UIT2504 Artificial Intelligence

Orientation to the course

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- Is AI a part of Computer Science?

What is AI?

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

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The textbook advocates "Acting Rationally"

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- "[The automation of] activities that we associate with human thinking such as decision-making, problem solving, learning . . ." [Bellman]
- "Computational Intelligence is the study of the design of intelligent agents" [Poole et al.]

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  - Computer Vision
  - Robotics

Thinking like a human

- Cognitive modeling
  - Introspection
  - Psychological experiments
  - Brain imaging
- General Purpose Problem Solver (Newell and Simon)

Rational Thinking

- Logical Reasoning (Propositional and Predicate logics)
- Non-monotonic Reasoning
- Probabilistic Reasoning

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Acting Rationally

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- However, always optimizing the expected outcome may not be feasible

AI cuts across various fields

Philosophy	methods of reasoning, mind as a physical system, foundations of learning, language, rationality
Computer Science	Formal representation and proof algorithms, computation, (un)decidability, (in)tractability, probability
Computer Engineering	building fast computers, IoT, sensors and actuators
Economics	utility, decision, and game theories
Neuroscience	physical substrate for mental activity, neural networks
Psychology	phenomena of perception and motor control, experimental techniques
Control theory	design systems that maximize an objective function over time
Linguistics	knowledge representation, grammar

Abridged History of AI

1943	McCulloch & Pitts: Boolean circuit model of brain
1950	Turing's "Computing Machinery and Intelligence"
1956	Dartmouth meeting: "Artificial Intelligence" adopted
1950s	Early AI programs: Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
1965	Robinson's complete algorithm for logical reasoning
1966–73	AI discovers computational complexity Neural network research almost disappears
1969–79	Early development of knowledge-based systems
1986–	neural networks return with back-propagation algorithm
1987–	Several modern approaches
1995–	The emergence of intelligent agents
2000–	Availability of large datasets
2012–	Deep learning takes over
2022–	Do I need to mention Generative AI !!?

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- DALL-E, ChatGPT

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- Written content augmentation and creation: Producing a "draft" output of text in a desired style and length
- Question answering and discovery: Enabling users to locate answers to input, based on data and prompt information
- Tone: Text manipulation, to soften language or professionalize text
- Summarization: Offering shortened versions of conversations, articles, emails and webpages
- Simplification: Breaking down titles, creating outlines and extracting key content
- Classification of content for specific use cases: Sorting by sentiment, topic, etc.
- Chatbot performance improvement: Bettering "sentity" extraction, whole-conversation sentiment classification and generation of journey flows from general descriptions
- Software coding: Code generation, translation, explanation and verification

AI: State of the Art

- Autonomous Vehicles: No hands across America (driving autonomously 98% of the time from Pittsburgh to San Diego)
- Game Playing: Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997
- Theorem Proving: Proved a mathematical conjecture (Robbins conjecture) unsolved for decades
- Logistics: During the 1991 Gulf War, US forces deployed an AI logistics planning and scheduling program that involved up to 50,000 vehicles, cargo, and people
- Autononous Planning: NASA's on-board autonomous planning program controlled the scheduling of operations for a spacecraft
- NLP and Problem Solving: Proverb solves crossword puzzles better than most humans

AI: State of the Art

- Speech recognition: Automated speech recognition and dialog management (Alexa, Google, Siri, Cortana, etc.)
- Spam filtering: Learning algorithms outperform traditional approaches
- Robotics: robotic vacuum cleaners, robotic receptionists, service robots, humanoid robots for geriatric care, etc.
- Machine Translation: On-the-fly translation from one language to another
- Image / Video analysis: Recognize and track different objects (from thousands of classes)
- Text semantics: King - Male + Female = Queen
- Text / Image / Speech synthesis

Risks of AI

- Lethal autonomous weapons
- Surveillance and persuasion (social media)
- Biased decision making
- Impact on employment
- Safety critical applications
- Cybersecurity
- Artificial Super Intelligence ???

Course Overview

- Agents and Environments
- Problem solving agents
- Game playing and Constraints satisfaction
- Logical Reasoning
- Probabilistic Reasoning

Questions?

- Read chapter 1 of the textbook!