Formal Methods for Multi Modal UI for Robotics

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Abstract

A formal system of mathematics the dog-ears, is introduced to describe javascript or object notation, sensor event and action event with state modelling in the framework of DPA for a smart home and work robotics . It is assumed that a multi modal interface can be developed similar to AWS APL for this purpose.
The RAVA natural programming language is introduced, which simplifies coding by eliminating the need for syntax.

Keywords: Smart Home Automation, AWS Alexa, Dog-Ears, Formal System

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Introduction

What: Formal Method for creation of state machine and flexible rule based DPA, with a formal definition of sensor streams, sensor events and action events. A mathematical and natural programming formal model for a smart connected home.
How: **dog-ear**, a formal system of event based logic and sensor fusion, is described in an axiomatic framework.

So what: dog-ear forms the axiomatic formulation of

RAVA, a natural and mathematical programming language , illustrated with Alexa blueprints for APL based skills for a connected home. Beyond the connected home, the same framework can be used for business and work automation skills.

Axiom 001; There exists a stream s for every sensor a, integrated in a connected model M.

Axiom 002; Two or more streams, si can be merged into a single stream in sensor fusion.

Axion 003: There exist events ei as features extracted from a stream s, called event ei(s), the event-sensor space.

Axiom 004: There exist events ei as actions defined in the action-event space Ai.

Theorem 001:

In an I.O.T definition of sensor and action integration, there exist separate or combined controls Ci for a connected home. Ci defines sensor-events, sensor-streams and action-events for cloud integration.

Theorem 002:

There exists a MUI, as part of a RAVA agent, with a state machine, and a rule engine, for a state based control of Ci, residing in the cloud.

The MUI, re and s are defined in the cloud and executed in remote hardware than the home automation.

Theorem 003:

The rule engine and the state machine are sufficient in the existence of a flexible rule framework to automate all smart home tasks. In the event of any exception ei, manual intervention with the addition of data gathering to the cloud, there thus exists machine learning for rule formulation based on data for all ei.

Theorem 004: Wisdom Capital and expert systems. Data mining and a data repository of exceptions ei and data(ei) lead to associations of an expert system, with knowledge data-structures KM.

KM is persisted to machine DNA which holds a new emergence of machine 'common sense', called Wisdom Capital.

Wisdom Capital.

Wisdom Capital is machine DNA encrypted knowledge management that delineates all designs and machine learning. This enables the metaphorical staircase to Singularity#1, the design of DPA rules for automated and self learning automation systems.

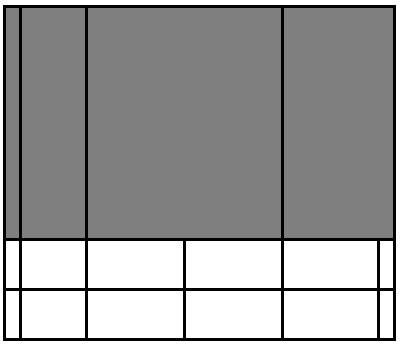

Fig 1: Abstract Surrealism, a symbol of the present SQL table like thinking, to be replaced by a void, denoting associative memory in the digit zero.

Discussion

An event based formal system is defined for a multi modal UI interface with cloud functions using Amazon AWS as an illustration

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A comparison with other formal systems,

(Pommaret, Haddak, and Bendiab 1989; Torbensen 2008) indicate various approaches that range from

field based nonlinear dynamical systems, to propositional calculus based systems which include many propositional logic based calculi for discrete event programming in home and work automation.(Hutter 2006; Bringsjord 2013)

A DNA representation for encoding digital human and robotic machines will usher a new era of optronic based robotics. Soul machines is one of the early pioneers in this direction.(Makari 2015; Kurzweil 2000; Fisher 2012)

(Makari 2015; Kurzweil 2000; Fisher 2012)tal is a close formulation of common sense in A.I . Introduced in this publication, (Naidenova and Xenia 2009; Mueller 2014; Minsky 2007; Sun 1994; Friedman, Forbus, and Sherin 2018; McCarthy and Lifschitz 1990)

There has been a plethora on formalizing common sense, with many early attempts at creating a A.I usable data set for common sense reasoning and the knowledge models required for common sense perception in conversational UI. Present practical systems make use of wiki-data and a plethora of publicly available data sources. Wisdom Capital is a superset of commonsense reasoning, including heuristics for natural and machine based reasoning.

Conclusion and Future Work.

We have described a formal system for event and model programming with a DPA framework for robotic automation with external control of retro hardware using RetroSwitches(™). As an example we have described the use of Pega, Twilio and AWS Alexa and Lambda@Edge/Lambda in the creation of Alexa Business skills.

Future Work is in the form of an EdTech experiment, A-633 a course in the use of low code solutions to use Dog-Ears in creating Alexa Skills for retro home automation and with most auto-pilot enabled work machines, with a demonstration in afforestation.

References

Bringsjord, Selmer. 2013. *What Robots Can and Can't Be*. Springer Science & Business Media.

Fisher, Len. 2012. *Weighing the Soul: Scientific Discovery from the Brilliant to the Bizarre*. Skyhorse Publishing, Inc.

Friedman, Scott, Kenneth Forbus, and Bruce Sherin. 2018. "Representing, Running, and Revising Mental Models: A Computational Model." *Cognitive Science* 42 (4): 1110–45.

Hutter, Marcus. 2006. *Universal Artificial Intelligence: Sequential Decisions Based on Algorithmic Probability*. Springer Science & Business Media.

Kurzweil, Ray. 2000. *The Age of Spiritual Machines: When Computers Exceed Human Intelligence*. Penguin.

Makari, George. 2015. *Soul Machine: The Invention of the Modern Mind*. W. W. Norton & Company.

McCarthy, John, and Vladimir Lifschitz. 1990. *Formalizing Common Sense: Papers*. Intellect Books.

Minsky, Marvin. 2007. *The Emotion Machine: Commonsense Thinking, Artificial Intelligence, and the Future of the Human Mind*. Simon and Schuster.

Mueller, Erik T. 2014. *Commonsense Reasoning: An Event Calculus Based Approach*. Morgan Kaufmann.

Naidenova, and Xenia. 2009. *Machine Learning Methods for Commonsense Reasoning Processes: Interactive Models: Interactive Models*. IGI Global.

Pommaret, J. F., A. Haddak, and O. Bendiab. 1989. "Nonlinear Differential Formal Calculus in Automation and Robotics." *IFAC Proceedings Volumes*. https://doi.org/10.1016/b978-0-08-037869-5.50017-0.

Sun, Ron. 1994. *Integrating Rules and Connectionism for Robust Commonsense Reasoning*. Wiley-Interscience.

Torbensen, Rune. 2008. "OHAS: Open Home Automation System." *2008 IEEE International Symposium on Consumer Electronics*.

https://doi.org/10.1109/isce.2008.4559480.