# Artificial Intelligence

1. Introduction

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What is Artificial Intelligence (AI)?

- Intelligence – Ability to apply knowledge to one's environment, to think abstractly, to learn, to understand or to predict

- Artificial Intelligence [1] – Understanding and building intelligent entities (machines) that can (compute how to) act effectively and safely in a wide variety of unseen situations

- Artificial Intelligence [2] – The study of computations that make it possible to perceive, reason and act
  - AI is about doing the "right thing," or rationality
  - Since AI is relevant to any intellectual task, it is a truly universal field
  - The term was coined by Shannon, McCarthy and Minsky in 1956 in a memo to organize a workshop at Dartmouth College

What is AI?
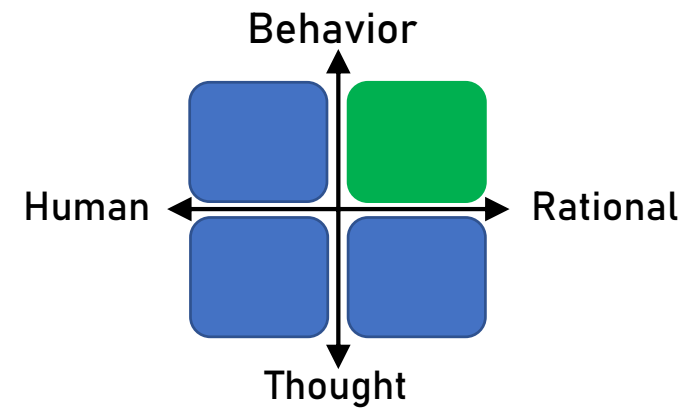
- Human-like system
  - Psychology, neuroscience, human behavior
- Rational system i.e., doing the right thing
  - Mathematics, statistics, engineering, control theory, economics
- Intelligence can be characterized by
  - Internal thought process and reasoning – internal characterization
  - Intelligent behavior – external characterization
- This course: Designing systems that act rationally
- Intelligence from computation
  - Fast search, planning, constraint satisfaction, adversarial and uncertain search
- Intelligence from data
  - Bayes' nets, Decision theory, Machine learning

Applications of AI

- Learn from the vast corpus of knowledge and data available on the Internet to answer questions and generate new content
  - Education, editing, programming, farming, making people more intelligent, daily life work, …
- Assist medical professionals with diagnosis, surgery, treatment plan, patient care
- Assist in manufacturing with automated and intelligent assembly line, inspection, maintenance and supply-chain management
- Household jobs, cook and personal assistant
- Running an office, taking impartial and optimal decisions
- Endless possibilities!

History of AI

- As old as CS: motivation to build computers was to build machines that can think
  - Calculators already existed
  - Georgetown-IBM experiment: "Electronic brain" to translate Russian to English, 1954

- 1940-50 : Early days
  - 1943 : McCulloch and Pitts – Boolean circuit model of brain
  - 1950 : Turing – Computing Machinery and Intelligence

MIND

A QUARTERLY REVIEW

OF

## PSYCHOLOGY AND PHILOSOPHY

———— ❦ ————

I.—COMPUTING MACHINERY AND INTELLIGENCE

By A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?'
This should begin with definitions of the meaning of the terms
'machine' and 'think'.   The definitions might be framed so as to
reflect so far as possible the normal use of the words, but this
attitude is dangerous.   If the meaning of the words 'machine'
and 'think' are to be found by examining how they are commonly
used it is difficult to escape the conclusion that the meaning
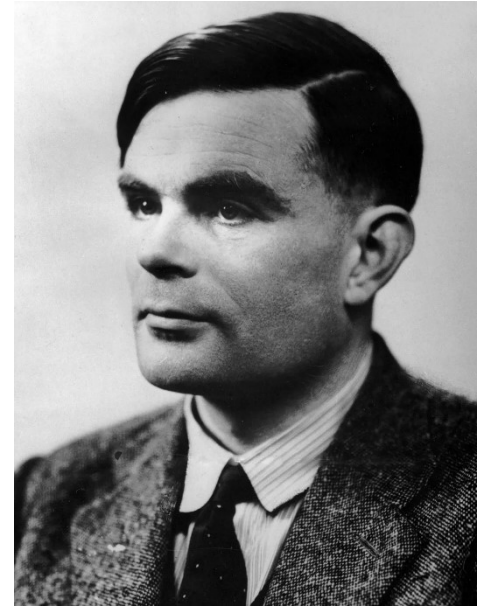
History of AI

- **1950–70 : Initial development, over-optimism**
  - 1950s : Samuel's Checker player, Newell and Simon's Logic Theorist, early AI programs
  - 1956 : Dartmouth Meeting, "Artificial Intelligence" coined
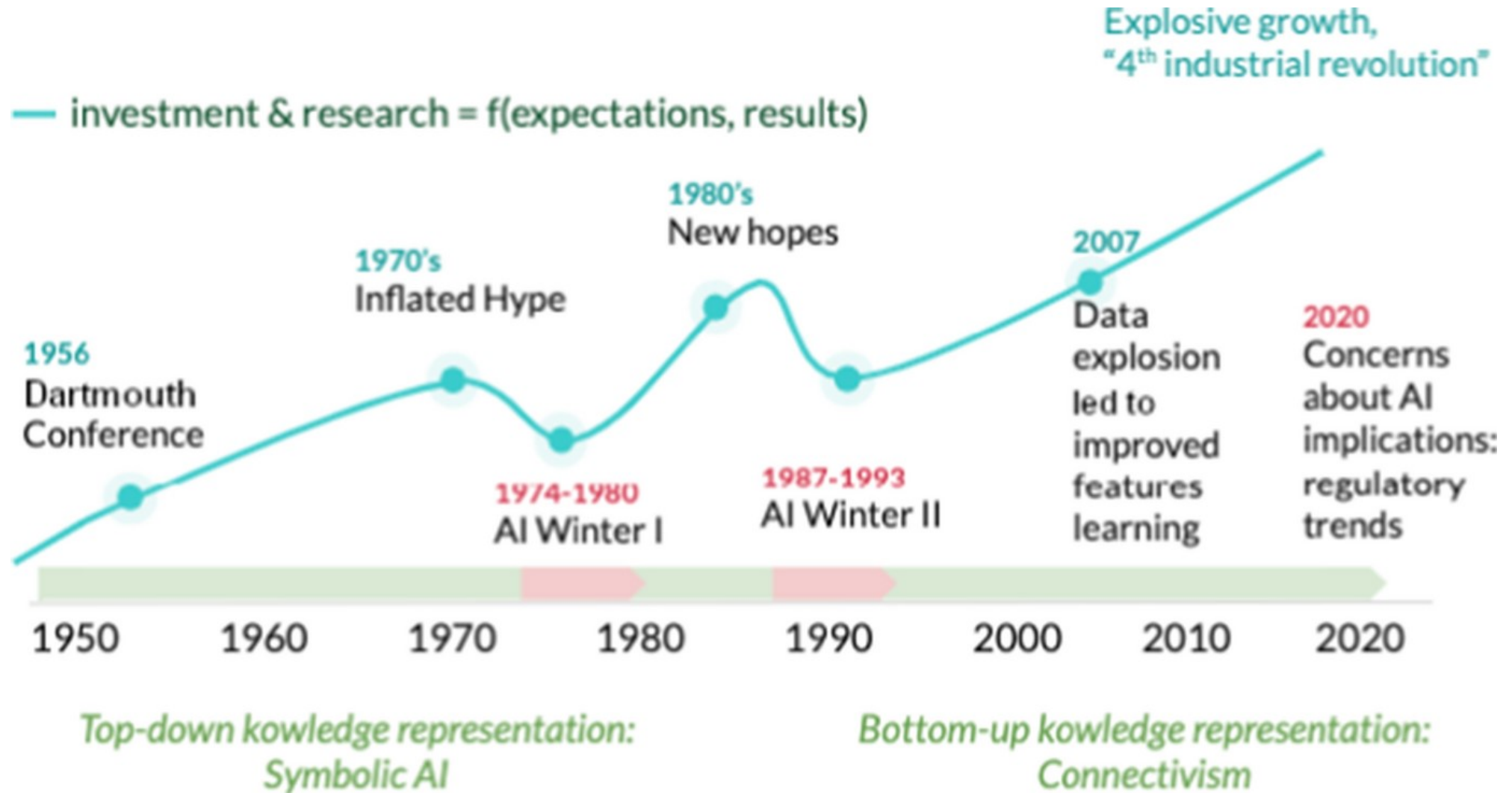 - 1965 : Robinson's complete algorithm for logical reasoning

- **1970–90: Knowledge-based approaches**
  - 1969–79 : Early development of KB systems, Dendral (Molecular structure), Mycin (blood infection diagnosis)
  - 1980–88 : Expert system industry boom
  - 1988–93 : Expert system industry bust, AI winter (extending to 2000)

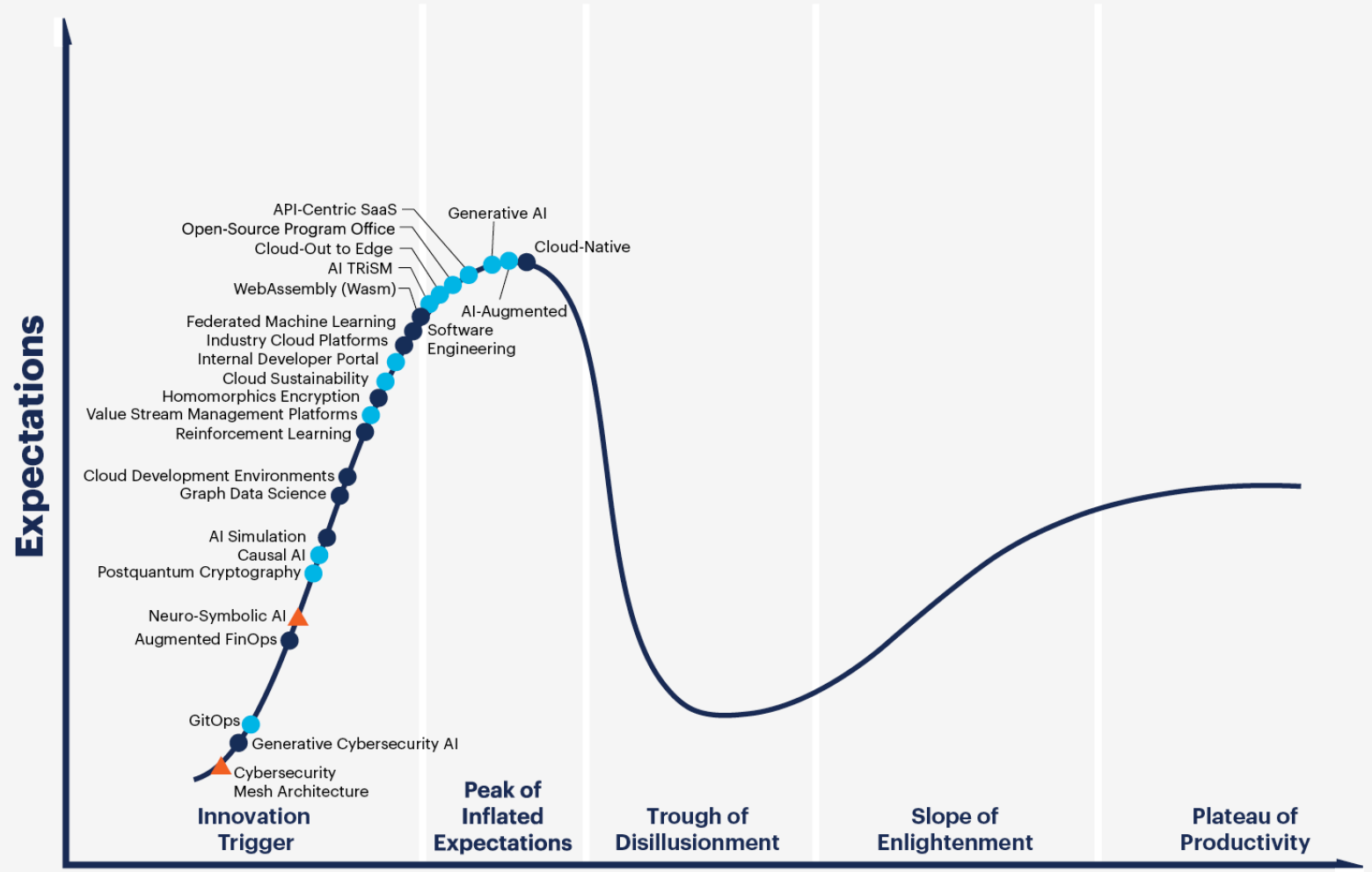# History of AI

- 1990–2012 : Statistical approaches
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - AI spring – agents and learning systems

- 2012 – : Excitement, exponential growth
  - Big data, deep learning, large language models, generative AI
  - Reunification of fields
  - AI adopted in many industries
  - AI reached mass population

AI Winters

— investment & research = f(expectations, results)

Explosive growth, "4th industrial revolution"

1980's New hopes

1970's Inflated Hype

2007 Data explosion led to improved features learning

1956 Dartmouth Conference

2020 Concerns about AI implications: regulatory trends

1974-1980 AI Winter I

1987-1993 AI Winter II

1950   1960   1970   1980   1990   2000   2010   2020

Top-down kowledge representation: Symbolic AI

Bottom-up kowledge representation: Connectivism

AI Outlook

Hype Cycle for Emerging Technologies, 2023

Expectations (y-axis)

Time (x-axis)

- API-Centric SaaS
- Open-Source Program Office
- Cloud-Out to Edge
- AI TRiSM
- WebAssembly (Wasm)
- Generative AI
- Cloud-Native
- Federated Machine Learning
- Industry Cloud Platforms
- Internal Developer Portal
- Cloud Sustainability
- Homomorphics Encryption
- Value Stream Management Platforms
- Reinforcement Learning
- AI-Augmented Software Engineering
- Cloud Development Environments
- Graph Data Science
- AI Simulation
- Causal AI
- Postquantum Cryptography
- Neuro-Symbolic AI
- Augmented FinOps
- GitOps
- Generative Cybersecurity AI
- Cybersecurity Mesh Architecture

Innovation Trigger | **Peak of Inflated Expectations** | **Trough of Disillusionment** | **Slope of Enlightenment** | **Plateau of Productivity**

Plateau will be reached:

○ less than 2 years   ● 2 to 5 years   ● 5 to 10 years   ▲ more than 10 years   As of August 2023

gartner.com

Administrative Matters

- Office: **125 GICT**

- Office hour: **Wednesdays 1:00 PM to 3 PM**

- Lectures: **Mon & Fri 1:00 to 2:30 PM**

- Website: shashi-prabh.github.io/teaching

- Textbook: **Russell and Norvig, 4th Edition**
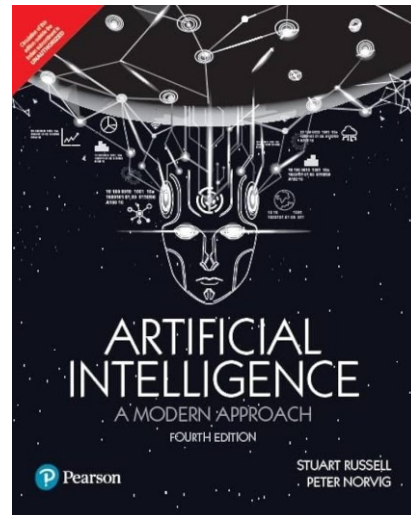
Artificial Intelligence
CSE 518, Monsoon 2024

Lectures: Mon and Fri 1:00 PM - 2:30 PM. GICT 203
Instructor: Shashi Prabh
  Office: GICT 125
  Office hour: Wed 2:00-4:00 PM, or by appointment
  Email: shashi.prabh @ ahduni
Prerequisites: Introduction to Computation and Programming (CSC 104), Data Structures and Algorithms (CSE210), Discrete Math (MAT 101), Probability and Random Processes (MAT 202). Programming ability is a MUST.

Introduction and course objectives
Artificial intelligence (AI) is bound to impact human life in a big way. The syllabus is State spaces, Search (uninformed, informed, local), Games and adversarial search, Logical inference, Constraint satisfaction problems, Bayesian networks, Markov chains, Hidden Markov models, Forward and Viterbi algorithms, Markov decision processes, Machine learning, Neural networks, Reinforcement learning, Deep learning and AI for Robotics.
The objectives are:
- Learn the fundamentals of Artificial Intelligence.
- Learn to represent knowledge.
- Learn to build autonomous agents that can make efficient decisions in fully informed, uncertain and adversarial environments.

AI, Monsoon 2024
Course Calendar

Session No.	Topic Title	Topic and subtopic details	Readings, Programming
1	Introduction	What is AI, Foundations of AI, Current state of AI	1 Install AIMA Python package
2,3	Intelligent Agents	Agents and Environment, Rationality, Nature of Environment, Structure of Agent	2
4,5	Search Algorithms	Problem solving agents, Best-first Search, Uninformed Search: Breadth First Search, Uniform cost search, Depth First Search	3.1-3.4

Administrative Matters

- Evaluation
  - Mid-term exam: 35%
  - Final exam: 35%
  - Quizzes (2): 10%
  - Assignments and Project: 20%
- Relative grading
- No Make-up
  - Scaling possible in emergency or important family events
    - Supporting documents must be provided on the day of final exam

Project

- Default topic or a topic of your choice
  - Approach me for approval
- Due 2 weeks before the last day of classes
  - Start early

What this course is and is not

- This course is about fundamentals of AI
  - Theory [AI is an old discipline!]
  - Applications
  - Practice
- This is a mathematics and programming intensive technical course
- This is NOT a course that
  - Makes you an LLM expert ready to launch your start-up
  - Teaches you some technology in 15 minutes
  - Teaches AI related policy or detailed discussions on ethical implications
    - Try SAS or Management School courses

Helpful Suggestions

- Take notes! Remain attentive!
  - Learn to take notes efficiently: search the web

- Clear your doubts during the lecture itself
  - Do not hesitate to ask questions

- Before coming to sessions
  - Review your notes
  - Scan the portion of the textbook to be covered

- Do exercises on your own

Expectations from students

- Spend 10-12 hours per week

- Remain up-to-date
    - Course material will get difficult with time
    - Catching-up will get difficult

- If absent, find out missed content and announcements from other students

- Absolutely no noise and distractions
    - Use of cellphone, laptop or tablet during lectures is prohibited. Put cellphones in silent mode and keep it in your bag.
    - Come to classes on time

Expectations from students

- **Academic integrity**
  - Penalty of one letter grade upon the first incident
  - Fail grade plus report to the university disciplinary committee upon the second incident.