

Artificial Intelligence ¹

BITS-Pilani Goa

¹Material for the presentation taken from Stuart Russell and Peter Norvig, *Artificial Intelligence – A Modern Approach*, Third Edition;

► What is intelligence?

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude?

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude? Is Lionel Messi intelligent?

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude? Is Lionel Messi intelligent? Is A. R. Rehman intelligent?

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude? Is Lionel Messi intelligent? Is A. R. Rehman intelligent?
 - ▶ Intelligence may refer to different abilities.
- ▶ What is Artificial intelligence?

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude? Is Lionel Messi intelligent? Is A. R. Rehman intelligent?
 - ▶ Intelligence may refer to different abilities.
- ▶ What is Artificial intelligence?
 - ▶ Make a program capable of something:

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude? Is Lionel Messi intelligent? Is A. R. Rehman intelligent?
 - ▶ Intelligence may refer to different abilities.
- ▶ What is Artificial intelligence?
 - ▶ Make a program capable of something:
 - ▶ It could be correct logical reasoning.

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude? Is Lionel Messi intelligent? Is A. R. Rehman intelligent?
 - ▶ Intelligence may refer to different abilities.
- ▶ What is Artificial intelligence?
 - ▶ Make a program capable of something:
 - ▶ It could be correct logical reasoning.
 - ▶ It could be solving a puzzle in minimum number of steps.

- ▶ What is intelligence?
 - ▶ Intellectual capability of humans
 - ▶ Is it just the aptitude? Is Lionel Messi intelligent? Is A. R. Rehman intelligent?
 - ▶ Intelligence may refer to different abilities.
- ▶ What is Artificial intelligence?
 - ▶ Make a program capable of something:
 - ▶ It could be correct logical reasoning.
 - ▶ It could be solving a puzzle in minimum number of steps.
 - ▶ It could be playing chess like a Grandmaster.

- ▶ Includes all the topics in data science.

- ▶ Includes all the topics in data science.
- ▶ Scope of this course: Learn algorithms and techniques that will allow an agent (program) take optimal (intelligent) action for various problems.

Birth of AI: Initial conjecture

- ▶ *Every aspect of learning or any other feature of (human) intelligence can in principle be so precisely defined that a machine can be made to simulate it. (1956)*

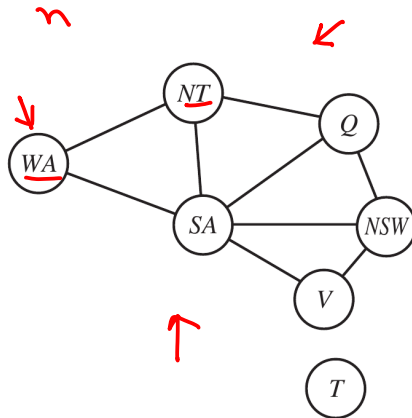
Birth of AI: Initial conjecture

- ▶ *Every aspect of learning or any other feature of (human) intelligence can in principle be so precisely defined that a machine can be made to simulate it. (1956)*
- ▶ Most problems that are of interest are NP-hard

Example: Map coloring problem



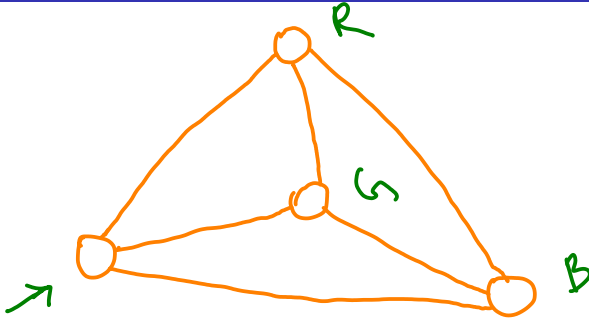
(a)



(b)

Figure 6.1 (a) The principal states and territories of Australia. Coloring this map can be viewed as a constraint satisfaction problem (CSP). The goal is to assign colors to each region so that no neighboring regions have the same color. (b) The map-coloring problem represented as a constraint graph.

Vertex-coloring problem



Is it 3-colorable?

$$(3)^n$$
$$3 \times 3 \times 3 \dots \times 3 = 3^n$$
$$O(3^n)$$

Vertex-coloring problem

- ▶ Best algorithm will still take exponential time (unless $P = NP$).

Vertex-coloring problem

- ▶ Best algorithm will still take exponential time (unless $P = NP$).

- ▶ Current best algorithm: $O(1.3289^n)$

1.31^n



Vertex-coloring problem

- ▶ Best algorithm will still take exponential time (unless $P = NP$).
- ▶ Current best algorithm: $O(1.3289^n)$
- ▶ We are only interest in **general** tools and techniques for Constraint Satisfaction Problems.

In this course

- ▶ We will define a problem.

In this course

- ▶ We will define a problem.
- ▶ We will represent the problem. (Usually, as a graph or a tree.)

In this course

- ▶ We will define a problem.
- ▶ We will represent the problem. (Usually, as a graph or a tree.)
- ▶ The problem turns out to be NP-hard.

In this course

- ▶ We will define a problem.
- ▶ We will represent the problem. (Usually, as a graph or a tree.)
- ▶ The problem turns out to be NP-hard.
- ▶ What are the general techniques (**heuristics**) we can use so that the problem can be solved more easily in practice?