INDRAPRASTHA INSTITUTE *of*
INFORMATION TECHNOLOGY **DELHI**

**M.Tech Thesis Defense**

# A novel technique for delaying the birth of giant component in Achlioptas Process

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Abstract

In recent years random graph model plays a significant role in the complex network domain specially in the field of social media network and material science, more precisely in the percolation theory. The theory of random graphs generally lies at the intersection of probability and graph theory where the graphs are generated either by probability distribution or by a stochastic process. The most common widely known random graph model is the Erd˝os-R´enyi random graph. We know that the phase transition occurs at step 0.5n in case of classical Erd˝os-R´enyi model and the size of the largest component in the sub-critical phase is atmost O(logn) i.e. the components are tree-like structure or atmost a unicyclic component whereas there is a unique giant component of order$\omega$(n) emerge when it cross-over the scaling window. To accelerate or delay the birth of the giant component in random graph models Dimitris Achlioptas proposed a new problem called ’Achlioptas process’ where we can choose two edges uniformly at random out of all possible edges and add one of the edge based on some decision rules. There are several rules exist for selecting a particular edge related to the component size of the vertices in the graph. These rules can be classified into bounded and unbounded size rules where Sum-rule(SR) and Product-rule(PR) belong to the unbounded size rule and Bohman-Frieze(BF) and Bohman-Kravitz(BK) belong to the bounded size rules where we fix a constant K for the component size and above that all components are treated as same. Petrut Cobarzan proved that each online Achlioptas process can postponed the appearance of the giant component upto 0.9455n steps by using the bounded size rules and edge density argument. We propose a modified version of Achlioptas process work for both bounded size and unbounded size rules and use the concept of expected change in the isolated vertices. Thus, we establish a differential equation system for our algorithm and solve this system using the Runge-Kutta-4 method. By our algorithm we can conclude that any online-Achlioptas process w.h.p can produce the birth of the giant component before 0.9397n steps.