Business Application – Acquisition, Development & Implementation

(Module - 5 : DISSA Course) **- AI**

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March 20, 2022

Brief History of AI: 1950s

- Computers were thought of as an electronic brains
- Term "Artificial Intelligence" coined by John McCarthy
  - John McCarthy also created Lisp in the late 1950s
- Alan Turing defines intelligence as passing the Imitation Game (Turing Test)
- AI research largely revolves around toy domains
  - Computers of the era didn't have enough power or memory to solve useful problems
  - Problems being researched include
    - games (e.g., checkers)
    - primitive machine translation
    - blocks world (planning and natural language understanding within the toy domain)
    - early neural networks researched:
    - automated theorem proving and mathematics problem solving

The 1960s

- AI attempts to move beyond toy domains
- Syntactic knowledge alone does not work, domain knowledge required
  - Early machine translation could translate English to Russian (*"the spirit is willing but the flesh is weak*" becomes "*the vodka is good but the meat is spoiled")*
- Earliest expert system created: Dendral
- US sponsored research into AI targets specific areas – not including machine translation
- Weizenbaum creates Eliza to demonstrate the futility of AI

1970s

- AI researchers address real-world problems and solutions through expert (knowledge-based) systems
  - Medical diagnosis
  - Speech recognition
  - Planning
  - Design
- Uncertainty handling implemented
  - Fuzzy logic
  - Certainty factors
  - Bayesian probabilities
- AI begins to get noticed due to these successes
  - AI research increased
  - AI labs sprouting up everywhere
  - AI shells (tools) created
  - AI machines available for Lisp programming
- Criticism: AI systems are too brittle, AI systems take too much time and effort to create, AI systems do not learn

Today: AI

- ❖ **Evolution of AI**
- ❖ 1986-Rise of Machine Learning
- ❖ 1990-Role of Expert Systems, DSS
- ❖ 1995- AI as Science
- ❖ 2018 - AI : Disruptive Technology

- **Areas of current research interest:**
  - Information Retrieval, Speech Recognition
  - Planning/Design, Diagnosis/Interpretation
  - Sensor Interpretation, Perception, Visual Understanding , Robotics
- **Approaches**

- ❖ Knowledge-based- Intelligence-The Capacity to learn & solve
- ❖ AI = simulation of human intelligence by machine
  - **Ontologies** = Ontology is the branch of philosophy that studies concepts such as existence, being, becoming, and reality
  - ontology is an explicit specification of a conceptualization
  - Probabilistic (Hidden Markov Models -HMM, Bayesian Nets)
  - Neural Networks, Fuzzy Logic, Genetic Algorithms

AI

'Artificial intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs.' – John McCarthy, father of AI

- Thinking humanly
- Thinking rationally
- Acting humanly
- Acting rationally

Goals of AI

- To make computers more useful by letting them take over dangerous or tedious tasks from human
- Understand principles of human intelligence
- Mathematics formalizes 3 main area of AI: *computation*, *logic*, and *probability*
- ***Philosophy***
  - Initiate the idea of mind as a machine and its internal operations

AI : Capabilities

- Pattern recognition
- **Face recognition**: Pose, lighting, occlusion (glasses, beard), make-up, hair style
- **Character recognition**: Different handwriting styles.
- **Speech recognition:**
- **Medical diagnosis**: From symptoms to illnesses
- **Web Advertizing**: Predict if a user clicks on an ad on Internet.

What is Learning?

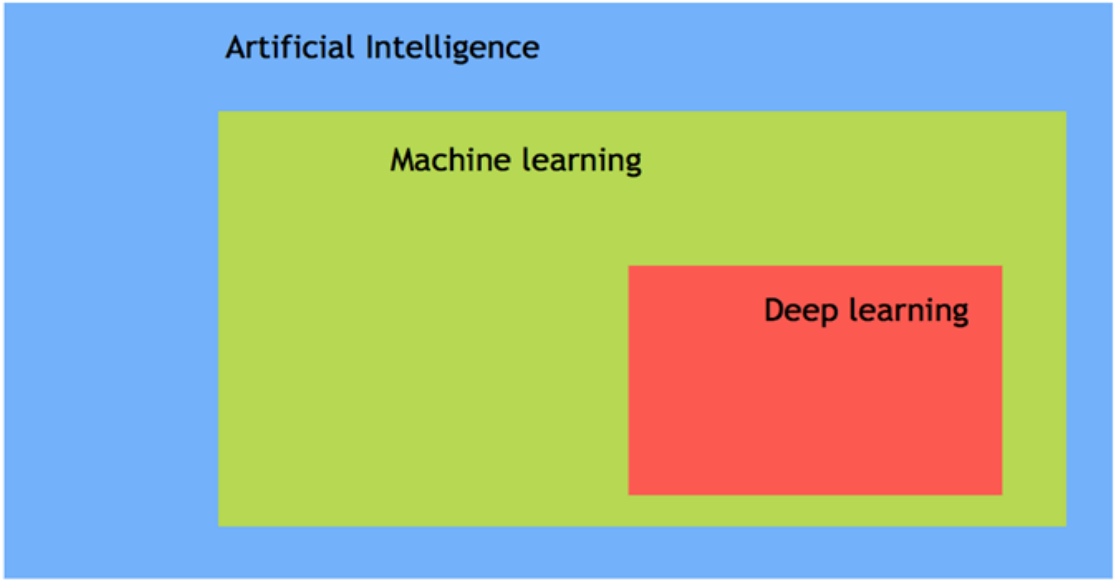
- *"Learning denotes changes in a system that ... enable a system to do the same task … more efficiently the next time."* - Herbert Simon
- *"Learning is constructing or modifying representations of what is being experienced."* - Ryszard Michalski
- *"Learning is making useful changes in our minds."* - Marvin Minsky

*"**Machine learning** refers to a system capable of the autonomous acquisition and integration of knowledge."*

Machine Learning- major avenues

- **No human experts interface**
  - industrial/manufacturing control
  - drug design, astronomic discovery
- **Human expertise- Simulation**
  - face/handwriting/speech recognition
  - driving a car, flying a plane
- **Rapidly changing phenomena**
  - credit scoring, financial modeling
  - diagnosis, fraud detection
- **Need for customization/personalization**
  - personalized news reader
  - movie/book recommendation

ML = Related Fields



Machine learning = primarily concerned with accuracy &effectiveness of the *computer system*.

Class 1 – Basic Automation (RPA)

- operate **on presentation layer of business applications without interfering** with the underlying IT architecture.
- processes **structured data (spreadsheets, data present in relational databases, etc.), rule-based and transactional tasks** by mimicking human actions.
- **Class 2 – Enhanced Automation (Intelligent Automation)**
- Uses data extraction techniques augmented with ML capability **to ingest unstructured data (scanned document images, PDF and scanned handwritten images)** with a higher **accuracy rate & confidence as compared to OCR**
- **Pattern recognition**

Class 3 – Cognitive Automation (AI)

Uses sophisticated AI technologies :

- **Natural Language Generation,**
- **Speech Recognition,**
- **Computer Vision**, etc., to ingest super data sets , perform cognitive tasks previously done by humans such as:

1. **reasoning,**
2. **perceiving,**
3. **interacting with the environment variables**
4. **and problem solving.**

AI= Duplicate intelligent (human) behaviour in computer systems

- **Cognitive solutions :** *advanced self-learning capabilities, advanced predictive analytics.*
- **Costly to develop and implement**, and **generally require a long lead time.**
- **IS Auditor :** assist in migration, adoption, operation, optimisation

AI, ML, DL

- **AI = study of training machine (computers) to mimic human brain & it's thinking capabilities"**.
- **Benchmark for AI :** human intelligence regarding reasoning, speech, learning, vision & problem solving.
- AI focuses on 3 major aspects(skills):

✓ learning,

✓ reasoning &

✓ self-correction .

- **Machine Learning:** study/process which provides system(computer) to learn automatically on its own through experiences it had & improve accordingly without being explicitly programmed. **ML = application or subset of AI.**
- **Deep Learning:** sub-part of broader family of ML - use of **Neural Networks**(neurons working in brain) to mimic human brain-like behavior.
- DL algorithms focus : **information processing patterns** mechanism to possibly identify patterns just like our human brain does & classifies the information

ML types

- **1. Supervised ML** = assets & operations modeled by humans selecting relevant sensors (tags) - statistically related & selected periods of archived Big Data that represent **"good behavior"**
- **Hence =** software can create digital signature of what is considered to be proper operation.
- Incoming real-time data is then compared to this digital signature,
- Deviations are identified as possible early warnings of asset or operational degradation
- **2. Unsupervised** =
- data is automatically analyzed,
- relationships among data are systematically determined,
- deviations from patterns of normal behavior are identified with no human intervention

4 P's of Industrial AI:

- **1. Predictive:** method of anomaly detection in near-real-time
- Based on ML , type of pattern recognition & anomaly detection leveraging Industrial Big Data to create digital signatures of assets & processes
- to detect both deviations & matching patterns =indicate early warning of pending problems & inefficiencies, errors in design process.
- Spot anomalies in how processes, equipment & assets are performing with advanced pattern recognition powered by ML.
- Early detection & warning of equipment failure, inefficiencies, errors in engineering, operations & performance improves safety, operational risk
- The **Big Data sourcing** =
- sensors, data base, calculated values, audio, video, SCADA , online meters , other control systems
- advanced pattern recognition = digital signatures of **normal behavior** of an asset or process are captured
- Then = **used as basis** of comparison with incoming, real-time data
- **AI apps -** identification of fraudulent claims & invoices,
- OCR for vehicle tracking & real-time safety monitoring within factories.

2. Performance based AI

- Based on simulation & ML = optimization system leveraging industry & asset specific algorithms and modeling techniques to provide early warning detection of pending problems & inefficiencies when compared to actual sensor values.
- Based on issues detected in Predictive & Performance analytics = Root cause analysis, optimized solutions, risk-based decision support guide user to most efficient decision
- Combination of both online & simulation software that leverages ML to baseline performance through advanced pattern analysis in order to ensure mathematical models accurately match operational reality.
- Deviations can be quickly detected = early action taken to rectify situation.
- **3. Prescriptive:**
- Based on issues detected in Predictive & Performance analytics = provides root cause analysis, planning & decision-support, & probabilistic courses of action to best remedy & optimize given situation.

- **4. Prognostics:**
- **Prognostics** - Forecast future events, schedules, & operational scenarios to manage risk, maximize profitability & improve sustainability
- Leveraging neural net, deep-learning, & reinforcement learning = provides forecast of future events.
- Used in **monitoring/control & scheduling optimization**
- Determining **how long an asset or process can continue to safely operate** (after anomaly has been detected) before failure or significant loss of functionality occurs.
- **Risk-based insight in decisions** - whether or not an operation should attempt to run to next planned maintenance outage.
- Can the system make it to next planned maintenance outage?

Use of Chatbots

A program designed to carry on conversation with human user

- Chatbots = computer programmes which mimic conversation with people using NLP & AI.
- Can interact with people on internet by initiating a conversation.
- Act as digital assistants = address queries regarding products or services
- Chatbots don't need to be downloaded, don't need storage space on devices.
- **Typical usage**

✓ Answering FAQs of users accessing websites,

✓ generate customer leads,

✓ Provide support services (HR, IT, Finance etc.)

✓ provide legal advice to user.

✓ Chatbots can work 24x7, with no disruption, accessed anytime anywhere.

Advantages of Artificial Intelligence

- more powerful and more useful computers
- new and improved interfaces
- solving new problems
- better handling of information
- relieves information overload
- conversion of information into knowledge

Challenges

- increased costs
- difficulty with software development - slow and expensive
- few experienced programmers
- Limited practical products have reached the market.

Robots = Vendor selection

- ***IS Auditor Consulting role = review areas***

1. Clearly laying down business requirements. e.g., geographic scope, vendor preferences;
2. Evaluate characteristics of vendors to best suit objectives e.g., integration capability, level of developer support;
3. Review vendor for specialized solutions showcasing industry & functional expertise;
4. Determine appropriate delivery model & pricing structure considering resource availability & support model;

- 5. Flexibility & costs with licensing model of vendor tool
- 6. Vendor support for training, service desk support & implementation
- 7. Architecture structure of systems, interconnections & dependencies
- 8. Functionality capabilities related to level of support for RPA functions
- 9. Development effort
- 10. Management, auditing & logging capability
- 11. Effort for robot management, scheduling, event triggers & priorities

IS Audit of AI

- **Elements of AI Ecosystem**
- **1. Artificial intelligence ethics & governance models**
- Formal standards & procedures for implementation of AI engagements
- **2. Data and model management, governance & privacy**
- **3. Understanding human-machine integration, interactions, decision-support & outcome**
- **4. Third-party AI vendor management**
- **5. Cybersecurity vulnerability, risk management & business continuity**
- **Auditability** = possibility to evaluate algorithms, models, & datasets;
- to analyse operation, results , effects, expected + unexpected of AI systems.
- **Part 1** = technical -measuring performance of system according to several criteria (reliability, accuracy of results, etc.).
- **Part 2** = ethical part - apprehending its individual & collective impacts, checking that it does not pose risk of breaching certain principles of privacy or equality.