Module 1 : Introduction to AI -
Intelligent Agents.

Edwin Boring : first intelligence test (IQ test) in USA to recruit WW1

Intelligence : ability to learn and understand things instead of doing things by instinct or automatically.
* to solve problems & make decisions

1950 Turing test — Imitation Game. — (AI) what the game is

Vaucanson's Duck Jacques de Vaucanson
1700s — developed mechanical automatons
* Mechanical duck — talk, eat, digest, excrete
400 moving parts in the coing
quack

Imitation Game
3 people — man (A)
women (B)
interrogator (C)

A tries to make C give wrong identity
B helps to make C give right "

restriction : only permit digital computers
intended to carry out operations which could be done by a human computer.

digital computer — 3 parts
(i) Store
(ii) Executive unit
(iii) control ☆ ensuring its followed is duty of control

paper/ book of rules — "table of instructions"

* Analytical Engine] entirely mechanical

Discrete-state machines
↳ move by sudden jumps or clicks from one quite definite state to another

contrary view on main question:
① the Theological objection — immortal soul
② the 'Head in the Sand' Objection — machine get soul
③ the mathematical objection
④ the argument from consciousness
↳ not until machine has feelings; can it be equal to brain
⑤ Arguments from various disabilities.
Scientific induction — method of reasoning in which the premises are viewed as supplying some evidence, but not full assurance, & the conclusion

experience & observations & what are learnt from others are used to synthesize a general truth.

*machine does not make mistakes → errors of functioning
↓
errors of conclusion
↳ electrical
↳ mechanical
avoiding means we talking about abstract machines

⑥ Lady Lovelace's Objection

"Analytical Engine has no pretensions to originate anything. It can do whatever we know how to order it to perform."

⑦ Argument from continuity in Nervous system

not discrete state machine

Continuous machine: differential analyser

⑧ Argument from Informality of behaviour
- rules of conduct.

⑨ Argument from Extrasensory Perception
- telepathy
- psychokinesis
- clairvoyance
- precognition

Cybernetics

Norbert Wiener — PHD math @ 18
└ 1917 (WWI) → GE ⇒ work on ballistics at Aberdeen Proving Ground

Ballistics
└ physical science, technology & a tool of war

Interior Exterior
Behavior & after leaving barrel

Interior ballistics — chemistry & physics, the thermodynamics of combustion & expanding gas

Exterior ballistics — physics of a projectile moving through a resisting medium.

Fire control
Anti-aircraft fire? — pseudo-random generators based on statistical history
derived complex solutions that weren't practical

Cybernetics:
"control & communication in the animal or in the machine"
"The acquisition, communication, processing & application of information."
about systems with feedback.
deals with ~~feedback~~

- Robotics
- Learning Systems
- Neural Nets — AI
- HCI

can be +ve & -ve feedback.
+ve reinforces event
-ve counteracts an event

Claude Shannon { idea of digital transmissions
2 motors serving 1 relays

Ross Ashby } First "Electric Brain"

- machine within a machine
- reacts to environment to maintain stability
- 2 kinds of variables
- self reorganization

Grey Walter } Tortoise
- self recognition?

1950s high hopes

Brief History of AI

3 streams 1) symbolic reasoning
2) Logic
3) computer training

1960s - Perceptrons - learn XOR

1970s - 2 main research groups : neats • scruffies
used logic approach

Why not much success with AI?
1) lack of computer power
2) commonsense reasoning (Minsky)
3) Qualification problem (McCarthy)

Turing Machine

→ Finite State Machine (FSM)

2 elements — Object's internal state
— Derived information from external inputs.

- have a finite number of states
- be able to examine its own state
- be able to receive external input

— consists of an infinite tape that goes under a moveable (head) — read
— write
— move one space left or right

current state
input
Symbol to write
dir^n to move
next state

Self Replicating Machines

(John Von Neumann)

logic gates → Neurons
Parts → Organs

AI Projects

1. Planning & Problem Solving
2. Perception process of obtaining data from one or more sensors
   → maybe visual, IR, x-ray, microwave, tactile, auditory, chemical, electromagnetic
3. Natural language — language for communication b/w machine & human
4. Expert Systems
5. Automation, Teleoperation & Robotics

6. Distributed Data Mngt — ways
transmission & distribution
accomplished rapidly, efficiently
which best supports overall system operation

7. Cognition and Learning
8. Research & Development in AI

Cellular Automata (CA)

an array of identically programmed automata, or "cells", which interact with one another.

CA — STATE — either a no. or a property
NEIGHBOURHOOD — set of cells that a cell interacts with
PROGRAM — set of rules that defined how its state changes in response to its current state

Game of Life — STATE - ON or DIE
1 cell has 8 neighbour cells
if NO neighbour cells are alive then cell dies of loneliness
if ≥3 cells alive then cells dies of overcrowdness
if =3 cells in neighbour, cell is alive

Can CA's be reversed? It can if we use a Margolus Neighbourhood.

Stephen Wolfram developed concept of 1D CA. — state is either ON (1) or OFF (0)
each cell has 2 neighbours (to left & right) or 4 or 8

4 classes of CAs
class 1 - Boring
2 - Stable
3 - Disordered
4 - Display complex behaviour.

Christopher Gale Langton

↳ Langton Loops

↳ came up with CA with 8 colours

white : extends
green : turn left

loops produce identical loops in 151 steps

* this creates growth along of loops

↳ Langton Vants
Virtual Ants — try to stimulate behaviour of ants.

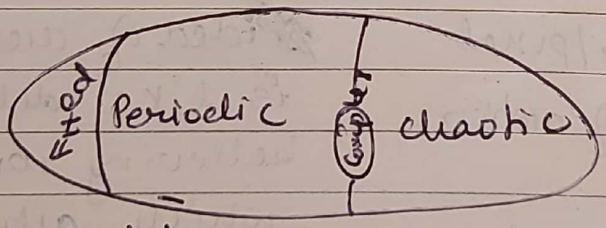
example of emergent behaviour

empty cell : keep moving
black cell : turn right & cell is white
white cell : turn left & cell is left.

↳ developed the lambda parameter — measure of complexity

- power law distribution $1/n^k$
- gives values from 0 to 1 —— Game of life has value 0.273

Artificial life



life exists on the edge of chaos.

2 main principles
1) Look at life as a process
2) Work from the bottom up.

chaos & complexity

Computation at the edge at chaos

CA – D dimensional lattice with a finite automaton residing at each lattice site.

(N) ≤ D
neighbourhood template

Emergence Patterns on the Edge of Chaos.
(trying to explain how this patterns emergence.

Universe
Is Reality digital??
→ History of Science moving from continuous to discrete phenomenon (particle-based).
(↳ eg Electrical : ~~electrons~~)

BUT ~~is quantum mechanics considered digital??~~
Quantum has both continuous & digital at fundamental level.

very microscopic/pixel creates illusion of motion & continuity
(eg TV, movies, frame by frame)

~~idea~~ of creating universe is like delude into believing continuous which actually emerge from discrete event by event

Imitation Game - by Alan Turing

according to Turing - if a machine can converse with a human without being detected as a machine then it has demonstrated human intelligence.

Game Of Life

(1) Moore's Neighbourhood.
- 8 neighbours
- if no. of ON is 2 neighbours then cell maintains its current state
- if no. of ON is 3 neighbours then the cell will be ON in the next period regardless of its current state.
- If number of ON neighbours is any others number then cell is OFF in next period

(2) Margolus neighbourhood.
- Reversible CA

→ 4-cell squares
→ rule specifies how they change in the next generation.

Module 3) Programming Language (Prolog)

Logic/Declarative rather than procedural

Proposition A logic stmt that may or may not be true
- objects < constant / variables

- Atomic propositions
- Compound term — one element of a mathematical relation written like a mathematical f^n.

functor — tuple — ordered list of parameters

functor: function symbol that names the rel^n

Proposition
- fact: prop is assumed to be true
- Query: truth of prop is to be determined

logical operators: ¬ ≡ ∩ ⊕ ∪ ≥ ∀x.P ∃x.P

C — antecedant / consequent — right side / left side

Resolution
- unification
- Instantiation

Sorted List Array

sort (old-list , new_list) ⊂
permute (old-list , new_list) ∩
sorted (new_list)

sorted (list) ⊂ $\forall_j$ such that
$1 \leq j \leq n$,
list (j) ≤ list (j+1)

A2-03

* AI Techniques — that allow computers to learn
↳ find current or future applications.

1. Artificial Neural Nets
2. Genetic Algorithms
3. Genetic Programming
4. Intelligent Agents
5. Robot learning
6. Swarm Intelligence
7. Hybrid Systems.

* how the technique works?
* types of problems it can solve.
* try to write sample programs to illustrate techniques strengths & weaknesses

4-5 Pages

Q1 → interesting news article
Q2 → which AI approach would be most suited for 2 different scenarios
Q3 → proposed AI project & you comment on approach & suitability of project
Q4 → general aspect of AI.
Q5 → overview of field.

AI approach —
1) GA
2) GP
3) ANN
4) Swarm
5) Robotics
6) Intelligent Agents
7) Hybrid

Particle Swarm Optimization

EA
Expert & Fuzzy

1 - 10 minutes

fully autonomous car

fully autonomous car

Q2

healthcare
jobs
poverty
peace ??