21世纪高等学校计算机规划教材

21st Century University Planned Textbooks of Computer Science

信息管理专业英语教程

Information Management English

司爱侠 侯安才 张强华 黄祝菲 编著

- 贴近行业实际，培养专业英语人才
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内 容 提 要

本书作者根据多年的教学经验，精心安排书中每个单元的内容，读者在学习专业英语的同时，还可以学到目前最新的专业知识。全书主要围绕信息的概念、信息的组织、信息技术、因特网介绍、电子商务、安全技术及管理信息系统等内容展开。另外，本书的习题针对课文来设计安排，学生据此可检验学习效果。

本书为授课教师提供教学课件，有需要者请登录人民邮电出版社教学服务与资源网（http://www.ptpedu.com.cn）免费下载。

本书既可作为高等院校信息类专业的专业英语教材，也可作为培训班教材或供从业人员自学使用。

21世纪高等学校计算机规划教材

信息管理专业英语教程

◆ 编　　著　司爱侠　侯安才　张强华　黄祝菲
责任编辑　滑　玉
执行编辑　武恩玉

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出版者的话

计算机应用能力已经成为社会各行业从业人员最重要的工作技能要求之一，而计算机教材质量的好坏会直接影响人才素质的培养。目前，计算机教材出版市场百花争艳，品种急剧增多，要从林林总总的教材中挑选一本适合课程设置要求、满足教学实际需要的教材，难度越来越大。

人民邮电出版社作为一家以计算机、通信、电子信息类图书与教材出版为主的科技教育类出版社，在计算机教材领域已经出版了多套计算机系列教材。在各套系列教材中涌现出了一批被广大一线授课教师选用、深受广大师生好评的优秀教材。老师们希望我社能有更多的优秀教材集中地呈现在老师和读者面前，为此我社组织了这套“21 世纪高等学校计算机规划教材——精品系列”。

本套教材具有下列特点。

（1）前期调研充分，适合实际教学需要。本套教材主要面向普通本科院校的学生编写，在内容深度、系统结构、案例选择、编写方法等方面进行了深入细致的调研，目的是在教材编写之前充分了解实际教学的需要。

（2）编写目标明确，读者对象针对性强。每一本教材在编写之前都明确了该教材的读者对象和适用范围，即明确面向的读者是计算机专业、非计算机理工类专业还是文科类专业的学生，尽量符合目前普通高等教育计算机课程的教学计划、教学大纲以及发展趋势。

（3）精选作者，保证质量。本套教材的作者，既有来自院校的一线授课老师，也有来自 IT 企业、科研机构等单位的资深技术人员。通过他们的合作使老师丰富的实际教学经验与技术人员丰富的实践工程经验相融合，为广大师生编写出适合目前教学实际需求、满足学校新时期人才培养模式的高质量教材。

（4）一纲多本，适应面宽。在本套教材中，我们根据目前教学的实际情况，做到“一纲多本”，即根据院校已学课程和后续课程的不同开设情况，为同一科目提供不同类型的教材。

（5）突出能力培养，适应人才市场要求。本套教材贴近市场对于计算机人才的能力要求，注重理论知识与实际应用的结合，注重实际操作和实践动手能力的培养，为学生快速适应企业实际需求做好准备。

（6）配套服务完善。对于每一本教材，我们在教材出版的同时，都将提供完备的 PPT 课件，并根据需要提供书中的源程序代码、习题答案、教学大纲等内容，部分教材还将在作者的配合下，提供疑难解答、教学交流等服务。

在本套教材的策划组织过程中，我们获得了来自清华大学、北京大学、中国人民大学、浙江大学、吉林大学、武汉大学、哈尔滨工业大学、东南大学、四川大学、上海交通大学、西安交通大学、电子科技大学、西安电子科技大学、北京邮电大学、北京林业大学等院校老师的大力支持和帮助，同时获得了来自信息产业部电信研究院、联想、华为、中兴、同方、爱立信、摩托罗拉等企业和科研单位的领导或技术人员的积极配合。在此，向他们表示衷心的感谢。

我们相信，“21 世纪高等学校计算机规划教材——精品系列”一定能够为我国高等院校计算机教学做出应有的贡献。同时，对于工作欠缺和不妥之处，欢迎老师和读者提出宝贵的意见和建议。

前 言

信息是最重要的资源之一。因此，信息管理在许多组织中具有重要地位，信息管理专业也应运而生，它承担着培养信息管理人才的重任。信息管理专业已成为我国开设最多的专业之一。

信息管理专业跨管理、网络及软件等各专业，具有很强的综合性。同时，信息管理的各组成部分也在高速发展中，具有国际化的特征。因此，信息管理人才的专业英语水平对其专业技能的发展至关重要，许多高校都把信息管理专业英语设为专业必修课。

根据当前行业的最新发展，我们精心选择了本书素材。课文既包括行业的基础知识和基本概念，也包括常用软件及常用设备的相关知识，同时还注意了行业最新的发展及未来动向。

本书以单元为单位，每个单元包括以下内容。

- Text A 及 Text B：精心选择了两篇课文，既包括基本概念和基础知识，也包括行业应用，同时尽量覆盖行业的主要子领域。
- New Words：给出课文中出现的新词，读者由此可以积累专业词汇。在选择单词时，我们主要选择公共英语中不常使用、而在专业英语中经常出现的单词，也选择了在专业英语中有特殊含义的单词。
- Phrases：给出课文中的常用专业英语词组及部分非专业英语词组。
- Abbreviations：给出课文中出现的、业内人士必须掌握的缩略语。缩略语在本行业中十分重要，必须给予充分的重视。

单词、词组和缩略语已经进行了计算机程序处理，排除了重复，并根据先出现先选择、Text A 优先于 Text B 的原则进行了整理。

- Notes：对课文中出现的难句、长句、语法结构复杂的句子加以讲解。这有利于读者透彻领会难句的含义，也可以培养读者的阅读理解能力。
- Exercises：练习巩固部分。其中，【Ex1.】检查读者对 Text A 课文的掌握情况；【Ex2.】巩固本课学习的英语单词；【Ex3.】培养读者英文翻译成中文的能力；【Ex4.】通过短文选词填空，培养读者的篇章阅读能力和对整篇文章的领悟能力；【Ex5.】检查读者对 Text B 课文的掌握情况。
- Reading Material：选择了与 Text A 和 Text B 课文相关的材料，进一步扩大读者的视野。同时，对读者可能感觉困难的单词，在旁边注释了词义。
- 参考译文：给出了 Text A 的参考译文，供读者参阅。
- 参考答案：附录提供了本书全部习题的参考答案，可供读者对照检查学习效果。

另外，我们还提供了教学电子课件，教师可以从人民邮电出版社教学服务与资源网（http://www.ptpedu.com.cn）免费下载。如果读者有任何问题，可以通过电子邮件与我们交流。我们的 Email 地址：zqh3882355@sina.com；zqh3882355@163.com。

本书既可作为高等院校信息类（信息管理、软件工程、电子商务、电子政务等）专业的专业英语教材，也可作为培训班教材或供从业人员自学使用。

编 者

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Unit 1

Text A
About Information

1. Information Society

An information society is a society in which the creation, distribution, diffusion, use, and manipulation of information is a significant economic, political, and cultural activity. The knowledge economy is its economic counterpart whereby wealth is created through the economic exploitation of understanding.

Specific to this kind of society is the central position information technology has for production, economy, and society at large. Information society is seen as the successor to industrial society. Closely related concepts are the post-industrial society, post-fordism, post-modern society, knowledge society, telematic society, information revolution, and network society.

2. Information Science

Information science (also information studies) is an interdisciplinary science primarily concerned with the collection, classification, manipulation, storage, retrieval and dissemination of information. Information science is by some regarded as synonym with library, while others maintain the two terms cover different fields.

Information science studies the application and usage of knowledge in organizations, and the interaction between people, organizations and information systems. It is often (mistakenly) considered a branch of computer science. It is actually a broad, interdisciplinary field, incorporating not only aspects of computer science, but also mathematics, library science, cognitive science, and the social sciences.

Information science focuses on understanding problems from the perspective of the stakeholders involved and then applying information and other technologies as needed. In other words, it tackles systemic problems first rather than individual pieces of technology within that system. In this respect, information science can be seen as a response to technological determinism, the belief that technology "develops by its own laws, that it realizes its own potential, limited only by the material resources available, and must therefore be regarded as an autonomous system controlling and ultimately permeating all other subsystems of society." Within information science, attention has been given in

recent years to human-computer interaction, groupware, the semantic web, value sensitive design, iterative design processes and to the ways people generate, use and find information. Today this field is called the Field of Information, and there are a growing number of schools and colleges of information.

Information science should not be confused with information theory, the study of a particular mathematical concept of information, or with library science, a field related to libraries which uses some of the principles of information science.

3. Information Technology

Information technology (IT), as defined by the Information Technology Association of America (ITAA), is "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware." IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit, and securely retrieve information.

Today, the term information technology has ballooned to encompass many aspects of computing and technology, and the term is more recognizable than ever before. The information technology umbrella can be quite large, covering many fields. IT professionals perform a variety of duties that range from installing applications to designing complex computer networks and information databases. A few of the duties that IT professionals perform may include data management, networking, engineering computer hardware, database and software design, as well as the management and administration of entire systems. When computer and communications technologies are combined, the result is information technology. Information Technology (IT) is a general term that describes any technology that helps to produce, manipulate, store, communicate, and/or disseminate information. Presumably, when speaking of Information Technology (IT) as a whole, it is noted that the use of computers and information are associated.

4. Information Theory

The main concepts of information theory can be grasped by considering the most widespread means of human communication: language. Two important aspects of a good language are as follows: First, the most common words (e.g., "a", "the", "I") should be shorter than less common words (e.g., "benefit", "generation", "mediocre"), so that sentences will not be too long. Such a tradeoff in word length is analogous to data compression and is the essential aspect of source coding. Second, if part of a sentence is unheard or misheard due to noise — e.g., a passing car — the listener should still be able to glean the meaning of the underlying message. Such robustness is as essential for an electronic communication system as it is for a language; properly building such robustness into communications is done by channel coding. Source coding and channel coding are the fundamental concerns of information theory.

Note that these concerns have nothing to do with the *importance* of messages. For example, a platitude such as "Thank you! Come again" takes about as long to say or write as the urgent plea "Call an ambulance!" ,while clearly the latter is more important and more meaningful. Information theory, however, does not consider message importance or meaning, as these are matters of the quality of data

rather than the quantity and readability of data, the latter of which is determined solely by probabilities.

Information theory is generally considered to have been founded in 1948 by Claude Shannon in his seminal work "A Mathematical Theory of Communication" .The central paradigm of classical information theory is the engineering problem of the transmission of information over a noisy channel. The most fundamental results of this theory are Shannon's source coding theorem, which establishes that, on average, the number of bits needed to represent the result of an uncertain event is given by its entropy; and Shannon's noisy-channel coding theorem, which states that reliable communication is possible over noisy channels provided that the rate of communication is below a certain threshold called the channel capacity and that the channel capacity can be approached in practice by using appropriate encoding and decoding systems.

Information theory is closely associated with a collection of pure and applied disciplines that have been investigated and reduced to engineering practice under a variety of rubrics throughout the world over the past half century or more: adaptive systems, anticipatory systems, artificial intelligence, complex systems, complexity science, cybernetics, informatics, machine learning, along with systems sciences of many descriptions. Information theory is a broad and deep mathematical theory, with equally broad and deep applications, amongst which is the vital field of coding theory.

Coding theory is concerned with finding explicit methods, called codes, of increasing the efficiency and reducing the net error rate of data communication over a noisy channel to near the limit that Shannon proved is the maximum possible for that channel. These codes can be roughly subdivided into data compression (source coding) and error-correction (channel coding) techniques. In the latter case, it took many years to find the methods Shannon's work proved were possible. A third class of information theory codes are cryptographic algorithms (both codes and ciphers). Concepts, methods and results from coding theory and information theory are widely used in cryptography and cryptanalysis.

Information theory is also used in information retrieval, intelligence gathering, statistics, and even in musical composition.

New Words

information	[ˌinfə'meiʃən]	*n.* 信息
technology	[tek'nɔlədʒi]	*n.* 技术，工艺，科技
creation	[kri'eiʃən]	*n.* 创造，建立
distribution	[distri'bju:ʃən]	*n.* 分发，分配
diffusion	[di'fju:ʒən]	*n.* 传播，流传，扩散
manipulation	[məˌnipju'leiʃən]	*n.* 管理，处理，操作
significant	[sig'nifikənt]	*adj.* 有意义的，重大的，重要的
counterpart	['kauntəpɑ:t]	*n.* 副本，相对物
position	[pə'ziʃən]	*n.* 位置 *vt.* 安置，决定……的位置
production	[prə'dʌkʃən]	*n.* 生产，产品
successor	[sək'sesə]	*n.* 继承者，接任者，后续的事物

concept	['kɔnsept]	*n.* 概念，观念，思想
telematic	[teli'mætik]	*adj.* 信息通信的
network	['netwə:k]	*n.* 网络
interdisciplinary	[intə'disi'plinəri]	*adj.* 学科间的，跨学科的
collection	[kə'lekʃən]	*n.* 收集，收取；收集的东西
classification	[ˌklæsifi'keiʃən]	*n.* 分类，分级
storage	['stɔridʒ]	*n.* 存储
retrieval	[ri'tri:vəl]	*n.* 检索；恢复，修补
dissemination	[disemi'neiʃən]	*n.* 传播，宣传
synonym	['sinənim]	*n.* 同义词
library	['laibrəri]	*n.* 图书馆，藏书室
field	[fi:ld]	*n.* 领域，区域
application	[ˌæpli'keiʃən]	*n.* 应用；应用程序，应用软件
usage	['ju:sidʒ]	*n.* 使用，用法
interaction	[ˌintər'ækʃən]	*n.* 交互作用
consider	[kən'sidə]	*vt.* 考虑；照顾；认为
branch	[brɑ:ntʃ]	*n.* 枝，分枝
incorporate	[in'kɔ:pəreit]	*v.* 合并，并入
cognitive	['kɔgnitiv]	*adj.* 认知的，认识的，有感知的
perspective	[pə'spektiv]	*n.* 远景，观点，看法
stakeholder	['steikhəuldə]	*n.* 股东，利益相关者
systemic	[sis'temik]	*adj.* 系统的
individual	[ˌindi'vidjuəl]	*n.* 个人，个体
		adj. 个别的，单独的，个人的
piece	[pi:s]	*n.* 块，件，片，篇，张，条
response	[ris'pɔns]	*n.* 回答，响应，反应
potential	[pə'tenʃəl]	*adj.* 潜在的，可能的；势的，位的
		n. 潜能，潜力；电压
material	[mə'tiəriəl]	*n.* 材料，原料，资料；素材
autonomous	[ɔ:'tɔnəməs]	*adj.* 自治的
permeate	['pə:mieit]	*vt.* 弥漫，渗透，透过，充满
subsystem	['sʌbˌsistim]	*n.* 子系统
groupware	[gru:pwɛə]	*n.* 组件，群件
semantic	[si'mæntik]	*adj.* 语义的，语义学的
iterative	['itərətiv]	*adj.* 重复的，反复的
principle	['prinsəpl]	*n.* 法则，原则，原理
design	[di'zain]	*n.* &*v.* 设计，计划
support	[sə'pɔ:t]	*vt.* 支持
convert	[kən'və:t]	*vt.* 转变，变换
protect	[prə'tekt]	*vt.* 保护

transmit	[trænz'mit]	*vt.* 传输，转送，传导，传播
encompass	[in'kʌmpəs]	*vt.* 包括，包含
recognizable	['rekəgnaizəbl]	*adj.* 可认识的，可辨认的，可公认的，可认知的
professional	[prə'feʃənl]	*n.* 专业人员，职业艺人 *adj.* 专业的，职业的
perform	[pə'fɔ:m]	*vt.* 履行，执行
database	['deitəbeis]	*n.* 数据库
hardware	['hɑ:dwɛə]	*n.* 硬件
administration	[ədminis'treiʃən]	*n.* 管理，经营，行政
communications	[kəmju:ni'keiʃənz]	*n.* 通信
combine	[kəm'bain]	*v.*（使）联合，（使）结合
describe	[dis'kraib]	*v.* 描述
produce	[prə'dju:s]	*n.* 产品 *vt.* 提出；生产
disseminate	[di'semineit]	*vt.* 散布，传播（消息、观念等）
grasp	[grɑ:sp]	*vt.&n.* 抓住，抓紧，掌握，领会
widespread	['waidspred]	*adj.* 分布广泛的，普遍的
tradeoff	['treidɔf]	*n.*（公平）交易，折衷，权衡
essential	[i'senʃəl]	*adj.* 本质的，实质的，基本的；提炼的，精华的 *n.* 本质，实质；要素，要点
analogous	[ə'næləgəs]	*adj.* 相似的，类似的；模拟的
unheard	['ʌn'hə:d]	*adj.* 未听到的，未被倾听的，未知的
noise	[nɔiz]	*n.* 声音，噪音；干扰
message	['mesidʒ]	*n.* 消息，信息 *vt.* 通知
entropy	['entrəpi]	*n.* 熵
fundamental	[ˌfʌndə'mentl]	*adj.* 基础的，基本的 *n.* 基本原则，基本原理
platitude	['plætitju:d]	*n.* 老生常谈，陈词滥调
urgent	['ə:dʒənt]	*adj.* 急迫的，紧急的
meaningful	['mi:niŋful]	*adj.* 有意义的
quality	['kwɔliti]	*n.* 质量，品质，性质
quantity	['kwɔntiti]	*n.* 量，数量
readability	[ˌri:də'biliti]	*n.* 易读性，可读性
seminal	['si:minl]	*adj.* 开创性的，有重大影响的
classical	['klæsikəl]	*adj.* 古典的，正统派的；传统的，权威的
theorem	['θiərəm]	*n.* 定理，法则
state	[steit]	*vt.* 陈述，说明

		n. 状况，情形，状态
capacity	[kə'pæsiti]	*n.* 容量；生产量
encoding	[in'kəudiŋ]	*n.* 编码，译码
decoding	[di'kəudiŋ]	*n.* 译码，解码
discipline	['disiplin]	*n.* 学科
practice	['præktis]	*n.* 实行，实践，实际
adaptive	[ə'dæptiv]	*adj.* 适应的
anticipatory	[æn'tisipeitəri]	*adj.* 预料的，预想的
cybernetics	[saibə'netiks]	*n.* 控制论
informatics	[ˌinfə'mætiks]	*n.* 信息学，情报学
vital	['vaitl]	*adj.* 极为重要的，关系重大的
explicit	[ik'splisit]	*adj.* 明确的，清楚的
method	['meθəd]	*n.* 方法，办法
code	[kəud]	*n.* 代码，密码，编码
		v. 编码
subdivide	['sʌbdi'vaid]	*v.* 再分，细分
technique	[tek'ni:k]	*n.* 技术，技巧，方法，
cryptographic	[ˌkriptə'græfik]	*adj.* 用密码写的
algorithm	['ælgəriðəm]	*n.* 算法
cipher	['saifə]	*n.* 密码
		v. 译成密码
cryptography	[krip'tɔgrəfi]	*n.* 密码学，密码术
cryptanalysis	[ˌkriptə'nælisis]	*n.* 密码分析，密码分析学
statistics	[stə'tistiks]	*n.* 统计学，统计表

Phrases

information society	信息社会
knowledge economy	知识经济
information technology	信息技术
at large	详尽，普遍
industrial society	工业社会
post-industrial society	后工业社会
knowledge society	知识社会
Information Revolution	信息革命
be concerned with	牵涉到，与……有关，参与
regard as	把……认作
in other words	换句话说
deal with	涉及，处理，安排
a variety of	多种的

as well as	也，又
as a whole	总体上
information theory	信息论
data compression	数据压缩
source coding	源编码
channel coding	信道编码
on average	平均起来
artificial intelligence	人工智能
systems sciences	系统科学
coding theory	编码理论

Abbreviations

IT (Information Technology)	信息技术
ITAA (Information Technology Association of America)	美国信息技术协会

Notes

[1] An information society is a society in which the creation, distribution, diffusion, use, and manipulation of information is a significant economic, political, and cultural activity.

本句中，in which the creation, distribution, diffusion, use, and manipulation of information is a significant economic, political, and cultural activity 是一个定语从句，修饰和限定 a society。in which 等于 where。

[2] Information science (also information studies) is an interdisciplinary science primarily concerned with the collection, classification, manipulation, storage, retrieval and dissemination of information.

本句中，(also information studies)是对主语 Information science 的补充说明；primarily concerned with the collection, classification, manipulation, storage, retrieval and dissemination of information 是一个过去分词短语，作定语，修饰和限定表语 an interdisciplinary science，它可以扩展为一个定语从句：which is primarily concerned with the collection, classification, manipulation, storage, retrieval and dissemination of information。

[3] Information science should not be confused with information theory, the study of a particular mathematical concept of information, or with library science, a field related to libraries which uses some of the principles of information science.

本句中，the study of a particular mathematical concept of information 是 information theory 的同位语，对其进行补充说明。a field related to libraries which uses some of the principles of information science 是 library science 的同位语，对其进行补充说明。在该同位语中，related to libraries which uses some of the principles of information science 是一个过去分词短语，做定语，修饰和限定表语 a field，其中 which uses some of the principles of information science 是一个定语从句，也修饰和限定 a field。

[4] Information theory is closely associated with a collection of pure and applied disciplines that have been investigated and reduced to engineering practice under a variety of rubrics throughout the world

over the past half century or more: adaptive systems, anticipatory systems, artificial intelligence, complex systems, complexity science, cybernetics, informatics, machine learning, along with systems sciences of many descriptions.

本句中，that have been investigated and reduced to engineering practice under a variety of rubrics throughout the world over the past half century or more 是一个定语从句，修饰和限定 a collection of pure and applied disciplines。冒号后面的 adaptive systems, anticipatory systems, artificial intelligence, complex systems, complexity science, cybernetics, informatics, machine learning, along with systems sciences of many descriptions 是对 a collection of pure and applied disciplines 的举例说明。

Exercises

【Ex1.】根据课文内容，回答以下问题。

1. What is an information society?
2. What is the knowledge economy?
3. What is information science?
4. What do some people regard information science as? What about others?
5. What does information science study?
6. What is the definition given to IT by the Information Technology Association of America (ITAA)?
7. What does IT deal with?
8. When and by whom was information theory founded?
9. What does Shannon's source coding theorem establish?
10. What does Shannon's noisy-channel coding theorem state? How can the channel capacity be approached in practice?

【Ex2.】根据给出的汉语词义和规定的词类写出相应的英语单词。每词的首字母已给出。

n. 网络 n_____

n. 传播，流传，扩散 d_____

n. 技术，工艺，科技 t_____

n. 密码学，密码术 c_____

n. 分发，分配 d_____

n. 信息 i_____

n. 检索，恢复，修补 r_____

n. 应用，应用程序，应用软件 a_____

n. 管理，处理，操作 m_____

n. 存储 s_____

n. 收集，收取 c_____

n. 交互作用 i_____

n. 子系统 s_____

vt. 传输，转送，传达，传导，传播 t_____

n. 管理，经营，行政部门 a_____

n. 熵 e_____

n. 容量，生产量 c_____

n. 译码，解码 d_____

n. 代码，密码，编码 c_____

adj. 重复的，反复的，迭代的 i_____

n. 法则，原则，原理 p_____

vt. 履行，执行 p_____

n. 数据库 d_____

n. 通信 c_____

n. 消息，信息 m_____

adj. 基础的，基本的 f_____

n. 编码，译码 e_____

n. 信息学，情报学 i_____

adj. 用密码写的 c_____

n. 算法 a_____

n. 密码分析，密码分析学 c_____

【Ex3.】把下列句子翻译为中文。

1. Management is the process of working with and through people and other organizational resources to accomplish organizational goals.
2. Good managers do those things both effectively and efficiently.
3. To be efficient is to achieve goals with minimum waste of resources.
4. The best managers maintain a clear focus on both effectiveness and efficiency.
5. Comprehensive plans, solid organizations, and outstanding leaders do not guarantee success.
6. A board is a group of people who are legally charged to govern an organization (usually a corporation).
7. The chief executive officer reports to the board and is responsible for carrying out the board's strategic policies.
8. Another common view is that "management" is getting things done through others.
9. Their top executives could be called Chief Executive Officers.
10. Others believe that managing and leading occur at many levels of the organization.

【Ex4.】从下列词中选择适当的词填空。

quantification	find	applied	analysis	Intuitively
as	quantum	expressed	communicating	than

Information theory is a branch of __1__ mathematics and engineering involving the __2__ of information. Historically, information theory was developed to find fundamental limits on compressing

and reliably __3__ data. Since its inception it has broadened to __4__ applications in many other areas, including statistical inference, networks other __5__ communication networks as in neurobiology, the evolution and function of molecular codes, model selection in ecology, thermal physics, __6__ computing, plagiarism detection and other forms of data __7__ .

A key measure of information that comes up in the theory is known __8__ information entropy, which is usually __9__ by the average number of bits needed for storage or communication. __10__ ,entropy quantifies the uncertainty involved in a random variable. For example, a fair coin flip will have less entropy than a roll of a die.

Text B
What Is Information?

Now, although differences in such cases are virtual only, the information itself is not. It is just another type of information — indeed, the most elementary one. I will subsequently call it parainformation (by contrast, the hitherto discussed "juxtaposition- type" information will be called structural information).

There are many systems which can deal with parainformation only. Let us examine some of them briefly.

Photocell-operated systems (doors, elevators, etc.) discriminate just two states — "open electrical circuit" and "closed circuit" —disjunctively present. And (para) information occurs whenever one state changes into another.

In homeostatic devices the alphabet also consists of two states, e.g., "above some preset value" and "below it" , as in the case of a thermostat. Parainformation is the virtual difference between the actual temperature and the preset one.

Biological cells can also handle situations where only parainformation is available. Let us consider what is called a "genetic code" . The alphabet consists here of four nucleotides (commonly abbreviated as C, A, G, U) which can be discriminated by some enzyme. The code here is any linear sequence of the nucleotides in a DNA or RNA chain. At that structural level no information whatever is present. Information enters the scene only when the double helix splits and the enzyme polimeraze detects which one of the four nucleotides occurs at a particular place in the chain, and then adds to it a complementary one (the processes of replication and transcription). What is involved is thus parainformation, for no concurrent states are detected.

What about translation, where we are told that most of the possible 64 triplets of nucleotides in the messenger-RNA (codons), created during transcription of the DNA's structure, "encode" one of the 20 amino acids necessary to build any protein? At first it may seem that what must be detected here are differences between concomitant states, i.e., between particular nucleotides within a triplet (say A/C/G or G/G/C). A closer examination of the mechanisms involved during codon detection reveals, however, that this is not the case. The particular codon is detected by the complementary triplet (anticodon) in the transfer-RNA, which then adds a specific associated amino acid to the polypeptide under construction.