Table 2. The important metrics

Metric	Description	Definition
TW	Time Weight	$TW(v,w)=t) = \exp(-\psi(T-t)$
CD	Change Degree of CN	$CD_t(cn) = \frac{t}{\sum_{i=2}^{t} ed_{i-1,i}}$
CB	Closeness Between CNs	$CB_t(v,w) = \ln(\lvert ACN_t \rvert)$

Time Weight: Suppose that we have known three graph snapshots at time t=1, t=2 and t=3 in figure 1. They are denoted as respectively G^1, G^2 and G^3. Obviously, there are an indirect link and a common neighbor between node v and w in G^1 and G^2, whereas there is no an indirect link between node v and w in G^3. Now, we want to predict the link between node v and w at time t=4. If only considering the network topology of G^3, the occurrence probability of $e(v,w)$ is low. However, if considering the network topologies of G^1, G^2 and G^3, the occurrence probability of $e(v,w)$ is relatively high. As a result, the time weight is defined as $TW(t)$ in table 2 for giving prominence to the importance of network topologies at previous time stamps.

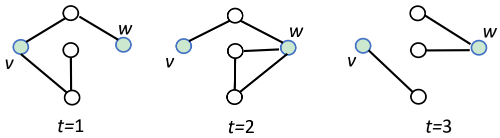

Fig. 1. An example of time weight.

Change Degree of *CN*: For a pair of nodes (v,w), we can acquire their CN set denoted as $CN_t(v,w)$ at time t. Thus a sequence of CN sets can be denoted as $\{CN_t(v,w)\}_{t=0,\ldots,T}$ in the period of the evolving network. Intuitively, $CN_t(v,w)$ will change constantly over time. Thus the change degree of CN should be considered, since it has an impact on the link prediction. The impact is defined as $CD_t(cn)$ in table 2, where cn is a CN, $ed_{i-1,i}$ is the Euclidean distance of cn between time $t-1$ and t. In detail, for each $v \in cn$, Euclidean distance indicates the absolute difference of its degree(in-degree and out-degree included) at time t=i and t=i−1.

Closeness Between *CNs*: In figure 3, there are the same CNs between node v and w in graph G^1 and G^2. Since the relationship of CN^1 is more intimate or complex than CN^2, the probability of establishing a link between node v and w based on common neighbor is relatively higher. For example, suppose two people are not friends but have many mutual friends, if relationship of those mutual friends is very intimate or close, they would have a great opportunity to meet and become friends.

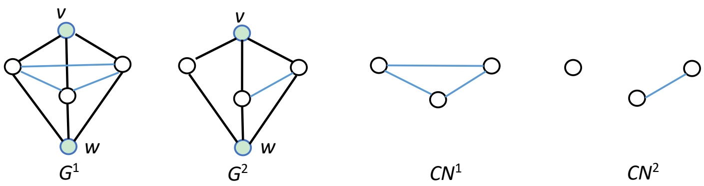

Fig. 2. An example of closeness between *CNs*.

Based on the above idea, the closeness between *CNs* at time t is defined as $CB_t(v,w)$ in table 2, Where ACN_t can be denoted as ACN_t=$\{e(v,w)|v,w\in CN_t(v,w)\}$, and the size of ACN_t is $|ACN_t|$.