Locating Phones Indoors with WiFi Fingerprint

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December 4, 2019

Agenda

Background

Modelling

- Model Building
- Model Performance

Conclusion

Background

- Mission: Locate device by its WiFi fingerprint
- Area to cover:
  - Three buildings of Universitat Jaume I with 4 or more floors and almost 110.000 m^2
  - More than 20 different users and 25 Android devices, with widely varying signal strengths
  - Area covered by 520 different WiFi access-points

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- No scaling was done as all the models used where tree based
- Outlier dropping was tried, but this led to worse performance, so all observations where kept in the analysis

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  3. Lastly the just predictions from the second layer were given to a last layer of 4 models that made the final prediction

Model Evaluation

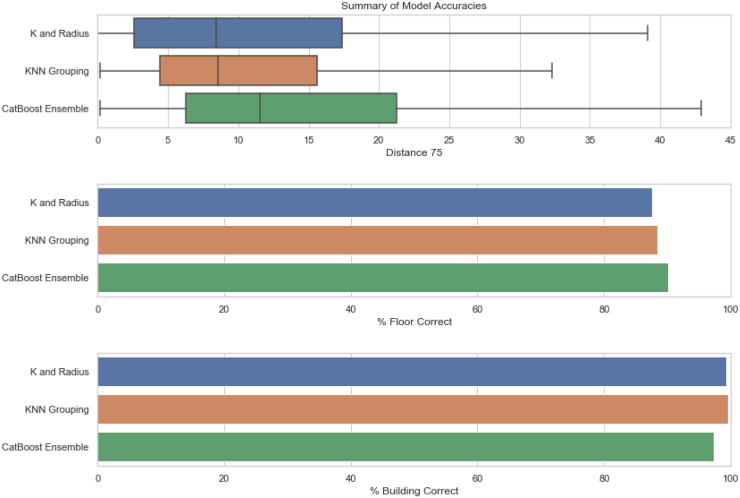
Models were evaluated by a single scoring metrics named Distance 75 that combines all the 4 target values. This metric calculates the manhattan distance between prediction and actual values in 3D space and adds an additional penalty for getting the building wrong:

Distance75 =

$$
\begin{aligned}
&\frac{1}{n} * \sum_{n=1}^{n} (|longitude_{predicted} - longitude_{actual}| \\
&+|latitude_{predicted} - latitude_{actual}| \\
&+4 * |floor\ number_{predicted} - floor\ number_{actual}| \\
&+50 * |building\ number_{predicted} - building\ number_{actual}|)
\end{aligned} \tag{1}
$$

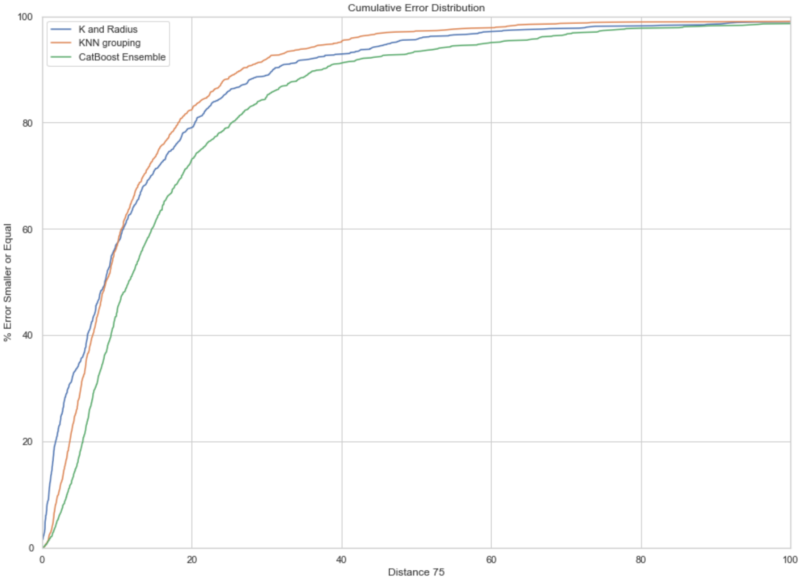
Overall Performance

- KNN models perform clearly much better than CatBoost
- Building is easy to predict, but floor is not



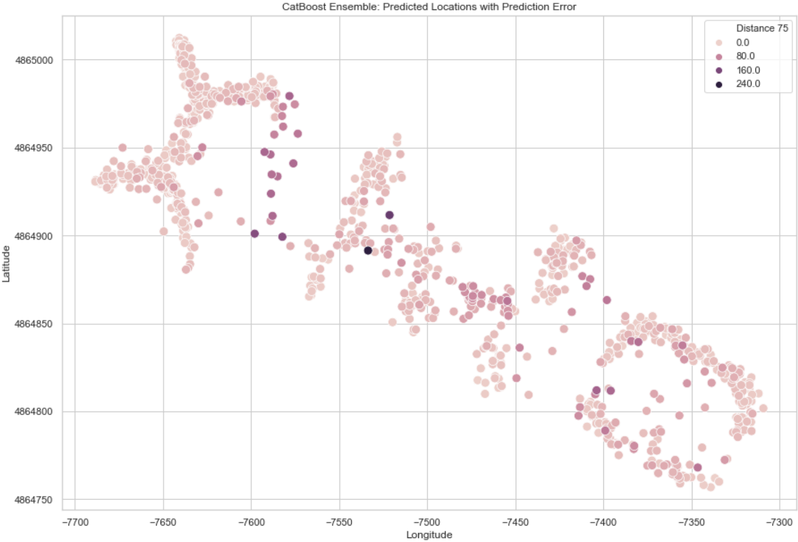
Error distribution

- K and radius model has a fatter tail than KNN grouping in errors



KNN models vs. CatBoost

- CatBoost makes predictions that are outside the buildings



KNN models vs. CatBoost

- KNN keeps to already observed values and makes no stupid errors

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5. If the final training data does not have identifiers for unique locations or we get more training data in the future that does not have these labels, then K and radius model is the best choice

Questions?