信息与控制专业英语

翟俊祥　杨向明

西安交通大学出版社

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内容简介

本书内容基本覆盖了信息与控制技术的各个领域，可作为电子信息类各专业本科生的专业英语教材。另外，其它专业的本科生和研究生希望辅修电子信息专业，或者信息产业的从业人员及广大英语爱好者希望了解信息技术的概貌和发展，都可阅读本书。本书专业内容广泛、通俗，英语流畅、易读。阅读本书，既可丰富专业知识，又可提高英语水平。

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前 言

本书用作大学信息与控制类专业的专业英语教材。专业英语是在结束了大学基础英语的学习后开设的，旨在使学生巩固已有的英语知识，进一步提高英语水平，并培养学生阅读相关专业资料的能力。

外语是本科教育的重要课程，熟练掌握一门外语是要求学生的一项基本技能，外语能力是衡量学生素质的一个重要方面。英语是目前应用最广、最为普及的一种语言，而信息技术是发展最为迅速，影响最为深远，也是目前最为热门的学科和技术领域。编者希望通过本书，能对提高学生的英语水平和普及信息技术知识作出贡献。

基础英语作为必修课，由于学业的要求和考试的压力，学生还比较重视。专业英语是一门考查课，很多学生又通过了英语四级考试，加之后继课程负担加重，大多数人往往放松了英语学习。而这个时候学生的现状是：有了相当的英语基础和读、听能力，但熟练掌握和实际应用英语的能力还很差，处在英语学习的关

键时刻。如果放松学习，甚至慢慢遗忘，实在是既可惜又可悲的事情。如何使“要我学”变为“我要学”，把“应试型”变为“应用型”，关键就是要有一本通俗而有趣的教材，激发学生的兴趣，吸引学生自觉地去学习。如果教材索然无味，学生就不想去看；但如果过于艰深，学生就看不下去。当然，“通俗”不等于“简单”，过于简单的东西是无味的。我们的任务是引导学生在原有的基础上一步一步地提高。当他们增长了知识，看到了自己的进步，就会激发浓厚的兴趣，自觉坚持学习。时间长了，日积月累，英语水平和能力自然而然就提高了。编者根据多年来专业英语教学的经验和目前大多数学生英语水平的现状，力图使本教材具有通俗性和趣味性的特点。

专业英语是基础英语的继续，学完基础英语、通过四级考试的学生，阅读本书应该没有很大的困难。考虑到三年级学生，刚刚开始接触专业课，所以本书的专业内容定位在专业教材与科普读物之间——不是用原版英语教材进行专业课教学，而是用英语介绍广泛的专业内容和知识。从专业的角度看，本书可叫做“信息技术概论”或“信息技术博览”，全书包括控制论与电子技术、计算机科学与技术、通信工程与技术等几部分。每篇文章，例如计算机、电视或电话机，不但分别介绍了它们各自的组成部分、各部分的工作原理、各种体系结构和分类，还介绍了技术进步和发展的历史、目前的技术现状和成果、未来的发展方向和前景等。信息技术日新月异，本书力图反映最新的技术成果，例如因特网和全球卫星定位系统等。

本书内容广泛，基本覆盖了信息与控制领域的各个方面，同时专业内容浅显，符合素质教育中拓展学生知识面的指导思想。不仅信息与控制类专业的学生可以用它作为专业英语教材，其它专业的本科生和研究生希望辅修电子信息专业，信息产业从业人员以及广大的英语爱好者希望了解信息技术的概貌和发展，都可阅读本书，从中获取专业知识，提高英语水平。

本书是由翟俊祥总体策划和选材，由翟俊祥和杨向明共同编写的。翟俊祥编写了全部词汇和句子注释，杨何明编配了第 2，3，4，5，6，11，12，14，15，16，17，18，19，21，27，28，

33课的练习题和答案，其余练习题和答案全由翟俊祥编配。另外，赵友安、高锦秀也参加了部分编写工作。

西安交通大学曹建福副教授审阅了书稿，提出了宝贵的修改意见，编者对他表示衷心的感谢。由于编者水平所限，仍有很多缺点和错误，希望广大读者批评指正。

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CONTENTS

Unit 1

INFORMATION THEORY

1 Introduction

Information theory is the theory concerned with the mathematical laws governing the transmission, reception, and processing of information. More specifically, information theory deals with the numerical measurement of information, the representation of information (such as encoding), and the capacity of communication systems to transmit, receive, and process information.① Encoding can refer to the transformation of speech or images into electric or electromagnetic signals, or to the encoding of messages to ensure privacy.

Information theory was first developed in 1948 by the American electrical engineer Claude E. Shannon in his article "A Mathematical Theory of Communication". The need for a theoretical basis for communication technology arose from the increasing complexity and crowding of communication channels such as telephone and teletype networks and radio communication systems. Information theory also encompasses all other forms of information transmission and storage, including television and the electrical pulses transmitted in computers and in magnetic and optical data recording. The term information refers to the transmitted messages: voice or music transmitted by telephone or radio, images transmitted by television systems, digital data in computer systems and networks, and even nerve impulses in living organisms.[②] More generally, information theory has been applied in such varied fields as cybernetics, cryptography, linguistics, psychology, and statistics.

2 Components of a Communication System

The most extensively studied type of communication system consists of several components. A source (such as a person speaking) produces information, or a message, that is to be transmitted. A transmitter, such as a telephone and amplifier or a microphone and radio transmitter, converts the message into electronic or electromagnetic signals. These signals are transmitted through the channel, or medium, such as a wire or the atmosphere. The channel, in particular, is susceptible to interference issuing from many sources, which distorts and degrades the signals. (Examples of interference, known as noise, include the static in radio and telephone reception, fading in mobile communication, and the "snow" in television picture reception.) The receiver, such as a radio receiver, reconstructs the signal into the original message. The final component is the destination, such as a person listening to the message.

Two of the major concerns of information theory are the reduction of noise-induced errors in communication systems and the efficient use of total channel capacity.[③]

3 Information Content

A fundamental concept in information theory is that the amount of information in a message, called information content, is a well-defined, measurable mathematical quantity. The term content does not refer to the meaning of the transmitted message, but to the probability that a given message will be received from a set of possible messages. The highest value for the information content is assigned to the message that is the least probable. If a message is expected with 100-percent certainty, its information content is 0. If a coin is tossed, for example, the combined message "heads or tails", describing the result, has no information content. The two separate messages "heads" and "tails", on the other hand, are equally probable and have probabilities of one-half. ④ In order to relate information content (I) to probability, Shannon introduced a simple formula:

$$I = \log_2 1/p$$

in which p is the probability of a message being transmitted and $\log_2$ is the logarithm of $1/p$ to a base 2. (Log_2 of a given number is the exponent that must be given to the number 2 in order to obtain the given number. Log_2 of 8 = 3, for example, because $2^3 = 8$. ⑤) Using this formula to calculate the information content of the messages "heads" and "tails" yields a value of $\log_2 2 = 1$. The information content of a message can be understood in terms of the number of possible symbols that represent a message. In the example above, if "tails" is represented by a 0, and "heads" by a 1, there is only one choice to repre-

sent the message: *either* 0 or 1. The 0 and the 1 are the digits of the binary system (see Number Systems), and the choice between those two symbols corresponds to the so-called binary information unit, or bit. If a coin is tossed three times in a row, the eight equally possible results (or messages) can be represented as 000, 001, 010, 011, 100, 101, 110, and 111. These messages correspond to the numbers 0, 1, . . . , 7 written in binary notation. The probability of each message is one-eighth, and its information content is $\log_2(1 \div 1/8) = 3$, which is the number of bits needed to represent each message. ⑥

4 Entropy

In most practical applications, one must choose among messages that have different probabilities of being sent. The term entropy has been borrowed from thermodynamics to denote the average information content of a message. Entropy can be understood intuitively as the amount of "disorder" in a system. In information theory the entropy of a message equals its average information content. If, in a set of messages, the probabilities are equal, the formula for the total entropy can be given as $H = \log_2 N$, in which N is the number of possible messages in the set.

5 Encoding and Redundancy

If transmitted messages consist of random combinations of the 26 letters of the English alphabet, the space, and five punctuation marks, and if it is assumed that the probability of each message is the same, the entropy $H = \log_2 32 = 5$. This means that five bits are needed to encode each character, or message: 00000, 00001, 00010, ... , 11111. Efficient transmission and storage of information require the reduction of the number of bits used for encoding. This is possible when processing English texts because letters are far from being completely random. The probability is extremely high, for example, that the letter following the sequence of letters informatio is an n. It can be shown that the entropy of ordinary written English is about one bit per letter. This indicates that the English language (like every other language) incorporates a large amount of redundancy called natural redundancy. This redundancy enables a person to understand messages in which vowels are missing, for example, or to decipher unclear handwriting. ⑦In modern communications systems, artificial redundancy is added to the encoding of messages in order to reduce errors in message transmission.

Words & Terms

1. cryptography 密码术,密码编制学
2. cybernetics 控制论
3. decipher 译解,解释
4. encode 编码
5. entropy 熵,平均信息量
6. in a row 成排,接连
7. information content 信息量
8. linguistics 语言学
9. probability 几率,概率

10. psychology 心理学
11. random 随意,随机的
12. redundancy 冗余,冗余度
13. snow 雪花形干扰,雪花效应
14. static 静电干扰,天电干扰
15. statistics 统计学,统计数字
16. thermodynamics 热力学

Notes

①More specifically, information theory deals with the numerical measurement of information, the representation of information (such as encoding), and the capacity of communication systems to transmit, receive, and process information.

更具体地说,信息理论讨论信息的数值测量、信息的表示(例如编码)和通信系统传输、接收和处理信息的能力。

② The term information refers to the transmitted messages: voice or music transmitted by telephone or radio, images transmitted by television systems, digital data in computer systems and networks, and even nerve impulses in living organisms.

"信息"一词指的是所传递的消息:电话或广播所传递的声音和音乐、电视系统所传递的图像,计算机系统和网络中的数字数据,甚至还有生物体中的神经刺激。

③Two of the major concerns of information theory are the reduction of noise-induced errors in communication systems and the efficient use of total channel capacity.

信息理论所关心的两个主要问题是减小通信系统中的噪声感应误差和有效利用总的通道容量。

④ If a coin is tossed, for example, the combined message "heads or tails", describing the result, has no information content. The two separate messages "heads" and "tails", on the other hand, are equally probable and have probabilities of one-half.

例如,投掷硬币时,用"正面或背面"这种组合信息来描述结果,其信息量为零,而"正面"和"背面"这两个单独的信息,其可能性相等,概率各为一半。

⑤Log_2 of a given number is the exponent that must be given to the number 2 in order to obtain the given number. Log_2 of $8=3$, for example, because $2^3=8$.

一个给定数的以 2 为底的对数是这样一个数,当以其作为 2 的指数时,幂值必须等于该给定数。例如 $Log_2 8=3$, 这是因为 $2^3=8$ 。

⑥If a coin is tossed three times in a row, the eight equally possible results (or messages) can be represented as 000, 001, 010, 011, 100, 101, 110, and 111. These messages correspond to the numbers 0, 1, . . . , 7 written in binary notation. The probability of each message is one-eighth, and its information content is $\log_2(1\div 1/8)=3$, which is the number of bits needed to represent each message.

如果一个硬币连续投三次,有 8 种可能性相同的结果(信息),可以用 000, 001, 010, 011, 100, 101, 110, 和 111 来表示。这些信息对应于二进制表示的 0, 1, . . . , 7 这几个数。每个信息的概率为 1/8,其信息量是 $\log_2(1\div 1/8)=3$,这就是为了表示每个信息所必须的位数。

⑦This redundancy enables a person to understand messages in which vowels are missing, for example, or to decipher unclear handwriting.

这种冗余使一个人能够理解漏掉的信息，譬如漏掉了元音，或者看懂不清楚的笔迹。

Exercises

Choose the best answer according to the passage.

1. Information theory deals with _____.
   a. the numerical measurement of information
   b. the representation of information (such as encoding)
   c. the capacity of communication systems to transmit, receive, and process information
   d. All above.
2. The term information refers to _____.
   a. voice, music and images
   b. digital data
   c. nerve impulses
   d. the transmitted messages by different media, that is, all above items.
3. A communication system consists of _____.
   a. a source, a transmitter, medium, a receiver, and the destination
   b. a transmitter, medium, and a receiver
   c. a source, medium, and the destination
   d. a transmitter, medium, a receiver, and the destination
4. If a message is absolutely certain, its information content is _____.
   a. 100 percent   b. 0
   c. 1   d. a half
5. According to Shannon's formula, the information content of

a binary code with four bits is ______.

a. 4　　b. 16

c. 0　　d. 1

6. In the example of tossing a coin three times in a row, the total entropy is ______.

a. 8　　b. 1/8

c. 3　　d. 1/3

7. In encoding of messages, redundancy can ______.

a. reduce bits to encode

b. reduce errors in message transmission

c. increase the speed of message transmission

d. increase information content