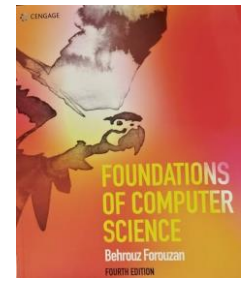
Chapter 18

Artificial Intelligence

人工智慧



Objectives 學習目標

After studying this chapter, students should be able to:

- ❑ **Define and give a brief history of artificial intelligence.人工智慧簡史**
- ❑ **Describe how knowledge is represented如何標示知識 in an intelligent agent.**
- ❑ **Show how expert systems專家系統 can be used when a human expert is not available.**
- ❑ **Show how an artificial agent can be used to simulate mundane tasks performed by human beings.**
- ❑ **Show how expert systems and mundane systems can use different search techniques to solve problems.不同搜尋方法來解決問題**
- ❑ **Show how the learning process in humans can be simulated模擬人類的學習方法, to some extent, using neural networks that create the electronic version of a neuron called a perceptron.**

What is artificial intelligence?

Although there is no universally-agreed definition of artificial intelligence, we accept the following definition that matches the topics covered in this chapter:
人工智慧為程式化系統的學習，它能模擬人類活動至某種程度，如察覺、思考、學習及動作等。

Artificial intelligence is the study of programmed systems that can simulate, to some extent, human activities such as perceiving, thinking, learning and acting.

The term "**artificial intelligence**" was first coined by John McCarthy in **1956**.

18.3

Intelligent agents 人工代理

An **intelligent agent** is a system that perceives its environment, learns from it, and interacts with it intelligently.人工代理是一種能察覺周圍環境、學習及互動的系統 Intelligent agents can be divided into two broad categories: **software agents** and **physical agents**.

Software Artificial Agents 軟體人工代理

A software agent is a set of programs that are designed to do particular tasks. For example, a software agent can check the contents of **received e-mails** and classify them into different categories如區別郵件的重要性 **(junk, less important, important, very important and so on**). Another example of a software agent is a search engine used to search the World Wide Web and find sites that can provide information about a requested subject.

18.4

Physical Artificial Agents 實體人工代理

A physical agent (robot) is a programmable system that can be used to perform a variety of tasks. Simple robots can be used in **manufacturing to do routine jobs such as assembling, welding, or painting**製造機器人能組裝、焊接或油漆. Some organizations use **mobile robots** **that do routine delivery jobs such as distributing mail or correspondence to different rooms**行動機器人能分配郵件到各房間. Mobile robots are used underwater to prospect for oil. A **humanoid robot** 人形機器人 is an autonomous mobile robot that is supposed to behave like a human.

18.5

AI for Programming languages AI 程式語言

Although some all-purpose languages such as C, C++ and Java are used to create intelligent software, **two languages are specifically designed for AI: LISP and PROLOG.**

LISP (LISt Programming) was **invented by John McCarthy in 1958**. As the name implies, LISP is a programming language that manipulates lists.

PROLOG (PROgramming in LOGic) is a language that can **build a database of facts and a knowledge base of rules**. A program in PROLOG can use logical reasoning to answer questions that can be inferred from the knowledge base. **For example**,

P1: Linda is Mary's mother **P2: Mary is Anne's mother**
The system can deduce P3: Linda is Anne's grandmother

18.6

AI Perception 人工智慧之察覺

Another goal of AI is to create a machine that behaves like an ordinary human. One of the meanings of the word **"perception" is understanding what is received through the senses—sight, hearing, touch, smell, taste, object** 經由感測察覺而能看、聽、接觸、聞、味覺及判斷物件形狀等. A human being sees a scene through the eyes, and the brain interprets it to **extract the type of objects** in the scene. A human being hears a set of voice signals through the ears, and the brain interprets it as a meaningful sentence, and so on.

18.7

AI for Searching 人工智慧之搜尋

One of the techniques for solving problems in artificial intelligence is searching, which is discussed briefly in this section. Searching can be describe as solving a problem using a set of states (a situation). **A search procedure starts from an initial state, goes through intermediate states until finally reaching a target state**.從初始狀態至中間狀態到目標狀態 For example, in solving a puzzle如解謎題, the initial state is the unsolved puzzle, the intermediate states are the steps taken to solve the puzzle and the target state is the situation in which the puzzle is solved. The set of all states used by a searching process is referred to as the **search space**搜尋空間.

18.8

Search methods 搜尋方法

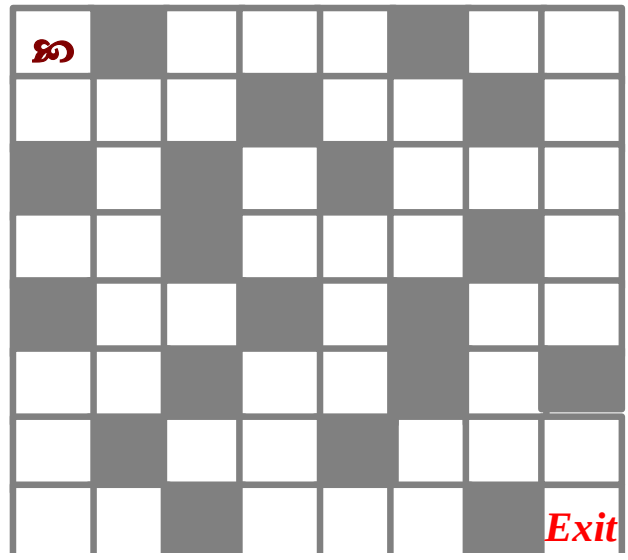
There are **two general search methods兩種普遍搜尋法**: **brute-force暴力搜尋法** and **heuristic啟發式搜尋法**.

Brute-force search 暴力搜尋法

The brute force method is itself either **breadth-first廣度優先** or **depth-first深度優先**. We use brute-force search if we do not have any prior knowledge about the search. For example, consider the steps required to find our way through **the maze with points A and T as starting起點 and finishing 終點points** respectively.

18.9

Maze routing for a shortest path between two nodes
從迷宮繞線找出兩點最短路徑之兩步驟：Expansion擴展及Backtracking反向追蹤



18.10

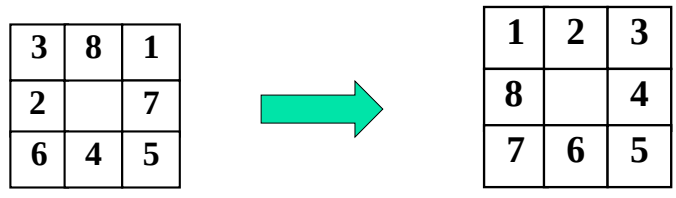
Heuristic Search 啟發式搜尋法

Using heuristic search, we assign a quantitative value called a heuristic value (h value) to each node.對每個節點指定一個量值，即h值. **This quantitative value shows the relative closeness of the node to the goal state.** h值越小即越接近於目標狀態

18.11

Example 8-puzzle 智慧盤謎題

Another example of a puzzle that shows the search space is the **famous 8-puzzle**. The tiles are numbered from 1 to 8. Given an initial random arrangement of the tiles (the initial state), the goal is to rearrange the tiles until a ordered arrangement of the tiles is reached (the target state). The rule of the game is that a tile can be slid into an empty slot.

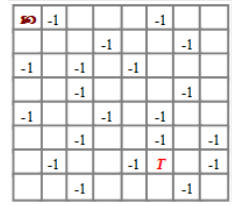


初始狀態　　目標狀態

18.12

Review Questions

- Please point out all the possible **applications using AI**.
- Please explain the major differences between **bread-first search** and **depth-first search**.
- Please show **the shortest path** of a maze using **bread-first search**.



- Please build **the 8-puzzle tree from initial state to target state**.

3	8	1
2		7
6	4	5

1	2	3
8		4
7	6	5