Biomedical Informatics Needs New Nosology for Collective, Community, Social and Public Health

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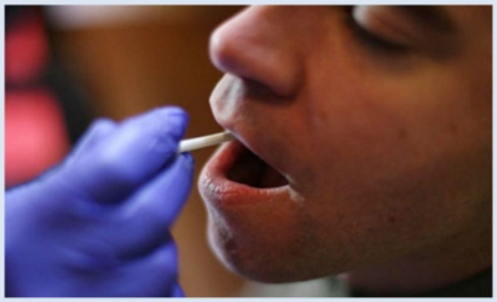
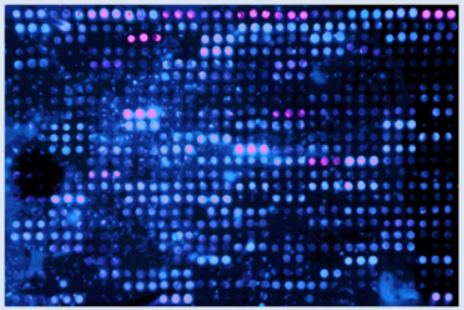
AIME 2024 Conference July 9
Paper 352 Workshop VI @ 14:25

PharmacoGenomic Molecular Imaging (PGMI) as a Multi-Modal Multi-Scalar Data Mining Grand Challenge

Genetic Testing



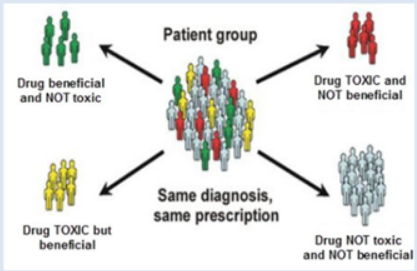
Cheek swab



Gene chip image

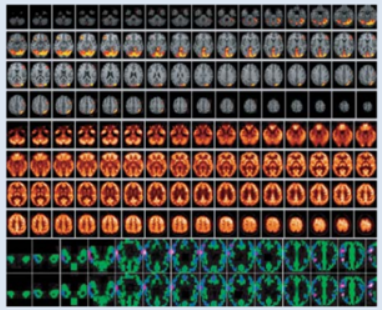
Drug Dosing

Gene-specific drug and dose selection individualized per patient to optimize care and avoid undesirable outcomes shown below for non-individualized treatment



Molecular Imaging

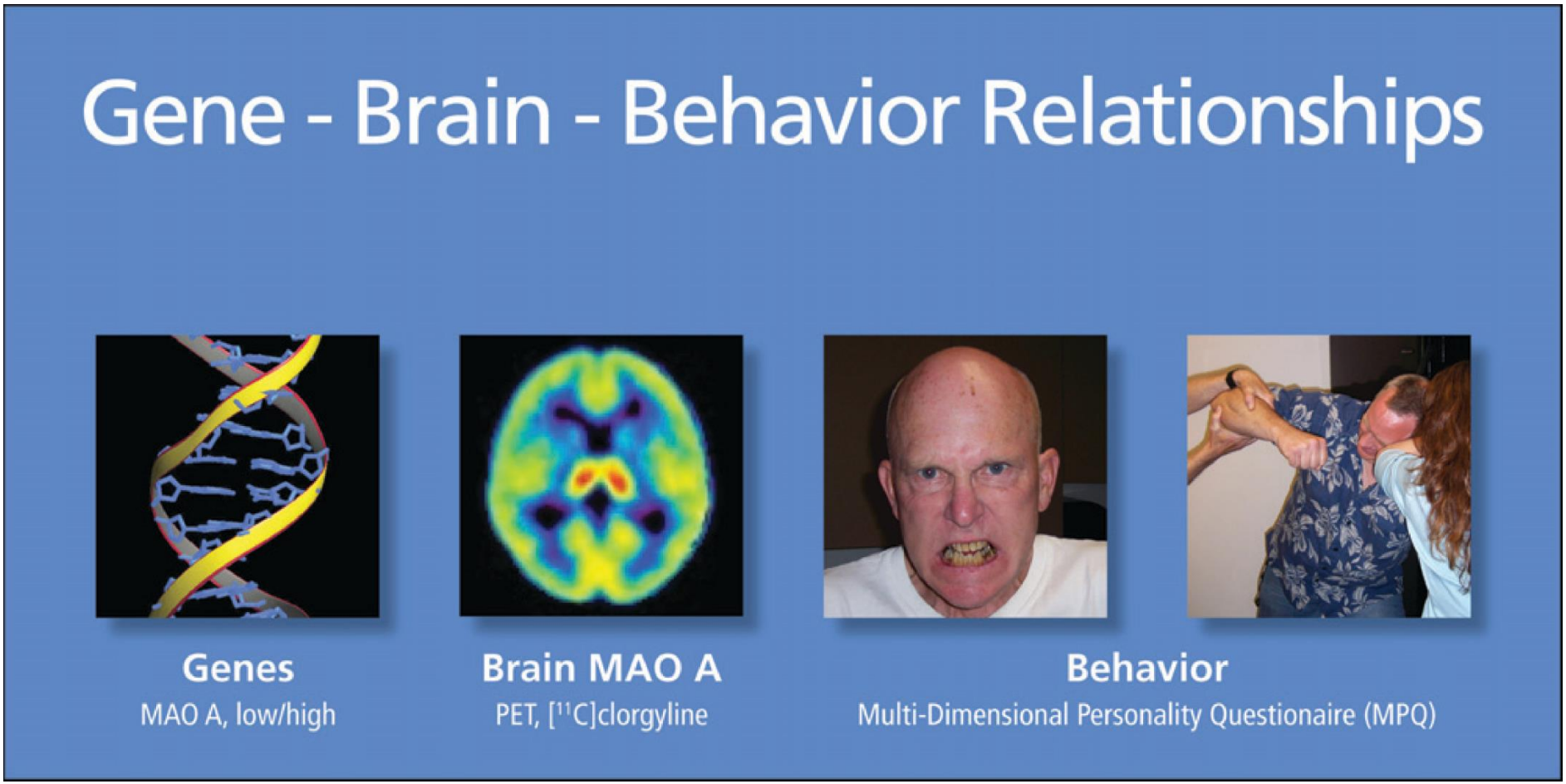
Mobile SPECT scanner



Tri-modal PET/MRI/EEG scans

Gene-specific drug and dose selection individualized per patient to optimize care and avoid the undesirable outcomes of non-individualized treatment approaches (C. Taswell 2010b).

2007 SNMMI Image of the Year



Alia-Klein et al 2007 SNMMI Annual Meeting Poster 1194
Wagner 2007 Journal Nuclear Medicine 48:7 p15N

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PGMI as Data Search/Mining/Integration/Fusion Problem

- Data with extracted feature sets exist at more than three layers of scale and complexity each with multi-modal data: 1) Genome level with genetic tests for genotypes 2) Brain level with imaging biomarker phenotypes 3) Human level with behavioral syndrome phenotypes
- Knowledge engineering for the genotype-phenotype correlation problem (C. Taswell 2009) further complicated by requirement to analyze effectiveness of diagnostic and therapeutic interventions
- Application to the Entire-body PET Scans for Multiple Sclerosis (EPSMS) Study with ClinicalTrials.gov identifier NCT04390009
- PGMI as motivating real-world problem that inspired the original design principles and guides continuing development of software for PORTAL-DOORS Project and NPDS Cyberinfrastructure
- Is progress on PGMI possible without addressing current infowars and cyberwars that impact collective, community, social, public health?

Nexus-PORTAL-DOORS-Scribe (NPDS)

- A distributed and democratized internet-enabled cyberinfrastructure system for platform-independent information repositories to manage data and metadata for online and offline resource entities
- NPDS read-only API for Nexus, PORTAL, DOORS services
  - Lexical PORTAL registries where
    PORTAL = Problem Oriented Registry of Tags and Labels
  - Semantic DOORS directories where
    DOORS = Domain Ontology Oriented Resource System
  - Combined Nexus diristries where
    a diristry = DIR(ectory) + reg(ISTRY)
- NPDS read-write API for Scribe registrar service
- Driving applications: PGMI, public health, biomedical informatics, clinical trials, automated search and meta-analysis of scientific engineering and biomedical literature

2006 PORTAL-DOORS Design (C. Taswell 2007)

IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE, VOL. 12, NO. 2, MARCH 2008

DOORS to the Semantic Web and Grid With a PORTAL for Biomedical Computing

Carl Taswell, *Member, IEEE*

***Abstract*—The semantic web remains in the early stages of development. It has not yet achieved the goals envisioned by its founders as a pervasive web of distributed knowledge and intelligence. Success will be attained when a dynamic synergism can be created between people and a sufficient number of infrastructure systems and tools for the semantic web in analogy with those for the original web. The domain name system (DNS), web browsers, and the benefits of publishing web pages motivated many people to register domain names and publish web sites on the original web. An analogous resource label system, semantic search applications, and the benefits of collaborative semantic networks will motivate people to register resource labels and publish resource descriptions on the semantic web. The Domain Ontology Oriented Resource System (DOORS) and Problem Oriented Registry of Tags and Labels (PORTAL) are proposed as infrastructure systems for registries are proposed with scientific problem-oriented designs that avoid the engineering-technology-oriented restrictions of existing registries.**

Sections II–IV review the background and motivation for DOORS, PORTAL, and BioPORT. Section II explains key concepts of the current semantic web and grid, and summarizes how they are driving the transformation of software architecture from designs based on closed-world computing to those based on open-world computing. Section III reviews the literature and current state-of-the-art in the life sciences web and grid, and summarizes the opinions of leading commentators in the bioinformatics community on existing barriers that impede development. Section IV defines the meaning and scope of biomedical

2009 PORTAL-DOORS Update (C. Taswell 2010a)

Future Internet **2010**, *2*, 156-189; doi:10.3390/fi2020156

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Article

A Distributed Infrastructure for Metadata about Metadata: The HDMM Architectural Style and PORTAL-DOORS System

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Received: 30 December 2009; in revised form: 12 April 2010 / Accepted: 20 May 2010 / Published: 1 June 2010

Abstract: Both the IRIS-DNS System and the PORTAL-DOORS System share a common

2016 PORTAL-DOORS Update (Craig et al. 2016)

Web Service APIs for Scribe Registrars, Nexus Diristries, PORTAL Registries and DOORS Directories in the NPD System

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Abstract. The Nexus-PORTAL-DOORS System (NPDS) has been designed with the Hierarchically Distributed Mobile Metadata (HDMM) architectural style to provide an infrastructure system for managing both lexical and semantic metadata about both virtual and physical entities.

2019 PORTAL-DOORS Update (Craig et al. 2019)

2019 IEEE 11th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)

DREAM Principles and FAIR Metrics from the PORTAL-DOORS Project for the Semantic Web

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***Abstract*—Articles published in *Scientific Data* by Wilkinson *et al.* argued for the adoption of the Findable, Accessible, Interoperable, and Reusable (FAIR) principles of data management without citing any of the prior work published by Taswell. However, these principles were first proposed and described by Taswell in 2006 as the foundation for work on the PORTAL-DOORS Project (PDP) and the Nexus-PORTAL-DOORS-Scribe (NPDS) cyberinfrastructure, and have been published in numerous conference presentations, journal articles, and patents. This**

set of stakeholders – representing academia, industry, funding agencies, and scholarly publishers – have come together to design and jointly endorse a concise and measurable set of principles that we refer to as the FAIR Data Principles" [1]. While advocacy by more 'stakeholders' for making data findable, accessible, interoperable and reusable represented progress towards the goal of reproducible science, their use of the term 'design' gave the impression that these 'stakeholders'

2020 PORTAL-DOORS Update (Choksi et al. 2020)

2020 Second International Conference on Transdisciplinary AI (TransAI)

NPDSLINKS: Nexus-PORTAL-DOORS-Scribe Learning Intelligence aNd Knowledge System

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Abstract*—With the continuing growth in use of large complex data sets for artificial intelligence applications (AIA), unbiased methods should be established for assuring the validity and reliability of both input data and output results. Advancing such standards will help to reduce problems described with the aphorism 'Garbage In, Garbage Out' (GIGO). This concern remains especially important for AIA tools that execute within the environment of interoperable systems which share, exchange, convert, and/or interchange data and metadata such as the *Nexus-PORTAL-DOORS-Scribe* (NPDS) cyberinfrastructure and its associated *Learning Intelligence aNd Knowledge System

The simple intuitive principle implied by that description has remained central to the core foundation of calculating and computing machines from the early history of primitive computers to the present era with the advances of multi-core chip architectures, big data, and artificial intelligence.

Over a century after Babbage made his famous remarks, Army Specialist William Mellin expressed his concern about the inability of computers to think for themselves when interviewed for a 10 November 1957 newspaper article, and explained that "sloppily programmed" inputs inevitably lead

2023 PORTAL-DOORS Update (Athreya et al. 2023)

Opening democratised portals and doors to the free flow of findable facts

- Communication barriers across different scientific communities have increased the need for interoperable information systems.
- Available tools and technologies for finding and accessing data across fields of study continue to face obstacles and have not yet risen to the challenge.
- Established in 2006, the PORTAL-DOORS Project (PDP) continues to work on developing and maintaining the Nexus-PORTAL-DOORS-Scribe (NPDS) cyberinfrastructure as an open information management system founded on the principle of supporting the free flow of findable facts for democracies around the world.

researchfeatures.com

The Essence of PORTAL-DOORS

- PORTAL-DOORS for the semantic web modeled on the success of IRIS-DNS for the original lexical web
- Designed to address major problems including: information tsunami (find needle haystack), informatics tower of babel (harmonization for interoperability), cybersilos in scientific discourse, search engine consolidation with monopolies, continuing transition barriers caused by information wars
- Founded on principles for interoperability, universality, flexibility, extensibility with a schema for required, permitted, and extended features that remain consistent with the Hierarchically Distributed Mobile Metadata architectural design for distributed and democratized systems
- Applied to bioinformatics, clinical trials and complex information systems such as those necessary for brain imaging and study of gene-brain-behavior relationships

PORTAL-DOORS vs IRIS-DNS

- A paradigm and infrastructure for the semantic web and grid (design principles considered novel when proposed in 2006)
- Problem Oriented Registry of Tags And Labels (PORTAL designed as an IRIS analogue) for resource entity label and tag registering
- Domain Ontology Oriented Resource System (DOORS designed as a DNS analogue) for resource entity location and description publishing
- PORTAL-DOORS for the semantic web modeled on the success of IRIS-DNS for the original lexical web
- PORTAL-DOORS uses an analogous paradigm with resource entity labels instead of domain names
- Taswell 2008 IEEE TITB 12(2):191-204 (received 10/31/2006, published online 8/3/2007, in print 3/5/2008)

Hierarchically Distributed Mobile Metadata Systems with Entity Registering and Attribute Publishing

	IRIS-DNS	PORTAL-DOORS
Registering system	IRIS registries	PORTAL registries
– Entity registered	domain	resource
– Identified by	unique name	unique label
Publishing system	DNS directories	DOORS directories
– Attributes published	address	location and description
– Specified by	IP number	URIs, URLs, RDF triples

Semantic Search and Applications

- Web search often yields innumerable irrelevant results that may lose practical usefulness, ie, too costly in time for a person to review
- Information wars have increased concerns about the trustworthiness of information sources and the reliability validity and integrity of data
- Fast accurate delivery of relevant and reliable information remains an important motivating driver for development of semantic web search applications — how to find needle in haystack from which of many possibly unknown haystacks?
- Translational medical research with drug development, clinical trials, and precision medicine — including smart search through records linked by genetic pedigree

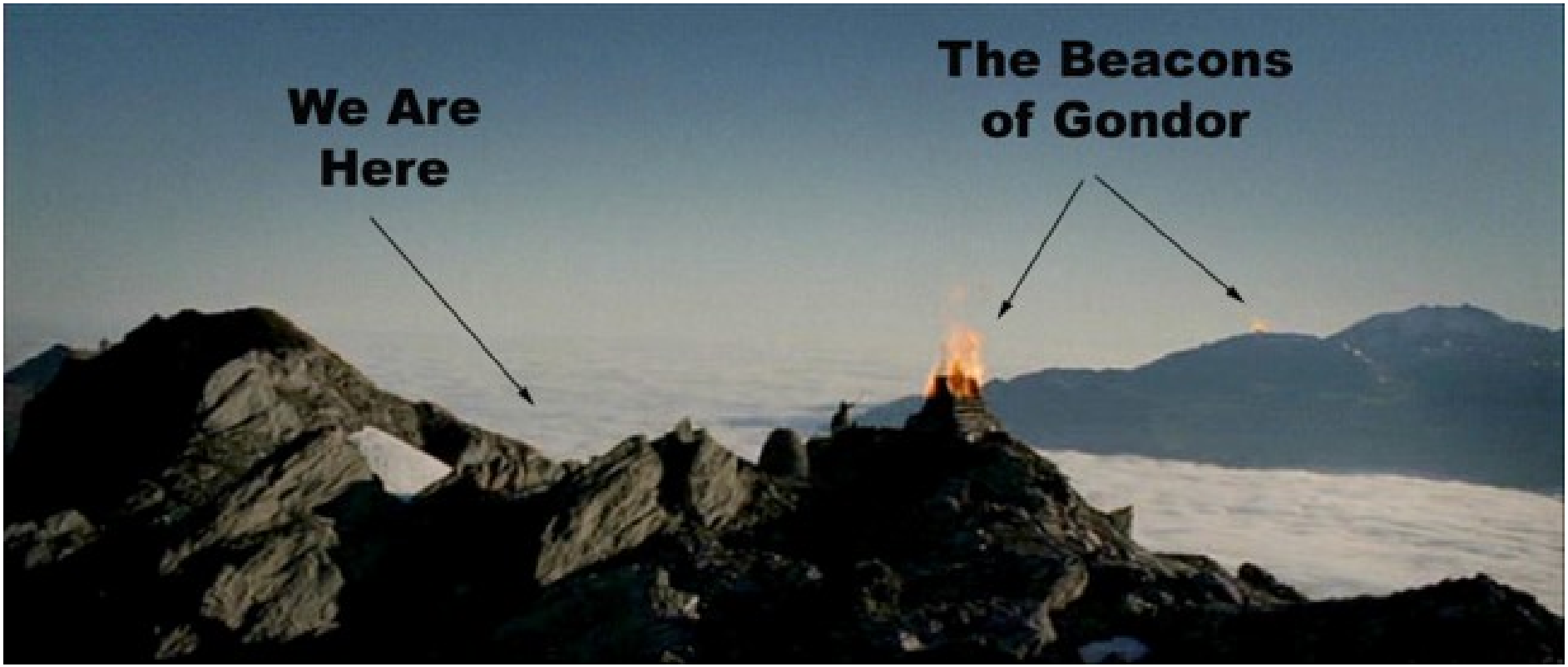
Democratization of Search

- PORTAL-DOORS interlinks registries, directories, databases across fields, disciplines, specialties
- PORTAL-DOORS supports mass collaboration via its hierarchical and distributed but decentralized and localizable infrastructure
- PORTAL-DOORS provides a democratized solution to the problems of search engine consolidation
- Mowshowitz and Kumar in Feb 2009 IEEE Computer (p108) discuss the realities and risks of search engines that restrict access to information; has search improved or worsened since 2009?
- Should a corporate monopoly or autocrat-led oligopolies control the flow of information within or for an alliance of democracies?

Algorithmic Search in Network Graphs

- Random graphs and other dynamic models of network growth
- Node degree distributions, clustering, and preferential attachment
- Search via hierarchical versus peer-to-peer network paths
- Search for best path from known source to known target node: peer-to-peer?
- Search for any path to unknown node for possibly non-existent target: hierarchical?

HDMM Hybrid Search Analogy from "Lord of the Rings"



HDMM hybrid (not pure peer-to-peer) communication networks enable search and discovery of a small item in a large world of many peaks and isolated valleys when the item's existence and location (which valley to search) may be unknown (C. Taswell 2010a).

HDMM Conjecture

- Hierarchically Distributed Mobile Metadata (HDMM) architectural style characterizes both IRIS-DNS and PORTAL-DOORS registry-directory who-what-where metadata management systems
- Semantic HDMM hybrid networks should scale more effectively and efficiently than strictly peer-to-peer networks when searching by various query criteria for an unknown entity at an unknown location when it may not exist; when is a result of 'nothing found' (aka 'zero hits') a true negative vs false negative?
- C. Taswell 2010a Future Internet "A Distributed Infrastructure for Metadata about Metadata: The HDMM Architectural Style and PORTAL-DOORS System" doi:10.3390/FI2020156

DREAM Principles and FAIR Metrics

- DREAM Principles: "Discoverable Data with Reproducible Results for Equivalent Entities with Accessible Attributes and Manageable Metadata" = the original 2006 PORTAL-DOORS design principles + the 2019 "equivalent entities" principle
- FAIR Metrics: "Fair Acknowledgment of Information Records" and "Fair Attribution to Indexed Reports" with quantitative metrics for citational justice to evaluate fair citation of published literature
- References on DREAM, FAIR, scientific truth, research integrity:
  - Athreya et al. 2020 Brainiacs, Athreya et al. 2023 Research Features
  - Craig et al. 2019 ECAI, Craig et al. 2023 eScience
  - Dutta et al. 2019 eScience, Dutta et al. 2020 ICSC
  - S. K. Taswell et al. 2020 ASIS&T, S. K. Taswell et al. 2021 Brainiacs
  - C. Taswell 2022 Brainiacs, C. Taswell 2023 Brainiacs
  - Unfairness by the FAIR Principles Promoters: Case Study on Absence of Accountability for Integrity in Research Publishing 2024 C. Taswell

Use of Acronym 'FAIR' and Words 'Fair' and 'Metrics'

- FAIR principles of Wilkinson et al with acronym 'FAIR' for the principles called *Findable, Accessible, Interoperable, Reproducible* are a subset of the PDP and NPDS principles from the PORTAL-DOORS Project plagiarized by Wilkinson et al from the work of Taswell
- FAIR metrics of Wilkinson et al are used with the word 'metrics' in a manner that is not consistent with its usage in most fields of science
- FAIR metrics of Craig et al. 2019 are used with acronym 'FAIR' for *Fair Acknowledgment of Information Records and Fair Attribution to Indexed Reports* and the word 'metrics' in a manner consistent with both the meaning of the word 'fair' because it is a recursive acronym, and usage of the word 'metrics' with its meaning as a quantitative numerical value for the measure of something
- FAIR Metrics 1st family by Craig et al. 2019 focus on citation and plagiarism, 2nd family by Craig et al 2024 (submitted) on peer review of peer review, 3rd family by BHAVI co-authors 2025 (planned) on novel measures of collective, community, social, and public health

New Nosology for Biomedical Informatics

- There are many kinds of collectives from families living together in the same home to professional communities of colleagues working in the same research domain on the same research problem.
- How will we restore communication, cooperation, collaboration and collegiality to the professional conduct of science if we cannot fairly cite one another when engaging in scientific research?
- What will be the new *rules of engagement* for discussions and presentations at conferences and publications in journals?
- Can we develop a new nosology for the health of groups rather than individuals, especially collective community social and public health?
- What aspects of collective community social and public health should we attempt to measure with the planned 3rd family of FAIR Metrics?
- Work relevant to the October 9 Guardians 2024 Conference on Reproducibility, Validity, and Integrity may be submitted before September 9 at Guardians.BHAVI.us. Collaborations with BHAVI co-authors on the planned 3rd family of FAIR Metrics are welcome.

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  - www.BrainHealthAlliance.org
  - EPSMS.BrainHealthAlliance.net
  - www.PORTALDOORS.org
  - www.NPDSLINKS.org

References I

[1] Anousha Athreya et al. "Opening democratised portals and doors to the free flow of findable facts". In: *Research Features Magazine* (148 July 26, 2023), pp. 54–57. ISSN: 2399-1548. URL: https://researchfeatures.com/opening-democratised-portals-doors-free-flow-findable-facts/.

[2] Anousha Athreya et al. "The Essential Enquiry 'Equal or Equivalent Entities?' About Two Things as Same, Similar, Related, or Different". In: *Brainiacs Journal of Brain Imaging And Computing Sciences* 1.1, PEDADC885 (1 Dec. 30, 2020), pp. 1–7. DOI: 10.48085/PEDADC885. URL: https://brainiacsjournal.org/arc/pub/Athreya2020EEEEE.

[3] Shreya Choksi et al. "NPDSLINKS: Nexus-PORTAL-DOORS-Scribe Learning Intelligence aNd Knowledge System". In: *2020 IEEE 2nd International Conference on Transdisciplinary Artificial Intelligence (TransAI)* (Sept. 21, 2020). IEEE, Sept. 2020. DOI: 10.1109/transai49837.2020.00027.

[4] Adam Craig et al. "DREAM Principles and FAIR Metrics from the PORTAL-DOORS Project for the Semantic Web". In: *2019 IEEE 11th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)* (June 28, 2019). Pitesti, Romania: IEEE, June 2019, pp. 1–8. DOI: 10.1109/ECAI46879.2019.9042003. URL: https://portaldoors.org/pub/docs/ECAI2019DREAMFAIR0612.pdf.

[5] Adam Craig et al. "Example evaluations of plagiarism cases using FAIR Metrics and the PDP-DREAM Ontology". In: *IEEE eScience 2023* (Oct. 13, 2023).

[6] Adam Craig et al. "Web Service APIs for Scribe Registrars, Nexus Diristries, PORTAL Registries and DOORS Directories in the NPD System". In: *Proceedings 9th International SWAT4LS Conference*. Amsterdam, Netherlands, 2016. URL: https://ceur-ws.org/Vol-1795/paper4.pdf.

[7] Shiladitya Dutta et al. "DREAM Principles from the PORTAL-DOORS Project and NPDS Cyberinfrastructure". In: *2020 IEEE 14th International Conference on Semantic Computing (ICSC)*. IEEE, Feb. 4, 2020, pp. 211–216. DOI: 10.1109/ICSC.2020.00044. URL: https://portaldoors.org/pub/docs/ECAI2019DREAMFAIR0612.pdf.

[8] Shiladitya Dutta et al. "Managing Scientific Literature with Software from the PORTAL-DOORS Project". In: *2019 IEEE 15th International Conference on eScience (eScience)* (Sept. 24, 2019). San Diego, California: IEEE, Sept. 2019. DOI: 10.1109/eScience.2019.00081. URL: https://portaldoors.org/pub/docs/BCDC2019PdpDemo0806.pdf.

References II

[9] Carl Taswell. "A Distributed Infrastructure for Metadata about Metadata: The HDMM Architectural Style and PORTAL-DOORS System". In: *Future Internet* 2.2 (2010), pp. 156–189. ISSN: 1999-5903. DOI: 10.3390/FI2020156. URL: https://www.mdpi.com/1999-5903/2/2/156/.

[10] Carl Taswell. "DOORS to the Semantic Web and Grid with a PORTAL for Biomedical Computing". In: *IEEE Transactions on Information Technology in Biomedicine* 12.2 (2 Mar. 2007). In the Special Section on Bio-Grid published online 3 Aug. 2007, pp. 191–204. ISSN: 1089-7771. DOI: 10.1109/TITB.2007.905861.

[11] Carl Taswell. "Epistemic Injustice, Open Access, and Citational Justice". In: *Brainiacs Journal of Brain Imaging And Computing Sciences* 3.2 (Dec. 30, 2022). ISSN: 2766-6883. DOI: 10.48085/x3b678b7a.

[12] Carl Taswell. "Knowledge Engineering for PharmacoGenomic Molecular Imaging of the Brain". In: *2009 Fifth International Conference on Semantics, Knowledge and Grid*. Institute of Electrical and Electronics Engineers (IEEE), Sept. 2009, pp. 26–33. DOI: 10.1109/SKG.2009.101.

[13] Carl Taswell. "Reproducibility, Validity, and Integrity in Scholarly Research: What Accountability for Willful Disregard?" In: *Brainiacs Journal of Brain Imaging And Computing Sciences* 4.2 (Dec. 31, 2023). DOI: 10.48085/13570f30f.

[14] Carl Taswell. "The ManRay Project in Biomedical Informatics for Nuclear Medicine and PharmacoGenomic Molecular Imaging". In: *Proceedings 35th Annual Western Regional Meeting of the Society of Nuclear Medicine*. 2010.

[15] S. Koby Taswell et al. "The Hitchhiker's Guide to Scholarly Research Integrity". In: *2020 ASIS&T 83rd Annual Meeting* (Oct. 22, 2020). Vol. 57. Wiley, 2020, e223. DOI: 10.1002/pra2.223. URL: https://asistdl.onlinelibrary.wiley.com/doi/abs/10.1002/pra2.223.

[16] S. Koby Taswell et al. "Truth in Science". In: *Brainiacs Journal of Brain Imaging and Computing Sciences* 2.1 (1 Dec. 31, 2021), pp. 1–9. DOI: 10.48085/M85EC99EE. URL: https://BrainiacsJournal.org/arc/pub/Taswell2021Truth.