Counting Mutations and Anti-chains In Motzkin Trees and Complete Binary Trees.
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The *Fundamental Theorem for Rooted Trees* gives us the basic relationship between the vertex and leaf generating function in a class of trees. We distinguish a vertex in each tree and identify it as a mutator. We then use an extension the Fundamental Theorem to decompose each tree and to count “new” vertices (modn) produced by the mutator. Additionally, we count “new” anti-chains in both Motzkin Trees and Complete Binary Trees. We develop formulas that can be expressed both recursively and in terms of Riordan Matrices. Lastly we explore several interesting connections between Catalan numbers and Motzkin numbers via Motzkin Trees and Complete Binary Trees.

Keywords: Motzkin trees, Complete Binary Trees, generating functions, Riordan Matrices, Catalan numbers, Motzkin numbers, anti-chains