

Uninformed Search

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Problem-solving

What to do to find the **sequence of actions** that allow reaching the **goal (desirable state)**?

Uninformed Search

1. Search the sequence of actions.
2. Uninformed? The only available information is the definition of the problem.



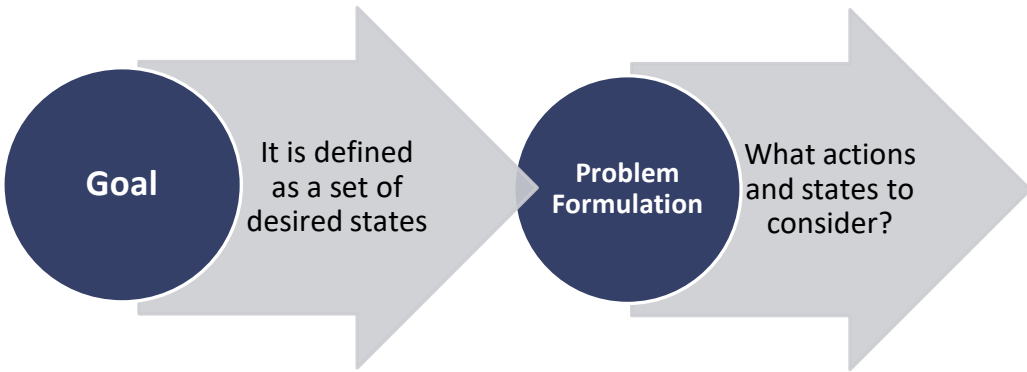
Problem solving

Goal

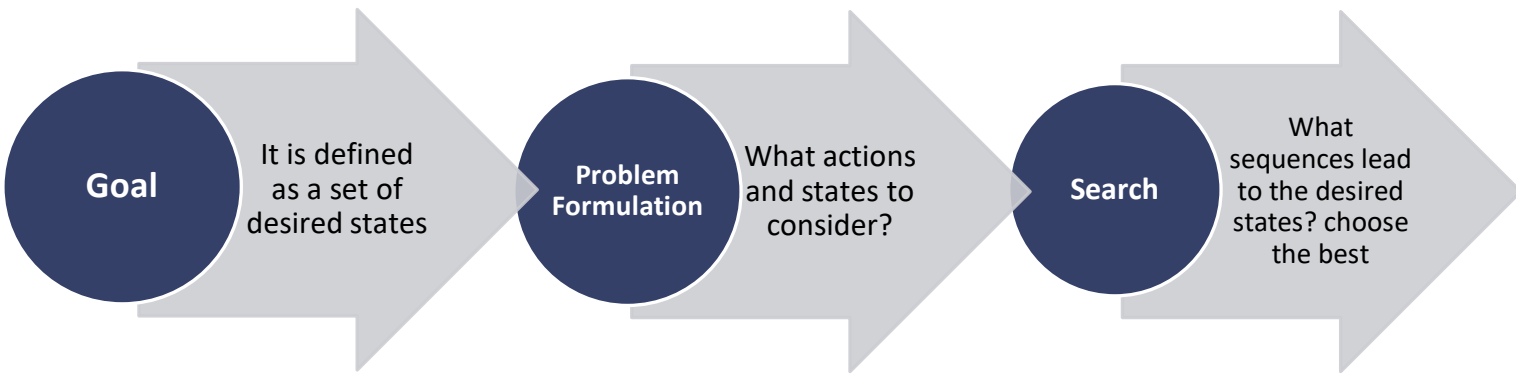
It is defined as
a set of desired
states



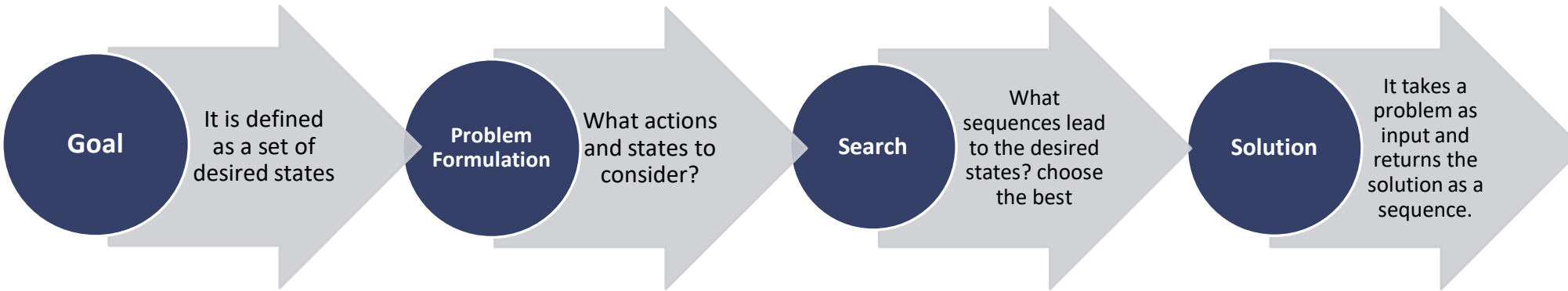
Problem solving



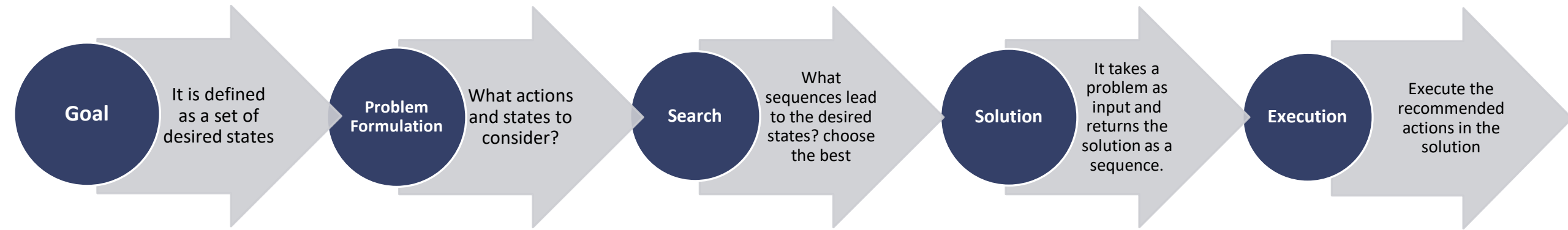
Problem solving



Problem solving



Problem solving



Problem Solver Agent Algorithm

```
function solve returns action
  inputs: perception
  static: seq: Sequence of actions, initially empty.
         state: Current state
         goal: Initially null
         problem: Problem formulation, initially null
  state <- UPDATE-STATE (state, perception)
  if (seq is empty) then
    goal <- GOAL_FORMULATION(state)
    problem <- PROBLEM_FORMULATION(state, goal)
    seq <- SEARCH (problem)
  end_if
  action <- FIRST(seq)
  seq <- LEFT (seq)
  returns action
end_function
```

Environment

1. Static
2. Completely observable
3. Discret
4. Sequence
5. Deterministic
6. Mono-agent

PROBLEM_FORMULATION



Problem Formulation

How is the
agent initially?

Initial State

Problem Formulation

How is the agent initially?

Initial State

successor function:
given a state, returns
a set of ordered pairs
<action, successor>

Actions

Problem Formulation

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Actions

Is the current the **goal state**?

Goal test

Problem Formulation

How is the agent initially?

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Actions

Is the current
the **goal state**?

Goal test

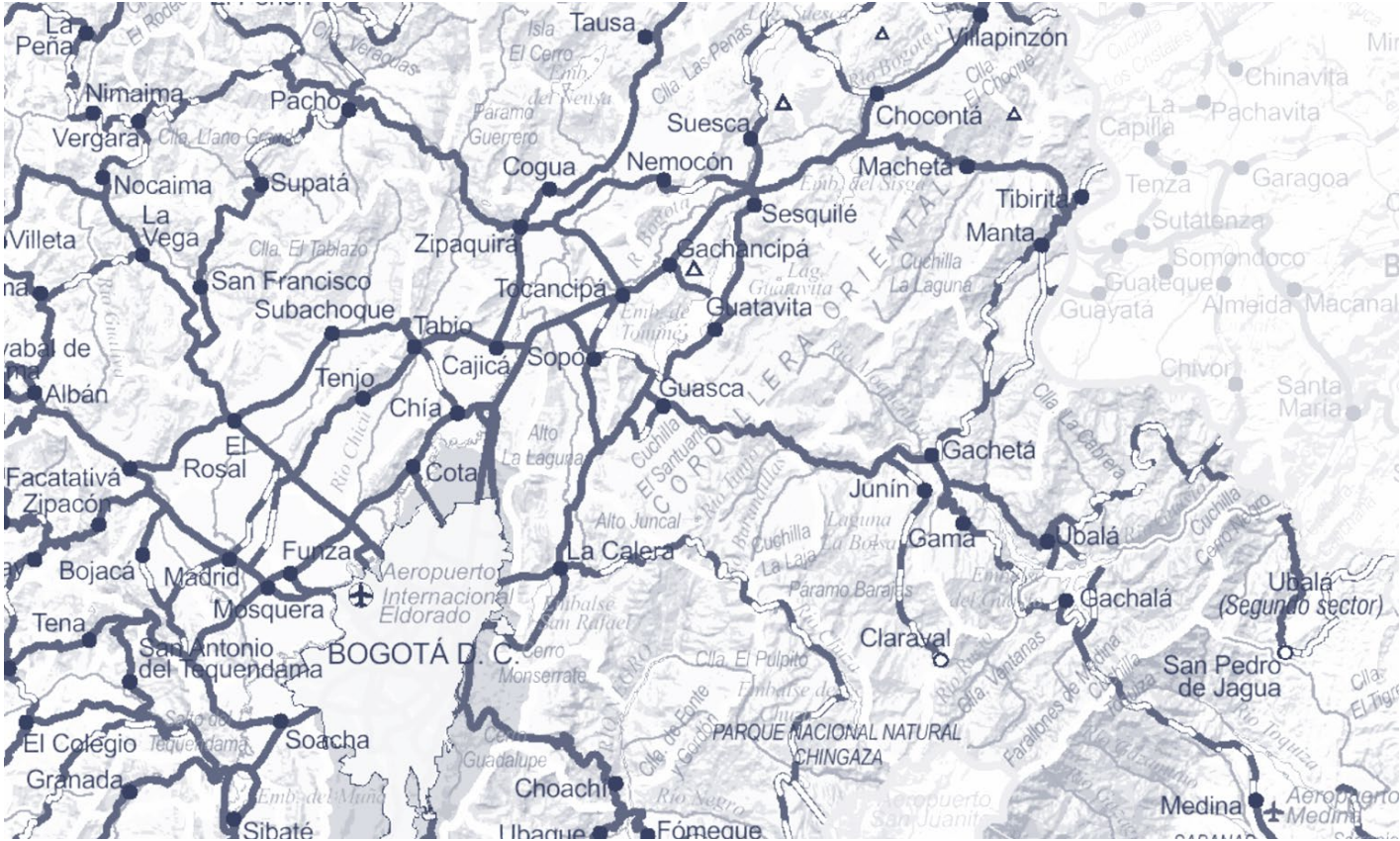
Numerical cost of
each path. A path
is a **sequence of
states**.

Path cost

GLOSSARY

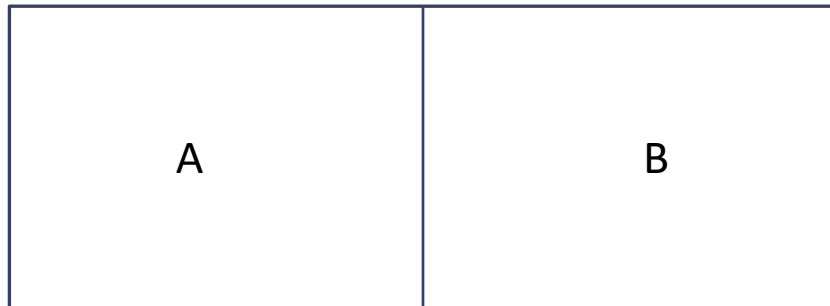
1. **Initial State**: State in which the agent **starts**
2. **Actions**: Concrete **execution**. E.g. Move to left.
3. **Successor Function**: Function that, **given a state**, returns a set of **ordered pairs** where each pair defines a possible action from the parameter state and the consequent state after executing the action.
4. **States space**: Set of all the possible **states**.
5. **Path**: State sequence connected by **actions**.
6. **Goal Test**: Function that determines if a given state is the **goal state**.
7. **Path cost**: Numeric cost associated with a path.
8. **Individual cost**: Associated to a given action.
9. **Abstract**: Representing eliminating details.

Example



Example

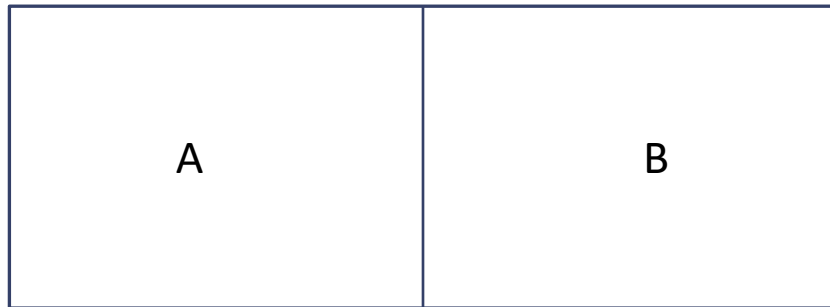
“Toy problem” (Russell, 2008)



- States:
- Initial State:
- Successor Function:
- Goal test:
- Cost:

Example

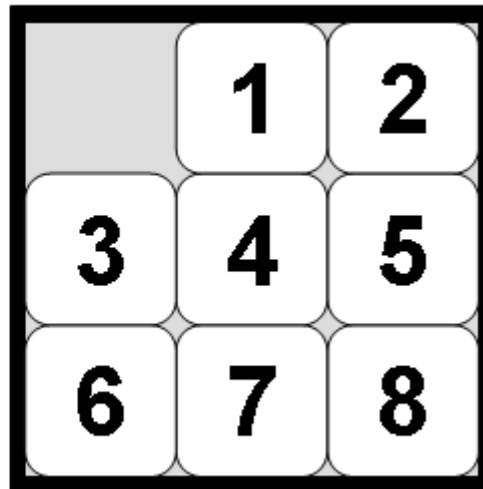
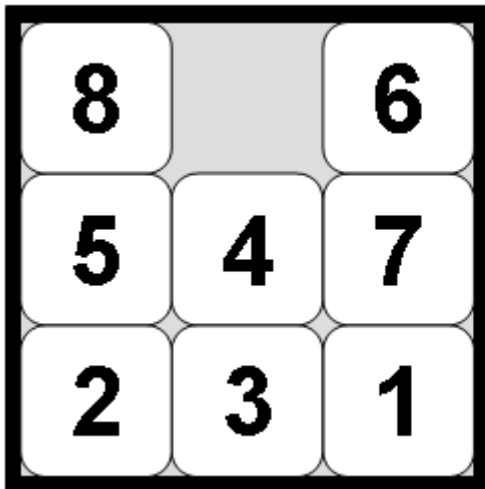
“Toy problem” (Russell, 2008)



- **States:** 2×2^2 : (A,B,CleA), (A,B, CleA), (A,B, CleA), (A,B, CleA), (A,B, CleB), (A,B, CleB), (A,B, CleB), (A,B, CleB)
- **Initial State:** Any of the 8 possible.
- **Successor function:** <action,successor> donde acción Left, Right, Clean.
- **Goal test:** Is the state (A,B,CleA) or (A,B, CleB)?
- **Cost:** Each action costs 1.

Example

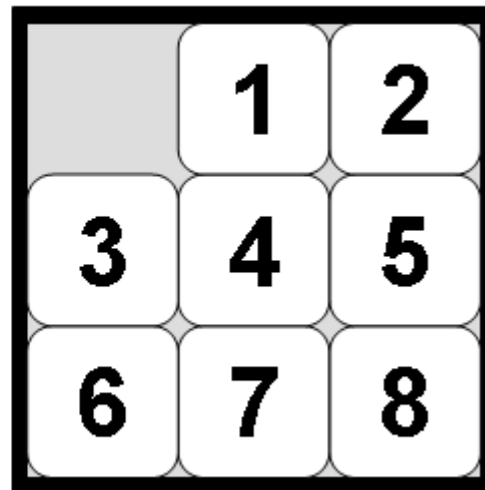
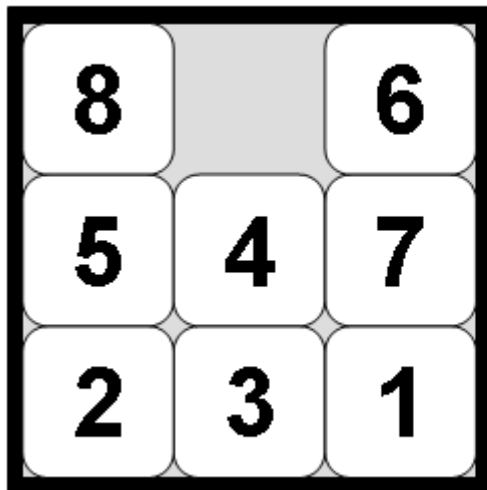
“Toy problem”: 8-Puzzle (Russell, 2008)



- States:
- Initial State:
- Successor Function:
- Goal test:
- Cost:

Example

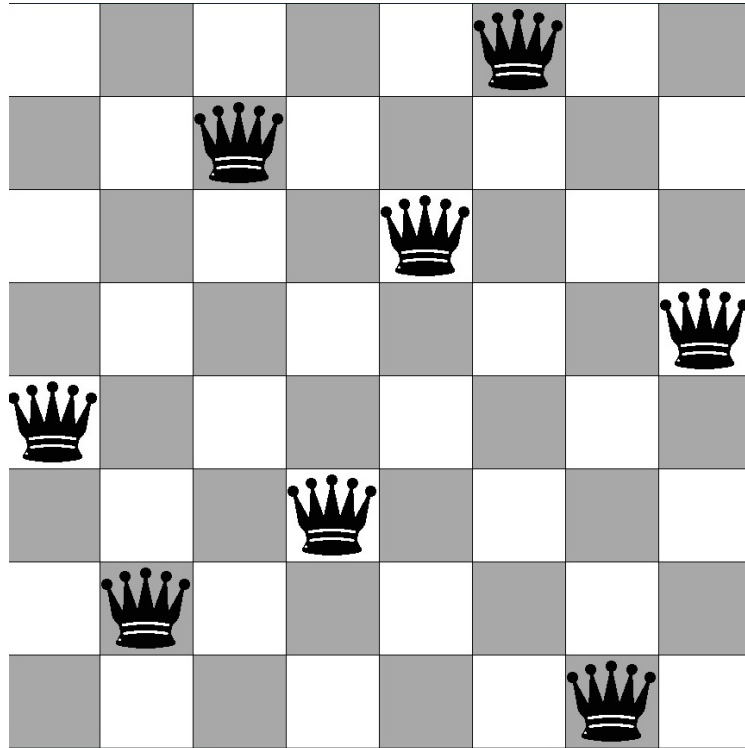
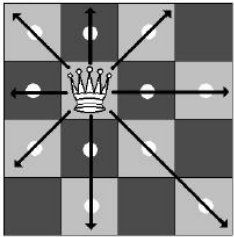
“Problema de juguete”: 8-Puzzle (Russell, 2008)



- **States:** All possible configurations: 9!
- **Initial State:** Any of the 9!
- **Function successor:** <action, successor>
Possible actions: move the hole up, down, left, right.
- **Goal test:** Is the board ordered? (The desirable state may change)
- **Cost:** Each movement costs 1.

Example

“Toy problems”: 8 Queens (Russell, 2008)



- **States:** $64 \times 63 \times 62 \times 61 \times 60 \times 59 \times 58 \times 57$ different configurations of the board with 8 Queens.
Initial State: Any of the previous.
- **Function successor:** $\langle \text{action}, \text{successor} \rangle$
Possible actions: Move queen N to the position (x, y) .
- **Goal test:** State with 8 Queens on the board, with none attacking other. (92 options)
- **Cost:** Each movement costs 1.

Real world problems

Route finding (Russell, 2008)

- **States:** Each state obviously includes a location (e.g., an airport) and the current time. Furthermore, because the cost of an action (a flight segment) may depend on previous segments, their fare bases, and their status as domestic or international, the state must record extra information about these “historical” aspects.
- **Initial state:** This is specified by the user’s query.
- **Actions:** Take any flight from the current location, in any seat class, leaving after the current time, leaving enough time for within-airport transfer if needed.
- **Transition model:** The state resulting from taking a flight will have the flight’s destination as the current location and the flight’s arrival time as the current time.
- **Goal test:** Are we at the final destination specified by the user?
- **Path cost:** This depends on monetary cost, waiting time, flight time, customs and immigration procedures, seat quality, time of day, type of airplane, frequent-flyer mileage awards, and so on.

Real world problems

Turist

Travel guide

VLSI

Robotic navigation

Assignment

1. Breadth-first search (*Búsqueda primero en anchura*)
2. Uniform-cost search (*Búsqueda de costo uniforme*)
3. Depth-first search (*Búsqueda primero en profundidad (y hacia atrás)*)
4. Depth-limited search (*Búsqueda de profundidad limitada*)
5. Iterative deepening depth-first search (*Búsqueda primero en profundidad con profundidad iterativa*)
6. Bidirectional search (*Búsqueda bidireccional*)

- Explanation
- Example
- Advantages
- Disadvantages

References

González, E. (2015) *Agentes Racionales y SMA, Notas de clase*. Pontificia Universidad Javeriana.

González, J. (n.d.) *Inteligencia Artificial. Tema 1: Introducción*. Recuperada de: https://ccc.inaoep.mx/~jagonzalez/AI/Sesion1_Introduccion.pdf Julio 2017.

Russell, S. & Norvig P. (2008) *Inteligencia Artificial: Un Enfoque Moderno*. Pearson, Prentice Hall.

Winston, P. (1992) *Artificial Intelligence*, 3ra edición. Addison-Wesley Publishing Company. Recuperado de: <http://courses.csail.mit.edu/6.034f/ai3/rest.pdf> Julio 2017.