Chapter 11

Machine Learning Methods for Better Understanding, Resolving, and Preventing International Conflicts[1]

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1 MOTIVATION AND BACKGROUND

The main motivation guiding our research during the last 15 years, formulated as question, has been: Is it possible to aid decision-makers or their advisors who want to prevent the outbreak of hostilities/wars or to end them by means of negotiations or mediation, by giving them (interactively) recommendations as the result of applying Artificial Intelligence methods to existing war/crisis/mediation databases?

If the answer is at least partially "yes" then these results should definitely not only be made available to decision-makers from government but also to groups who may oppose a government heading, in their opinion, towards war.

Two methods from Artificial Intelligence, specifically machine learning, namely computing decision trees and case-based reasoning, have mainly been applied.

1. The research reported in this chapter was in part supported by the Austrian Federal Ministry for Education, Science, and Culture, and in part commissioned by the European Humanitarian Aid Office of the European Commission (ECHO). The authors would like to thank Johannes Fürnkranz for helpful comments on a draft version of this chapter.

R. Trappl (ed.), Programming for Peace, 251–318.

In the following "Insert" the basics of both methods will be briefly explained; the methodologically experienced reader is recommended to skip it.

Insert: Methodological Background

The basic idea behind decision trees is very simple, and shall be explained by an example that is based on Quinlan (1993).

Depending on the weather conditions, a person decides to go for a walk with her dog, or not.

The weather conditions and the outcome, i.e. if the person goes for a walk, have been recorded 12 times. These observations are listed in the following table:

Table 11.1. Database

No.	*Outlook*	*Temperature*	*Humidity*	*Windy*	*Walk?*
1	sunny	hot	high	false	no
2	sunny	hot	high	true	no
3	overcast	hot	high	false	yes
4	rain	mild	high	false	yes
5	rain	cool	normal	false	yes
6	rain	cool	normal	true	no
7	overcast	cool	normal	true	yes
8	sunny	mild	high	false	no
9	sunny	cool	normal	false	yes
10	rain	mild	normal	false	yes
11	sunny	mild	normal	true	yes
12	overcast	mild	high	true	yes
13	overcast	hot	normal	false	yes
14	rain	mild	high	true	no

Is it possible to predict from this albeit small database if, given specific weather conditions, the person will go for a walk or not? The program, originally ID3, now usually C4.5, tries to find the variable which reduces the uncertainty most. This is done by applying an information theoretic measure. When this variable is found, it is placed at the root of a tree. The number of values of this variable gives the number of branches going down from the root. Now for each of these values all remaining variables are tested which of them contributes most to the reduction of uncertainty of the prediction. The one which does it is placed at the end of this branch ("a leaf") and from this leaf all values of this variable define a branch. This procedure is continued until termination.

Figure 11.1. shows the resulting graph: the most important variable, therefore at the root of the tree, is "Outlook". Depending on "sunny", "overcast" or "rain", the user of this decision tree comes to another variable, where she/he has to decide on