**Project: A Computational Framework for Identity**

**Background:** We address both *numerical identity* and what we call *conceptual identity*. When we pick out a unique person, the identity is numerical identity. In the social and behavioral sciences, there is another notion of identity [Vignoles 2011], conceptual identity, which involves one's answer to the question, "Who are you?" This is also an interest of those who study narratives, including online material [Poletti 2014]. A given individual may have several conceptual identities, and the same conceptual identity may be instantiated by more than one individual. Conceptual identities facilitate our understanding of individuals and support generalizations about behavior, and a conceptual identity may help nail down a numerical identity. We are interested in identity in both senses not only regarding people but also regarding people using artifacts (such as software products) and even regarding autonomous artifacts. The analog of conceptual identity here involves behavior patterns.

Our framework [Esterline 2014], unlike the Superidentity project [Hodges 2012] (the most mature computational framework for identity), takes situations, not just "elements," as basic. In situation theory [Barwise 1983, Devlin 1991], an *infon* is the basic item of information. A *real situation* is a part of reality that supports an indefinite number of infons, while an *abstract situation* is a fixed set of (possibly parameterized) infons. An abstract situation is a type and a real situation is a token. Information flow depends on *constraints* that link various types of situations. It is natural to see a situation embedded in, referenced by, or otherwise related to another. Our approach exposes how an identification or characterization depends on other actions and events and thus reveals structure. So provenance, context, and narrative detail are retained.

*Id-situations* include identity-relevant actions. Identifying or characterizing an individual can involve various props, which relate to other situations. An (identity) *environment* is a coherent set of standards for identifying and characterizing individuals. A structure consisting of an id-situation and supporting situations is an *id-case*. The abstract version is an *id-case type*. We have identified the category-theoretic structure by which situations are amalgamated into id-cases both at the token and at the type level and have identified *identity categories*. Sometimes two identities actually related to the same person and so are fused. When the identity categories are from the same environment, the fusion is essentially a union of the id-cases. Cross-environment fusion, however, requires amalgamating categories with different structures; for this, we have introduced functors between categories. All this in fact can be done in terms of data types or OWL constructs without explicitly relying on category theory, but category theory does give a rigorous, concise, and in some sense universal, foundation. (The use of category theory here was inspired by channel theory [Barwise 1997], which was developed as a foundation for capturing information flow across situations.)

This project is led by Co-PI Dr. Albert Esterline, assisted by the PI Dr. Kaushik Roy. It is derived in part from on-going research supported by the Army Research Laboratory (ARL).

**Research Activities:** The initial challenge is to develop software for an analyst to capture id-situations and the supporting situations that go into an id-case. We will use semantic-web, especially social-semantic-web, technology. [Kokar 2014] presents an ontology for situations, and [FOAF 2014], [Bojars 2010], and [Stankovic 2008] provide useful suggestions for online identity. Software will facilitate production of RDF or OWL documents to capture information on specific situation types and will allow customization for any well-defined type. A second challenge is fusing identities, which will require programming with a semantic-web framework such as Jena [Jena 2014]. A third challenge, uncertainty, will be captured by defining a probability distribution on the set of constraints as done in [Lalmas 1994]. A fourth challenge is learning behavior patterns. Throughout, any aspect of an identity can be queried regarding its support and the provenance and context of the support.

**Outcomes:** This project will result in a workbench for capturing situations related to identity and amalgamating them. It will support descriptions of conceptual identities and combining evidence for identifying individuals. It will provide uncertainty measures for identifying individuals and fused identities. Finally, it will support machine learning of behaviors as part of conceptual identities. A key environment will be online identity, but the workbench will be useful in any environment, say, news articles or historical records. Students will report results in peer-reviewed conferences and journals.

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**Readings**

These can be downloaded from the webpage. They all relate to the Superidentity project, which is like our project but with a less powerful mathematical background.)

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