Intelligent Agents

- What is Intelligent agent?,

  - Components of an AI system (Intelligent Agent),

- How Agents should Act?

  - Tasks Parameters for Agents to perform accurately,

  - Environment Parameters for Agents to perform accurately.

- Agent Types,

  - Simple reflex agents,
  - Reflex agents with state,
  - Goal-based agents,
  - Utility-based agents,
  - Learning agent.

- Examples of Intelligent Agents in AI,

  - Xavier mail delivery robot,
  - Pathfinder Medical Diagnosis System,
  - Alvinn,
  - Talespin,
  - Robot Soccer.

- Other Examples of Intelligent Agents.

- Explore: Topics based Research Areas:

1. What is Intelligent Agent?

- An agent **is** anything that;
  - can be viewed as **perceiving** its environment.
  - through **sensors.**
  - **and acting** upon that environment through **effectors (actuators).**

- A human agent has eyes, ears, and other organs for sensors.
- hands, legs, mouth, and other body parts for effectors.

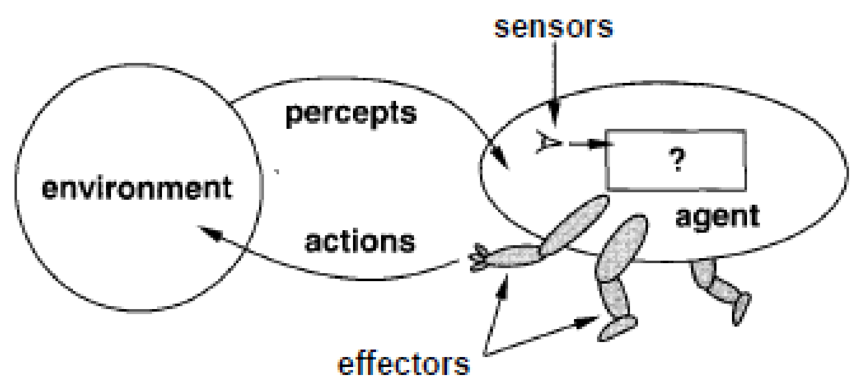


Figure: Agents interact with environment through sensors and effectors.

<u>For example</u>;

- A robotic agent substitutes <u>cameras and infrared range finders for the sensors</u>.
- various motors for the effectors.

1.1. Components of an AI System (Intelligent Agent)

- An agent perceives its environment through sensors and acts on the environment through actuators.

- Human: (sensors) are eyes, ears, actuators (effectors) are hands, legs, mouth.

- Robot: (sensors) are cameras, sonar, lasers, bumble-bee, (effectors) are grippers, manipulators, motors.

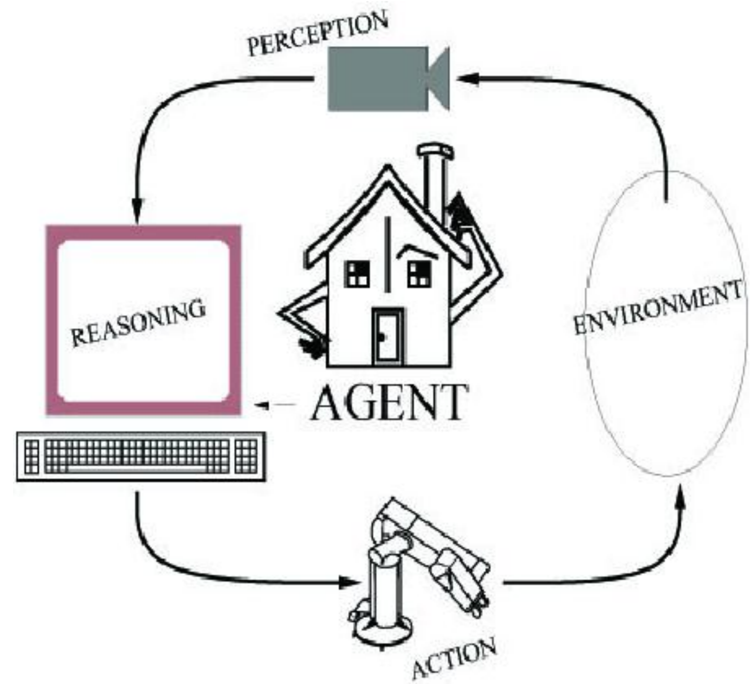


Figure: Components of an AI system.

- The agent's behavior is described by its function that maps percept to action.

2. How Agents should Act?

- An agents includes factor known as;
  - a rational agent that <u>does the right thing</u>. (what is this?)
  - Obviously, this is <u>better than doing the wrong thing</u>, but what does it mean?

- As a first approximation, we will say that the right action is the one that will <u>cause the agent to be most successful</u>.

- That leaves us with the problem of deciding "*how*" and "when" to evaluate the agent's success.

- Solution is;
  - A fixed performance measure evaluates the <u>sequence of observed action effects on the environment</u>.

2. How Agents should Act? (Cont…)

Example; Consider the case of an agent that is supposed to vacuum a dirty floor.

✓In case of "*How*" work with the evaluating performance measure.

- First, the performance measure would be the amount of dirt cleaned up in a single eight-hour shift.

- Second, performance measure would factor in the amount of electricity consumed and the amount of noise generated as well.

- Third, performance measure might give highest marks to an agent that not only cleans the floor quietly and also efficiently.

✓The "*when*" of evaluating performance measure is also important.

- If we measured how much dirt the agent had cleaned up in the first hour of the day.

- either we query for appreciation or punishment to get positive results.

2. How Agents should Act? (Class Participation)

Example; Consider the case of an agent in which Taxi driver cover a reasonable distance ????

✓ In case of "*How*" work.

- First,.
- Second,.
- Third, .

✓ The "*when*" .

- ………………...
- ………………

2. How Agents should Act? (Cont…)

2.1:- <u>Tasks Parameters for Agents to perform accurately</u>:

➢ Major factors to evaluate the agents actions are;

- Use PEAS to describe task
  - Performance measure
  - Environment
  - Actuators
  - Sensors

<u>Example</u>: Taxi driver

- Performance measure: safe, fast, comfortable (maximize profits).
- Environment: roads, other traffic, pedestrians, customers.
- Actuators: steering, accelerator, brake, signal, horn.
- Sensors: cameras, sonar, speedometer, GPS, odometer, accelerometer, engine sensors.

2. How Agents should Act? (Cont…)

2.2:- **Environment Parameters for Agents to perform accurately**:

i) Fully observable vs. partially observable

ii) Deterministic vs. stochastic / strategic

iii) Episodic vs. sequential

iv) Static vs. dynamic

v) Discrete vs. continuous

vi) Single agent vs. multiagent

i) Fully observable vs. partially observable

- monitoring the specific tasks (either Fully or partial).
- agent's sensory apparatus gives it access to the complete/partial state of the environment, then we say that the environment is accessible (fully or partial) to that agent.

Example :

- Chess is the fully observable scenario.
- Taxi driving is the partially observable scenario.

2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

ii) Deterministic

- well-known knowledge of particular tasks. (either strategic or stochastic (change with condition)).

✓If the next state of the environment is completely determined by the current state then deterministic. (e.g., pick an object is acting as deterministic).

✓If the next state of the environment is previously knowledge-based determined by the current state then Strategic. (e.g., chess is acting as strategic).

✓If the next state of the environment is uncertain situation determined by the current state then Stochastic. (e.g., driving car is acting as stochastic).

iii) Episodic

- series of separate parts (either sequential or episodic).

✓the agent's experience is divided into "episodes." Each episode consists of the agent perceiving and then acting.

✓ (e.g., delivering lecture is episodic, && playing chess is a sequential task).

2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

iv) Static vs dynamic

- knowledge about properties of process of a system. (either static or dynamic).

✓Static environments are easy to deal with because the agent need not keep looking at the world. (e.g., Medical diagnosis is acting as static).

✓If the environment can change while an agent is deliberating (thinking), then we say the environment is dynamic. (e.g., driving a car is acting as dynamic).

✓If the environment does not change and agent's performance score does, then we say the environment is semidynamic. (e.g., chess is acting as semidynamic).

v) Discrete vs Continuous

- individually separate or without interruption (either discrete or continuous).

✓There are a fixed number of possible moves on each turn, then Discrete. (e.g., chess is acting as discrete).

✓Agent receives numerous range of continuous values, then its Continuous. (e.g., driving car is acting as continuous).

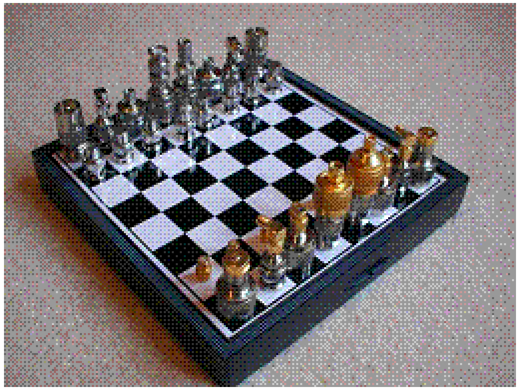
vi) Agents

- events are performed by individual or group of users. (either single or multi).

2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

(Examples)



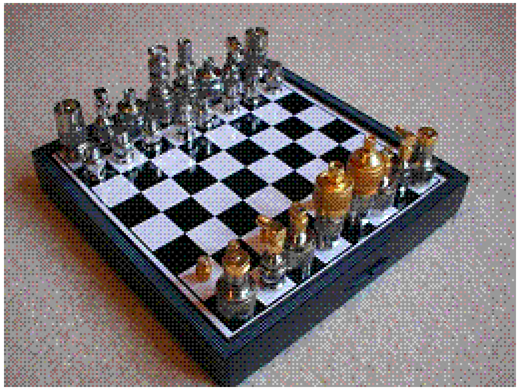
Environments	**Observ able**	**Determi nistic**	**Episodic**	**Static**	**Discrete**	**Agents**
Chess with a clock						

Fully observable vs. partially observable
Deterministic vs. stochastic / strategic
Episodic vs. sequential
Static vs. dynamic
Discrete vs. continuous
Single agent vs. multiagent

2. How Agents should Act? (Cont…)

2.2:- **Environment Parameters for Agents to perform accurately**:

(Examples)



Environments	**Observable**	**Deterministic**	**Episodic**	**Static**	**Discrete**	**Agents**
Chess with a clock	Fully	Strategic	Sequential	Semi	Discrete	Multi

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2. How Agents should Act? (Cont…)

2.2:- **Environment Parameters for Agents to perform accurately**:

(Examples)

Environments	**Obser vable**	**Determi nistic**	**Episodic**	**Static**	**Discrete**	**Agents**
Chess with a clock	Fully	Strategic	Sequential	Semi	Discrete	Multi
Taxi driving						

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2. How Agents should Act? (Cont…)

2.2:- **Environment Parameters for Agents to perform accurately**:

(Examples)

Environments	Obser vable	Determi nistic	Episodic	Static	Discrete	Agents
Chess with a cl ock	Fully	Strategic	Sequential	Semi	Discrete	Multi
Taxi driving	Partial	Stochasti c	Sequential	Dynami c	Continuo us	Single

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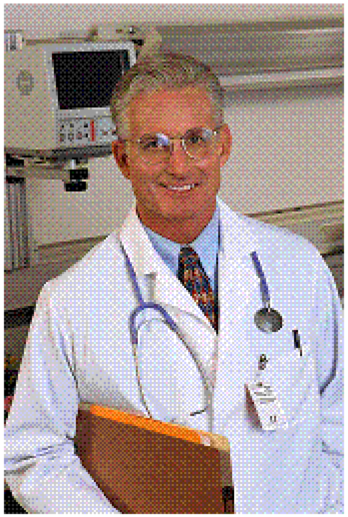
2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

(Examples)



Environments	Observ able	Determini stic	Episodic	Static	Discrete	Agent s
Chess with a clock	Fully	Strategic	Sequential	Semi	Discrete	Multi
Taxi driving	Partial	Stochastic	Sequential	Dynami c	Continuous	Single
Medical diagnosis						

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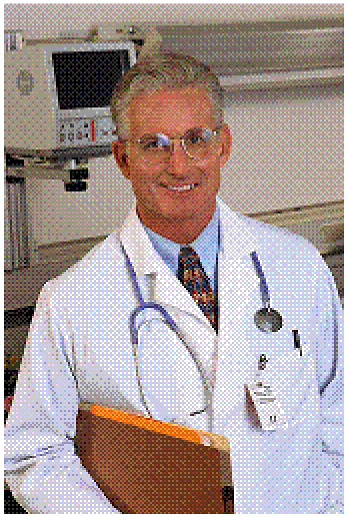
2. How Agents should Act? (Cont…)

2.2:- **Environment Parameters for Agents to perform accurately**:

(Examples)



Environments	**Observable**	**Deterministic**	**Episodic**	**Static**	**Discrete**	**Agents**
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2. How Agents should Act? (Cont…)

2.2:- **Environment Parameters for Agents to perform accurately**:

(Examples)

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Image analysis						

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2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

(Examples)

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2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

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Robot part picking						

2. How Agents should Act? (Cont…)

2.2:- <u>Environment Parameters for Agents to perform accurately</u>:

(Examples)

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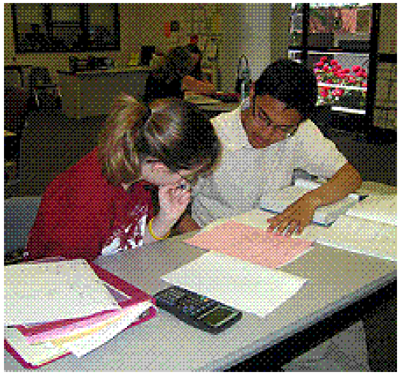
Robot part picking	Fully	Deterministic	Episodic	Semi	Discrete	Single

2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

(Examples)



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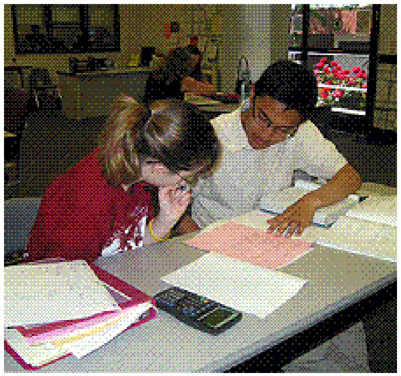
Environments	**Observable**	**Deterministic**	**Episodic**	**Static**	**Discrete**	**Agents**
Chess with a clock	Fully	Strategic	Sequential	Semi	Discrete	Multi
Taxi driving	Partial	Stochastic	Sequential	Dynamic	Continuous	Single
Medical diagnosis	Partial	Stochastic	Episodic	Static	Continuous	Single
Image analysis	Fully	Deterministic	Episodic	Semi	Discrete	Single
Robot part picking	Fully	Deterministic	Episodic	Semi	Discrete	Single
Interactive English tutor						

2. How Agents should Act? (Cont…)

2.2:- Environment Parameters for Agents to perform accurately:

(Examples)



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Environments	**Observable**	**Deterministic**	**Episodic**	**Static**	**Discrete**	**Agents**
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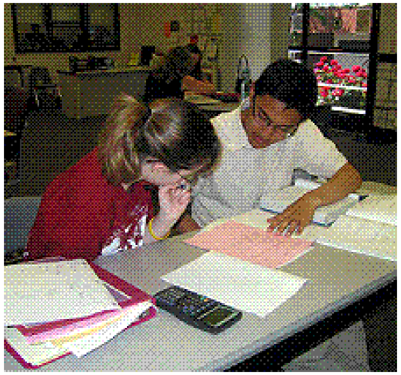
Image analysis	Fully	Deterministic	Episodic	Semi	Discrete	Single
Robot part picking	Fully	Deterministic	Episodic	Semi	Discrete	Single
Interactive English tutor	Partial	Stochastic	Sequential	Dynamic	Discrete	Multi

2. How Agents should Act? (Class Participation)

2.2:- **Environment Parameters for Agents to perform accurately**:

(Examples)



Fully observable vs. partially observable
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Single agent vs. multiagent

Environments	**Observable** (Fully/Partial)	**Deterministic** (Strategic/Stochastic/Deterministic)	**Episodic** (Episodic /Sequential)	**Static** (Static/Semi /Dynamic)	**Discrete** (Discrete /Continuous)	**Agents** (Single/ Multi)

3. Agent Types

- Types of agents (increasing in generality and ability to handle complex environments).
  1. Simple reflex agents.
  2. Reflex agents with state.
  3. Goal-based agents.
  4. Utility-based agents.
  5. Learning agent.

3. Agent Types (1. Simple Reflex Agent)

- **Simple reflex agents** act only on;
  - the basis of the current percept, ignoring the rest of the percept history.
- The **agent** function is based on the condition-action rule:
  - if condition then action.
- This **agent** function only succeeds;
  - when the environment is fully observable.

SimpleReflexAgent(percept)
  state = InterpretInput(percept)
  rule = RuleMatch(state, rules)
  action = RuleAction(rule)
  Return action

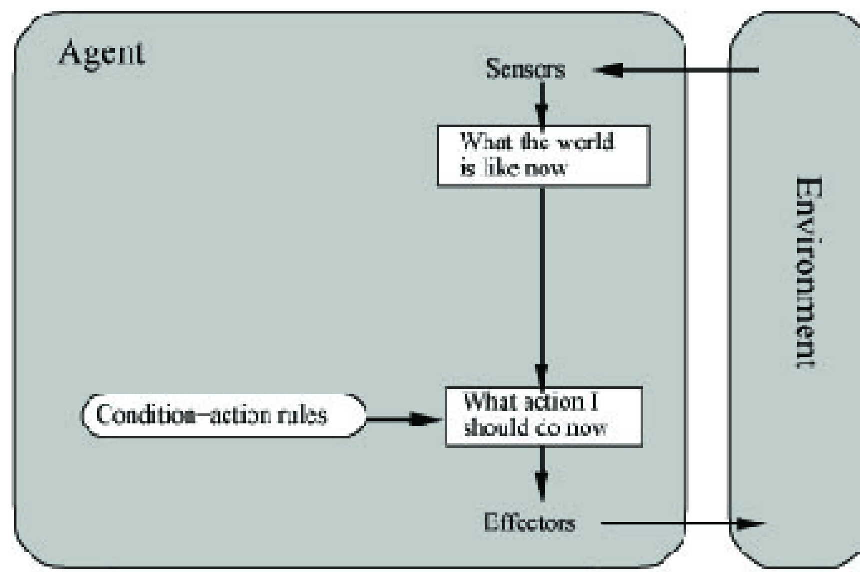
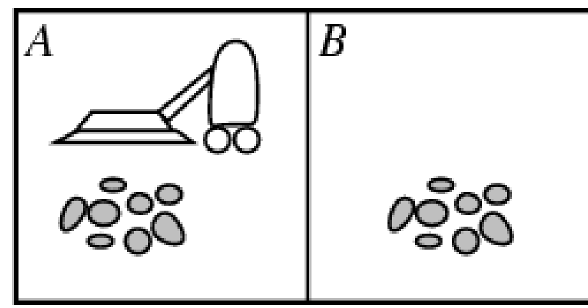


Figure: Schematic diagram of a simple reflex agent.

3. Agent Types (1. Simple Reflex Agent) (Cont…)

- Performance?
  - 1 point for each square cleaned in time T?
  - #clean squares per time step - #moves per time step?

- Environment: vacuum, dirt, multiple areas defined by square regions.



- Actions: left, right, suck, idle.

- Sensors: location and contents.
  - RuleMatch[A, dirty] then RuleAction[suck]

Class Test: Another example:-

- **if** *car-in-front-is-speed_breaker*

then *initiate-braking*

3. Agent Types (2. Reflex Agent With State)

- Store previously-observed information.
- Can reason about unobserved aspects of current state

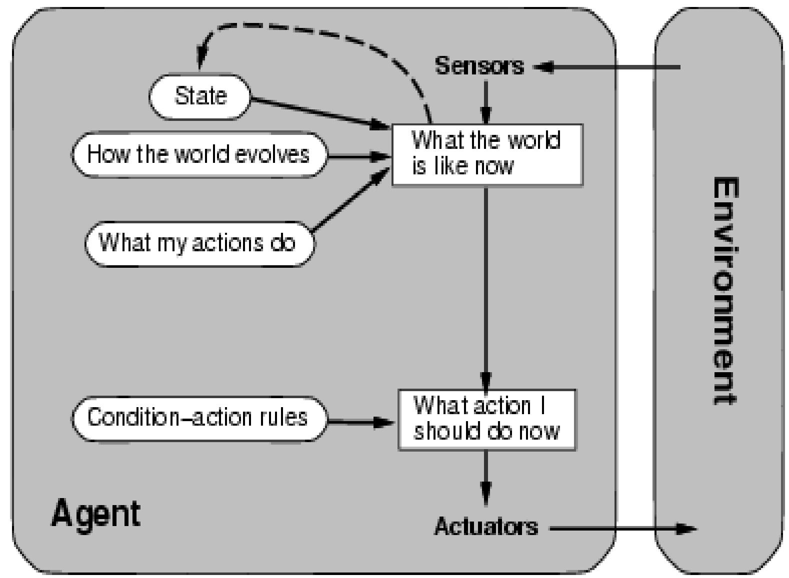


Figure: A reflex agent with internal state.

ReflexAgentWithState(percept)
  state = UpdateDate(state,action,percept)
  rule = RuleMatch(state, rules)
  action = RuleAction(rule)
  Return action

Example: Reflex Vacuum Agent

If status=Dirty then return Suck
else if location=A then return Right
else if location=B then right Left

3. Agent Types (3. Goal-based Agents)

- Knowing about the current state of the environment;

  - is not always enough to decide what to do.

For example: at a road junction, the taxi can turn left, right, or go straight on.

- ✓ The right decision depends on where the taxi is trying to get to.

- In other words, the agent needs some sort of **goal** information.

  - describes situations that are desirable.

- here, decider need search and planning issues.

3. Agent Types (3. Goal-based Agents) (Cont…)

- Goal reflects desires of agents.
- May project actions to see if consistent with goals.
- Takes time, world may change during reasoning.

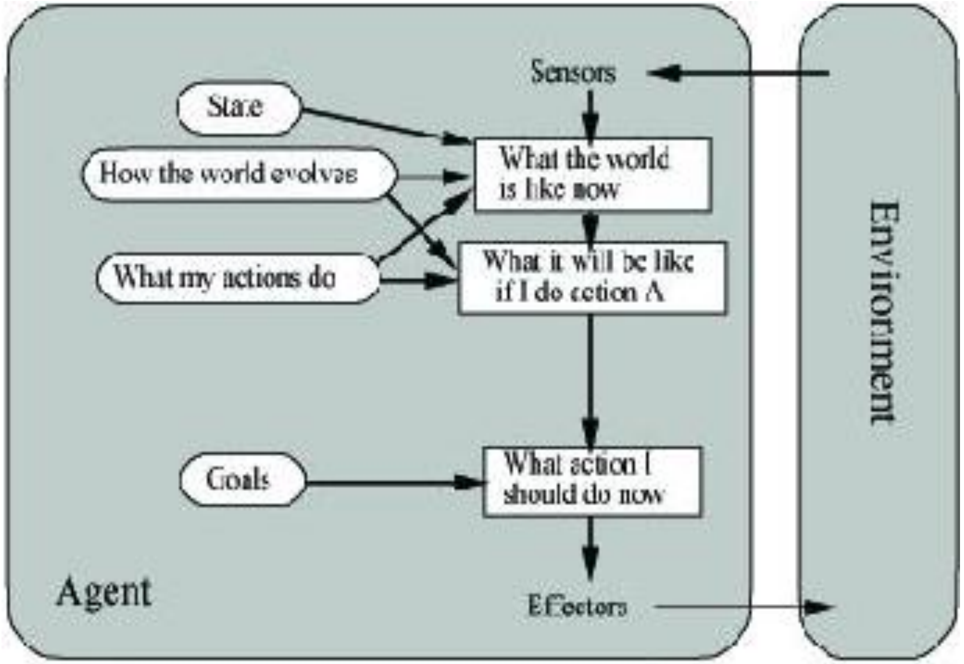


Figure: An agent with explicit goals.

3. Agent Types (4. Utility-based Agents)

- Goals alone are not really enough to generate high-quality behavior.

For example, there are many action sequences that will get the taxi to its destination, thereby achieving goal.

✓ but he must quicker, safer, more reliable, or cheaper than others.

- Goals just provide a crude distinction between "happy" and "unhappy" states.

- How utility function make the agents “happy”.

  - if one world state is preferred to another, then it has higher **utility** for the agent.

3. Agent Types (4. Utility-based Agents) (Cont…)

- Utility is therefore a function that <u>maps a state onto a real number</u>;
  - describes the associated degree of happiness.
- Two kind of cases <u>in Utility</u>;

First, when there are <u>conflicting goals</u>. (for example; speed or safety).

- the utility function specifies the <u>appropriate trade-off</u>.

Second, when there are several goals that the agent can aim for, <u>none of which can be achieved</u> <u>with certainty</u>.

- utility function provides a way in which the <u>likelihood of success</u> can be <u>weighed up against the importance of the goals</u>.

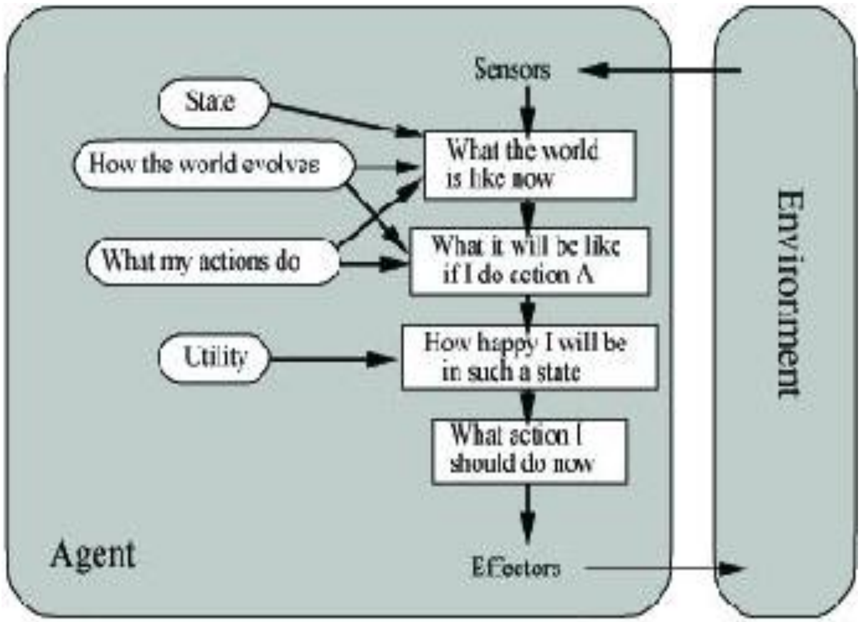


Figure: A complete utility-based agent.

3. Agent Types (4. Utility-based Agents) (Cont…)

- Evaluation function to measure utility f(state) -> value.
- Useful for evaluating competing goals.

3. Agent Types (5. Learning Agents) (Cont…)

- Learning agent aim to learn new actions as it goes about its business, education, commercial industries.

Example, several people make news houses, so learned-based system having general training provides effective results in short-time.

- This still requires some initial knowledge but cuts down on the programming greatly.

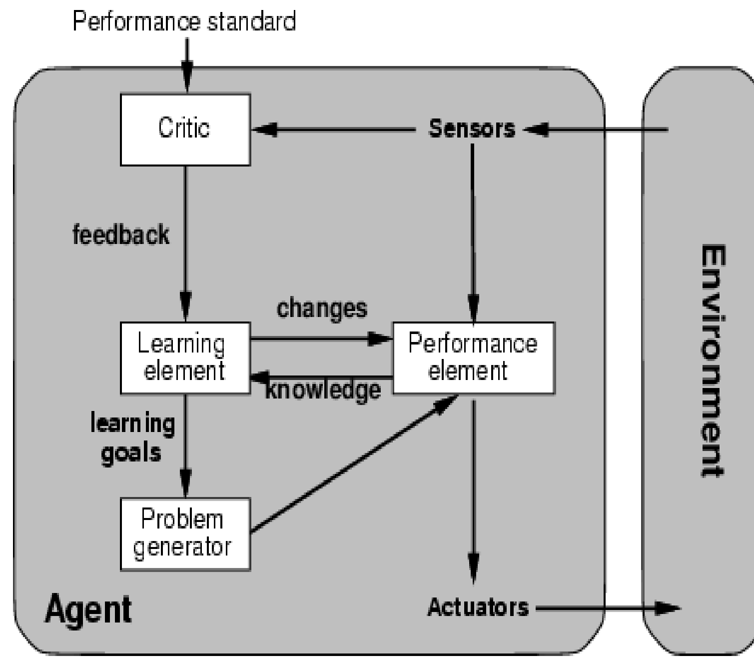
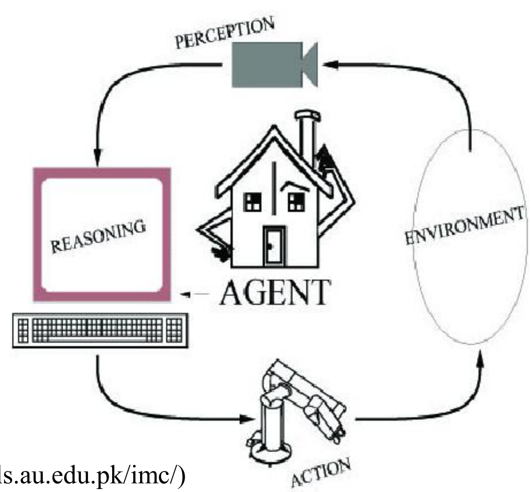


Figure: procedure for learning-based agent.

4. Examples of Intelligent Agents in AI
+
Class Discussions

Pathfinder Medical Diagnosis System

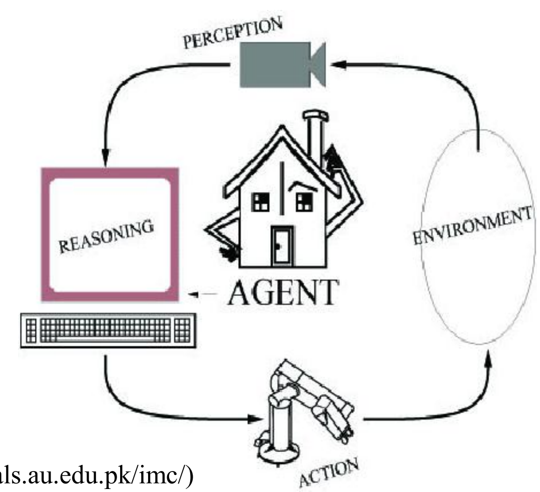
- Performance: Correct Hematopathology diagnosis.
- Environment: Automate human diagnosis, partially observable.
- Actuators: Output diagnostic kids and further test suggestions.
- Sensors: Input symptoms and test results.



Xavier mail delivery robot

➢ What is "Xavier mail delivery robot" agent is?

- Performance: Completed tasks
- Environment: See for yourself
- Actuators: Wheeled robot actuation
- Sensors: Vision, sonar, dead reckoning



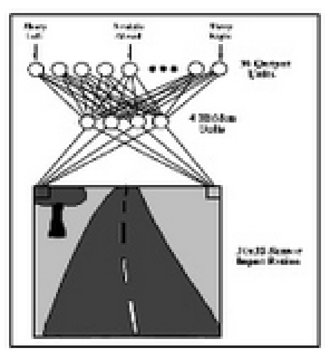
Alvinn

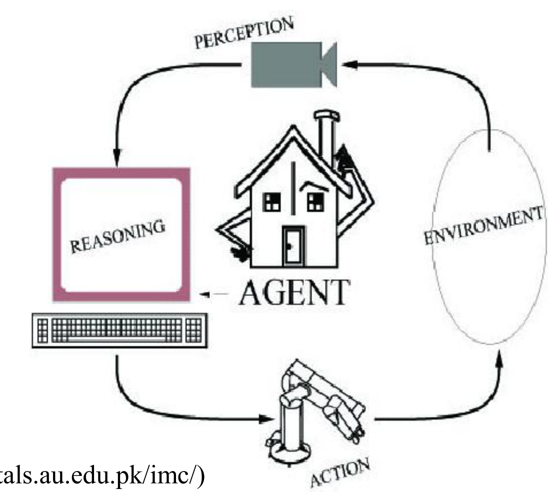
➢ What is “Alvinn” agent is?

- Autonomous Land Vehicle in a Neural Network.

- Performance: Stay in lane, on road, maintain speed.
- Environment: Driving Hummer on and off road without manual control (Partially observable, stochastic, episodic, dynamic, continuous, single agent), Autonomous automobile.
- Actuators: Speed, Steer.
- Sensors: Stereo camera input.

Drives 70 mph on a public highway



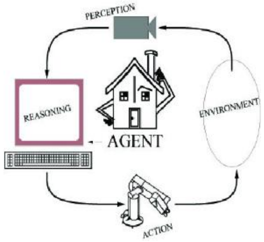


Talespin

- What is "Talespin" agent is?

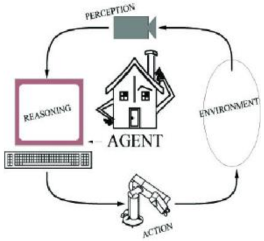
  - A way to describe telling a story..

- Performance: Entertainment value of generated story.
- Environment: Generate text-based stories that are creative and understandable
  - One day Joe Bear was hungry. He asked his friend Irving Bird where some honey was. Irving told him there was a beehive in the oak tree. Joe threatened to hit Irving if he didn't tell him where some honey was.
  - Henry Squirrel was thirsty. He walked over to the river bank where his good friend Bill Bird was sitting. Henry slipped and fell in the river. Gravity drowned. Joe Bear was hungry. He asked Irving Bird where some honey was. Irving refused to tell him, so Joe offered to bring him a worm if he'd tell him where some honey was. Irving agreed. But Joe didn't know where any worms were, so he asked Irving, who refused to say. So Joe offered to bring him a worm if he'd tell him where a worm was. Irving agreed. But Joe didn't know where any worms were, so he asked Irving, who refused to say. So Joe offered to bring him a worm if he'd tell him where a worm was…
- Actuators: Add word/phrase, order parts of story.
- Sensors: Dictionary, Facts and relationships stored in database.



Robot Soccer

- Performance:
- Environment:
- Actuators:
- Sensors:



5. Other Examples of Intelligent Agents (Assignment)

- Translation of Caterpillar truck manuals into 20 languages
- Shuttle packing
- Military planning (Desert Storm)
- Intelligent vehicle highway negotiation
- Credit card transaction monitoring
- Billiards robot
- Juggling robot
- Credit card fraud detection
- Lymphatic system diagnoses
- Mars rover
- Sky survey galaxy data analysis

6. Explore: Topics based Research Areas

(1) Agent-based intelligent medical diagnosis :-

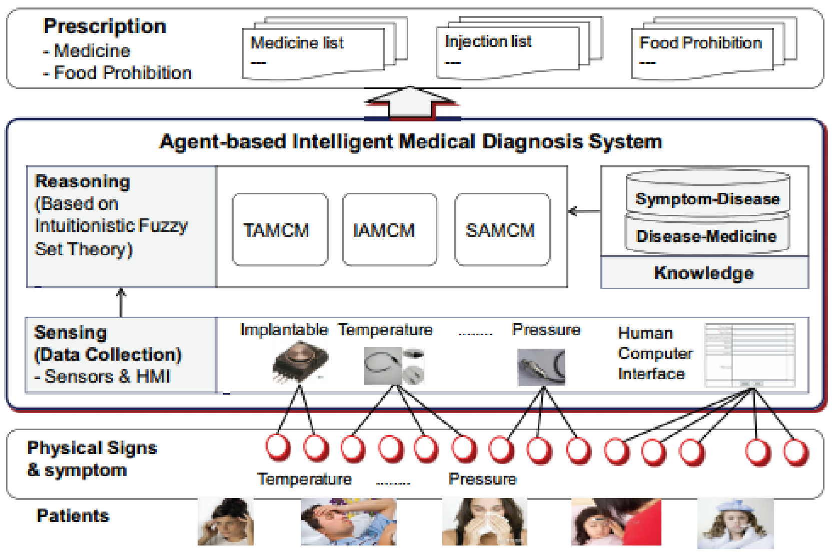


Fig. 1. Overall architecture of AIMDS.

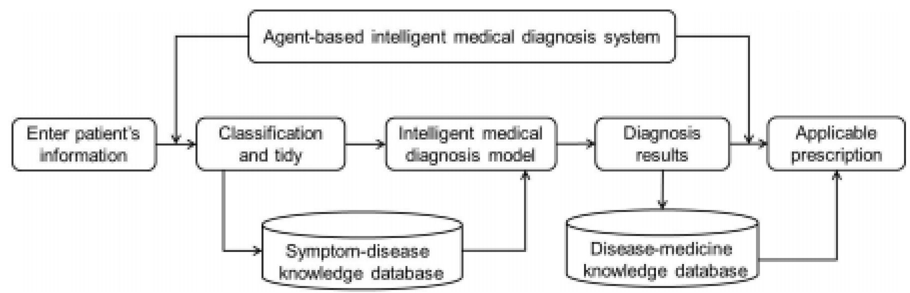


Fig. A flow diagram of agent-based intelligent medical diagnosis system for patient.

Proposed architecture of Model

Symptom-disease matched knowledge base

	Disease 1	Disease 2	Disease 3	...	Disease j	...	Diseases n
Symptom 1	(μ_{11}, ν_{11})	(μ_{12}, ν_{12})	(μ_{13}, ν_{13})	...	(μ_{1j}, ν_{1j})	...	(μ_{1n}, ν_{1n})
Symptom 2	(μ_{21}, ν_{21})	(μ_{22}, ν_{22})	(μ_{23}, ν_{23})	...	(μ_{2j}, ν_{2j})	...	(μ_{2n}, ν_{2n})
Symptom 3	(μ_{31}, ν_{31})	(μ_{32}, ν_{32})	(μ_{33}, ν_{33})	...	(μ_{3j}, ν_{3j})	...	(μ_{3n}, ν_{3n})
...	...	...	...	...	...	...	...
Symptom i	(μ_{i1}, ν_{i1})	(μ_{i2}, ν_{i2})	(μ_{i3}, ν_{i3})	...	(μ_{ij}, ν_{ij})	...	(μ_{in}, ν_{in})
...	...	...	...	...	...	...	...
Symptom n	(μ_{n1}, ν_{n1})	(μ_{n2}, ν_{n2})	(μ_{n3}, ν_{n3})	...	(μ_{nj}, ν_{nj})	...	(μ_{nn}, ν_{nn})

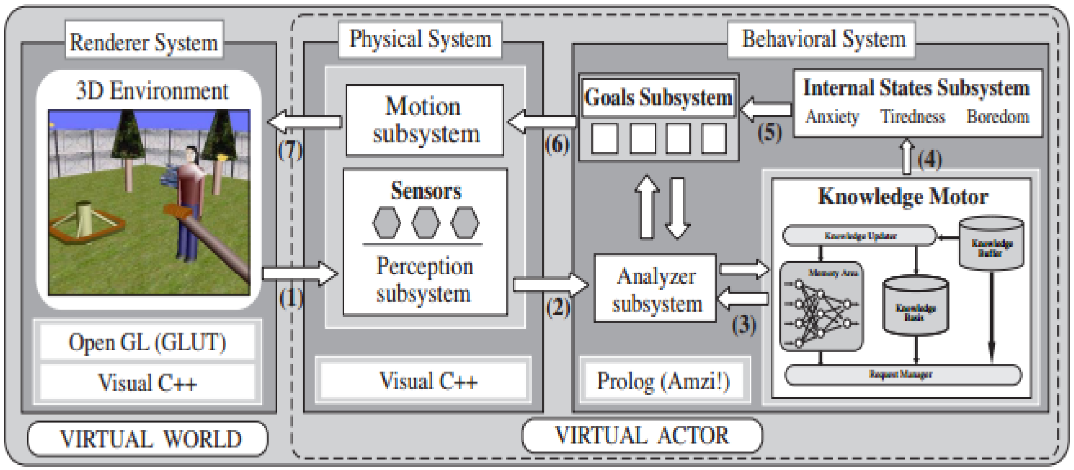
Symptom-disease matched knowledge set

	Dysentery	Influenza	Migraine	Enteritis	Pharyngitis
Body temperature: 38.5C	(0.5, 0.0)	(0.5, 0.1)	(0.5, 0.0)	(0.3, 0.3)	(0.3, 0.2)
White blood cell: High	(0.4, 0.2)	(0.6, 0.1)	(0.5, 0.3)	(0.1, 0.5)	(0.2, 0.8)
Fever	(0.4, 0.3)	(0.7, 0.0)	(0.2, 0.6)	(0.2, 0.7)	(0.2, 0.6)
Headache	(0.1, 0.7)	(0.5, 0.4)	(0.9, 0.0)	(0.2, 0.7)	(0.3, 0.3)
Cough	(0.3, 0.1)	(0.5, 0.1)	(0.0, 0.5)	(0.0, 0.7)	(0.5, 0.2)
Weakness	(0.5, 0.0)	(0.4, 0.2)	(0.3, 0.3)	(0.3, 0.2)	(0.0, 0.7)
Pharyngodynia	(0.3, 0.3)	(0.6, 0.2)	(0.1, 0.5)	(0.0, 0.6)	(0.8, 0.0)
Diarrahea	(0.3, 0.4)	(0.1, 0.3)	(0.0, 0.8)	(0.6, 0.0)	(0.0, 0.6)

Implemented results

6. Explore: Topics based Research Areas

(2) Intelligent Agents in Virtual Worlds :-



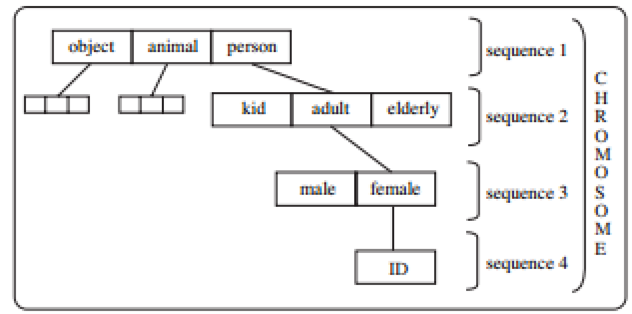


Figure . Sequences of the chromosome

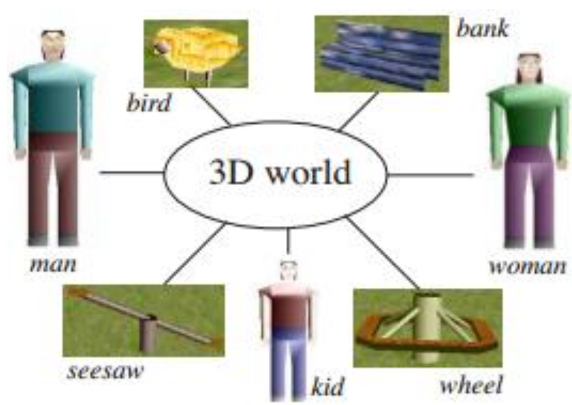


Figure . The virtual park includes different virtual objects and agents

Proposed architecture of Model

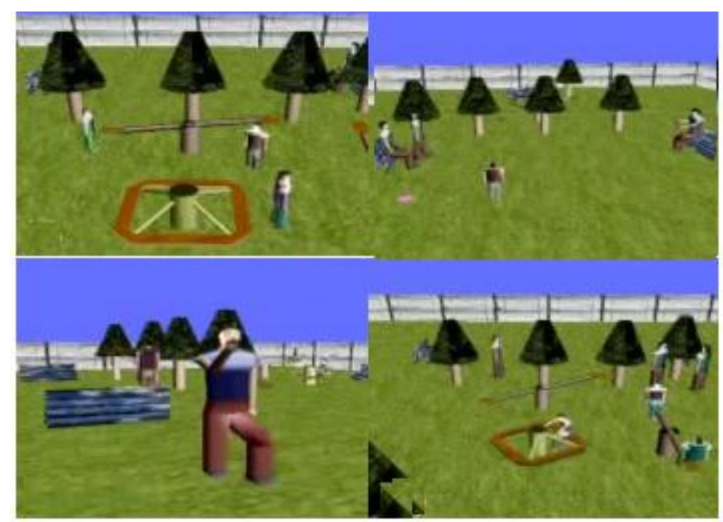


Figure. Some movie screenshots

Implemented results