Engineering Standards for Anthropomorphic Algorithms

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1 Proposed Approach

1.1 Abstract

Thefield of human-like computing — and the study of algorithms which mimic human behaviours especially[1] — is one of increasing importance in academic and industrial circles. Academic circles are increasingly looking to use the metaphor of anthropomorphic behaviour in information security, human-computer interaction, and fields tangentially related to computing science such as urban planning and smart city development.

Developing these anthropomorphic algorithms can be complicated, however. They require rigorous study in social sciences such as psychology, anthropology, and sociology, as well as the understanding of artistic studies such as philosophy. This added complication means that pursuit of human-like computing requires interdisciplinary study to effectively research and implement these systems. This complexity often results in simple models of one human behavioural trait, rather than more involved multiple-trait models.

This limitation is problematic: the complexity of the field, and its obscurity relative to other fields such as pervasive computation or quantum computing paradigms, mean that many researchers are not drawn to the field as a possible opportunity.

In this proposal, a research opportunity is described which can solve both of these issues by producing currently absent tooling and methodologies for the field. Once successfully completed, the tools and methodologies produced would reduce the interdisciplinary complexity of the field, and create jargon and tools which reduce the friction involved in undertaking this research from multiple angles. These tools and methodologies would, in turn, permit currently difficult-to-pursue research which engineers multiple-trait anthropomorphic algorithms. These models would strengthen the industrial utility of this field, as the utility of the models is compounded with more traits — garnering more interest in the field, and putting existing research to better use, though applications in smart cities, voice assistants, and more.

Problem Outline

Human-like computing, as a research field, has grown significantly in recent years — particularly with regards literature on trust formalisms. However, the field is unusual, in that the development of an anthropomorphic algorithm requires an understanding of not only computing science, but also social sciences: a formalism's accuracy depends on its psychological and sociological perspective. More anthropomorphic formalisms require an understanding of other fields, such as philosophy and ethnography also, as their modelling of human traits — and affect on our culture — is critical to understand during the model's creation. This interdisciplinary nature is one of the field's greatest strengths and most curious aspects.

It is also one of its greatest weaknesses. The requirement for a formalism to have a well-defined psychological and sociological model, as well as potential ethnographic and philosophical perspectives, so as to be implemented and evaluated by a computing science researcher, means that only particularly polymathematical researchers can undertake the research — assuming that it arouses their interest in the first place. The alternative, an interdisciplinary team who can perform the research with a shared understanding of different components of the formalism, has its own complications, communication can be hampered by the differences in different parties' jargons. Moreover, the aims of researchers with different backgrounds can differ: some fields, such as the social sciences, have an interest in modelling human activity accurately, but computing scientists and philosophers can find the models useful as a metaphor in their studies — as a thought experiment for philosophers, and in human-computer interaction for computing scientists.

Therefore, no suitable system currently exists for undertaking this research. Either a researcher adept in both computing science and social science is required, or a team with unusually good communication skills, each of the members of which should understand the (complicated) jargons of the others.

Moreover, this interdisciplinary disparity can create further tensions, as no guidelines exist on how these models should be implemented and tested. A team of differing backgrounds will naturally diverge on how a formalism should be evaluated, and its creation can be complicated by the lack of clear guidelines on its implementation and evaluation. A model of multiple human traits can quickly couple the many traits together, and should one trait need to be altered, this can ripple through a particularly sophisticated model to cause major setbacks. Given the difficulty communicating between team members, and the complexity of the project for a single researcher, these major setbacks should be expected at present.

[1] Henceforth referred to as "Anthropomorphic Algorithms".

Solving this problem has its own complexities. This particularly can be seen when analysing the intricate nature of psychological and sociological research on a single topic.[2]. The problem can be tackled however — as will be seen — by separating the engineering from the theory, and creating guidelines and tooling which simplify the model's creation and structure.

Approaching the Problem

To approach the problem of simplifying the engineering, one must first analyse what trends exist currently — a standard should fit the direction that the field is currently taking. Once undertaken, however, this analysis will lend itself to the creation of:

1. A methodology for formalism creation and evaluation.
   This should help the engineering effort to get out of the way of the research, being the definition and evaluation of a formalism of a trait.

2. Tooling to support this methodology.
   This will help drive adoption of the methodology, as well as ensuring that evaluable, well-engineered formalisms are easier to create — strengthening the case for industrial applications.

Methodology/Guideline Component

To create the methodology appropriate for solving the problem of the creation and engineering of these anthropomorphic algorithms, it will be important to analyse multiple aspects of the existing literature.

For example, it is critical that the methodologies and guidelines produced are in line with existing models. Moreover, it is vital that these methodologies and guidelines are suitable at a number of levels: they must support not only the engineering of a model, but the engineering of models with psychological, sociological, ethnographic or philosophical perspectives on their respective traits.

The methodologies and guidelines created would note only support the creation of a model, but would support the creation of several models, ideally of different traits. This would increase the degree to which different models can be compared, and can be used as the basis of other models.

Once these methodologies and guidelines exist, jargons around this framework can be made concrete, providing one jargon that all members of a research team investigating anthropomorphic algorithms and formalisms of human traits can learn. This would simplify the existing research, and solve some of the issues in interdisciplinary communication.

[2]As an example, consider the differences between Luhmann's approaches to trust [2] compared to Deutsch's [1] Deutsch believed that trust was inherently a perspective of an individual regarding the world, whereas Luhmann's perspective centred around the broader-scale sociological impact that trust has.

Tooling Component

Once the methodology and guideline component of work is complete, tooling for the system can be constructed which supports this as a specification. This tooling would take the form of engineering techniques, such as appropriate design patterns, as well as libraries which encourage the construction and design of a formalism according to the guidelines.

Ideally, these guidelines would simplify model construction so as to greatly reduce the technological barrier to entry; perhaps enabling social sciences researchers to implement the models themselves without a dedicated software engineer/computing science researcher. The feasibility of this goal is dependant on the results of an in-depth background survey, which would identify the complexity of the methodologies and guidelines, as well as whether one set of methodologies and guidelines can sufficiently cover all anticipated models.

An aspect of this tooling component would be demonstration that the tools would work; this can be done in two stages.

1. Re-implementation/redesign of existing models according to the methodologies and guidelines, built using the tools created.

2. An industrial proof-of-concept, using the tools to create models with the simplicity, reliability, and power to have commercial application.

1.2 Use Cases

2 Background

Trust

Marsh

Something about Marsh[3]

C&F

Eigentrust

Reputation

Comfort

Responsibility

3 Methodology

4 Risks

5 Project Management

6 Impact

National Importance

Academic Impact

References

[1] M. Deutsch. Cooperation and trust: Some theoretical notes. 1962.

[2] N. Luhmann. Familiarity, confidence, trust: Problems and alternatives. 2000.

[3] S. P. Marsh. Formalising Trust as a Computational Concept. *Computing*, Doctor of(April):184, 1994.