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Random Prediction in Metric Space

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Abstract

There are different classes of the graph generation. Node is one of the important parts in graph which is associated with the metric space. The elements of the set are placed very close to each other. These elements are similar to each other having minor or unobservable difference. Hence, it is difficult to find them in a given set in several of applications. The application area finds at many branches like multimedia, computer science and pattern reorganization. Here, we are focused on metric space and its prediction. Also, we have discussed some methods with some examples and the view of all known proposals to organize metric spaces. There are a large number of solutions are available. The notations of a random metric space and tried to prove that space was isometric. The study is focused on universal and random distance matrices. The properties of universal metric space with the properties of distance metric were correlated. Latent metric was also considered. This review includes the different scenarios of metric space with the basic concepts and mathematical formulae.

Keywords: Random objects, Random prediction, Metric space, Space theory

I. Introduction

The Random objects are simple algebraic and geometric categories. There are some basic concepts about how social graphs are generated. There are also common self techniques for prediction whether two nodes are connected. In the present review, we discuss the formal connection between intuitions and heuristics; popular link prediction. There are different classes of the graph generation. Node is one of the important parts in graph which is associated with the metric space. We judge the number of common neighbors with its weighted variants. This help to predict the missing link which is not a direct derivative of inactive space graph models. We also give the theoretical justifications for the success of computations as compared to others measures which are previously studied. Here we estimate a sequence of results which describes the bound. This bound is related to degree of node which plays important role in link prediction. It shows the shortest path as compared to long path. It causes the effect on increment in non-determinism in process of link generation on link prediction quality. The results generated here can generalize to any model until the assumptions of latent space are on hold. Here it is must to discuss some scenarios like space theory, number theory, dynamical system, probability theory.

In graph mining link prediction plays important role as it is a key problem. Different types of link predictions are proposed in the recent years. Lots of recommendations systems are attracted. Basically different observations are considered here. One is prediction link between the pairs of nodes with very close common neighbors even if lots of complications are observed and second one is a variant of this method in which with the help of appropriate function the weights the common neighbors carefully. It gives better results in many graphs and provides the shortest path between the two nodes.

The personal computer's program which can perform various tasks. from various experience 'E' with respect to the different tasks, 'T' to be performed and measures the performance 'P' of the system. The relation between the task, experience and performance decides the quality. When we want to do the classification, it is must to choose the right metric. So, it is needed to review the most commonly used metrics.

II. Related work

Locally compact and proper spaces, if every point in space has a compact neighborhood, then it is known as locally compact metric space. Connectedness spaces have both open and close subset. These subsets are empty. Separable spaces have a countable dense subset. Its example is the real numbers. Pointed metric spaces have elements means it is non-empty spaces. There are different types of maps between metric spaces such as continuous maps, uniformly continuous maps, lipschitz-continuous maps and contractions, Isometrics and Quasi-isometrics [I-IV]. The relation between the non neighborhood nodes were reported previously [V]. The quality of estimation of distance between the nodes decides the quality of link prediction [VI, VII].

Space is the free space without boundary having three-dimensional extent. In this area, the events and objects are having their own position and direction. Physical space has three linear dimensions, whereas in modern physicists the time is considered as a part of a boundless four-dimensional system named as space-time. Number theory is also called as arithmetic or higher arithmetic. It is a branch of pure mathematics includes the study of the integers. Mathematics is the heart of the sciences while number theory is the heart of mathematics.

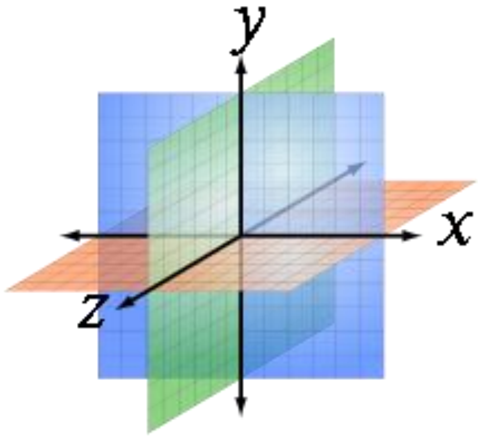

Figure 1. 3D Cartesian coordinate system (indicate positions in space)

The dynamical system is defined as a system in which a function is time dependent point in a geometrical space. For e.g. water flow in pipe. The dynamical system has a real number. It is represented by a point in proper geometric space. The evolutionary rule for the dynamical system in which the system describes the future state is followed by the current state. Under dynamical systems we focus on dynamical systems theory. Dynamical systems theory covers application areas like mathematics, physics, and engineering. Chaos theory, logistic map dynamics, the self-assembly process and bifurcation theory are based on Dynamical systems.

III. Explanation of method

Probability theory is the branch of mathematics which deals with probability. Here we consider the probability in terms of a probability space, which considers the values between 0 and 1. The set of outputs /outcome of this called as the sample space knows as the probability measure. Probability theory plays an important role in mathematics as it set of axioms.

IV. Existing system

A metric space is a set which is consisting of the distance. This distances is nothing but the distances in all the nodes or we can say members of that space. It considers all distance together, then it is called as a metric space. 3-dimensional euclidean space is highly familiar metric space. Metric is the generalization of the Euclidean distance, a distances between the two points. Naturally, every metric space is a uniform space. Every uniform space is a topological space. Uniform and topological spaces can generalizations of metric spaces. There are different types of the metric spaces such as complete spaces, Bounded and totally bounded spaces, Compact spaces, locally compact and proper spaces, Separable spaces and pointed metric spaces.

A metric space which is consists of Cauchy sequence converges and every complete Euclidean distance known as complete space. This completed Euclidean space is a subset of the complete space. Each metric space is a unique. For example, the completions of the rationales are obtained by real numbers. The complete metric space is known as space. The spaces are said to be Bounded and totally bounded spaces if there exists some number *n*, such that $d(x,y) \leq n$ for all elements of *x* and *y* in Metric M then this metric is known *as* bounded. n is the smallest diameter. This metric is also called as totally bounded or precompact. The Euclidean space which is bounded set is referred to as finite region or finite interval. Compact spaces, metric space *M* is compact for every sequence in *M* has a subsequence. That space has converged to a point in Metric *M*. it also named as sequential compactness and compactness defined via covers. It includes closed interval [0, 1]. This interval consists of the absolute value metric having all metric spaces with finitely many points and the Cantor set.

Metric spaces are the generalized as probabilistic metric space. Distances do not have the nonnegative value i.e. real number. In case of random metric space D is a set of PDF such that F(0) = 0. For the pair (S,F) is a random metric space if S have some elements. There some conditions for the random metric space [V]

$F_{a,b}(x) = 1$ for every $x > 0 \Leftrightarrow a = b$ $(a, b \in S)$.

$F_{a,b} = F_{b,a}$ for every $a, b \in S$.

$F_{a,b}(x) = 1$ and $F_{a,c}(y) = 1 \Rightarrow F_{a,c}(x + y) = 1$ f or $a, b, c \in S$ and $x, y \in R+$.

V. Results and analysis

V a. Latent space models

Togetherness is the important aspect related to social network i.e. notation of homophily. It shows the network with different types. Its includes friends, family member, working zone, advice, exchange or the transfer of the information and many more types of the relationships. If the nodes are having similar characteristics, then it form link with high probability. It considers the different aspects like work location, geographic location, colleges, universities, area of interest. It introduces the statistical model of node having locations in a D-dimensional space. There is the strong and close link between the nodes if these entities are locates very close to each other in latent space.

If we consider the basic original model logistics function decides the link between two nodes. The distances in the latent space are known as the latent positions.

We proposed the model with radius r in the exponent. For the RHH model r=1. r is the sociability of a node. This model is known as the non-deterministic model.

RHH model is $P(i \sim j | d_{ij}) = 1/1 + e^{\alpha x}$

Where, $x = d_{ij} - 1$.

Proposed model is: $P(i \sim j | d_{ij}) = 1/1 + e^{\alpha y}$

Where, $y = d_{ij} - r$.

Parameter α controls the sharpness and r determines the threshold [V].

V b. Deterministic model

In case of the simple RHH model, all radii are equal to r, $\alpha \rightarrow \infty$. This creates two nodes as i and j having a link , if the distance between this node i and j denoted as d_{ij} where the distance between the two nodes i and j is less than radius. In this case, the link between nodes is deterministic, but the node positions are not deterministic. Fig.2 indicates simple RHH model with two nodes.

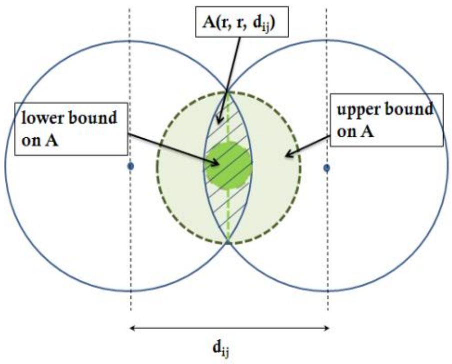

Figure 2. Simple RHH model with two nodes

$N_{(i)}$= set of neighbors of node i. Y_k= random variable which is 1 if $k \in N(i) \cap N(j)$, and 0 otherwise. Given d_{ij} is the distance between the two node i and j, for all $k \notin \{i, j\}$, the Y_k 's are independent .Y depends only depend on the position of k.

$$E[Y_k | d_{ij}] = P(i \sim k \sim j | d_{ij}) = \int_{d_{ik}, d_{jk}} P(i \sim k | d_{ik}) P(j \sim k | d_{jk}) P(d_{ik}, d_{jk} | d_{ij}) d(d_{ij})$$

VI. Link prediction problem

For the given nodes i, the latent space model is well suited for link prediction. The nodes which non neighbors are lies at smallest distance. This distance is denoted by d_{ij}. There are two cases considered from latent space model indicating measure of distance listed as follows

1. Nondirected graph with identical radius. Node distance from i to j is d_{ij}

2. Directed graph where d_{ij} is smaller than radius of j or radius of i with leading distance of $d_{ij} - r_j$ or $d_{ij} - r_i$.

For mentioned cases, the prediction of the distances between nodes is the key. This predicted distance i.e. the key can achieve by maximizing the likelihood of statistical model. This can be obtained with highest probability.

With the help of most useful heuristic which have minor factor of actual distance, we get the distance of picked node. If N has the large value this minor factor goes to 0. This extended model is used for obtaining boundaries of distance. The property homophily is most useful property for latent metric space that means two nodes are close having small distance they definitely form link between them.

VII. Prediction of link using common neighbors

Let consider the link prediction for neighborhood nodes and non neighborhood nodes say OPT. If we know the position of each node so we can easily pick up the nodes which have very less distance and strong link. But in case of latent space positions are unknowns. We predict the link with most common neighbors say MAX. Lemma shows below indicates the node distance with largest common neighbors. dMAX is factor which changes with N. If N is goes on increasing this factor becomes 0. This relation shows that increase in N, link prediction with number of available neighbors becomes the optimal prediction. η OPT and η MAX are the number of common neighbors between i and OPT and between i and MAX respectively. Now try to find out the relation between d OP T with d MAX [5].The distance between them is large than radius r. hence denote the intersection of these two nodes. Mathematical representation is as follows

$$\epsilon_o = \sqrt{\frac{2var_N(Y_{OPT})\log 2/\delta}{N}} + \frac{7\log 2/\delta}{3(N-1)}$$

VIII. Conclusion

In this paper, we have discussed the different scenarios related to the mathematics. We listed out the different types of spaces in case of metrics. Also, different theories like number theory, probability theory, and space theory were evaluated. The basic the RHH model and latent model with some mathematical concepts were also considered along with the link is predicted and finding the smallest distance is discussed.

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