**File S1. The additional definitions in TNP**

**A. The functional similarity for genes**

The functional similarity of two genes is measured by the F1-score between their experimental GO terms. For a gene pair , the F1-score between their GO terms is defined as:

, , (S1)

where is the number of same GO terms between two genes, and are the numbers of GO terms for genes and , respectively.

**B. Distance rank-based strategy**

The distance rank-based strategy (DRBS) is executed on normalized embedding matrix of training genes () and normalized embedding vector of query gene () to obtain a confidence score vector, denoted as , where is the confidence score that query is associated with the -th GO term from the view of distance rank in the embedding space.

The details of DRBS are described as follows. First, we rank training genes based the distances between the training and query genes in embedding space in ascending order. The distance between the-th training gene and query gene is calculated as follows:

(S2)

Then, we select top training genes which have the shortest distance with query in embedding space as templates to calculate the confidence scores of GO terms for query as follows:

(S3)

(S4)

where is the weight for the -th template, and is the rank of the -th template; , if the -th template is associated with the -th GO term in the experimental function annotation; otherwise, . In this work, the value of is set to be 100.