Technical English

For Information and Communication Engineering

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Unit Seventeen

Artificial Intelligence

概述

- 什么是人工智能？为什么要研究人工智能？
- 人工智能包含的领域和能解决的问题
- 图灵测试法：人的行为
- 认知模型
- 理性思维和理性行事

mental	精神的，心智的
entity	实体
quest	探求
coin	创造，杜撰
genetics	遗传学
discipline	学科
encompass	包含，包围，完成
perception	感觉
reasoning	推理
theorem	定理
endeavor	努力
alchemist	点金术士
eternal	永恒的，不灭的
terrestrial	地面的，地球上的
explicit	显的，明白的

dimension	维，尺度
rationality	合理性，理性
insane	有精神病的，愚蠢的
grandmaster	大师
empirical	凭经验的，经验性的
hypothesis	假设
aspersion	诽谤，中伤
interrogator	询问者，质询者
teletype	电传打字机
adapt	适应
extrapolate	推断，外延
hatch	孵化，舱口
cognitive	认知的
content (v.)	满足，满意
interdisciplinary	跨学科的

fertilize	施肥，滋养
irrefutable	不能反驳的
syllogism	三段论，推演
premise	前提
mortal	人的，不免一死的
exhaust	耗尽
agent	代理
inference	推论
provably	可证明地
reflex	反射，映像
deliberation	深思熟虑
comprehensible	可理解的
erudition	博学

人类已赋予自己智慧之人的称号，因为我们的智能对日常生活和自我感觉是如此重要。

Humankind has given itself the scientific name *homo sapiens* (man the wise) because our mental capacities are so important to our everyday lives and our sense of self. The field of artificial intelligence, or AI, attempts to understand intelligent entities. Thus, one reason to study it is to learn more about ourselves. But unlike philosophy and psychology, which are also concerned with intelligence, AI strives to build intelligent entities as well as understand them.

AI力求构建智能实体并去理解智能

其本身

Another reason to study AI is that these constructed intelligent entities are interesting and useful in their own right. AI has produced many significant and impressive products even at this early stage in its development. Although no one can predict the future in detail, it is clear that computers with human-level intelligence (or better) would have a huge impact on our everyday lives and on the future course of civilization.

具备或超越人类智能水平的计算机将在我们日常生活和未来的文明进程中具有巨大的冲击力

一个又慢又小的大脑或电脑如何能感知、理解、预测和操纵一个远远比它大而复杂的世界？

AI addresses one of the ultimate puzzles. How is it possible for a slow, tiny brain, whether biological or electronic, to perceive, understand, predict, and manipulate a world far larger and more complicated than itself? How do we go about making something with those properties?

我们如何使某些东西具备这些特性？

不同于寻求超光速运动或反重力装置

These are hard questions, but unlike the search for faster-than-light travel or an antigravity device, the researcher in AI has solid evidence that the quest is possible.[1] All the researcher has to do is to look in the mirror to see an example of an intelligent system.

AI is one of the newest disciplines. It was formally initiated in 1956, when the name was coined, although at that point work had been under way for about five years. Along with modern genetics, it is regularly cited as the "field I would most like to be in" by scientists in other disciplines.

和现代遗传学一起，AI经常被其他学科的科学工作者称为"最愿意从事的领域"。

人们需要经过多年的研究才能贡献出一个新的想法

A student in physics might reasonably feel that all the good ideas have already been taken by Galileo, Newton, Einstein, and the rest, and that it takes many years of study before one can contribute new ideas. AI, on the other hand, still has openings for a full-time Einstein.

从诸如感知和逻辑推理等的通用领域，到下棋、证明数学定理、写诗和诊断疾病等具体任务。

AI currently encompasses a huge variety of subfields, from general-purpose areas such as perception and logical reasoning, to specific tasks such as playing chess, proving mathematical theorems, writing poetry, and diagnosing diseases.

他们在这里发现了能使他们自己毕生从事的智力工作实现系统化和自动化的工具和语言

Often, scientists in other fields move gradually into artificial intelligence, where they find the tools and vocabulary to systematize and automate the intellectual tasks on which they have been working all their lives.[2] Similarly, workers in AI can choose to apply their methods to any area of human intellectual endeavor. In this sense, it is truly a universal field.

We have now explained why AI is exciting, but we have not said what it is. We could just say, “Well, it has to do with smart programs, so let’s get on and write some.” But the history of science shows that it is helpful to aim at the right goals. Early alchemists, looking for a potion for eternal life and a method to turn lead into gold, were probably off on the wrong foot.

早年寻求长生不老药和点石成金秘诀的点金术士恐怕是迈错了步。

只有改变目标，用早期天文学家预言星宿和行星运动那样的方法寻求能给出人间世界准确预言的明确理论，科学的方法和有成效的科学才会出现。

Only when the aim changed, to that of finding explicit theories that gave accurate predictions of the terrestrial world, in the same way that early astronomy predicted the apparent motions of the stars and planets, could the scientific method emerge and productive science take place.[3]

上面的是关于思维和推理过程，下面的是关于行为

Definitions as given in Table 12.1 vary along two main dimensions. The ones on top are concerned with thought processes and reasoning, whereas the ones on the bottom address behavior. Also, the definitions on the left measure success in terms of human performance, whereas the ones on the right measure against an ideal concept of intelligence, which we will call *rationality*. A system is rational if it does the right thing.

人的表现 … 智能概念 … *理性*

Table 12.1 Four possible goals to pursue in artificial intelligence

Systems that think like humans	**Systems that think rationally**
Systems that act like humans	**Systems that act rationally**

以人为中心的方法和以理性为中心的方法之间存在着矛盾

As one might expect, a tension exists between approaches centered around humans and approaches centered around rationality. We should point out that by distinguishing between human and rational behavior, we are not suggesting that humans are necessarily "irrational" in the sense of "emotionally unstable" or "insane".

我们并不是在"情续不稳"和"精神失常"的意义上暗示人必然没有理性

One merely need note that we often make mistakes; we are not all chess grandmasters even though we may know all the rules of chess; and unfortunately, not everyone gets an A on the exam. A human-centered approach must be an empirical science, involving hypothesis and experimental confirmation.

以人为中心的方法必然是一个经验的科学，包括假设和实验验证。

每个群体中的人们有时互相批评其他群体的工作

A rationalist approach involves a combination of mathematics and engineering. People in each group sometimes cast aspersions on work done in the other groups, but the truth is that each direction has yielded valuable insights. Let us look at each in more detail.

Unit 17 Acting Humanly: the Turing Test Approach

图灵把智能行为定义为在所有认知任务中达到人的水平，足以骗过讯问者。

The *Turing Test*, proposed by Alan Turing, was designed to provide a satisfactory operational definition of intelligence. Turing defined intelligent behavior as the ability to achieve human-level performance in all cognitive tasks, sufficient to fool an interrogator. Roughly speaking, the test he proposed is that the computer should be interrogated by a human via a teletype, and passes the test if the interrogator cannot tell if there is a computer or a human at the other end.

Details of the test, and whether or not a computer is really intelligent if it passes the test, will be discussed later. For now, programming a computer to pass the test provides plenty to work on. The computer would need to possess the following capabilities:

Natural language processing **to enable it to communicate successfully in English (or some other human language);**

Knowledge representation **to store information provided before or during the interrogation;**

Automated reasoning **to use the stored information to answer questions and to draw new conclusions;**

Machine learning **to adapt to new circumstances and to detect and extrapolate patterns.**

检测并向外推断模式

避免在询问者和计算机之间的直接物理接触

Turing's test deliberately avoided direct physical interaction between the interrogator and the computer, because physical simulation of a person is unnecessary for intelligence. However, the so-called *total Turing Test* includes a video signal so that the interrogator can test the subject's perceptual abilities, as well as the opportunity for the interrogator to pass physical objects "through the hatch".[4]

询问者就可以对被测试者的感觉能力进行测试，同时也包括询问者"通过舱口"传递实物的可能性

To pass the total Turing Test, the computer will need:

***Computer vision* to perceive objects;**

***Robotics* to move them about.**

一个专家系统解释它是如何得出诊断

Within AI, there has not been a big effort to try to pass the Turing test. The issue of acting like a human comes up primarily when AI programs have to interact with people, as when an expert system explains how it came to its diagnosis, or a natural language processing system has a dialogue with a user.

自然语言处理系统与用户进行对话

These programs must behave according to certain normal conventions of human interaction in order to make themselves understood. The underlying representation and reasoning in such a system may or may not be based on a human model.

在这样一个系统里基本的表达和推理可能是基于人类模型的，也可能不是。

If we are going to say that a given program thinks like a human, we must have some way of determining how humans think. We need to get inside the actual workings of human minds. There are two ways to do this: through introspection — trying to catch our own thoughts as they go by — or through psychological experiments.

有两种方法去做：通过内省，当我们的思维出现时抓住它们；或者通过心理学实验。

那就证明程序的某些机理也可以在人体内运行

Once we have a sufficiently precise theory of the mind, it becomes possible to express the theory as a computer program. If the program's input/output and timing behavior matches human behavior, that is evidence that some of the program's mechanisms may also be operating in humans. For example, Newell and Simon, who developed GPS, the "General Problem Solver", were not content to have their program correctly solve problems.

发明"通用解题装置"的纽厄尔和西蒙并不会满足于他们的程序能正确地解决问题。

他们更关注于比较程序推理步骤和人解决同一个问题的步骤。

They were more concerned with comparing the trace of its reasoning steps to traces of human subjects solving the same problems. This is in contrast to other researchers of the same time, who were concerned with getting the right answers regardless of how humans might do it.[5]

这和同时期只关心获得正确答案而不管人们会怎样做的其他研究者形成对比。

认知科学这一交叉学科领域将人工智能领域中的计算机模型与心理学中的实验技术结合起来，试图构建人类思维精确并可测试的理论。

The interdisciplinary field of *cognitive science* brings together computer models from AI and experimental techniques from psychology to try to construct precise and testable theories of the workings of the human mind.[6]

然而真正的认知科学必定建立在实际的人或动物实验研究基础上。

Although cognitive science is a fascinating field in itself, we are not going to be discussing it all that much. Real cognitive science, however, is necessarily based on experimental investigation of actual humans or animals. We will simply note that AI and cognitive science continue to fertilize each other, especially in the areas of vision, natural language, and learning.

我们只是要说明，AI和认知科学继续互相促进，特别是在视觉领域、自然语言和学习方面。

Thinking Rationally: the Laws of Thought Approach

他著名的三段论法提供了争论结构的模式，给定正确的前提就能得出正确的结论。

The Greek philosopher Aristotle was one of the first to attempt to codify "right thinking", that is, irrefutable reasoning processes. His famous *syllogisms* provided patterns for argument structures that always gave correct conclusions given correct premises. For example, "Socrates is a man; all men are mortal; therefore Socrates is mortal". These laws of thought were supposed to govern the operation of the mind, and initiated the field of *logic*.

人们假定这些思想法则支配思维活动，它们开创了逻辑学领域。

十九世纪后期和二十世纪初形式逻辑的发展提供了描述世界上各类事物的精确表示法和他们之间的关系。

The development of formal logic in the late nineteenth and early twentieth centuries provided a precise notation for statements about all kinds of things in the world and the relations between them. (Contrast this with ordinary arithmetic notation, which provides mainly for equality and inequality statements about numbers.)

与常规算术表示法形成对照，算术主要提供关于数值相等和不等的表述。

只要提供足够的时间和存储空间，就会有计算机程序以逻辑表达方式描述问题，而且只要有解，就能找到这些解。

By 1965, programs existed that could, given enough time and memory, take a description of a problem in logical notation and find the solution to the problem, if one existed.[7] (If there is no solution, the program might never stop looking for it.) The so-called *logicist* tradition within artificial intelligence hopes to build on such programs to create intelligent systems.

人工智能领域中所谓的逻辑主义实践派期望构造这样的程序以创建人工智能系统。

获取非正式的知识而用逻辑表示法所需的正式术语描述它们并不容易，特别是当知识不是100%确定时。

There are two main obstacles to this approach. First, it is not easy to take informal knowledge and state it in the formal terms required by logical notation, particularly when the knowledge is less than 100% certain. Second, there is a big difference between being able to solve a problem "in principle" and doing so in practice.

即使仅有几十个事实的问题就可能耗尽任何计算机的资源，除非有关于首先尝试哪个推理步骤的某种指引。

Even problems with just a few dozen facts can exhaust the computational resources of any computer unless it has some guidance as to which reasoning steps to try first.

Although both of these obstacles apply to any attempt to build computational reasoning systems, they appeared first in the logicist tradition because the power of the representation and reasoning systems are well-defined and fairly well understood.

虽然这两个障碍都适用于任何构建计算推理系统的尝试，但他们首先出现在逻辑主义实践派的传统中因为对表达和推理系统的能力有明确定义并有相当好的理解。

Unit 17 Acting Rationally: the Rational Agent Approach

理性行事意思是在给定某人信念的情况下，为了达到其目的而实行的行为。

Acting rationally means acting so as to achieve one's goals, given one's beliefs. An *agent* is just something that perceives and acts. (This may be an unusual use of the word, but you will get used to it.) In this approach, AI is viewed as the study and construction of rational agents.

AI被看作是研究和构建理性代理

In the “laws of thought” approach to AI, the whole emphasis was on correct inferences. Making correct inferences is sometimes part of being a rational agent, because one way to act rationally is to reason logically to the conclusion that a given action will achieve one’s goals, and then to act on that conclusion.[8]

因为理性行事的方式之一就是合乎逻辑地推出这样的结论：某一给定的行为将能达到目的，然后照此行事。

正确推断并不是理性的全部，因为通常有这样的情况，没有什么可证明为正确的事情要做，但仍然要去做某些事。

On the other hand, correct inference is not all of rationality, because there are often situations where there is no provably correct thing to do, yet something must still be done.

There are also ways of acting rationally that cannot be reasonably said to involve inference. For example, pulling one's hand off of a hot stove is a reflex action that is more successful than a slower action taken after careful deliberation.

把手从火热的炉子上抽回来只是一种反射行为，这要比经过深思后采取的缓慢行动要成功得多。

我们需要有能力去表达知识和用它进行推理，因为这使得我们能在各种各样的情形下达到好的决策。

All the “cognitive skills” needed for the Turing Test are there to allow rational actions. Thus, we need the ability to represent knowledge and reason with it because this enables us to reach good decisions in a wide variety of situations. We need to be able to generate comprehensible sentences in natural language because saying those sentences helps us get by in a complex society.

我们需要能用自然语言产生易于理解的语句，因为说这些语句可帮助我们适应复杂的社会环境。

我们需要学习并不仅仅是为了博学，而是因为对世界如何运转有一个较好的观念能使我们产生更有效的策略来处理它。

We need learning not just for erudition, but because having a better idea of how the world works enables us to generate more effective strategies for dealing with it. We need visual perception not just because seeing is fun, but in order to get a better idea of what an action might achieve.

我们需要视觉并不仅仅是因为能看见很有趣，而是为了对行为所能达到的效果有一个更好的概念。

结合课文的思考题

- What is artificial intelligence?
- How do you understand the relations between the two rows and two columns in the table given in the text?
- What is Turing's test?
- What are rational thinking and rational action?

Alan Mathison Turing

Alan Mathison Turing was born on June 23rd 1912 in Paddington, London. He was educated at Sherborne School, and then went to King's College, Cambridge in 1931 to read Mathematics. Alan Turing was a brilliant original thinker. Formally a mathematician, in his lifetime he studied and wrote papers over a whole spectrum of subjects, from philosophy and psychology through to physics, chemistry and biology. He was probably at his happiest when he could combine high-level thinking with hands-on experience with machinery or experiments. In addition to his many other interests, for most of his postgraduate life he probably had a deeper understanding of computers and their potential in the future than anyone else.