

# Criteria for transience of branching Markov chains

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## Abstract

A branching Markov chain (BMC) is a system of particles in discrete time. The BMC starts with one particle in an arbitrary starting position  $x$ . At each time particles split up in offspring particles independently according to some probability distributions that may depend on the locations of the particles. The new particles then move independently according to a Markov Chain.

An irreducible Markov Chain is either recurrent or transient: either all or none states are visited infinitely often. It turns out that this dichotomy breaks down for BMC and that one can classify BMCs in three different types. Let  $\alpha(x)$  be the probability that, starting the BMC in  $x$ , the state  $x$  is hit infinitely often by some particles. There are three possible regimes: *transient* ( $\alpha(x) = 0 \forall x$ ), *weakly recurrent* ( $0 < \alpha(x) < 1 \forall x$ ) and *strongly recurrent* ( $\alpha(x) = 1 \forall x$ ). We give equivalent criteria for transience of BMC and discuss some interesting consequences.