Yuxuan Wang, December 2020, solution for final project Q4.

4 Bayesian Network

4.1 Implement chow-liu algorithm

To implement chow-liu algorithm, the given data set are firstly shuffled and seperated to training data and test data. The training data contains the first 2500 instances after shuffling and the test data contains the remaining 696 instances.

- Calculate the weight $I\left(X_i, X_j \mid c\right)$ of each possible edge.

Here, c=0 represents for "nowin" while c=1 represents for "won".

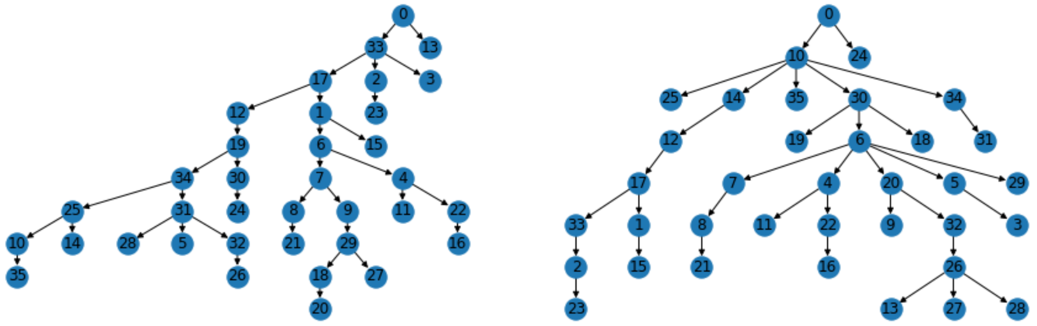
$$I\left(X_i, X_j \mid c=0\right)=\sum_{x_i, x_j} \hat{P}\left(x_i, x_j \mid c=0\right) \log \frac{\hat{P}\left(x_i, x_j \mid c=0\right)}{\hat{P}\left(x_i \mid c=0\right) \hat{P}\left(x_j \mid c=0\right)}$$

$$I\left(X_i, X_j \mid c=1\right)=\sum_{x_i, x_j} \hat{P}\left(x_i, x_j \mid c=1\right) \log \frac{\hat{P}\left(x_i, x_j \mid c=1\right)}{\hat{P}\left(x_i \mid c=1\right) \hat{P}\left(x_j \mid c=1\right)}$$

- Find a maximum weight spanning tree.

After calculating the weights, the MST can be built by greedily add edges with the greatest weight that can make it a tree.

- Give directions to edges in MST



(a) results for "nowin",c=0

(b) results for "won",c=1

Figure 1: MST for data set

4.2 Use chow-liu tree to predict

Two possibilities are calculated using each building maximum spanning trees.

$$P_c^{(T)}\left(x_1 \ldots x_{36}\right)=\prod_{i=1}^{36} P_c\left(x_i \mid \operatorname{parent}_T\left(x_i\right)\right)$$

Comparing the two possibilites, we are able to make a prediction between "win" or "nowon". The prediction results are shown on the table as follows:

Table 1: Accurancy on training data and test data using MST

	Training data	Test data
Accurancy	0.9076	0.9021