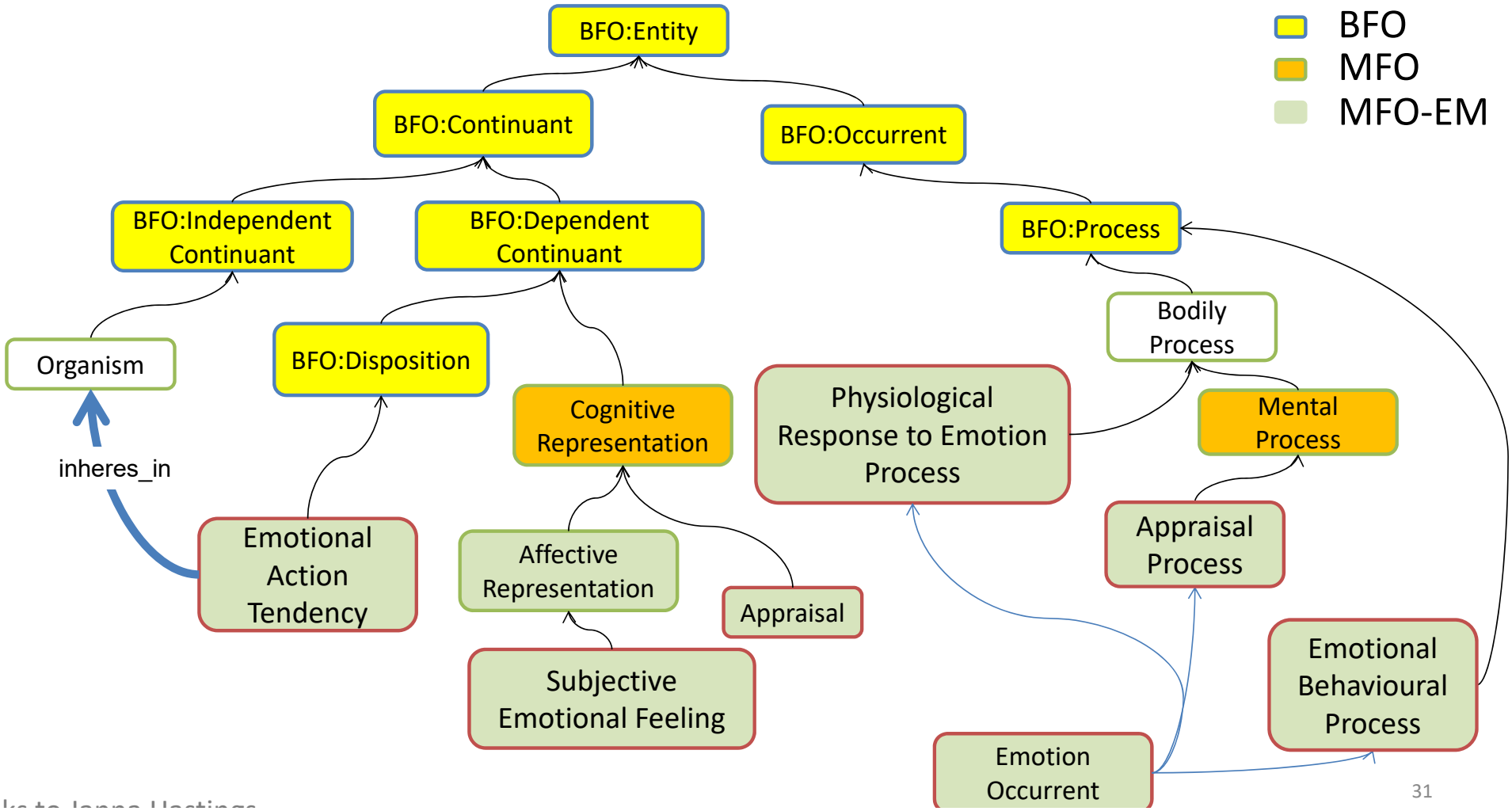


Emotion Ontology (MFO-EM) extends MFO



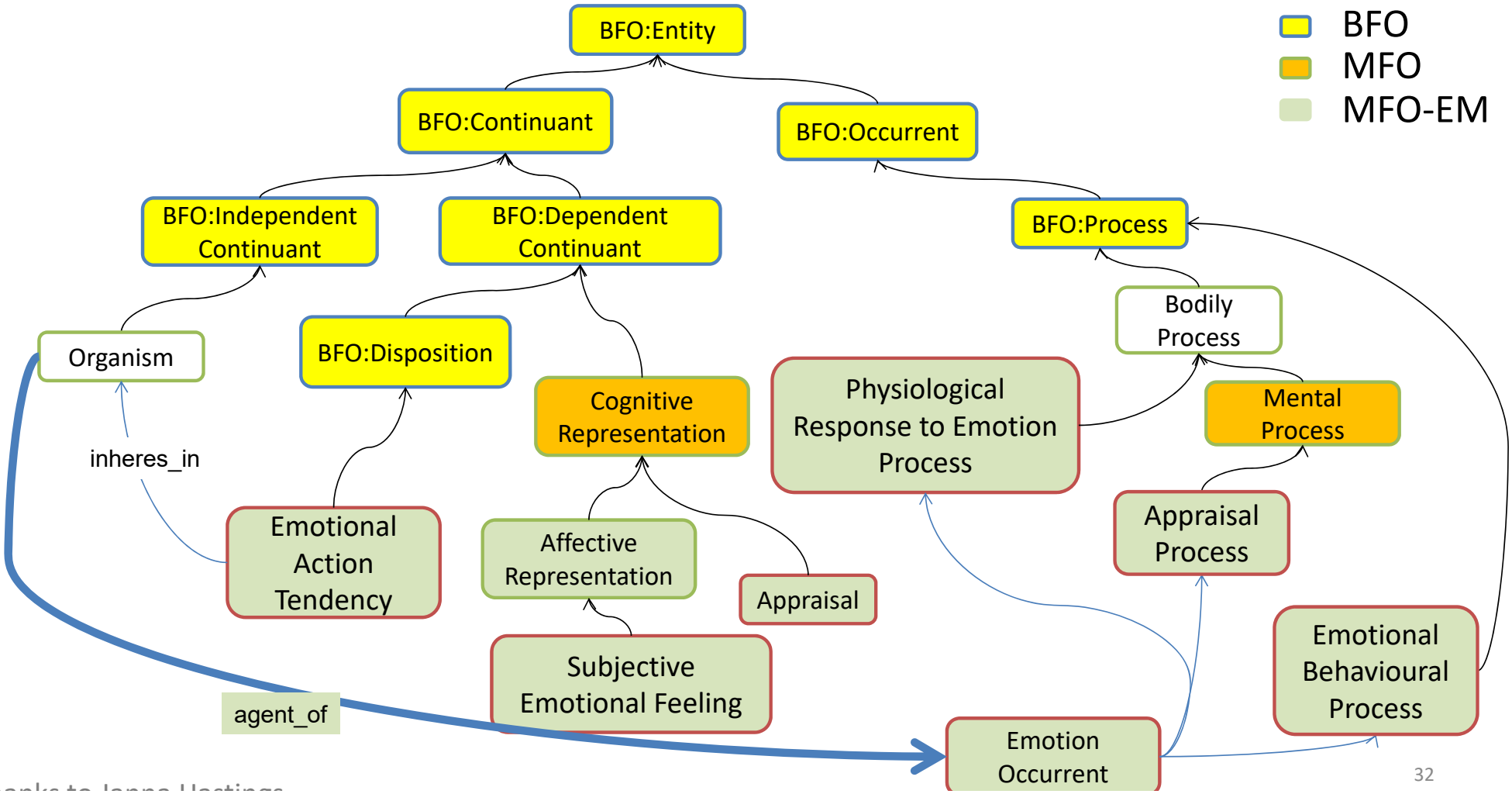
with thanks to Janna Hastings

Emotion Ontology (MFO-EM)

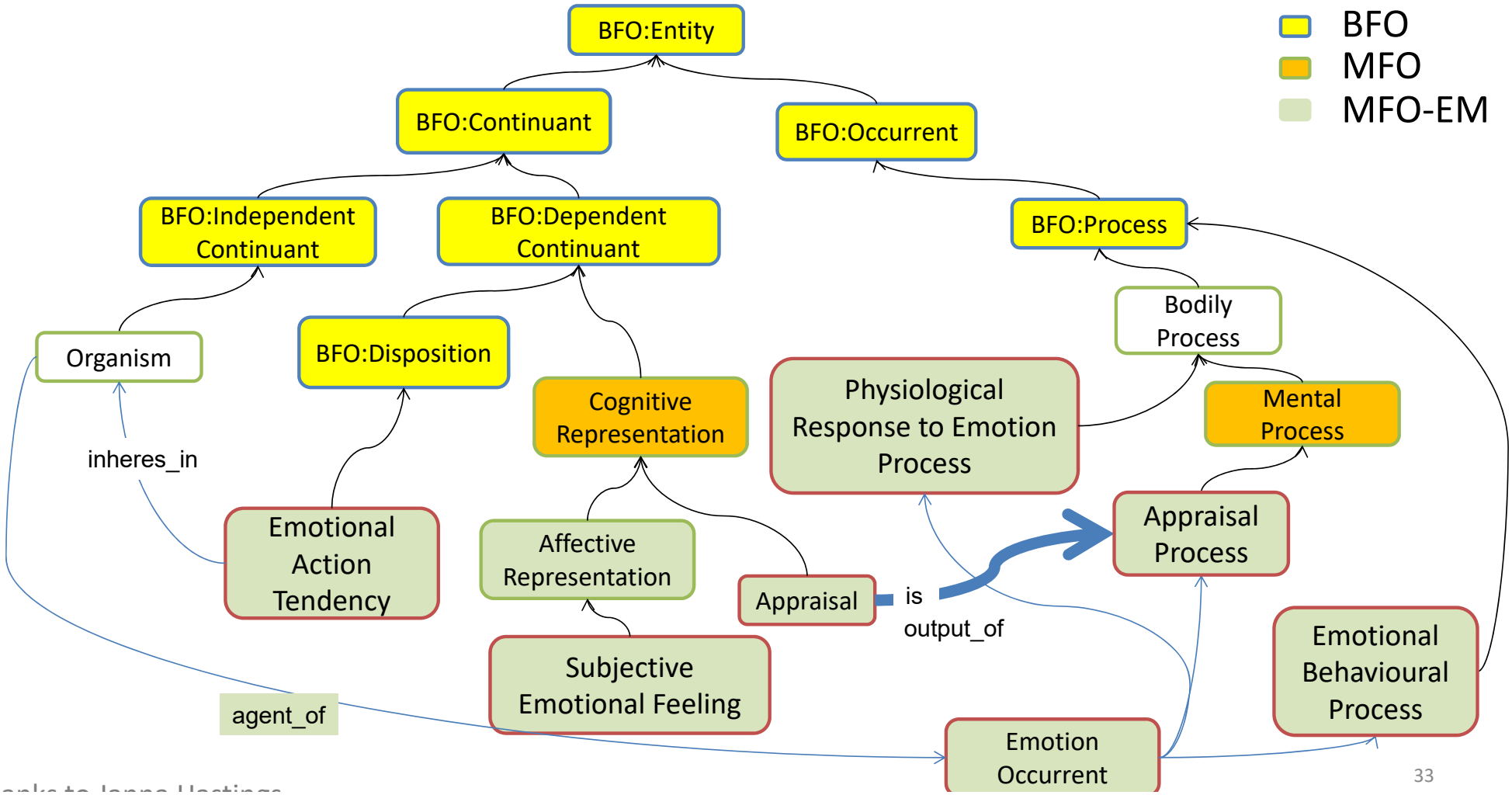


with thanks to Janna Hastings

Emotion Ontology (MFO-EM)

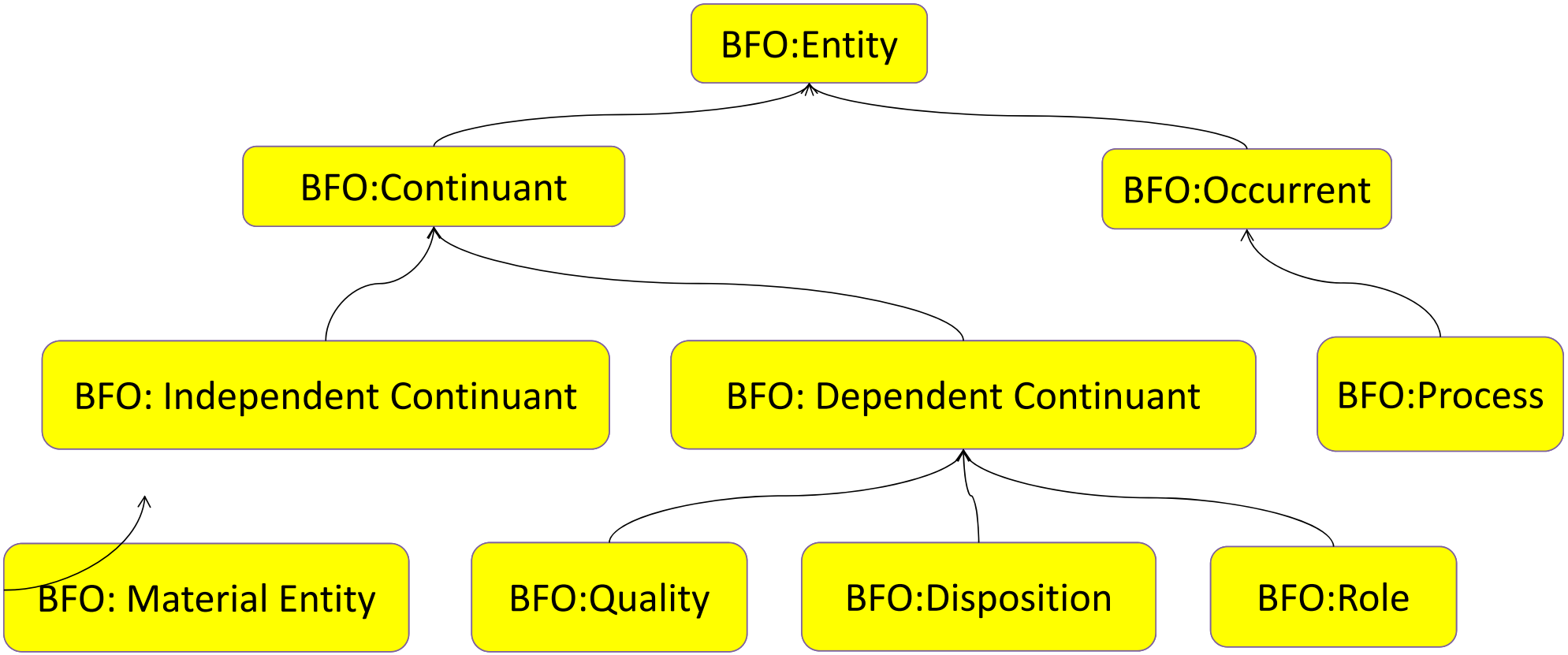


Emotion Ontology (MFO-EM)

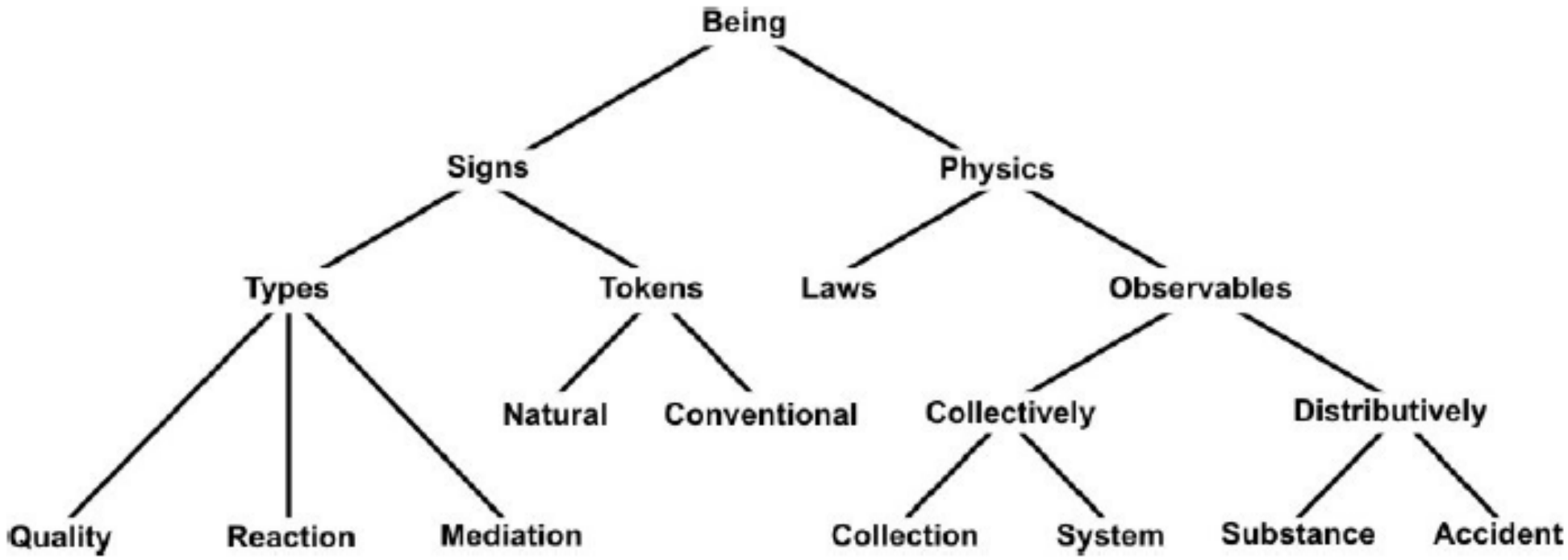


with thanks to Janna Hastings

BFO *is_a* hierarchy



A Top Level Based on Peirce and Wilkins



Best ontology John has ever seen

mediation *is_a* types

distributively *is_a* physics

system *is_a* collectively

collection *is_a* observables

quality *is_a* signs

Signs include all data and sensory stimuli from any source, including emotions, proprioception, and internal signaling.

Proprioception *is_a* signs (*part_of* signs)?

GO coverage

generic biological entities of three sorts:

- cellular components (continuants)
- molecular functions (continuants)
- biological processes (occurrents)

GO does not provide representations of diseases, proteins, symptoms, anatomy, pathways, …

nature biotechnology

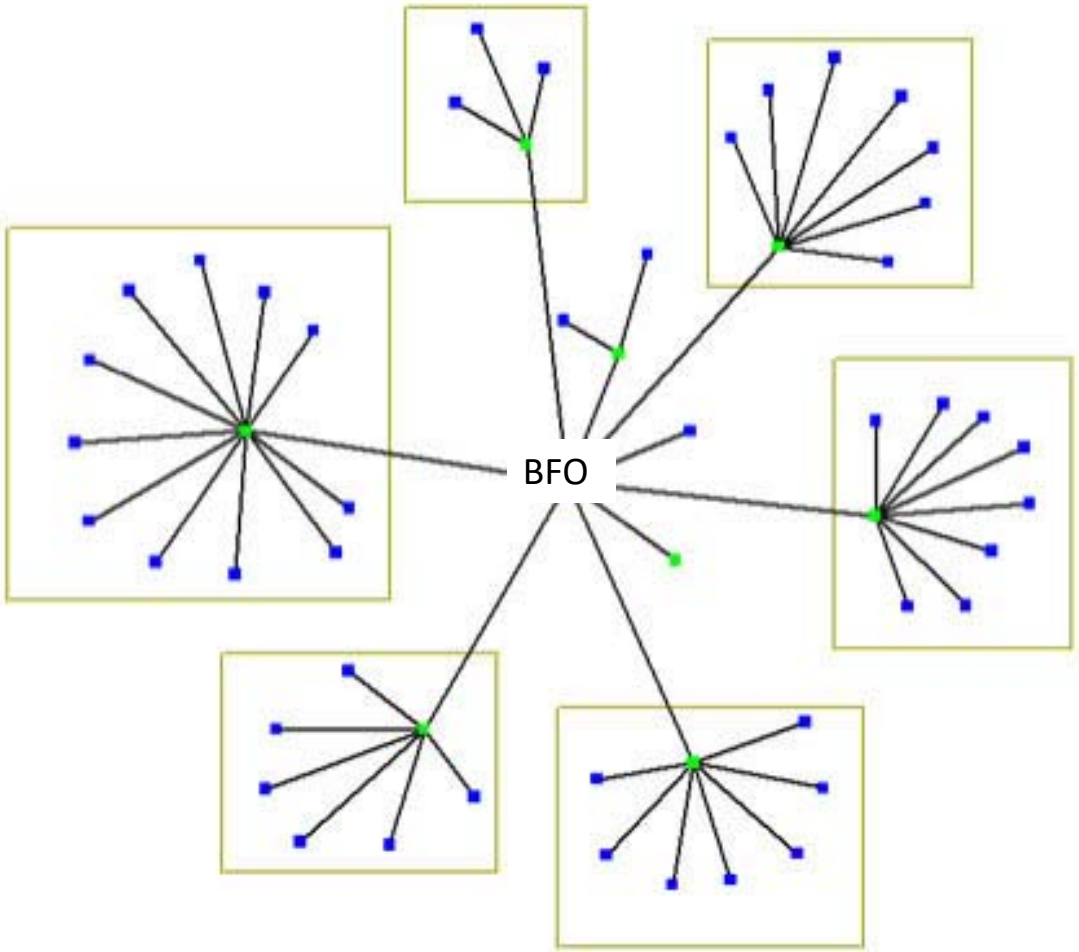
Perspective

Nature Biotechnology **25**, 1251 - 1255 (2007)
Published online: 7 November 2007 | doi:10.1038/nbt1346

The OBO Foundry: coordinated evolution of ontologies to support biomedical data integration

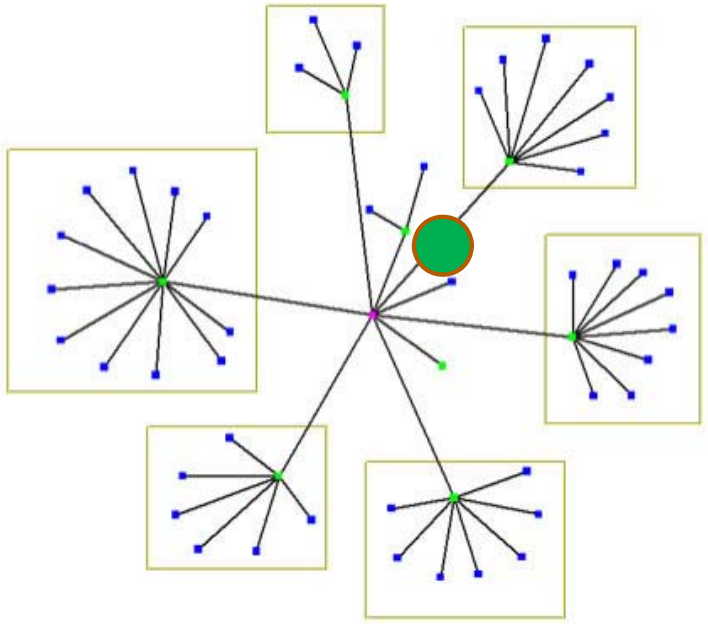
Barry Smith[1], Michael Ashburner[2], Cornelius Rosse[3], Jonathan Bard[4], William Bug[5], Werner Ceusters[6], Louis J Goldberg[7], Karen Eilbeck[8], Amelia Ireland[9], Christopher J Mungall[10], The OBI Consortium[11], Neocles Leontis[12], Philippe Rocca-Serra[9], Alan Ruttenberg[13], Susanna-Assunta Sansone[9], Richard H Scheuermann[14], Nigam Shah[15], Patricia L Whetzel[16] & Suzanna Lewis[10]

Hub and spokes approach



ontologies are networked together and developed in coordination with each other

terms in **spokes** ontologies are defined logically using terms from ontologies nearer the **hub**

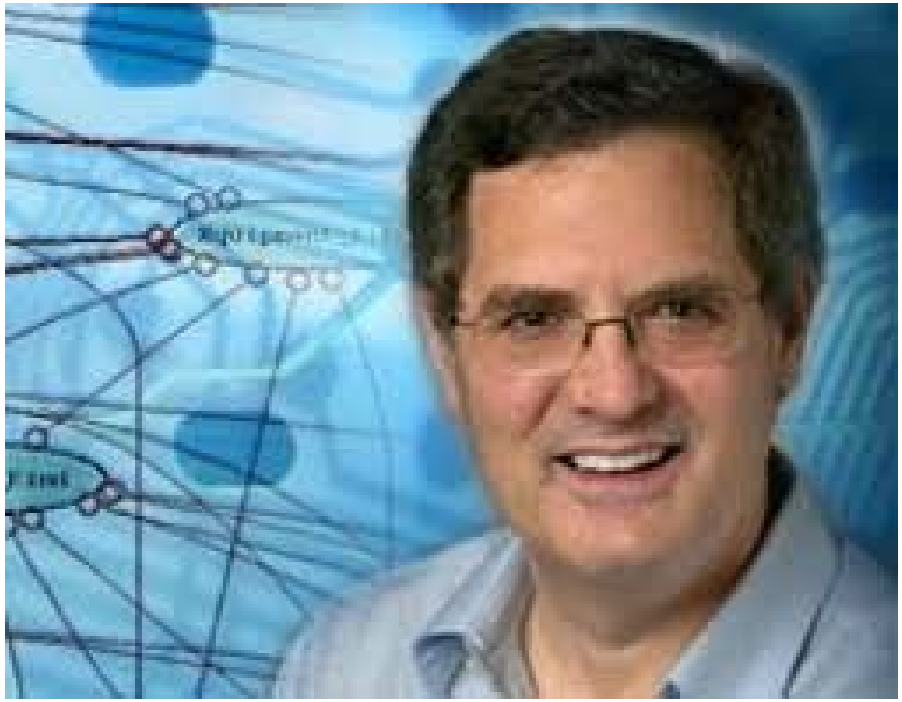


The Gene Ontology vs. the Semantic Web



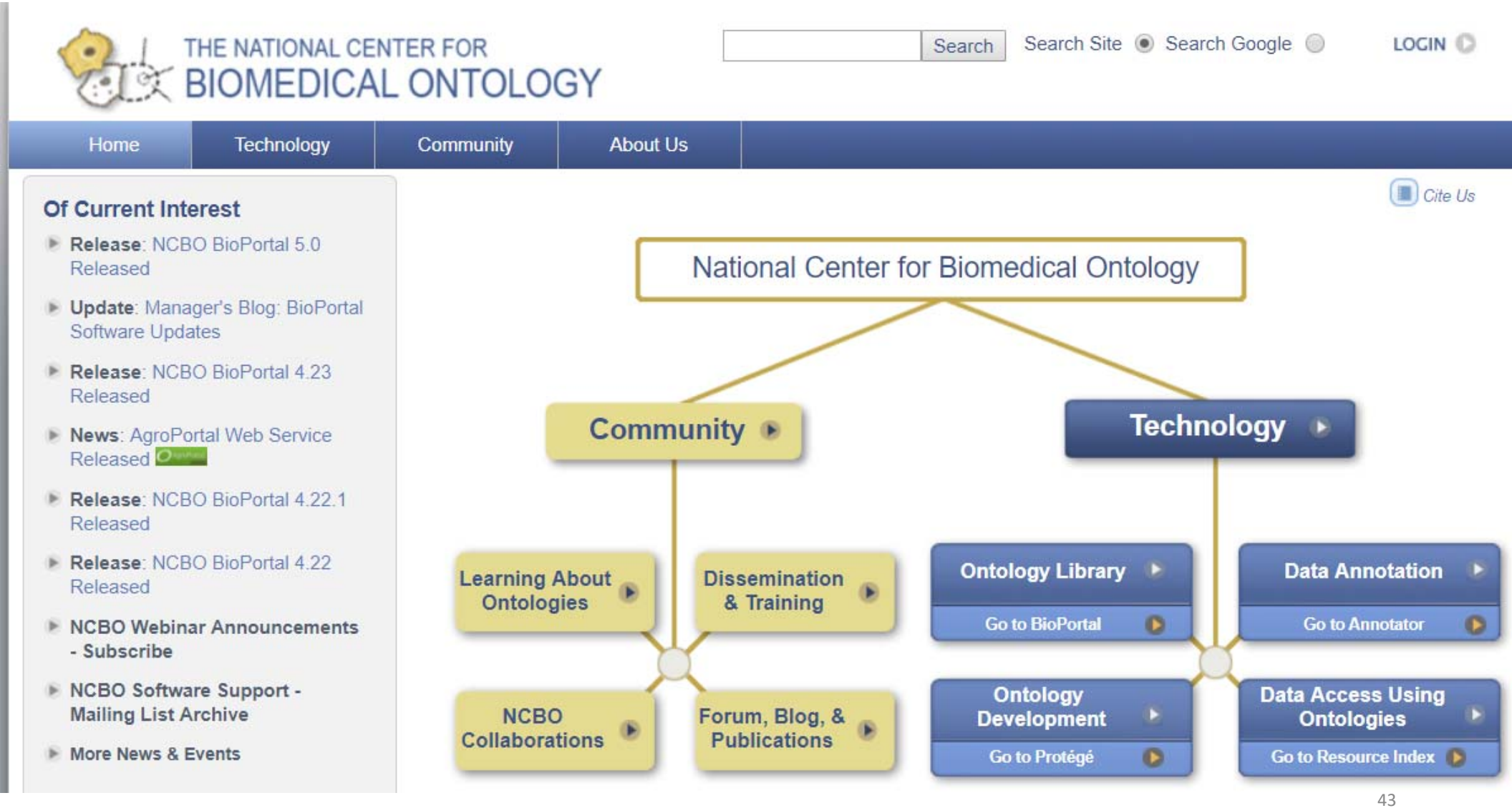
Michael Ashburner

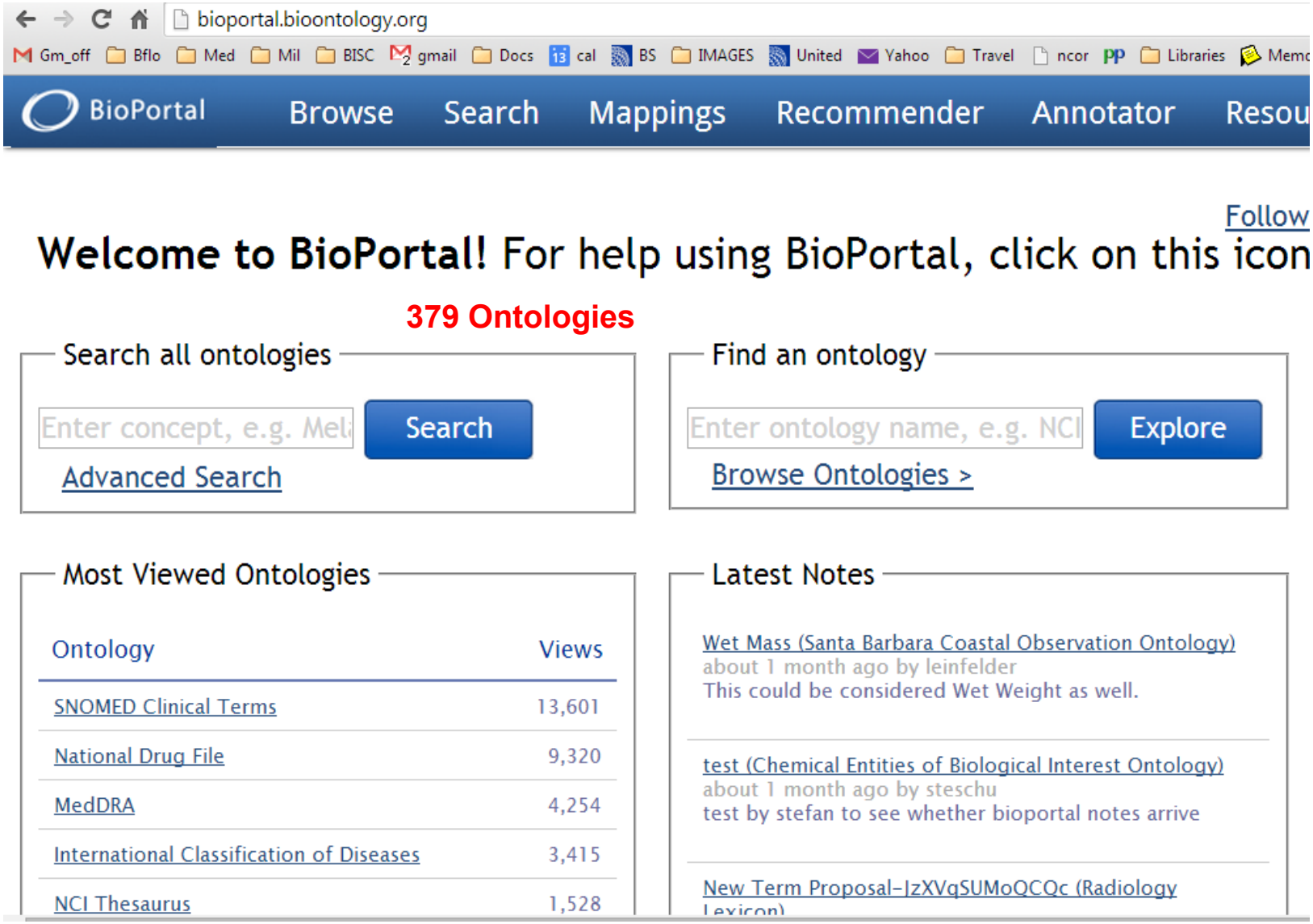
Cambridge, UK (Drosophila)



Mark Musen

Stanford, USA (informatics)


THE NATIONAL CENTER FOR
BIOMEDICAL ONTOLOGY
Search
Search Site
Search Google
LOGIN
Home
Technology
Community
About Us
Cite Us
Of Current Interest
Release: NCBO BioPortal 5.0 Released
Update: Manager's Blog: BioPortal Software Updates
Release: NCBO BioPortal 4.23 Released
News: AgroPortal Web Service Released
Release: NCBO BioPortal 4.22.1 Released
Release: NCBO BioPortal 4.22 Released
NCBO Webinar Announcements - Subscribe
NCBO Software Support - Mailing List Archive
More News & Events
National Center for Biomedical Ontology
Community
Technology
Learning About Ontologies
Dissemination & Training
NCBO Collaborations
Forum, Blog, & Publications
Ontology Library
Go to BioPortal
Data Annotation
Go to Annotator
Ontology Development
Go to Protégé
Data Access Using Ontologies
Go to Resource Index


bioportal.bioontology.org
Gm_off Bflo Med Mil BISC gmail Docs cal BS IMAGES United Yahoo Travel ncor Libraries
BioPortal
Browse
Search
Mappings
Recommender
Annotator
Resou
Follow
Welcome to BioPortal! For help using BioPortal, click on this icon
379 Ontologies
Search all ontologies
Enter concept, e.g. Mel
Search
Advanced Search
Find an ontology
Enter ontology name, e.g. NCI
Explore
Browse Ontologies >
Most Viewed Ontologies
Ontology
Views
SNOMED Clinical Terms 13,601
National Drug File 9,320
MedDRA 4,254
International Classification of Diseases 3,415
NCI Thesaurus 1,528
Latest Notes
Wet Mass (Santa Barbara Coastal Observation Ontology)
about 1 month ago by leinfelder
This could be considered Wet Weight as well.
test (Chemical Entities of Biological Interest Ontology)
about 1 month ago by steschu
test by stefan to see whether bioportal notes arrive
New Term Proposal-IzXVqSUMoQCQc (Radiology

Unifying goal of NCBO/Bioportal integration of biological and clinical data through tagging with ontologies

- within and across domains
- across different species
- across levels of granularity (organ, organism, cell, molecule)
- across different perspectives (physical, biological, clinical)

Email from John Sowa to Mary Keeler on Barry Smith and Ontology (2002)

Mary,

Barry is not only misguided, he is profoundly, obsessively misguided. His misunderstanding of Peirce comes from his obsessive search for fragments that fit his own world view, while ignoring everything outside his extremely narrow perspective …

http://mars.virtual-earth.de/pipermail/

Email from John Sowa to Mary Keeler on Barry Smith and Ontology

Mary,

Barry is not only misguided, he is profoundly, obsessively misguided. His misunderstanding of Peirce comes from his obsessive search for fragments that fit his own world view, while ignoring everything outside his extremely narrow perspective …

- John F. Boler, *Charles Peirce and Scholastic Realism. A Study of Peirce's Relation to John Duns Scotus*, Seattle: University of Washington Press, 1963.

Email to Mary Keeler on Barry Smith and Ontology

…

The word "purpose", by the way, is significant because Barry has tried to eliminate it from his version of "formal ontology". We were both at a conference on ontology in Padua around 1994, where I and other people who came from an AI background were emphasizing the need to recognize the purpose of any representation. …

http://mars.virtual-earth.de/pipermail/

Email to Mary Keeler on Barry Smith and Ontology

… We kept saying that you cannot begin to do kn. rep. without considering the purpose for which you were doing it.

Barry would turn livid at any such claim because he was trying to do "formal ontology" in a "scientific" manner in which all consideration of purpose was forbidden.

John

html>http://mars.virtual-earth.de/pipermail/

On not eliminating *purpose* from ontology

BFO: Function

For artifacts (screwdriver, car, heater, …): function =def. disposition whose realization the artifact was designed and created for

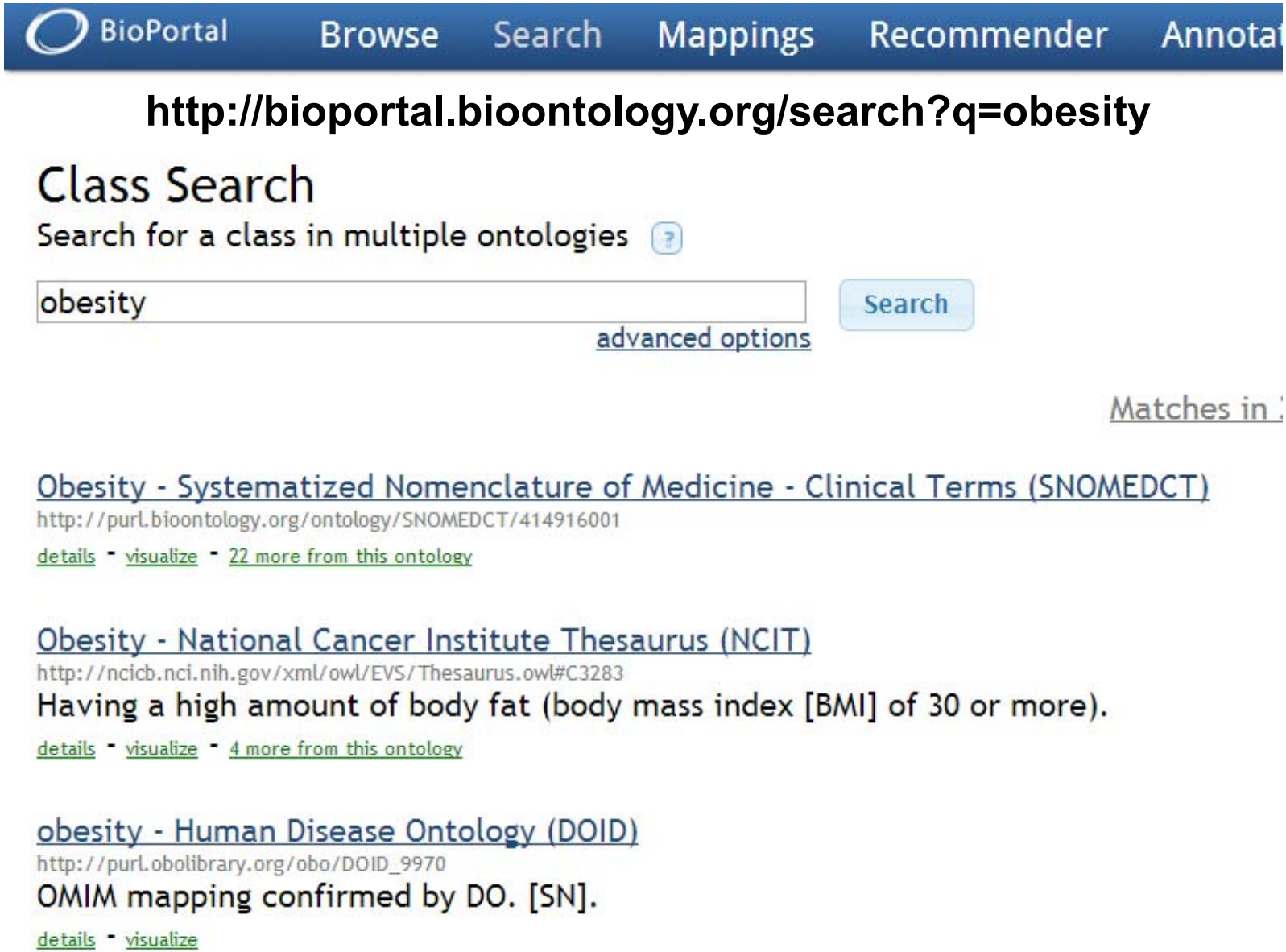
For organizations: purpose =def. disposition whose realization the organization was designed and created for

On why reference ontologies should not be built to address specific purposes

Because this undermines the ability of ontologies to serve interoperability.

Unifying goal of NCBO/Bioportal: integration of biological and clinical data through tagging with ontologies

- within and across domains
- across different species
- across levels of granularity (organ, organism, cell, molecule)
- across different perspectives (physical, biological, clinical)


BioPortal
Browse
Search
Mappings
Recommender
Annotat
http://bioportal.bioontology.org/search?q=obesity
Class Search
Search for a class in multiple ontologies
obesity
Search
advanced options
Matches in
Obesity - Systematized Nomenclature of Medicine - Clinical Terms (SNOMEDCT)
http://purl.bioontology.org/ontology/SNOMEDCT/414916001
details - visualize - 22 more from this ontology
Obesity - National Cancer Institute Thesaurus (NCIT)
http://ncicb.nci.nih.gov/xml/owl/EVS/Thesaurus.owl#C3283
Having a high amount of body fat (body mass index [BMI] of 30 or more).
details - visualize - 4 more from this ontology
obesity - Human Disease Ontology (DOID)
http://purl.obolibrary.org/obo/DOID_9970
OMIM mapping confirmed by DO. [SN].
details - visualize

Class Search

Search for a class in multiple ontologies

obesity

Search

advanced options

Matches in 35 ontologies

Obesity - Systematized Nomenclature of Medicine - Clinical Terms (SNOMEDCT)
http://purl.bioontology.org/ontology/SNOMEDCT/414916001
details - visualize - 22 more from this ontology

Obesity - National Cancer Institute Thesaurus (NCIT)
http://ncicb.nci.nih.gov/xml/owl/EVS/Thesaurus.owl#C3283
Having a high amount of body fat (body mass index [BMI] of 30 or more).
details - visualize - 4 more from this ontology

obesity - Human Disease Ontology (DOID)
http://purl.obolibrary.org/obo/DOID_9970
OMIM mapping confirmed by DO. [SN].
details - visualize

Additional References from other Ontologies

obesity - Natural Products Ontology (NATPRO)
http://www.owl-ontologies.com/NPOntology.owl#DOID_9970
details - visualize - 1 more from this ontology

Obesity, unspecified - Suggested Ontology for Pharmacogenomics (SOPHARM)
http://www.loria.fr/~coulet/ontology/sopharm/version2.1/disease_ontology.owl#DOID_1480
details - visualize - 1 more from this ontology

Obesity - Medical Dictionary for Regulatory Activities (MEDDRA)
http://purl.bioontology.org/ontology/MEDDRA/10029883
details - visualize - 7 more from this ontology

Obesity - Human Phenotype Ontology (HP)
http://purl.obolibrary.org/obo/HP_0001513
details - visualize

Additional References from other Ontologies

Obesity - Bone Dysplasia Ontology (BDO)
http://purl.org/obo/owl/HP#HP_0001513
details - visualize - 1 more from this ontology

obesity - Experimental Factor Ontology (EFO)
http://www.ebi.ac.uk/efo/EFO_0001073
An eating-related disorder in which excess body fat has accumulated to such an extent that health may be negatively affected. It is commonly defined as a body mass index (weight divided by height squared) of ...
details - visualize - 3 more from this ontology

Additional References from other Ontologies

obesity - Cell Line Ontology (CLO)
http://www.ebi.ac.uk/efo/EFO_0001073
An eating-related disorder in which excess body fat has accumulated to such an extent that health may be negatively affected. It is commonly defined as a body mass index (weight divided by height squared) of ...
details - visualize

obesity - Cell Culture Ontology (CCONT)
http://www.ebi.ac.uk/efo/EFO_0001073

Obesity - Medical Subject Headings (MESH)
http://purl.bioontology.org/ontology/MSH/D009765
A status with BODY WEIGHT that is grossly above the acceptable or desirable weight, usually due to accumulation of excess FATS in the body. The standards may vary with age, sex, genetic or cultural background. ...
details - visualize - 3 more from this ontology

Additional References from other Ontologies

Obesity - Robert Hoehndorf Version of MeSH (RH-MESH)
http://phenomebrowser.net/ontologies/mesh/mesh.owl#G07.100.100.160.120.699.500
details - visualize - 15 more from this ontology

Obesity - Online Mendelian Inheritance in Man (OMIM)
http://purl.bioontology.org/ontology/OMIM/MTHU000250
details - visualize - 23 more from this ontology

Obesity - International Classification of Diseases, Version 10 (ICD10)
http://purl.bioontology.org/ontology/ICD10/E66
details - visualize - 2 more from this ontology

Obesity - Read Codes, Clinical Terms Version 3 (CTV3) (RCD)
http://purl.bioontology.org/ontology/RCD/C380.
details - visualize - 9 more from this ontology

Obesity - Neuroscience Information Framework (NIF) Standard Ontology (NIFSTD)
http://ontology.neuinfo.org/NIF/Dysfunction/NIF-Dysfunction.owl#nlx_dys_20090302
An eating-related disorder in which excess body fat has accumulated to such an extent that health may be negatively affected. It is commonly defined as a body mass index (weight divided by height squared) of ...
details - visualize - 3 more from this ontology

OBESITY - Coding Symbols for a Thesaurus of Adverse Reaction Terms (COSTART)
http://purl.bioontology.org/ontology/CST/OBESITY

OBESITY - World Health Organization (WHO) Adverse Reaction Terminology (WHO-ART)
http://purl.bioontology.org/ontology/WHO/0397
details - visualize

obesity - Physician Data Query (PDQ)
http://purl.bioontology.org/ontology/PDQ/CDR0000467910
details - visualize

Obesity - Common Terminology Criteria for Adverse Events (CTCAE)
http://ncicb.nci.nih.gov/xml/owl/EVS/ctcae.owl#Obesity
details - visualize

obesity - Computer Retrieval of Information on Scientific Projects Thesaurus (CRISP)
http://purl.bioontology.org/ontology/CSP/0467-3154
excessively high accumulation of body fat or adipose tissue in relation to lean body mass; the amount of body fat (or adiposity) includes concern for both the distribution of fat throughout the body and the ...
details - visualize

Obesity - MedlinePlus Health Topics (MEDLINEPLUS)
http://purl.bioontology.org/ontology/MEDLINEPLUS/C0028754
Obesity means having too much body fat. It is different from being overweight, which means weighing too much. The weight may come from muscle, bone, fat, and/or body water. Both terms mean that a person's ...
details - visualize - 1 more from this ontology

Obesity - Portfolio Management Application (PMA)
http://www.bioontology.org/pma.owl#PMA_936
excessively high accumulation of body fat or adipose tissue in relation to lean body mass; the amount of body fat (or adiposity) includes concern for both the distribution of fat throughout the body and the ...
details - visualize - 1 more from this ontology

Obesity - Neuroscience Information Framework (NIF) Dysfunction Ontlogy (NIFDYS)
http://ontology.neuinfo.org/NIF/Dysfunction/NIF-Dysfunction.owl#nlx_dys_20090302
An eating-related disorder in which excess body fat has accumulated to such an extent that health may be negatively affected. It is commonly defined as a body mass index (weight divided by height squared) of ...
details - visualize - 1 more from this ontology

obesity - Bleeding History Phenotype Ontology (BHO)
http://www.semanticweb.org/ontologies/2010/10/BPO.owl#obesity
details - visualize

Obesity - Galen Ontology (GALEN)
http://www.co-ode.org/ontologies/galen#Obesity
details - visualize

Obesity - Resource of Asian Primary Immunodeficiency Diseases (RAPID) Phenotype Ontology (RPO)
http://www.semanticweb.org/ontologies/2012/5/Ontology1338526551855.owl#Obesity
details - visualize

obesity - Alzheimer's disease ontology (ADO)
http://scai.fraunhofer.de/AlzheimerOntology#obesity
details - visualize - 1 more from this ontology

Obesity - KB_Bio_101 (AURA)
http://www.projecthalo.com/aura#Obesity
details - visualize

Obesity - Bilingual Ontology of Alzheimer's Disease and Related Diseases (ONTOAD)
http://doe-generated-ontology.com/OntoAD#C0028754
Excès de poids par augmentation des graisses stockées dans le corps. Elle peut provenir de facteurs héréditaires, d'une alimentation mal équilibrée et trop importante, ou de problèmes hormonaux. L'obésité ...
details - visualize - 2 more from this ontology

obesity - Human Dermatological Disease Ontology (DERMO)
http://purl.obolibrary.org/obo/DERMO_0002752
details - visualize

Obesity [Disease/Finding] - National Drug File - Reference Terminology (NDFRT)
http://purl.bioontology.org/ontology/NDFRT/N0000002200
details - visualize

large body habitus artifact - Radiology Lexicon (RADLEX)
http://www.owl-ontologies.com/RADLEX.owl#RID11305
An artifact resulting from a patient with a large body size or body mass.
details - visualize

obese - Mammalian Phenotype Ontology (MP)
http://purl.obolibrary.org/obo/MP_0001261
details - visualize

Obesity, unspecified - International Classification of Diseases, Version 9 - Clinical Modification (ICD9CM)
http://purl.bioontology.org/ontology/ICD9CM/278.00
details - visualize - 1 more from this ontology

Other obesity - International Classification of Diseases, Version 10 - Clinical Modification (ICD10CM)
http://purl.bioontology.org/ontology/ICD10CM/E66.8
details - visualize - 1 more from this ontology

Genetic obesity - Orphanet Rare Disease Ontology (ORDO)
http://www.orpha.net/ORDO/Orphanet_77828
details - visualize - 1 more from this ontology

Truncal obesity - Fanconi Anemia Ontology (IFAR)
http://www.semanticweb.org/ontologies/2012/11/abnormalities.owl#phenodb:0048
GROWTH and BUILD: Other growth characteristics > Truncal obesity
details - visualize

Generalized obesity - Disease core ontology applied to Rare Diseases (HRDO)
http://www.limics.org/hrdo/rdfns#sgn_id_53100
details - visualize - 1 more from this ontology

Constitutional obesity - Systematized Nomenclature of Medicine, International Version (SNMI)
http://purl.bioontology.org/ontology/SNMI/D6-11110
details - visualize - 2 more from this ontology

What is missing

- a common set of principles for ontology development
- a common top-level ontology
- a basis for division of expertise
- a basis for training
- a basis for feedback from users

ELSEVIER

Journal of Biomedical Informatics

Volume 71, July 2017, Pages 165-177



An empirical analysis of ontology reuse in BioPortal

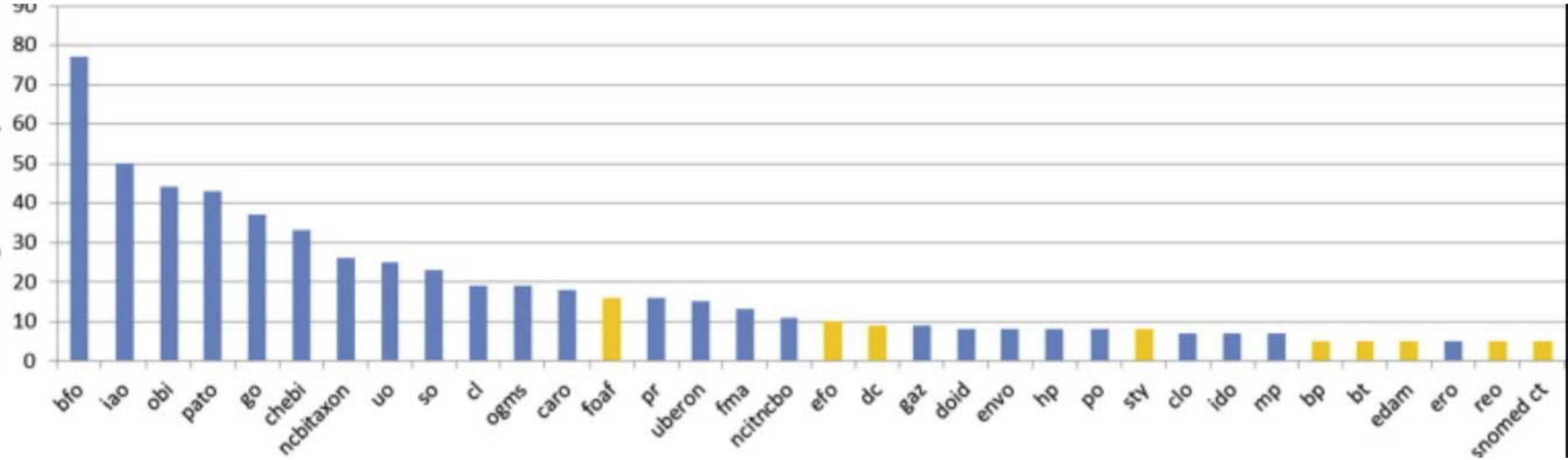
Christopher Ochs [a], Yehoshua Perl [a], James Geller [a], Sivaram Arabandi [b], Tania Tudorache [c], Mark A. Musen [c]

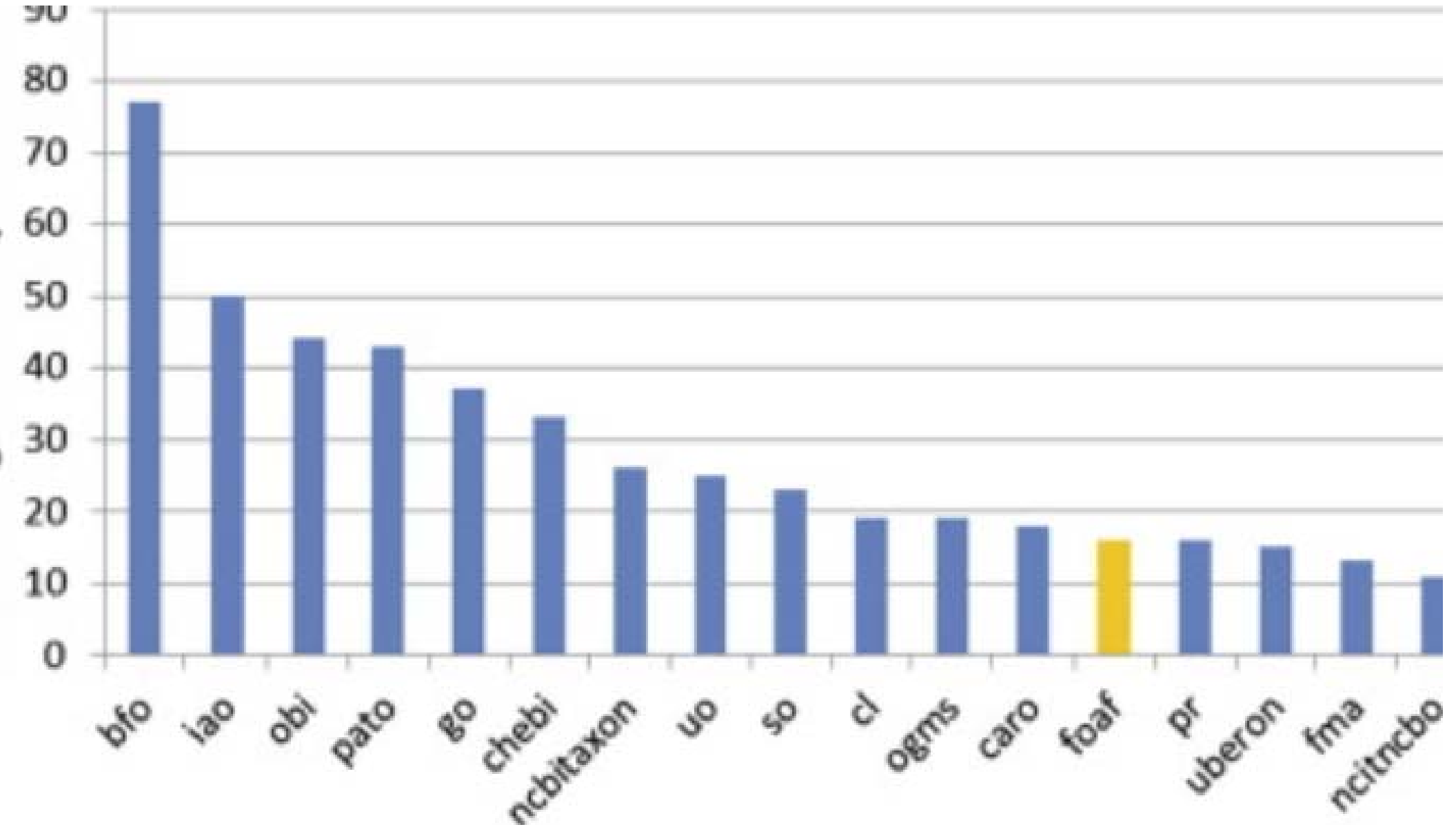
Show more

https://doi.org/10.1016/j.jbi.2017.05.021

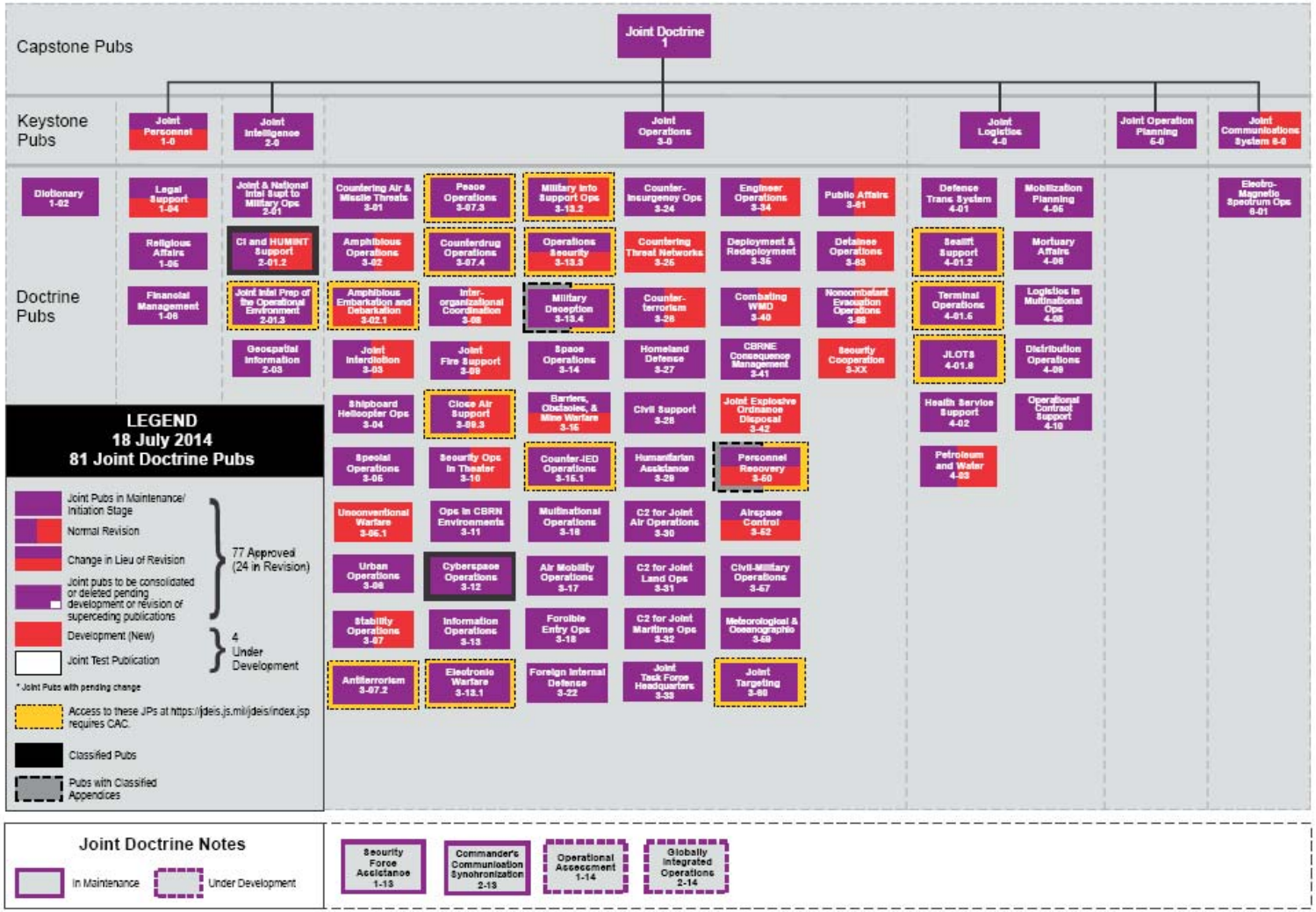
Get rights and content

Most reused source ontologies




90
80
70
60
50
40
30
20
10
0
bfo
iao
obi
pato
go
chebi
ncbitaxon
uo
so
cl
ogms
caro
foaf
pr
uberon
fma
ncitncbo

JOINT DOCTRINE HIERARCHY



Two approaches to military interoperability

- Joint Doctrine
- Wordnet

- I want to emphasize the requirements *for* a general-purpose ontology:

  1. Top level highly underspecified, but with sufficient "pegs" to guide the placement and relationship of everything else.

  2. Emphasis on microtheories for the details of every possible application -- including the trillions of dollars of legacy systems.

  3. Relationship to NL terminologies, which everyone from novices to experts in any subject use for communication, entering data, and interpreting results.

  > BFO in particular makes no claims to completeness, or indeed to being
  > the single ontology -- quite the contrary

  That's my major complaint. If you want to design BFO as a niche ontology, I have no complaints. That's fine for Part 2. But I'm complaining that Part I provides no guidance for anything outside that niche.

  Part I is inadequate for providing any guidance for designing general-purpose ontologies that can support interoperability among an open-ended variety of systems, including the trillions of dollars of legacy systems that will never go away.

  I have serious criticisms of Cyc and SUMO, but at least they were designed to cover a broader range of applications.

Three putative problems with BFO as a top-level ontology, as described by John

1. No place for universals
2. No place for information artifacts
3. No place for purpose … reference to an interpretant … thirdness (no place for human beings)

Three putative problems with BFO as a top-level ontology, as described by John

1. No place for universals
2. No place for information artifacts
3. No place for purpose … reference to an interpretant … thirdness (no place for human beings)

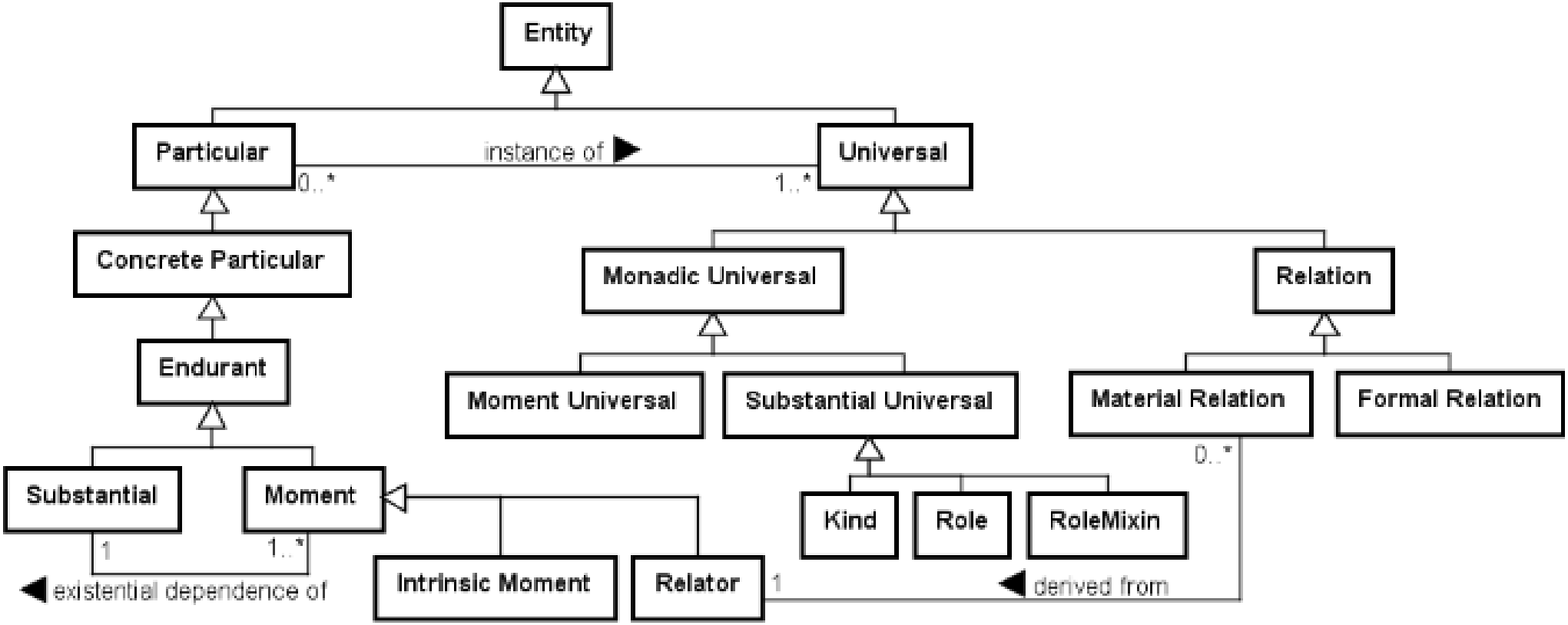
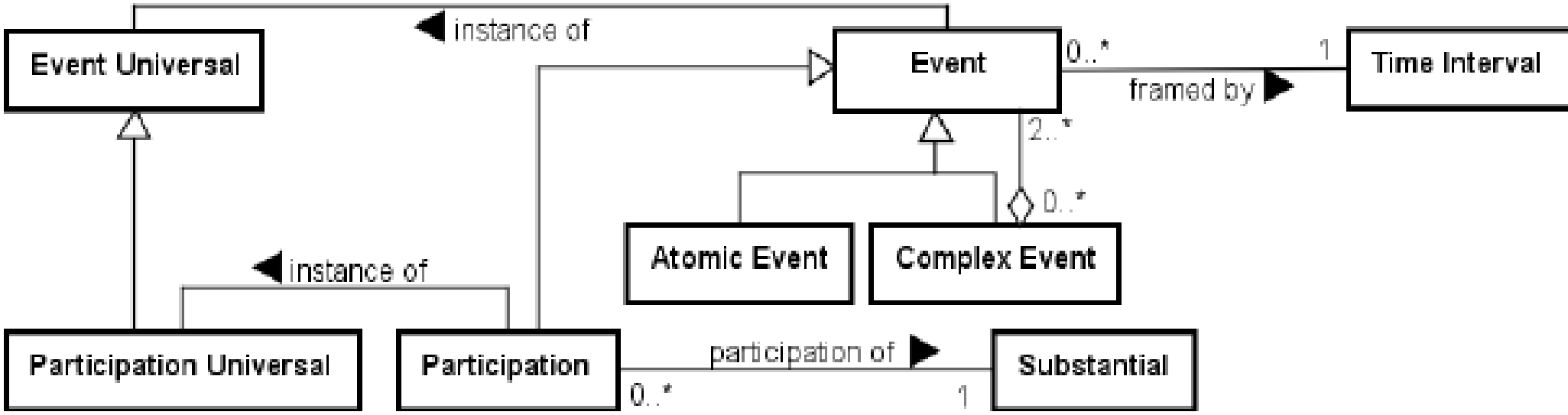
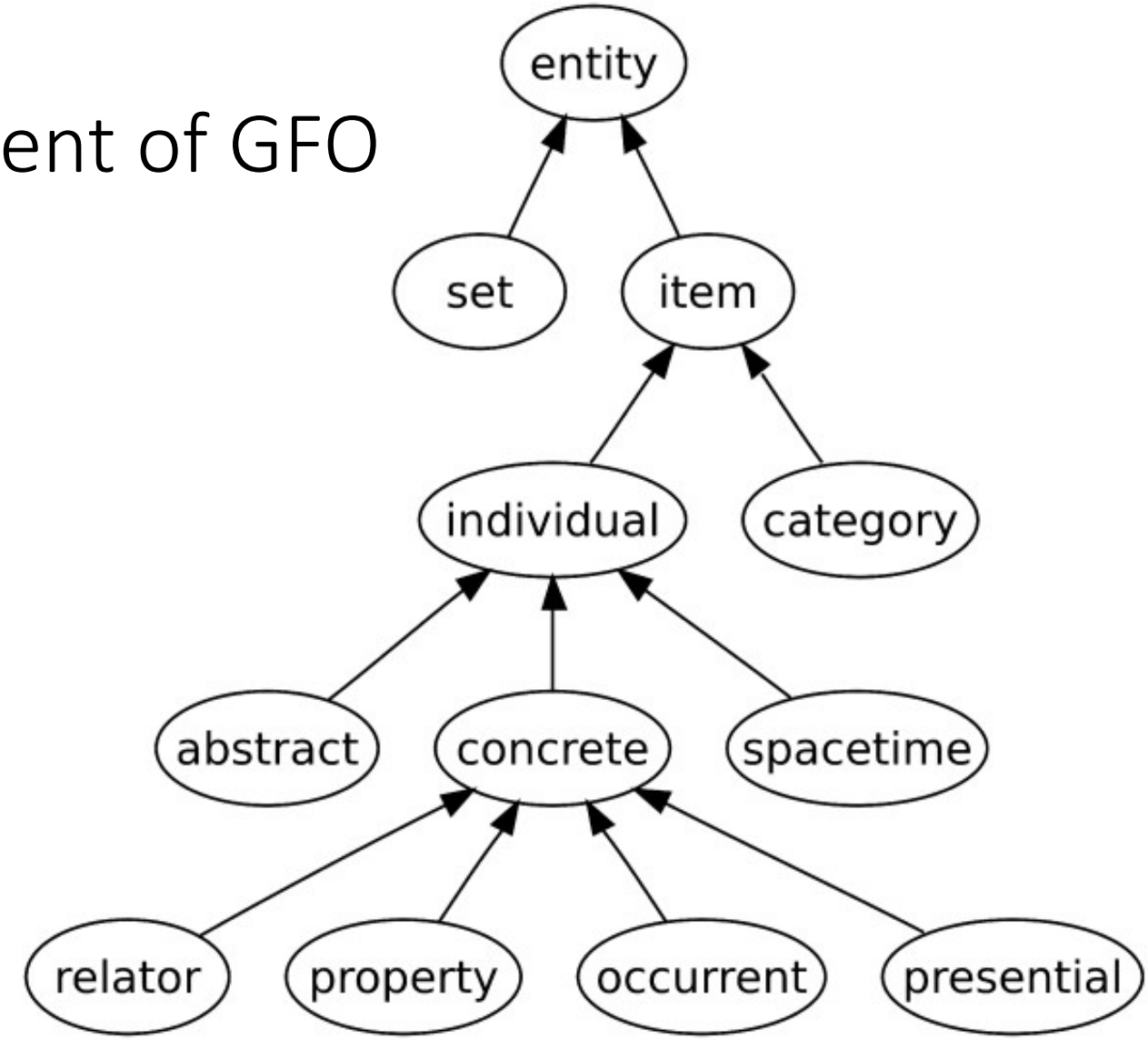


Figure 1. A Fragment of UFO-A – An Ontology of Endurants.

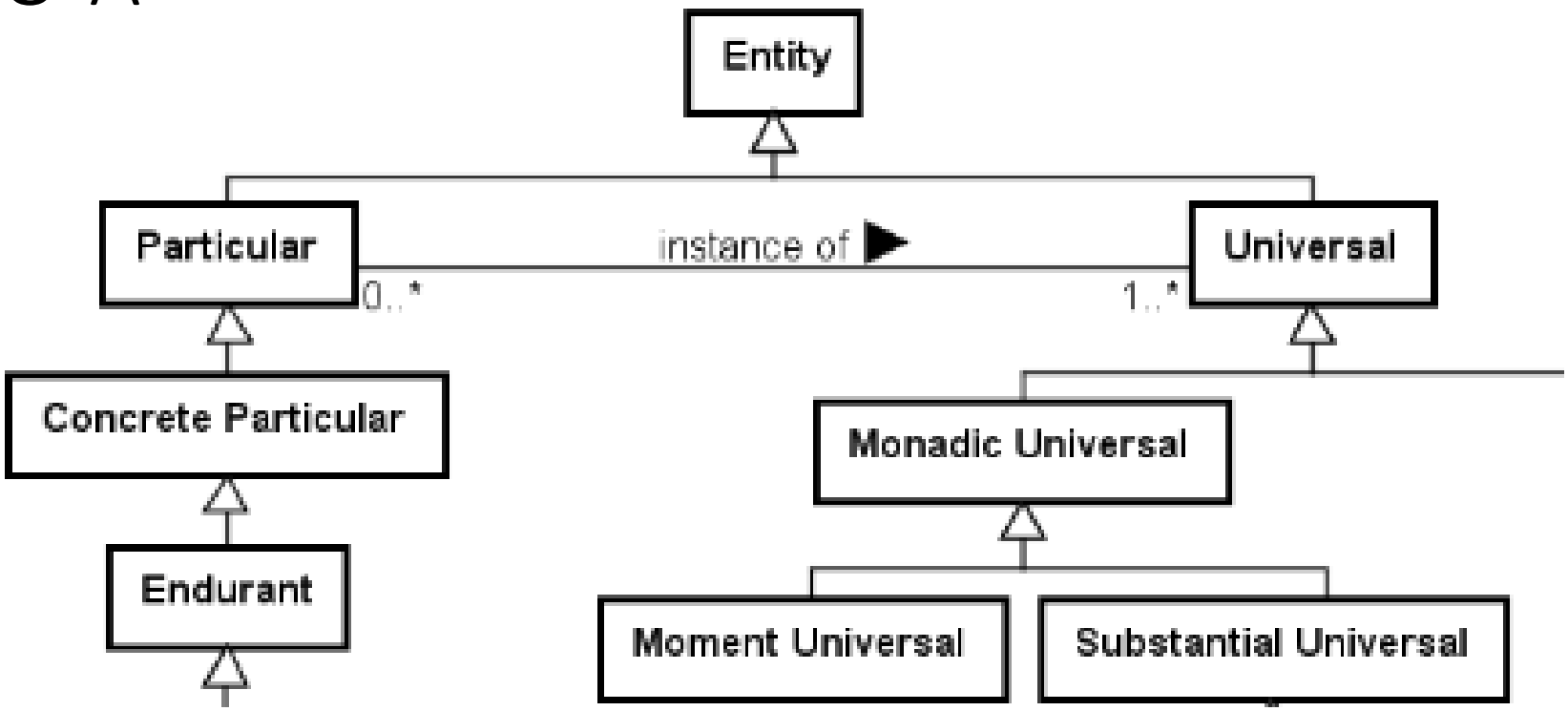


Fragment of UFO-B: Perdurants

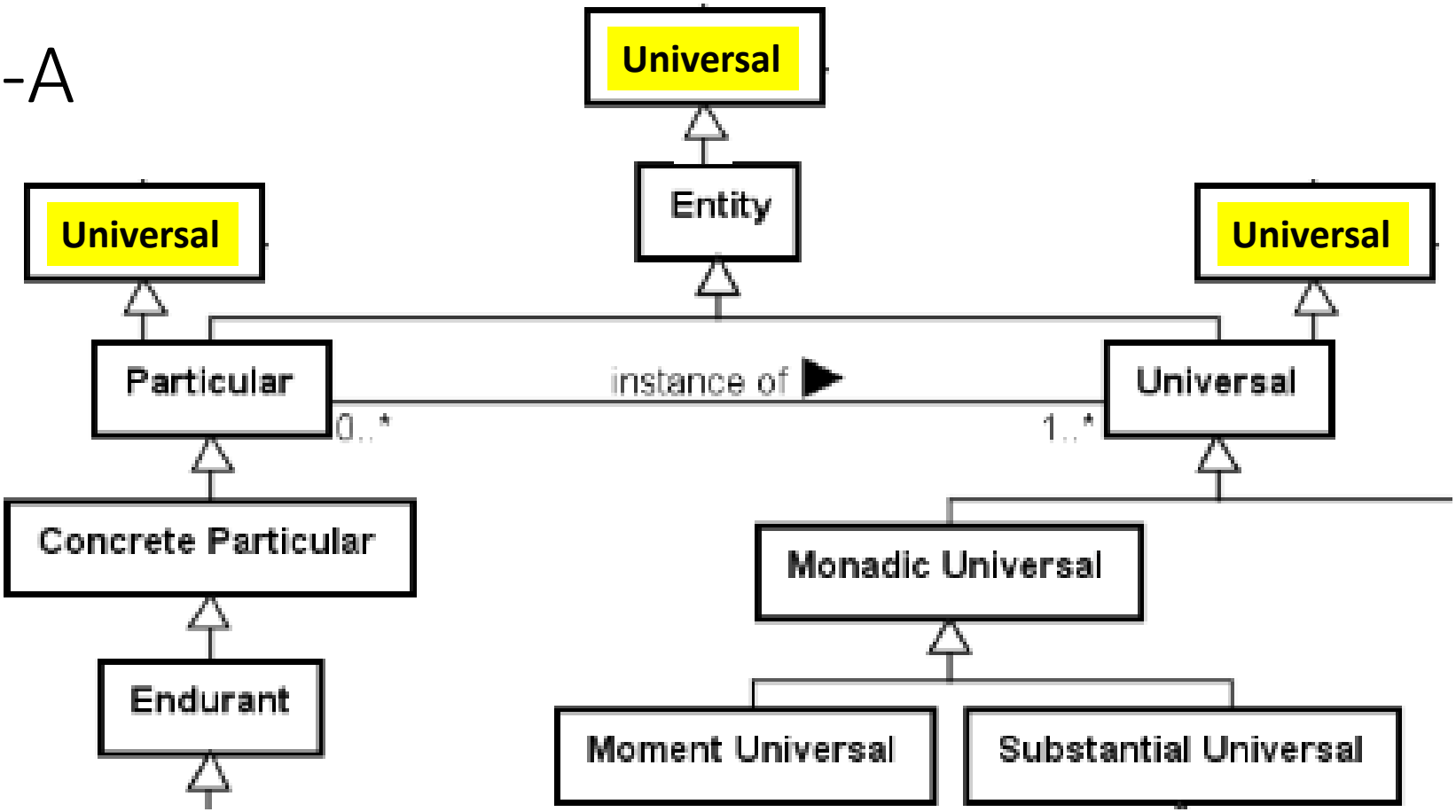
Fragment of GFO



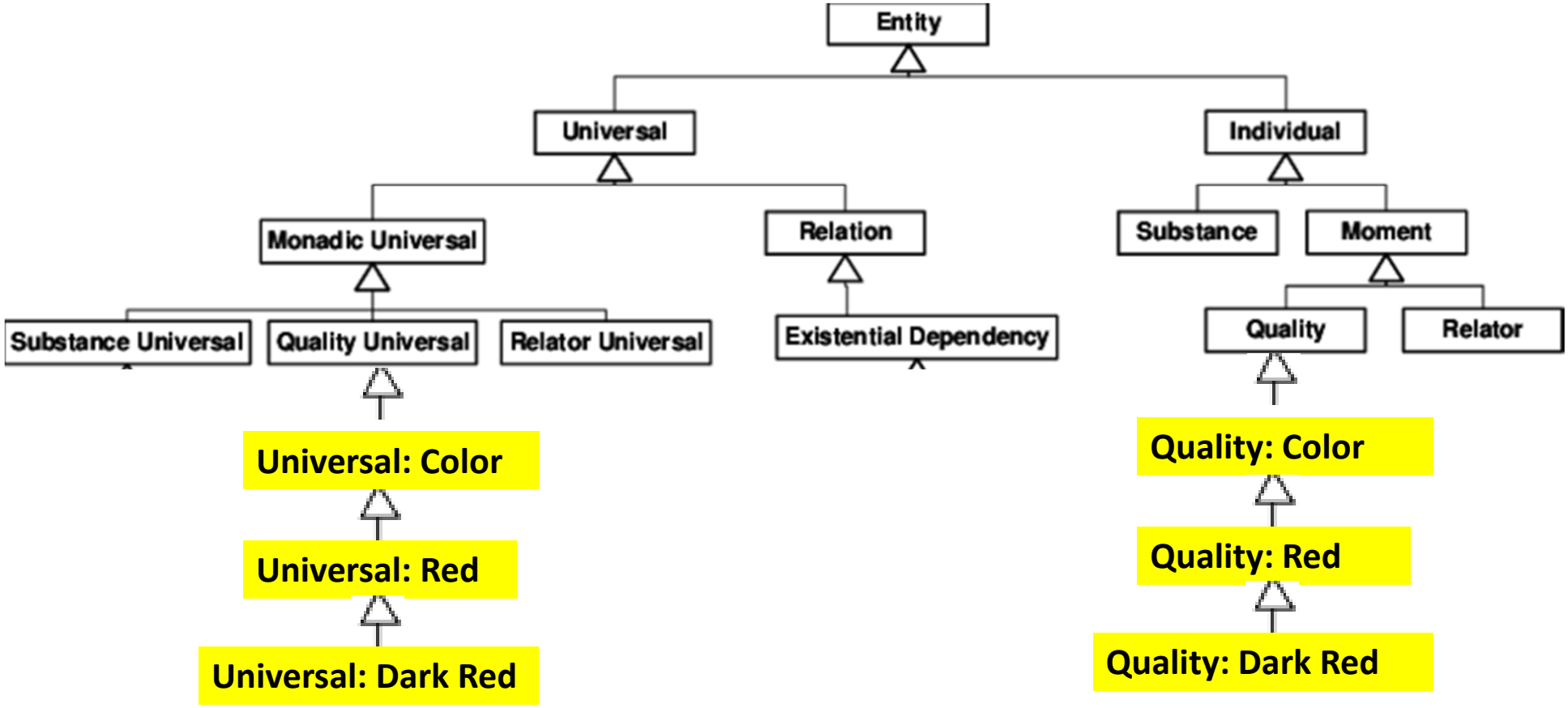
UFO-A


Entity
Particular
instance of
Universal
0..*
1..*
Concrete Particular
Endurant
Monadic Universal
Moment Universal
Substantial Universal

UFO-A


Universal
Entity
Universal
Universal
Particular
instance of
0..*
1..*
Universal
Concrete Particular
Monadic Universal
Endurant
Moment Universal
Substantial Universal

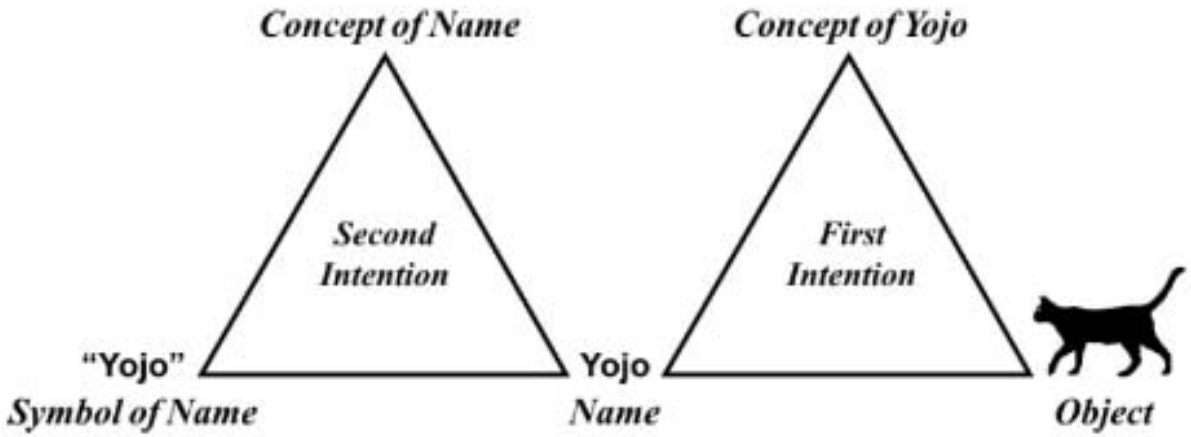
UFO-A


Entity
Universal
Individual
Monadic Universal
Relation
Substance
Moment
Substance Universal
Quality Universal
Relator Universal
Existential Dependency
Quality
Relator
Universal: Color
Universal: Red
Universal: Dark Red
Quality: Color
Quality: Red
Quality: Dark Red

Three putative problems with BFO as a top-level ontology, as described by John

1. No place for universals
2. No place for information artifacts
3. No place for purpose … reference to an interpretant … thirdness (no place for human beings)

Metalanguage



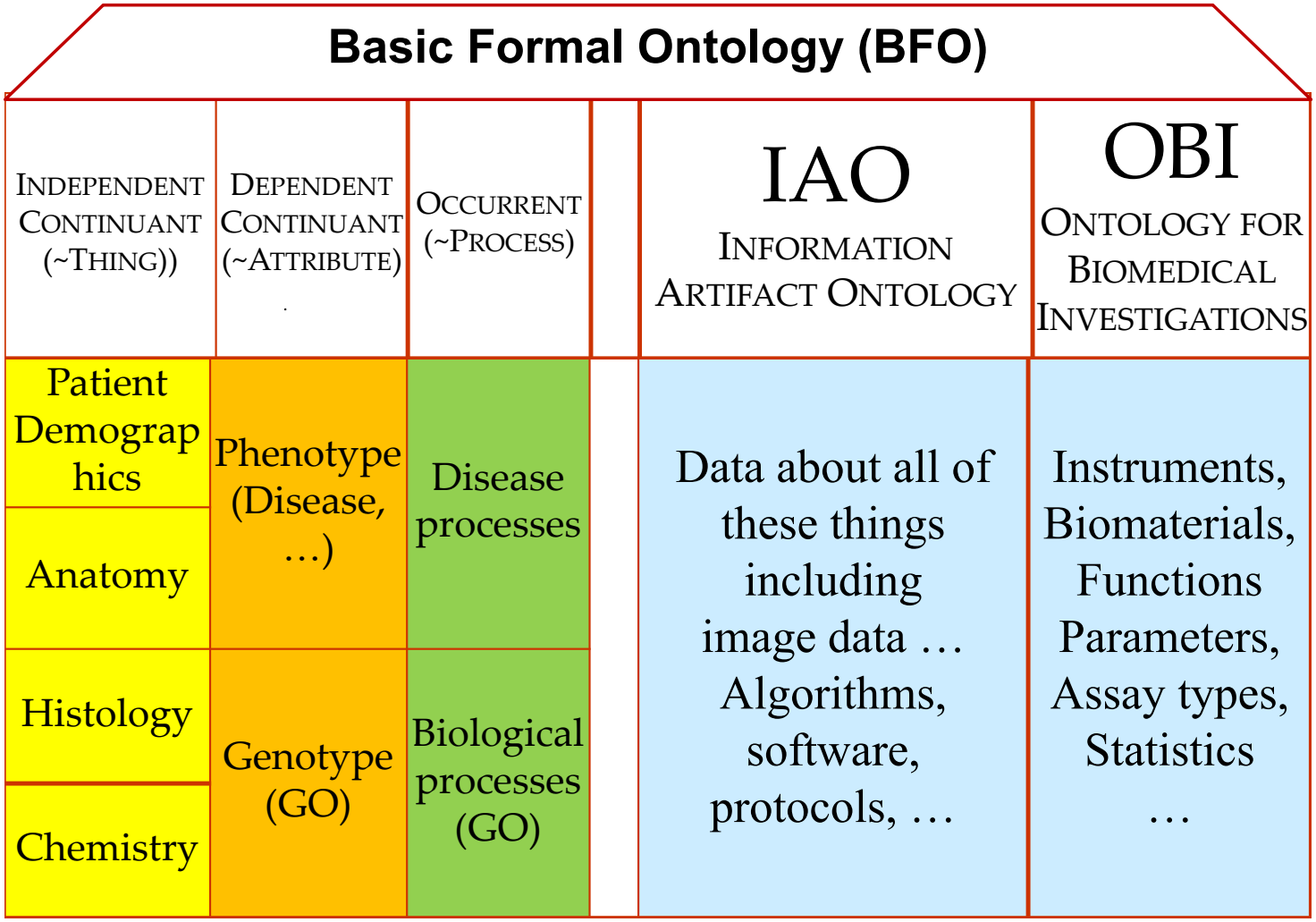
John [roughly]: “These things must be recognized by every ontology, because the workings of the computer are based on signs, databases are based on signs, etc.”

BFO 1.1

adds *generically dependent continuant*

representing copyable patterns, including:

- information entities
- nucleic acid sequences


Basic Formal Ontology (BFO)
INDEPENDENT CONTINUANT (~THING))
DEPENDENT CONTINUANT (~ATTRIBUTE)
OCCURRENT (~PROCESS)
IAO
INFORMATION ARTIFACT ONTOLOGY
OBI
ONTOLOGY FOR BIOMEDICAL INVESTIGATIONS
Patient Demographics
Anatomy
Histology
Chemistry
Phenotype (Disease, …)
Genotype (GO)
Disease processes
Biological processes (GO)
Data about all of these things including image data … Algorithms, software, protocols, …
Instruments, Biomaterials, Functions Parameters, Assay types, Statistics …

Similarly for life, intentionality, purpose …

Quantum mechanics?

From: John F Sowa <sowa@bestweb.net>
To: "ontolog-forum@googlegroups.com" <ontolog-forum@googlegroups.com>
Sent: Tuesday, July 4, 2017 3:30 PM
Subject: [ontolog-forum] Proposed ISO standard for ontology

In fact, scientists in physics, chemistry, biology... never use the BFO terms to state or describe their research data or theories.

BS: BFO is not trying to provide terms for physicists, chemists, biologists to use. There is **cancer of the liver**, but there is no **cancer of the independent continuant**.

But BFO is being *used* in physics, chemistry and biology

EMMO

the EUROPEAN MATERIALS MODELLING ONTOLOGY

Emanuele Ghedini *(University of Bologna)*
Adham Hashibon *(Fraunhofer IWM)*
Jesper Friis *(SINTEF)*
Gerhard Goldbeck *(Goldbeck Consulting)*
Georg Schmitz *(ACCESS)*
Anne de Baas *(European Commission)*

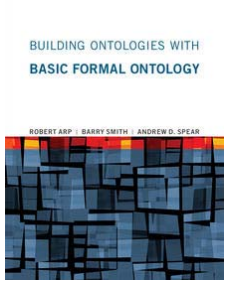
EMMO RELIES ON THE STRUCTURE OF BASIC FORMAL ONTOLOGY (BFO).

The **Basic Formal Ontology** (**BFO**) is a small, upper level ontology that is designed for use in supporting information retrieval, analysis and integration in scientific and other domains.

BFO is a genuine upper ontology. Thus it does not contain physical, chemical, biological or other terms which would properly fall within the coverage domains of the special sciences.

The theory behind BFO was developed in 2002 first by Barry Smith and Pierre Grenon.

http://basic-formal-ontology.org/

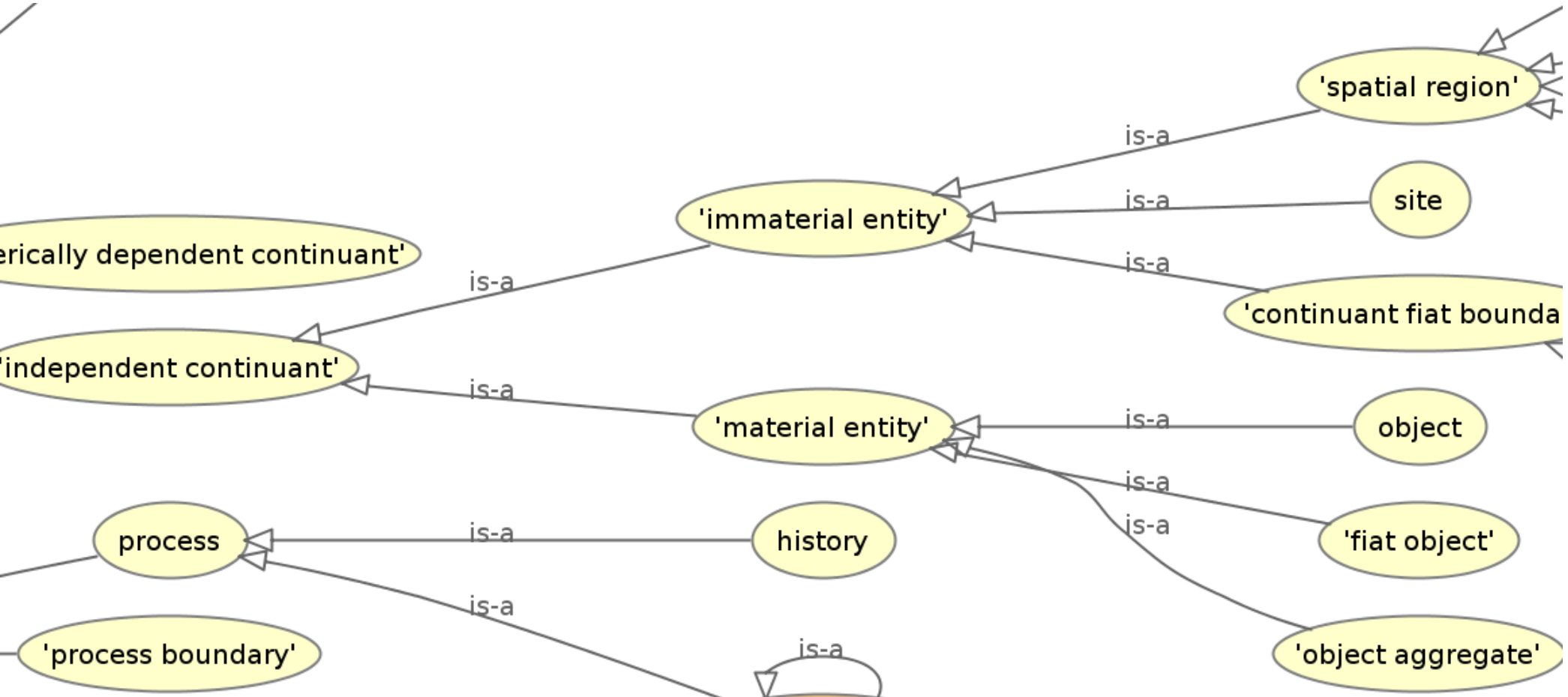


NOTE: *material_entity* (BFO) is any *independent continuant* that has some portion of matter as part (e.g. 'human being')

Hence: *material_entity* (BFO) *is* not the same as 'material entity' in RoMM and not the same as 'material' from the chemistry or engineering point of view.

BFO HIERARCHY

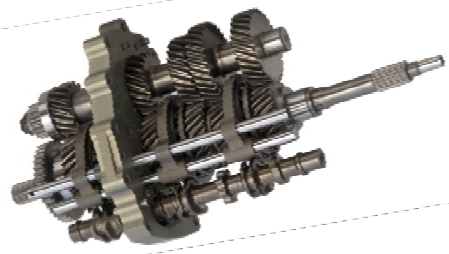
EMMO RELIES ON THE STRUCTURE OF BASIC FORMAL ONTOLOGY (BFO).



EMMO MEREOLOGY



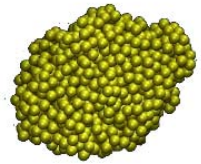
has_part



has_part



has_part



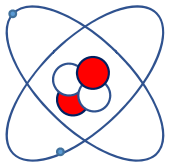
has_part



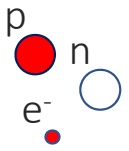
has_part



has_part



has_part



EMMO Material Entities are defined by a
hierarchy of parthood relations,
combining the concepts of direct parthood and object

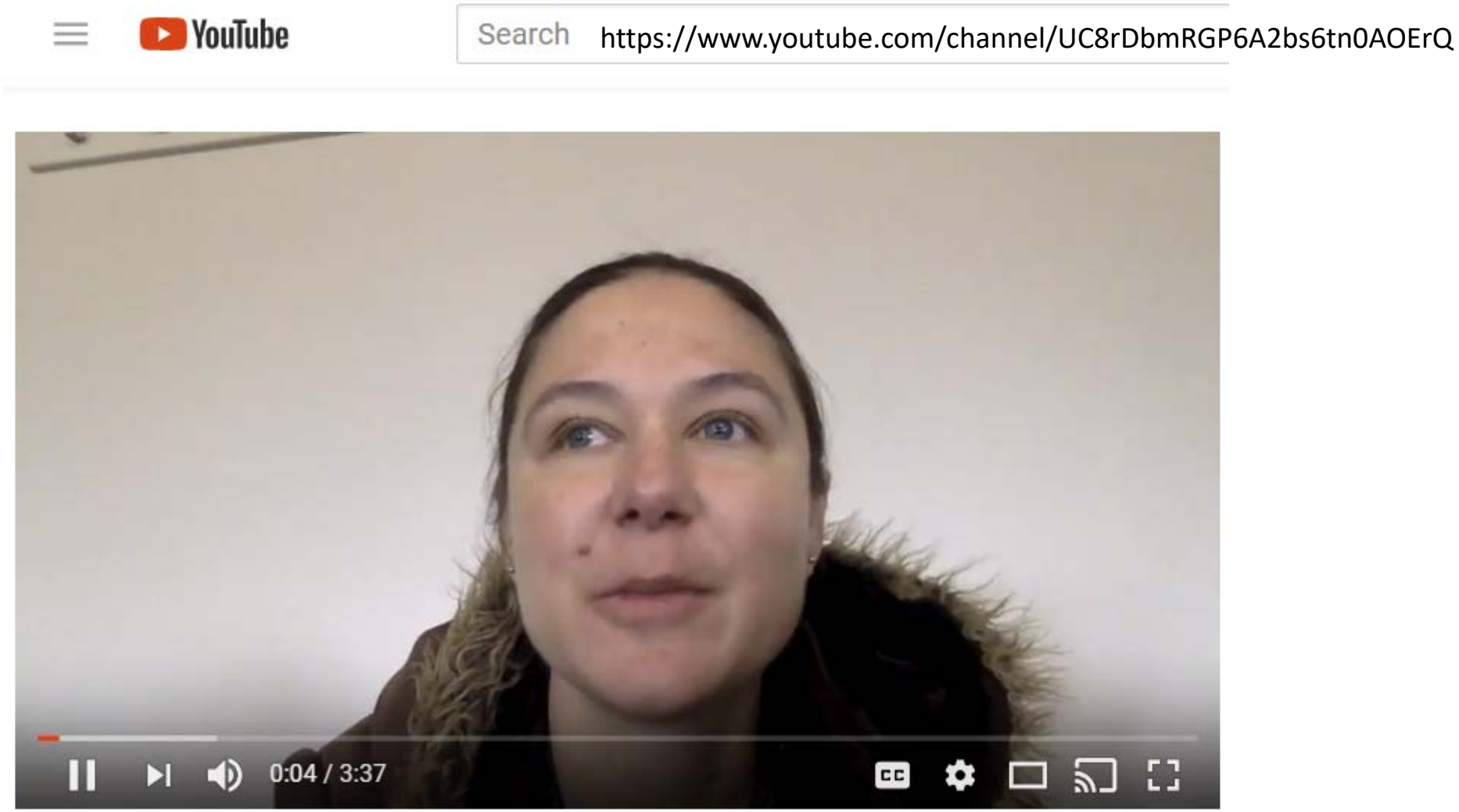
With **EMMO** we create a representation of the real world granularity of *material entities* that follows physics and materials science perspectives.

A 'material' in the user case can be described univocally by declaring *entities* under **EMMO** hierarchy.

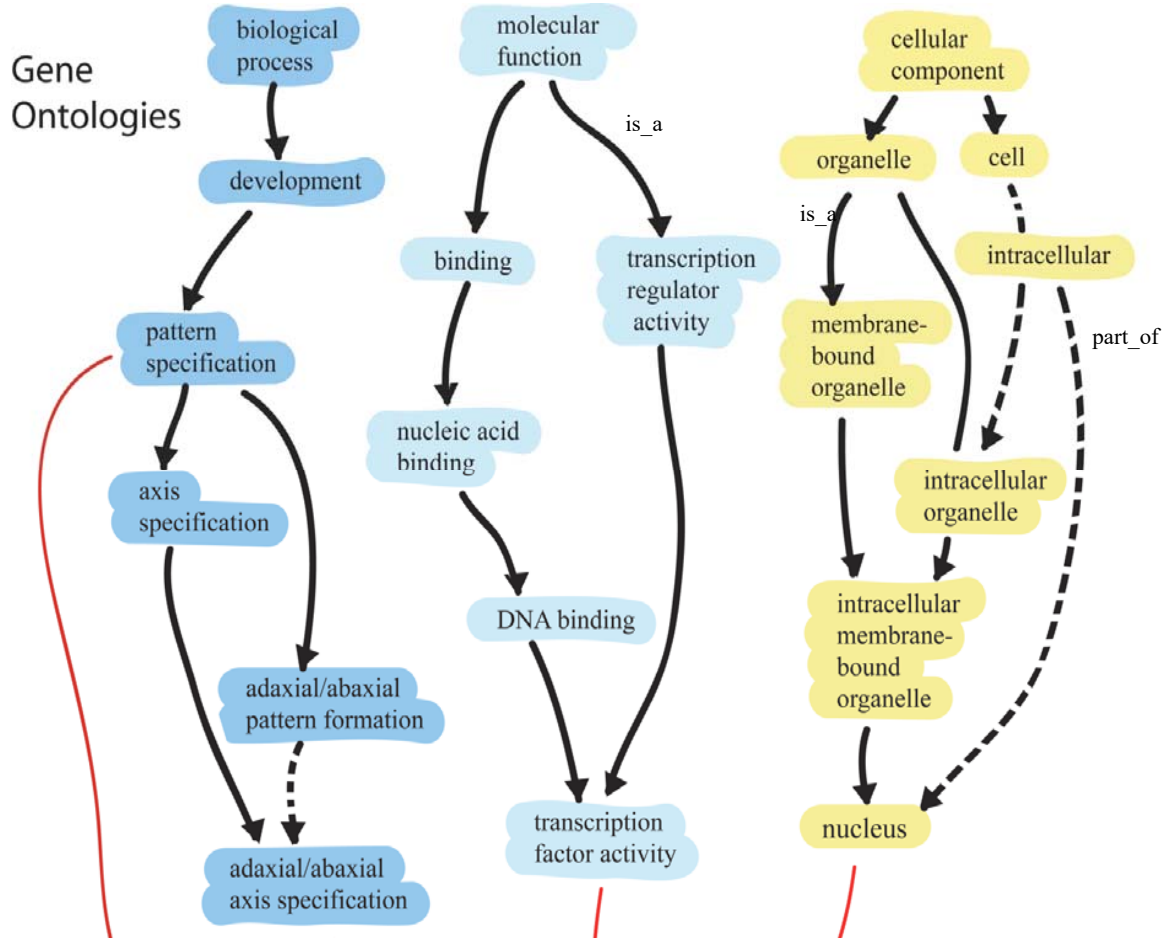
The basic idea is that the 'material' can be represented at different levels of granularity, depending on **perspective**.

From: John F Sowa <sowa@bestweb.net>
To: "ontolog-forum@googlegroups.com" <ontolog-forum@googlegroups.com>
Sent: Tuesday, July 4, 2017 3:30 PM
Subject: [ontolog-forum] Proposed ISO standard for ontology

In the physical sciences, everything is a process (occurrent). An object (continuant) is a process that changes so slowly that it can be recognized at repeated encounters. There is a continuum, not a dichotomy.

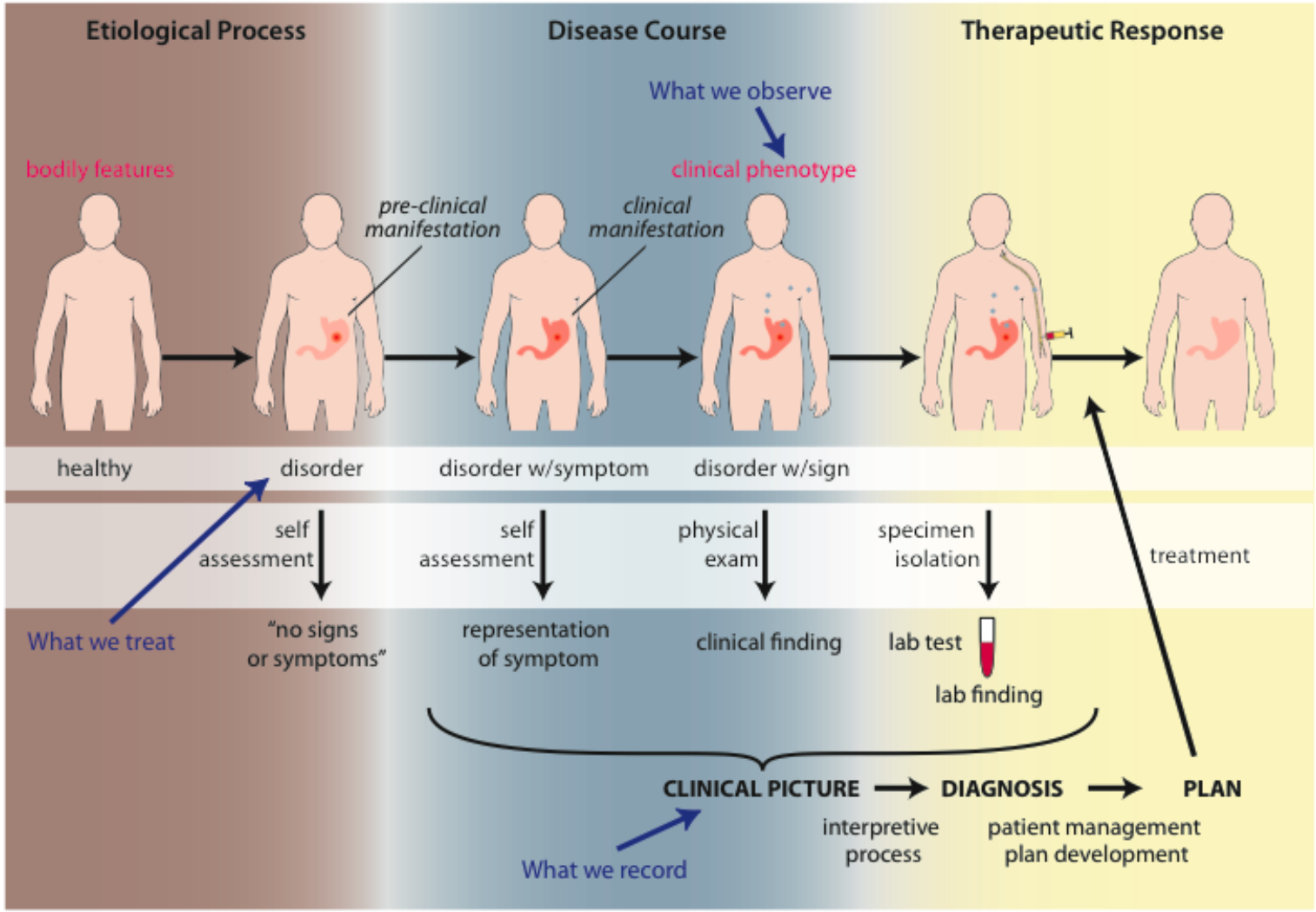

YouTube
Search
https://www.youtube.com/channel/UC8rDbmRGP6A2bs6tn0AOErQ
0:04 / 3:37
Janna Hastings: BFO and the Chemistry Ontology (ChEBI)

GO's three sub-ontologies



cellular component
molecular function
biological process

Ontology for General Medical Science (OGMS)



Occurrents

Continuants
(People, Livers, Tumors, …)

Occurrents

Continuants