





- Assistant Professor |
- In-charge Intelligent Machines and Robotics
- Department of Computer Science, CUI Lahore

INDUSTRY 4.0

- Co-founder, Chairperson
- Neocog Pvt Ltd

- Co-founder, Executive Director eCOG(Pvt) Ltd
- Co-founder, Executive Director Quick Bee (Pvt) Ltd [in progress]

- *Consultant (AI & Robotics)* Arctan Engineering Solutions; Services Syndicate; MegaKart



- Executive Director
- Institute of Molecular Sciences & Bioinformatics



- IEEE Lahore Section Treasurer
- Founding Vice Chair IEEE RAS Pak Joint Chapter
- In charge IEEE RAS CUI Lahore

Dr. Wajahat M. Qazi
PhD (Machine Consciousness)



- *Member Expert/Focus Group of Coordination Committee on AI & Robotics, Ministry of Science & Technology, Govt Pakistan*
- *Member, Technology Foresight Committee for Robotics for Vision 2025, Pakistan Commission for Science & Technology, Govt of Pakistan*
- *Invited to Prime Minister's House, Governor House, Chief Minister House and Air Force (Kamra)*
- *Member Evaluation Board of National Center for Artificial Intelligence, Pakistan*
- *PPSC Govt of Punjab Ex-Exam-Paper Setter*
- *Worked for NDC, Ministry of Defense*



- *Asia Pacific United Nations Educational, Scientific and Cultural Organization (UNESCO) Committee on Ethic in Artificial Intelligence*
- *Member Technical Committee, IEEE RAS Cognitive Robots*

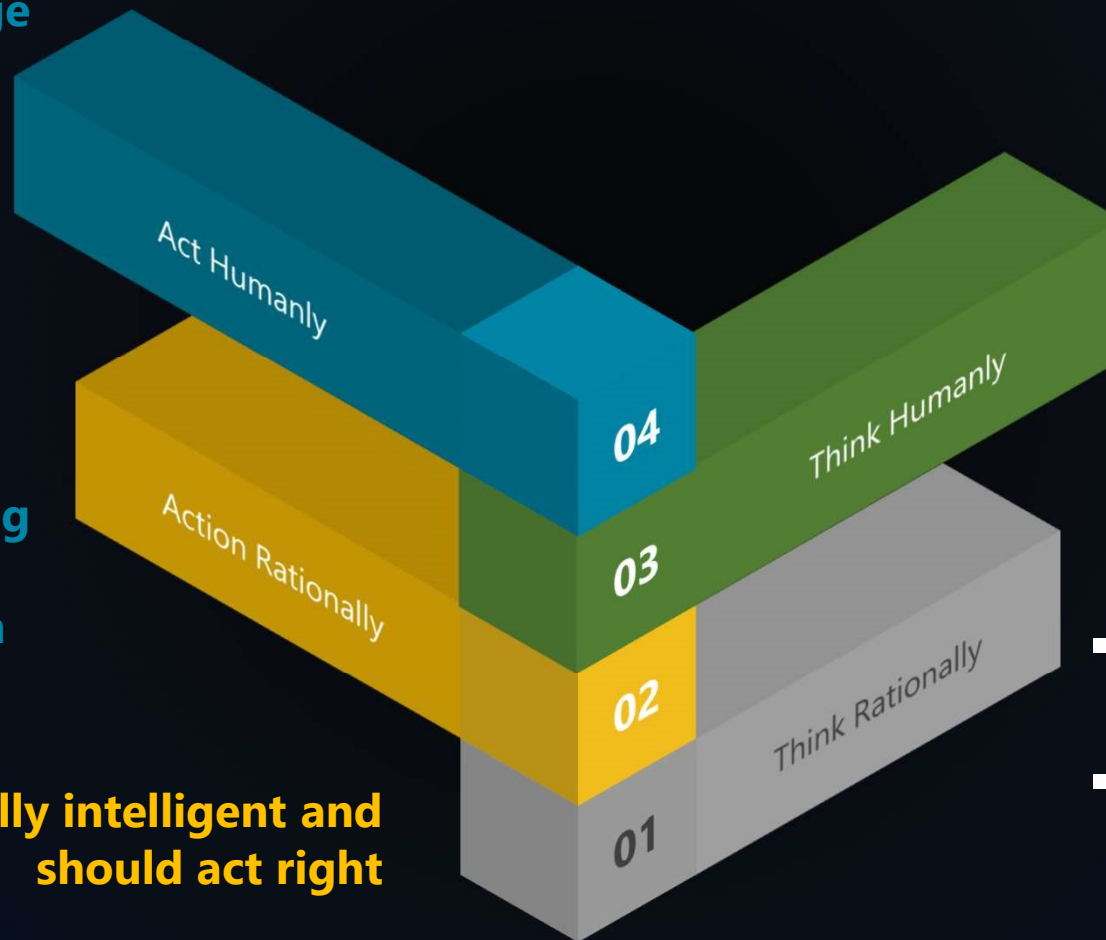
ARTIFICIAL INTELLIGENCE

introduction

AI: Definitions

- Natural Language Processing
- Knowledge Representation
- Automated Reasoning
- Machine Learning
- Computer Vision
- Robotics

- **Functionally intelligent and should act right**

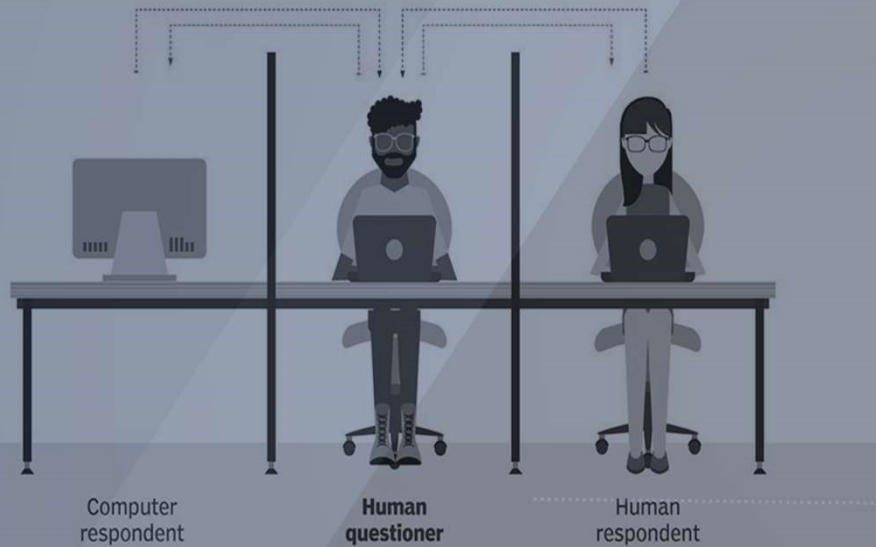


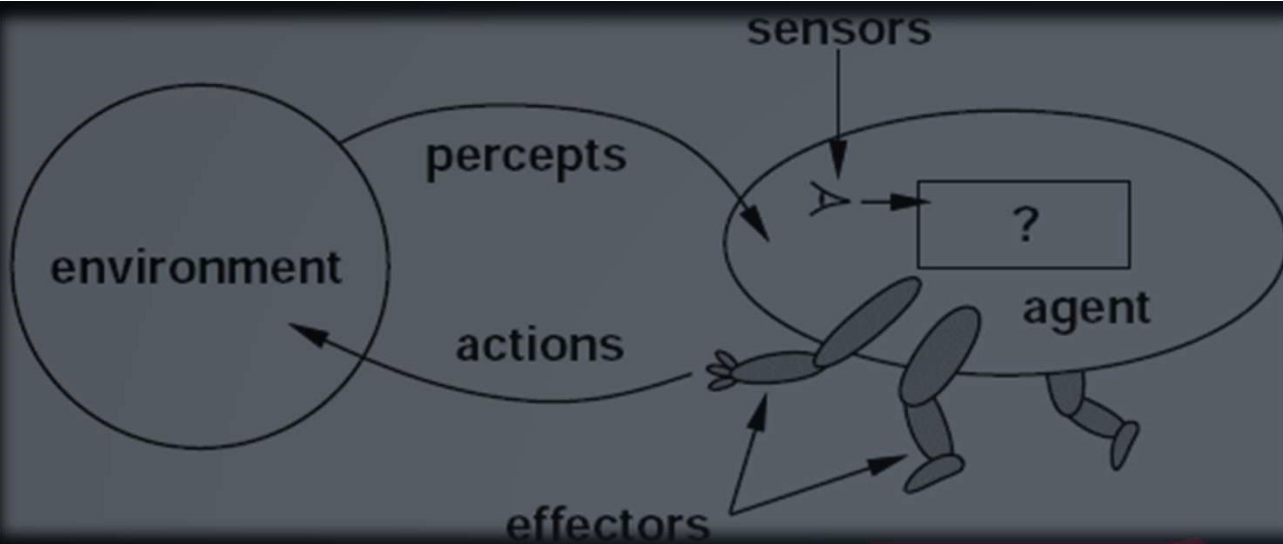
- Cognitive Modeling to mimic brain/mind
- Computational Neuroscience
- Computational Psychology
- Law of thoughts
- Logic based

Turing test

During the Turing test, the human questioner asks a series of questions to both respondents. After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.

■ QUESTION TO RESPONDENTS ■ ANSWERS TO QUESTIONER





Architecture + Program = Agent

ACTION



ENVIRONMENT



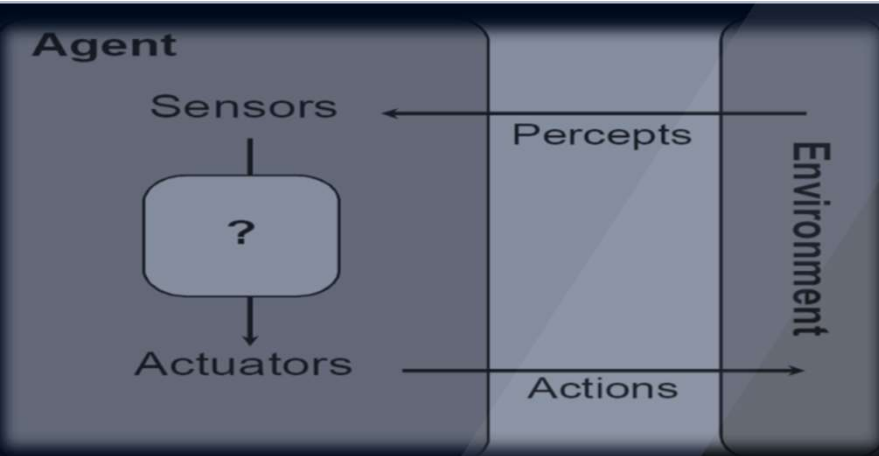
SENSORS



PERCEPTION



Agent Architecture



Fixed Control

What to do and How to do =
Preprogrammed to follow Action-Rules

Learning

What to do is preprogrammed
How to is learned by the agent

Rational

What to do and How to do =
Preprogrammed to follow Goal/Utility

Cognitive

What and How, both are learned by the
agent

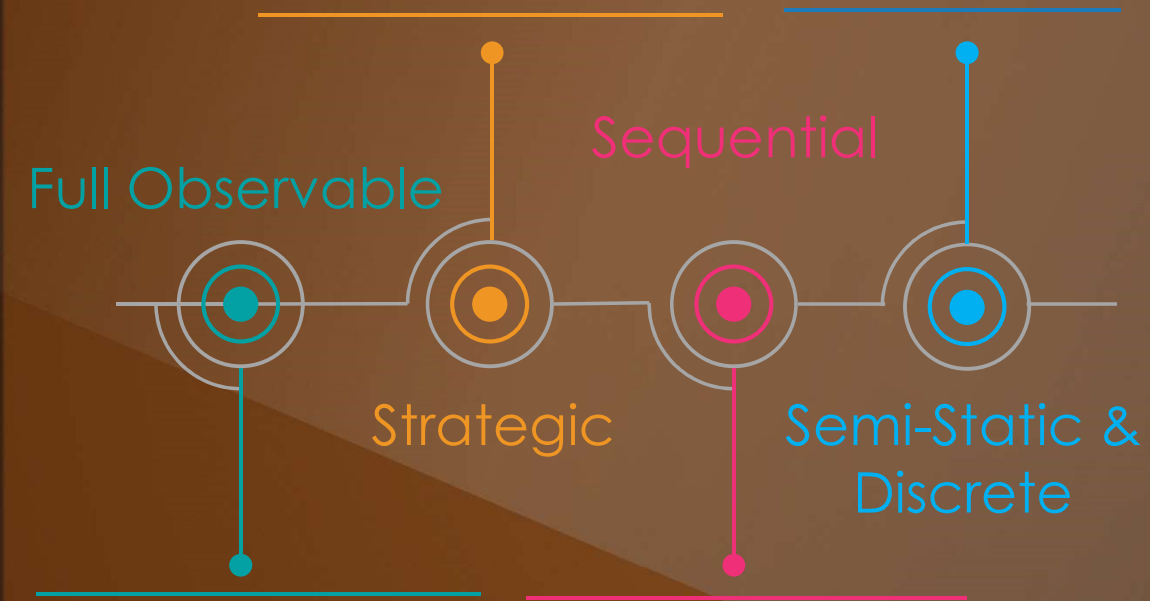
Agent Environment



- Fully observable vs. partially observable
- Deterministic vs. stochastic (Strategic)
- Episodic vs. sequential
- Static vs. dynamic (Semi-dynamic)
- Discrete vs. continuous
- Single agent vs. multi-agent

Dr Klaus Verweyen
Audi

Agent Environment



Rational Agents

- Pre-defined goals
- How you specify your goals is important
- Only concerns what decisions are to be made
- Goals are expressed in terms of utilities of outcomes
- Being rational means maximizing your expected utility
- Define the utility then see what can be done to achieve it.

```
Fontconfig warning: "/etc/fonts/conf.d/50-user.conf", line 9: reading configurations from ~/.fonts.conf is deprecated.
Pacman died! Score: -514
Average Score: -514.0
Score: -514
Win Rate: 0/1 (0.00)
Record: Loss

9:41 ~code/CS188 1x/proj 2/multiagent
pacman.py -p ReflexAgent -l tight5g -z 2.2 -k 9

Fontconfig warning: "/etc/fonts/conf.d/50-user.conf", line 9: reading configurations from ~/.fonts.conf is deprecated.
Pacman died! Score: -506
Average Score: -506.0
Score: -506
Win Rate: 0/1 (0.00)
Record: Loss

9:41 ~code/CS188 1x/proj 2/multiagent
pacman.py -p ReflexAgent -l tight5g -z 2.2 -k 9

Fontconfig warning: "/etc/fonts/conf.d/50-user.conf", line 9: reading configurations from ~/.fonts.conf is deprecated.
Pacman died! Score: -514
Average Score: -514.0
Score: -514
Win Rate: 0/1 (0.00)
Record: Loss

9:41 ~code/CS188 1x/proj 2/multiagent
pacman.py -p ReflexAgent -l tight5g -z 2.2 -k 9

Fontconfig warning: "/etc/fonts/conf.d/50-user.conf", line 9: reading configurations from ~/.fonts.conf is deprecated.
Pacman died! Score: -509
Average Score: -509.0
Score: -509
Win Rate: 0/1 (0.00)
Record: Loss

9:41 ~code/CS188 1x/proj 2/multiagent
pacman.py -p ReflexAgent -l tight5g -z 2.2 -k 9

Fontconfig warning: "/etc/fonts/conf.d/50-user.conf", line 9: reading configurations from ~/.fonts.conf is deprecated.
Pacman died! Score: -523
Average Score: -523.0
Score: -523
Win Rate: 0/1 (0.00)
Record: Loss

9:41 ~code/CS188 1x/proj 2/multiagent
```

```
william lab 9:40 ~code/CS188 1x/proj 2/multiagent
% ls
```

```
commands.txt  ghostAgents.pyc  keyboardAgents.pyc  multiAgents.pyc  util.py
docs          graphicsDisplay.py  layout.py           pacmanAgents.py  projects.txt
game.py       graphicsDisplay.pyc layout.pyc          pacmanAgents.pyc textDisplay.py
game.pyc      graphicsUtils.py   layouts            pacman_multi_agent.pyc  testDisplay.py
game.pyc      graphicsUtils.pyc  multiagentProject.html  pacman.py         util.pyc
ghostAgents.pyc  keyboardAgents.pyc  multiagentProject.html  pacman.py         util.pyc
```

```
william lab 9:40 ~code/CS188 1x/proj 2/multiagent
% ls
```

```
Initial recording window is set to:
X:1440 Y:4 Width:1920 Height:1072
Your window manager appears to be i3
Buffer size adjusted to 4096 from 4096 frames.
Opened PCM device hw:0,0
Recording on device hw:0,0 is set to:
2 channels at 44100Hz
Capturing!
*****
Cached 448 MB, from 180 MB that were received.
Average cache compression ratio: -148.6 %
*****
Shutting down.Saved 1588 frames in a total of 1586 requests
....
STATE:ENCODING
Encoding started!
This may take several minutes.
Pressing Ctrl-C will cancel the procedure (resuming will not be possible, but
any portion of the video, which is already encoded won't be deleted).
Please wait...
Output file: out.ogv
[0%] ^Csh: segmentation fault recordmydesktop -x 1440 --width 1920
```

```
william lab 9:41 ~code/CS188 1x/proj 2/multiagent
% rm out.ogv
```

```
william lab 9:41 ~code/CS188 1x/proj 2/multiagent
% rm out.ogv
```

```
Initial recording window is set to:
X:1440 Y:0 Width:1920 Height:1080
Adjusted recording window is set to:
X:1440 Y:4 Width:1920 Height:1072
Your window manager appears to be i3
Initializing...
Buffer size adjusted to 4096 from 4096 frames.
Playback frequency 22050Hz is not available...
Using 44100Hz instead.
Recording on device hw:0,0 is set to:
2 channels at 44100Hz
```

```
william lab 9:41 ~code/CS188 1x/proj 2/multiagent
% rm out.ogv
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```

Agent Design

PEAS

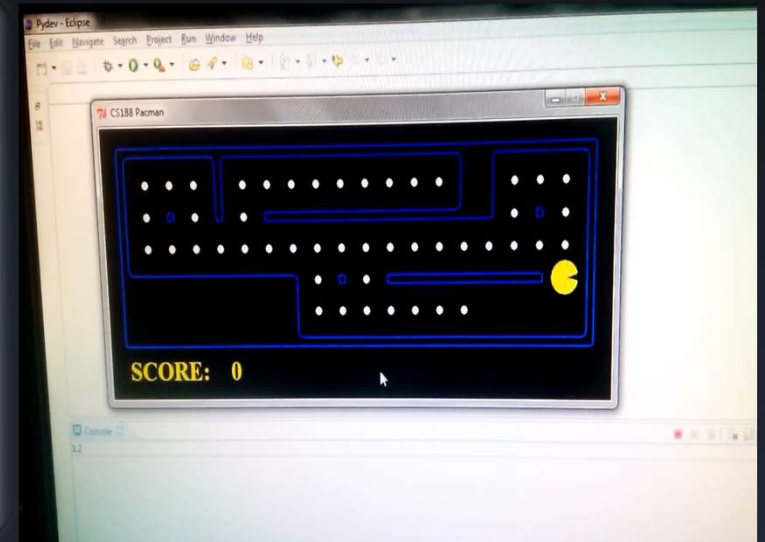
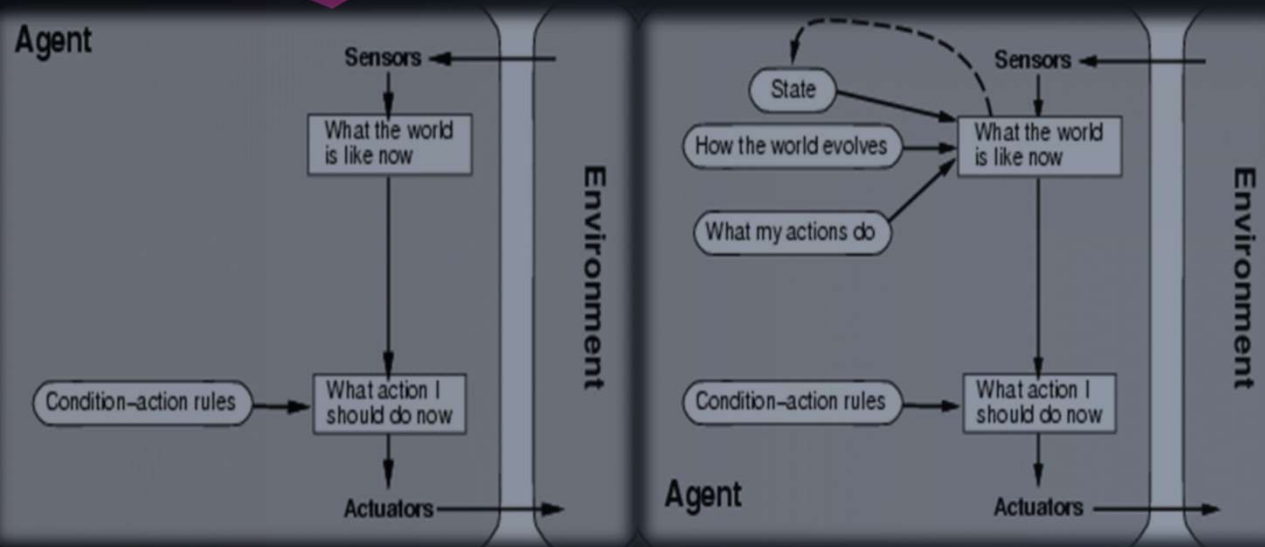
- Performance measure
 - Environment
 - Actuators
 - Sensors
-

PAGE

- Percepts
 - Action
 - Goal
 - Environment
-

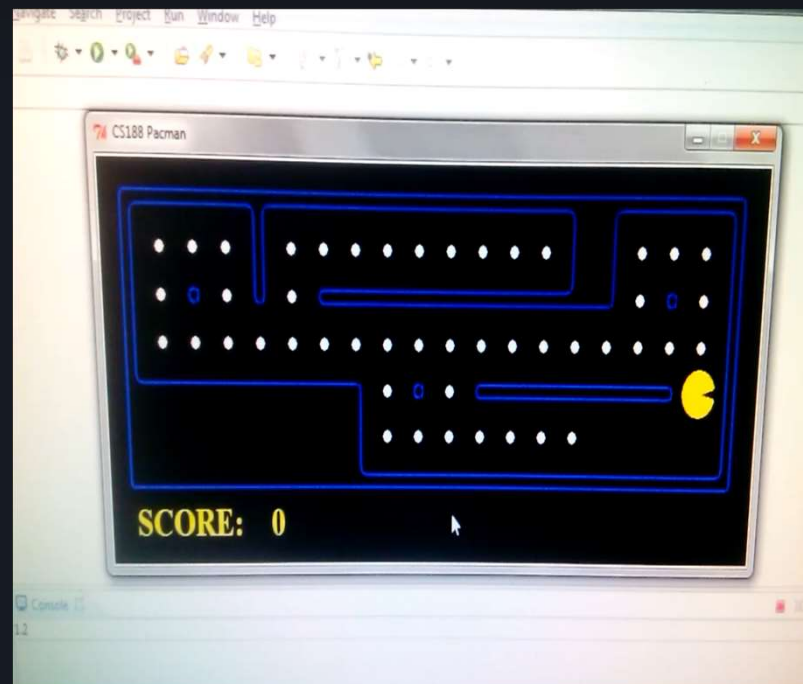
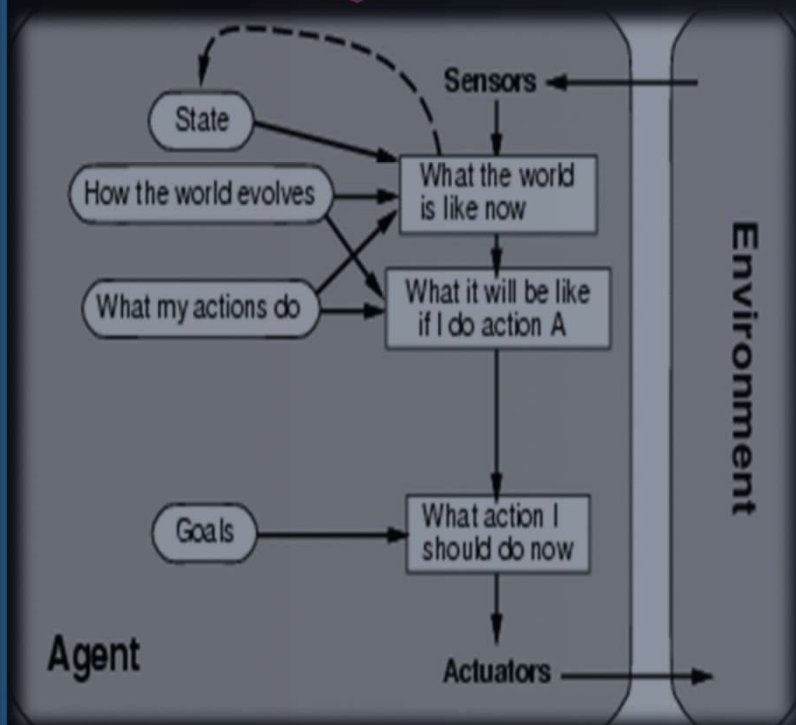
Rational Agents

■ Reflex and Model Based Agents



Rational Agents

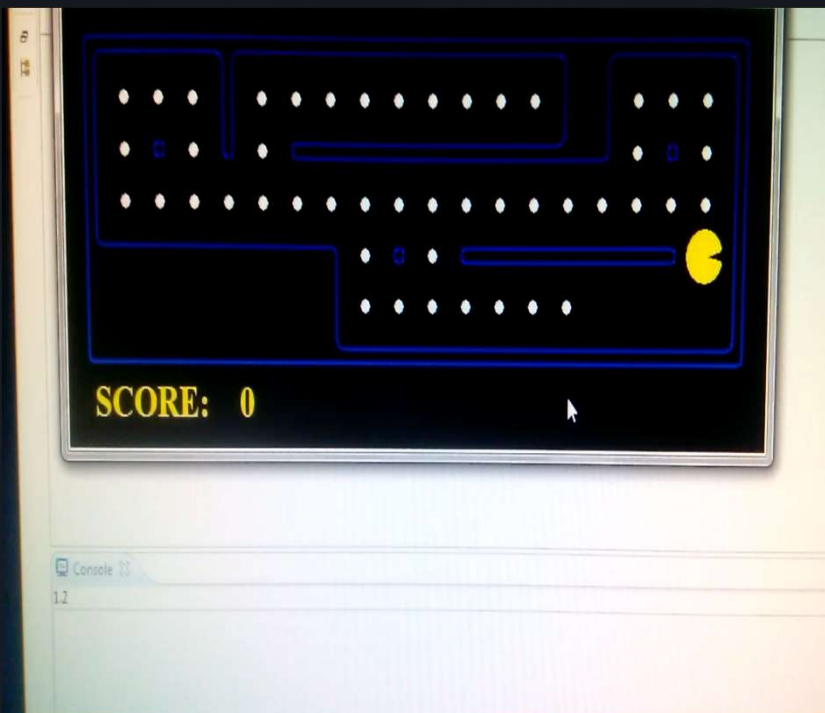
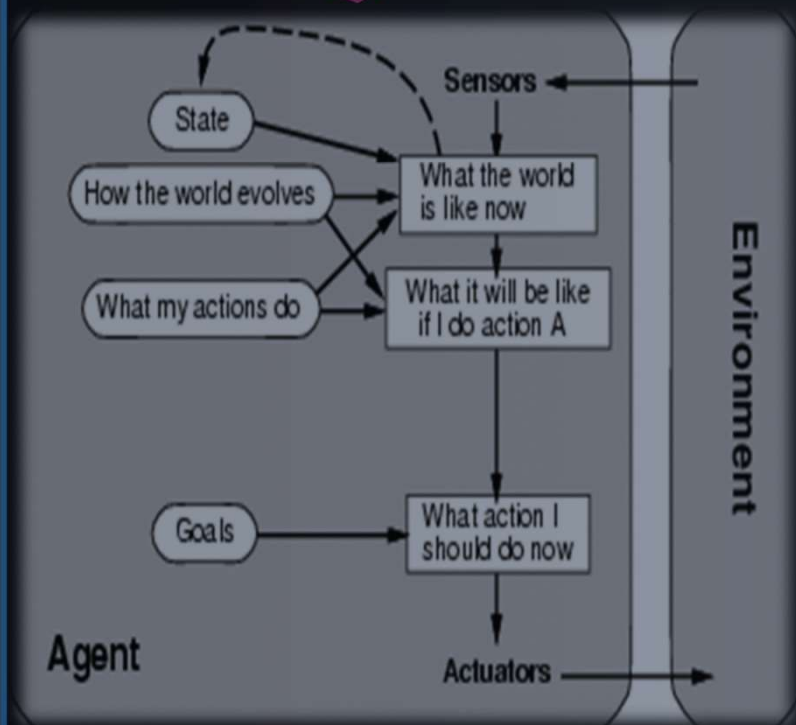
■ Goal Based Agents



Planning

Rational Agents

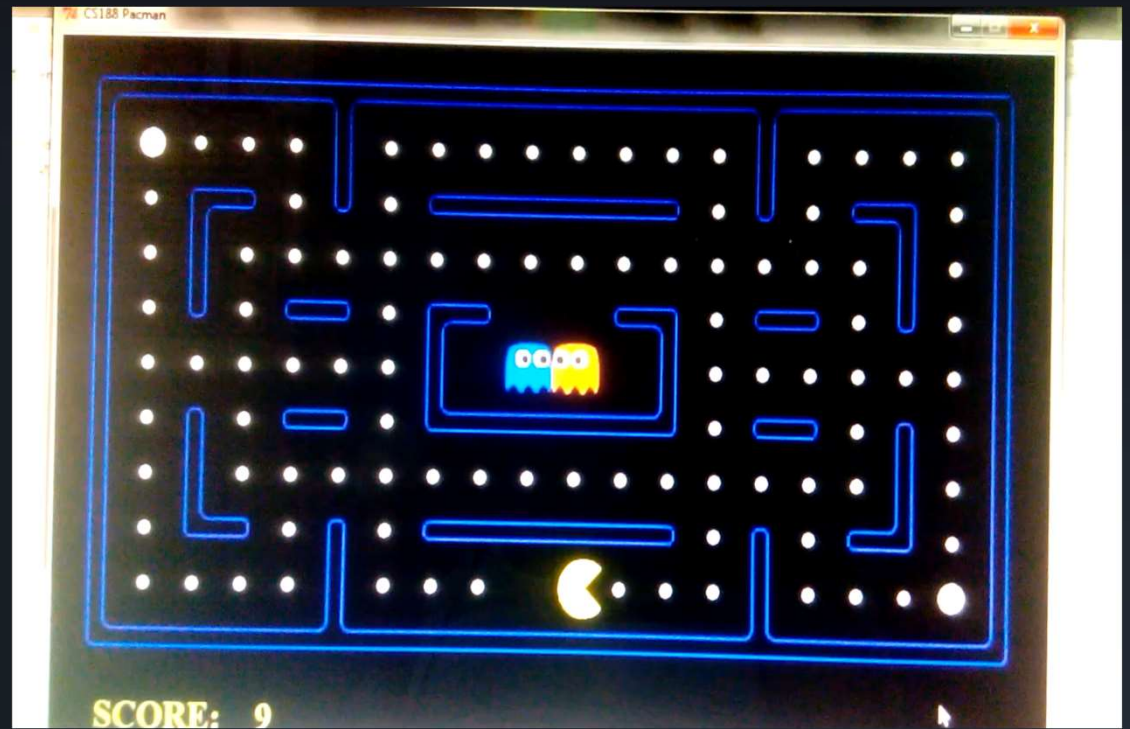
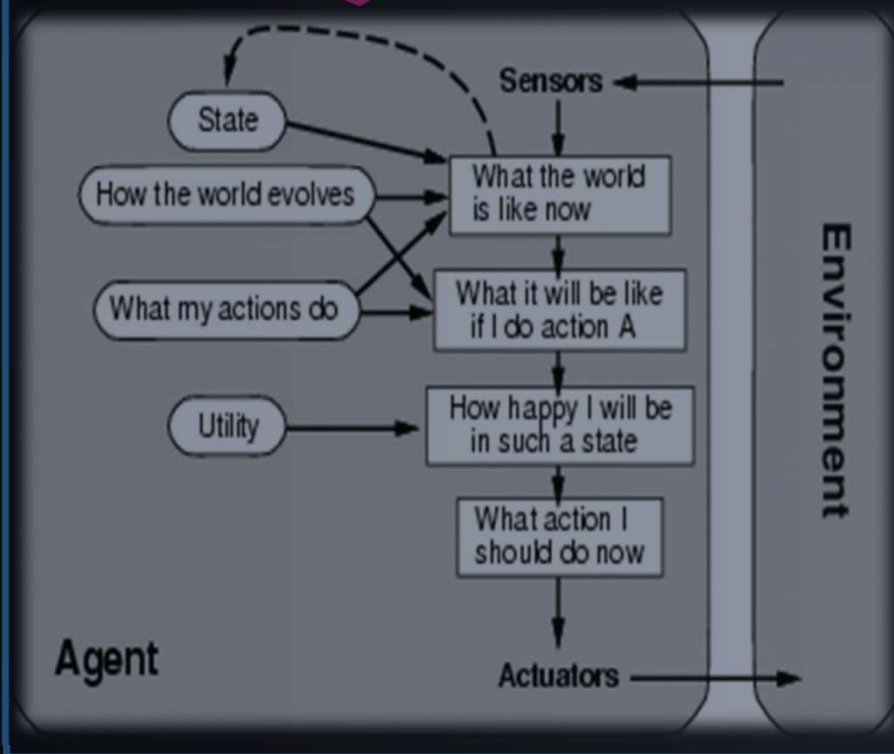
■ Goal Based Agents



Re-Planning

Rational Agents

■ Utility Based Agents



JAZAK ALLAH

