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RE-ENGINEERING EXPERT SYSTEM POWERED BY MACHINE LEARNING

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Abstract

This paper explores an approach to building an adaptive expert system and machine learning power many technologies today related to online education system to health care system in an environment of human-computer collaboration. Components of an adaptive system are identified, with an emphasis on the mechanisms that enable adaptive behavior to occur. Knowledge representation in a rule-based, object-orientated expert system is described through the establishment of appropriate relationships utilizing heuristic rules, objects, and agents. The experimental expert system with machine learning displays low level learning capabilities that show sufficient promise to warrant further research.

Keywords: Expert System, Machine Learning, Knowledge Representation, Objects, Powered, Human-Computer Collaboration.

Introduction

"An expert system collaborative with machine learning is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise." Well-designed systems emulate the reasoning processes used by experts to solve problems, and are popularly used in medicine, business management, design, and searching for natural resources.

"Even though expert systems aim to mimic human experts, they lack an extremely important capability of human intelligence: the ability to learn from experience." First of all, it takes a significant amount of time to build an expert system with many hours of testing and debugging. If a human expert comes to an incorrect conclusion, he may be able to learn from the mistake and avoid making the same or similar mistakes in the future. Once an expert system with machine learning is found to have an error, the only way to correct that error is to reprogram the expert system. In other words, most current expert systems are lacking an adaptive capability. Computer based adaptive capabilities are essential in situations where environments change, in situations where standards of expertise are changing, and in situations where there are nohistorical data and learning occurs as a task that has been performed.

Alan L. Schulle, (2017) This research investigates the connection of manmade brainpower (AI) and machine learning with worldwide compassionate law (IHL) in self-ruling weapon frameworks (AWS). Legal counselors and researchers over and again express a requirement for viable and target substantive direction on the legal improvement of self-rule in weapon frameworks. This Article proposes five foundational standards to empower advancement of mindful AWS arrangement. The discoveries rose up out of an examination venture directed by a group of military and regular citizen educators at the Stockton Center for the Study of International Law at the U.S. Maritime War College. The examination is educated by specialists in PC sciences, government and military, non-legislative associations, think tanks, and the scholarly world. Advances in AI will probably deliver AWS that are diverse in kind from existing weapon frameworks and in this way require a new way to deal with assessing IHL consistence. Initially, this Article depicts the innovative points of interest correlated to understanding the qualification amongst present and future frameworks. It contends that the mechanical assessment of the range of independence should center around the blend of experts conceded to the PC that controls an AWS, while likewise considering the physical abilities of the framework. Second, it contends that a key issue bearing on IHL consistence is whether an AWS has been conceded some mix of specialists and abilities that practically appoint the choice to kill from human to machine. Third, it sets that consistency must be at the center of an assessment into whether a specific AWS ruptures this designation limit and looks at how AI handles vulnerability, a basic segment of the consistency examination. At last, the Article proposes five foundational standards to direct the improvement of AWS approach.

Kevin D. Ashley (2002) This research portrays late jurisprudential records of analogical lawful thinking and looks at them in detail to the computational model of case-based legitimate contention in CATO. The jurisprudential models give a hypothesis of significance in view of low-level legitimate standards produced in a procedure of case-looking at intelligent modification. The

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jurisprudential investigate centers around the issues of allotting weights to contending standards and managing incorrectly chose points of reference. CATO, a modernized instructional condition, utilizes Artificial Intelligence strategies to show law understudies how to make fundamental legitimate contentions with cases. The computational model enables understudies to test lawful speculations against a database of legitimate cases, attracts analogies to issue situations from the database, and forms contentions by similarity with an arrangement of contention moves. The CATO display represents some of the critical highlights of the jurisprudential records, including executing a sort of intelligent modification. It likewise maintains a strategic distance from a portion of the issues recognized in the scrutinize; for example, it manages weights in a non-numeric, setting delicate way. The article closes by depicting the commitments AI research can make to jurisprudential examinations of complex psychological marvels of lawful thinking. For example, not at all like the jurisprudential models, CATO gives a nitty gritty record of how to produce different understandings of a refered to case, making light of or accentuating the lawful criticalness of qualifications as far as the reasons for the law as the contention setting requests.

Rule-Based Programming and Object-Oriented Design

Rule-based programming is commonly utilized to develop expert systems. Rules are used to represent heuristics, which specify a set of actions to be performed for a given situation.

According to Giarratano and Riley (1998), rule-based expert systems are popular for a number of reasons:

1. Modular nature: This makes it easy to encapsulate knowledge and expand the expert system by incremental development.
2. Explanation facilities: By keeping track of which rules have fired, an explanation facility can present the chain of reasoning that led to a certain conclusion.

Similarity to the human cognitive process. Rules appear to be a natural way of modeling how humans solve problems.

Object-Oriented design is "a technique for developing a program in which the solution is expressed in terms of objects - self-contained entities composed of data and operations on that data". Taylor (1998) proposes that object-oriented design is an ideal approach for building adaptive systems because "objects are naturally adaptive elements. If allowed to interact freely, managing their own actions, they can be excellent components for building up adaptive systems".

A Learning Environment

The word 'learning' is mainly reserved for human beings. Researchers have long wondered whether computers could also learn. In order to answer this question, a definition of learning is necessary. According to Lacey (1998), learning is "Any relatively permanent change in behavior brought about through experience – that is, through interaction with the environment.

It could be assumed that learning may involve four factors: the learner; the environment; their interaction; and, state. A learner could be defined as a relatively independent system, exhibiting a learning capability and adapting to its environment. In other words, a learner is a system with the capability to change itself as a result of interactions with its environment. The constantly changing environment provides a basic force that drives a leaner to learn.

A state is a collection of characteristics that can be used to define the status of a learner and its environment at a certain time. An environment is partially comprised of the external circumstances of a learner, and influences the way in which a learner behaves. In other words, a learner exists in an environment, which changes over time. The internal impact of this external environment impels the learner, which results in adaptive action on the part of the learner.

An approach to learning, therefore, is through the interaction between the learner and its environment. The interaction operates in terms of three basic elements: percepts; actions; and, goals. It defines these elements as follows:

"An action is a physical change that occurs inside the learner, such as a muscle contraction inside a human body or an electrical signal sent to some switch in a robot. A percept is a representation inside the learner about the state information of the environment. A goal is defined as a set of percepts that the learner wishes to receive from the environment."

This also explains the learning process as:
"With actions and percepts as building blocks, the learner is to construct a model of the environment so that it can predict the consequences of its actions and direct its actions towards the goal."

When knowledge is available, and a learner possesses and uses a capability to obtain and store this knowledge from its external environment, this capability could be defined as memorization.

Knowledge Representation

1. From Data, Meaning, Information to Knowledge

Computer systems have displayed significant increases in sophistication and capability while maintaining basic data storage and manipulation principles. Data in a computer system, based on a particular computer language, are letters, numbers, strings or special characters. A single piece of data consists of a combination of electrical pulses. It has no meaning to the computer by itself.

"When human beings or computer-based agents draw conclusions (i.e., inferences) from information then these conclusions are knowledge". Knowledge exists when humans attempt to solve problems or make decisions based on the state of a condition, and information provides a description of the state. In a rule-based computer system, the process of taking certain actions based on certain conditions can be represented as rules. Thus, information and rules can define knowledge.

2. Objects and Agents

"An object is a software package that contains a collection of related procedures and data .Procedures may be referred to as methods, which are relationships and behaviors among data. Objects are defined as encapsulations of properties (facts) and behavior (relationships among facts) in CLIPS Version 6.10 (NASA, 1998). Objects represent information. A well-defined object describes its states with the data it holds, and manipulates the data through its methods. An object-oriented system processes information, rather than data.

Objects are ideal building blocks to build adaptive systems. Since methods are encapsulated with data into objects in an object-oriented computer system, when a change is necessary, even if it is possible to change only a single or a few objects then the whole system will adapt to this change automatically through the reactions of other objects. However, in a conventional system (i.e., non-object-based), a change will require significant restructuring, anything less will result in a broken system.

Agents act at the knowledge level. Data within an object describe 'what' the object is, and object methods indicate 'how' it will react to changes. A rule, which acts as an agent, will provide some control of 'when' and 'whether' the object carries out its methods.

3. Notions from the Theory of Complex Adaptive System

All scientific studies are in the business of trying to make sense of the world, and research of Complex Adaptive System (CAS) is one of these. A driving force behind CAS research is a desire to understand how complex order arises out of the interaction of relatively simple components, such as: "How did life emerge out of the interaction of inert molecules? How do termites cooperate to build arches and other architectural structures? How do the phenomena of thought and consciousness arise out of the interactions of neurons in the brain.

Human-Computer Collaboration

While engaged in the process of problem-solving and decision-making, human beings typically draw upon a broad range of personal experience and often rely upon intuition. Computers, on the other hand, have a narrow area of expertise, greater computational power, and lack a good mechanism for knowledge acquisition through experience. Human-computer collaboration proposes an approach in which computers and humans cooperate to solve problems, especially to solve those problems that neither can effectively solve alone. For example, an expert system helps non-expert humans to solve problems and make decisions based on internal expertise. The system might not work appropriately if the problem changes, unless human users provide more knowledge. The system may thus be said to learn through its interactions with humans.

Building an Adaptive Expert System with Machine Learning

An expert system could be viewed as one heuristic rule, or if-then statement, since all rules in the system work together to define a specific condition, which is achieved by asking a user relevant questions. Thereafter, the system reacts with one or more actions. It is postulated that an expert system becomes adaptive during an interaction with a human user if this system proves to be capable of the formulation of new relevant questions and the adjustment of action(s).

1. Knowledge-Node-Network

The concept of a knowledge-node-network is proposed as an approach to knowledge representation in building an adaptive rule-based, object-oriented expert system. In a knowledge node-network, all nodes are represented as objects, and adaptivity of the system is achieved through node modification and creation. Two types of nodes exist in a knowledge-node-network:
question nodes (i.e., representation of relevant questions); and, action nodes (i.e., representation of corresponding actions).
A question node may contain one or more input-connections, each weighted, whose values change

based on a successful search or a failed search. Each input-connection corresponds to two output-connections, each of which connects to another question node or action node. A question node carries a relevant question and a corresponding answer-key. During a reasoning process, if a question node is activated by a message, the question will be evaluated, and the return value will lead to the next activation.

An action node may contain one or more input-connections, each weighted, whose values change based on whether user feedback is positive or negative. An action node carries one or more actions, and may be activated by messages sent from question nodes. Also, such a knowledge-node-network contains an initial body of knowledge (i.e., a group of question nodes and action nodes with appropriate connections). Upon interaction with human users, this initial body of knowledge may prove inadequate within the context of a changing problem. The system adapts to these changes through the modification of existing knowledge nodes and the creation of new knowledge nodes.

In a knowledge-node-network, each node is associated with a value represented by either a relevant question or an action. Each node also contains connections to other nodes. The creation of new nodes and the modification of either the value or the connections of the node are defined as constituting a form of system adaptation in response to a change.

2. Concept of Mind Object

The concept of "Mind" object is implemented as an agent-control strategy. Similar to human behavior, no matter how many things we want to do, we can choose to do only one at a particular time. "One part of me wants this, another part wants that. I must get better control of myself".

In the experimental expert system that was developed as part of the research, a "Mind" object acts as an "agent manager" that decides which agent should be activated at any particular time. The "Mind" object is designed with six different "states"; namely “inactive”, “querying”, “feedback”, “modifying”, “creating”, and “reporting”. Each state represents a condition that will trigger a particular agent to be active. The concept of a “Mind” object proposes a useful approach to solving conflicts, especially when both randomness and probability are unlikely good decision-making approaches, because a “Mind” object provides uniqueness. Since the state of the “Mind” object is changed dynamically by the activation of agents and object methods, each agent and object evolves as a part of the decision-maker. In other words, the control mechanism is not hierarchical but parallel.

Mind" object involves one agent only. However,according to Minsky (1993), a state of the human mind involves innumerable agents and subagents, leading to a much higher degree of complexity: “Let's oversimplify matters for the moment and imagine that the mind is composed of many "divisions," each involved with a different activity, like vision, locomotion, language, and so forth. This pattern repeats on smaller scales, so that even the thought of the simplest ordinary object is made up of smaller thoughts in smaller agencies; a mind can have exactly one total state at any moment, but it can be in many partial states at the same time”.

3. System Architecture

In terms of inference process, an adaptive expert system describes a generate-and-test loop that endows a system with a leaning capability, while a conventional expert system describes a unidirectional flow with no adaptive behavior. From a system structure perspective, an adaptive expert system differs from a conventional expert system as follows:

a) Unlike a static knowledge base in a conventional expert system, an adaptive expert system contains a dynamic knowledge base. Knowledge is represented by a knowledge network (i.e., objects and their interactions) that can be dynamically modified in real-time based on interactions with the human user.
b) In addition to containing the capabilities of a conventional inference engine, an adaptive expert system is capable of real-time adaptation to feedback and restructuring of the knowledge network.

The architecture of such an adaptive expert system consists of three major components: an inference engine; a knowledge network; and, a node-modification agent engine. The inference engine infers through condition-satisfaction action selection. In the rule-based system, it searches for the rules satisfied by facts or objects, and executes the rule with the highest priority. The knowledge base is composed of knowledge nodes and their connections. The node-modification agent engine consists of a node-maintainer, a node-builder and a node-merger. These agents analyze feedback and reconstruct the knowledge base accordingly. The goal of the system is the development of corresponding answers to satisfy the needs of clients based on client provided information. The mechanism provided by this system demonstrates a primitive adaptive capability of a computer-based expert system.

Conclusion

Counterfeit consciousness of machine learning has been territory of dynamic research for a long time, with a focal topic of delivering machines which have knowledge. His hypothesis on the last prompted which is presently called the "Turing Test". Information based framework is look into sub-area of machine learning. The learning based frameworks have discovered their way into numerous application areas, for example, drug, law, topographical mappings to give some examples. The case application areas of learning based frameworks/Expert System Applications are lawful emotionally supportive network, expectation and gauging, control framework arranging, railroad course arranging, money related bookkeeping, computer helped outline, gear setup, emergency administration, Other booking applications, planning rail route team task, arranging and configuration in assembling and so on. The expressions "Expert System" or "astute machine learning based frameworks" are likewise used to express a similar idea of information based frameworks. The master framework gets realities from the client and gives mastery consequently. The principle segments of the master framework (imperceptible all things considered) are the learning base, the deduction motor, clarification framework and UI. The induction motor may gather or make determinations (arrangements) from the information construct, based with respect to the 'certainties' provided by the client. The certainties and manage base cooperate with the master framework bi-directionally. During an interaction with a expert human user machine learning, the conclusion is as follows:

1. The system adjusts priorities of its actions based on the feedback received from the human user in real-time. In this way, useful actions can be enhanced, and inappropriate actions can be combed out.
2. The system automatically corrects its inappropriate actions based on evaluations received from the human user.
3. The system can define new problems and search for new actions (i.e., creating new relevant questions and actions), according to the feedback received from the human user.
4. Besides the memorization capability, the system is capable of self-reorganizing its knowledge base (i.e., mergerence of knowledge nodes).

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