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Modeling cell proliferation in the transition from neurogenesis to gliogenesis

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Modeling cell proliferation in the transition from neurogenesis to gliogenesis

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In the developing brain, radial glial progenitor cells follow patterns of proliferation and differentiation to produce neurons and glia. These progenitor cells first undergo neurogenesis, producing neurons in a fairly deterministic manner, and then a portion of the cell population switches to producing glia. We explore two different ways of modeling cell divisions, branching random walks and Galton-Watson processes, particularly focusing on their application to gliogenesis. A primary quantity of interest is the number of generations of cell division required to produce N cells from a single progenitor. We develop models that systematically determine the depth of all binary trees with N leaf nodes. This information is used to estimate the number of generations of cell division in data sets tracing cell lineages in the developing mouse brain. We examine the hypothesis that cell proliferation patterns are altered as development transitions from neurogenesis to gliogenesis.