Using Machine Learning and Open Source Tools to Improve the Commodity Flow Survey

Economic Reimbursable Surveys Division

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Background

Commodity Flow Survey (CFS)

- Sponsored by BTS and Census
- Conducted every 5 years
- Respondents select and report data on a sample of shipments made in each calendar quarter

Problem: Significant number of establishments are out of scope (OOS)

Goal: Identify OOS establishments where there is no shipping activity

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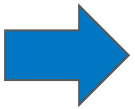
Impact

Higher rate of in-scope responses in future surveys



- More accurate shipping data
- Lower Census administrative costs
- Reduced burden on respondents

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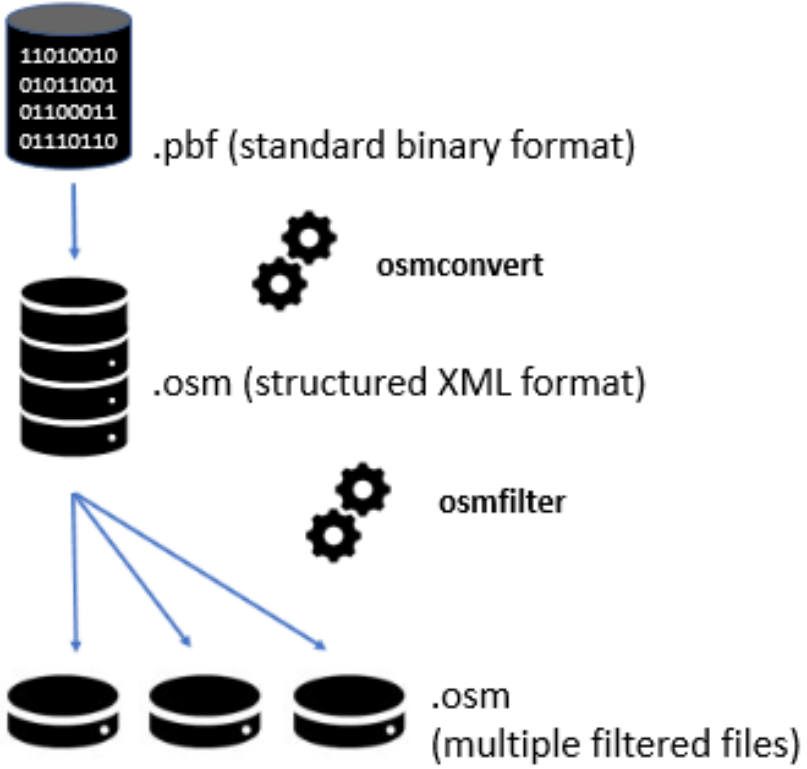
OpenStreetMap Data Pipeline



1. OpenStreetMap data for the United States is downloaded by region in compressed format

2. The data is converted to a larger but much more useful file format

3. The text files are then parsed through to find specific objects by their feature tags

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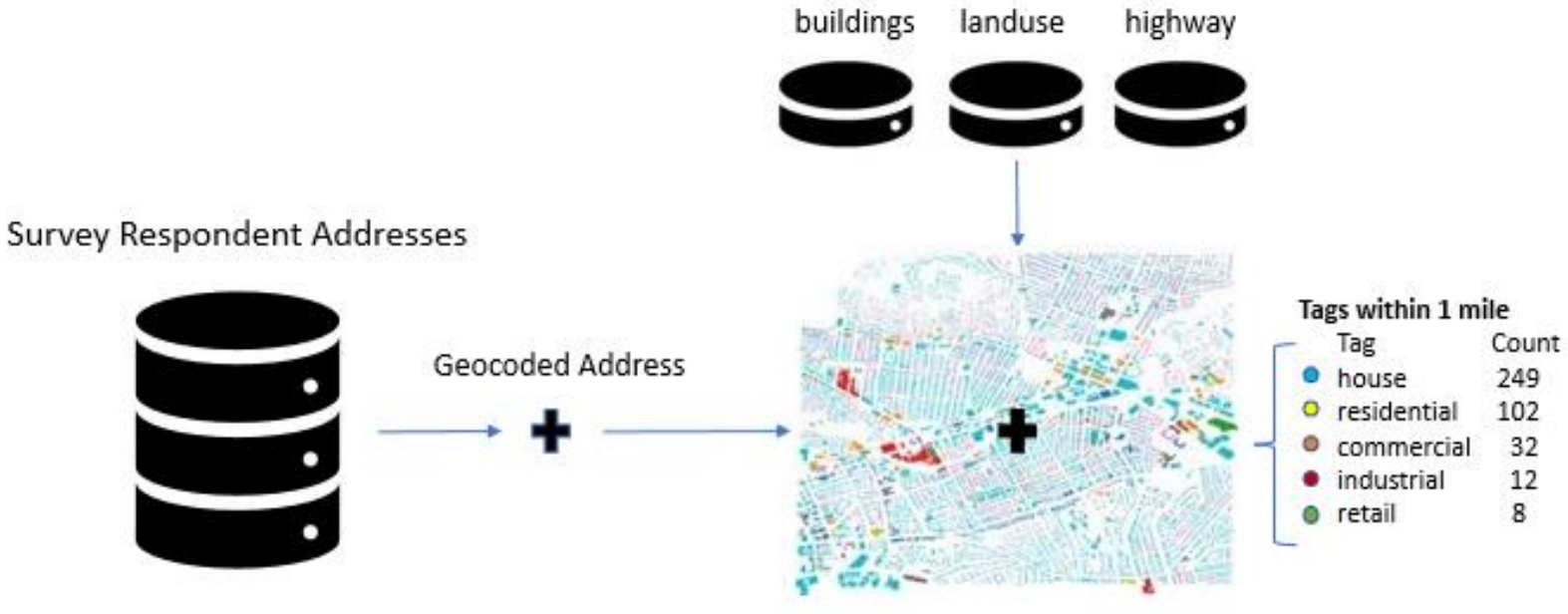
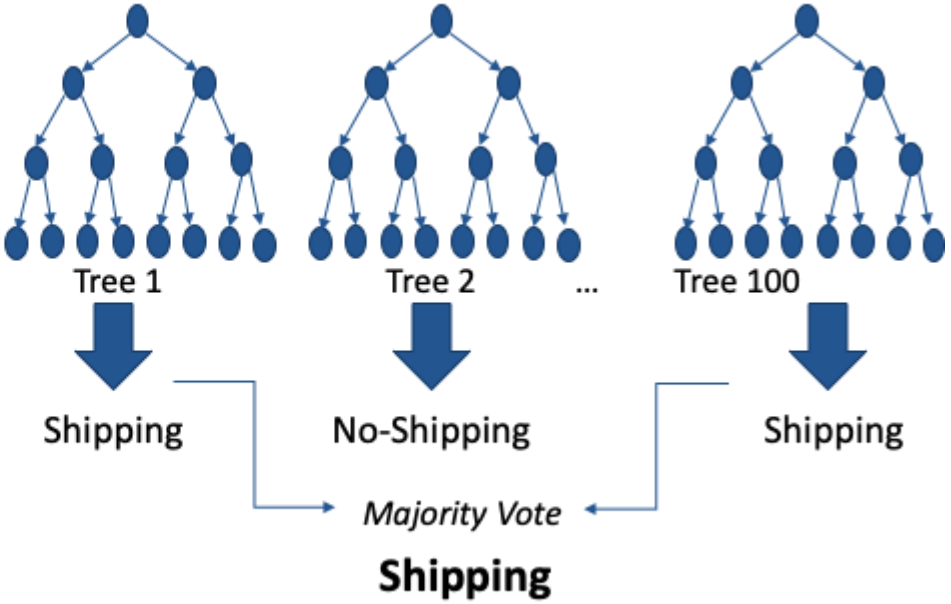
OpenStreetMap Data Pipeline, contd.



Random Forest Classifier

Gather geographic data by location → **Ensemble Decision Tree-based ML model**



78% accuracy

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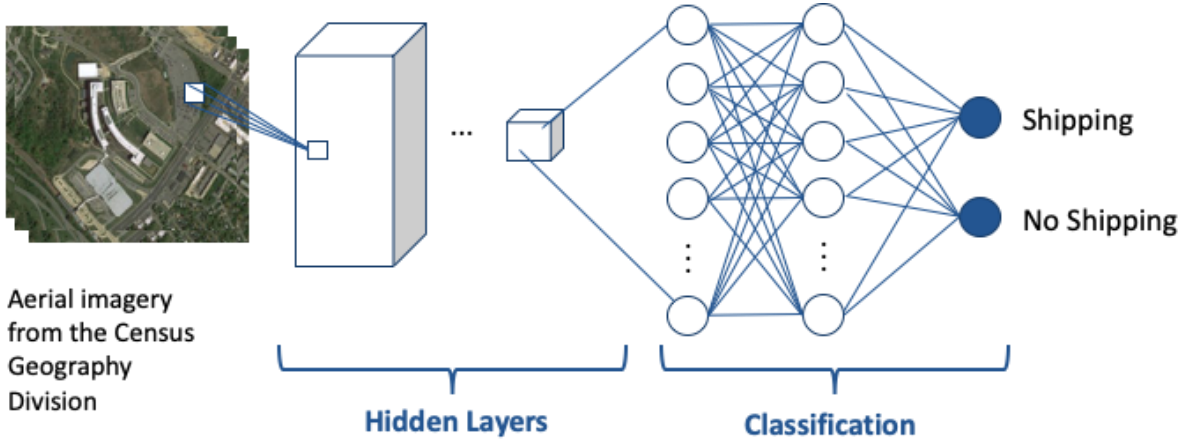
Convolutional Neural Network (CNN)

A deep learning approach to find patterns in images.



CNN assigns importance (learnable weights and biases) to aspects/objects in the image to be able to differentiate between shipping/no shipping classifications.

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CNN Results

85% validation accuracy

Model predictions on public data

(green = correct; red = incorrect)

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Future Impact

- 10% of respondents reported no shipping activity
- Model can lead to a **70% reduction** in error rate (to 3%)
- **$450,000** savings in respondent burden (using the OMB estimated 2.5 hours per questionnaire) for each CFS

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