

Semantic Integration of Neuroinformatics Data in the Arkansas Image Enterprise System with Open Biomedical Ontologies

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Abstract

The Arkansas Image Enterprise System (ARIES) pilot project brings together data from three collaborating investigative teams in an effort to identify common pathways of neurodegeneration. These datasets include images and image-derived features, motor assessments, cognitive assessments, clinical rating scales, demographics, and clinical data. ARIES achieves semantic integration of its diverse datasets using representations based on axiomatically-rich ontologies.

Keywords:

Neuroinformatics, semantic integration, imaging

The Arkansas Image Enterprise System (ARIES) is an instantiation of the Platform for Imaging in Precision Medicine (PRISM) (1). PRISM containerizes The Cancer Image Archive (TCIA) (2) technology stack, streamlining its deployment, and incorporating new tools to organize and analyze data. PRISM's development improves TCIA's ability to manage and analyze integrated datasets. ARIES is both a testbed for PRISM and an institutional research data management resource. It demonstrates the capabilities of the PRISM infrastructure's semantic representation approach by integrating diverse data relevant to research questions about neurodegenerative disease.

The ARIES pilot project combines data from three collaborating investigative teams in an effort to identify common pathways of neurodegeneration. These data come from three unique study cohorts diagnosed with Parkinson's disease (PD), Mild Cognitive Impairment (MCI), or Cancer-Related Cognitive Impairment (CRCI). The datasets include images and image-derived features, motor assessments, cognitive assessments, clinical rating scales, demographics, and clinical data.

ARIES integrates and manages these data and associated metadata using a shared representation that accounts for both explicit and implicit connections among the data across the source data sets. This approach removes obstacles to 1) working with different source representations for the same type of information; 2) connecting and interpreting different types of data that are about the same phenomena; and 3) combining

diverse data sets that are about the same individuals. The result is deidentified, curated datasets for third-party exploration

ARIES achieves semantic integration of diverse datasets by using representations based on axiomatically-rich ontologies to construct a knowledge graph that combines instance data from these unique study cohorts into a shared semantic representation. This is stored in a triple store database that supports reasoning over and querying the integrated data.

We represent the entities that ARIES data collections are about using OBO Foundry resources, taking advantage of the consistent representational strategy underlying these resources.

This poster reports on ongoing work on our pilot test case linking image-derived measures of hippocampal volumes to a diverse set of cognitive assessment results. We use the Neuropsychological Testing Ontology (3), among others, to represent, combine, and explore study subjects' cognitive assessment results with imaging and image derived measures.

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