Concept Based Censor Production Rules

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ABSTRACT

This paper presents a rule structure called Concept Based Censor Production Rule (CBCPR) that deals with real time cases. CBCPR is an extension of a rule structure called Censored Production Rule (CPR). CPR is a standard rule structure with UNLESS slot, which contains various censor conditions that might rarely happen and prevent the action of the rule to be taken. The more time one has, the more censor conditions one can check. The major extension of CPR is by concentrating on what is called concept. The concept is what about the user needs the decision. Each rule will have a certain concept title that specifies its job. In addition, in every CBCPR structure, at least one slot related to UNLESS part in the rule is existing, where each UNLESS slot is related to a certain category having censor conditions concerned with the concept. The structure will help the system to give more certain answers within the given time for the real-time systems instead of keep checking unnecessary censor conditions for the same concept of different UNLESS categories.

KEYWORDS

Censor Production Rules, General Structure Rule, Hierarchical Censor Production Rule, Knowledge Representation, Real Time Systems, Variable Precision Logic

1. INTRODUCTION

A very well-known knowledge representation is the rule structure of the form:

IF condition <antecedent> THEN action <consequence>

This structure is very simple to write, use and understand, but its drawbacks according to Michalski and Winston (1986) is that it can’t capture the real-time systems and application or what so called variable precision logic. To overcome this drawback, Michalski and Winston (Michalski & Winton, 1986) proposed a rule structure called Censored Production Rule (CPR) that can deal with real time systems. Using CPR, the more time is available; the more conditions that might occur rarely can be checked. The CPR structure is as below:

IF condition THEN action UNLESS [c1,c2,c3,....cn]

1.1. CPR

In this section, we explain the CPR in more details, the formal structure of CPR is:

IF condition THEN action UNLESS [c1,c2,c3,....cn]: \( \vee, \delta \)
where \( Y \) is the certainty value that the action will be taken given that the condition is true, \( \delta \) is the maximum certainty value that can be achieved by checking censor conditions within the given time before the system response. The maximum value for \( \delta \) is 1 and \( Y <= \delta \). \( Y = \delta \) occurs when the time does not permit to check any of the censor conditions. To make the idea clear, let us have the following example:

IF X is bird Then X flies UNLESS \[X \text{ is penguin:0.02, X has a broken wing:0.05, X is sick:0.01}\]: 0.8

The above rule says if we have a bird, then it flies with a certainty factor 0.8. This means 0.8 is the value for \( Y \). The 0.02 value for example scales how often this censor occurs and we shall call it Censor Importance (CI), and this value is added to \( Y \) value whenever time permits. Now let us assume we have more time for the system response, we can check some censors until time does not permit. Let us assume that the time can allow us to check the first two censors, this will make the value of \( \delta \) as:

\[
\delta = 0.8 + 0.02 + 0.05 = 0.87
\]

This means after the above calculation, we can conclude X flies if it is a bird with certainty factor 0.87. For sure the writer of the rule can still write the censor conditions order based on their importance. The maximum value for \( \delta \) is 1 and in this case, it means that all the censor conditions are listed in the slot and checked. In other cases, the value for \( \delta \) is not 1 despite we have enough time to check all the listed censor conditions, but this means we are still have some unlisted unknown censor conditions. It is to be noted that if any of the censors is true, the action will not be taken. This means the relation between the censor conditions is OR relation.

1.2. Extensions of CPR

There are many attempts to extend CPR to be useful in many situations, domains and have faster accessibility and inference (Bharadwaj & Jain, 1992) (Hewahi, 2002).

1.2.1. Hierarchical Censored Production Rules (HCPR)

Bahradwaj and Jain[1] extended CPR to have more specific or more general situation. They come up with what so called Hierarchical Censored Production Rules (HCPR). HCPRs has two additional slots GENERALITY and SPECIFICITY in addition to UNLESS slot, where GENERALITY is to show the more general information for a given piece of information and useful in backward chaining, whereas the SPECIFICITY is to show the more specific information and useful for forward chaining. In HCPR, the more is the given time the more specific results can be achieved. HCPR with other related HCPRs can form a tree like structure called HCPR-tree. In HCPR-tree, the higher HCPR level gives more general results, whereas, lower level HCPRs give more specific results. The SPECIFICITY slot in HCPR might have none, one or more than one information if any, which represents the possible children of the current HCPR, and the GENERALITY slot in HCPR has only one information if any to show more general information of the current CPR and represent the HCPR parent. If more than one member in the SPECIFICITY slot, the members (information) will have the XOR relation, which means only one of the members will be selected. HCPR general structure is as below:
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