EST Reading

科技英语阅读

主　编：贾晓锋　王盛
副主编：侯孝俊　韩晶　王小燕　焦娜

甘肃人民出版社

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前　言

21 世纪是科学技术飞速发展的世纪，随着我国对外科技交流的深入开展，科技英语在提高学生科技创新能力以及国际科技合作与交流中发挥着越来越重要的作用。进一步加强当代大学生科技英语阅读能力，是我国高校适应创新型国家建设需求、是培养创新型人才的重要内容。为了推动新世纪大学英语教学改革，提高本科生面向科技创新的后期大学英语学习能力，我们精心设计并编写了《科技英语阅读》一书。

本书收集和整理了 38 篇不同类型的科普文章，从不同的侧面反映了当今科技发展的现状和趋势，同时展现了科技英语自身的语言特点。所选内容丰富，难易兼顾，内容均选自互联网上的科普文章，收录了科技领域的最新报道，涉及基因工程、环境保护、互联网、气候、能源、生物、计算机、农业、地理等领域。每个篇章后设计有生词、短语、注释以及与课文相关的练习等，以方便学习者使用。本书具有以下特点：题材新颖，兼顾知识性和趣味性于一体，时代性强，语言富有科技英语特色，含有较丰富的通用和专业科技英语词汇和语法结构。

本书在编写过程中吸收了最新的科技研究成果，参考和引用了有关论著、文章及其他文字资料，文中未能一一注明，在此向有关作者表示感谢。由于编写时间较为仓促，如有遗漏或不当之处，敬请同行专家及广大读者随时提出宝贵意见。

编　者

2011 年 10 月

Contents

1. Automating Science

David Waltz and Bruce G. Buchanan

内容概要

本文从自动化科学的发展历程讲起,通过一些科学技术领域自动化装置的具体应用实例介绍了自动化科学与人们生产和生活的密切相关性。并且,作者对未来自动化科学的发展前景提出展望,对它的发展前景做出了预测。将来,更多的自动化技术将会应用在人们生活中,它会成为人们生产和生活的更好的帮手。

The idea of automating aspects of scientific activity dates back to the roots of computer science, if not to Francis Bacon. Some of the earliest programs automated the processes of creating ballistic tables, cracking cyphers, collecting laboratory data, etc., by carrying out a set of instructions from start to finish. Starting with DENDRAL in the 1960s, artificial intelligence programs such as Prospector, Bacon, and Fahrenheit automated some of the planning, analysis, and discovery portions of the scientific enterprise. However, most of these programs were still designed to run a calculation to completion, produce an answer, and then stop. They did not fully "close the loop" in the sense of examining the results of their actions, deciding what to try next, potentially cycling forever.

Two reports on pages 85 and 81 of this issue push the boundaries of automatic scientific experimentation and discovery. King et al. describe a robotic system for running biological experiments, evaluating their results, and deciding what experiments to try next. Schmidt and Lipson describe their work on discovering compact equations that characterize complex nonlinear dynamical systems, derived from visual observation of such systems. As these reports show, it is possible for one computer program to step through the activities needed to conduct a continuously looping procedure that starts with a question, carries out experiments to answer the question, evaluates the results, and reformulates new questions.

Semiautomated. Scientists at Stanford's Instrumentation Research Laboratory (circa 1970) linked a gas chromatograph and high-resolution mass spectrometer to computers to automate studies of biological fluids, meteorites, and other materials. Stanford's DENDRAL Project experimented with automated interpretation of the data and experiment planning to specify nuclear magnetic resonance or infrared data that would resolve ambiguities in the mass spectral data.

CREDIT: ROBERT K. LINDSAY

The main goals of automation in science have been to increase productivity by increasing efficiency (e.g., with rapid throughput), to improve quality (e.g., by reducing error), and to cope with scale, allowing scientific treatment of topics that were previously impossible to address. Tycho Brahe spent a lifetime recording observations that allowed Johannes Kepler to formulate Kepler´s laws of planetary motion; today, computer-controlled data collection is commonplace and necessary for both experimental and observational science. Automating many activities beyond data collection offers even more benefits.

In the near term, a useful metaphor is to consider computers as intelligent assistants. Some assistants gather data and attend to such tasks as noise filtering, data smoothing, outlier rejection, and data storage. Other assistants are specialists at statistical analysis, still others at bench work. This metaphor has driven many research projects over the past several decades and has led to many of the most successful applications of computers.

An early articulation of this metaphor is Joshua Lederberg´s effort at Stanford University School of Medicine to develop an automated biomedical laboratory to examine the soil of Mars for traces of life, as part of the 1975 Viking mission deployed by the U.S. National Aeronautics and Space Administration. The robot assistant Lederberg designed, with engineer Elliott Levinthal, consisted of a conveyor belt that scooped up samples of Martian soil and deposited them within a computer-controlled mass spectrometer. Each soil sample was bombarded with electrons, producing a fragmentation pattern that sorted the charged particles (ions) according to their mass. This pattern was transmitted to Earth, where scientists could analyze it for evidence of organic compounds and microbial life. In addition, part of Lederberg´s vision for this instrumentation was also to close the loop by performing the analysis onboard the spacecraft to inform a next round of experiments without waiting for Earth-based instructions. This was, in part, the motivation for the DENDRAL project at Stanford in which an intelligent assistant hypothesized the molecular structure of organic molecules on the basis of mass spectrometry data (see the figure).

Intelligent assistants are currently numerous and well integrated into the activities of science and industry. In the longer term, however, new kinds of computer programs are needed to cope with the sheer volume of data that can be collected automatically and with the volume of relevant information available in the literature.

Closing the loop from experiment design and data collection to hypothesis formation and revision, and from there to new experiments, will be one important way to cope with the volume of data. A new wave of programs will test the efficacy of using computers in closed-loop fashion and will explore the questions of which activities can be automated, and which ones we would even want to automate. Even for the relatively straightforward task of data collection, there are myriad questions to answer before streaming data from a laboratory instrument into a computer, including why particular data are being collected, which variables should be measured, and which instrument will measure them. If no such instrument exists, can it be designed and built?

Beyond coping with the volume of data, however, computers need to be called into service to cope with the volume of information and background knowledge relevant to any scientific question. Search engines and automated libraries will return more articles in response to a query than anyone has time to read. (For example, Google returns about 200,000 hits for the phrase "laboratory automation" and 10 million hits for the pair of terms "science" + "automation".) Programs that have the intelligence to read and interpret the online information for us will contribute to the next level of closing the loop. This is already an active area of computer science research.

For any such program to select the most cost-effective and informative hypotheses, prune hypotheses that cannot be realized experimentally, avoid repeating unsuccessful experiments that have already been tried by others, etc., it must include a rich model of the entire process of the loop, as well as knowledge of the specific scientific area being automated. This will increasingly involve a substantial modeling effort, as is already required for planning and interpreting experiments in systems biology or weather and climate.

For the foreseeable future, the prospect of using automated systems as assistants holds vast promise as these assistants are becoming not only faster but much broader in their capabilities—more knowledgeable, more creative, and more self-reflective. Human-machine partnering systems that match the tasks to what each partner does best can potentially increase the rate of scientific progress dramatically, in the process revolutionizing the practice of science and changing what scientists need to know.

New words:

automate	v. (使)自动化
date back to	追溯到…; 从…开始
ballistic	adj. 发射的;弹道(学)的; 衡量冲击强度的
cypher	n.密码
instruction	n. 指令,说明
artificial intelligence	人工智能
close the loop	完成循环,停止循环
enterprise	n. 企业,事业
boundary	n. 界限,边界,疆界
robotic	n. 机器人的
compact	adj. 紧凑型的
equation	n. 方程式
nonlinear	adj. 非线性的
dynamical	adj. 动力学的
derive from	起源,来自
continuously looping procedure	无限循环过程
semi-automated	adj. 半自动的,半自动化的
chromatograph n.	色层分析仪
high-resolution	高分辨率
meteorite	n. 陨星
magnetic	adj. 有磁性的
resonance	n.共鸣,回声,共振
ambiguity	n. 含糊,不明确

spectral	adj. 光谱的
productivity	n. 生产率,生产力
efficiency	n. 效率
commonplace	n. 普遍现象
prospector	n. 勘探者;探矿者
bacon	n. 熏肉
Fahrenheit	n. 华氏温标
semiautomatic adj.	半自动化的
spectrometer	n. 分光计, 分光仪
planetary	adj. 似行星的
metaphor	n. 暗喻,比喻
filtering	n. 过滤
storage	n.储存
specialist	n.专家
bench work	钳工工作
application	n.实际应用,用途
articulation	n. 说话,提出
scoop	vt. 铲,舀
deposit	v. 储藏,储存,保管
electron	n.电子
conveyor	n.传送带
bombard	n.碰撞
fragmentation	n. 分裂,破碎
microbial	adj. 微生物的,细菌的
instrumentation	n. 装置
motivation	n. 动力,推动力
hypothesize	v. 假设,假定,猜测
molecular	adj. 分子的
efficacy	n. 功效,能效
myriad	n. 许多,无数
relevant	adj. 与……相关的
substantial	adj. 巨大的,相当的
prospect	n. 前景,前途

Explanations to key sentences:

1. However, most of these programs were still designed to run a calculation to completion, produce an answer, and then stop. They did not fully "close the loop" in the sense of examining the results of their actions, deciding what to try next, potentially cycling forever.

然而,这些程序中大多数仍然是靠计算来完成的,找出一个问题的答案即停止了。从检验运算结果的角度来讲,它们并没有完全停止循环,而是对下一步要干什么做出判断,有可能会一直循环下去。

2. As these reports show, it is possible for one computer program to step through the activities needed to conduct a continuously looping procedure that starts with a question, carries out experiments to answer the question, evaluates the results, and reformulates new questions.

这些报道说明计算机程序能够进行无限循环的指令,提出一个问题、开展试验来找出问题的解决办法、评估该问题并在最后提出新的问题。

3. Schmidt and Lipson describe their work on discovering compact equations that characterize complex nonlinear dynamical systems, derived from visual observation of such systems.

施密特和利普森描述了他们是怎样发现紧凑型方程式的。该方程式是通过观察而得到的,特点是具有复杂的非线性动力系统。

4. In the near term, a useful metaphor is to consider computers as intelligent assistants. Some assistants gather data and attend to such tasks as noise filtering, data smoothing, outlier rejection, and data storage.

在近期内,计算机被人们比喻为有用的智能助手。有些助手能够收集数据,并执行诸如噪音过滤、数据平滑、异常排除以及储存的任务。

5. In the longer term, however, new kinds of computer programs are needed to cope with the sheer volume of data that can be collected automatically and with the volume of relevant information available in the literature.

然后,从长远角度来看,人们需要有新的计算机程序来应对自动收集到的大量数据的储存以及文学作品中可得到的相关数据的储存的任务。

Questions:

1. When did automating science come into being?
2. What are the goals of automating science?
3. What is the prospect of using automated systems as assistants?

2. Coding and Computing Join Forces

Bernard Chazelle

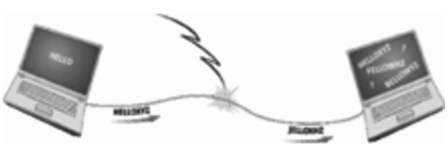
内容概要

现代编码技术的发展是数码时代王冠上的一颗明珠。然而,编码技术和计算机技术的完美结合预示着将会有更多新型的科技事物来到我们的生活。本文通过 Bob 和 Alice 在新时代的通讯说明编码技术和计算机技术的结合使用对人们生活的影响。

Unlike vinyl recordings of yore, today's CDs and DVDs are impervious to the feral assaults of even the most determined toddler. For this triumph of civilization over savagery, we owe thanks to coding theory, one of the crown jewels of the digital era. Since Claude Shannon´s pioneering work in the mid-20th century, error-correcting codes are found in all manner of communication devices—so much so, in fact, that by the 1990s coding theorists began to wonder if their brightest days had not passed. However, recent developments highlight a remarkable confluence of coding and computing, which may herald the shape of things to come.

Imagine Bob communicating with Alice the 21st-century way, text messaging. Complying with her request, Bob texted Alice his age: 48. But one digit was garbled, and 28 is what she got. It might have been wise of Bob to add at least one redundant symbol so she could spot the corruption of any single digit, sparing him much grief. For example, Bob could take the sum of the digits modulo 10 [i.e., the remainder of (4 + 8) = 12 divided by 10, which equals 2]. Adding the "2" gives the new message "482"and Alice could detect the error by doing the same calculation. In fact, by tagging on more symbols to his message, Bob could have enabled his friend to recover it in the presence of one or more garbled digits.

If Alice is to have any chance of restoring Bob's message if corrupted by e errors, Bob would need to inject at least 2e redundant symbols. Courtesy of so-called Reed-Solomon codes, this is sufficient. On the downside, it requires complex computations. Yet the added complication has not stopped these codes from becoming the world's most popular.



Safe transit. An example of list decoding. Additional information("xyz") is appended to a message ("hello") sent through a noisy channel, enabling the receiver to check the message's accuracy. The garbled message is compared against a list of all possible encoded messages bearing close similarity to the one received ("jelloxhz").

CREDIT: P. HUEY/SCIENCE

If the message Alice receives differs from the one Bob sent in more than e places, the decoding may not be unique. Back at the dawn of coding theory, Elias observed that such ambiguity is unlikely and saw in this an opportunity. Why not let Alice set a parameter E > e of her choice and reconstruct a list of all the messages Bob might have written that could have produced the received message in the presence of up to E errors? If the transmission noise stays within this bound, obviously Alice's list will include his message and it will just be a matter of picking it out from the crowd. To do that, she might choose the message whose encoding matches the received message most closely; or her preference might go to the message she deems most likely to be Bob's.

The success of "list decoding," as Elias's suggestion is called, hinges on the shortness of the list (as a function of E) and the ease of collecting it. In two breakthrough papers, Sudan and Guruswami and Sudan showed how to list-decode Reed-Solomon codes efficiently. And here the word "efficiently" is everything, for decoding is trivial when time is not an issue. Sudan and Guruswami's key insight was to trade single-variable polynomials, the natural habitat of Reed-Solomon, for the two-variable kind. This then led to a series of improvements by Parvaresh and Vardy and Guruswami and Rudra.

What were Sudan and Guruswami, two theoretical computer scientists, doing on the stomping grounds of coding theorists? List decoding can function as a tool for changing one computational problem into another. Suppose that I compose a message that enumerates the solutions of a given problem for all possible inputs of a certain length. With list decoding, my message can be recovered from its encoded version even if 99% of its information has been destroyed. Until the work of these researchers, a message more than 50% garbled could not be recovered.

Thinking now of the encoded message as another problem's "solution sheet," we conclude that even an algorithm so bad that it solves the new "problem" erroneously 99% of the time can be used to recover the message correctly, and hence solve the original problem, all of the time. Conversely, a problem known to be hard on just a few inputs can be transformed into one that is hard on nearly all of them. Strange as it may seem, cryptographers crave such problems because hard problems can be used to create difficult-to-break encryption.

In some cases, Alice may need to recover, say, the 217th bit of the message Bob intended without having to read all of the message she received. For this we turn to "locally decodable" codes and, specifically, to a remarkable recent result of Yekhanin: Bob's message can be encoded so that, should a small enough fraction of its symbols die in transit, Alice would still be able, with high probability, to recover the original bit anywhere in the message she chooses. The surprise: She can do it by picking at random a mere three bits of the received message and combining them the right way.

The randomness of the three single-bit lookups makes locally decodable codes ideally suited for private information retrieval. The concept was introduced by Chor et al. to allow users of a database to make queries without divulging what they are. Yekhanin's scheme would keep the anonymity of a query by breaking it down into three subqueries and passing on each one to a separate copy of the database. Individually, each subquery would look random and therefore unrelated to the parent query.

Computing theorists have been borrowing from coding theory for decades. Recently they have begun to return the favor. This symbiotic relationship, it is safe to predict, is far from having run its course. The quest for a practical solution to private information retrieval is still wide open. How to turn the beautiful mathematics of local decoding into working privacy tools is one of the main challenges ahead.

New words:

vinyl	n. 〈化〉乙烯基,乙烯基塑料
yore	n. 〈书〉往昔,昔时
impervious	adj. 密封的,不受影响的
feral	adj. 野生的,未驯服的
assault	n. 冲击,攻击
toddler	n. 初学走路的孩子
savagery	n. 野性,暴行
confluence	n. 汇合
herald	vt. 预报,预示
comply	vi. 顺从,依从
garble	vt. 断章取义,混淆
redundant	adj. 过多的,多余的
digit	n. 数字,数位
courtesy	adj. 礼貌,谦虚
sufficient	adj. 足够的,充分的
decode	vt. 译(码), 解(码)
append	vt. 附加;添加;(在文章后面)附加,增补
accuracy	n. 精确性,精确
encode	vt. 编制成计算机语言, 把…编码
ambiguity	n. 模棱两可的意思;模棱两可的话;含糊话
parameter	n. 参量, 参数
transmission	n. 传送,传播,传达
breakthrough	n. 突破,重要发现
trivial	n. 不重要的,琐碎的,微不足道的
insight	n. 洞察力
polynomial	adj. 多项式,由 2 字以上组成的学名
stomp	n. 跺脚;跺,践踏,重踏
enumerate	vt. 列举,枚举
algorithm	n. 算法;演算法;计算程序
erroneously	adv. 错误地,不正确地
conversely	adv. 相反地,反过来地
cryptographer	n. 译密码者
at random	任意地,随便地

anonymity	n. 匿名,名字不详
encryption	n. 加密; 编密码
subquery	n. 子查询
retrieval	adj. 数据检索
query	n. 问题, 疑问, 询问
symbiotic	adj. 共生的

Explanations to key sentences:

1. Unlike vinyl recordings of yore, today's CDs and DVDs are impervious to the feral assaults of even the most determined toddler. For this triumph of civilization over savagery, we owe thanks to coding theory, one of the crown jewels of the digital era.

与以往乙烯基塑料不同,即使遇到蹒跚学步者的猛烈摔击,当今的 CD 和 DVD 也不受任何影响。我们把这一文明的成就归因于编码理论,它是数码时代王冠上的一颗明珠。

2. Back at the dawn of coding theory, Elias observed that such ambiguity is unlikely and saw in this an opportunity.

早在编码理论出现的早期时代,埃利亚斯通过观察指出这种含糊性是不可能的,并且她从中看到了机会。

3. The randomness of the three single-bit lookups makes locally decodable codes ideally suited for private information retrieval.

这三个一位查找指令的随机性使得私人性息检索理想的适应了局部的解码编码。

4. Strange as it may seem, cryptographers crave such problems because hard problems can be used to create difficult-to-break encryption.

令人奇怪的是,译解密码者渴望遇到这样的问题,因为困难的问题才往往被用做很难被破解的加密。

Questions:

1. What character s do today's CDs and DVDs have, compared with vinyl recordings of yore?
2. What does "the 21st-century way" mean in the second paragraph?
3. What if the message Alice receives differs from the one Bob sent in more than e places?

3. Creating a Science of the Web

Tim Berners-Lee Wendy Hall, James Hendler, Nigel Shadbolt,
Daniel J. Weitzner

内容概要

互联网的出现改变了科学家们交流、合作以及接受教育的方式。然而,科学家们越来越深刻地意识到花更多的时间去了解当前日益先进的网络是必需的。本文就讲述了创建一个网络背景下科学研究的必要性。

Since its inception, the World Wide Web has changed the ways scientists communicate, collaborate, and educate. There is, however, a growing realization among many researchers that a clear research agenda aimed at understanding the current, evolving, and potential Web is needed. If we want to model the Web; if we want to understand the architectural principles that have provided for its growth; and if we want to be sure that it supports the basic social values of trustworthiness, privacy, and respect for social boundaries, then we must chart out a research agenda that targets the Web as a primary focus of attention.

When we discuss an agenda for a science of the Web, we use the term "science" in two ways. Physical and biological science analyzes the natural world, and tries to find microscopic laws that, extrapolated to the macroscopic realm, would generate the behavior observed. Computer science, by contrast, though partly analytic, is principally synthetic: It is concerned with the construction of new languages and algorithms in order to produce novel desired computer behaviors. Web science is a combination of these two features. The Web is an engineered space created through formally specified languages and protocols. However, because humans are the creators of Web pages and links between them, their interactions form emergent patterns in the Web at a macroscopic scale. These human interactions are, in turn, governed by social conventions and laws. Web science, therefore, must be inherently interdisciplinary; its goal is to both understand the growth of the Web and to create approaches that allow new powerful and more beneficial patterns to occur.

Unfortunately, such a research area does not yet exist in a coherent form. Within computer science, Web-related research has largely focused on information-retrieval algorithms and on algorithms for the routing of information through the underlying Internet. Outside of computing, researchers grow ever more dependent on the Web; but they have no coherent agenda for exploring the emerging trends on the Web, nor are they fully engaged with the emerging Web research community to more specifically focus on providing for scientists′ needs.

Leading Web researchers discussed the scientific and engineering problems that form the core of Web science at a workshop of the British Computer Society in London in September 2005. The participants considered emerging trends on the Web and debated the specific types of research needed to exploit the opportunities as new media types, data sources, and knowledge bases become "Webized," as Web access becomes increasingly mobile and ubiquitous, and as the need increases for privacy guarantees and control of information on the Web.

The workshop covered a wide range of technical and legal topics. For example, there has been research done on the structure and topology of the Web and the laws of connectivity and scaling to which it appears to conform. This work leads some to argue that the development of the Web has followed an evolutionary path, suggesting a view of the Web in ecological terms. These analyses also showed the Web to have scale-free and small-world networking structures, areas that have largely been studied by physicists and mathematicians using the tools of complex dynamical systems analysis.

The Web yesterday and today. (Left) The World Wide Web circa 1990 consisted primarily of text content expressed in the Hypertext Markup Language (HTML), exchanged via the hypertext transfer protocol (HTTP), and viewed with a simple browser pointing to a Universal Resource Locator (URL). (Right) Users of the Web now have a variety of top-level tools to access richer content including scalable vector graphics, the Semantic Web, multimodal devices (e.g., voice browsers), and service descriptions. These are expressed in extended markup language (XML), exchanged by newer protocols [e.g., HTTP 1.1 and SOAP (simple object access protocol)] and are addressed by uniform resource identifier (URI) schemes.

CREDIT: ADAPTED FROM THE WORLD WIDE WEB CONSORTIUM

The need for better mathematical modeling of the Web is clear. Take the simple problem of finding an authoritative page on a given topic. Conventional information-retrieval techniques are insufficient at the scale of the Web. However, it turns out that human topics of conversation on the Web can be analyzed by looking at a matrix of links. The mathematics of information retrieval and structure-based search will certainly continue to be a fertile area of research as the Web itself grows. However, approaches to developing a mathematical framework for modeling the Web vary widely, and any substantive impact will, again, require a new approach. The process-oriented methodologies of the formal systems community, the symbolic modeling methodologies of the artificial intelligence and semantics researchers, and the mathematical methods used in network analyses are all relevant, but no current mathematical model can unify all of these.

One particular ongoing extension of the Web is in the direction of moving from text documents to data resources (see the figure). In the Web of human-readable documents, natural-language processing tech-