Chapter 4 Analysis Methods

Methods of analysis for Petri nets may be classified into the following four groups: 1) the coverability (reachability) tree method, 2) the matrix equation approach, 3) reduction or decomposition techniques, and 4) methods using substructures such as siphons-traps, SM-components, handles, bridges, etc. The first method involves essentially the enumeration of all reachable markings or their coverable markings. It should be able to apply to all classes of nets, but is limited to "small" nets due to the complexity of the state-space explosion. On the other hand, matrix equations and reduction techniques are powerful but in many cases they are applicable only to special subclasses of Petri nets or special situations.

4.1 The Coverability Tree

Given a Petri net (N, M_0), from the initial marking M_0, we can obtain as many "new" markings as the number of the enabled transitions. From each new marking we can again reach more markings. This process results in a tree representation of the markings. Nodes represent markings generated from M_0 (the root) and its successors, and each arc represents a transition firing, which transforms one marking to another.

The above tree representation, however, will grow infinitely large if the net is unbounded. To keep the tree finite, we introduce a special symbol ω, which can be thought of as "infinity". It has the properties that for each integer n, $\omega > n$, $\omega \pm n = \omega$ and $\omega \geq \omega$.

The *coverability tree* for a Petri net (N, M_0) is constructed by the following algorithm.

Step 1. Label the initial marking M_0 as the root and tag it "new".

Step 2. While "new" markings exist, do the following:

Step 2.1. Select a new marking M.