Lecture - 4
Task Environments

Artificial Intelligence

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Today's Agenda

- Classical vs. Modern AI
- Task Environments
- Specifying Task Environments
- Properties (Types) of Task Environments

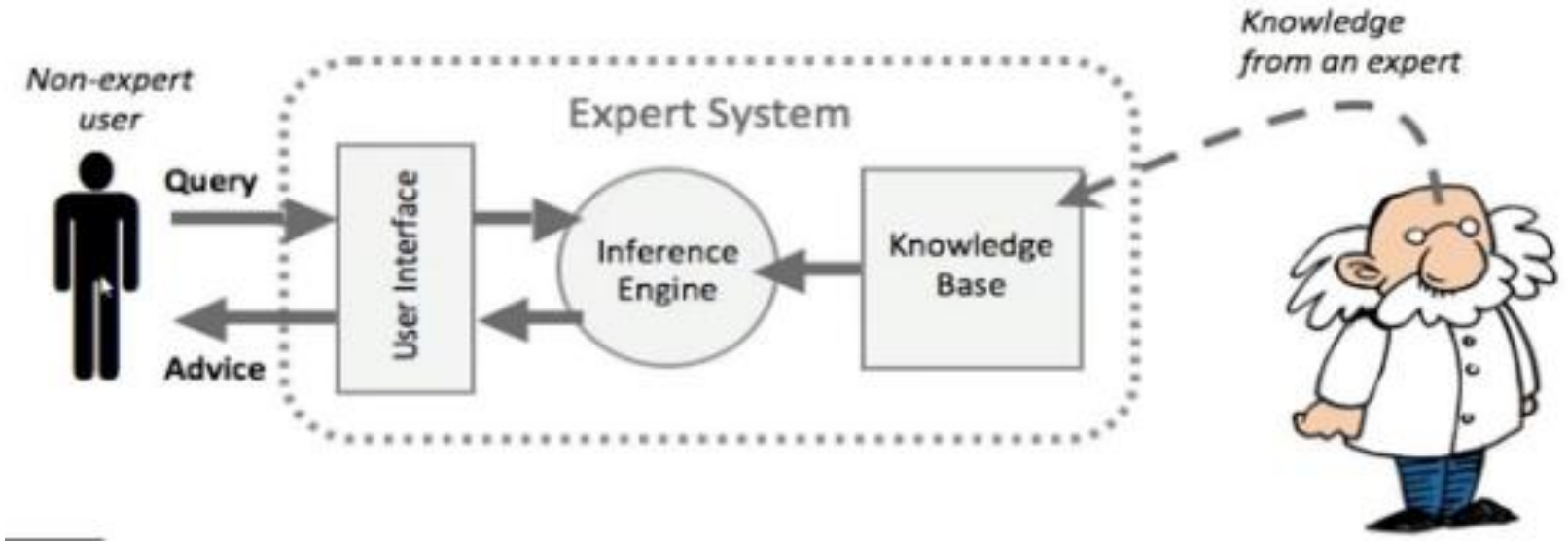
Classical AI

- Relies more on:
  - Pre-conceived rules
  - Symbolic reasoning
  - Inferences drawn
- For example, given as a set of constraints, deduce a conclusion.

Classical historical examples of this conception of intelligence

- Deep Blue, whose aim in life was to be the master of chess, ruling over the intelligent mankind.
- Eliza, a computer based therapist.
- Expert systems

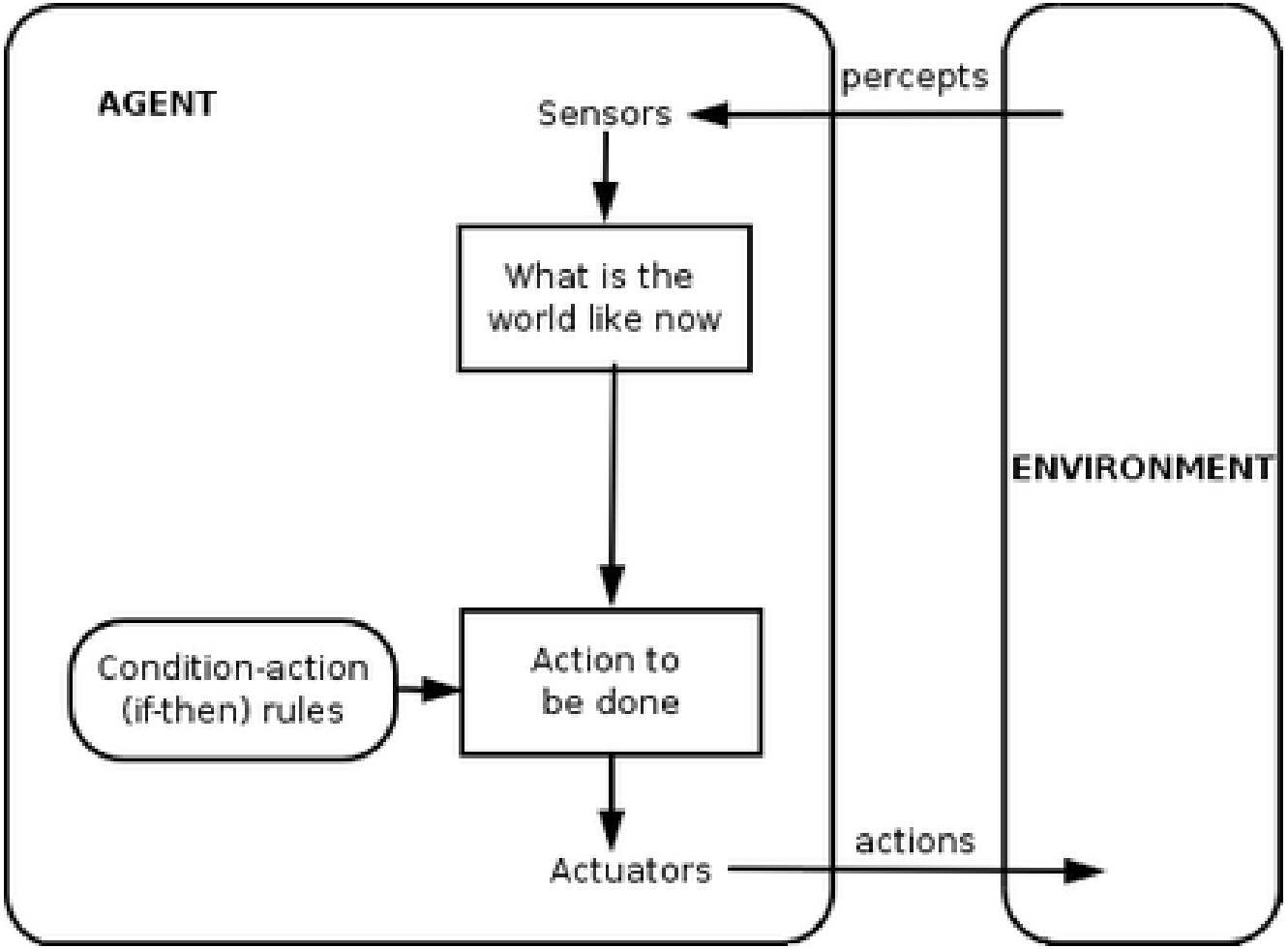
Expert Systems



Modern AI

- Modern AI is based on:
  - Computational intelligence
  - Neural networks
  - Deep learning
    - making inference in layers
- Has much better performance

Agents & Environments



PEAS

- **Task Environment**
  —Problems to which rational agents are solution

- To specify task environment we need:

- **P** - Performance measure
- **E** - Environment
- **A** - Actuators
- **S** - Sensors

Automated Taxi Driver Agent

- **Performance Measures:**

-Getting to correct Destination

-less cost

-high safety

- **Environment:**

-variety of roads

-Traffic

-different types of passenger

Actuators:

-Accelerators

-Steering & brakes

SENSORS:

-Camera

-GPS

- IR sensors

Environment Types (Properties)

- Fully Observable
  - —An agent's sensors give it access to the **complete state** of the environment at each point in time
  - —A task environment is effectively fully observable if the sensors detect all aspects that are **relevant**.
  - —Fully observable environments are **convenient**
  - —Example: Chess with a clock
  - —Image recognition operates in fully observable domains
- Partially Observable
  - —The relevant features of the environment are only **partially observable**
  - —An environment might be partially observable because of:
    - Noisy sensors
    - Missing parts
  - —Example: Automated Taxi

Environment Types (Properties)

- Single Agent Environment
  - —One and only one agent operating by itself in an environment
    - Playing a crossword puzzle – single agent
    - Sudoku
    - Map Coloring
- Multiagent Environment
  - —Two or more than two agents environment
  - —**Competitive** multiagent environment
    - —AI environments face AI agents against each other in order to optimize a specific outcome
      - Chess playing
      - Tic Tac Toe
  - —**Cooperative** multiagent environment
    - —Relies on the cooperation between multiple AI agents
      - Automated taxi driver
      - Smart home sensors

Environment Types (Properties)

- Deterministic
  - —The **next state** of the environment is completely determined by the **current state** and the **action** executed by the agent
    - What if environment is partially observable?
    - What happens in multiagent environment?
  - —**Strategic environment:** deterministic except for actions of other agents
- Stochastic
  - —Cannot clearly predict next state of the environment from current state of actions
  - —Example-Taxi Driving
    - Cannot clearly predict behavior of traffic exactly
    - Tires blow out
    - Engine seize up without warning
  - —uncertainty about outcomes is quantified in terms of probabilities

Environment Types (Properties)

- Episodic
  - —Agent's experience is divided into **atomic** episodes
  - —In each episode the agent receives a percept and then performs a **single** action
  - —**Next** episode does not **depend** on the actions taken in **previous** episodes
  - —Many **classification** tasks are episodic
- Sequential
  - —The current decision could **affect** all **future** decisions
  - —Chess and taxi driving are sequential
  - —**Short-term** actions can have **long-term** consequences
- Which one is simpler and why?

Environment Types (Properties)

- Static
  - —Environment **cannot change** while an agent is deliberating
- Dynamic
  - —Environment **can change** while an agent is deliberating
- SemiDynamic
  - —environment itself does not change with the passage of time but the agent's performance score does
- Which one is simpler and why?

Environment Types (Properties)

- Discrete
  - —If there are a **limited** number of **distinct states**, clearly defined percepts and actions, the environment is discrete
  - —Example- Chess Game
  - —Tic Tac Toe
  - —Sudoku
- Continuous
  - —Assumes continuous values
  - —Continuous time problem
  - —Example- Taxi Driving
- Input from Digital Cameras?

Characteristics of Environments

Task Environment	Observable	Agents	Deterministic	Episodic	Static	Discrete
Crossword puzzle	Fully	Single	Deterministic	Sequential	Static	Discrete
Chess with a clock	Fully	Multi	Deterministic	Sequential	Semi	Discrete
Poker	Partially	Multi	Stochastic	Sequential	Static	Discrete
Backgammon	Fully	Multi	Stochastic	Sequential	Static	Discrete
Taxi driving	Partially	Multi	Stochastic	Sequential	Dynamic	Continuous
Medical diagnosis	Partially	Single	Stochastic	Sequential	Dynamic	Continuous
Image analysis	Fully	Single	Deterministic	Episodic	Semi	Continuous
Part-picking robot	Partially	Single	Stochastic	Episodic	Dynamic	Continuous
Refinery controller	Partially	Single	Stochastic	Sequential	Dynamic	Continuous
Interactive English tutor	Partially	Multi	Stochastic	Sequential	Dynamic	Discrete