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An Algorithm for Transforming an Intuitionistic Fuzzy Graph to an Intuitionistic Fuzzy Generalized Net

Boyan Kolev

Technical University, Sofia, BULGARIA

The following algorithm is similar to the one described in [2].

Let an Intuitionistic Fuzzy Generalized Net (IFGN, see [1]) $\check{E}$ be given, and for this IFGN the set of transitions A is known, and for each transition $Z \in A$ are known the sets of input and output places, respectively L'_Z and L''_Z, and the index matrix of predicates r_Z.

Let graph $G(V,E)$ be given, where V is the set of nodes, and E is the set of bows, but this time the weights of the bows are defined, i.e. for each element from the set of bows E of the graph G degrees of truth and falsity are defined, respectively a and b. In other words we have an intuitionistic fuzzy graph. The operator Γ transforms the IFGN $\check{E}$ to the graph G in such a wat that to each place from $\check{E}$ it confronts an element from V and to each transition Z it confronts a set of bows E_Z.. Each bow of this set connects a node corresponding to an incoming for the transition place with a node corresponding to an outgoing for the transition place. For each bow weights a and b are given values respectively the degrees of truth and falsity of the predicate, which permits the tokens from the respective input place to move to the respective output one. However, from E_Z these bows are excluded, that correspond to a relationship between an input and an output place of transition Z of $\check{E}$, for which the respective predicate is strictly false, i.e. the degree of falsity b is 1. Now the set $E_Z \subset E$, that corresponds to the transition $Z \in A$, will not correspond to the Cartesian product of the sets L'_Z and L''_Z (see [2]).

$$\check{E} \xrightarrow{\Gamma} G$$

$$\bigcup_{Z \in A} (L'_Z \cup L''_Z) \xrightarrow{\Gamma} V$$

$$A \xrightarrow{\Gamma} E$$

We will now define an operator Γ^{-1}, that performs the opposite action to operator Γ and from the certain graph G restores the net $\check{E}$ and presents an algorithm that realizes the action of the operator Γ^{-1}. In fact this task is reduced to dividing set E into non-intersecting subsets E_Z, and then determining set A and for each $Z \in A$, determining sets L'_Z and L''_Z and the index matrix of predicates r_Z. This time the algorithm will not verify whether graph G is correctly defined, and when it determines that a bow between two nodes is needed. It gives degree of falsity 1 to the corresponding element of matrix r_Z.

We will present a recursive algorithm that realizes the transforming from graph G to the IFGN $\check{E}$. The subsets E_Z are separated subsequently and each element Z belonging to set A is determined in such a way that on each step an element is added to one of the sets L'_Z or L''_Z and/or the value of one of the elements of matrix r_Z is determined. The algorithm is realized by means of two mutually recursive procedures *DoLeft* and *DoRight*.

1. If there does not exist a not visited (not marked) bow $(k, l) \in E$, then go to 6 else:
2. A consecutive number Z for new transition is taken
3. DoLeft(k)
4. Z is added to A, go to 1
5. Message "The generalized net is determined successfully" is being printed
6. End

DoLeft(k):

1. k is added to L'_Z
2. $\forall j \in L''_Z \setminus X_k$, where X_k is the set of all nodes connected with k by outgoing from k marked bow:
   - 2.1. If $(k, j) \notin E$, then in the matrix of predicates r_Z we assign $r_Z(k,j) = \{0,1\}$ (i.e. degree of truth 0 and falsity 1), else:
   - 2.2. In the matrix of predicates r_Z we assign $r_Z(k,j) = \{a,b\}$, where a and b are the weights of the bow (k, j), and mark (k, j) with Z
3. For each outgoing from k bow (k, n) that observes the condition $n \notin L''_Z$:
   - 3.1. In the matrix of predicates r_Z we assign $r_Z(k,n) = \{a,b\}$, where a and b are the weights of the bow (k, n), and mark (k, n) with Z
   - 3.2. DoRight(n)

DoRight(l):

1. l is added to L''_Z
2. $\forall i \in L'_Z \setminus Y_l$, where Y_l is the set of all nodes connected with l by incoming to l marked bow:
   - 2.1. If $(i, l) \notin E$, then in the matrix of predicates r_Z we assign $r_Z(i,l) = \{0,1\}$, else:
   - 2.2. In the matrix of predicates r_Z we assign $r_Z(i,l) = \{a,b\}$, where a and b are the weights of the bow (i, l) and mark (i, l) with Z
3. For each incoming to l bow (m, l) that observes the condition $m \notin L'_Z$:
   - 3.1. In the matrix of predicates r_Z we assign $r_Z(m,l) = \{a,b\}$, where a and b are the weights of the bow (m, l) and mark (m, l) with Z
   - 3.2. DoLeft(m)

References:

[1] Atanassov K., Generalized Nets, World Scientific, Singapore, 1991.
[2] Kolev B., An Algorithm for Transforming a Graph to a Generalized Net. In:- Proceedings of the First Int. Workshop on Generalized Nets, Sofia, 6 July 2000, 26–28.