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The Ghirlanda–Guerra identities and ultrametricity in the
Sherrington–Kirkpatrick model

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The Parisi theory of the SK model completely describes the geometry of the Gibbs sample in a sense that it predicts the limiting joint distribution of the overlaps between i.i.d. replicas. One of the main properties of this distribution is the ultrametricity which means that the Gibbs measure concentrates on the ultrametric subset of all configurations ; another property is the Ghirlanda–Guerra distributional identities. It is well known that these two properties completely determine the distribution of the overlaps and for this reason they were considered complementary. We show that the Ghirlanda–Guerra identities imply ultrametricity provided that the replica overlaps take only a finite set of values.