Interface for a Better Tourist Experience, Bayesian Approach and Cox-Jaynes Support

Karim Elia Fraoua(✉) and Sylvain Michelin

Université Paris-Est Marne-La-Vallée, Equipe Dispositifs d'information et de Communication à l'Ere Numérique (DICEN IDF), Conservatoire National des Arts et Métiers, Université Paris-Nanterre, EA 7339, Champs-sur-Marne, France
{karim.fraoua, sylvain.michelin}@u-pem.fr

Abstract. This work presents a new way to enhance a tourism experience through an interface. Basically considering a Bayesian approach and introducing the Cox-Jaynes theorem, we can consider the improvement of this interface. We take in our approach how adding some features will ultimately create an interface that fit the needs of the tourist.

Keywords: Cox-Jaynes · Tourist behavior · Bayesian appraoch

1 Introduction

The quality of a tourist's visit becomes an important issue. In an unknown city or at least in asymmetric information, the experience can be felt [1] because the tourist does not know all the places to visit. Usually, the tourist uses social media, tourist guides, information sites or existing applications to know the interesting places to visit [2]. The interface is usually designed according to the existing offer proposed in a structured way the same approach considering that all users are identical, having the same culture, and the same beliefs. The observation is that often the tourist is not completely satisfied with his trip. He visits some places but others could escape him, because he did not have the necessary information to be able to reach it. More particularly when he misses some sites that are not far away from his trajectory, he maybe visit them as soon as he would have known their existences. This information gap is not always corrected by existing tools. We will analyze this visitor behavior, his mode of reasoning and propose a solution to improve his visit.

We will consider the use-centric approach incorporating a Bayesian approach [3]. This reflection can help to build a new interface, for better informations for the user and therefore for a better experience. The Bayesian approach is the first logical step to calculate or revise the probability of a hypothesis. Indeed, the tourist who visits a city makes assumptions relative to the choice of places to visit according to his degree of knowledge, or his beliefs. These beliefs are usually based on what he read on the websites, on social media or on word or mouth. In the Bayesian perspective, a probability is the numerical translation of this state of knowledge. Finally we will also integrate the new dimensions offered by so-called smart and connected cities based on sensors, open data, new ways of connectivity and exchange of informations [4]. In fact, We will allow the user to take advantage the free connections of cities.

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2 Tourist Behavior and Bayesian Modeling

A tourist visits a city with a priori behavior, that is he considers that if he visits for example Paris, he must visit museums, such as the Louvre, … He may not know that there are other sites to visit who often are on his move. It is sometimes a posteriori that he will know that there was a most interesting place he could have seen and it generates regrets. In addition, the tourist may also consider that one site is better than another, either on the basis of his beliefs or by consulting the evaluation sites. He then builds a utility related to this visit. The notion of utility U is an essential element in our decision making [5]. In this approach, a rational agent makes a calculation according to several components like profit due to this action, well-being, comfort… Trying to maximize this utility and for that we calculate the occurrence probability of each action, and so how we calculate this probability. Attributions of probabilities manifest the limits of our knowledge about a phenomenon. In fact, these measures only make sense in relation to our expectations. Frequentist interpretation defines probability assignments referring to frequencies in which certain events are repeated. Then the probability is defined as the relative frequency of occurrence of events over a long period [6]. In the case where the probability is based on a frequency of occurrence and we indicate all the knowledge we have to establish this probability of occurrence. No additional information will be able to modify our calculation. For example, no casino player would change his bet by seeing if it is raining outside. However this new element, this additional information, can be taken into account on the choice of a tourist visiting a city. In propensity probability, the measure of probabilities consists in considering them as measures of the possibilities of an event [7].

Thus the interest of the propensity approach is that no agent will use only a simple possibility to predict its eventual event. Moreover, the notion of possibility itself supposes that we can attribute to situations propensities, objective tendencies to the realization of these possibilities. In this model, the more informed the agent is, the more likely he can act according to a fact-based and frequency of occurrence. He must have information and a high level of knowledge. The notion of learning is very important in this propensity to act. This force of action can unfortunately not be identical for all agents and our tool will allow them to acquire necessary informations to calculate this probability, and consequently the best utility and the best experience.

2.1 Subjective Probabilities

In this approach the agent thinks to know the probability of appearance and does not try to calculate the true probability. The subjectivist conception of probability explains that the probabilistic results we calculate are solely linked to the limits of our knowledge of phenomena and especially of the ignorance of these limits [8]. Indeed, a subjective probability measures the degree of belief of an agent in the realization of an event, future or past. This hidden part of the reality is the cause of our subjective reasoning and we tend to simplify, to translate events according to our level of knowledge. For instance, if we suppose an agent does not know a place to visit, he builds his itinerary according to his beliefs and does not know the means to optimize his visits but will be sensitive to any information tending to improve the calculations and consequently to the actions improvement in order to enjoy his stay.

3 Bayesian Inference

This notion of subjective probability leads us to Bayes's work, which explains that we calculate a posteriori probabilities from a priori probabilities. Indeed, Bayesian inference is a simple mathematical theory that characterizes our "reasoning process" in a state of "uncertainty", our brain sometimes receives incomplete information and tend to supplement it according to our beliefs [3]. On this basis, we make decisions based on this calculation that allows us to obtain a probability only on the basis of estimation. We can think that going to a place believing that it is good to visit it. We will also consider the two ways we reason, the deductive and inductive approach. The deductive approach shows a mode of human reasoning where we say that all men are mortal and I am a man then I am mortal [9]. On the other hand in the inductive approach [10], we can lead to aberrant situations where we say that if all the cats are mortal and that I am mortal then I am a cat and that makes us lead to bad choices. We can begin to describe the idea that a tourist can end up in a disagreeable situation because he started from a bad reasoning. Bayes' formula makes it possible to put numerical values on the inductive reasoning. Classically, the agent will perform calculations that can enable him to evaluate a situation based on so-called subjective probabilities [11].

$$P(H|D) = \frac{P(D|H).P(H)}{P(D)} \quad (1)$$

$P(H)$ is the degree of belief that one has vis-à-vis the hypothesis H before taking into account the observations and it is called a priori probability. $P(H|D)$ is the degree of belief after taking into account observations, it is called a posteriori probability and $P(D|H)$ is the likelihood, and quantifies the degree of compatibility of hypothesis H and observations D. This formula makes it possible to revise our degrees of belief according to the observations and to make the inductive reasoning quantitative.

4 Cox-Jaynes Theorem and Error Corrections

This second aspect makes it possible to improve our application by giving a mathematical consideration of each of the functionalities. For Cox, an agent represents his degrees of belief by real numbers, he formulates a certain number of desiderata ensuring the consistency of his reasoning and deduces the properties necessarily verified by these real numbers [12]. Let's go back to the base of the beliefs of agents. One of the problems observed when choosing destinations is the degree of trust in the information issuer. Based on this fact, we must offer to the agent useful and reliable informations because we have indicated above, the agent is flexible and ethical i.e. he uses any pre-existing information to build his beliefs. According to Cox-Jaynes, this representation of the degrees of belief is done by real numbers, resulting in an internal consistency. If a conclusion can be obtained in many ways, each of these ways must lead to the same result, an intellectual honesty which means that the agent does not have to deliberately ignore the relevant information. Jaynes consistency of two identical mental states must be represented by two identical degrees of belief. For this reason, we can think about how agents acquire knowledge and on that basis we will design our interface.

5 Modality of Action of an Agent

An agent immersed in an environment is a person who acquires information through various sources, makes models and acts on what he considers useful. The agent is autonomous and possibly non-reactive, indeed he can ignore some of these perceptions and act or not. On the other hand, utility is a function which makes it possible to judge the value of an action, and is necessary for the decision-making process. The utility may vary over time, and depends on the type of agent and may be based on notions of survival, food, money. How to apply our model in the situation of an agent in asymmetric information, agent who has only low a priori probabilities about certain sites and who can miss opportunities to visit. In this situation, the most difficulty is to model this uncertainty or ignorance between a subjective uncertainty because of the insufficiency of our knowledge, and the real objective uncertainty that can exist because of the environment. Learning methods must answer these two main difficulties. First, we must note that an agent cannot learn if he does not have a minimum knowledge of the phenomenon he is studying. He must be able to give sense to the digital data received, specifically to understand that these data concern the same phenomenon. This notion of semantisation is important in our point of view, it is to be linked tç the informational and cultural level of the agent. It is obvious that our ability to understand remains limited to our ability to learn, unless we offer learning tools and the addition of wiki, video, route, map, presence of Guide-Speaker… to respond to needs of certain users. The tourism experience is therefore enriched. The agent then uses this model to integrate the new data and update its knowledge [13].

6 Features to Enhance the Tourist Experience

In this section, we consider that the functionalities that we will implement, based on the probabilistic theory of causality [14], have an effect on tourist decision. Indeed, we can consider that a cause have usually an effect, if an effect is observed after an action. This point of view is fundamental if we want to develop an interface with functionalities that makes possible, for an user, an increase of the information partition in the Bayesian sense, and as a consequence allow improvement of a priori probabilities. We will focus our research to determine the causes that can influence this probability, looking for active entities C_i that produce effects E_j, for example the places to visit. For each active cause C_i, a coefficient σ_i, representing its importance in the process, is measured [14]. The sign of σ_i measure the impact of the cause, the information acquired the effect observed and in our case if the decision of the tourist influenced by a new functionality. Our tool will constantly act in a positive way on the agent. We see clearly that by determining the causes C_i we can influence the propensity of a tourist to act. Moreover, we will integrate all specific forces, noted S_i, such as temporary exhibitions, the path to be accomplished given the geolocation of the tourist near the place to visit, amenities, kind of attraction forces on the tourist that have an impact on his decision. We aim to determine the transformation threshold of the a system states, represented by agent and the amount of informations available, i.e. to define the emergence of a new quality of agent and new decisions that would not have been taken specially if these informations were not available at first sight. By providing, the coefficients Ci related to the sites to visit and other factors that are provided by the city, that we have note Si, we see that the completeness of the information tends towards omniscience and can help tourist for a better way to enhance his experience (Fig. 1).

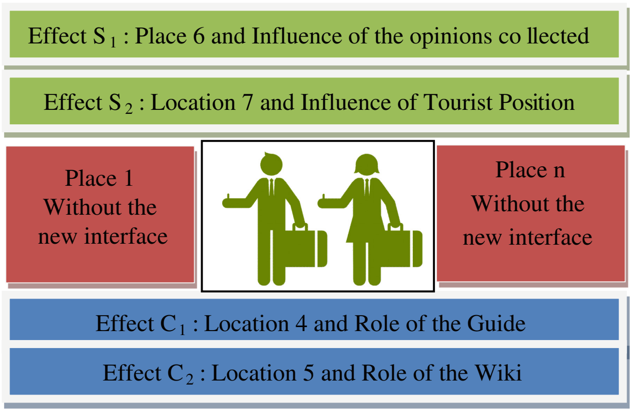

Fig. 1. Tourist in a different situations without our interface and with Causes C_i and/or Attraction S_i

7 Conclusion

In this work, we introduce a new approach for a new idea for functionalities, and we measure each contribution of each feature of this interface These characteristics have a weight and these causes may have an influence on the tourist, to make his visit easier and very pleasant. We considered the agent itself, using the Cox-Jaynes theorem, and we conclude an agent, if the information is accessible, to use this interface for his own well-being.

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