MAPPED Repository: An information system for the emerging unified community of researchers in cognitive, neuro and computer sciences

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Abstract
The disconnect between scientific schools of thought across the world is most notable in cognitive, neural, and computer sciences. The intersection of these fields is exactly where a powerful new approach has emerged recently, known as Biologically Inspired Cognitive Architectures (BICA). Here we describe a new initiative: to build an open informational resource for the emerging international community of researchers unified by the BICA Challenge - the challenge to create a computational replica of the human mind using solutions inspired by the brain. We call it the MAPPED repository, named by the following six components: Models, Architectures, People, Paradigms, Evaluations, and Dialogues, all represented by six components of the unified database.

Keywords: cognitive architectures; comparative study; standards; evaluation; outreach activities

1 Introduction

A dramatic disconnect between scientific schools and communities across the world can be seen in cognitive, neural and computer sciences. The intersection of these fields is exactly where a powerful new approach has emerged recently, known as Biologically Inspired Cognitive Architectures, or BICA (Stocco et al., 2010). To give an example of the extent of the disconnect, the term “cognition” is generally interpreted in Russia as a synonym of “learning” rather than “thinking”, and is not broadly accepted as a legitimate topic for research. Not surprisingly then, despite the great number of scientific institutions and people working in science in Russia, and their huge collective potential, their contribution does not get noticed in the West, and lacks synergy with science in the US. Bridging this gap is desirable and would benefit both communities and the society at large.

The Goal of this project is to build a unified community of U.S. and Russian researchers in cognitive, neural and computer sciences in order to further our collective understandings of how
intelligent systems develop their cognitive and learning functions, through peer-to-peer dialogues supported by the online MAPPED Repository.

The repository is named by its following six key components. Models: documents representing the architecture, including research papers, presentations, tables of specifications, manuals, etc. Architectures are task-independent and are formulated computationally, at any level: from algorithms and pseudocode to software packages, APIs, and online tools. People: a complete database of all researchers and developers who are related or potentially related to the architecture, including their views as well as their affiliations, contact information, background, interests and relevant results. Paradigms will include methodology, tests, challenges, decathlons, testbeds, simulation environments, settings and procedures, research questions, hypotheses and predictions, measures, scales and metrics, measuring tools, evaluation protocols, statistical analysis methods, visualization tools. Evaluations: empirical and analytic data resulting from tests, analysis and comparison of models to each other (e.g., Mueller et al., 2007). Dialogues: initiated by us and archived in the Repository peer-to-peer interactions among developer groups who disagree on terminology, interpretation of results and their analysis, values and priorities for research, etc., or are missing facts and knowledge that they want to learn from each other. Forms of interaction will include teleconferences, Wiki pages, webinars and Videopanels (Kalish & Samsonovich, 2011; http://bicasci.org/videos/vp.html), discussion boards, workshops and conferences in Russia and in the US. All six components will be mapped to each other; therefore, the repository will represent every cognitive architecture or model in one universal format, facilitating comparison and learning of models. Specifically, we target the following objectives:

1. Develop the MAPPED repository as an Internet-based resource with the functionality allowing users to enter and use (a) documents in various formats describing models and test procedures, (b) code implementing those models that can be executed online, (c) statistical and visualization tools that can be used to evaluate models online, and (d) data, including human data, test data and simulation data, that can be fed into (b) and (c) in order to produce meaningful results that can be compared to each other.

2. Populate the repository with the help of researchers from around the world. Ensure consistency and completeness.

3. Advertise and popularize the repository. Disseminate project outcomes online, through conference presentations and publications in mainstream journals.

4. Achieve the level of one unifying widespread framework for representation and evaluation of BICA used internationally.

2 Creating a Repository of Cognitive Architectures

Creation of a repository is necessary to facilitate direct comparison of different architectures. Development and research of cognitive architectures continues for decades, but it is difficult to understand how the various architectures are associated with each other, what features or components are missing, and what progress has been made. Different communities speaking different languages are often ignoring each other. Such models and the data are rarely available in a convenient format for mapping. This makes comparison inconvenient or impossible.

After analyzing the existing repositories, we created an editable comparative table of cognitive architectures, using the collective efforts of many researchers involved in its development (the original version of the table was described in Samsonovich, 2010). A new version of the table is accessible at http://bicasci.org/cogarch/test/.
2.1 Roadmap Construction

Firstly, we need to present a common view of an open online repository to know what steps should be taken to increase the popularity of information system among researchers. Carry out a road mapping MAPPED repository and draw up a roadmap.

Without a database of researchers it is hard to keep the repository up to date, because cognitive technologies are rapidly evolving, approaches to the study of architecture as a architectures are changing. Invited to the community researchers would regularly update and supplement the information on the website through the convenient form of interaction with the repository. Firstly we need to simultaneously conduct the task of creating a database of researchers and architectures.

Researchers have already started entering information into the BICA Society repository of cognitive architectures. This process requires processing of bibliographic data as well.

2.2 Automated Processing of Scientific Literature and Bibliographical Data

In consideration of the volume of papers, the format of their presentation and methods of data extracting, we have to write a program that will extract data about the full names and emails of the authors represented in the set of a PDF articles.

To accommodate the already available information, we conducted an analysis of existing repositories. This data added to our repository after modeling and database framework.

To add new information, it is necessary that the researchers replenished database via comfortable website interface by themselves. This way we again come to the question of needing to create a database of scientists and the implementation of a GUI to interact with the database.

We set a goal to create a database of researchers in cognitive, neural and computer science & to create and fill a database of architectures. To achieve this aim, we need the following:

- Develop an algorithm to extract information from text and write a script in Python for the formation a data bank of cognitive, neural and computer science researchers. Using this software create data bank.
- Select the main entities and characteristics of the cognitive architectures subject area. Create, fill and put online our database.
Thus, at the input of the algorithm we have supplied the PDF file, and the result of the algorithm is a table (Name, Last Name, E-mail), which can be imported into a database.

Fig. 2. MAPPED Repository construction algorithm.

2.3 Editable Database of Cognitive Architectures

The first attempt was to create an editable table that allows us to conveniently compare the diversity of the most popular cognitive architectures. We use a common language to describe the architecture and the well-known comparison metrics. The result is represented in Fig. 3. The created repository enables convenient comparison of the diversity of the most popular cognitive architectures.
3 Discussion

Seven years ago the BICA community has launched a new initiative: the construction of the international research community, united by a common goal - to create a copy of the processing of human thought using solutions based on a human brain. One of the key elements of the community is an open online repository developed jointly (Stocco et al., 2010; Samsonovich, 2012; Samsonovich et al., 2015). The result of the present work is the first step toward the open online MAPPED repository.

The script to extract the data of the authors from papers allowed us to formulate database of researchers. Researchers database give us a chance to send an invitation to join the BICA and to inform researchers about holding schools and conference. The script can be used on a large volume of papers and always get the latest information. Simple logic, a convenient code and detailed documentation will allow further refinement and comfortable supporting program.

The database of architectures allows us displaying a unique comparative table in the website. Users can work directly with the database.

In the future we are going to create web forms for adding user data by repository users. Moderator will check the information and add it to the online table. It will always help us to support a database in up to date and supplement comparative table. All of this changes allows increase number of repository visitors and make the repository more popular.

3.1 Conclusions

The disconnect between scientific schools of thought across the world is most notable in cognitive, neural, and computer sciences. The intersection of these fields is exactly where a powerful new approach has emerged recently, known as Biologically Inspired Cognitive Architectures (BICA). Several years ago, the BICA Society started a new initiative: to build an international community of researchers unified by the BICA Challenge - to create a computational replica of the human mind using solutions inspired by the brain. One of the key elements of the roadmap is a public online
repository developed by collective efforts. We call it the MAPPED repository, named by the following six components: Models, Architectures, People, Paradigms, Evaluations, and Dialogues. Each BICA is mapped to these six components, and vice versa; therefore, the repository represents cognitive architectures and models in a universal format, facilitating comparison and learning of models. We encourage all BICA researchers to support us and contribute their materials and efforts to this initiative.

3.2 Acknowledgments

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References


