OAK RIDGE National Laboratory

Downscaling Synthetic Populations to Realistic Residential Locations

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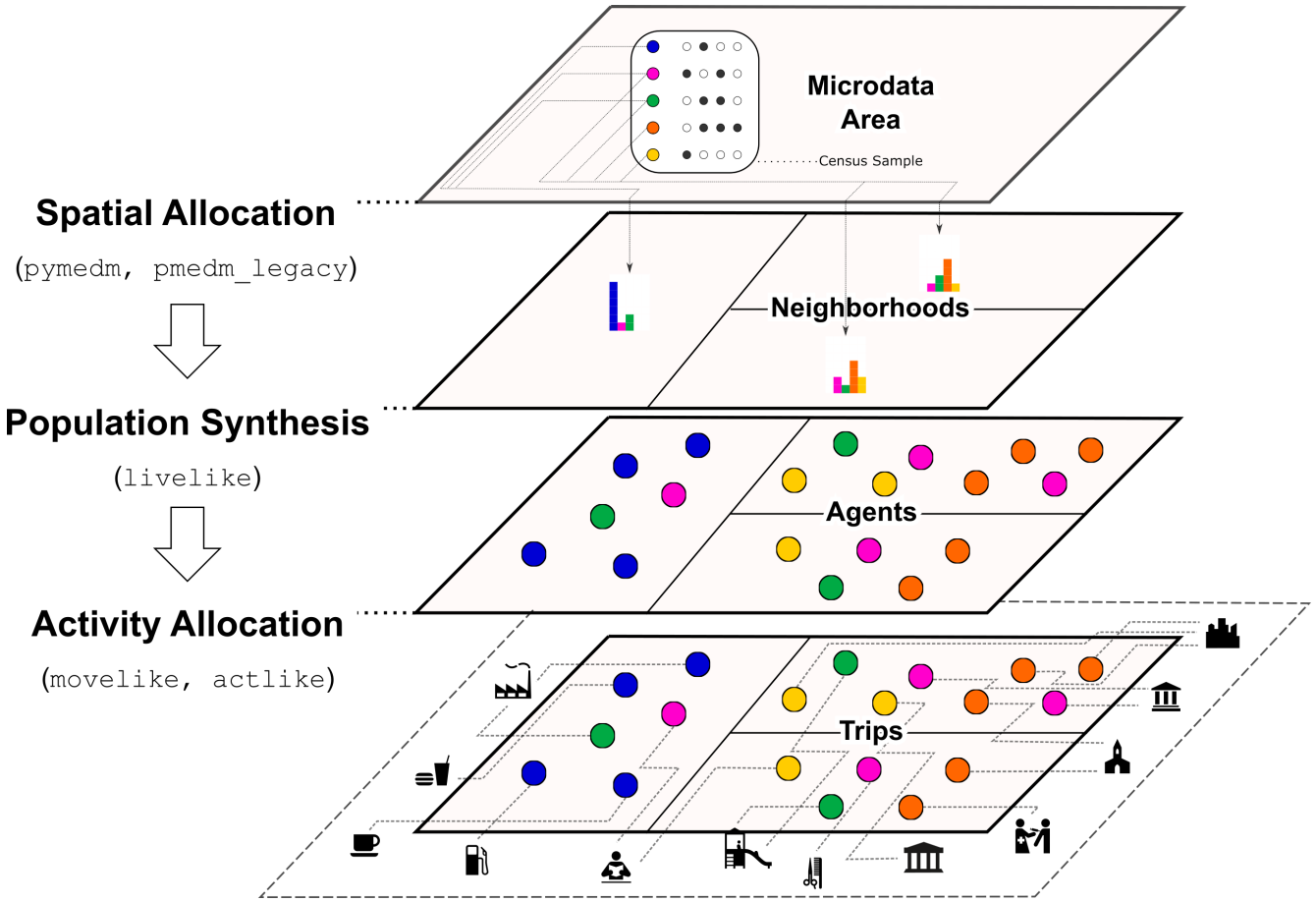
U.S. DEPARTMENT OF ENERGY

UrbanPop: Synthetic Populations for Human Dynamics Modeling

- **High-fidelity agents for simulating patterns of life**
  - Demographics
  - Socioeconomic status
  - Transportation
  - Housing
- **Likeness Python toolkit** supports operations "under the hood"
- **Likeness FY23 development →** generating residential anchor points for agents given:
  - **Residential structures** from **building footprints data** (FEMA USA Structures)
  - Ancillary **synthetic household attributes** (dwelling type, income…)



Likeness software stack

Likeness Downscaling Methods

Each synthetic household "selects" a residential structure in its neighborhood…

Conflation Scores

$$\Gamma = \frac{1}{exp(|h - s|)} \mid s \in S$$

Where:

- h is ta household's conflation criterion
- s is a residential structure's conflation criterion, scored across all structures S

Converted to sampling probabilities as:

$$p = \frac{\Gamma}{\sum_1^N \Gamma}$$

`livelike.homesim`

`select_residences_general`

General procedure for synthetic household selection of residential structures based on structural capacity (e.g., building floor area).

Let $\Gamma = S$

`select_residences_one_unit`

One-to-one synthetic household selection of residential structures based on 1) a measure of structural capacity (e.g., building floor area) and 2) a selection criterion (e.g., household income).

Let h = household income (ranked);

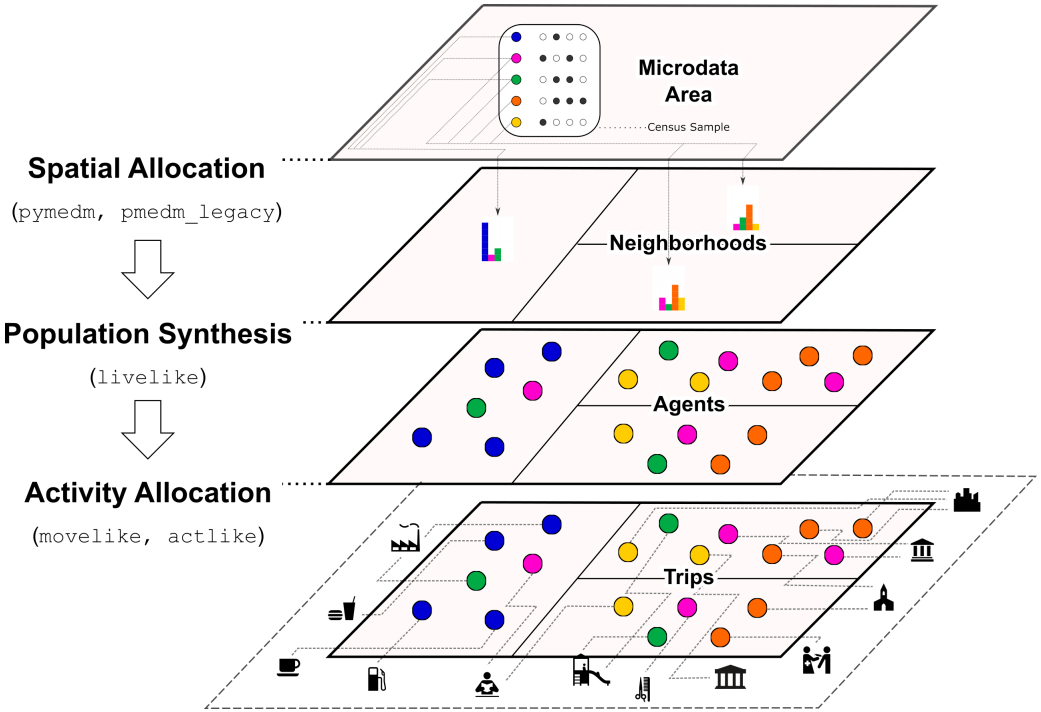
let s = building floor area (ranked)

`select_residences_multi_unit`

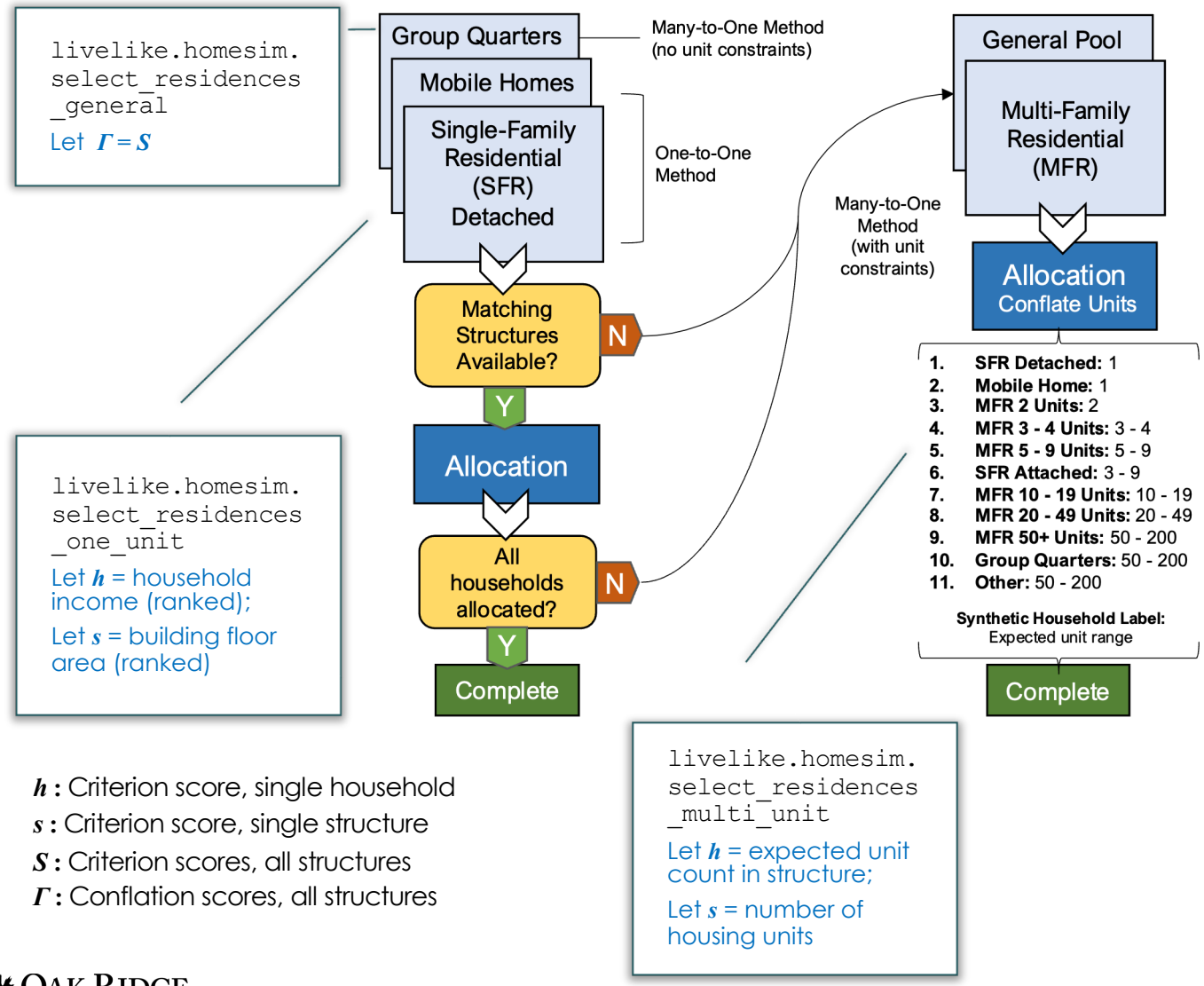
Synthetic household selection of residential structures based on number of units in structure.

Let h = expected unit count in structure;

let s = number of housing units

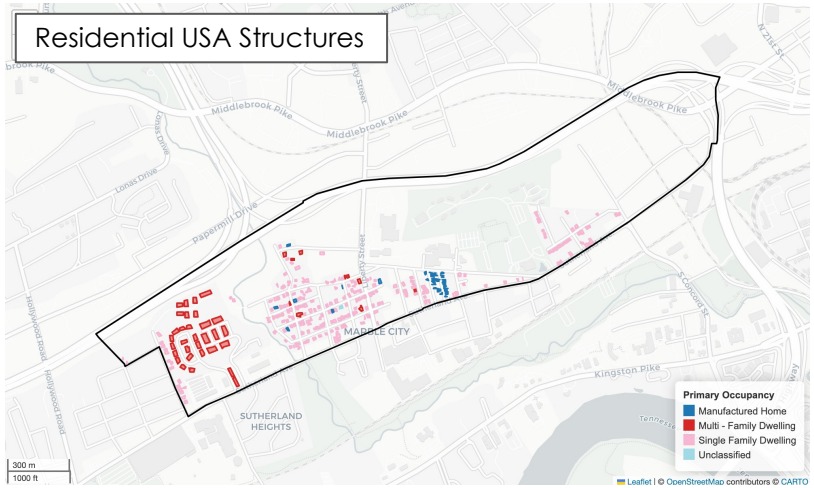


Example Workflow: USA Structures

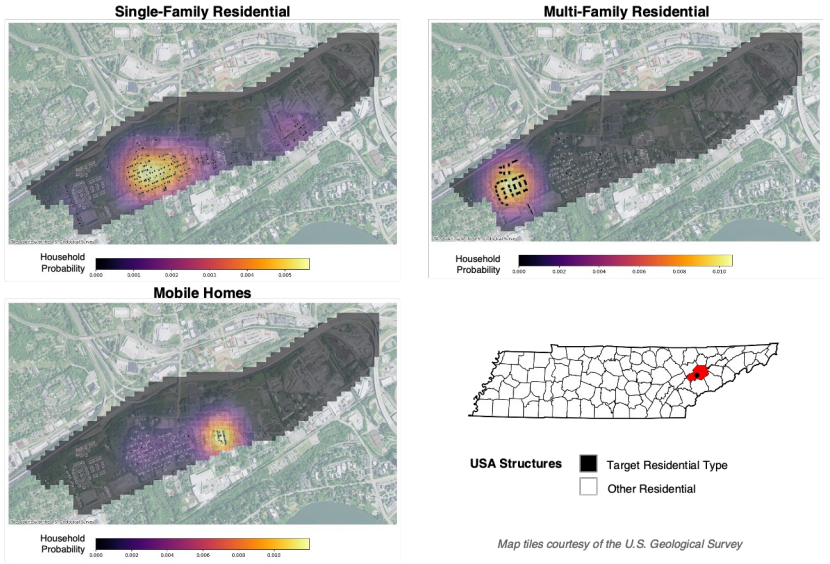


h : Criterion score, single household
s : Criterion score, single structure
S : Criterion scores, all structures
Γ : Conflation scores, all structures

Single Block Group Example



Synthetic Household Occurrence Probabilities



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Fostering Research Reproducibility

- Open sourcing core Likeness utilities (TBA 2024)
- “Bring your own structures” philosophy for `livelike.homesim`
- CI pipelines in place to ensure consistency of results

Thank you!

Questions?

Contacts

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