nla hw05

cs

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1 Implementation Summary

The provided notebook implements a spatial agent-based simulation on a 100×100 lattice representing the topology of Edinburgh. The map incorporates hard-coded geographic features, including parks (e.g., The Meadows), roads, and fixed amenities (schools, gyms, shops). Agents are initialized with income levels (derived from Scottish Index of Multiple Deprivation data) and heterogeneous attributes including religion, language, and age category.

The simulation evolves through two coupled dynamic processes:

1. **Price Evolution:** Housing prices V at location $\mathbf{x}$ are updated iteratively based on occupant income A and the average price of the Moore neighborhood $\mathcal{N}(\mathbf{x})$:

$$V^{t+1}(\mathbf{x}) = V^t(\mathbf{x}) + A^t(\mathbf{x}) + \lambda \frac{\sum_{\mathbf{y} \in \mathcal{N}(\mathbf{x})} V^t(\mathbf{y})}{\#\mathcal{N}(\mathbf{x})}$$

2. **Agent Mobility:** Unlike the vacancy-based model described in the text, the code utilizes pairwise swapping (Kawasaki dynamics). Two randomly selected grid cells $\mathbf{x}$ and $\mathbf{y}$ exchange occupants if the swap yields a positive net change in utility ($\Delta > 0$). The utility function balances economic affordability with social amenities:

$$\Delta = \Delta_{\text{money}} + \Delta_{\text{amenities}}$$

where Δ_{money} minimizes the squared difference between household income and property price, and $\Delta_{\text{amenities}}$ maximizes cultural similarity with neighbors (Schelling mechanism) and proximity to preferred facilities.