



Unit

3

Reasoning with Uncertainty



Part 1

Reading & Translating

Section A: Reasoning with Uncertainty

1. Introduction

Though there are various types of uncertainty in various aspects of a reasoning system, the “reasoning with uncertainty” (or “reasoning under uncertainty”) research in AI has been focused on the uncertainty of truth value, that is, to allow and process truth values other than “true” and “false”.

Generally speaking, to develop a system that reasons with uncertainty means to provide the following:

- a semantic explanation about the origin and nature of the uncertainty
- a way to represent uncertainty in a **formal language**
- a set of inference rules that derive uncertain (though **well-justified**) conclusions
- an efficient memory-control mechanism for uncertainty management

2. Non-monotonic logics

A reasoning system is monotonic if the truthfulness of a conclusion does not change when new information is added to the system—the set of **theorem** can only monotonically grow when new **axioms** are added. In contrast, in a system doing non-monotonic reasoning the set of conclusions may either grow or shrink when new information is obtained.

Non-monotonic logics are used to formalize plausible reasoning, such as the following inference step:

Birds typically fly.

Tweety is a bird.

Tweety (presumably) flies.

Such reasoning is characteristic of **commonsense** reasoning, where default rules are applied when case-specific information is not available.

The conclusion of non-monotonic argument may turn out to be wrong. For example, if Tweety is a penguin, it is incorrect to conclude that Tweety flies. Non-monotonic reasoning often requires jumping to a conclusion and **subsequently retracting** that conclusion as further information becomes available.

All systems of non-monotonic reasoning **are concerned with** the issue of consistency.

Inconsistency is resolved by removing the relevant conclusion(s) derived previously by default rules. Simply speaking, the truth value of **propositions** in a non-monotonic logic can be classified into the following types:

- facts that are definitely true, such as “Tweety is a bird”
- default rules that are normally true, such as “Birds fly”
- **tentative** conclusions that are presumably true, such as “Tweety flies”

When an inconsistency is recognized, only the truth value of the last type is changed.

Revising a knowledge base often follows the principle of minimal change: one conserves as much information as possible.

One approach towards this problem is truth maintenance system, in which a “justification” for each proposition is stored, so that when some propositions are rejected, some others may need to be removed, too.

Major problems in these approaches:

- conflicts in defaults, such as in the “Nixon Diamond” ^[1]
- computational expense: to maintain the consistency in a huge knowledge base is hard, if not impossible

3. Probabilistic reasoning

Basic idea: to use probability theory to represent and process uncertainty. In probabilistic reasoning, the truth value of a proposition is extended from $\{0, 1\}$ to $[0, 1]$, with binary logic as its special case.

Justification: though no conclusion is absolutely true, the one with the highest probability is preferred. Under certain assumptions, probability theory gives the optimum solutions.

To extend the basic Boolean connectives to probability functions:

- **negation:** $P(\neg A) = 1 - P(A)$
- **conjunction:** $P(A \wedge B) = P(A) * P(B)$ if A and B are independent of each other
- **disjunction:** $P(A \vee B) = P(A) + P(B)$ if A and B never happen at the same time

Furthermore, the conditional probability of B given A is $P(B|A) = P(B \wedge A) / P(A)$, from which Bayes’ Theorem is derived, and it is often used to update a system’s belief according to new information: $P(H|E) = P(E|H) * P(H) / P(E)$.

Bayesian Networks are directed **acyclic graphs** in which the nodes represent variables of interest and the links represent informational or causal dependencies among the variables. The strength of dependency is represented by conditional probabilities. Compared to other approaches of probabilistic reasoning, Bayesian network (Figure 3-1) is more efficient, though its actual computational cost is still high for complicated problems.

Challenges to probabilistic approaches:

- unknown probability values

Bayesian Network Motivation

- We want a representation and reasoning system that is based on conditional (and marginal) independence
 - Compact yet expressive representation
 - Efficient reasoning procedures
- Bayesian(Belief) Networks are such a representation
 - Named after thomas Bayes(ca. 1702—1761)
 - Term coined in 1985 by Judea Pearl(1936—)
 - Their invention changed the primary focus of AI from logic to probability



Thomas Bayes



Judea Pearl

Pearl just received the ACM Turing Award (widely considered the "Nobel Prize in Computing") for his contributions to Artificial Intelligence!

Figure 3-1 Bayesian Network

- inconsistent probability assignments
- computational expense

Considering the uncertainty in probability judgments, some people go further to study imprecise probability.

4. Fuzzy logic

Fuzzy logic is a generalization of classical logic, and reflects the imprecision of human language and reasoning.

Examples of fuzzy concepts: “young” ,“furniture” ,“most” ,“cloudy” ,and so on.

According to fuzzy logic, whether an instance belongs to a concept is usually not a matter of “yes/no” ,but a matter of degree. Fuzzy logic uses a degree of membership, which is a real number in $[0,1]$.

A major difference between this number and probability is: the uncertainty in fuzzy concepts usually does not get reduced with the coming of new information. Compare the following two cases:

- I’m afraid that tomorrow will be cloudy,so let’s take the picture today.
- I’m not sure whether the current weather should be classified as “cloudy” or not.

Basic fuzzy operators:

- negation: $M(\neg A) = 1 - M(A)$.
- conjunction: $M(A \wedge B) = \min\{M(A), M(B)\}$.
- disjunction: $M(A \vee B) = \max\{M(A), M(B)\}$.

Typically, in building a fuzzy system, the designer needs to provide all membership functions included in it, by considering how the concepts are used by **average people**. Most successful applications of fuzzy logic so far are in fuzzy control systems, where expert knowledge is coded into fuzzy rules.

Challenges to fuzzy approaches:

- degree of membership is often context dependent

- general-purpose fuzzy rules are hard to get

5. Truth-value as evidential support

This approach is taken in the **NARS** project, an intelligent reasoning system.

The basic idea is to see the truth-value of a statement as measuring the evidential support the statement gets from the system's experience. Such a truth-value consists of two factors: frequency (the proportion of positive evidence among available evidence) and confidence (the proportion of currently available evidence among all evidence at a near future).

This approach attempts to uniformly represent various types of uncertainty.

Words

well-justified 合理的

monotonic[mənə(u)'tɒnik] *adj.* 单调的, 无变化的

theorem['θiərəm] *n.* 定理, 原理

axiom['æksiəm] *n.* 公理

commonsense['kɒmən'sens] *adj.* 具有常识的, 常识的

subsequently['sʌbsɪkwəntli] *adv.* 随后, 其后

retract[ri'trækt] *v.* 取消, 收回, 缩回

proposition[ˌprəpə'ziʃn] *n.* 命题

tentative['tentətɪv] *adj.* 试验性的, 暂定的

justification[ˌdʒʌstɪfi'keɪʃn] *n.* 理由, 认为有理

negation[nɪ'geɪʃn] *n.* 否定, 否认

conjunction[kən'dʒʌŋkʃn] *n.* 连词, 结合

disjunction[dis'dʒʌŋkʃn] *n.* 析取, 分离

Phrases

formal language 形式语言

be concerned with 涉及

acyclic graph 非循环图

average people 普通人, 一般人

Abbreviations

NARS Non-Axiomatic Reasoning System 非公理推荐系统

Notes

[1] 尼克松菱形(Nixon Diamond)是包括两个扩展的缺省理论,其缺省逻辑是(美国)共和党人不爱好和平,教友会爱好和平。因为尼克松既是共和党的人又是教友会的人,两个

扩展都可以应用。但是,应用第一个扩展导致尼克松是不爱好和平的人的结论。以同样的方式,应用第二个扩展得出尼克松是爱好和平的人,因此使第一个扩展不可应用。这种特定的缺省理论因此有两个结论,其中一个是真,而另一个是假,就导致了矛盾。



Exercises

I. Read the following statements carefully, and decide whether they are true (T) or false (F) according to the text.

- _____ 1. The conclusion of non-monotonic argument is always true.
- _____ 2. Probabilistic reasoning is more efficient than Bayesian network.
- _____ 3. Conflicts in the “Nixon Diamond” is an example of conflicts in defaults.
- _____ 4. Inconsistent probability assignments is one of the challenges to probabilistic approaches.
- _____ 5. That general-purpose fuzzy rules are hard to get is one of the challenges to fuzzy approaches.

II. Choose the best answer to each of the following questions according to the text.

1. When was Thomas Bayes born? ()
 - A. In 1936
 - B. In 1702
 - C. In 1761
 - D. In 1985
2. Which of the following is right? ()
 - A. According to fuzzy logic, whether an instance belongs to a concept is usually not a matter of “yes/no”, but a matter of degree.
 - B. Fuzzy logic uses a degree of membership, which is a real number in $[0,1]$.
 - C. Fuzzy logic is a generalization of classical logic, and reflects the imprecision of human language and reasoning.
 - D. All of the above
3. Which of the following is not the challenge to probabilistic approaches? ()
 - A. Degree of membership.
 - B. Computational expense
 - C. Unknown probability values
 - D. Inconsistent probability assignments

III. Fill in the numbered spaces with the words or phrases chosen from the box. Change the forms where necessary.

some typical kind particular proposition
fuzzy base introduce refer aim

Fuzzy Logic

Fuzzy logic emerged in the context of the theory of fuzzy sets, 1 by Zadeh (1965). A 2 set assigns a degree of membership, 3 a real number from the interval $\setminus([0,1]\setminus)$, to elements of a universe. Fuzzy logic arises by assigning degrees of truth to propositions. The standard set of truth values (degrees) is $\setminus([0,1]\setminus)$, where $\setminus(0\setminus)$ represents “totally false”, $\setminus(1\setminus)$ represents “totally true”, and the other numbers 4 to partial truth, i.e., intermediate degrees of truth.

“Fuzzy logic” is often understood in a very wide sense which includes all 5 of formalisms and techniques referring to the systematic handling of degrees of 6 kind. In 7 in engineering contexts (fuzzy control, fuzzy classification, soft computing) it is 8 at efficient computational methods tolerant to suboptimality and imprecision. It focuses on logics 9 on a truth-functional account of partial truth and studies them in the spirit of classical mathematical logic (syntax, model theoretic semantics, proof systems, completeness, etc.; both at 10 and the predicate level).

IV. Translate the following passage into Chinese.

Non-monotonic Logic

Everyday reasoning is mostly non-monotonic because it involves risk: we jump to conclusions from deductively insufficient premises. We know when it is worthwhile or even necessary (for example, in medical diagnosis) to take the risk. Yet we are also aware that such inference is “defeasible” — that new information may undermine old conclusions. Various kinds of defeasible but remarkably successful inference have traditionally captured the attention of philosophers (theories of induction, Peirce’s theory of abduction, inference to the best explanation, and so on). More recently logicians have begun to approach the phenomenon from a formal point of view. The result is a large body of theories at the interface of philosophy, logic and artificial intelligence.

Section B: Probabilistic Reasoning

Probability theory is used to discuss events, categories, and hypotheses about which there is not 100% certainty.

We might write $A \rightarrow B$, which means that if A is true, then B is true. If we are unsure whether A is true, then we cannot make use of this expression.

In many real-world situations, it is very useful to be able to talk about things that lack certainty. For example, what will the weather be like tomorrow? We might formulate a very simple hypothesis based on general observation, such as “it is sunny only 10% of the time, and rainy 70% of the time”. We can use a notation similar to that used for predicate calculus to express such statements:

$$P(S) = 0.1$$

$$P(R) = 0.7$$

The first of these statements says that the probability of S (“it is sunny”) is 0.1. The second says that the probability of R is 0.7. Probabilities are always expressed as real numbers between 0 and 1. A probability of 0 means “definitely not” and a probability of 1 means “definitely so.” Hence, $P(S) = 1$ means that it is always sunny.

Many of the operators and notations that are used in propositional logic can also be used in probabilistic notation. For example, $P(\neg S)$ means “the probability that it is not sunny”; $P(S \wedge R)$ means “the probability that it is both sunny and rainy.” $P(A \vee B)$, which means “the probability that either A is true or B is true,” is defined by the following rule: $P(A \vee B) = P(A) + P(B) - P(A \wedge B)$

The notation $P(B|A)$ can be read as “the probability of B, given A.” This is known as conditional probability—it is conditional on A. In other words, it states the probability that B is true, given that we already know that A is true. $P(B|A)$ is defined by the following rule: Of course, this rule cannot be used in cases where $P(A) = 0$.

For example, let us suppose that the likelihood that it is both sunny and rainy at the same time is 0.01. Then we can calculate the probability that it is rainy, given that it is sunny as follows:

$$P(R|S) = P(R \wedge S) / P(S) = 0.01 / 0.1 = 0.1$$

The basic approach statistical methods adopt to deal with uncertainty is via the axioms of probability: Probabilities are (real) numbers in the range 0 to 1.

A probability of $P(A) = 0$ indicates total uncertainty in A, $P(A) = 1$ total certainty and values in between some degree of (un)certainly.

Probabilities can be calculated in a number of ways.

Probability = (number of desired outcomes) / (total number of outcomes)

So given a pack of playing cards the probability of being dealt an **ace** from a full normal **deck** is 4 (the number of aces) / 52 (number of cards in deck) which is 1/13. Similarly the probability of being dealt a **spade suit** is 13/52 = 1/4.

If you have a choice of number of items k from a set of items n then the

$C_n^k = \frac{n!}{k! (n-k)!}$ formula is applied to find the number of ways of making this choice. (! = **factorial**).

So the chance of winning the national lottery (choosing 6 from 49) is $\frac{49!}{6! (49-6)!} = 13\,983\,816$ to 1.

Conditional probability, $P(A|B)$, indicates the probability of event A given that we know event B has occurred.

A Bayesian Network is a directed acyclic graph: A graph where the directions are links which indicate dependencies that exist between nodes. Nodes represent propositions about events or events themselves.

Conditional probabilities quantify the strength of dependencies.

Consider the following example:

The probability, $P(E1)$ that my car won't start.

If my car won't start then it is likely that the battery is **flat** or the starting motor is broken. In order to decide whether to fix the car myself or send it to the garage I make the following decision:

- If the headlights do not work then the battery is likely to be flat so I fix it myself.
- If the starting motor is defective then send car to garage.
- If battery and starting motor are both **gone** send car to garage.

The network to represent this is as follows (Figure 3-2):

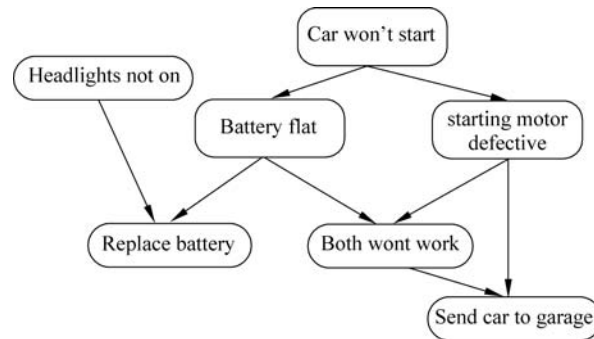


Figure 3-2 A simple Bayesian network

Bayesian probabilistic inference

Bayes' theorem can be used to calculate the probability that a certain event will occur or that a certain proposition is true. The theorem is stated as follows:

$$P(B|A) = P(A|B)P(B)/P(A)$$

$P(B)$ is called the prior probability of B . $P(B|A)$, as well as being called the conditional probability, is also known as the **posterior** probability of B .

$$P(A \wedge B) = P(A|B)P(B)$$

Note that due to the **commutativity** of \wedge , we can also write

$$P(A \wedge B) = P(B|A)P(A)$$

Hence, we can deduce: $P(B|A)P(A) = P(A|B)P(B)$

This can then be rearranged to give Bayes' theorem:

$$P(B|A) = P(A|B)P(B)/P(A)$$

Bayes Theorem states:

$$P(H_i | E) = \frac{P(E | H_i)P(H_i)}{\sum_{k=1}^n P(E | H_k)P(H_k)}$$

This reads that given some evidence E then probability that hypothesis H_i is true is equal to the ratio of the probability that E will be true given H_i times the **a priori** evidence on the probability of H_i and the sum of the probability of E over the set of all hypotheses times the probability of these hypotheses. ^[1]

The set of all hypotheses must be mutually **exclusive** and **exhaustive**.

Thus to find if we examine medical evidence to diagnose an illness, we must know all the prior probabilities of finding symptom and also the probability of having an illness based on certain symptoms being observed.

Bayesian statistics lie at the heart of most statistical reasoning systems. How is Bayes theorem exploited?

The key is to formulate problem correctly:

$P(A|B)$ states the probability of A given only B's evidence. If there is other relevant evidence then it must also be considered.

All events must be mutually exclusive. However in real world problems events are not generally unrelated. For example in diagnosing measles, the symptoms of spots and a fever are related. This means that computing the conditional probabilities gets complex.

In general if a prior evidence, p and some new observation, N then

$$P(H|N, p) = P(H|N)P(p|N, H)/P(p|N)$$

computing grows **exponentially** for large sets of p .

All events must be exhaustive. This means that in order to compute all probabilities the set of possible events must be closed. Thus if new information **arises** the set must be created **afresh** and all probabilities recalculated.

Thus simple Bayes rule-based systems are not suitable for uncertain reasoning.

- Knowledge acquisition is very hard.
- Too many probabilities needed—too large a storage space.
- Computation time is too large.
- Updating new information is difficult and time consuming.
- Exceptions like “one of the above” cannot be represented.
- Humans are not very good probability estimators.

However, Bayesian statistics still provide the core to reasoning in many uncertain reasoning systems with suitable enhancement to overcome the above problems.

Bayesian networks are also called Belief Networks or Probabilistic Inference Networks.

Words

probability[ˌprɒbəˈbɪləti] **n.** 概率

ace[eis] **n.** 幺点

deck[dek] **n.** 一副扑克牌

factorial[fækˈtɔːriəl] **n.** 阶乘

flat[flæt] **n.** 少许电量

posterior[pəˈstɪəriə(r)] **adj.** 其次的, 较后的

commutativity[kəˈmjuːtəˈtɪvɪti] **n.** 交换性

exclusive[ɪkˈsklʊːsɪv] **adj.** 独有的, 排外的, 专一的

exhaustive[ɪgˈzɔːstɪv] **adj.** 互补的

exponentially[ˌɛkspəˈnɛnʃ(ə)li] **adv.** 以指数方式

arise[əˈraɪz] **v.** 出现, 上升

afresh[əˈfreʃ] **adv.** 重新, 再度



Phrases

spade suit 黑桃花色

a priori 推理的



Notes

[1] **Original:** This reads that given some evidence E then probability that hypothesis H_i is true is equal to the ratio of the probability that E will be true given H_i times the a priori evidence on the probability of H_i and the sum of the probability of E over the set of all hypotheses times the probability of these hypotheses.

Translation: 这意味着给定一些证据 E , 那么假设 H_i 为真的概率等于 p_1 与 p_2 的比值, 其中 p_1 为给定 H_i 时 E 为真的概率乘以 H_i 的先验证据概率, p_2 为所有假设集合中 E 的概率之和乘以这些假设的概率。



Exercises

I. Read the following statements carefully, and decide whether they are true (T) or false (F) according to the text.

- _____ 1. Conditional probability, $P(A|B)$, indicates the probability of event B given that we know event A has occurred.
- _____ 2. Probability theory is used to discuss events, categories, and hypotheses about which there is 100% certainty.
- _____ 3. Bayes' theorem can be used to calculate the probability that a certain event will occur or that a certain proposition is false.
- _____ 4. $C_m^n = \frac{m!}{n!(m-n)!}$
- _____ 5. We might write $A \rightarrow B$, which means that if B is true, then A is true.

II. Choose the best answer to each of the following questions according to the text.

1. Which of the following is right? ()
 - A. $P(A|B) = P(B|A)P(A)/P(B)$
 - B. $C_m^n = \frac{m!}{n!(m-n)!}$
 - C. $P(U|V) = P(U \wedge V) / P(V)$
 - D. All of the above
2. What is Bayesian networks' other name? ()
 - A. Telecommunication Networks
 - B. Probabilistic Inference Networks
 - C. Traffic Networks
 - D. None of the above

3. Which of the followings are reasons for the simple Bayes rule-based systems that are not suitable for uncertain reasoning? ()
- A. Updating new information is difficult and time consuming.
 - B. Too many probabilities needed—too large a storage space.
 - C. Computation time is too large.
 - D. All of the above

III. Fill in the blanks with the words or phrases chosen from the box. Change the forms where necessary.

likely despite either have know
sure otherwise false give be

Understanding Truth-Values

A truth-value is a label that is 1 to a statement (a proposition) that denotes the relation of the statement to truth.

In general, all statements, when worded properly, are 2 true or false (even if we don't know with certainty their truth-value, they are ultimately true or false 3 our ability to know for sure).

With that said, and as noted, humans can't 4 every truth for certain, and thus there are some "unknowns."

Thus, all truth-values can be transposed to a three-value form: True, 5 , and Unknown (where unknown denotes our lack of knowledge, not a lack of truth).

Further, because there are things humans can't know for 6 , we have to express the likelihood of some truths using multiple-value truth-values. For example: very 7 false, likely false, likely true, very likely true. Or, such is the case where the quality of a complex statement or argument is 8 considered, False, Mostly False, Half True, Mostly True, and True.

Additionally, because some statements have a variable truth-value that changes depending on context or on more information like "the cat is on the mat" (which is only true when the cat is on the mat, 9 it is the case that it is false) and $x + 1 = 1$ (which is only true when for example $x = 0$) we also 10 to consider "variable" or "conditional" truth-values (propositions that have truth-values that are not constant and instead depend on more information, but otherwise adhere to the other rules stated).

IV. Translate the following passage into Chinese.

Probabilistic Reasoning

Probabilistic reasoning is a way of knowledge representation where we apply the concept of probability to indicate the uncertainty in knowledge. In probabilistic reasoning, we combine probability theory with logic to handle the uncertainty.

We use probability in probabilistic reasoning because it provides a way to handle the uncertainty that is the result of someone's laziness and ignorance.

In the real world, there are lots of scenarios, where the certainty of something is not confirmed, such as “It will rain today,” “behavior of someone for some situations,” “A match between two teams or two players.” These are probable sentences for which we can assume that it will happen but not sure about it, so here we use probabilistic reasoning.

Part 2

Simulated Writing: Communicating with Social Media

在科技交流方面, 社交媒体可成为广泛的信息来源, 其功能包括保持同事间的联系、从技术专家那里获取信息、了解顾客的喜好、与顾客分享最新的信息, 以及在专业领域内进行广泛的联系。这里介绍几种常用的社交媒体(如博客、微博、社交网络站点、QQ 和微信)进行交流的方式。

1. 博客

一个博客(Blog)就是一个网页, 它通常是由简短且经常更新的帖子构成; 这些张贴的文章都按照年份和日期排列, 也称为网络日志。博客的内容和目的有很大的不同, 从对其他网站的超级链接和评论, 有关公司、个人、构想的新闻到日记、照片、诗歌、散文, 甚至科幻小说的发表或张贴都有。许多博客都是作者个人心中所想的发表, 另一些博客则是一群人基于某个特定主题或共同利益领域的集体创作。

随着博客的快速扩张, 它的目的与最初的浏览网页心得已相去甚远。网络上数以千计的博主发表和张贴博客的目的有很大的差异。不过, 由于沟通方式比电子邮件、讨论群组更简单和容易, 博客已成为家庭、公司、部门和团队之间越来越盛行的沟通工具, 它也逐渐被应用在企业内部网络(Intranet)中。

有些公司利用博客在雇员间分享信息。这些仅在内部可访问的博客主要针对的是工程师、经理、行政人员和其他内部人员。公司所创建的内部博客可改进工作流程和提高士气。在大公司里, 博客可作为电子邮件的一种替代方式, 用于日常内部交流。在网络上每个人都可上传消息, 或对其他消息做出评论。在通过博客交流的环境里可以举行会议, 不受面对面会议时间和场地的限制。还可以进行员工培训, 传达公司发展的最新情况。博客对于协同工作特别有效。例如, 公司软件部的人员可以创建论坛, 讨论编程和测试的流程, 然后部门人员可以加以衡量并提出建议。

公司所创建的外部博客可向客户提供对产品和服务的反馈渠道, 改进营销和公共关系, 提供及时的信息和更新, 帮助大型组织的个性化。博客使公司有机会展示其人性化和非正式的一面, 对客户关注的问题做出亲切而快速的响应, 让客户能提供想法和反馈。在公司的博客里语气十分关键, 要表示友好、欢迎、真诚。博客应该邀请读者参与。

例如, 迪士尼乐园(Disney Parks)创建了一个叫 Disney Parks Blog 的博客(如图 3-3 所示), 尽管迪士尼的品牌本质上针对的是小孩子, 但是这个博客的内容对那些渴望获取一些旅行小贴士的父母来说是很很有用的。与大多数的博客不同的是, 迪士尼没有强调其社交的形象, 它只是具有 RSS(聚合内容)和电子邮件订阅的链接。迪士尼也没有将每一个帖子

底部的 Twitter 和 Facebook 的社交共享按钮包括进来。有关这个博客的参与度似乎有点低但比较稳定,每个帖子都有几个评论,并且每个帖子在任意位置最多有 100 个赞(like)。此外,通常缺失的元素是要号召导致读者想要评论的行动。还有一点就是,也许这个博客的受众就不是评论类的。

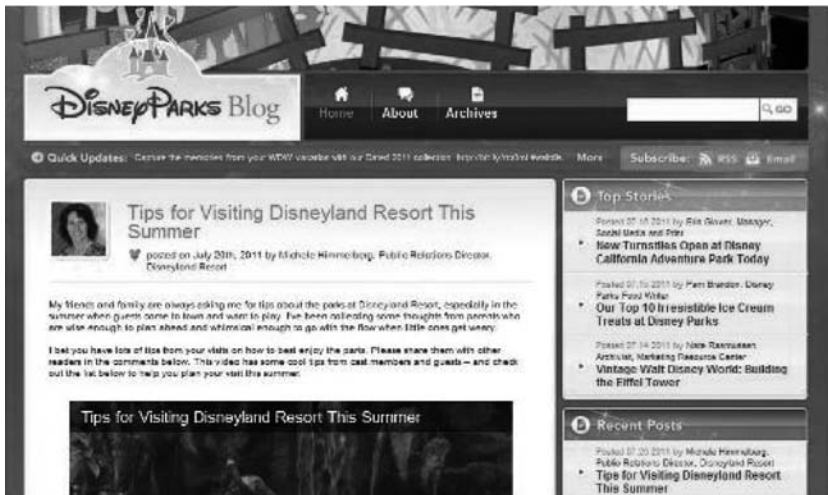


图 3-3 迪士尼乐园的博客

2. 微博

推特(Twitter)是美国的一个网站,它利用无线网络、有线网络的通信技术进行即时通信,是微博客(微博)的典型应用。它允许用户将自己的最新动态和想法以短信息的形式发送给手机和个性化网站群,而不仅仅是发送给个人。

推特是一个可让你播报短消息给你的朋友或“跟随者(followers)”的在线服务,它也同样允许你指定你想跟随(follow)的推特用户,这样你就可以在一个页面上就能读取他们发布的信息。

推特提供以简洁形式进行实时发帖和更新的手段。个人以及公司、政府机构、其他组织通过推特简讯使朋友、商务关系人、顾客、公民获得信息并及时更新。推特被称为“小鸟叫声”(tweets),其写作方式就是简洁,每条限制在 140 个字符以内。

假如你在推特中输入一个项目,它们可以是私有的,只有当你的朋友获得你的允许才能查看;或者也可以是公开的,也就是说,所有知道你 Twitter ID 的人都可以读取或订阅你发布的消息。另外还有一项就是,推特是完全免费的。

推特可以用在很多地方,比如企业可以用它提供客户服务。图 3-4 就是 JetBlue 公司所发布的推特。

也可以在中国流行的新浪微博上进行撰写。

3. 社交网络站点

社交网络网站可将人们联系在一起,并与共同感兴趣的站点相联系。Facebook(脸谱)是最流行的社交网之一。Facebook 最初是为大学生而开发的,现在被朋友、家庭、专业协会、政治组织、非盈利机构、商业公司所使用。许多企业都有 Facebook 页面,用来强调或推销企业的一种特定产品或服务。例如招聘公司,可以创建 Facebook 页面进行招聘。非盈

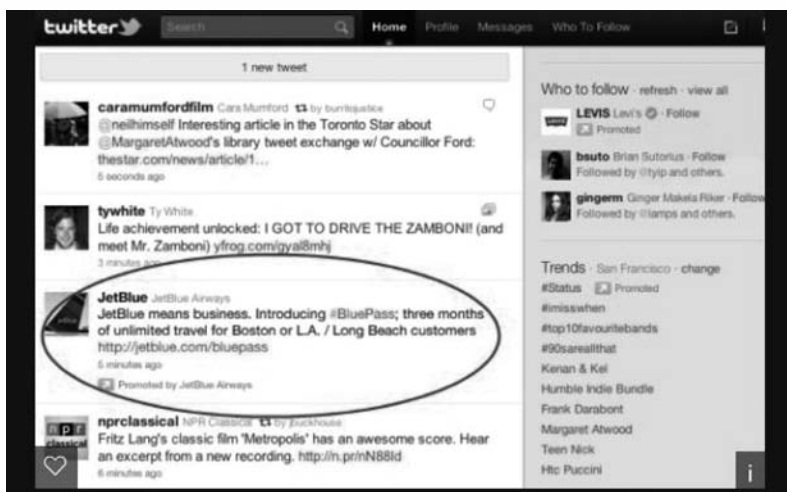


图 3-4 JetBlue 公司所发布的推特

利机构可以利用 Facebook 页面分享信息、提供更新和照片、允许其他 Facebook 用户进行评论,与朋友分享信息。NASA(美国航空航天局)的火星探测器“好奇”号有一个 Facebook 页面,曾经受到 50 万人的喜爱。

Facebook 最流行的使用是在个人之间,人们可以用它保持与亲友的联系。虽然用户可能认为自己的个人 Facebook 页面与工作没有什么关系,但应记住,雇主会经常查看 Facebook 和其他社交网站,作为他们招聘面试的一部分。

图 3-5 为一个典型的 Facebook 页面。



图 3-5 一个典型的 Facebook 页面

4. QQ

QQ 是一款基于 Internet 的即时通信(IM)软件。QQ 支持在线聊天、视频通话、点对点

断点续传文件、共享文件、网络硬盘、自定义面板、QQ 邮箱等多种功能,并可与多种通信终端相连。目前 QQ 已经覆盖 Microsoft Windows、macOS、Android、iOS 等多种主流平台。QQ 不仅仅是个人交流的平台,也是现代企业常用的推广工具。

图 3-6 是一个使用 QQ 进行交流的例子。



图 3-6 一个使用 QQ 进行交流的例子

5. 微信

微信(wechat)是一个为智能终端提供即时通信服务的免费应用程序。微信支持跨通信运营商、跨操作系统平台,通过网络快速发送免费的(需消耗少量网络流量)语音短信、视频、图片和文字;微信提供公众平台、朋友圈、消息推送等功能,用户可以通过“摇一摇”“搜索号码”、扫二维码等方式添加好友和关注公众平台,也可将内容分享给好友或朋友圈。

其实微信相当于另一个 QQ。但与 QQ 不同的是,它在交友方面的表现更具时效性,也更强大。不论是安卓系统还是苹果系统的手机用户,只要安装了微信,就可以进行跨手机平台的畅通聊天。

图 3-7 是一个使用微信进行交流的例子。

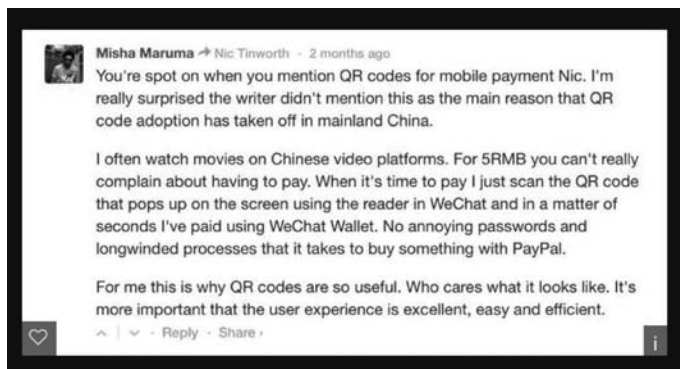


图 3-7 一个使用微信进行交流的例子

Part 3

Listening & Speaking

Dialogue: Reasoning with Uncertainty



在线音频

(Today is the first day after the National Day holiday. Henry met Mark and Sophie in the hall.)

Henry: Hi, Mark and Sophie. How was your National Day holiday?

Mark: It was not bad. During this holiday, I studied reasoning with uncertainty in AI. It's very interesting.

Henry: Reasoning with uncertainty? Don't we often reason with certainty?

Mark: Yes, you are right. Regarding knowledge representation using first-order logic and propositional logic with certainty, we are sure about the predicates. With this knowledge representation, we might write $A \rightarrow B$, which means if A is true then B is true, but consider a situation where we are not sure about whether A is true or not then we cannot express this statement, this situation is called uncertainty.

Henry: So how to represent uncertain knowledge?

Sophie: Well, to represent uncertain knowledge, where we are not sure about the predicates, we need uncertain reasoning or probabilistic reasoning.

Henry: Probabilistic reasoning?

Sophie: Yes. Probabilistic reasoning is a way of knowledge representation where we apply the concept of probability to indicate the uncertainty in knowledge. In probabilistic reasoning, we combine probability theory with logic to handle the uncertainty.

Mark: Furthermore,^[1] we use probability in probabilistic reasoning because it provides a way to handle the uncertainty that is the result of someone's laziness and ignorance.

Sophie: Actually, in the real world, there are lots of scenarios, where the certainty of something is not confirmed, such as "It will rain today," "behavior of someone for some situations," "A match between two teams or two players." These are probable sentences for which we can

[1] Replace with:

1. In addition,
2. Moreover,
3. What is more,
4. Additionally,
5. Besides,
6. Plus,
7. Also,

assume that it will happen but not sure about it, so here we use probabilistic reasoning.

Henry: So are there any ways to solve problems with uncertain knowledge?

Sophie: Of course. In probabilistic reasoning, there are two ways to solve problems with uncertain knowledge: Bayes' rule and Bayesian Statistics.

Mark: And as probabilistic reasoning uses probability and related terms, first, let's talk about probability. Probability can be defined as a chance that an uncertain event will occur. It is the numerical measure of the likelihood that an event will occur. The value of probability always remains between 0 and 1 that represent ideal uncertainties.

Sophie: That's right. Conditional probability is the probability of one event occurring with some relationship to one or more other events.

Henry: I'm sorry, I'm afraid I have to learn probability and other knowledge of reasoning with uncertainty a little bit in advance and then discuss it with you later, and otherwise^[2] it is very difficult for me to follow you. Thanks anyway.

Mark: Looking forward to seeing you again!

Sophie: Good luck to you!

[2] Replace with:

1. or else
2. or
3. if not
4. or then



Exercises

Work in a group, and make up a similar conversation by replacing the statements with other expressions on the right side.



在线音频

Listening Comprehension: Fuzzy Logic

Listen to the article and answer the following 3 questions based on it. After you hear a question, there will be a break of 15 seconds. During the break, you will decide which one is the best answer among the four choices marked (A), (B), (C) and (D).

Questions

1. When was the idea of fuzzy logic first advanced by Dr. Lotfi Zadeh of the University of California at Berkeley? ()
 - (A) In 1940s
 - (B) In 1950s
 - (C) In 1960s

(D) In 1970s

2. Which of the following is right? ()

- (A) Fuzzy logic seems closer to the way our brains work.
- (B) Fuzzy logic is essential to the development of human-like capabilities for AI.
- (C) Natural language is not easily translated into the absolute terms of 0 and 1.
- (D) All of the above

3. Which of the following is not right? ()

- (A) Fuzzy logic includes 0 and 1 as extreme cases of truth.
- (B) Fuzzy logic is not an approach to computing based on the usual “true or false” (1 or 0) Boolean logic on which the modern computer is based.
- (C) Fuzzy logic is an approach to computing based on “degrees of truth”.
- (D) None of the above



Words

advance[əd'vɑ:ns] **v.** 提出

aggregate['ægrɪgət i] **v.** 合计

threshold['θreʃhəuld] **n.** 阈值, 临界值



Phrases

in between 在中间

and so 因此, 所以

motor reaction 动作反应, 运动反应

Dictation: Bayesian Network

This article will be played three times. Listen carefully, and fill in the numbered spaces with the appropriate words you have heard.



在线音频

A Bayesian network, Bayes network, belief network, decision network, Bayes (ian) model or probabilistic directed acyclic 1 model is a probabilistic graphical model (a type of statistical model) that represents a set of variables and their conditional dependencies via a Directed Acyclic Graph (DAG). For example, a Bayesian network could 2 the probabilistic relationships between diseases and symptoms. 3 symptoms, the network can be used to compute the probabilities of the presence of various diseases.

Efficient 4 can perform inference and learning in Bayesian networks. Bayesian networks that model 5 of variables (e. g. speech signals or **protein** sequences) are called dynamic Bayesian networks. Generalizations of Bayesian networks

that can represent and solve decision problems under uncertainty are 6 influence diagrams.

The Bayesian methods have a number of advantages that 7 their suitability in uncertainty management. One of the advantages is that most 8 is their **sound** theoretical foundation in probability theory. Thus, they are 9 the most mature of all of the uncertainty reasoning methods.

While Bayesian methods are more developed than the other uncertainty methods, they are not without 10.

1. They require a significant amount of probability data to 11 a knowledge base. Furthermore, human experts are normally uncertain and 12 about the probabilities they are providing.

2. What are the relevant prior and conditional probabilities 13 on? If they are statistically based, the sample sizes must be 14 so the probabilities obtained are accurate. If human experts have provided the values, are the values consistent and comprehensive?

3. Often the type of relationship between the 15 and evidence is important in determining how the uncertainty will be 16. Reducing these associations to simple numbers removes relevant information that might be needed for successful reasoning about the uncertainties. For example, Bayesian-based medical diagnostic systems have 17 to gain acceptance because physicians 18 systems that cannot provide explanations describing how a conclusion was reached (a feature difficult to provide in a Bayesian-based system).

4. The reduction of the associations to numbers also 19 using this knowledge within other tasks. For example, the associations that would enable the system to explain its reasoning to a user are lost, as is the ability to browse through the 20 of evidences to hypotheses.



Words

protein['prəuti:n] *n.* 蛋白质

sound[saund] *adj.* 健全的, (非正式) 非常棒的