Part I
Equivalent Transformation Techniques

Consider the following TCAM Minimization Problem: *given a packet classifier, how can we generate another semantically equivalent packet classifier that requires the least number of TCAM entries?* Two packet classifiers are (semantically) equivalent if and only if they have the same decision for every packet. For example, the two packets classifiers in Tables 1.1 and 1.2 are equivalent; however, the one in Table 1.1 requires 900 TCAM entries, and the one in Table 1.2 requires only 6 TCAM entries.

Solving this problem helps to address the limitations of TCAMs. As we reduce the number of TCAM entries required, we can use smaller TCAMs, which results in less board space and lower hardware cost. Furthermore, reducing the number of rules in a TCAM directly reduces power consumption and heat generation because the energy consumed by a TCAM grows linearly with the number of ternary rules it stores [Yu et al(2005)Yu, Lakshman, Motoyama, and Katz].

While the optimal solution to the above problem is conceivably NP-hard, in this thesis, we propose a practical algorithmic solution using two techniques. Our first technique, TCAM Razor, generates new but equivalent classifiers, whereas our second technique, all-match redundancy removal, finds a set of rules that can be safely removed from a classifier