Building Modeling Optimization using Machine Learning

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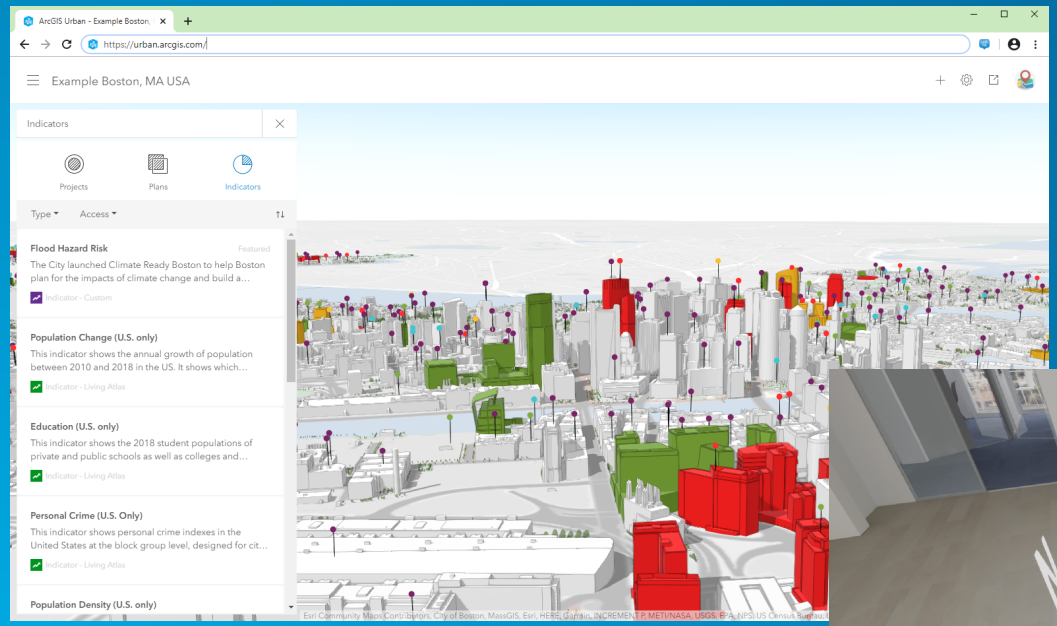
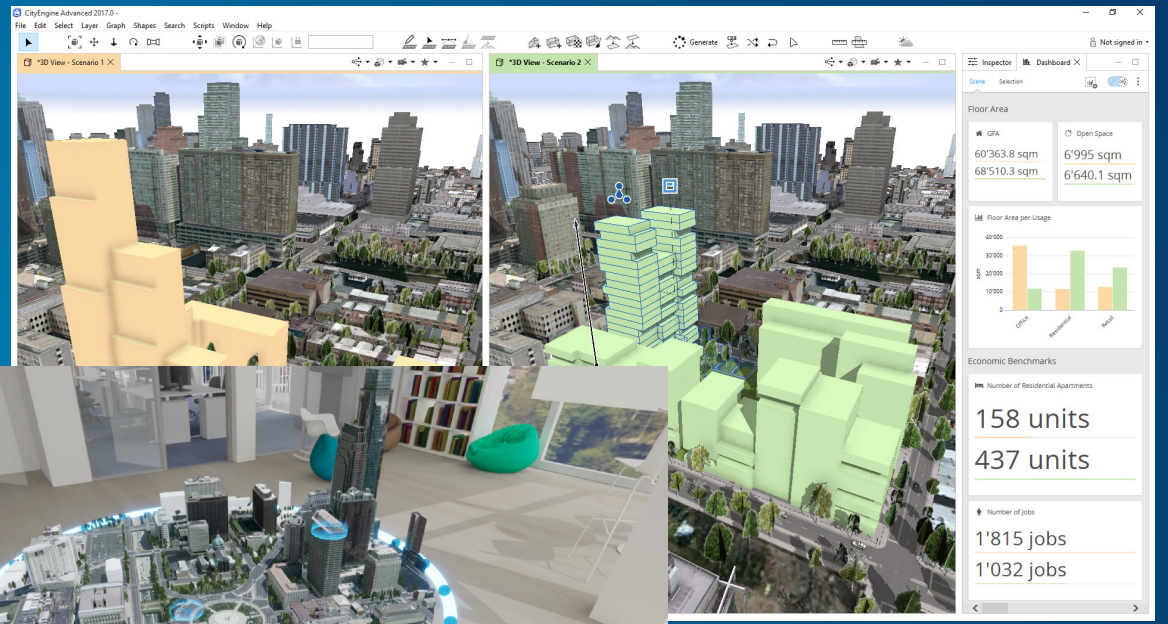
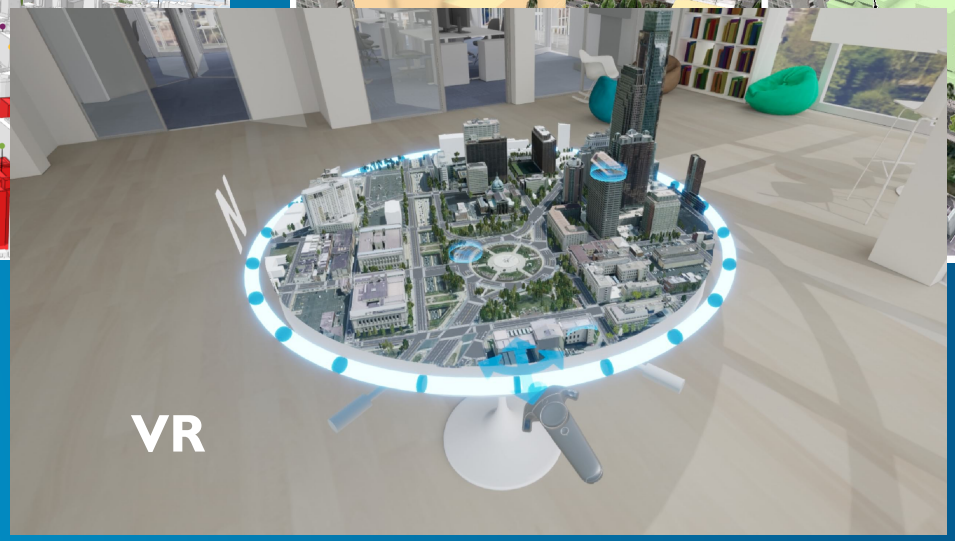
ArcGIS Urban



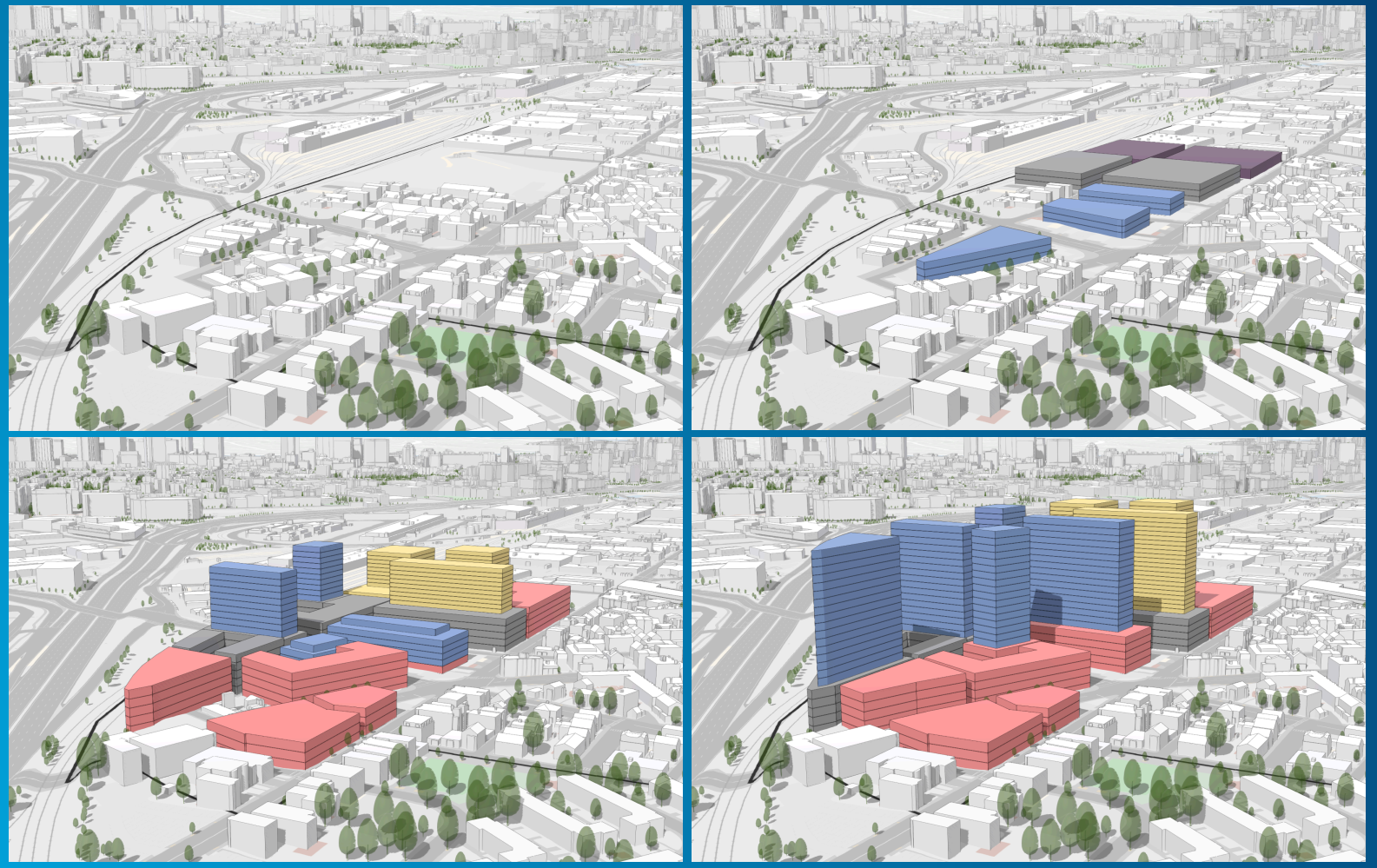
CityEngine



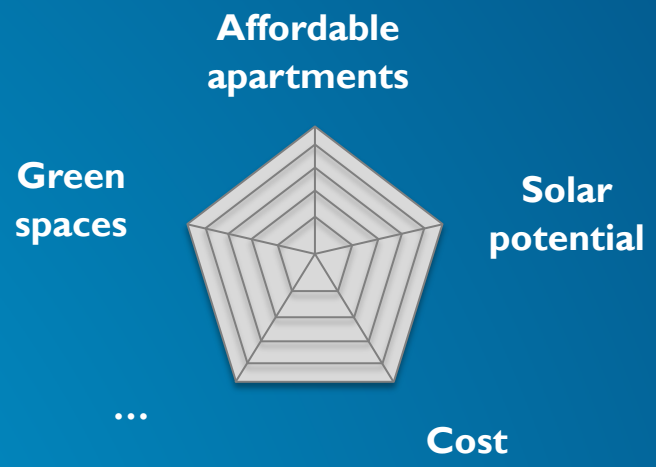


- Web team
- ArcGIS API for JavaScript
- PyPRT

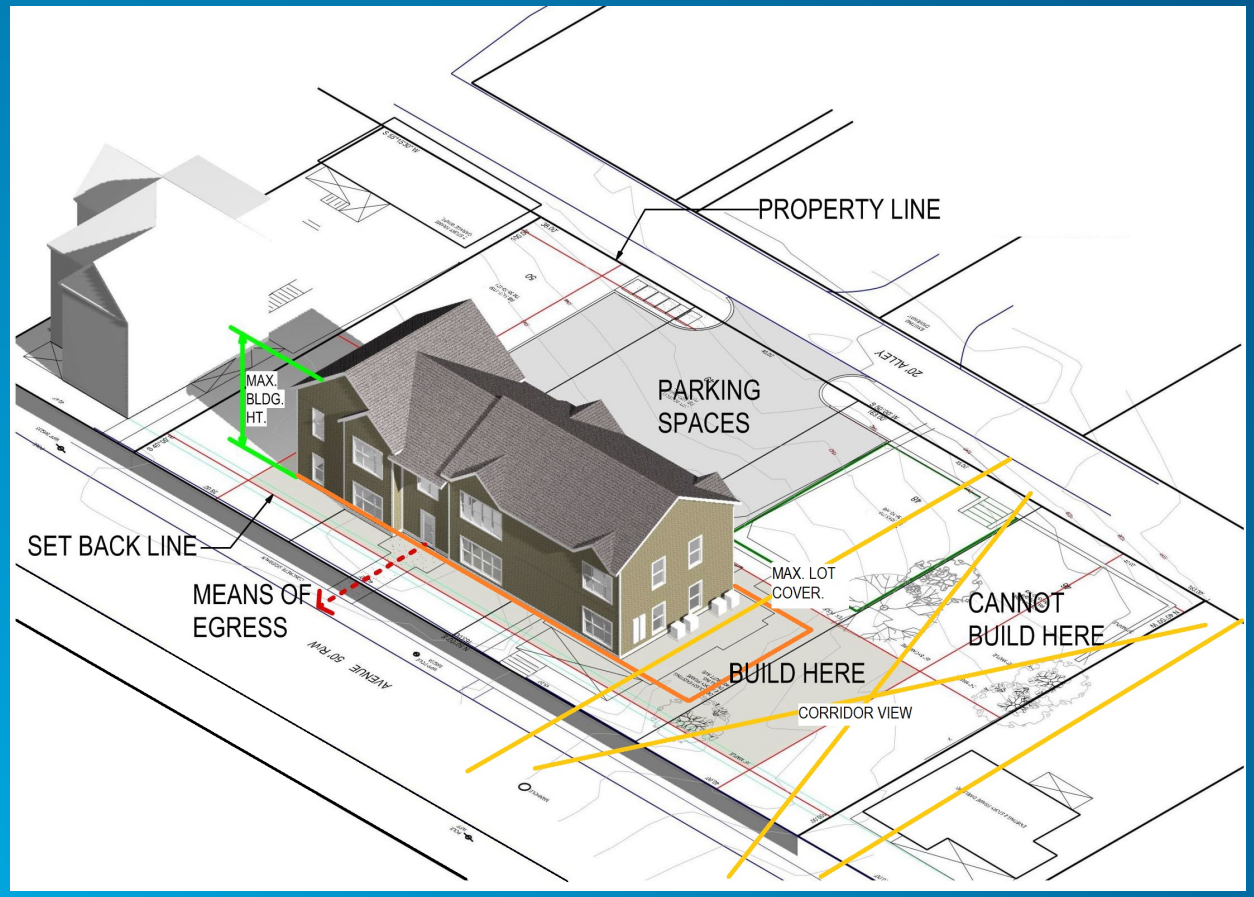
How can Boston Dorchester Avenue be redeveloped?



What is the best building design?



What/Where/How can I build on this parcel?



Zoning rules:

- **Maximum building height**
- **Minimum setback distances**
- **Maximum FAR**
- **Maximum lot coverage**
- **…**
- **…**
- **…**

COMPLEX

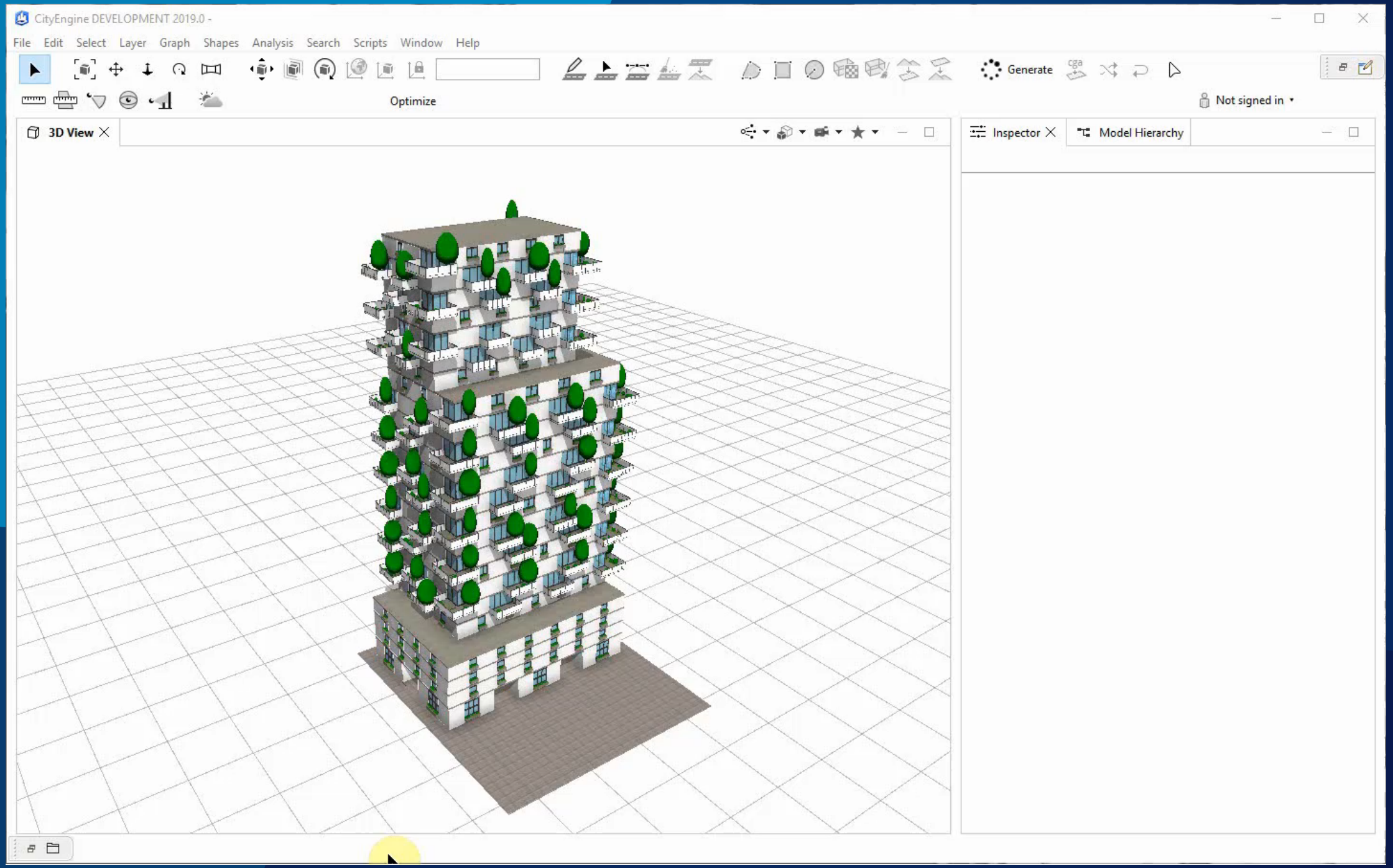
We want a system that can efficiently infer the optimal building design while fulfilling the zoning constraints

Max Greenery spaces
- Balcony width
- Floor height
- Wall width

Site Selection

Max FAR and Building Height
- Setbacks
- Building height

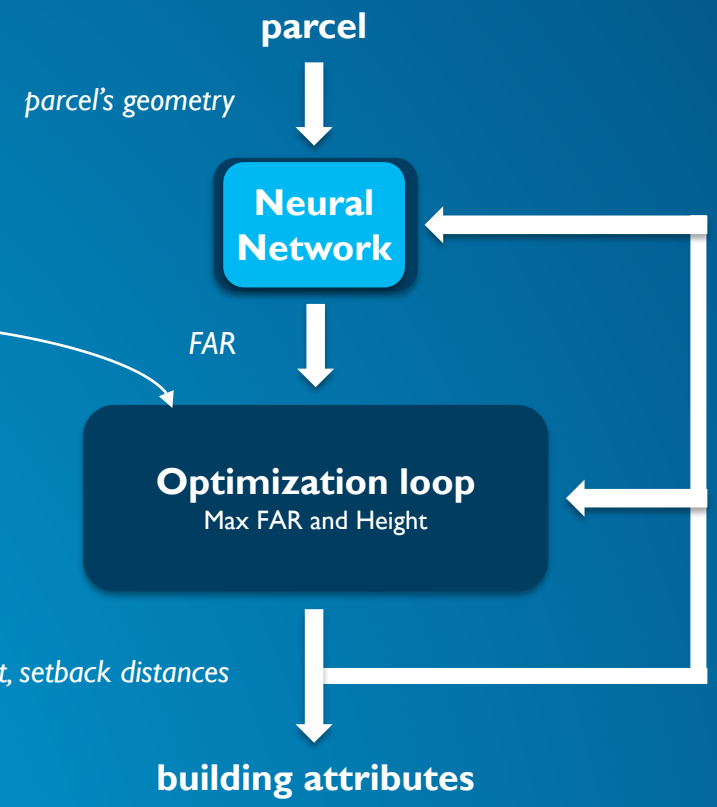
Cost – Benefit Tradeoff

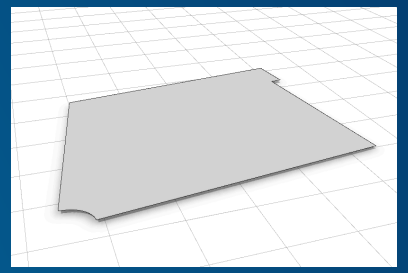

CityEngine DEVELOPMENT 2019.0 -
File Edit Select Layer Graph Shapes Analysis Search Scripts Window Help
Generate
Optimize
Not signed in
3D View
Inspector
Model Hierarchy

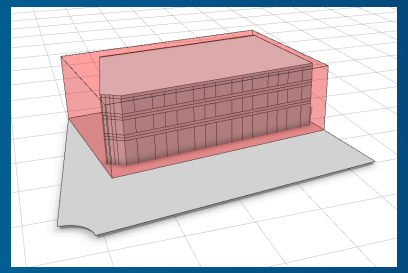
Applying Machine Learning on a simplified problem

Zoning Constraints:

- **minimum Setback Distances**
- **maximum Building Height**
- **maximum FAR**





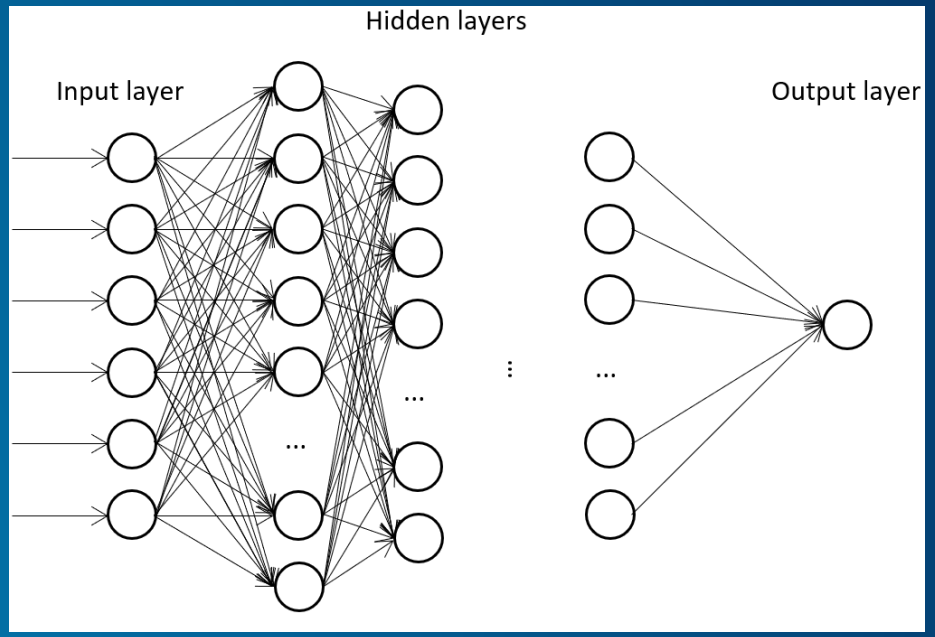


Neural Network Architecture and Dataset

Dataset:
- Zürich parcels
- ≈ 44 000 datapoints

Model Training:
- Cross-validation (10% validation, testing/training ratio 2/3)
- Grid Search (# neurons, # layers, activation function, biases initialization, learning rate, batch size)
- TensorFlow

Neural Network:
- 6 inputs (parcel geometry, building height)
- 8 hidden layers (5 to 25 neurons)
- 1 output (FAR)



Conclusion

- Deep Learning approach allows faster and smarter computation
- Machine Learning will be used to assist the urban planner

Thanks for your attention

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