**Incremental Intelligence**

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Abstract

One of the key challenge to building Intelligent System is the clarity in defining Intelligence itself. The clearer the requirement the simpler the design complexity. Digital circuits being the basis function to build intelligencee, 2 basic design principle exist in designing them, Combination and Sequencial. These 2 principles enable build diverse set of Intelligent systems, Supervised and Unsupervised methods stem from them. Intelligence enables systems to respond to environment most approptiatly. Sequenctial design inherintly allow Intelligent systems to refine progressively with the experience and time. Intelligent system is modelled as combinational in nature to start and evolve to sequential. This approach allows the system to produce insightful response initially to a evolved response incrementally.

Keywords: Intelligence, Incremental, Evolve

1. Need for Incremental Intelligence

Intelligent systems are expected to respond to stimulus in near real time. With the problem space, dimentions, degree of freedom, recall, prediction and similar factors the computational requirement increase and the response time. It would be hard to imagine the system respond to stimulus and all required expectation in near real time. Often the expecation and response time is an absolute requirement. Drawing parallel from the biological world, human intelect provide first response to stimulus and refine based on further stimulus, feedback and learned experience. A system with the above principle would have ability to incrementally deliver intelligent response. A design to deliver both high accuracy and degree of complexity has high probability of falling short of expectations. A system with above cabaility using combintorial logic would require model, dataset and training requiirements that is computationaly intesive, low energy efficiency. In mechanical automobile systems, the speed requirements depend on the fuel and response time requirements.

Dimentional reducttion, feature selection, embedded dimentions, are methods to achieve efficiency and manage resource utilization, reduce the ability to realise the knowledge content in the dataset, potential of the algorithm and computational resoures. A system design to explore the environment, stimulus, features of the dataset, instead of feature engineering, move to incremental feature extraction would magnification of the scope of the region of interest and deliver intelligence with limited resources.

1. Technology Evolution

Technology evolution has been driven by preceeding technology. Consider evolution of technology,

1. Simple dweelings to Civil engineering
2. Simple machines to Industrial resolution
3. Knowledge of EMF brough in Electrical engineering
4. Know of materials enabling semiconductores, devices, processors and computing capability.
5. This decade the research community and the industry are engaged in building Artifical Intelligence and Machine Learning systems.

|  |  |  |
| --- | --- | --- |
| Engineering Streams | Component | Observation  Learning |
| Civil | Knowledge of materials and structures and features. |  |
| Mechanical | Laws of Physics laws governing Forces, Vectors, momentum, inertia, functional elements – Spring, tension, bearings and materials |  |
| Electrical | Laws if Electric, Magnectic fields and charges. Power generation | Laws of Physics, motion, materials, machines |
| Elctronics | Properties of components, electonic functions, semiconductor doping, control of conduction | Usage of power, improved understanding of materials, and ability of machines to deliver them |
| Computer | Binary Logic, Gates, VLSI, processing and software. | Improved understanding of materials. Adoption of Logic, gates and minaturization using machines, power and control |
| AI & ML | Evolving, Cognitive Intelligence integated to Host devices and services in the above systems | Further improved understanding of materials. Complex Gates, Self programming models |

Table 1.0

The pattern of evolution is mostly likely involve improved understanding of materials and Complexity a level above the current.

1. Silicon to Biological Intelligence

Key advantage of exploring the biological elements responsible for intelligence would be traceability of evolution from single cell forms to Humans. A reference to model at cellular level, Organ level exhbiting specific fuctions and CNS Central Nervous system as a whole. One of the intruging fact of Biological intelligence intelligence, they constain one type of cells, Neurons.

Though this could be perceived as the simplicity, however the complexity of each neuron is unprecedented. Each Neuron perform dual function

1. Processing Element
2. Networking Element

Classical AI & ML deliver intelligence via Algorithms. Each neuron has DNA structures that charecterize the system and the process of Transcrption via mRNA modulates the response specific stimulus. As each neuron has the ability to modify the response. This makes the system multi-processing.

Networking is integral part of nervrous system. Each link the signal traverse, the processing of the signal continious in an integrated manner.

Given the number of neurons, the scale of processing capability incrementally as the stimulus traverse functional area of the nervous system and brain, converging to generate outcomes, sub-outcomes and diverge when options are presented. The system presents intelligent outcomes as stimulus is presented and outcomes generated with merits.

biological is the Consider the operation of Hydraulics. Some of the complex and critical infrastructures operations are driven by earthmovers. Hydraulics refers to the technology where in mechanical method to use force of liguid to produce work. Learning from Hydraulics uses Pascals principle [1] to deliver Force in the range of 20-50K.Psi. The pressure is incrementally delivered by the pump in the form or air, Oil, water.Such large amount of is the ability of the system to provide thrust rust incrementally The point isThe take away from the example is work d Key learningOne interesting observation, prior technology has enabled the base for the emerging. Ex. CNC machines, 3D printing combines mechanical, electrical, electronic and computational domains. Learns from the largly adopted technologie is a key enabler of the emerging technology.

1. Design for Incremental Intelligence

Consider analysis of system behaviour. One of the proven method is using Impluse Response. Infinite Impulse response model primarily for linear time invarient system, where the response to infinite impulse is asymptotic. This property isinherint the system considerts both feedforrward and feedback parameters. A concept that is parallel to Intelligent system, the systems produces responses considering current, part and future inputs. As infinite response adds to replicate intelligence as the response does not attain zero as the dataset evolves, the system would continue to transform.Intelligent system also borrows functions from FIR (finite impuse response) systems. The behaviour is charecterised by convolving the input with the.transferr function From intelligence pespective the interaction of input with dataset. Convolution could be generalized as the systems ability to learn applying hypothesis that is learnt. Eigenvalue could represent the magnification of the hypothesis in the direction towards the system Goals. Intelligence would require to be Time Varient as the system process information, detect patterns, models the target host. Holistically, as the inputs arrive the entrophy of the systems could be modelled as Gaussian. Initially the entrophy increases with episodes of experience, with time the system ingests, assimilates, realise features, structures to data frames, consolidate the stimulus and use the model, constrains and produce responses. The complexity involved in delivering Intelligence as a system response would require multiple technologies operate in coherence

Incremental Intelligence is an inherent feature of systems that deliver oucomes incrementally. Problem space magnification ensures optimized for power and reuse of computing resource.

In order to contain the computation and power, dimentional reduction and feature selection is applied on the dataset. In a way this reduces the ‘richness’ of the information content in the dataset. Reducing the features, the decision space is proportionally reduced, and the factor of randomess is reduced.

Incremental Dimentional disassociation using graphs, would present embedded dimentions for data explortion and correlation. Thus enabling respond to stimulus in an incremental manner each time with higher relavence, accuracy and recall.

Enginering streams evolved since historic times provide methods, technics to build Intelligence system, that truely interact and respond to target environment.

1. **Paradigm shift**

Computing Platforms are designed to perform tasks instructed by the user. The requirement, process and outcome are user centric. In order to deliver natural intelligence function the requirement, process and outcome needs to be transfered to the platform. This pardigm is not new in the technology space. Wireless communication at large operates in autonomous mode, user registration, services, handovers, policy contol and billing as well.

There is convincing evidence to such architecture, expalined as follows. The RMSSD (root mean square of successive differences between normal heartbeats) **RMSSD** represents the rate of blood flow and oxygen levels, energy transfer. RMSSD value are higher in the reegion of executive fuctions of the brain, in the Autonomous & Parasympathetic mode.

The implication of the above finding opens up architecture and options to explore and exploit.

Consider the computing systems built to deliver intelligence with high utilization higher compared to when the system is engaged on tasks. This alters the basic principles of computing, operating system and application. Idle statte CPU and memory utilization high. The application shifts to execution state while in standard inport wait cycle.

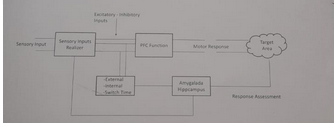
While(!kbhit()) {

}

Linux uses /sys/devices/system/cpu/cpuidle/ in sysfs. Based on the status of the CPU at the start of the Idle time,the scheduler computes the ticks to switch the CPU to power down mode. power management quality of service (PM QoS) framework manages the usability and readiness when the system switch out of idle state. Operating systems in general is design to detect the state of the CPU and apply respective methods to load balance and switching CPU’s to power down model.

This is in contrast to natural intelligence behavior. This trivia needs to be understood and applied to advantage.

Conceptually, an architecture that realize the concept of normalizing the usage of resources spread over period of time.



Validation from Clinical findings requires no further investigation and requires explanation.

Consider the architecture presented in the figure. There exist 2 paths.

1. The forward path, the system responds to stimulus presented based on the Transfer Faction in the form of algorithm, Model.
2. The feedback path represents the autonomous mode. Relatively idle when the system is engaged in responding to stimulus. During the absence of activity, the autonomous system, engages in Re-processing the episodes, the rewarding experience.
3. The Autonomous mode components emulate inputs that could **Convert** rewarding experience to higher degree and **Invert** negative rewarding experience to rewarding ones. Stimulus from multiple sources universalized allows the Autonomous systems perform multimode operations
4. The above model allows the system to be power conservative. The energy requirement for Physical requirement is approximatly equal to resting requirement.
5. Feature virtualization allows feature transfer, allow system to produce the randomess present in the cognition.
6. Count [( No. of Friends ) – ( Grades )] = Cognition
7. ConsolThe stimulus regenerated is synthesized by the system in heuristic manner. The virtualizer creates the make feel as the stimulus is natural. The stimulus arrives from heterogeneous sources, to be converted into system process able form. The system responds based on Transfer Function, in the form of algorithm, model. When the system The stimulus .hat utilizes the idle time to generate Intelligence viationComputers are by design Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Maecenas porttitor congue massa. Fusce posuere, magna sed pulvinar ultricies, purus lectus malesuada libero, sit amet commodo magna eros quis urna. Nunc viverra imperdiet enim. Fusce est. Vivamus a tellus. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Proin pharetra nonummy pede.

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