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Depth of high-degree vertices in Random Recursive Trees

A random recursive tree T_n is constructed, recursively, by adding to T_{n-1} a new vertex n attached to a uniformly chosen vertex $j \in V(T_{n-1})$, while T_1 consist of a single vertex labelled 1.

In this talk we will be concern with the degree and depth of a vertex i, denoted by $\deg(i)$ and $\mathrm{ht}(i)$ respectively. Two known results for a uniformly chosen vertex $u \in T_n$ are convergence in distribution of $\deg(u)$ to a geometric r.v. $\mathrm{Geo}(1/2)$ and of $(\mathrm{ht}(u) - \ln n)/\sqrt{\ln n}$ to a normal random variable. On the other hand, Devroye and Lu proved that the maximum degree Δ_n of T_n satisfies $\Delta_n / \log n \to 1$ a.s. and Goh and Schmutz obtained asymptotic tail bounds for $\Delta_n - \lfloor \log n \rfloor$. However, little was known about the properties of vertices with near-maximum degree.

In this talk we present an alternative construction of T_n which gives a new insight on both the degree and depth of its vertices. It allows us to recover and extend some of the results above mentioned, and furthermore we prove the asymptotic normality of the depth of vertices with near-maximum degree. Finally, interesting on its own, this alternative construction of random recursive trees is based on Kingman's coalescent and is also related to the data structure tree known as 'Union-Find'.