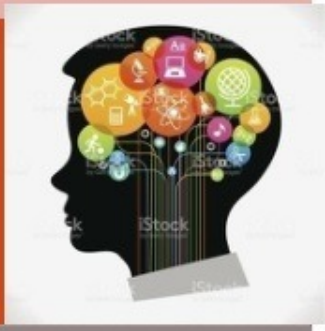
University of Science and Technology
Faculty of Computer Science and Information Technology

Artificial Intelligence (AI)



4th Year B.Sc : Information Technology

Academic Year : 2017-2018

Instructor : Diaa Eldin Mustafa Ahmed

Intelligent Agents (IA)- (1/2)

You will be expected to know

- **Agent**
- **Rational Agent**
- **Task Environment (PEAS)** :

- **P**erformance measure, **E**nvironment, **A**ctuators, **S**ensors

- **Examples for intelligent agents**
- **Properties of Task Environments:**
- **Basic Definitions:**Percept, percept sequance, agent function, agent program.
- **Agent Types :** Reflex ,Model-based ,Goal-based ,Utility-based agents , and Learning agents.

Agents and Environments

- Percept: agent's perceptual inputs at an instant.
- Agent's behavior is Mathematically described by:
- The agent function : A=F(P)
  - where P is the current percept,
  - A is the action carried out, and
  - F is the agent function
- F maps percepts to actions F: P* → A
  - where P* is the set of all percepts, and A is the set of all actions
- In general, an action may depend on all percepts obseved so far, not just the current percept.

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Agents Definition

- An **agent** is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators, and directs its activity towards achieving goals (i.e. it is "rational", Act rational with respect to a performance measure, e.g. time, energy, money, movement.

Human agent:

- **Eyes, ears, skin**, and other organs for sensors.
- **Hands, legs, mouth**, and other body parts for actuators.
- **Light, sound, solidity** as percepts.

- **Robotic agent:**
  - **Cameras , infrared detectors, microphone and accelerometers** for sensors .
  - Various **motors , grippers, wheels, speakers,** for actuators
  - **Light, sound, solidity** as percepts.

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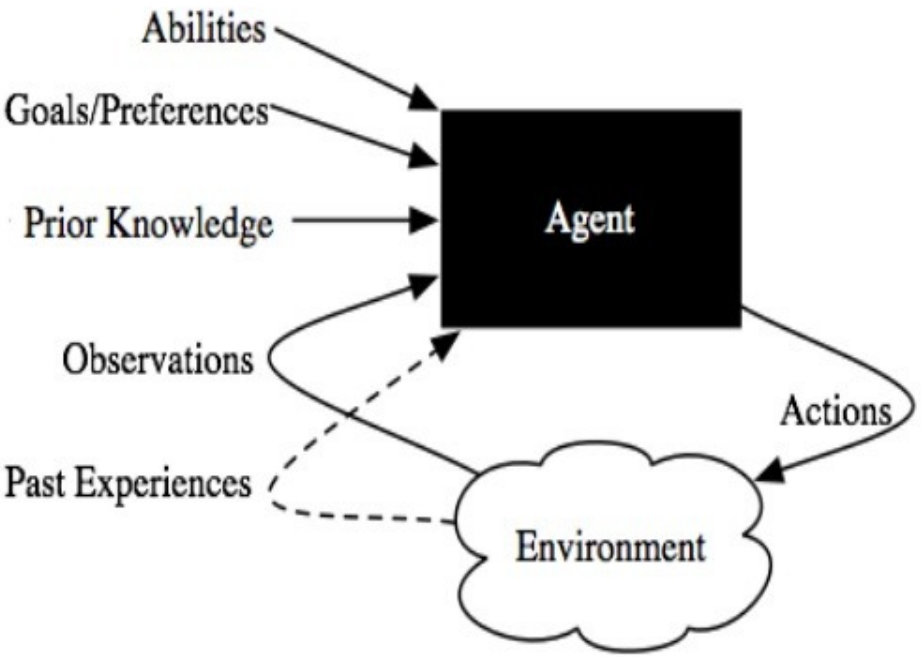
An agent interacting with an environment

- Prior knowledge:about the agent and the environment.
- History of interaction with the environment, which is composed of:
  - observations of the current environment and.
  - past experiences of previous actions and observations, or other data, from which it can learn.



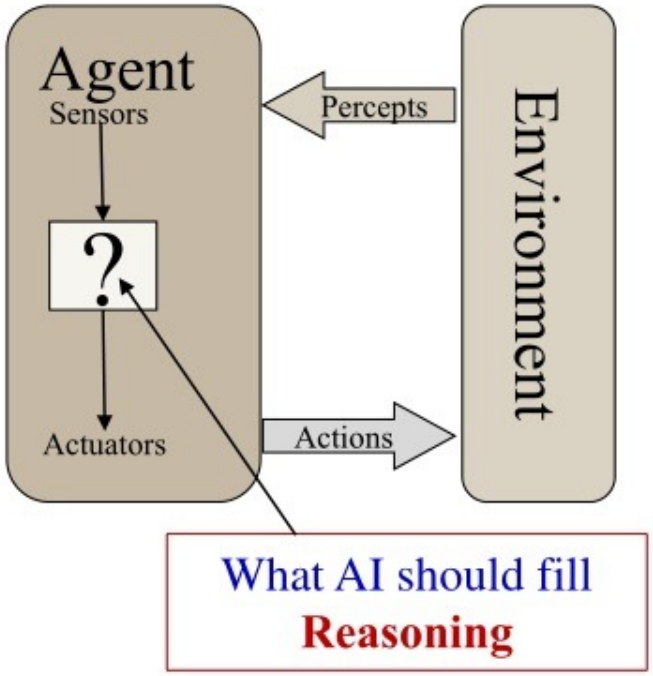
- Goals that it must try to achieve or preferences over states of the world; and abilities, which are the primitive actions it is capable of carrying out.
- An agent could be a program that acts in a purely computational environment--a software agent.

Structure of Agents

- The agent program :
  runs on the physical architecture
  to produce F.

agent = architecture + program

- **Architecture**
  - device with sensors and actuators



  - which also provides and interface to the environment (percepts, actions) .e.g., A robotic car, a camera, a PC.
  - implements the agent function on the architecture.
  - (Agent) Program = some function that implements the agent mapping = "?"= Job of AI

Rationality and Rational Agents

- Rationality
  - A rational agent is one that does the right thing.
  - More precisely, what is rational at any given time depends on **four things**:
    - The performance measure that defines the criterion of success.
    - The agent's prior knowledge of the environment.
    - The actions that the agent can perform.
    - The agent's percept sequence to date.
- Rational Agent:
  - For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure.
- Rational action:
  - whichever action maximizes the expected value of the performance measure given the percept sequence to date.

Specifying the Task Environments (PEAS)

- **Performance Measure**: captures agent's aspiration
  - An objective function that determines
  - How the agent does successfully
  - E.g., 90% or 30% ?
- **Environment:** context, restrictions.
  - the real world of the agent
- **Actuators**: indicates what the agent can carry out.
  - Actions that can perform
- **Sensors**: indicates what the agent can perceive

Basic Agent Algorithm

Basic algorithm for a rational agent

While (**true**) do

Get percept from sensors into memory

Determine best action based on memory

Record action in memory

Perform action.

```
function Skeleton-Agent(percept) returns action
  static: memory, the agent's memory of the world

  memory ← Update-Memory(memory, percept)
  action ← Choose-Best-Action(memory)
  memory ← Update-Memory(memory, action)
  return action
```

Note:

- Memory capacity can be **zero**
- Performance measure is **not part** of the agent.

Properties of Environments

Types of Environment

- Known vs. Unknown.
  - This distinction refers not to the environment itself but to the agent's (or designer's) state of knowledge about the environment.
  - In known environment, the outcomes for all actions are given.
    - **e.g**: solitaire card games.
  - If the environment is unknown, the agent will have to learn how it works in order to make good decisions.
    - **e.g**: new video game.

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Examples of Agents (1)

- Agent : automatic car (automated taxi driver)
  - **Environment**: streets, other vehicles, pedestrians, traffic signals /lights/signs.
  - **Goals/Performance Measure**: safe, fast, legal trip.
  - **Percepts/Sensors**: camera, GPS signals, speedometer, sonar.
  - **Actions**: steer, accelerate, brake.

Agent : intelligent house

- **Environment**: occupants enter and leave house, occupants enter and leave rooms; daily variation in outside light and temperature
- **Goals**: occupants warm, room lights are on when room is occupied, house energy efficient .
- **Percepts:** signals from temperature sensor, movement sensor, clock, sound sensor .
- **Actions**: room heaters on/off, lights on/off .

Examples of Agents (2)

- Agent :Medical Diagnosis System.
  - **Environment**: Patient, hospital, staff
  - **Performance measure:** Healthy patient, minimize costs, lawsuits
  - **Actuators**: Screen display (questions, tests, diagnoses, treatments, referrals)
  - **Sensors**: Keyboard (entry of symptoms, findings, patient's answers)
- Agent :Part-Picking Robot
  - **Environment**: Conveyor belt with parts, bins
  - **Performance measure**: Percentage of parts in correct bins
  - **Actuators**: Jointed arm and hand
  - **Sensors**: Camera, joint angle sensors

Examples of Agents (3)

- Agent: Internet Shopping
  - **Environment**: current and future WWW sites, vendors.
  - **Performance measure**: price, quality, appropriateness, efficiency shippers.
  - **Actuators**: display to user, follow URL, fill in form.
  - **Sensors**: HTML pages (text, graphics, scripts) .
- Agent: Program playing the game of checkers
  - **Environment:** A human opponent player
  - **Performance measure**: Maximize the number of games won
  - **Actuators**: Screen display (the move chosen by the program)
  - **Sensors:** Keyboard (the move chosen by the human player)

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  - **Sensors:** Keyboard (the move chosen by the human player)

Home Work

Specify the task environment (PEAS) of the following Agents:

1- Spam filter (A software that can detect spam and removed or discard it).

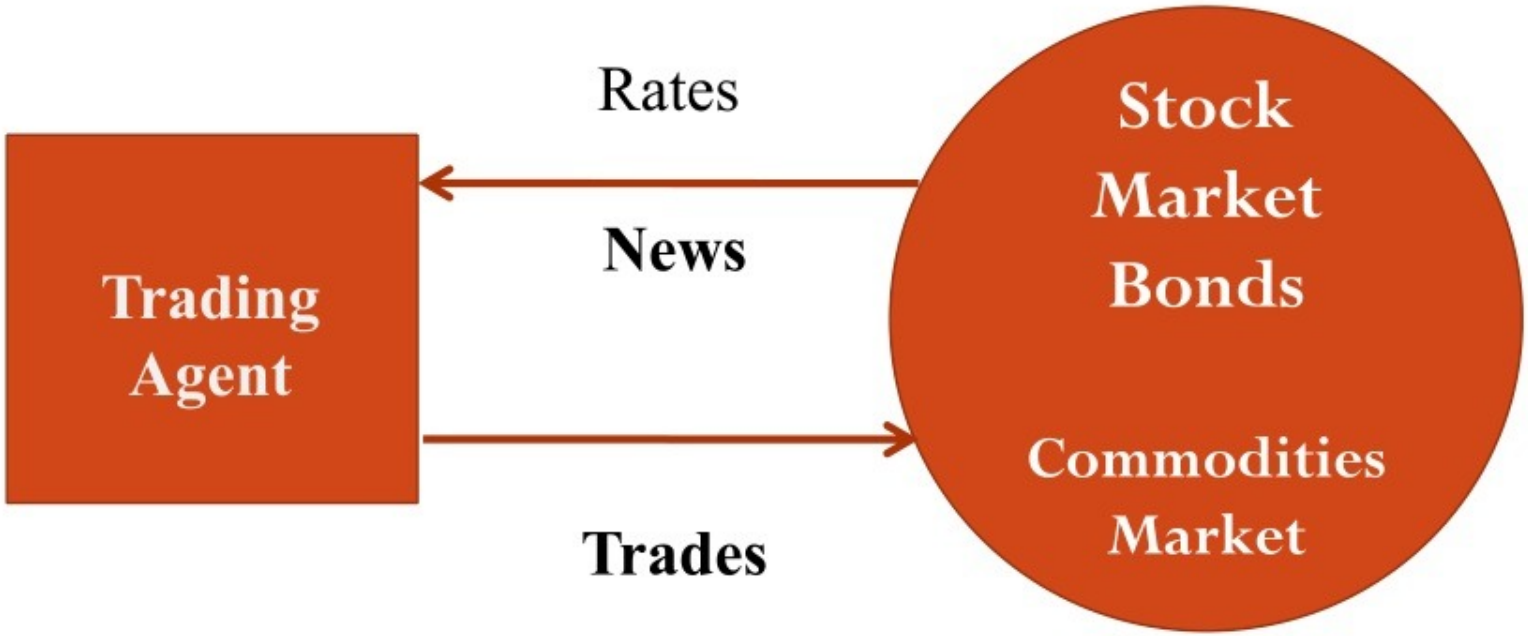
2- Washing machine (automated machine for washing and drying clothes).

3- Buyer agents (shopping bots): Buyer agents travel around a network (e.g. the internet) retrieving information about goods and services. These agents, also known as 'shopping bots', work very efficiently for commodity products such as CDs, books, electronic components, and other one-size-fits-all products. Buyer agents are typically optimized to allow for digital payment services used in e-commerce and traditional businesses.

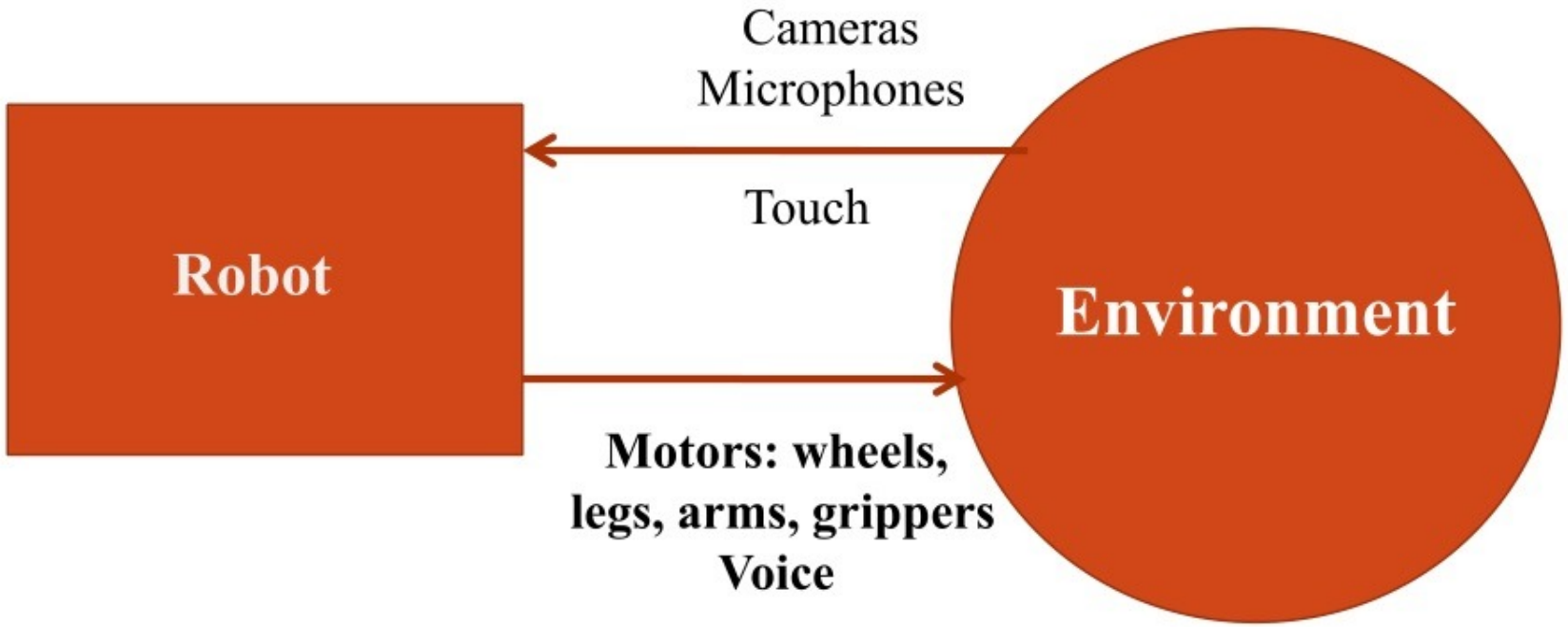
Major Applications of Intelligent Agents in our daily life

- AI has successfully been used in
  - Finance
  - Robotics
  - Games
  - Medicine
  - The Web
- The simplest environment is :
  - **Fully observable**, **deterministic**, **episodic**, **static**, **discrete** and **single-agent.**
- Most real situations are:
  - **Partially observable**, **stochastic**, **sequential**, **dynamic**, **continuous** and **multi-agent**.

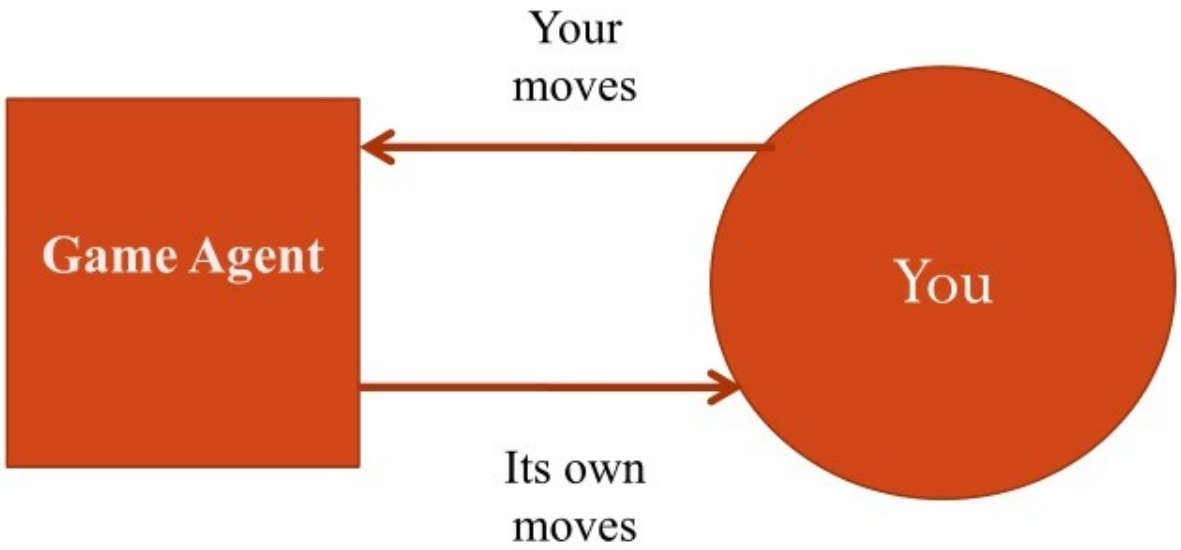
AI in Finance



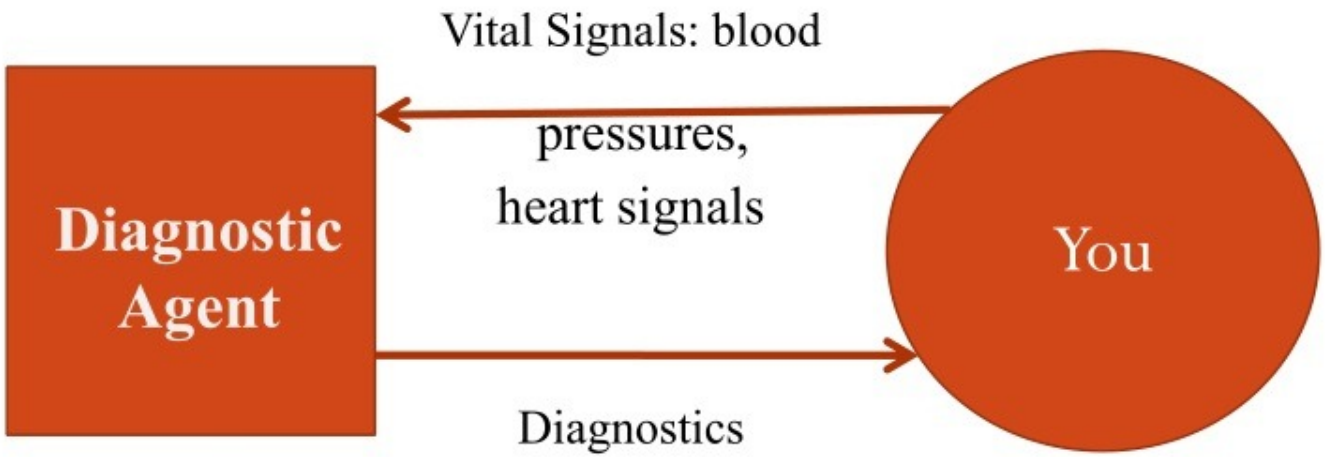
AI in Robotics



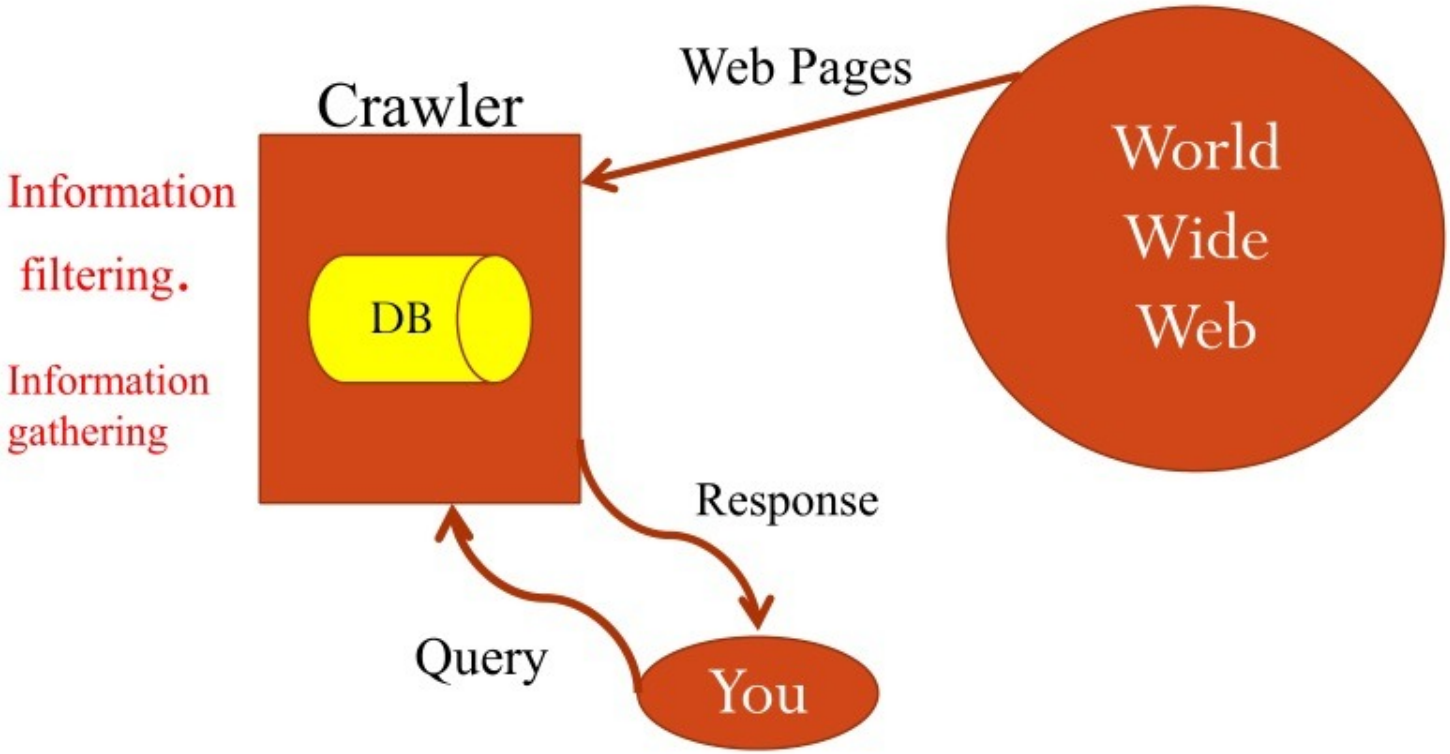
AI in Games



AI in Medicine



AI and the Web



Crawler: a program that systematically browses the World Wide Web in order to create an index of data.

Thank You

End