Problem Solving with AI

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AI Academy

NC STATE
UNIVERSITY

Agenda

Course Overview

Foundations

Problems

Agents

Agent Types

Course Overview

Broad Goals

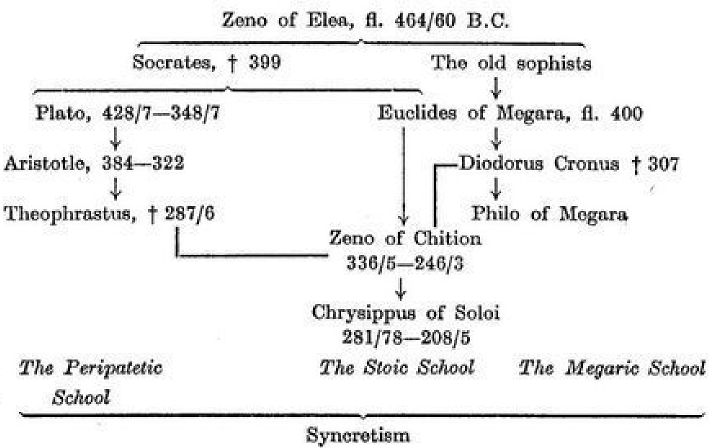
- Cover foundational *concepts* of AI.
- Highlight potential *applications* for AI tools.
- Cover *algorithms*, *techniques* and *design patterns* for AI applications.

Foundations

Origins

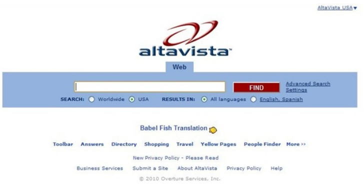
Credit: www.filmeducation.org

Logic



Credit: historyoflogic.com

Applications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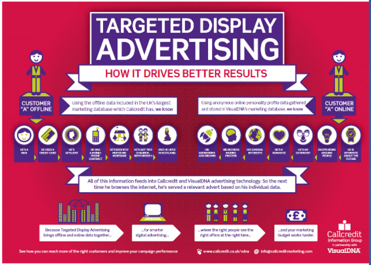

TARGETED DISPLAY ADVERTISING
HOW IT DRIVES BETTER RESULTS
CUSTOMER "A" OFFLINE
Using the offline data included in the UK's largest marketing database which Callcredit has, we know
Using anonymous online personality profile data gathered and stored in VisualDNA's marketing database, we know
CUSTOMER "A" ONLINE
HE'S A MAN
HE USES A CREDIT CARD
HE'S AFFLUENT
HE HAS A MOBILE PHONE CONTRACT
HE'S RECENTLY MOVED HIS MORTGAGE
HE'S GOT TWO CHILDREN - BOTH UNDER 5
AND HE LIVES IN SCOTLAND
HIS ASPIRATIONS AND DREAMS
HIS DECISION MAKING PROCESS
HIS GENERAL INTERESTS
HE'S A ROMANTIC
HE'S AN EXTRAVERT
ENJOYS BEING AROUND PEOPLE
HE IS OPTIMISTIC ABOUT THE FUTURE
All of this information feeds into Callcredit and VisualDNA advertising technology. So the next time he browses the internet, he's served a relevant advert based on his individual data.
Because Targeted Display Advertising brings offline and online data together..
..for smarter digital advertising..
..where the right people see the right offers at the right time..
..and your marketing budget works harder.
See how you can reach more of the right customers and improve your campaign performance
www.callcredit.co.uk/vdna
info@callcreditmarketing.com
Callcredit Information Group
in partnership with
VisualDNA

Image Credits: vipinonline.com callcredit.co.uk agweb.com techcrunch.com

The Boxes

"Machines with minds" **Think like humans.**	"Computations that perceive reason and act." **Think rationally.**
"Machines that perform functions that require intelligence when done by people." **Act like humans**	"Intelligent behavior in artifacts." **Act rationally**

Pragmatism

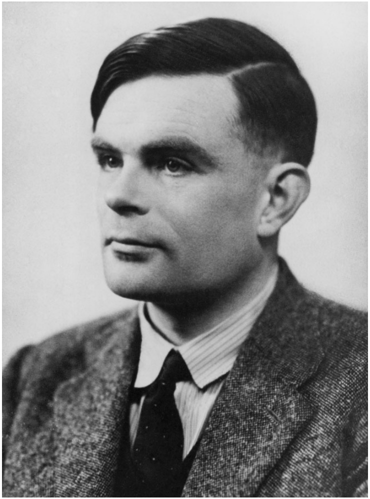
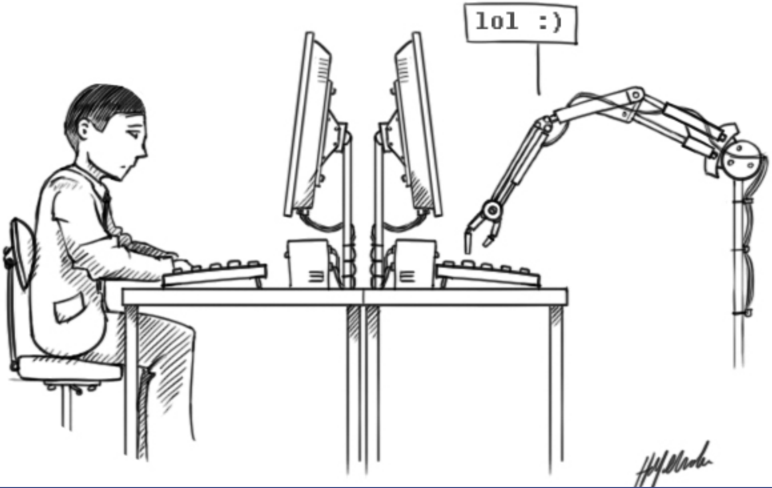


Image: mathworks.com

The Turing Test



Student: Can machines think?

Student: Can machines think?

Master: Can submarines swim?

Problems

What defines a problem?

Problem Types

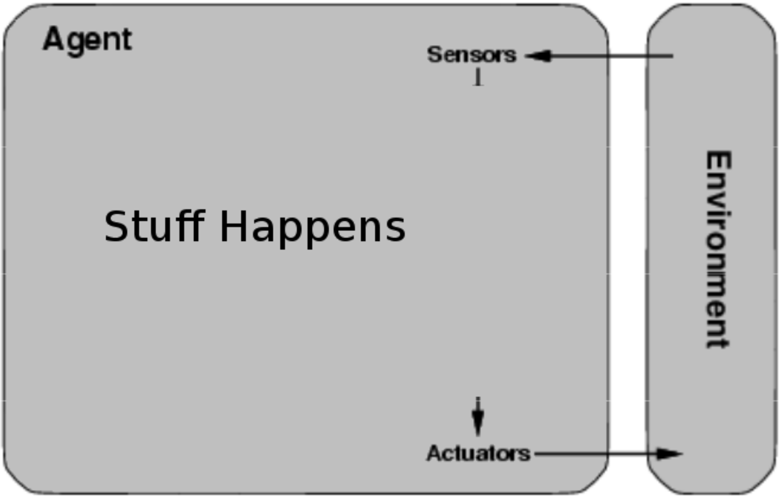
- Well-Structured (Well-Defined) (Turing Recognizable)
- Ill-Defined
- Wicked Problems
- Toy or Puzzle:
    - Atomic;
    - Observable;
    - Deterministic;
    - *Completely* Known.

Problem Solving

1. *Define* a representation of the problem (*abstraction*).
2. Solve the problem by *searching* for a *solution*.
3. *Execute* the planned solution.
4. *Evaluate* or *defend* your results and recompute.

Agents

Agent



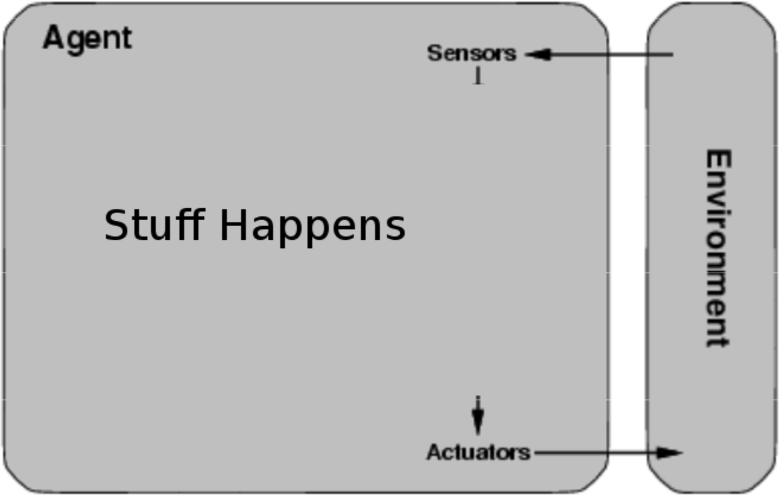
Aspects

- *Separation*:
  - The agent is distinct from the environment.
  - The *sensors* and *actuators* provide the interface.
  - These are distinct from the *percepts* and *actions* which are internal.
- *Architecture* agent hardware.
- *Function* $a : p_0, \ldots, p_n \to a_i$
- *Program* (implementation)

Context

- Performance measure for success.
- Agent's prior knowledge.
- The available actions.
- Percept sequence to date.

PEAS



Big Idea: Satisficing

Rationality

- Strong rationality rests on a basic assumption:
  - “Reasonable people all think the same,... if they think”
- This idea rests at the foundation of economics.
- And much other discussion, the basic idea that there are good processes of reasoning and clear values.

Rationality

- Strong rationality rests on a basic assumption:
  - “Reasonable people all think the same,... if they think”
- This idea rests at the foundation of economics.
- And much other discussion, the basic idea that there are good processes of reasoning and clear values.
- Needless to say humans don’t do this.
- and AI is more limited.

Rational Agents

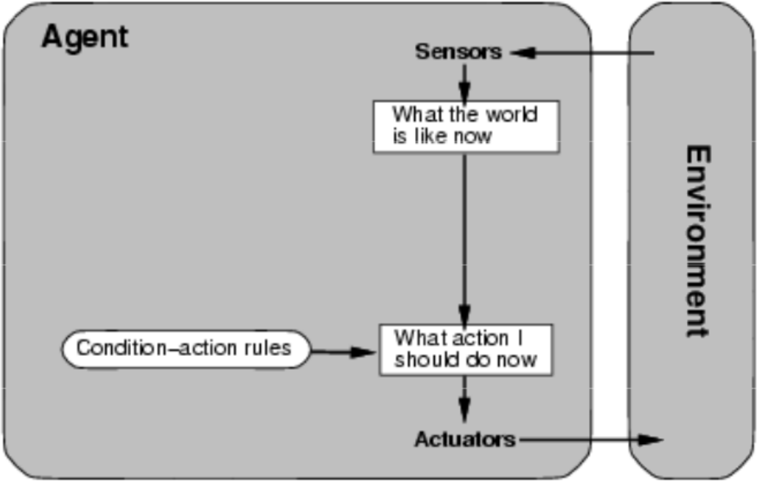
A rational agent seeks to maximize it's performance given it's current context.
(Rationality $\neq$ Omniscience)

Agent Types

Agent Types

- Simple Reflex
- Model-based reflex
- Goal-based
- Utility-based

Simple Reflex Agent



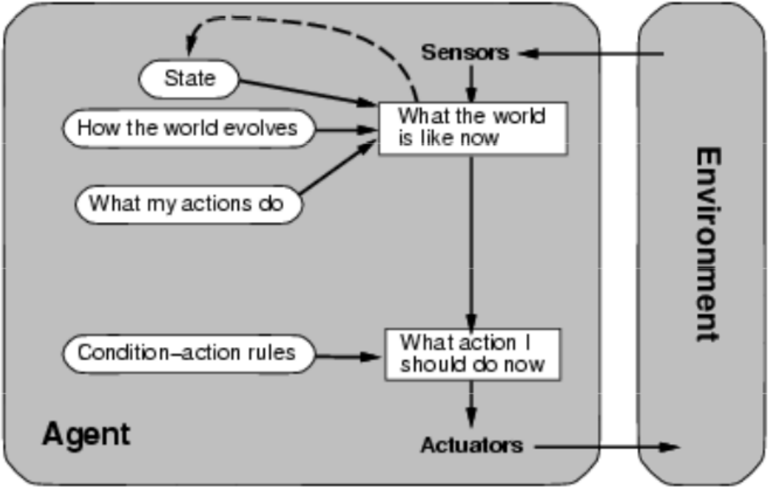
Simple Reflex Agent: Schema

```
def agent_func(Percept):
    Rules  = {"p0" : "a0", "p1" : "a3", ...}
    Action = Rules[Percept]
    return Action
```

(Pseudo-Random) Simple Reflex Agent: Schema (2)

```
def agent_func(Percept):
    Rules   = {"p0" : ["a0", "a4", ...],
               "p1" : ["a3", ...]}
    Actions = Rules[Percept]
    Choice  = random.choice(Actions)
    return Choice
```

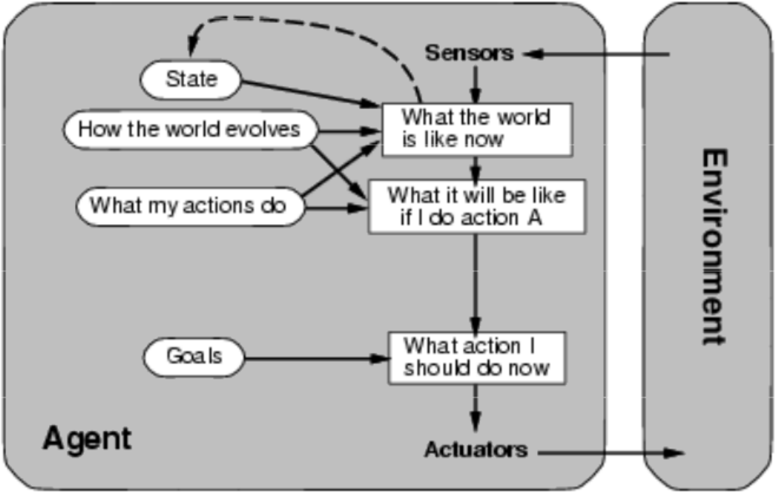
Model-Based Reflex Agent



Model-Based Reflex Agent: Schema

```
def agent_func(Percept, Curr_State, Last_Action):
    Rules  = {"s0" : "a0", "s1" : "a3", ...}
    New_State = update_state(Curr_State, Last_Action,
                            Percept, Model)
    Action    = Rules[New_State]
    return (Action, New_State)
```

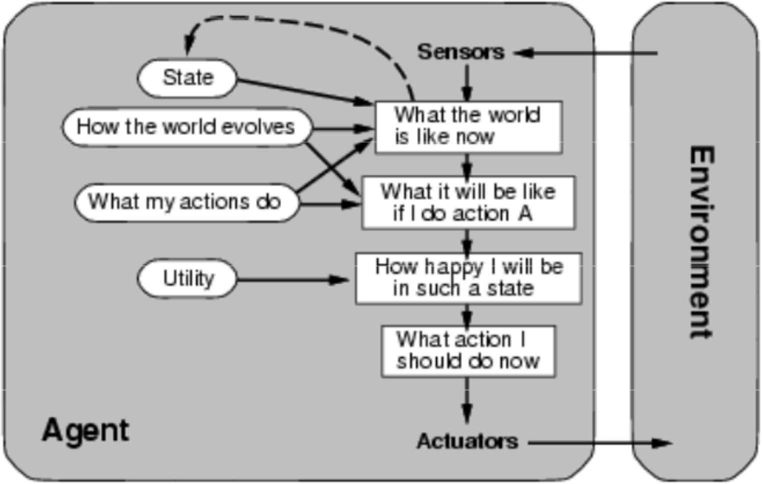
Goal-Based Agent


Sensors
State
How the world evolves
What my actions do
What the world is like now
What it will be like if I do action A
Goals
What action I should do now
Agent
Actuators
Environment

Goal-Based Agent: Schema

```
def agent_func(Percept, Curr_State, Last_Action):
    New_State = update_state(Curr_State, Last_Action,
                            Percept, Model)
    for Act in Possible_Actions:
        Possible_State = check_act(New_State, Act)
        if (Possible_State == Goal_State):
            return (Act, New_State)
```

Utility-Based Agent


Sensors
State
How the world evolves
What my actions do
Utility
What the world is like now
What it will be like if I do action A
How happy I will be in such a state
What action I should do now
Actuators
Agent
Environment

Utility-Based Agent: Schema

```
def agent_func(Percept, Curr_State, Last_Action):
    New_State = update_state(Curr_State, Last_Action,
                            Percept, Model)
    Potentials = [check_act(New_State, A)
                  for A in Possible_Actions]
    Potentials.sort()
    return Potentials[0]
```

Why Utility?

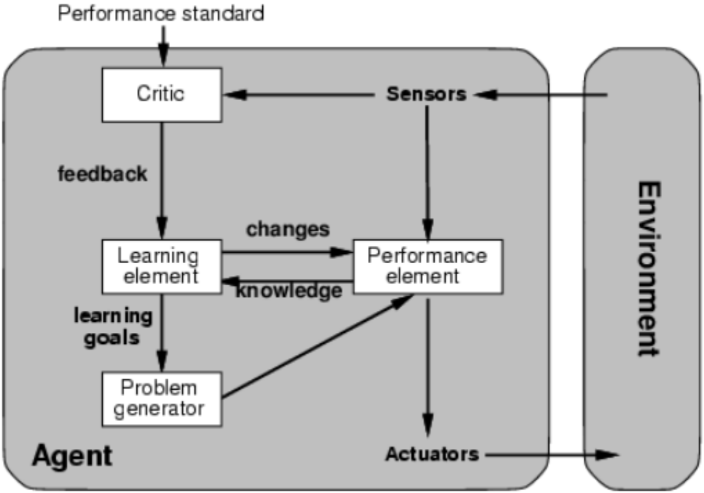
Why Utility?

- Sometimes there is no goal per-se.
- Sometimes the goal changes.
- Or the environment does.

Uncertainty.

- Certainty
- Uncertainty
- Risk

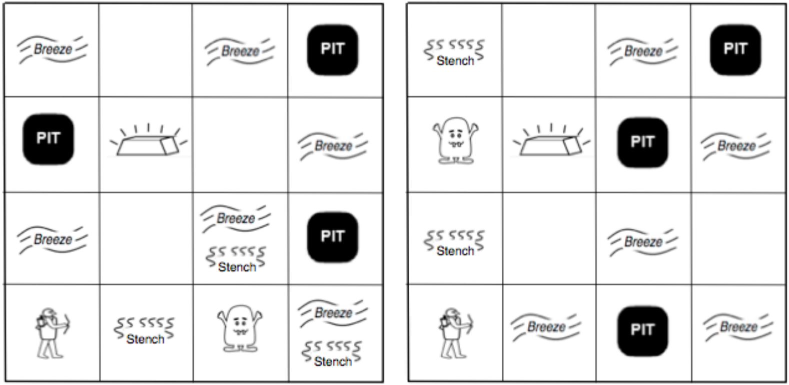
Learning Agent



Learning Agent: Schema

```
def update_func(\
    Percept, Curr_State, Last_Action, Perf_Standard):
    Est = Perf_Standard(\
          Percept, Curr_State, Last_Action)
    (Goals, Changes) = Learning_Elt.give_feedback(Est)
    New_Problems = Problem_Generator.gen_prob(Goals)
    (Knowledge, Next_Action) = agent_Func(\
       Percept, Curr_State, Last_Action, Changes)
    Learning_Element.add_knowledge(Knowledge)
    return(Next_Action)
```

Wumpus World



(a) Wumpus World A

(b) Wumpus World B

Figure 1: Two Instances of the Wumpus World (AI: A Modern Approach (Russell and Norvig))

Ethics

- Ethics has already started.

Ethics

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- **Applications**: what should be built?

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- **Engineering**: how should we build it?

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- **Implementation**: Can agents have ethics?

Ethics

- Ethics has already started.
- **Applications**: what should be built?
- **Engineering**: how should we build it?
- **Implementation**: Can agents have ethics?
- **Enforcement**: How can we enforce these rules?