Classification: Public

INTERNATIONAL RESEARCH SYMPOSIUM
Amsterdam, The Netherlands · December 4 - 5, 2024

ASSESSMENT INNOVATION & COLLABORATION WITH A FOCUS ON AI

Localized Explainability for Machine Learning Valuation Models

IAAO

IIFI IPTI
International Property Tax Institute

Classification: Public

Localized Explainability for Machine Learning Models

James Ellens
Senior Manager, Data Science
Valuation & Assessment Standards
MPAC

Mostafa Hosseinian (in absentia)
Data Analyst
Valuation & Assessment Standards
MPAC

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Overview

Classification: Public

Ontario's Property Assessment System

Government of Ontario

Establishes the province's assessment and taxation laws and determines the education tax rates.

MPAC

Determines property classifications and assessments for all properties in Ontario, in accordance with legislation set by the Ontario Government.

Municipalities

Determine revenue requirements, set municipal tax rates and collect property taxes to pay for municipal services.*

Property owners

Pay property taxes that fund community services and education taxes that fund public schools.

Municipal Property Assessment Corporation

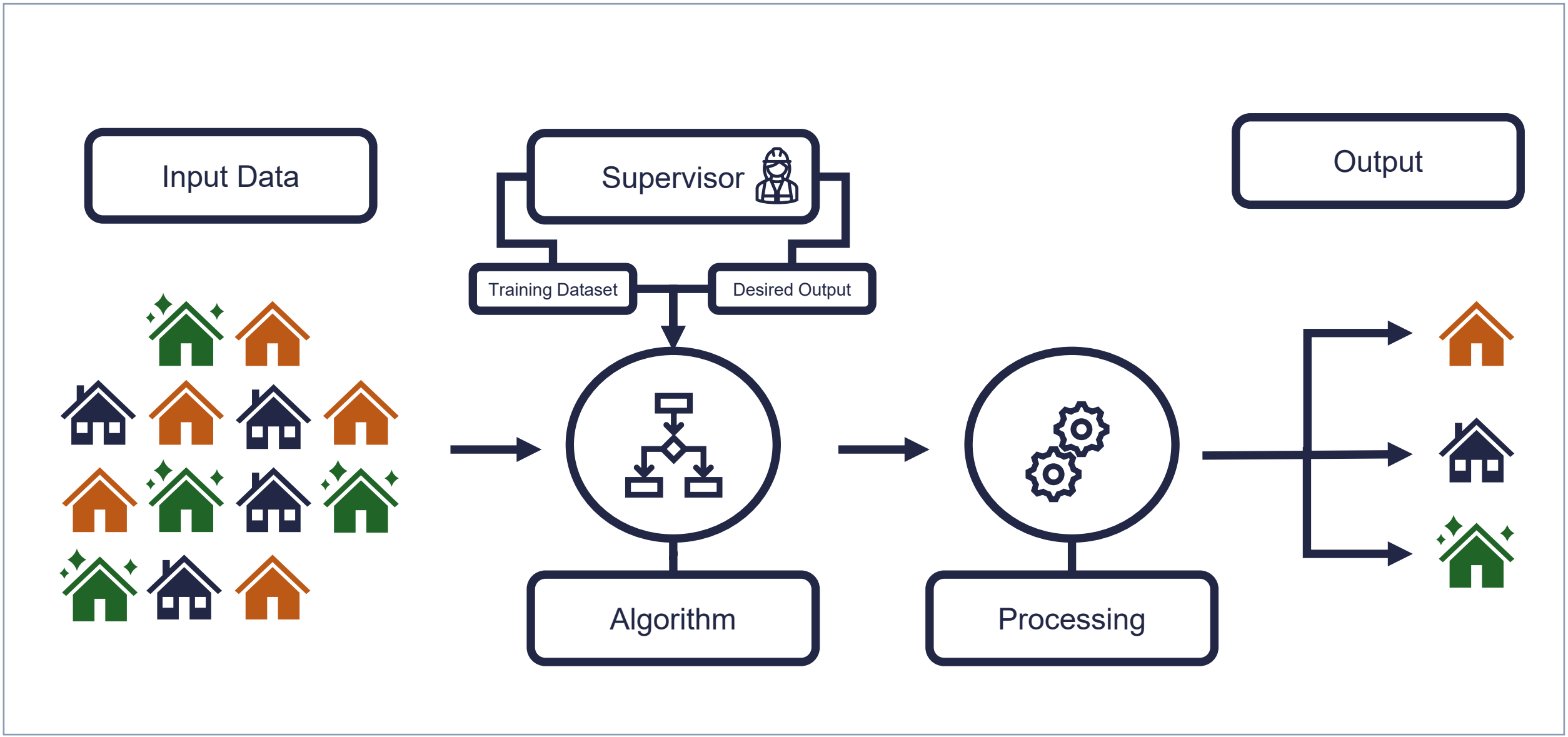
We are
1,800+ employees
across Ontario

Responsible for
assessing more than
5.6 million properties in
Ontario

Representing more
than **$3 trillion** in
property value

Serving all of Ontario's
444 municipalities

Classification: Public



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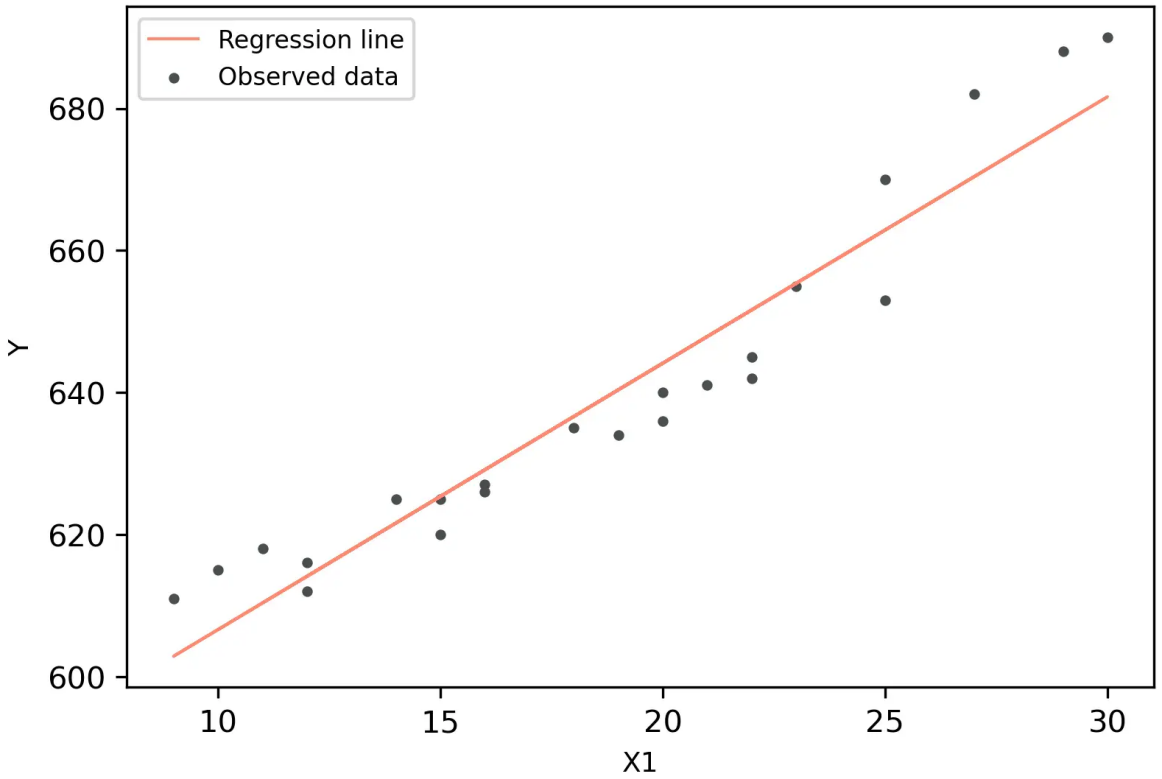
Ordinary Least Squares



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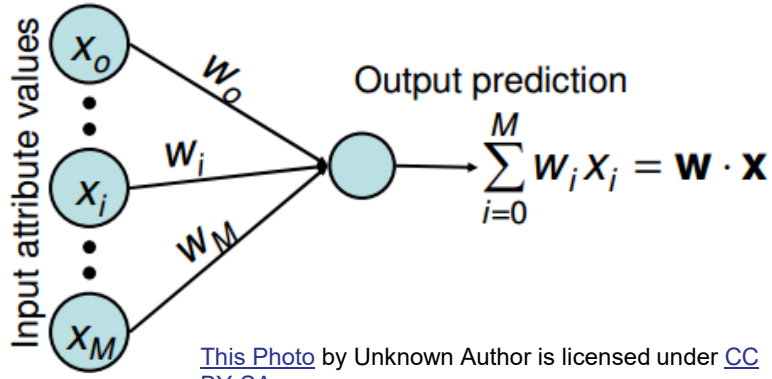

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Formula:

value = total_area * 625 +
age * -1600

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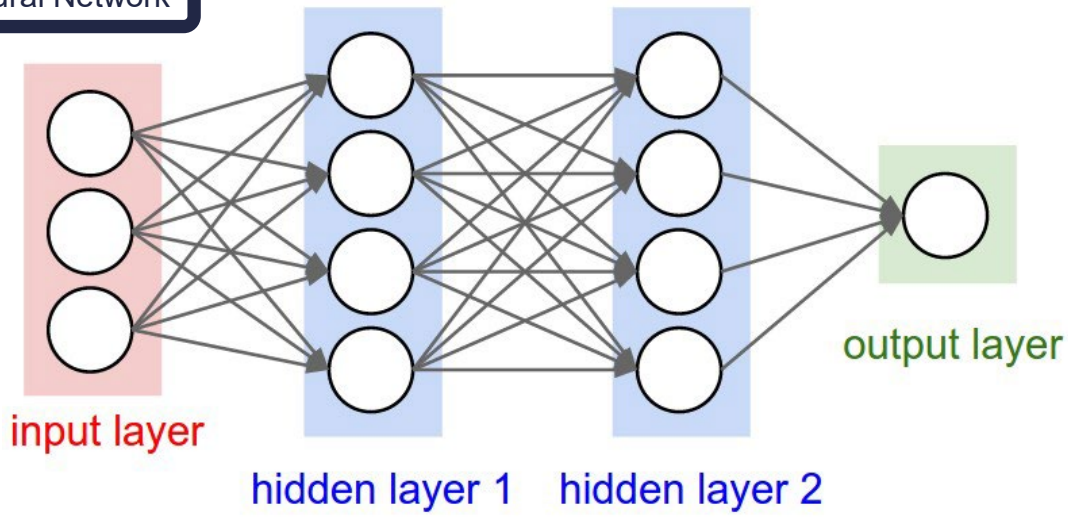
Neural Network



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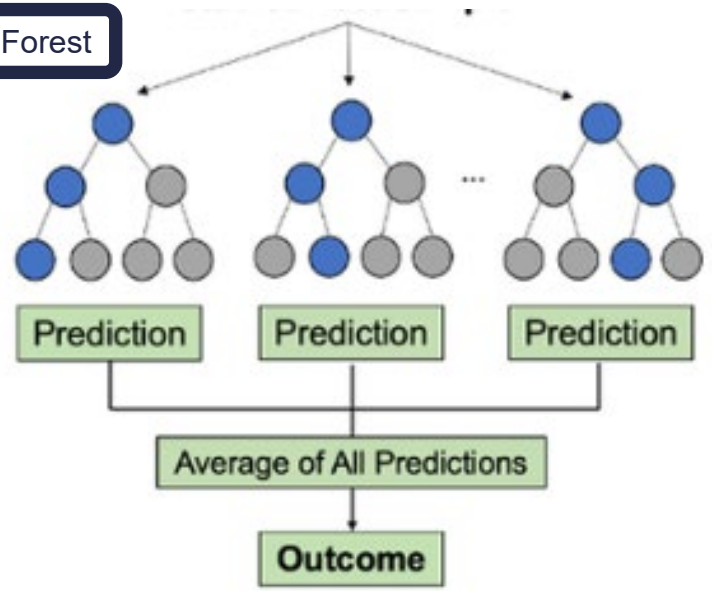
Random Forest



Formula:
value =

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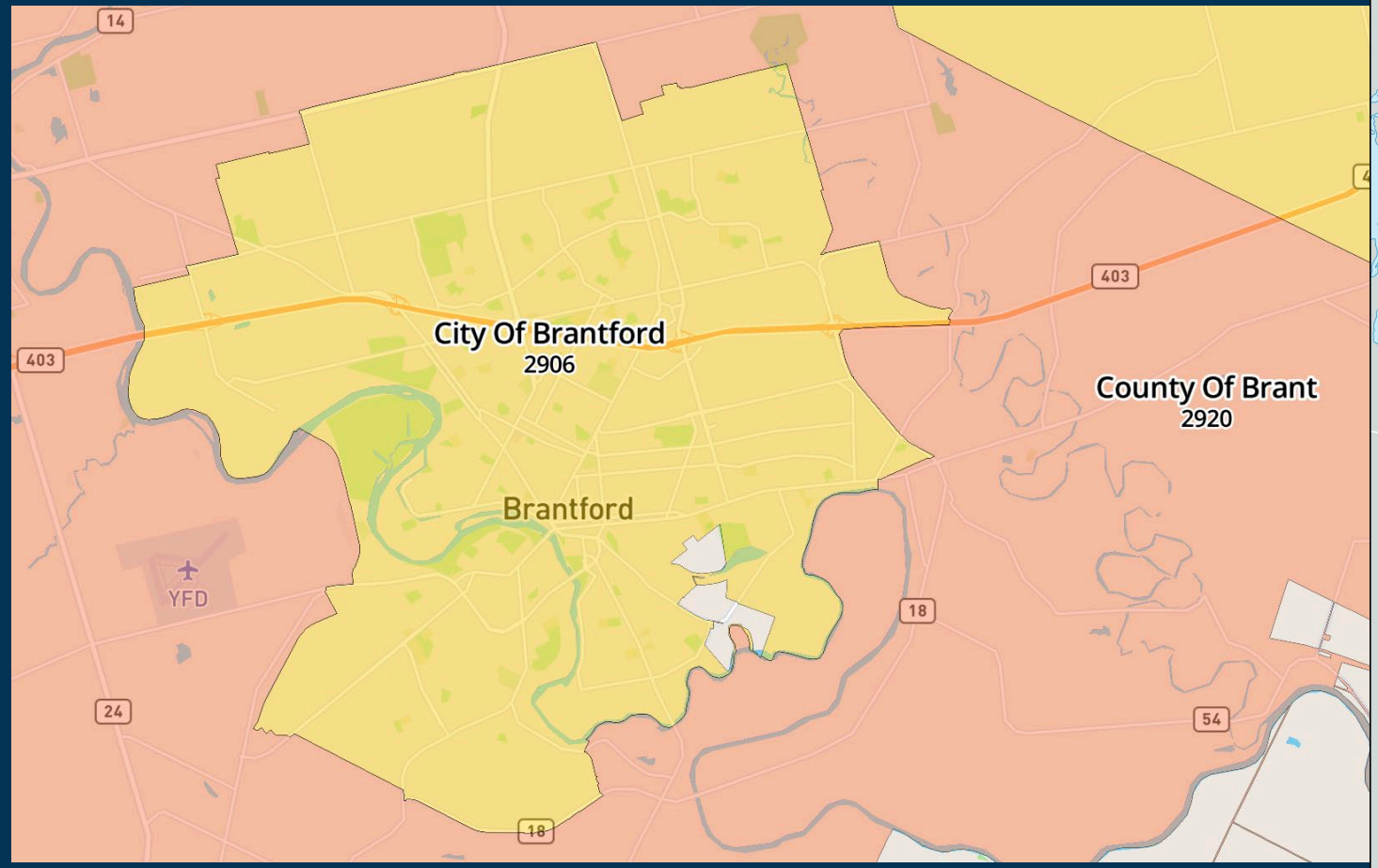
Model Explainability

Market Area


14
403
City Of Brantford
2906
403
County Of Brant
2920
Brantford
YFD
18
24
54
18

Hudson Bay
MANITOBA
James Bay
QUEBEC
ONTARIO
CANADA
Lake Superior
UNITED STATES
Lake Michigan
Lake Huron
Lake Ontario
Brantford
Lake Erie
0 100 200 mi
0 100 200 km
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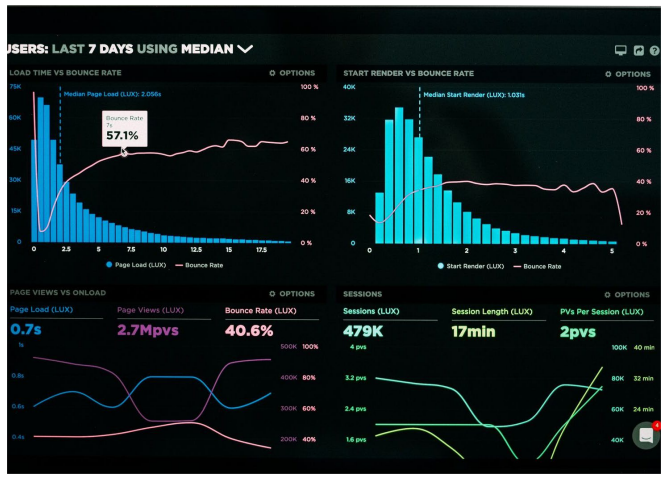
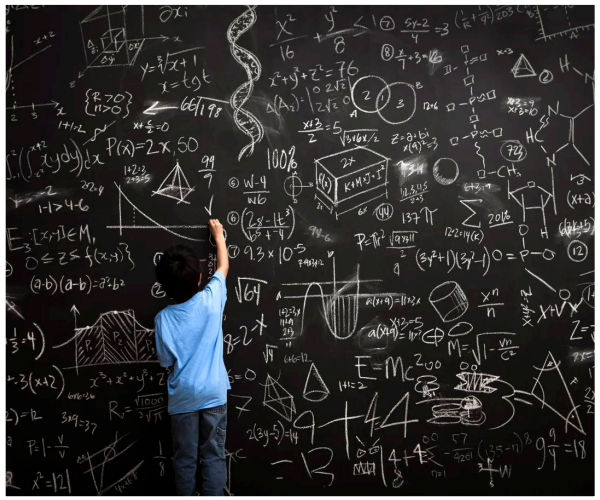
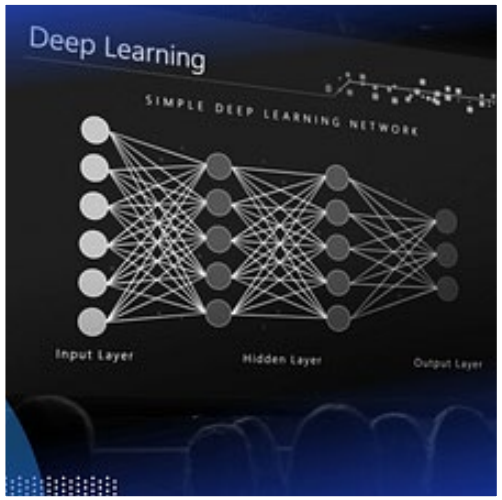

USERS: LAST 7 DAYS USING MEDIAN
LOAD TIME VS BOUNCE RATE
OPTIONS
Median Page Load (LUX): 2.056s
Bounce Rate
57.1%
Page Load (LUX)
Bounce Rate
START RENDER VS BOUNCE RATE
OPTIONS
Median Start Render (LUX): 1.031s
Start Render (LUX)
Bounce Rate
PAGE VIEWS VS ONLOAD
OPTIONS
Page Load (LUX)
0.7s
Page Views (LUX)
2.7Mpvs
Bounce Rate (LUX)
40.6%
SESSIONS
OPTIONS
Sessions (LUX)
479K
Session Length (LUX)
17min
PVs Per Session (LUX)
2pvs




Deep Learning
SIMPLE DEEP LEARNING NETWORK
Input Layer
Hidden Layer
Output Layer

Classification: Public

Classification: Public

Global Explanations

Providing an overall explanation of the model's behavior

Local Explanations

Understanding individual, property - level predictions

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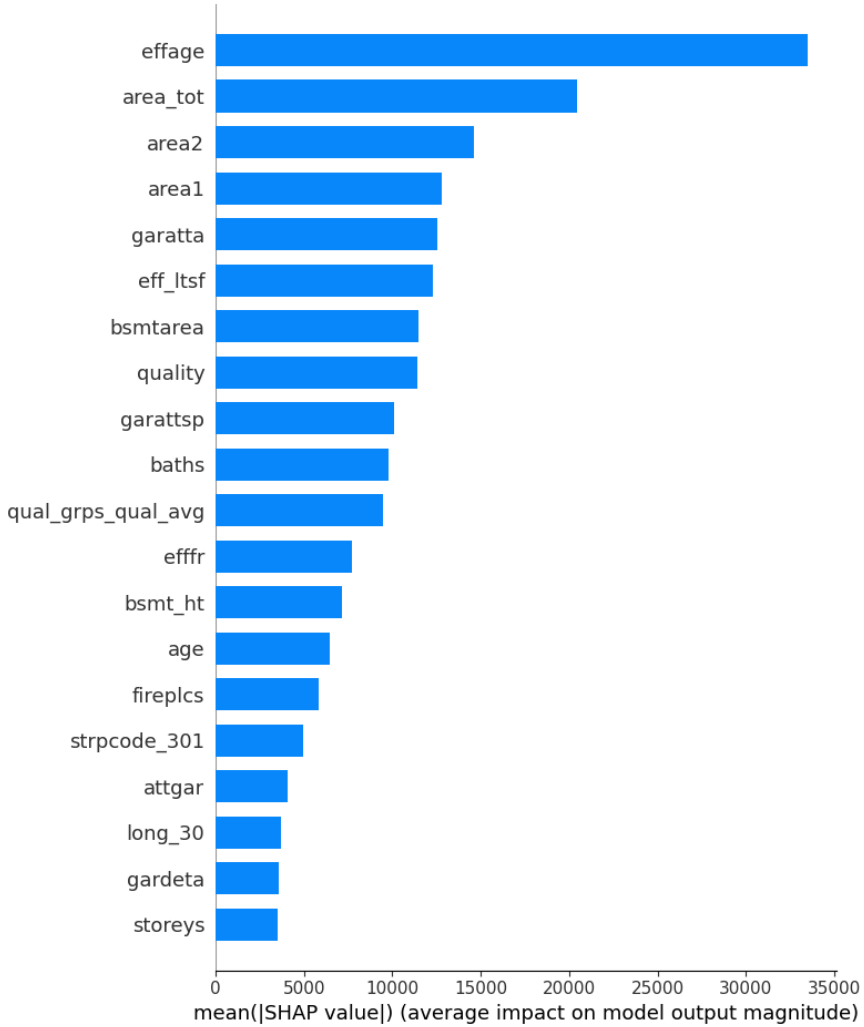
SHapley Additive exPlanations

Classification: Public

Classification: Public



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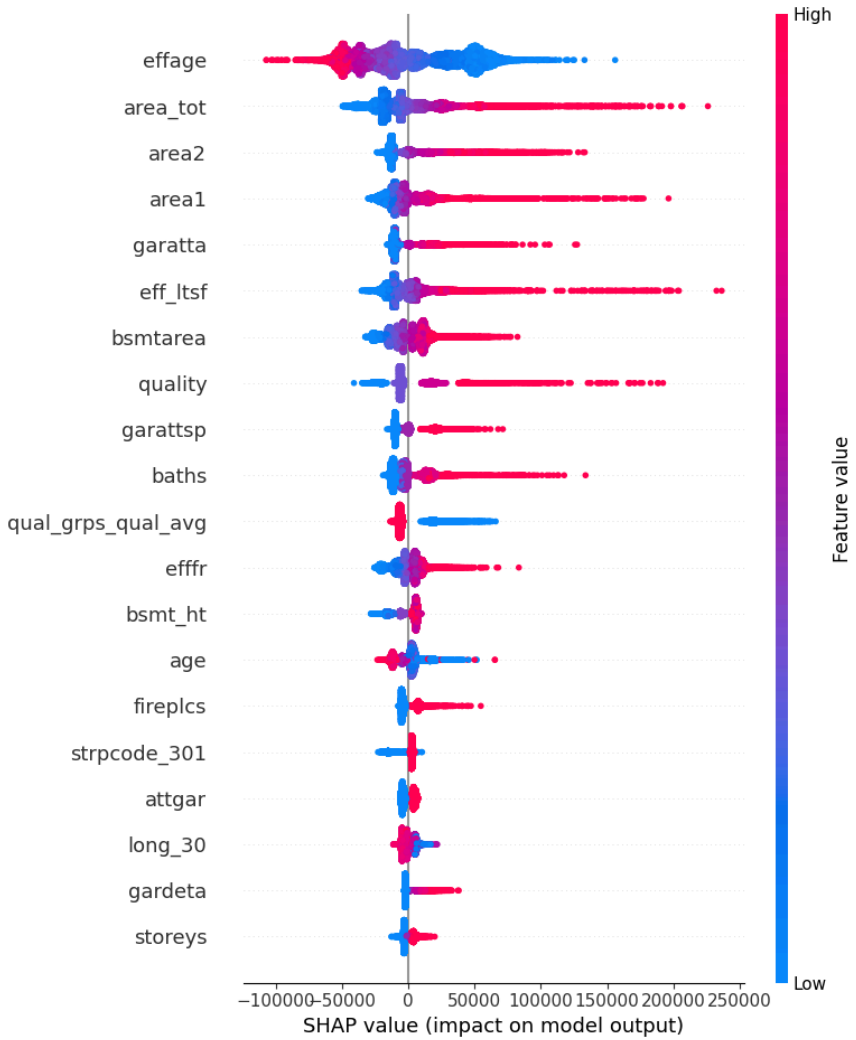

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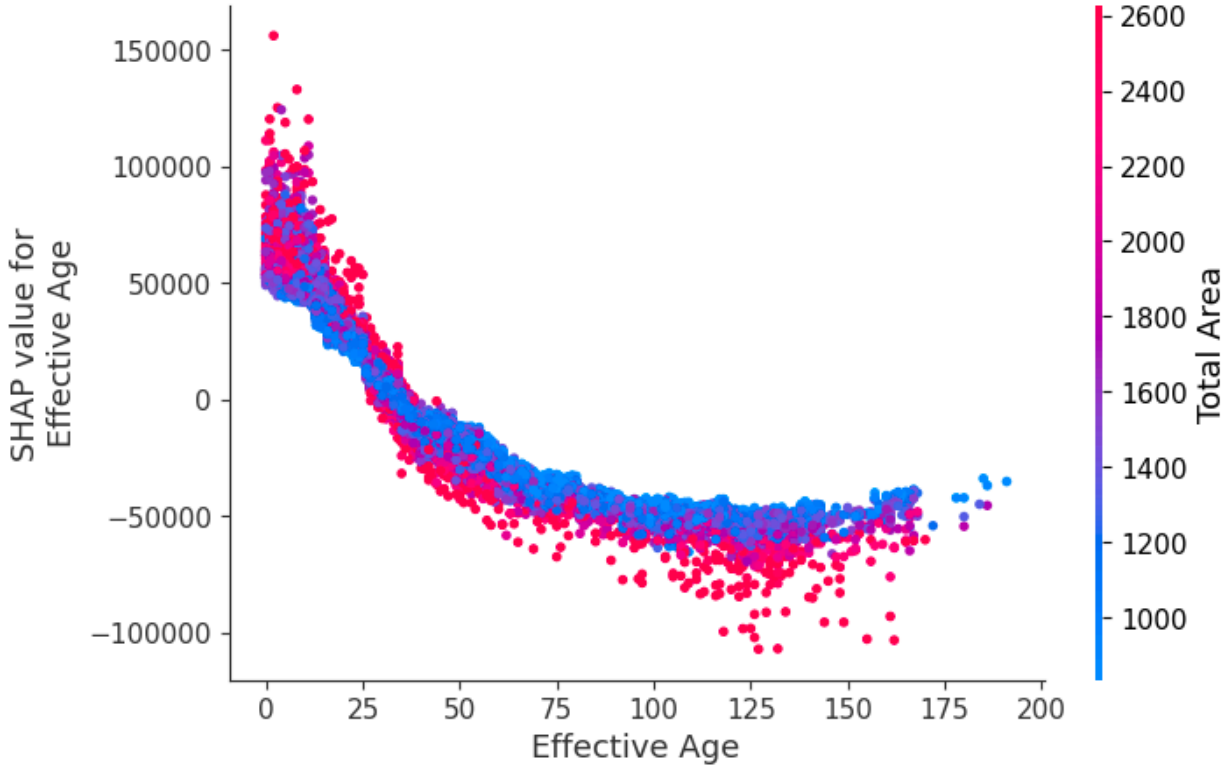
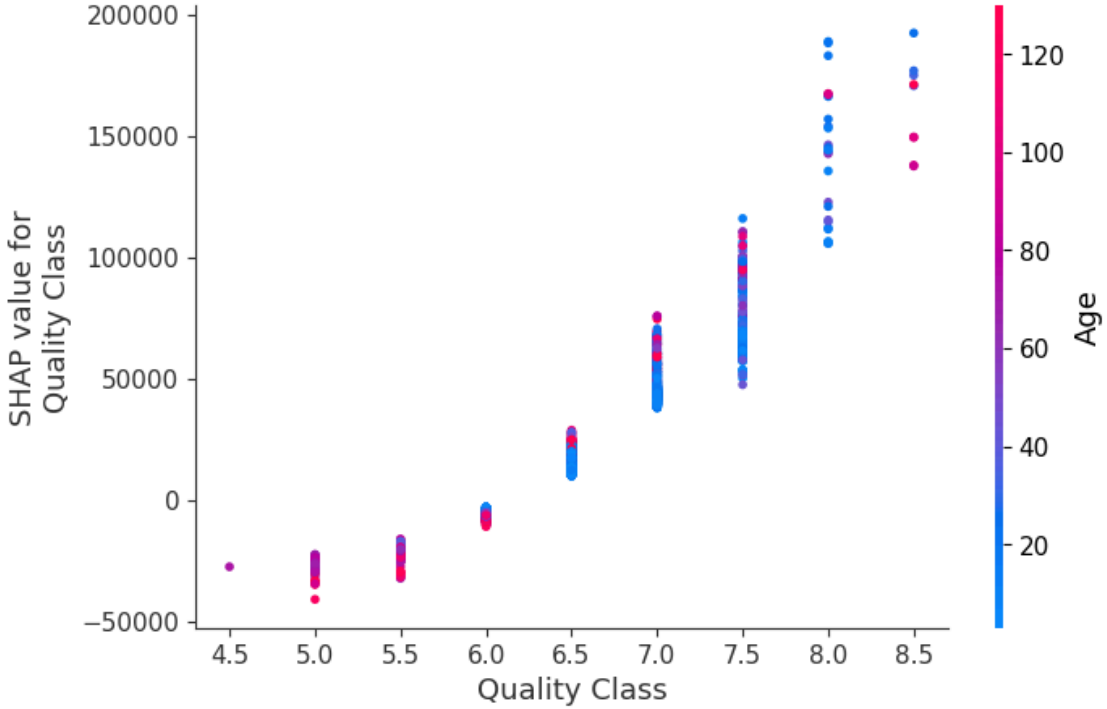
Partial Dependence Plots

Visualizing the relationship between a feature and the model's prediction





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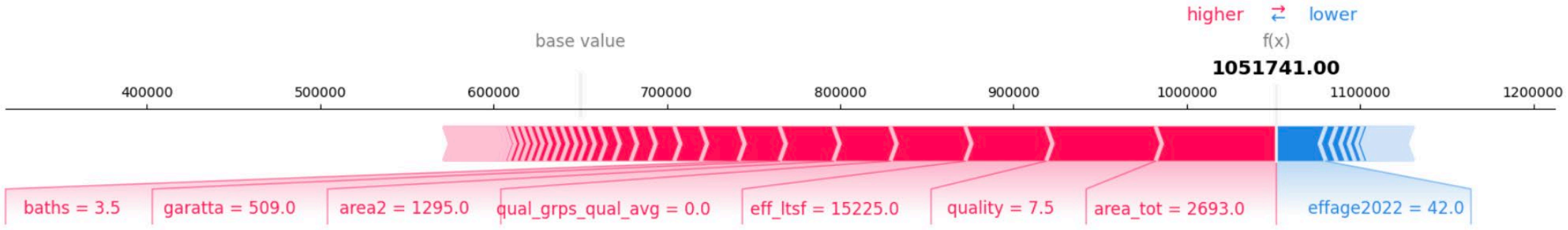
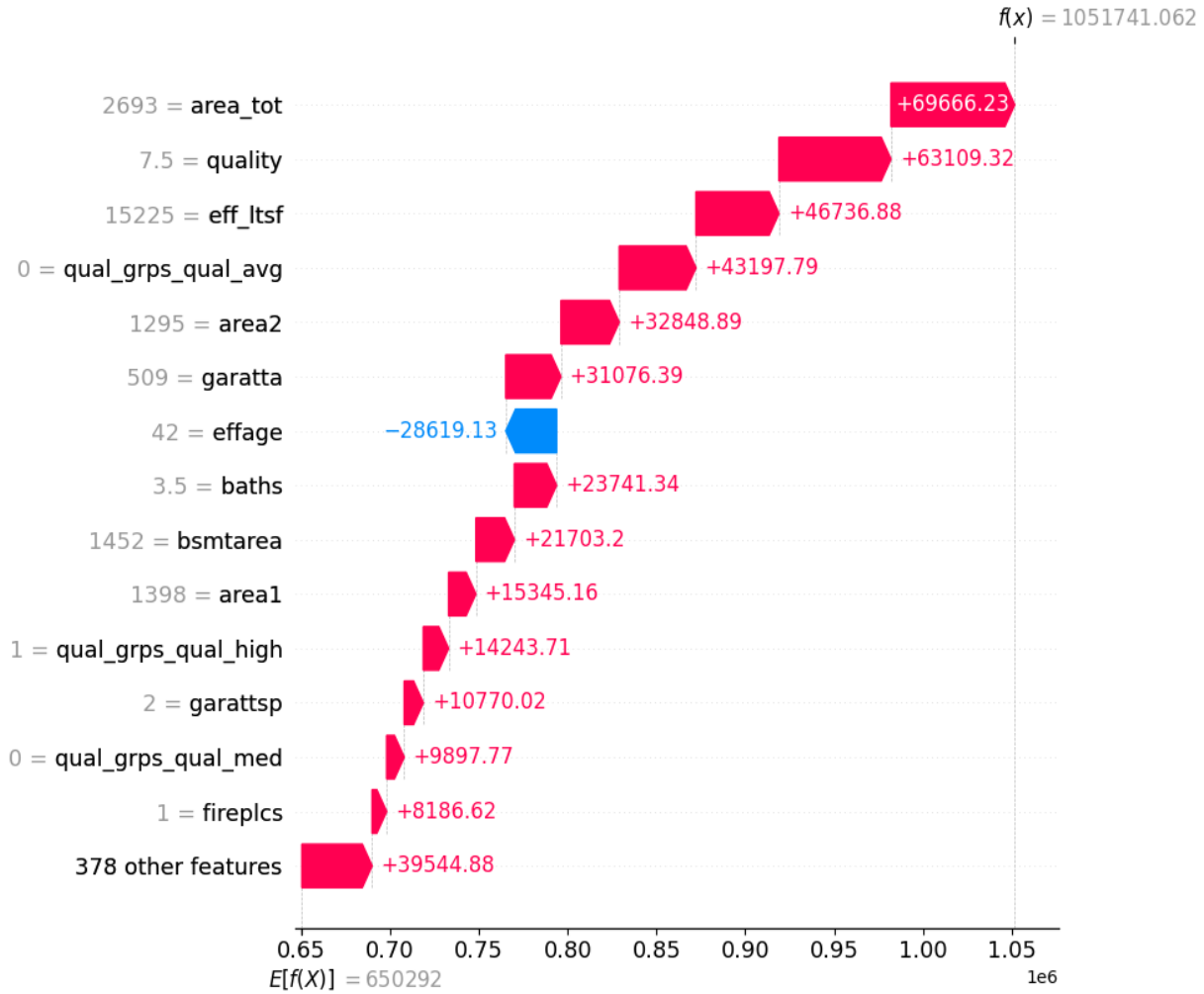
Force Plot

Plotting the features contributing to the model prediction for a specific instance/property




f(x) = 1051741.062
2693 = area_tot
+69666.23
7.5 = quality
+63109.32
15225 = eff_ltsf
+46736.88
0 = qual_grps_qual_avg
+43197.79
1295 = area2
+32848.89
509 = garatta
+31076.39
42 = effage
−28619.13
3.5 = baths
+23741.34
1452 = bsmtarea
+21703.2
1398 = area1
+15345.16
1 = qual_grps_qual_high
+14243.71
2 = garattsp
+10770.02
0 = qual_grps_qual_med
+9897.77
1 = fireplcs
+8186.62
378 other features
+39544.88
0.65
0.70
0.75
0.80
0.85
0.90
0.95
1.00
1.05
1e6
E[f(X)] = 650292

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Customized Explainability

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1.

2.

3.

4.

5.

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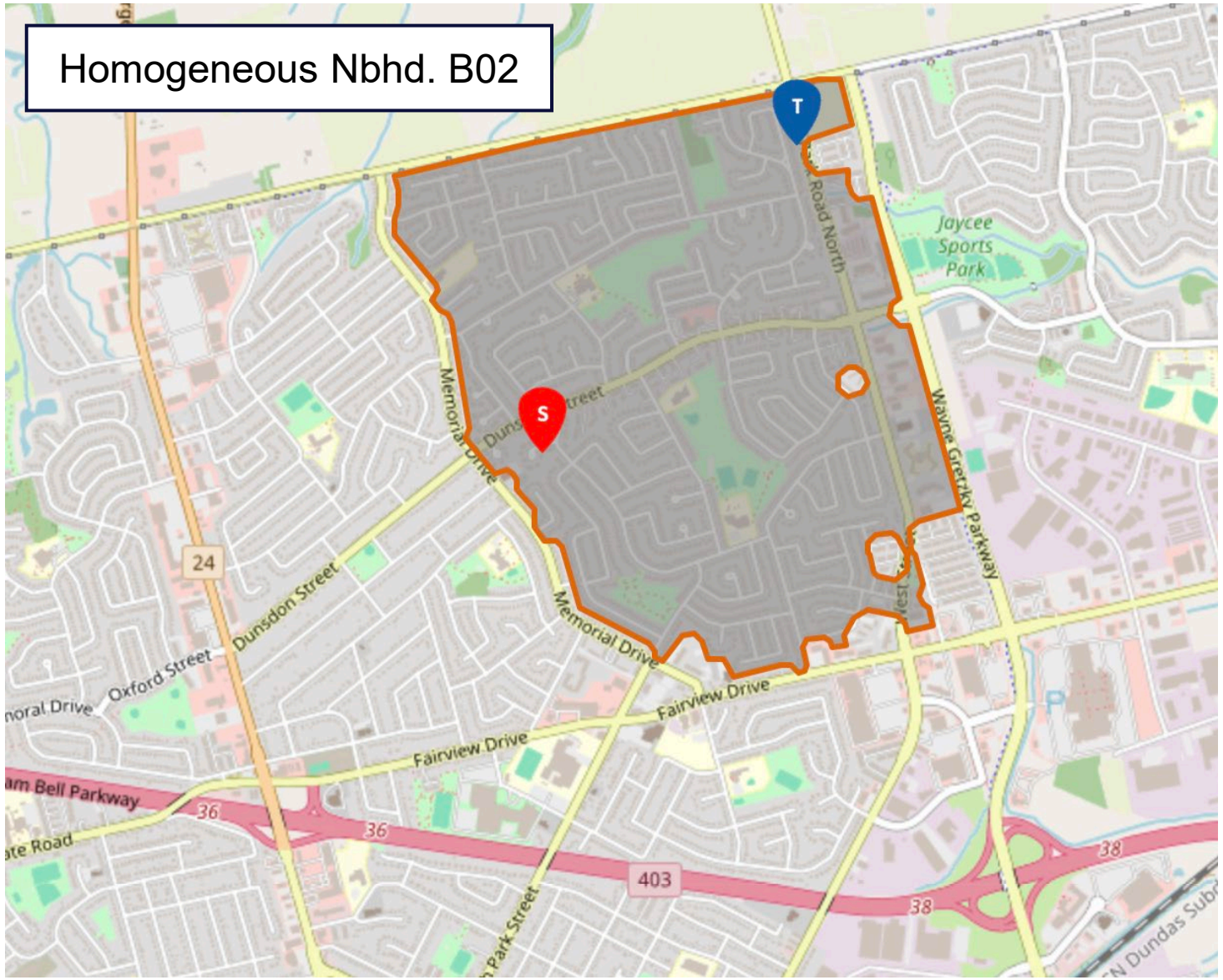
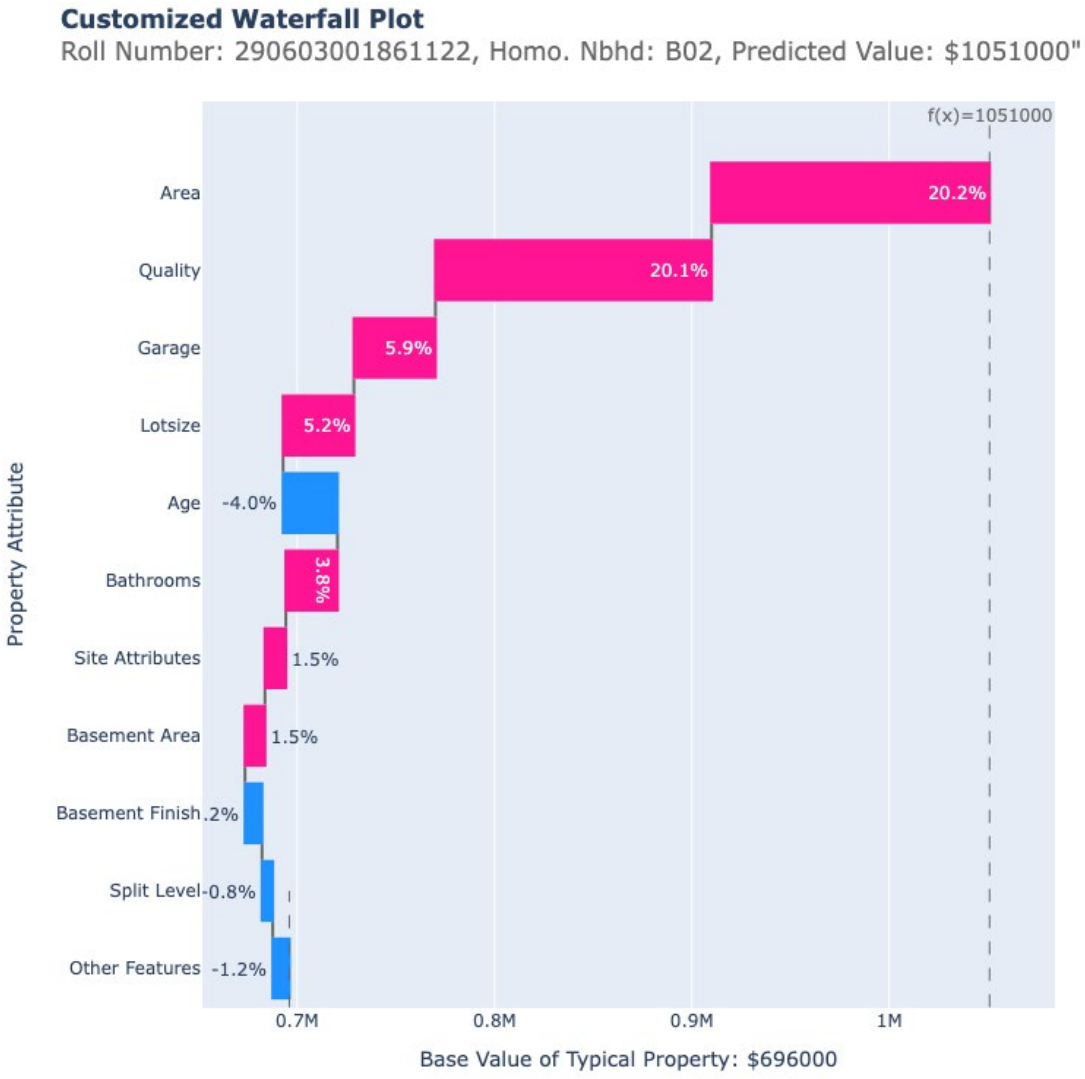


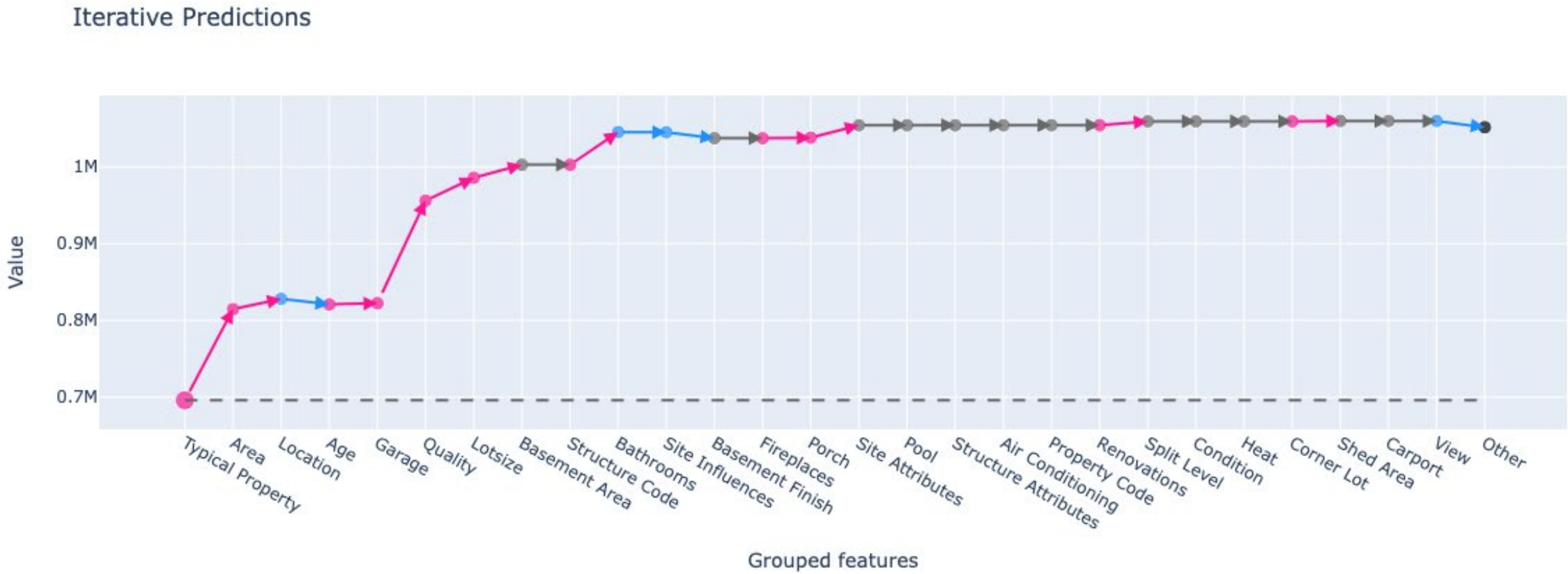
	Base	Subject
Homo Nbhd	B02	B02
Str. Type	Detached	Detached
Lotsize	0.18 acres	0.35 acres
Age	37 years	42 years
Quality	6.0	7.5
Total Area	1210 sq ft	2693 sq ft
Basement Area	1071 sq ft	1452 sq ft
Basement Finish	503 sq ft	0 sq ft
Garage	252 sq ft	509 sq ft
Bathrooms	1.5	3.5

Classification: Public

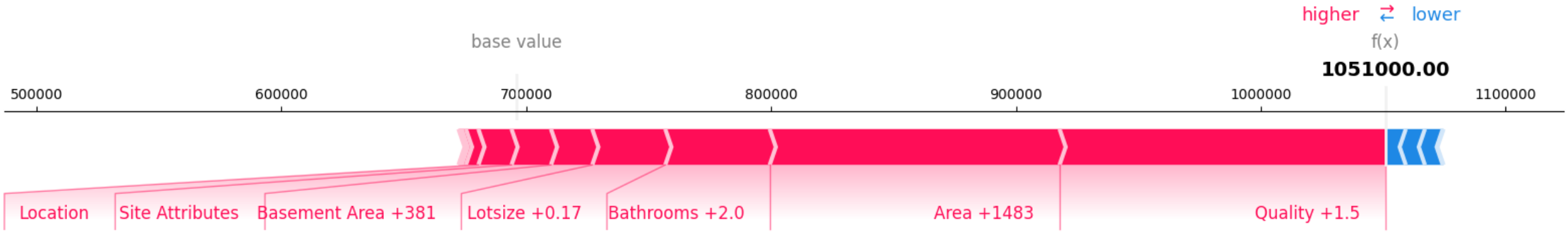


	Base	Subject	Adjustment
Area	1210 sq ft	2693 sq ft	20.2%
Quality	6.0	7.5	20.1%
Garage	252 sq ft	509 sq ft	5.9%
Lotsize	0.18 acres	0.35 acres	5.2%
Age	37 years	42 years	-4.0%
Bathrooms	1.5	3.5	3.8%
Site Attributes		Cul-de-sac	1.5%
Basement Area	1071 sq ft	1452 sq ft	1.5%
Basement Finish	503 sq ft	0 sq ft	-1.2%
Split Level	0.0	1.0	-0.8%
Other			-1.2%
Value	$696,000	$1,051,000	

Classification: Public



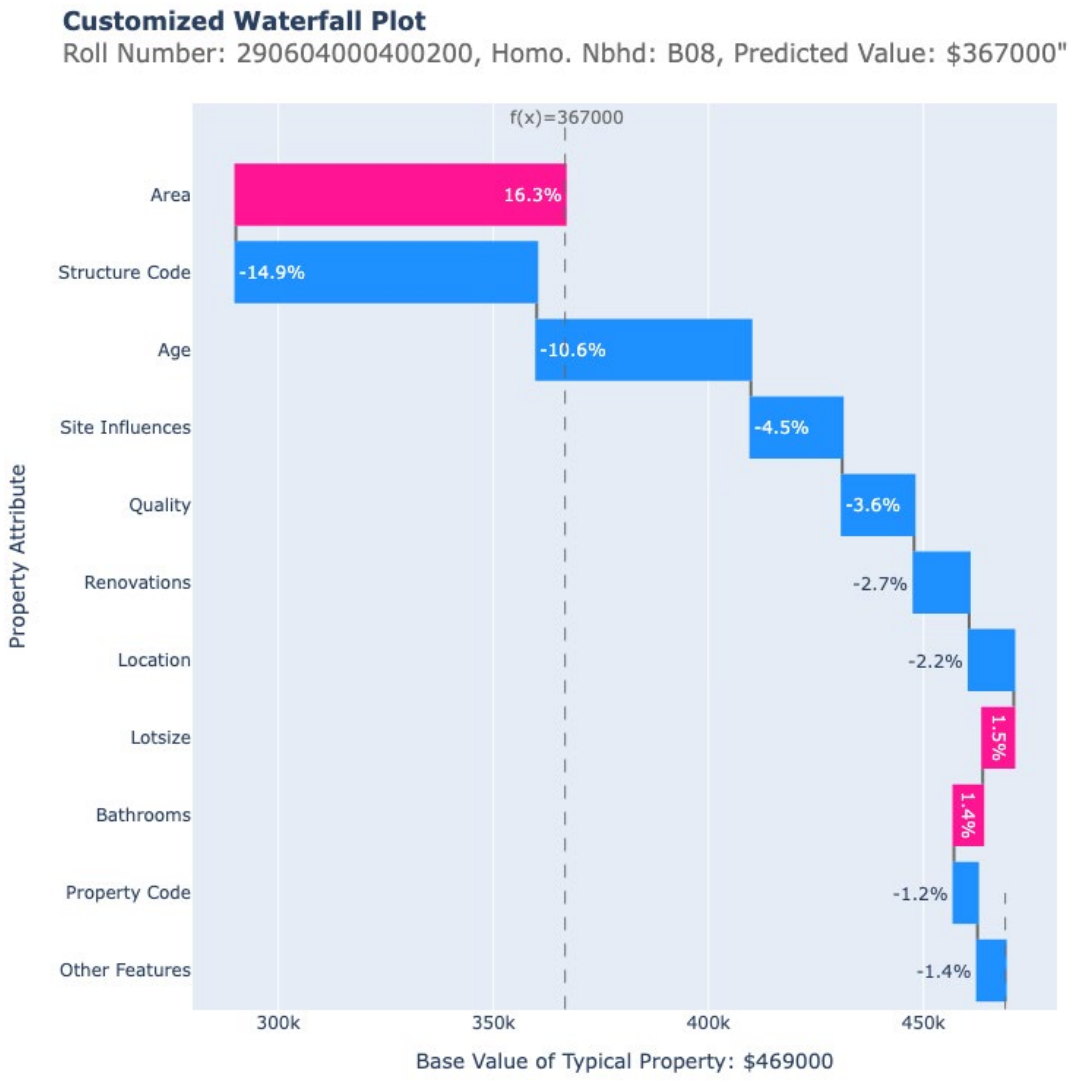
Classification: Public



Classification: Public

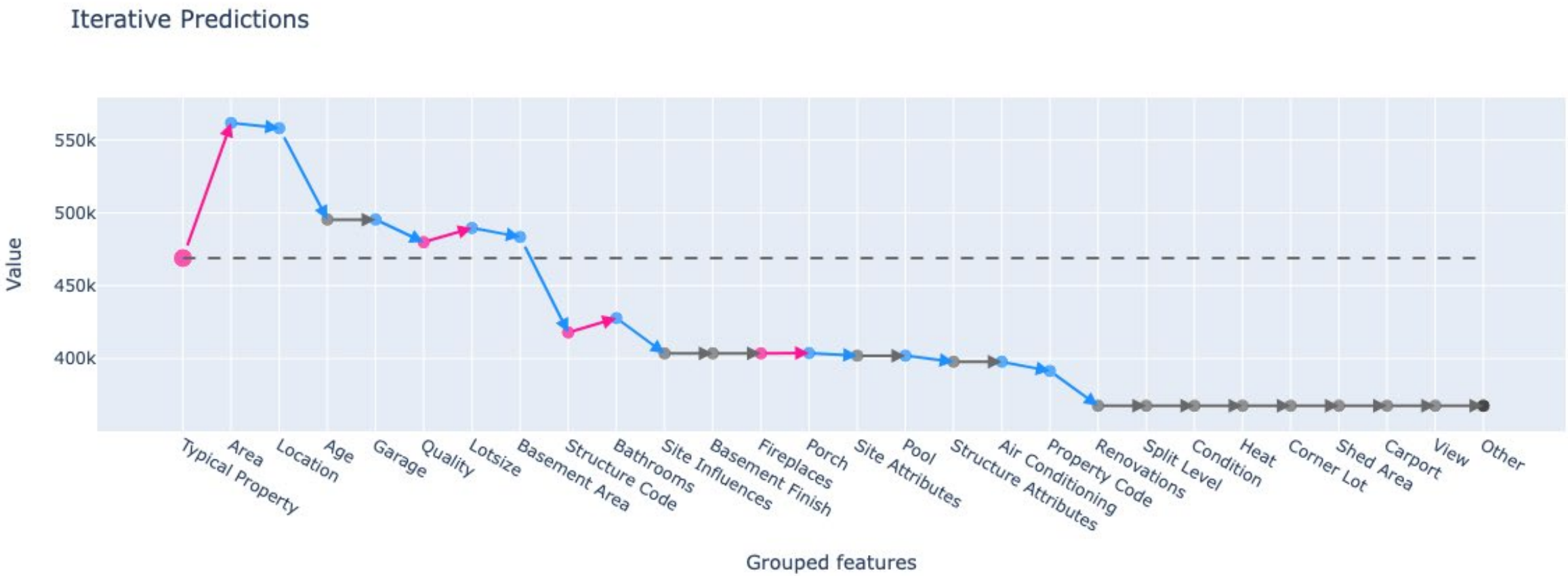
	Base	Subject
Homo Nbhd	B08	B08
Str. Type	Detached	Semi-Detached
Lotsize	0.04 acres	0.06 acres
Age	105 years	166 years
Quality	6.0	5.5
Total Area	1334 sq ft	2191 sq ft
Basement Area	667 sq ft	449 sq ft
Bathrooms	1	1.5

Classification: Public



	Base	Subject	Adjustment
Area	1334 sq ft	2191 sq ft	16.3%
Structure Code	Detached	Semi-Det.	-14.9%
Age	105 years	166 years	-10.6%
Site Influences		Abuts Com. & Traffic	-4.5%
Quality	6.0	5.5	-3.6%
Renovations	Yes	No	-2.7%
Location			-2.2%
Lotsize	0.04 acres	0.06 acres	1.5%
Bathrooms	1.0	1.5	1.4%
Property Code	Detached	Semi-Det.	-1.2%
Other			-1.2%
Value	$469,000	$367,000	

Classification: Public



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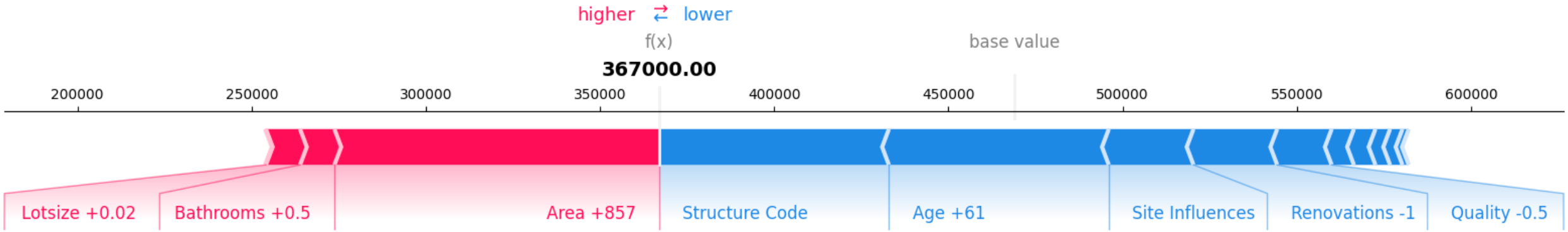

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