DESIGNING FOR WELLBEING

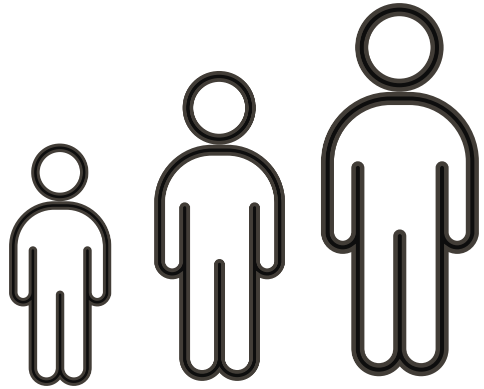
Machine-Learning Assessment Tool for Evaluating Indoor Wayfinding Quality of Dementia Care Spaces

Feras Alsaggaf
MSc Architecture, Urbanism, and Building Sciences
Building Technology Graduation Studio 2023-2024
TU Delft

P5 Presentation
4 July 2024

Problem Statement

2020 2030 2050



55m 78m 139m

35,000 beds
2020 – 2030
in the Netherlands

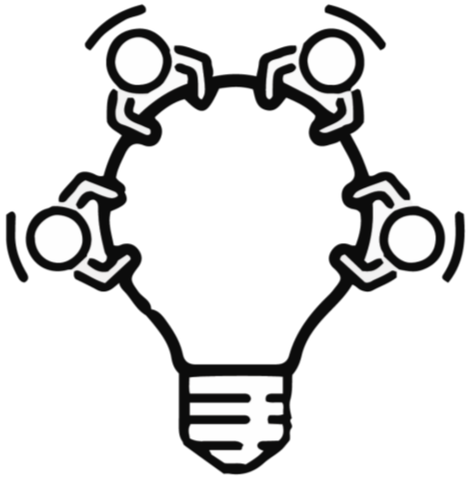
DEMENTIA ON THE RISE

Every 3 seconds, someone in the world develops dementia.

SHORTGAGE IN CARE

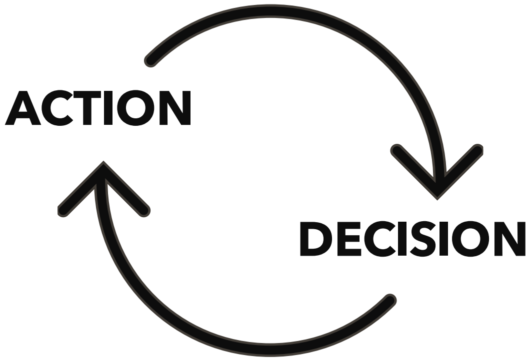
Equivalent to building 1450 nursing homes.

Problem Statement



KNOWLEDGE BARRIER

Requires extensive experience or research



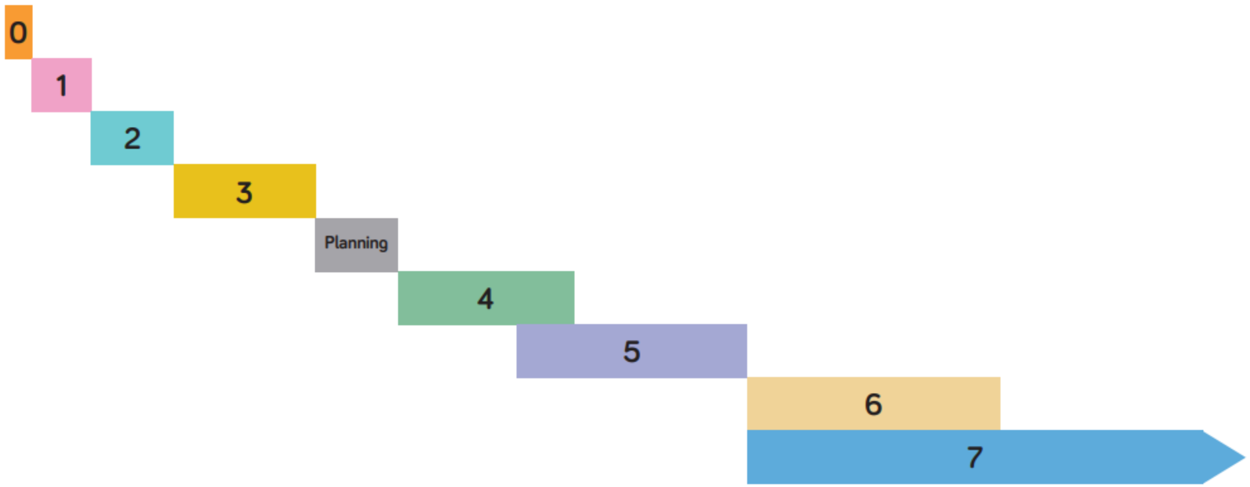
LONG FEEDBACK LOOP

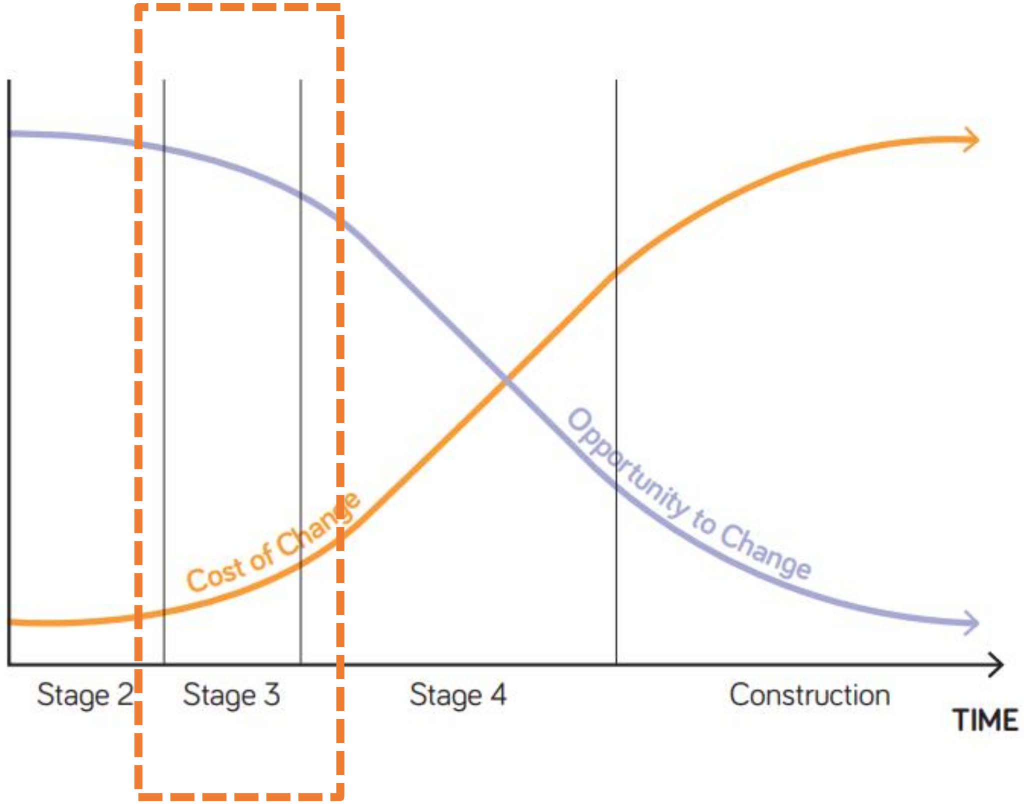
Hiring external consultants to evaluate the full design options

TIME-CONSUMING

Assessments are done by experts and takes time to complete a thorough analysis

Cost of Design Changes

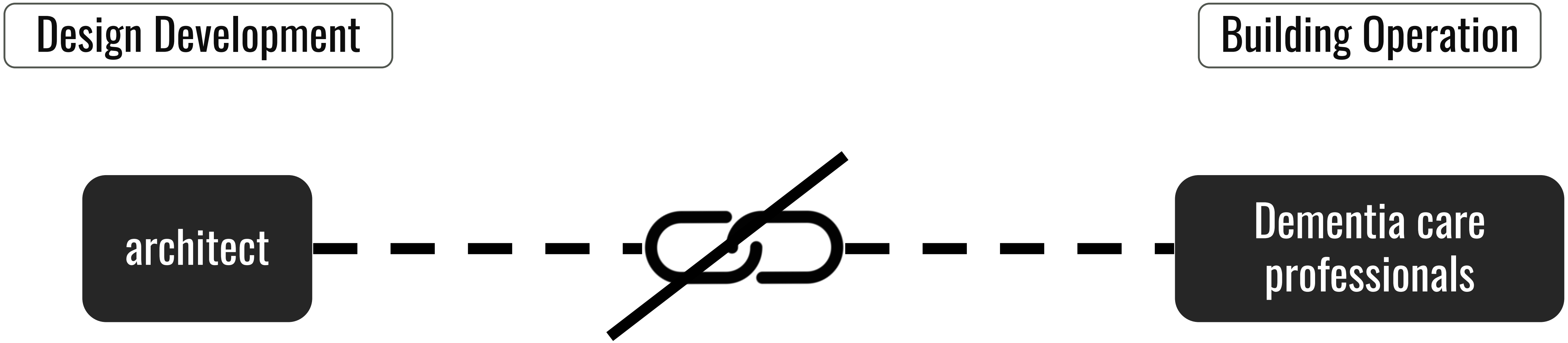




The **Architectural Concept** should be concluded and signed off at Stage 2, along with the **Project Brief**. The project should not proceed to Stage 3 if any **Spatial Requirements** or room adjacencies remain inconclusive. During Stage 3, **Change Control Procedures** should

Source: RIBA Plan of Works 2020

Problem Statement



Existing facilities.

Outcome:
Micro-interventions

Problem Statement

Project Development

Early Stages of Design

Design Validation

Developed Design

Outcome:
Design changes
Longer timelines
Added cost

Problem Statement

Project Development

Early Stages of Design

Design Validation

architect

SLOW FEEDBACK LOOP

Dementia care professionals

Dementia care expert with design background

?

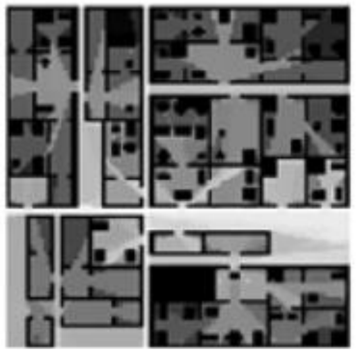
Developed Design

Outcome:
Design changes
Longer timelines
Added cost

How can AI support the design of dementia-friendly architecture in the early stages?

Deep Learning Models for Spatial and Visual Connectivity

MODEL



INPUT:
Floor plan

OUTPUT:
Visual Connectivity Map

Source: Spatial and Visual Connectivity Surrogate Model (Tarabishy et al. 2020)

Problem Statement

Project Development

Early Stages of Design

Design Validation

architect

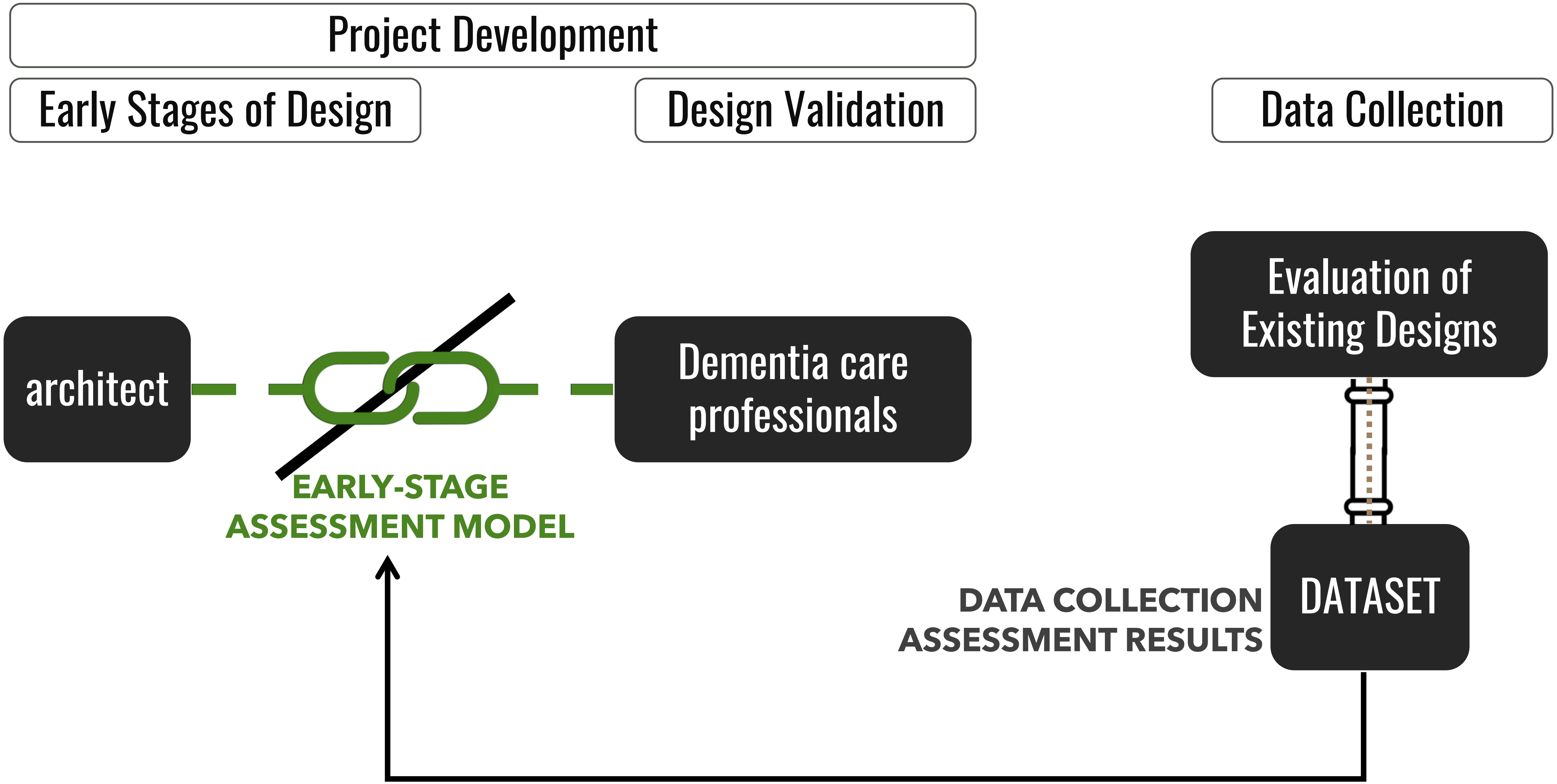
Dementia care professionals

SLOW FEEDBACK LOOP

Developed Design

Outcome:
Design changes
Longer timelines
Added cost

Problem Statement



Objective

A Predictive Model Trained on Dementia Care Design Principles

Building layout → model → Prediction

OCCUPANT WELLBEING (early stage) → DATA COLLECTION (assessment) → ASSEMBLING DATASET (ML) → FEATURE SELECTION → EVALUATE AND TEST MODEL

Research Questions

DEFINE	MEASURE	BUILD	EVALUATE
How does indoor environment promote wellbeing for people living with dementia?	How can a digital tool be used to measure ease of wayfinding based on dementia design principles?	What are the prerequisite data needed to build a machine learning model that predicts wayfinding quality from floor plan information?	To what extent can a model predict wayfinding quality?

What is Dementia?

Dementia is the loss of cognitive functioning – thinking, remembering, and reasoning – to such an extent that it interferes with a person's daily life and activities.

- Experiencing memory loss, poor judgment, and confusion
- Wandering and losing their way in a familiar environment

-National Institute of Aging

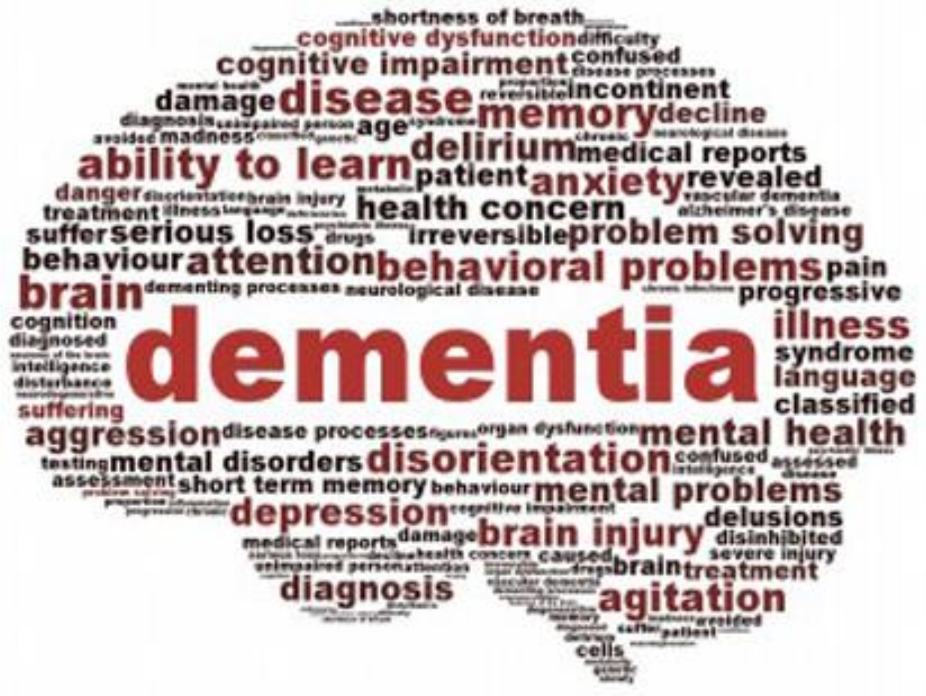
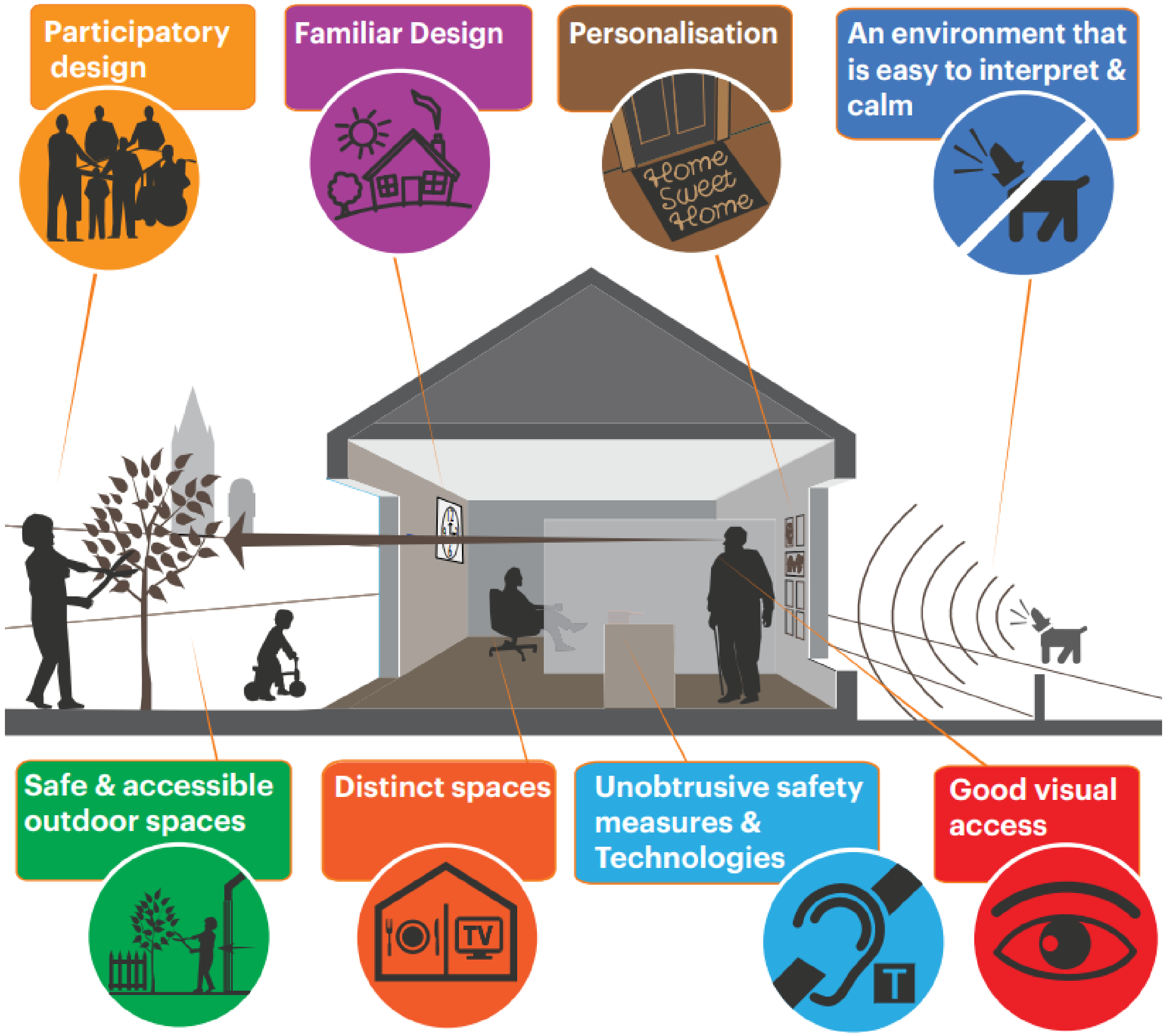


Image: @2015 - Rob Hobson. https://robhobson.co.uk/

Universal Design Guidelines

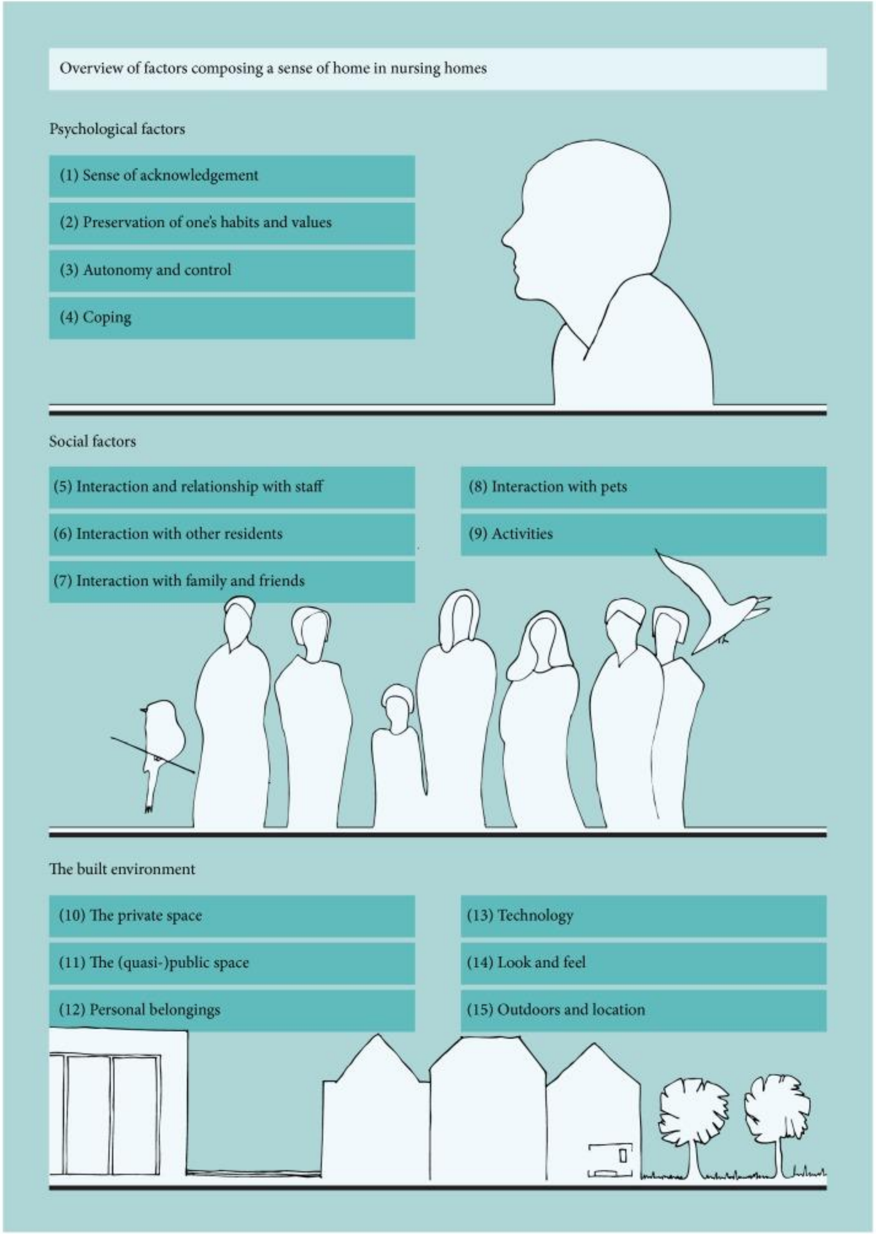
- Prolonging the person's ability to live independently in their own homes



Source: Universal Design Guidelines for Dementia-Friendly Dwellings

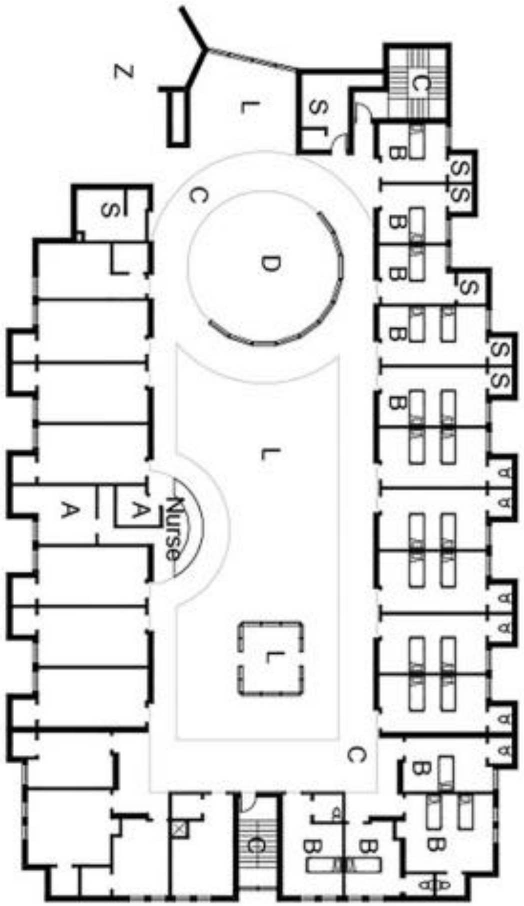
Factors Influencing Sense of Home

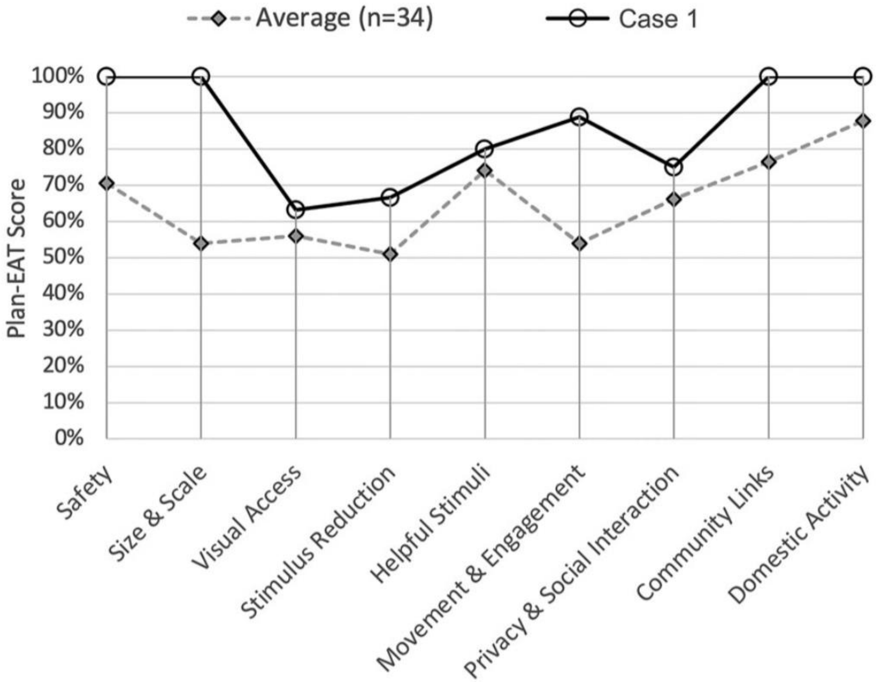
- Psychological factors:
  - Autonomy and control
  - Sense of acknowledgement
  - Preservations of one's habits and values
- Social Factors
  - Engaging in meaningful activities
  - Interaction with other residents
- Built Environment
  - Shared spaces conducive for social interaction



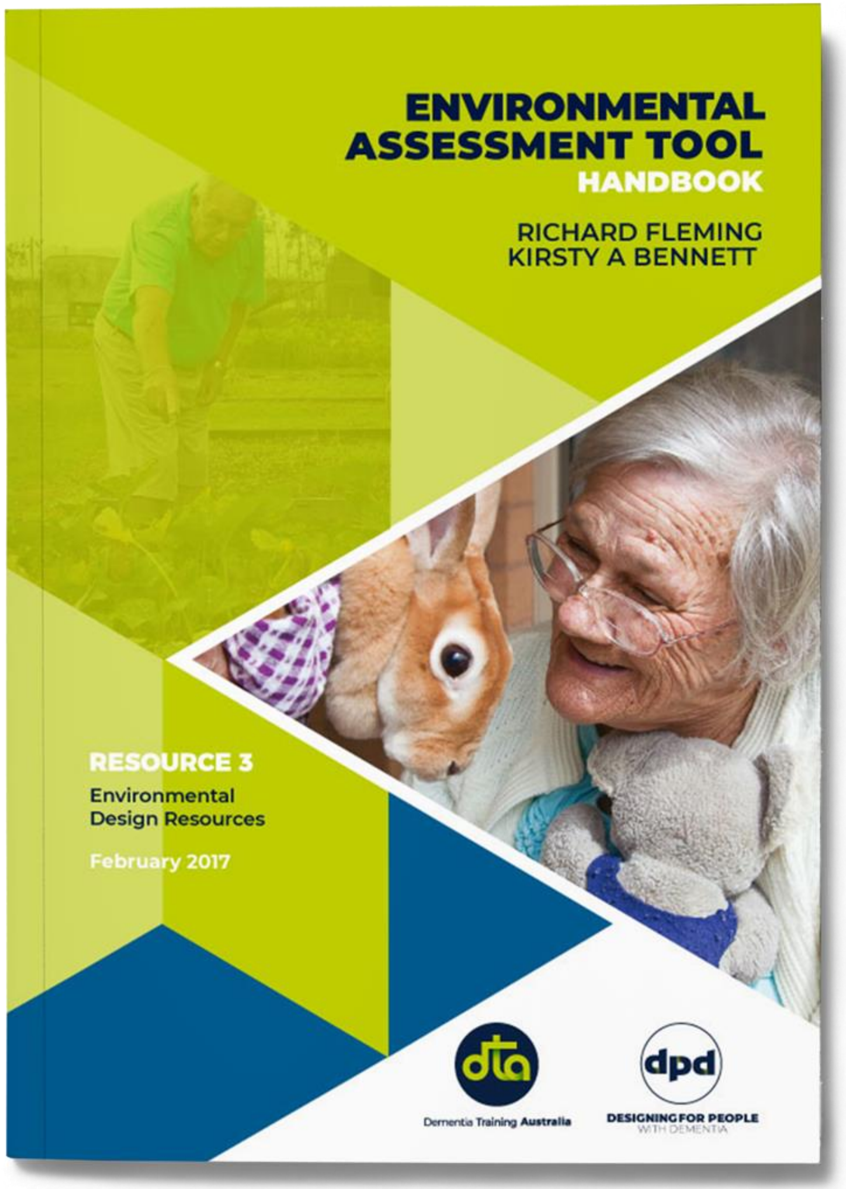
Factors influencing the sense of home. Source: Rijnaard et al. 2016

Environmental Assessment Tool



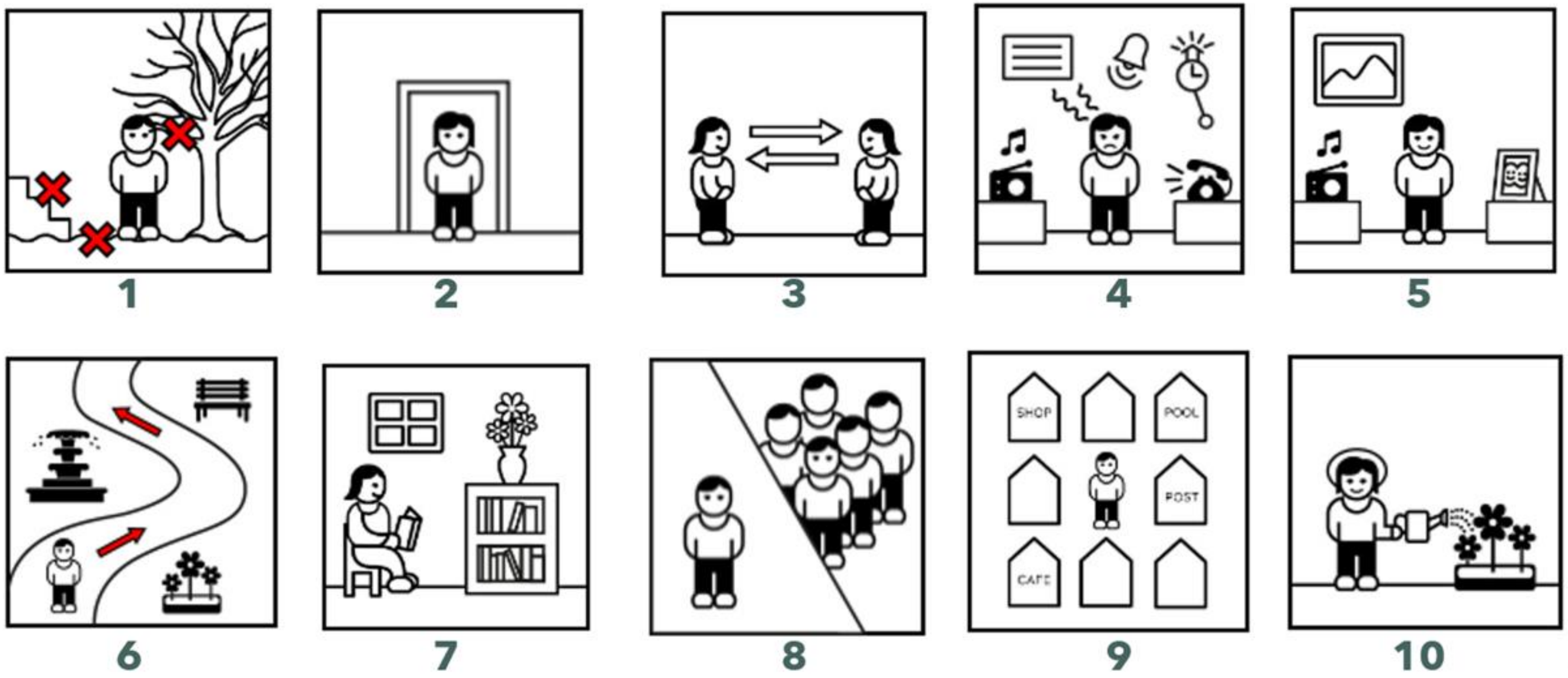


Source: Quirke et al., 2023



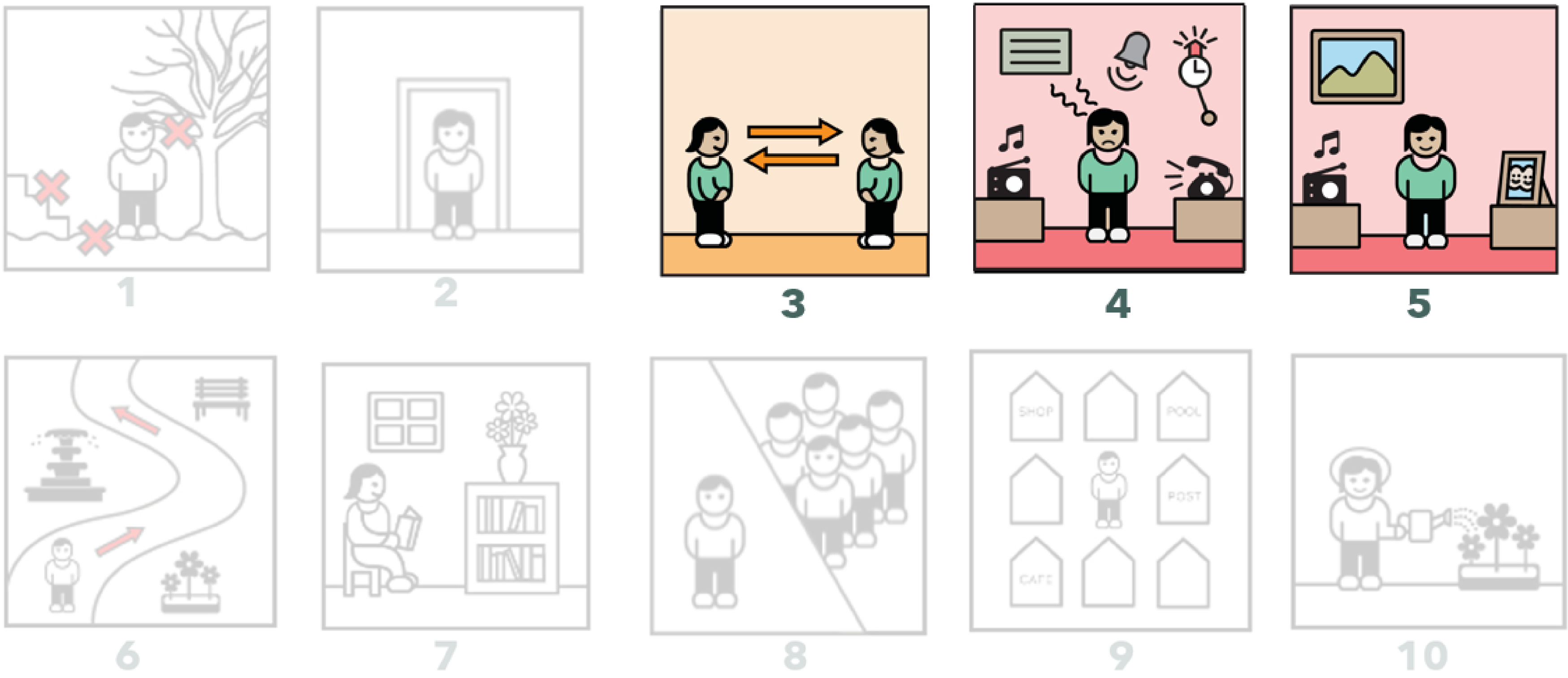
Source: Fleming & Bennett, 2017

10 Key Design Principles and How to Assess Them



1. Unobtrusively reduce risks
2. Provide a human scale
3. Allow people to see and be seen
4. Reduce unhelpful stimulation
5. Optimise helpful stimulation
6. Support movement and engagement
7. Create a familiar space
8. Provide opportunities to be alone or with others
9. Provide links to the community
10. Respond to a vision for way of life.

10 Key Design Principles and How to Assess Them



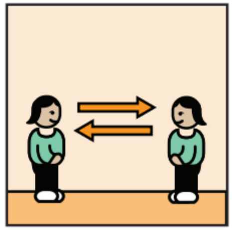
1. Unobtrusively reduce risks
2. Provide a human scale
3. **Allow people to see and be seen**
4. **Reduce unhelpful stimulation**
5. **Optimize helpful stimulation**
6. Support movement and engagement
7. Create a familiar space
8. Provide opportunities to be alone or with others
9. Provide links to the community
10. Respond to a vision for way of life.

Environmental Assessment Tool

Improvements in:-

- **wayfinding**
- Eating behaviour
- Motor functions
- Activities of daily living
- Self-help skills
- Mobility
- Pleasure
- Use of toilet
- Vitality
- Interaction between staff and residents/patients
- Independence in dressing
- Ease of supervision
- Likelihood of residents/patients making friends with one another
- Quality of life

3. ALLOW PEOPLE TO SEE AND BE SEEN



To give them the **choice** where they want to go based on what they see. It can also give individual **confidence** to explore their environment.

5. MANAGE LEVELS OF STIMULATION - OPTIMISE HELPFUL STIMULATION

Enabling the person with dementia to see, **hear** and **smell** things that give them **cues** about where they are and what they can do… minimizing their confusion and uncertainty.

Source: Effects of well-designed environments (Fleming & Bennett, 2017)

Source: Part 1: Key Design Principles (Fleming & Bennett, 2017)

Wayfinding Definition

- **Wayfinding** is the ability to know one's position while planning and following a route

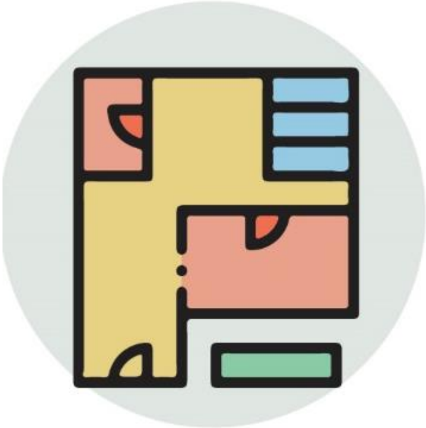
- **Visual Access** is the ability to see your surroundings. It is associated with improved wayfinding for people living with dementia.

Image: New York Times

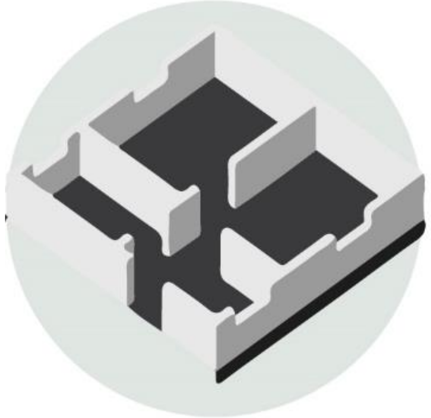
Why Wayfinding?

Critical Decisions Made by the Designer During Early Stages

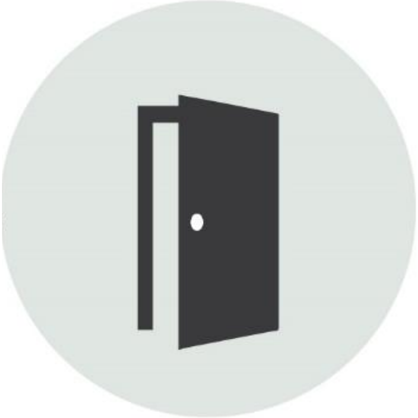
DECISION



ZONES



WALLS



DOORS

FURNITURE AND FIXTURES

EFFECT

- Indoor navigation
- Sense of community
- Environmental stimuli
- Accessibility

Early-Stage Design Criteria

AUTONOMY

CONNECTION

STIMULATION

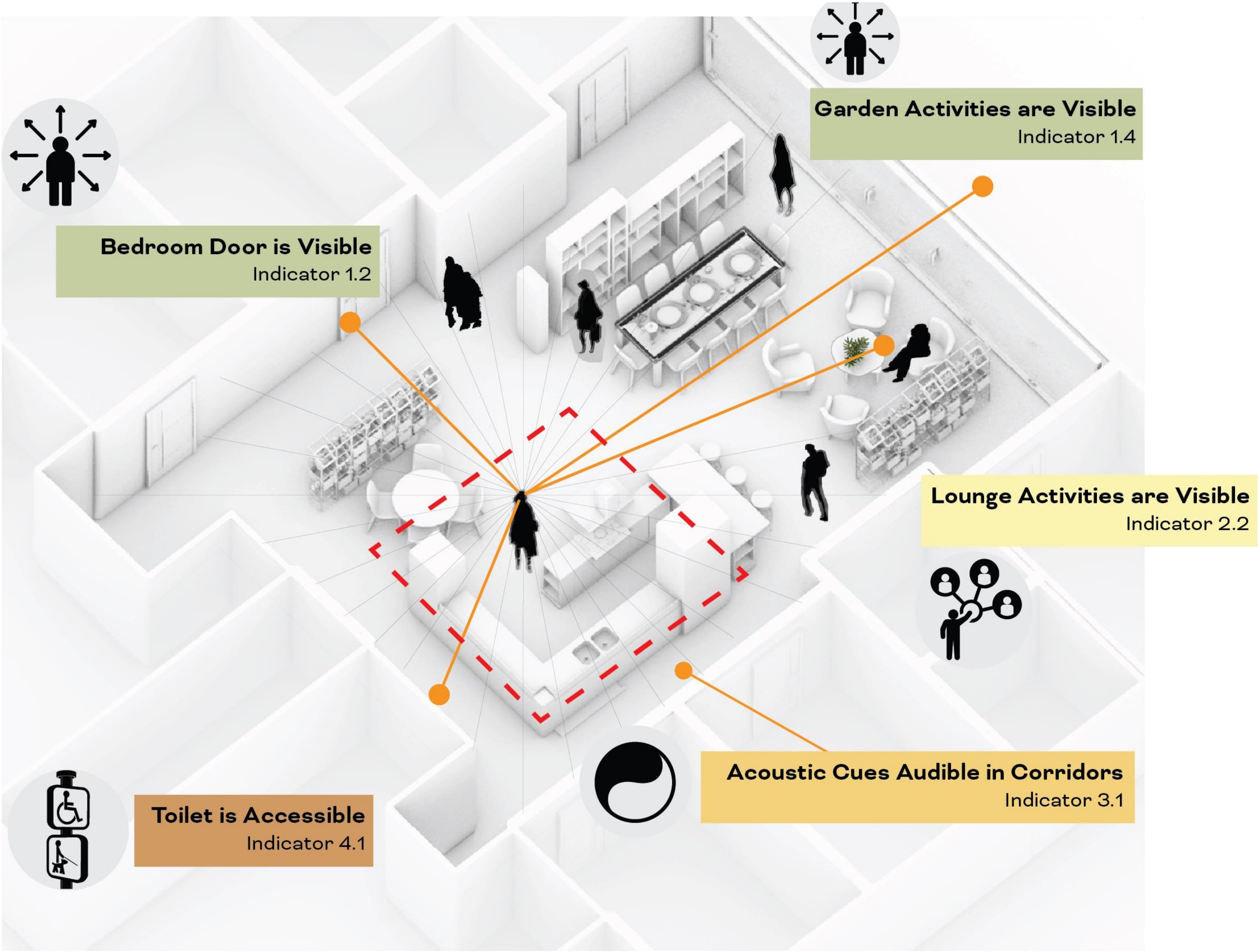
ACCESSIBILITY

Early-Stage Design Criteria

Visually-Connected Kitchen gives autonomy to individuals

Visually-Connected Kitchen provides sense of community

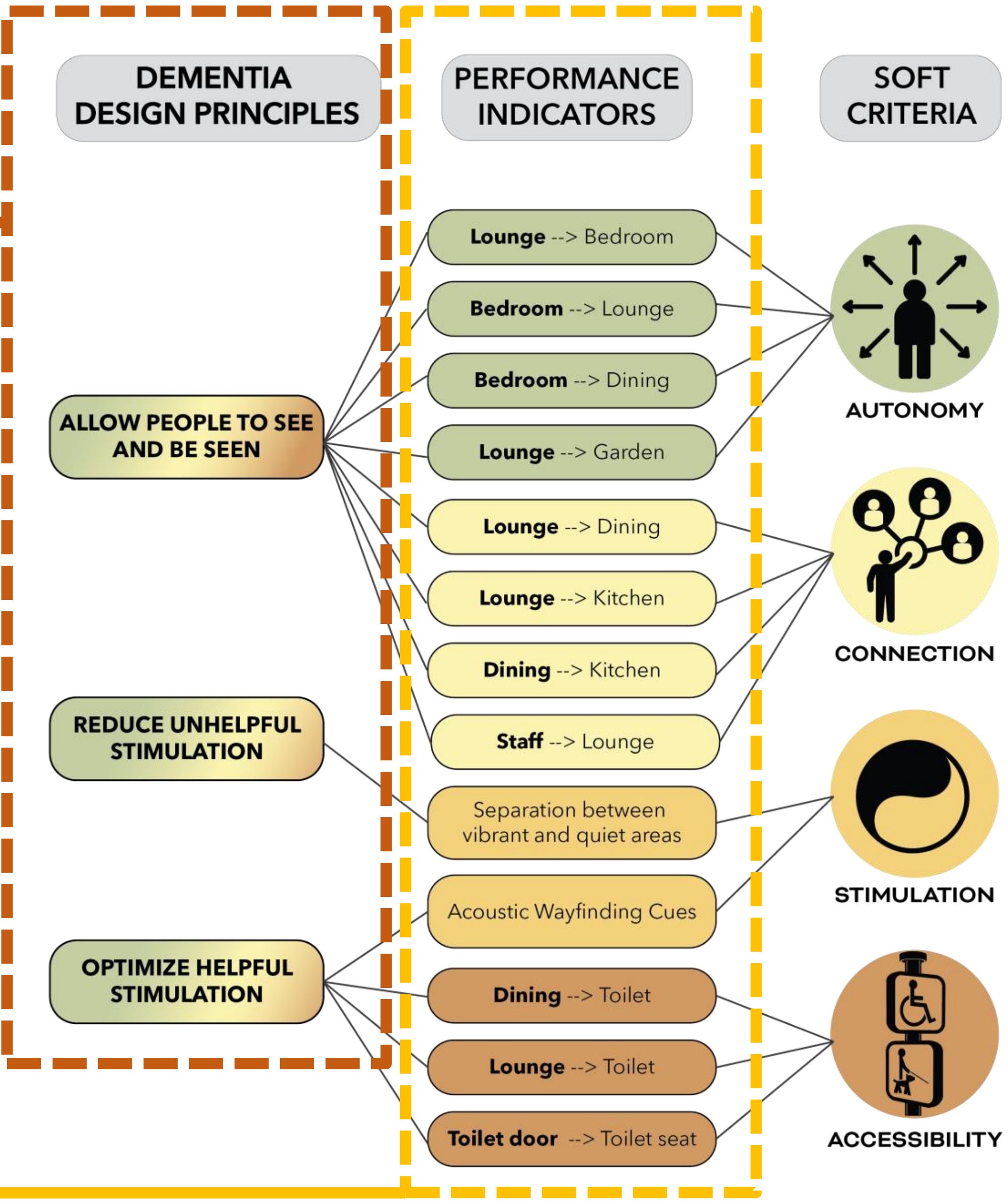
Audio stimulation is high. Acoustic wayfinding cues are discenerable



Early-Stage Design Criteria

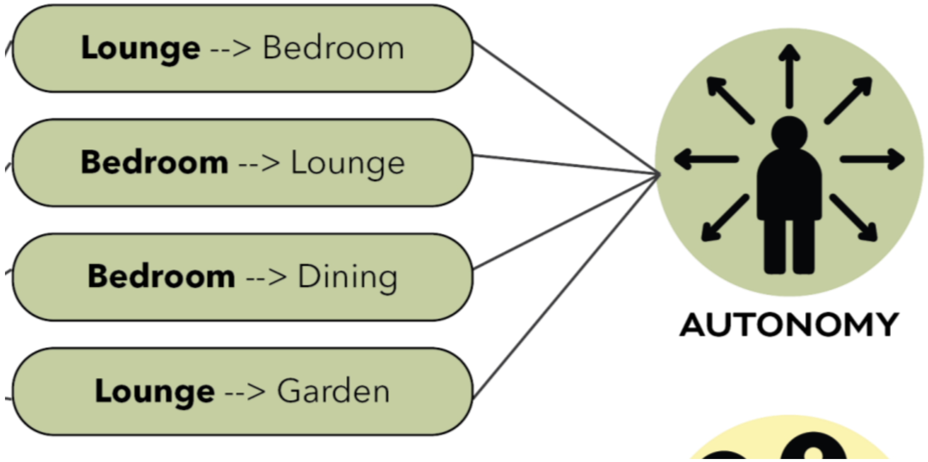
KEY DESIGN PRINCIPLE

GUIDED BY 'EAT' CHECKLIST ITEM



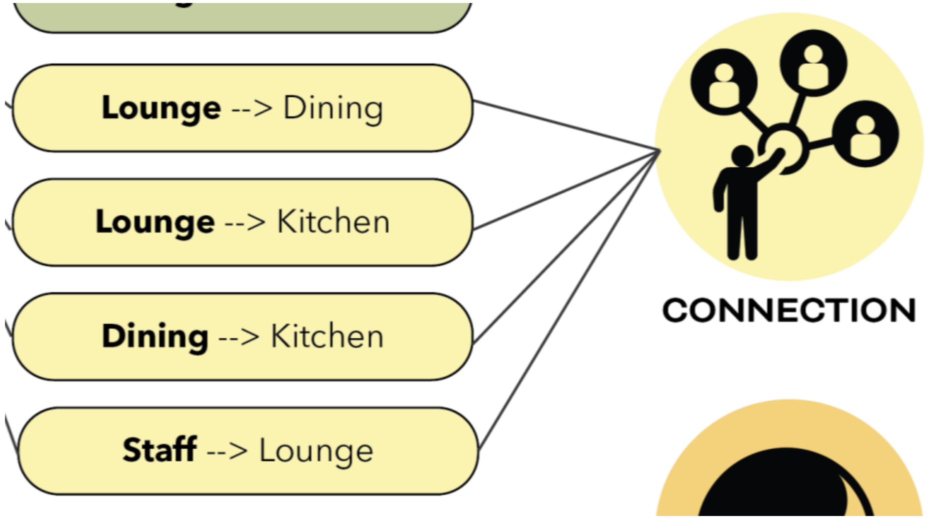
Personal Autonomy

- A spatial layout that gives the individual autonomy and control over their environment.



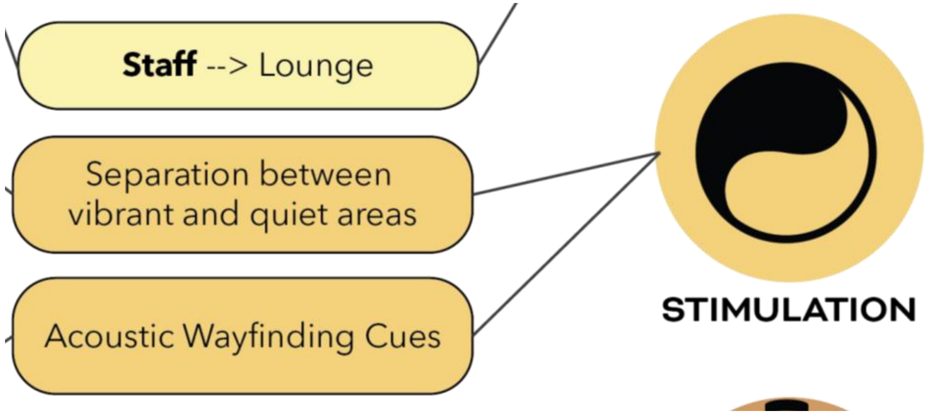
Sense of Connection

- Individual have easy access to other spaces and can see what other residents are doing in different parts of the building and also be seen by others.



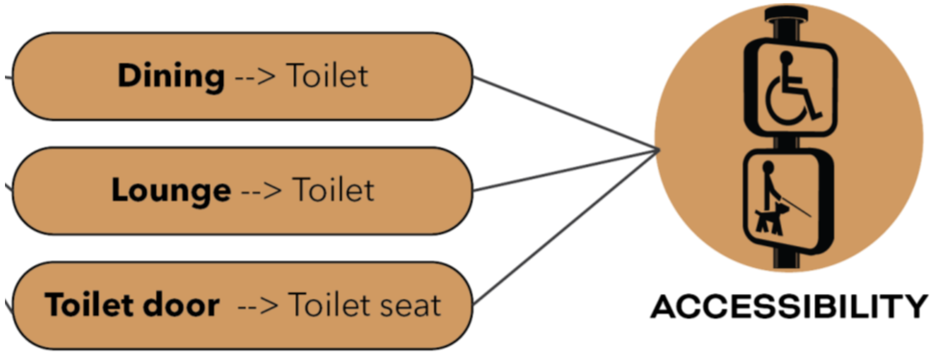
Balanced Stimulation

- Measuring how household stimuli can affect wayfinding abilities.

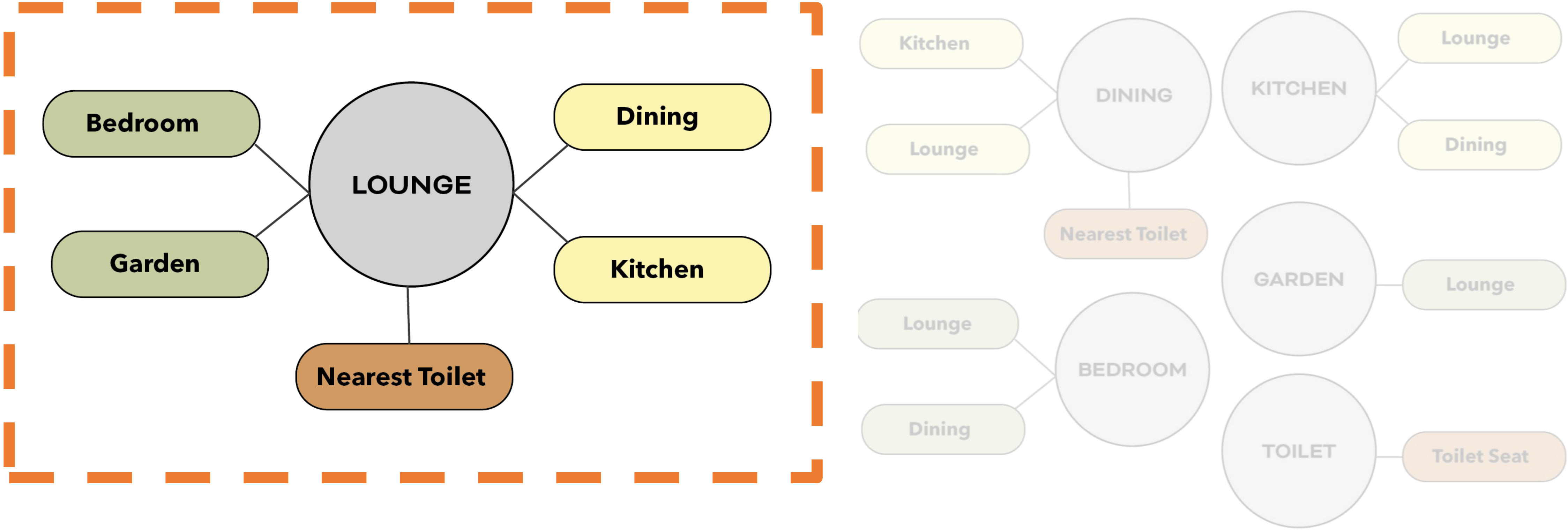


Accessibility

- Toilet rooms are in distinct places and within reach.

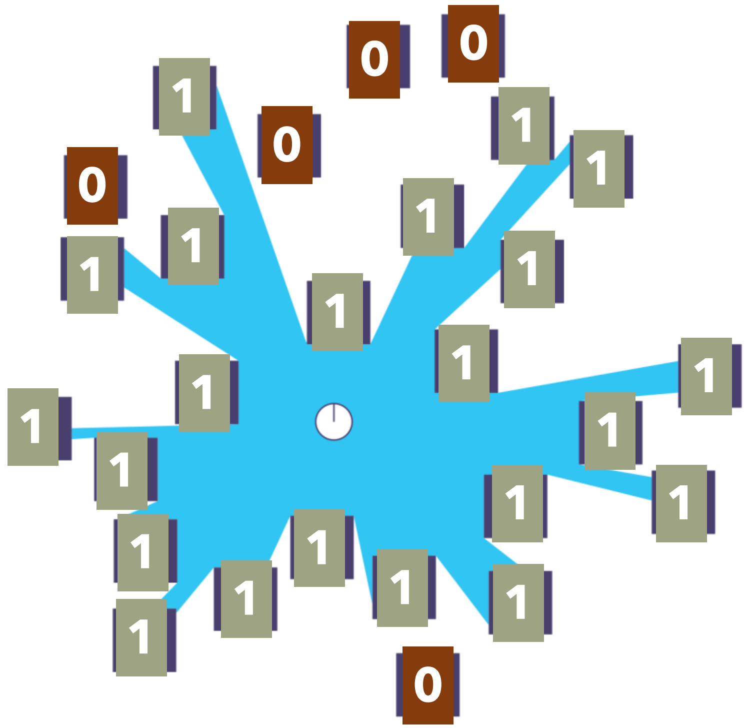


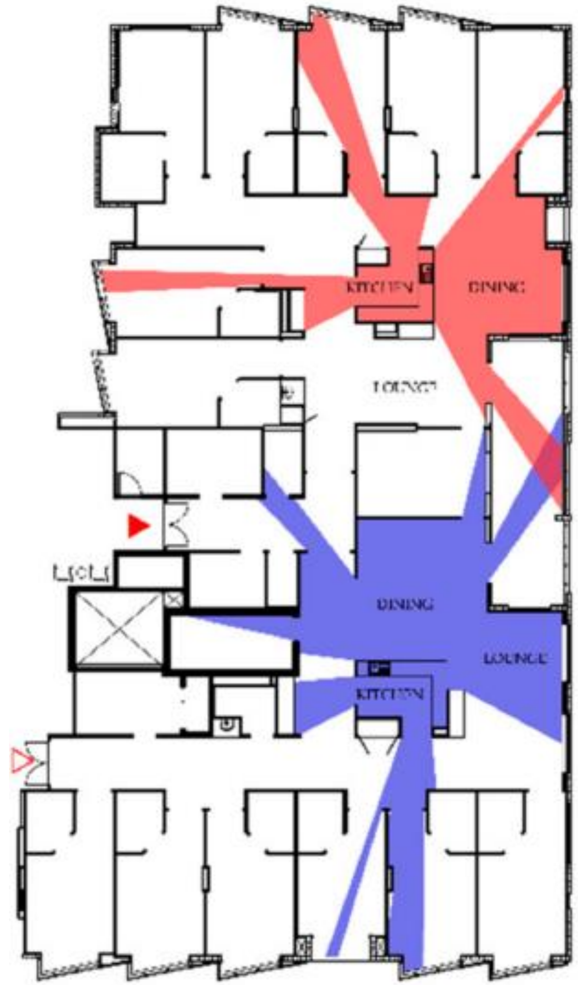
Data Collection Scope Boundary



Visual Access

Isovist Method

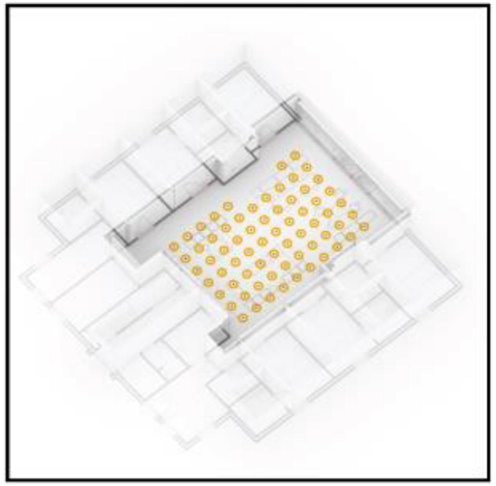




Source: Lessons Learned from Three Australian Dementia Support Facilities. Hing-wah et al. 2018

Visual Access

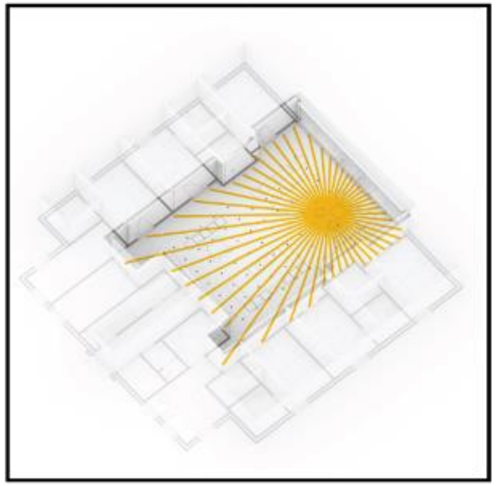
Isovist Grid Points



Is Lounge visible from Kitchen?

0% — INSUFFICIENT
33% — SUFFICIENT
>33% — PREFERRED

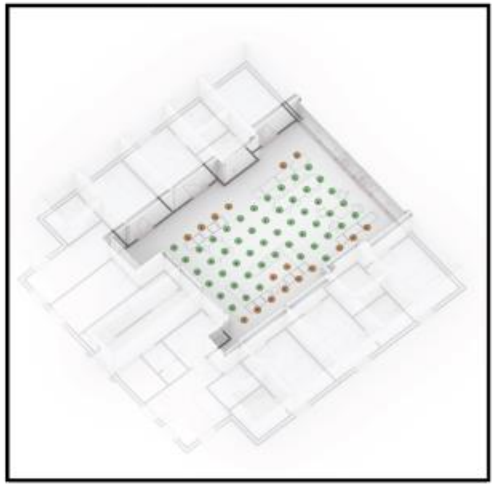
Ray Properties



Average Ray Length

5m — POOR
15m — GOOD
30m — POOR

Visibility Distribution



Avg. Distance of Points

1 m — GOOD
2 m — POOR

Assessment Score

0	1.5	2
INSUFFICIENT	SUFFICIENT	PREFERRED

Visual Access

Pt_1 = yes

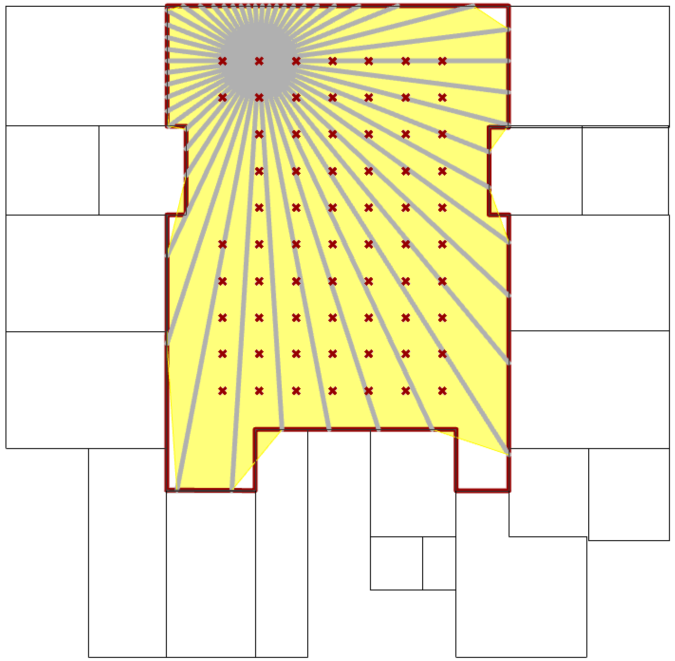
Pt_2 = no

…

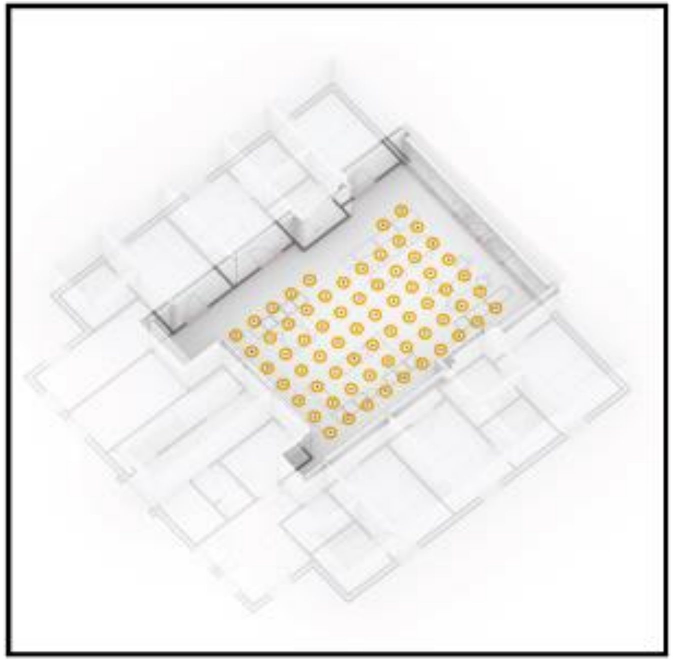
Pt_n = yes / no

Visual access score:

‘yes’ points / total points



Isovist Grid Points



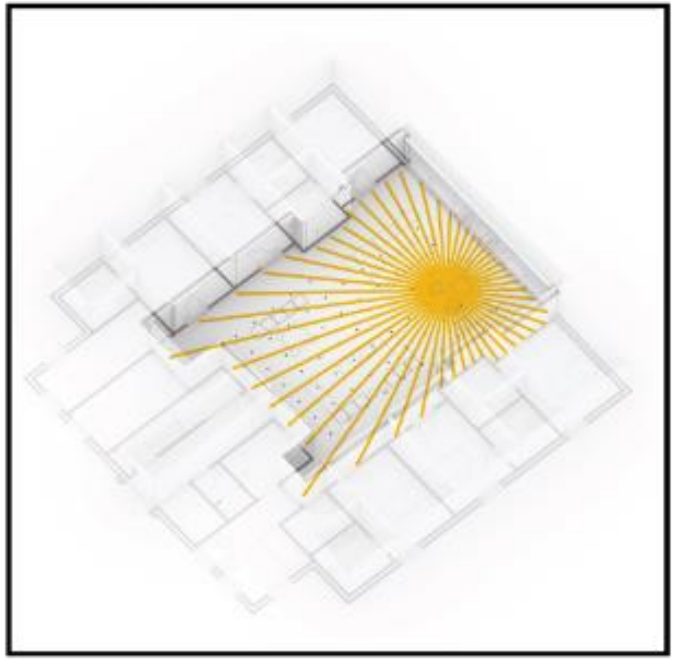
Lounge visible from Kitchen?

Visual Access

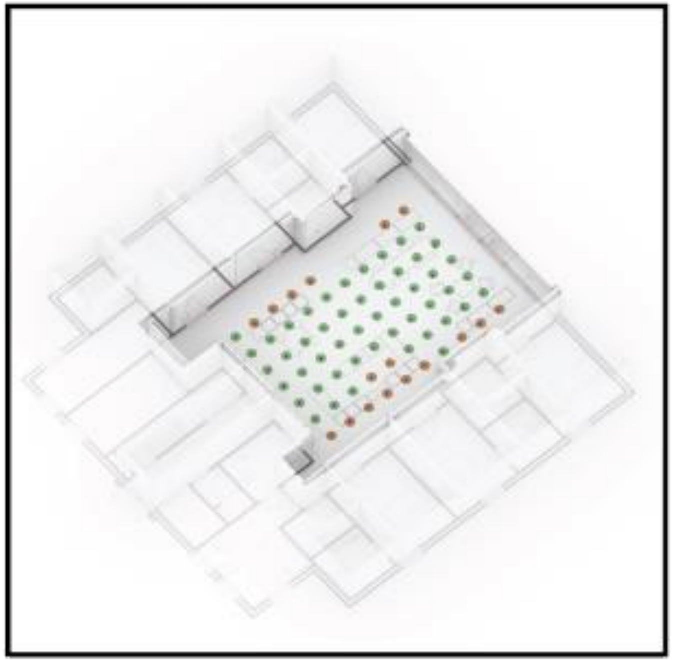
Are the sightlines too short or too long?

Is the visibility consistent in space?

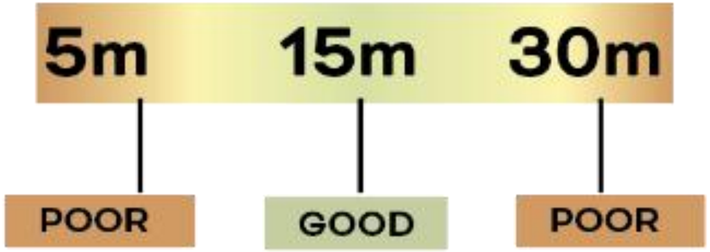
Ray Properties



Visibility Distribution

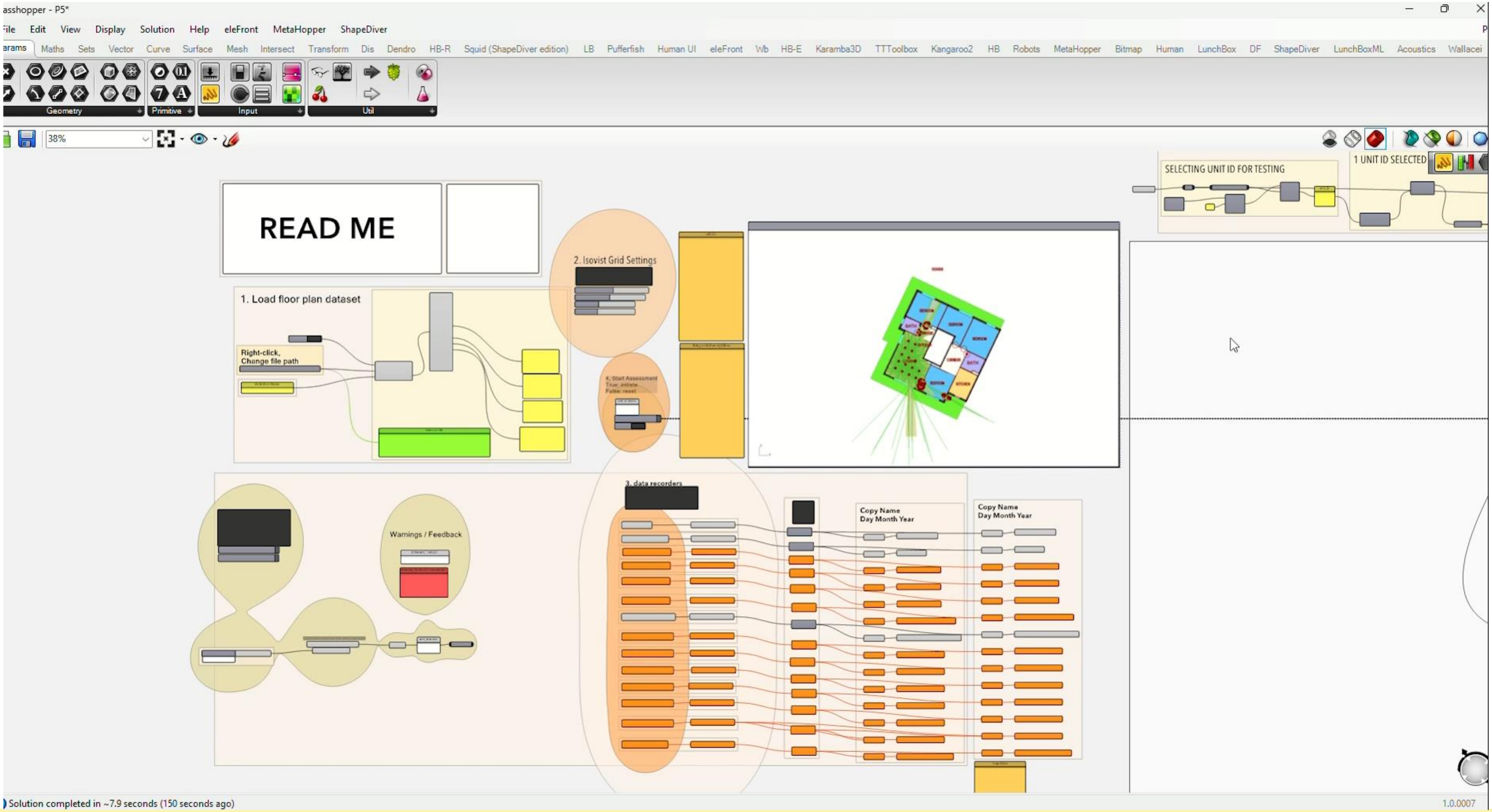


Average Ray Length

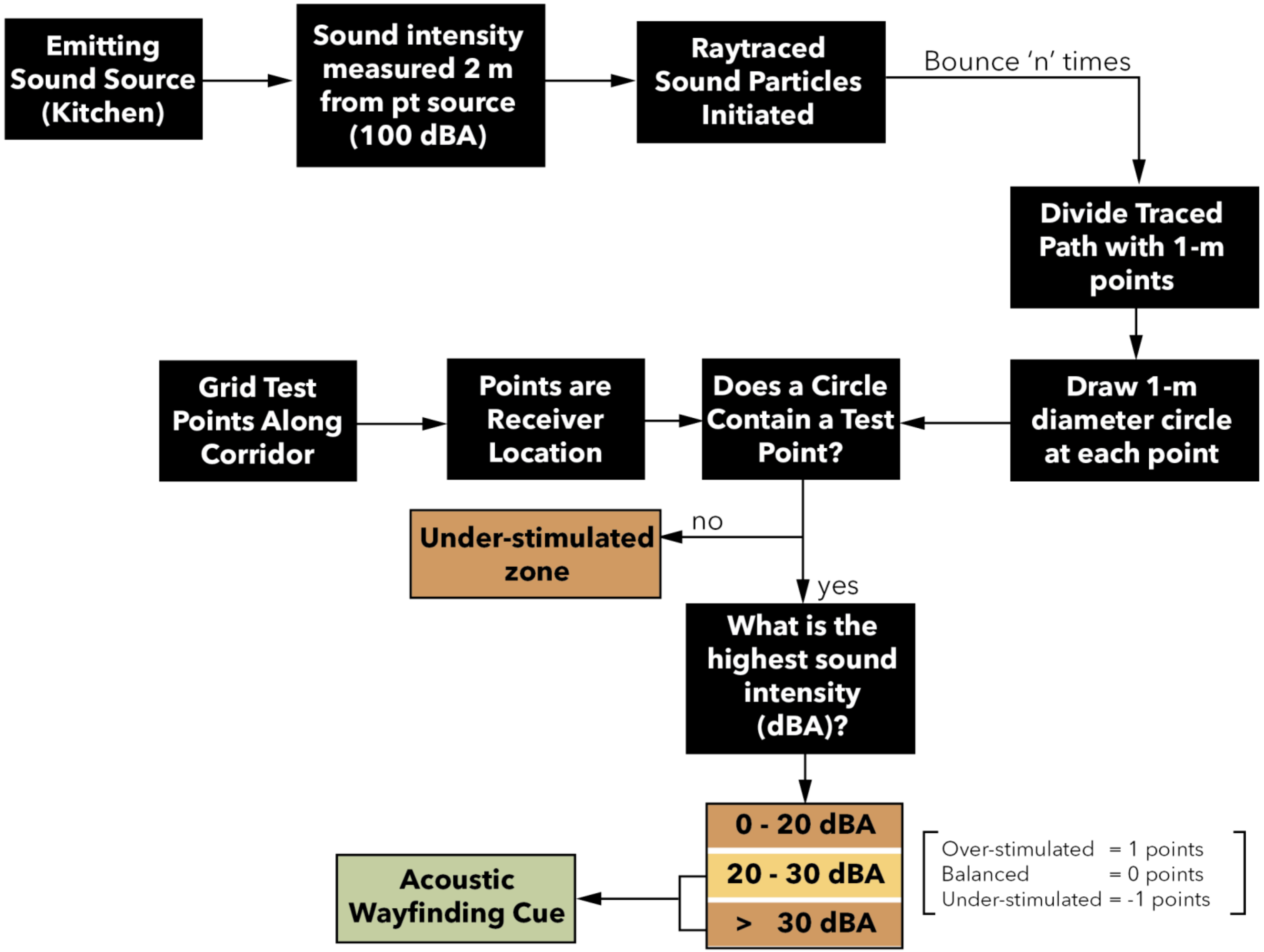


Avg. Distance of Points

Visual Access



Acoustic Wayfinding Cues



Limitation of Wayfinding Quality

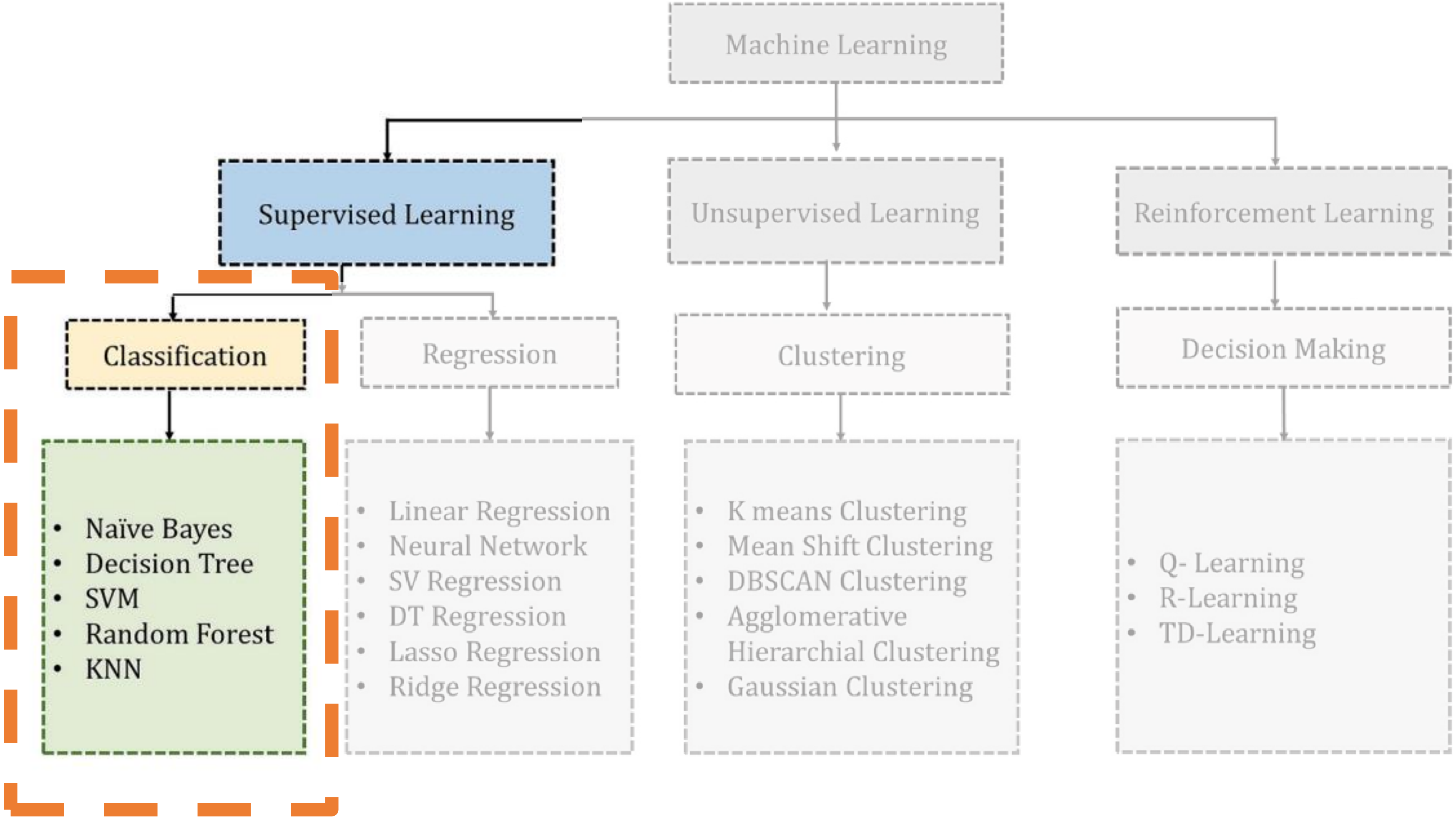
Data collected was for ML prototype

User Validation on Assessment Outcomes

Only Visual Access Indicators

2D Assessment Space

Machine Learning

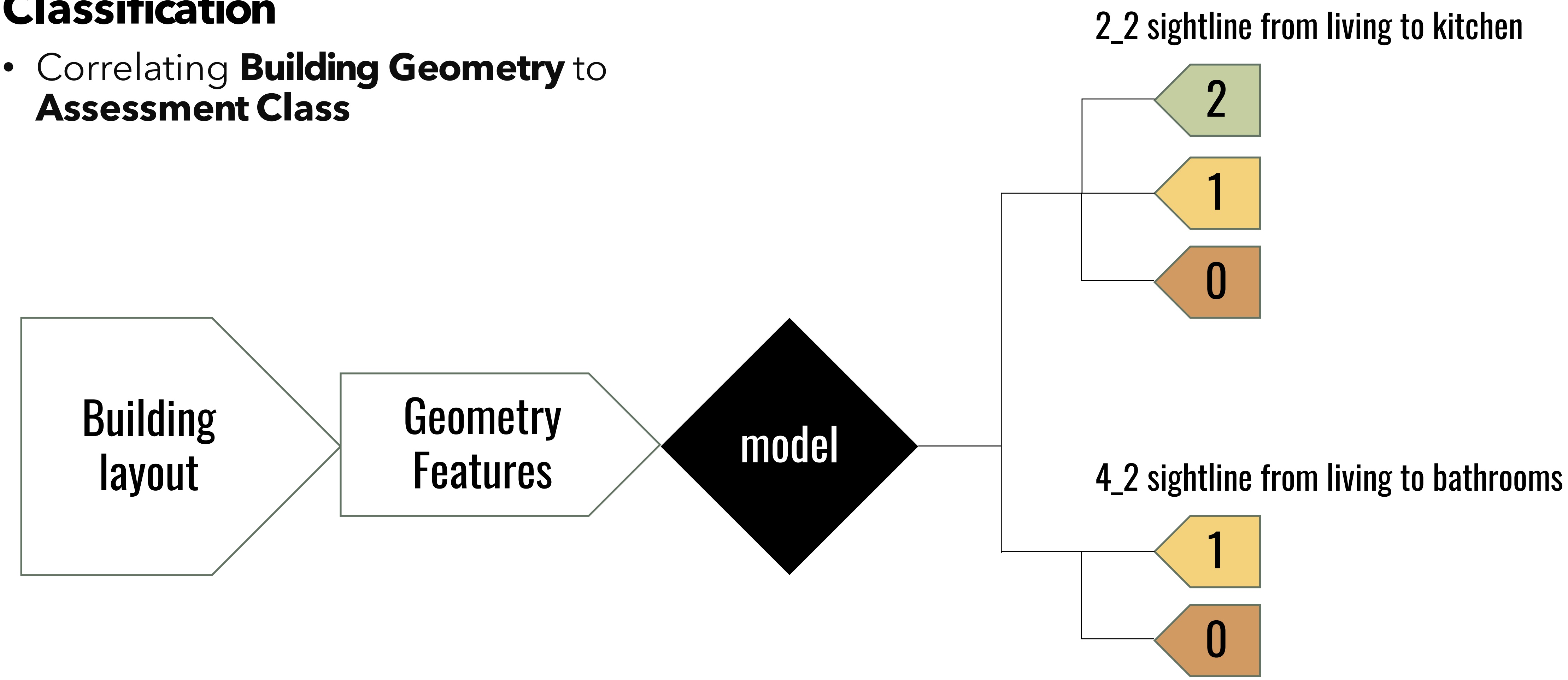


Source: most common machine learning algorithms (Ross et al. 2023).

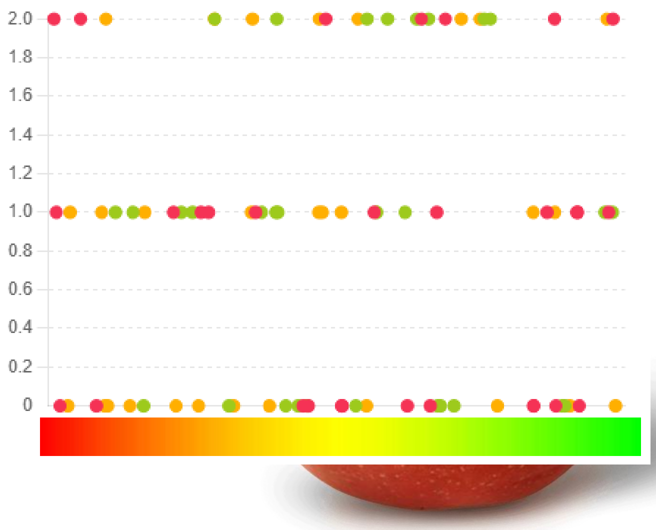
Multi-Output Classification

Multiclass

- Correlating **Building Geometry** to **Assessment Class**



Classify the Type of Apple



What type of fruit is this?

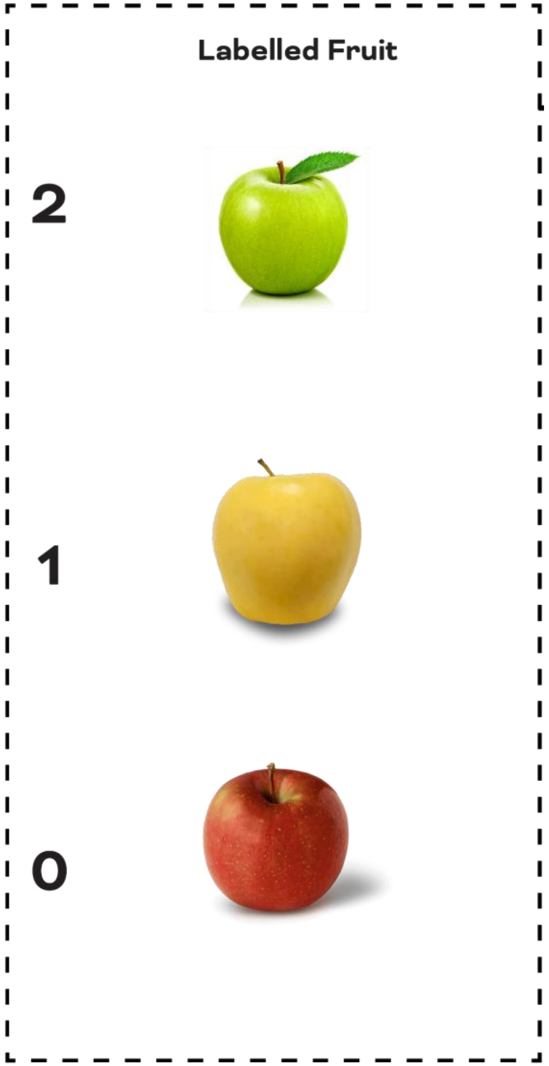
A: Fuji (red)

B: A golden delicious

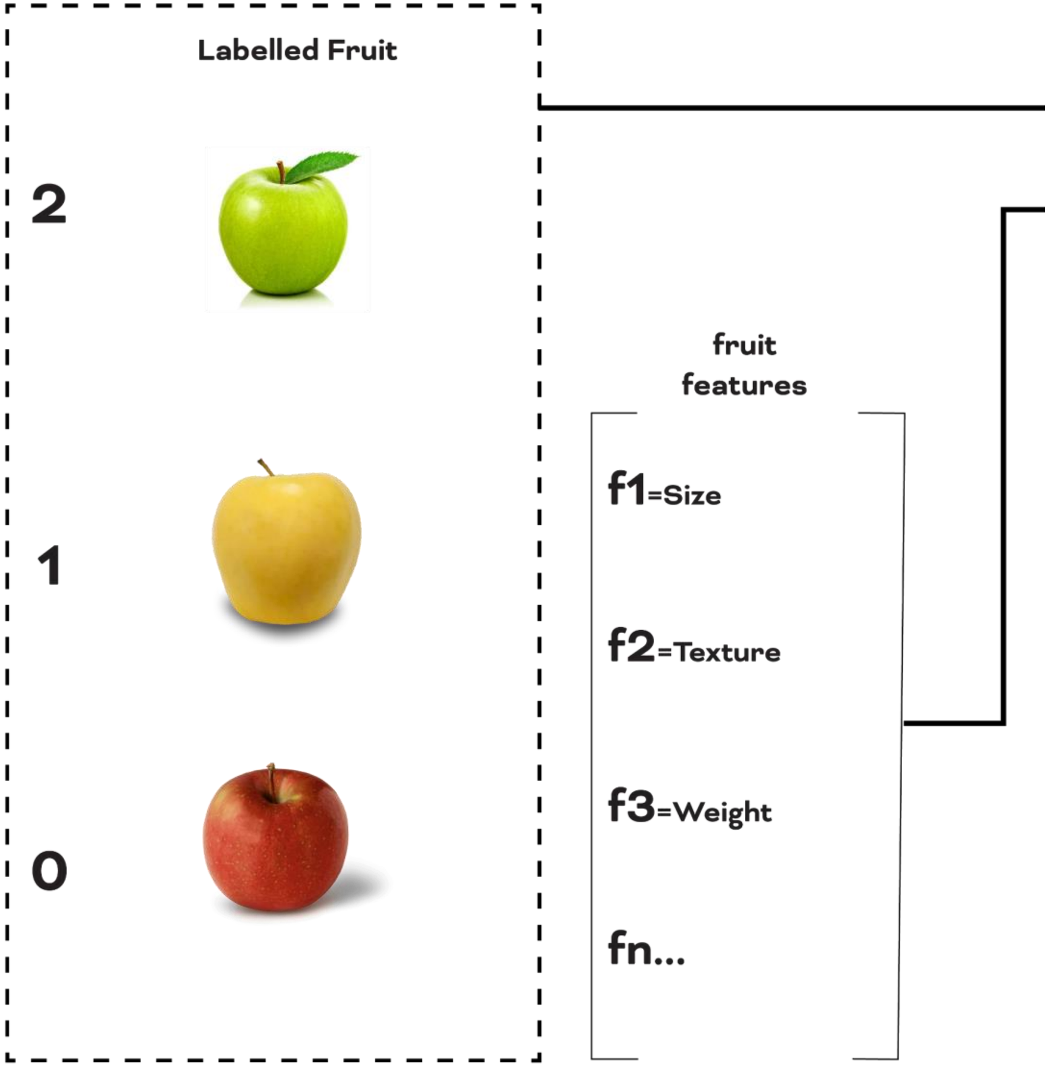
C: Granny smith (green)

D: An orange disguised as an apple

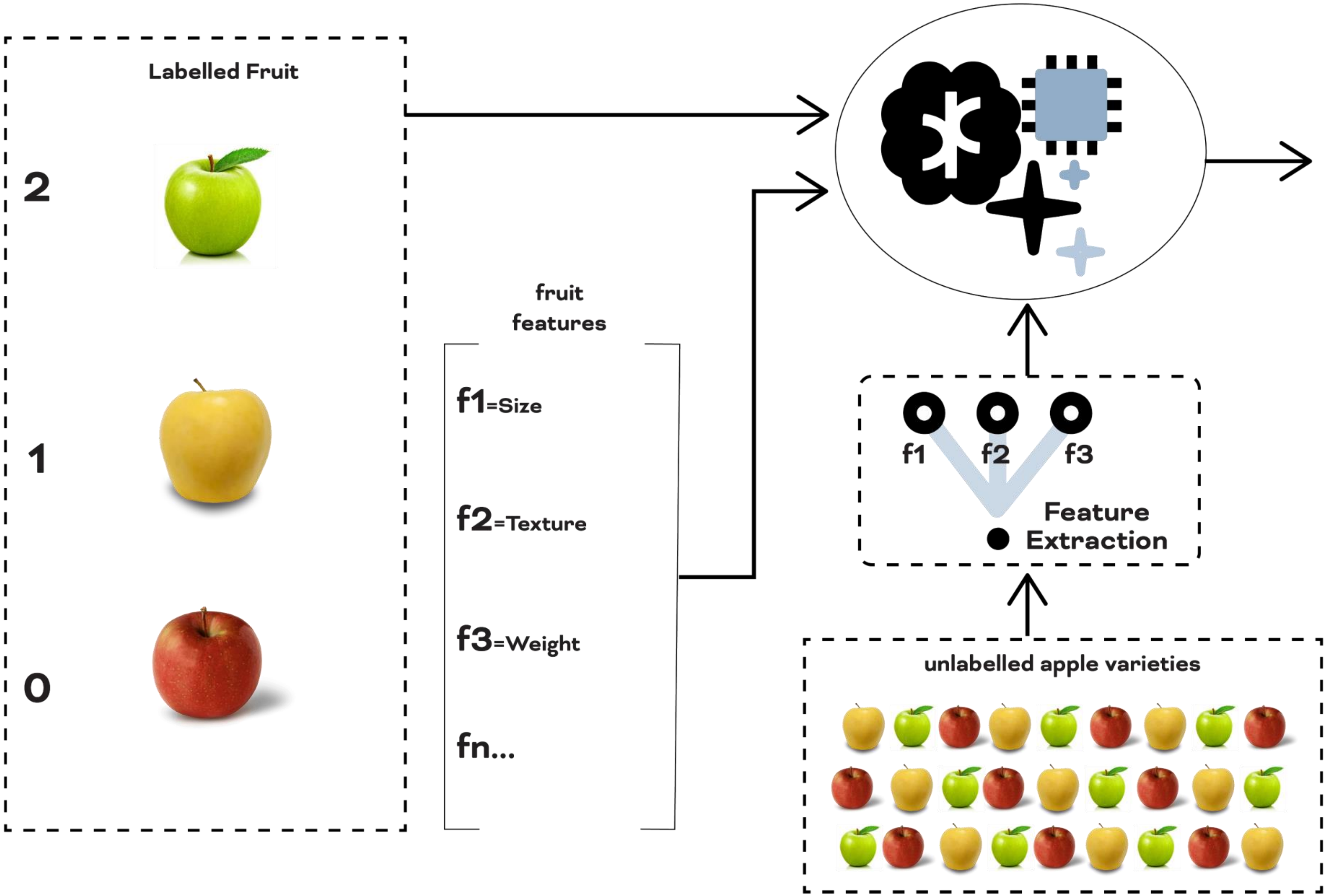
Multiclass Classification



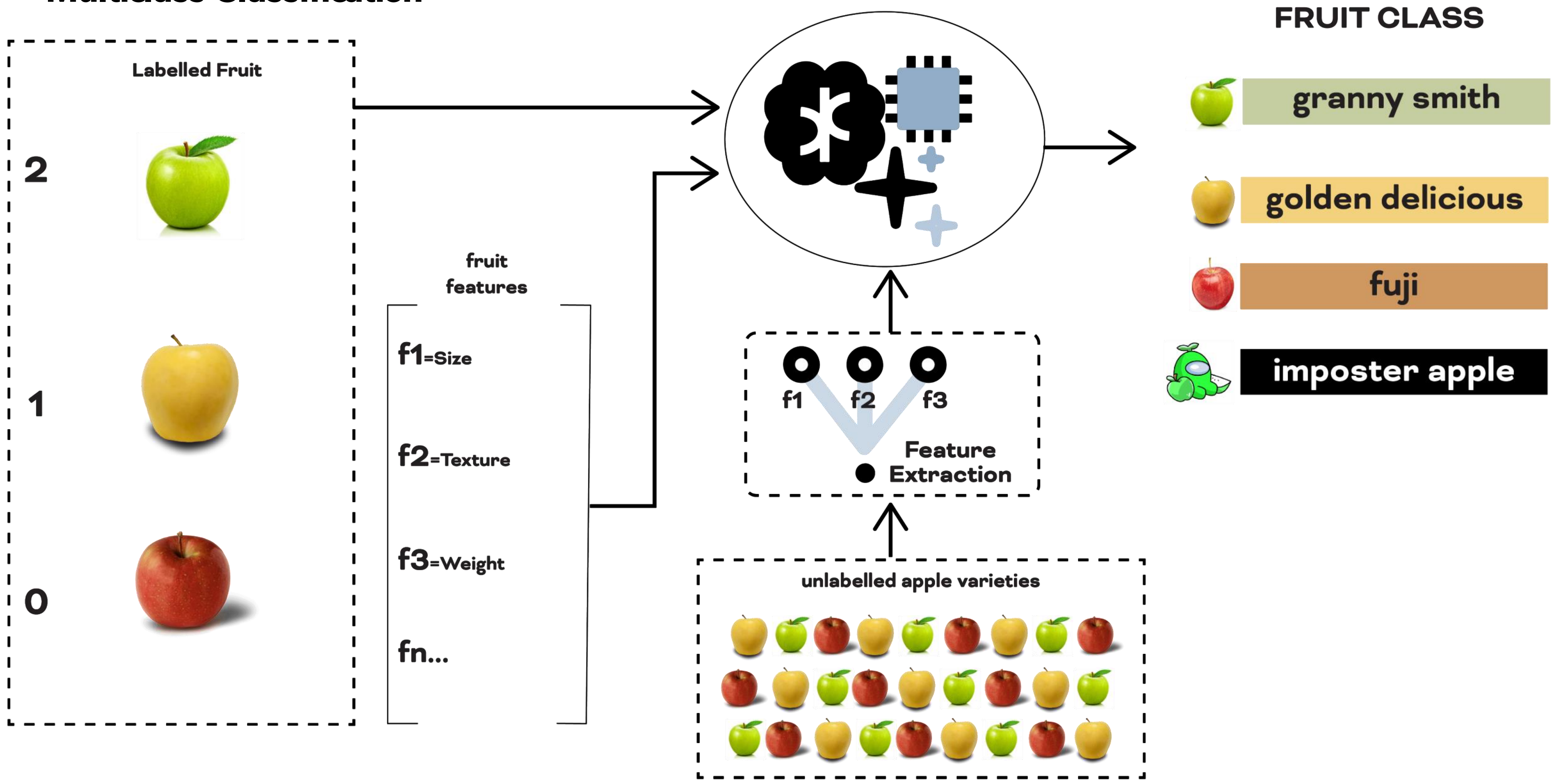
Multiclass Classification



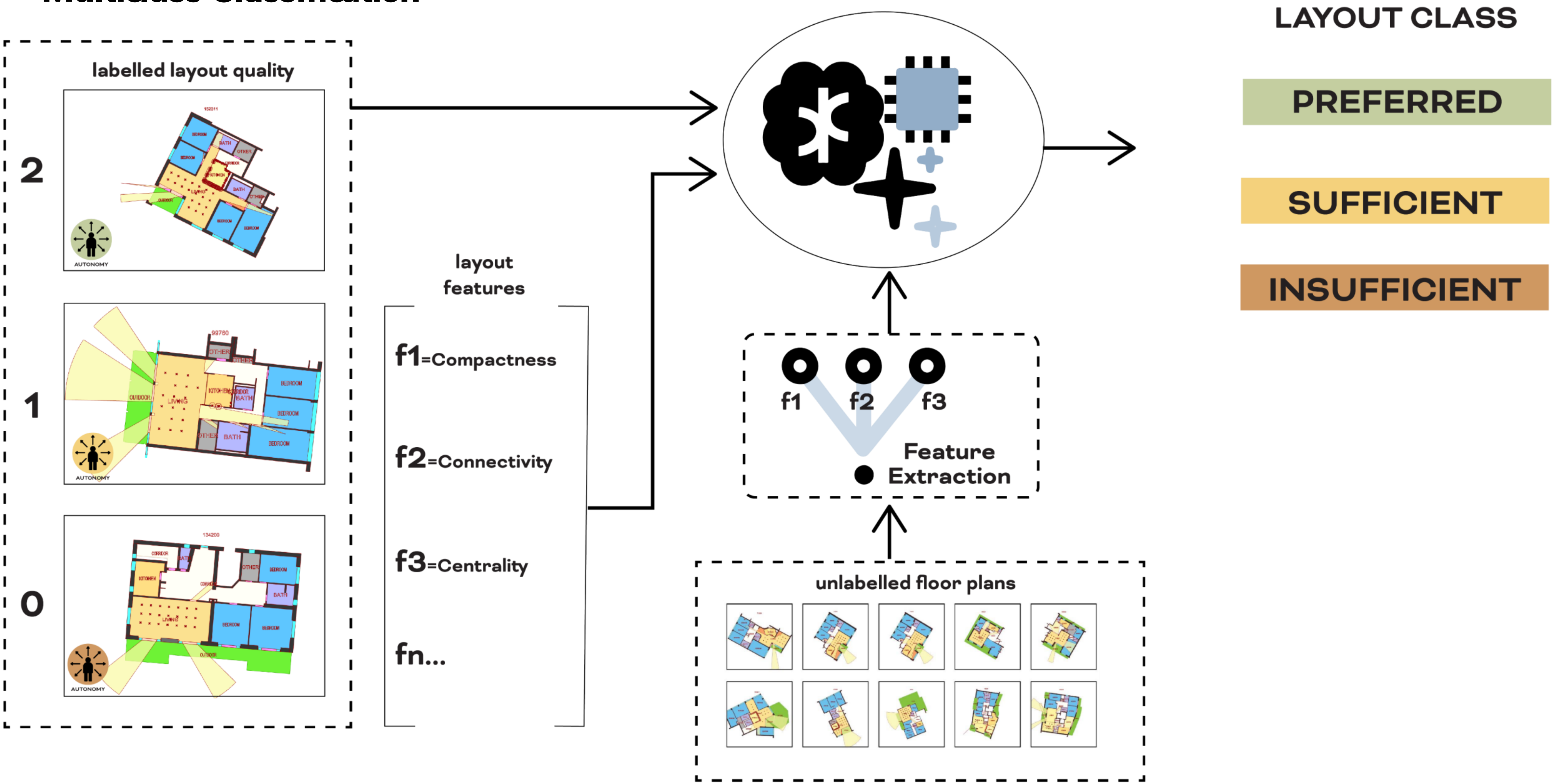
Multiclass Classification



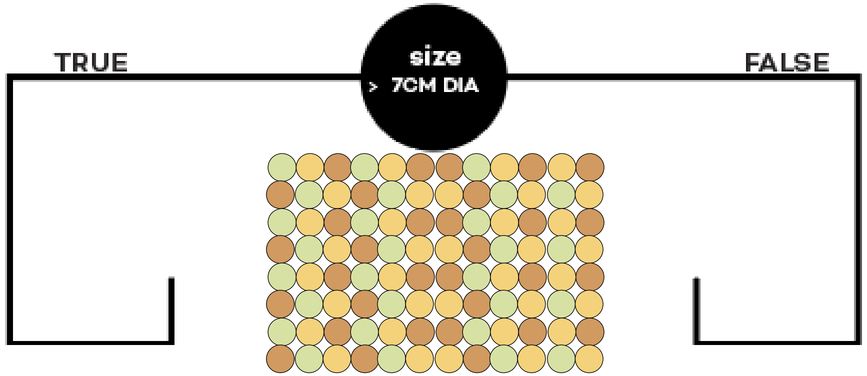
Multiclass Classification



Multiclass Classification

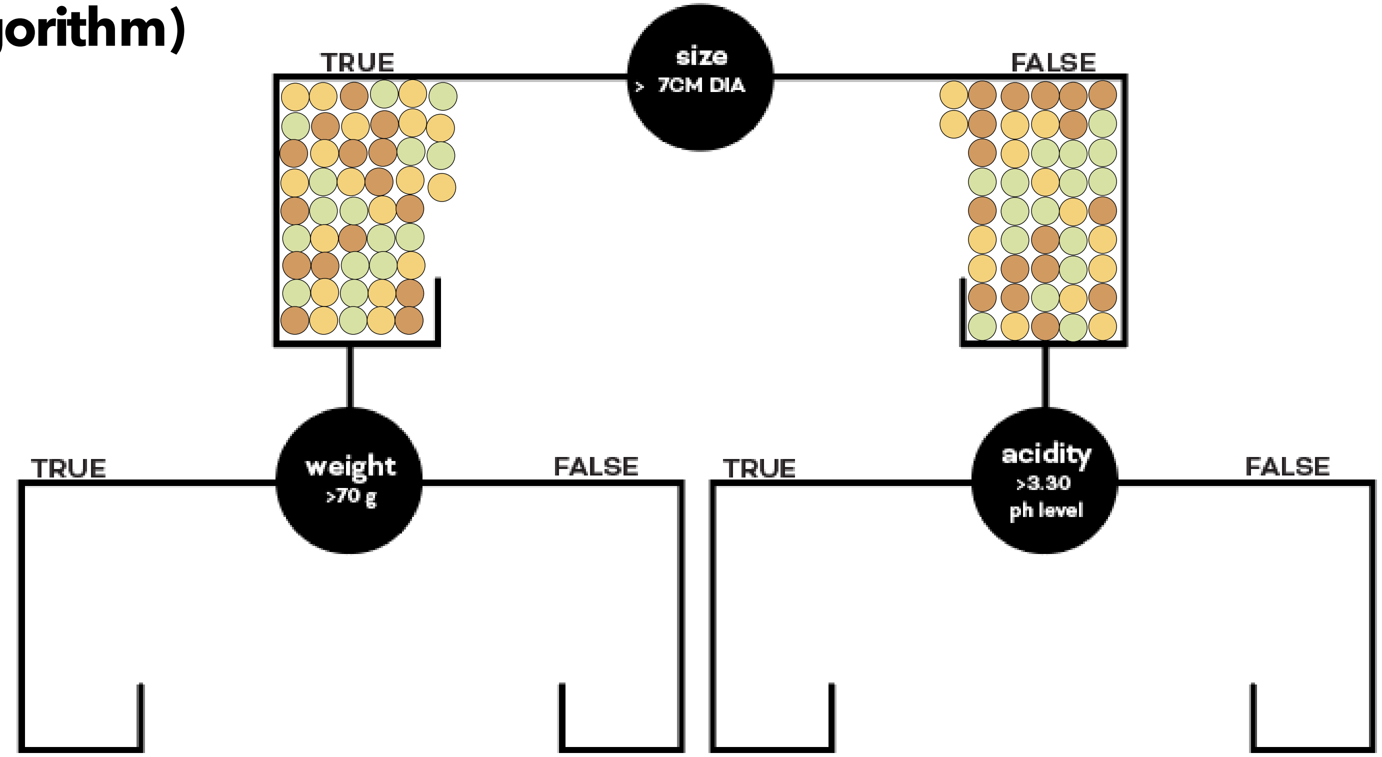


Decision Tree (ML Algorithm)

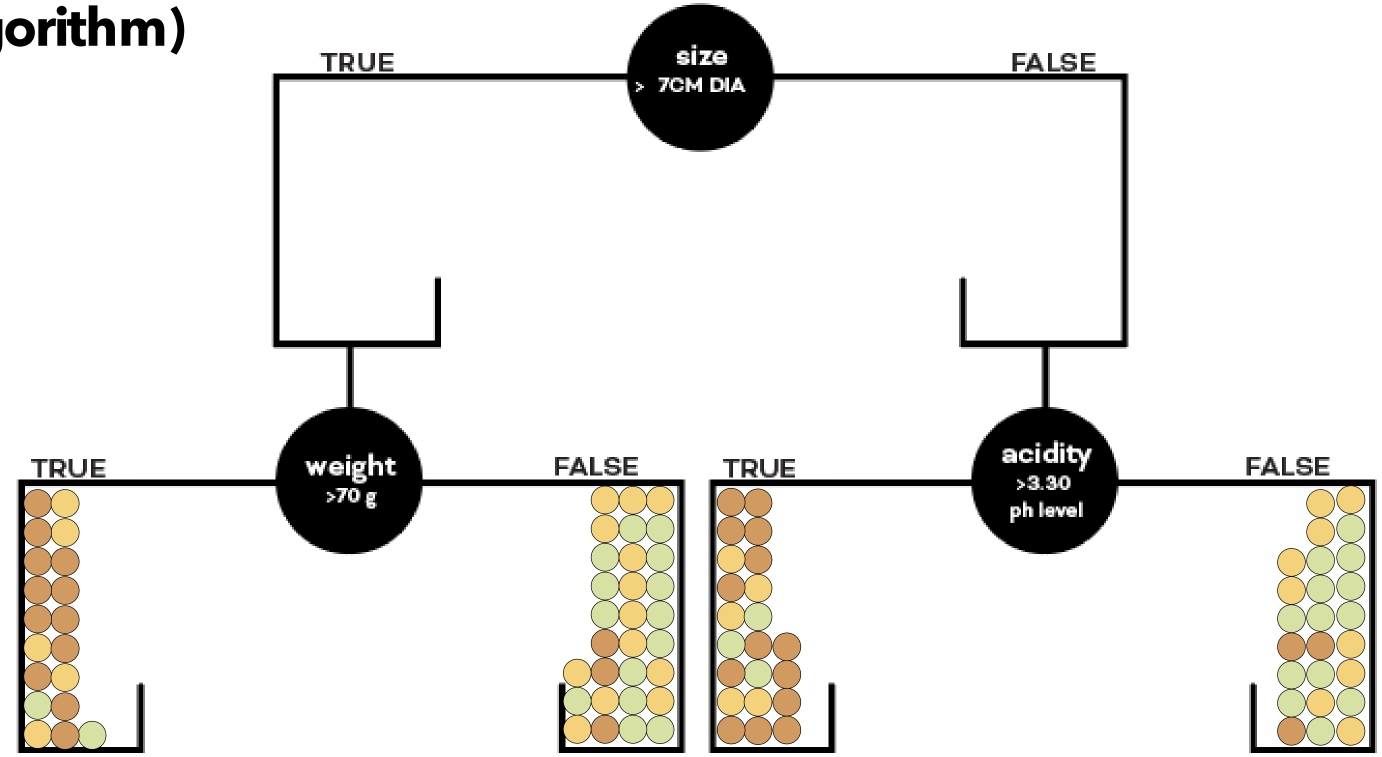


Decision Tree (ML Algorithm)

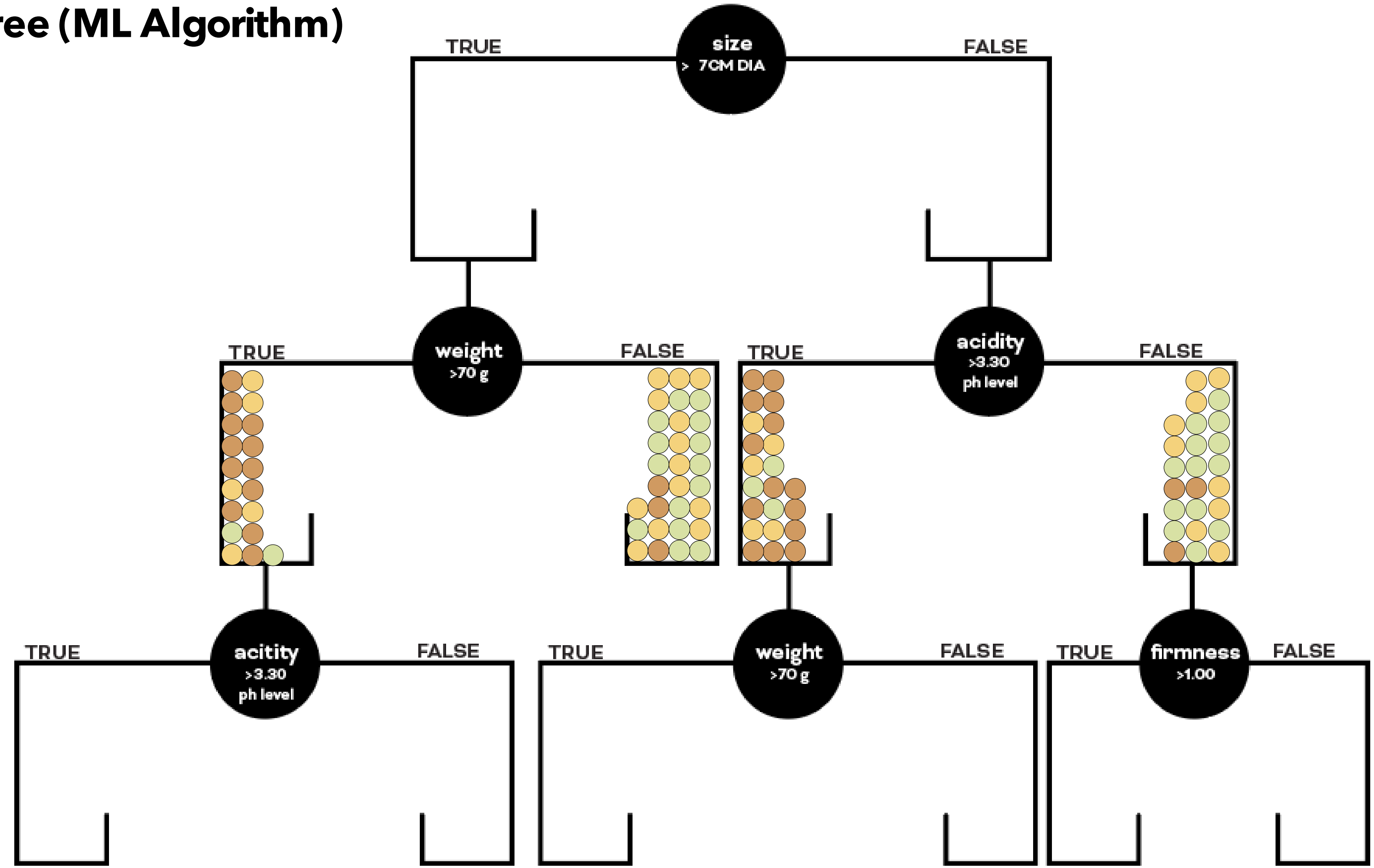
Decision Tree (ML Algorithm)



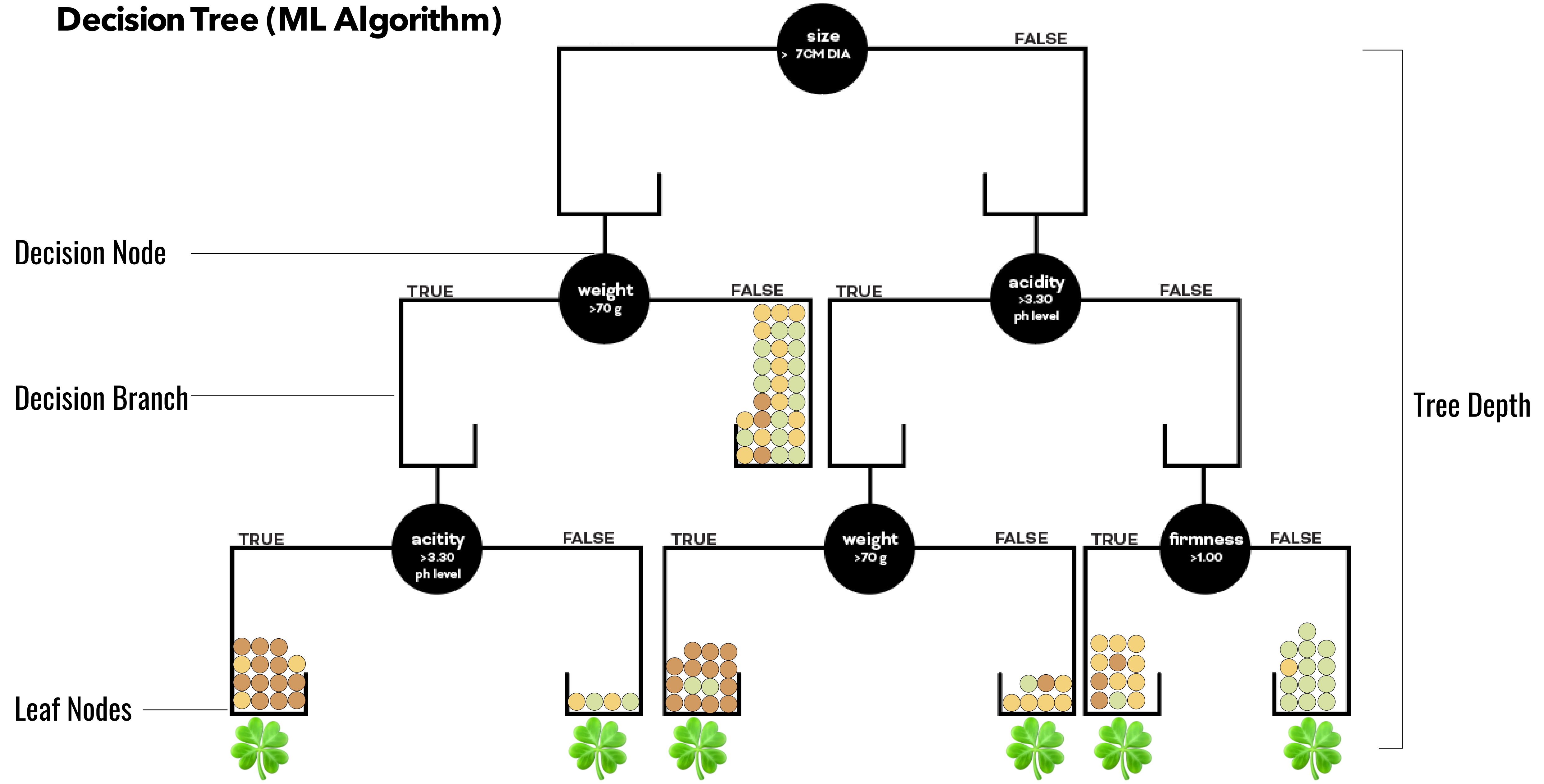
Decision Tree (ML Algorithm)



Decision Tree (ML Algorithm)

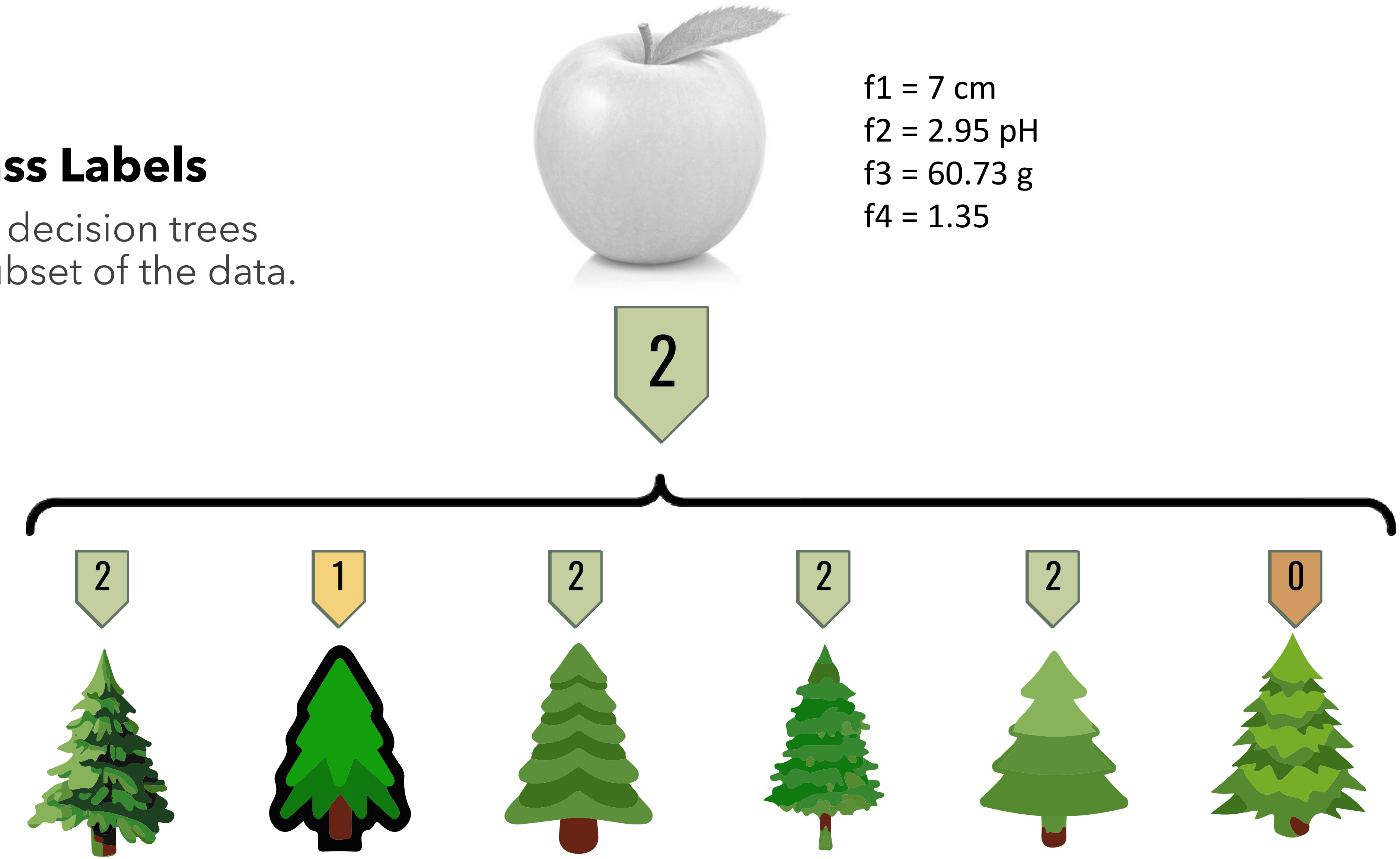


Decision Tree (ML Algorithm)



Predicting Class Labels

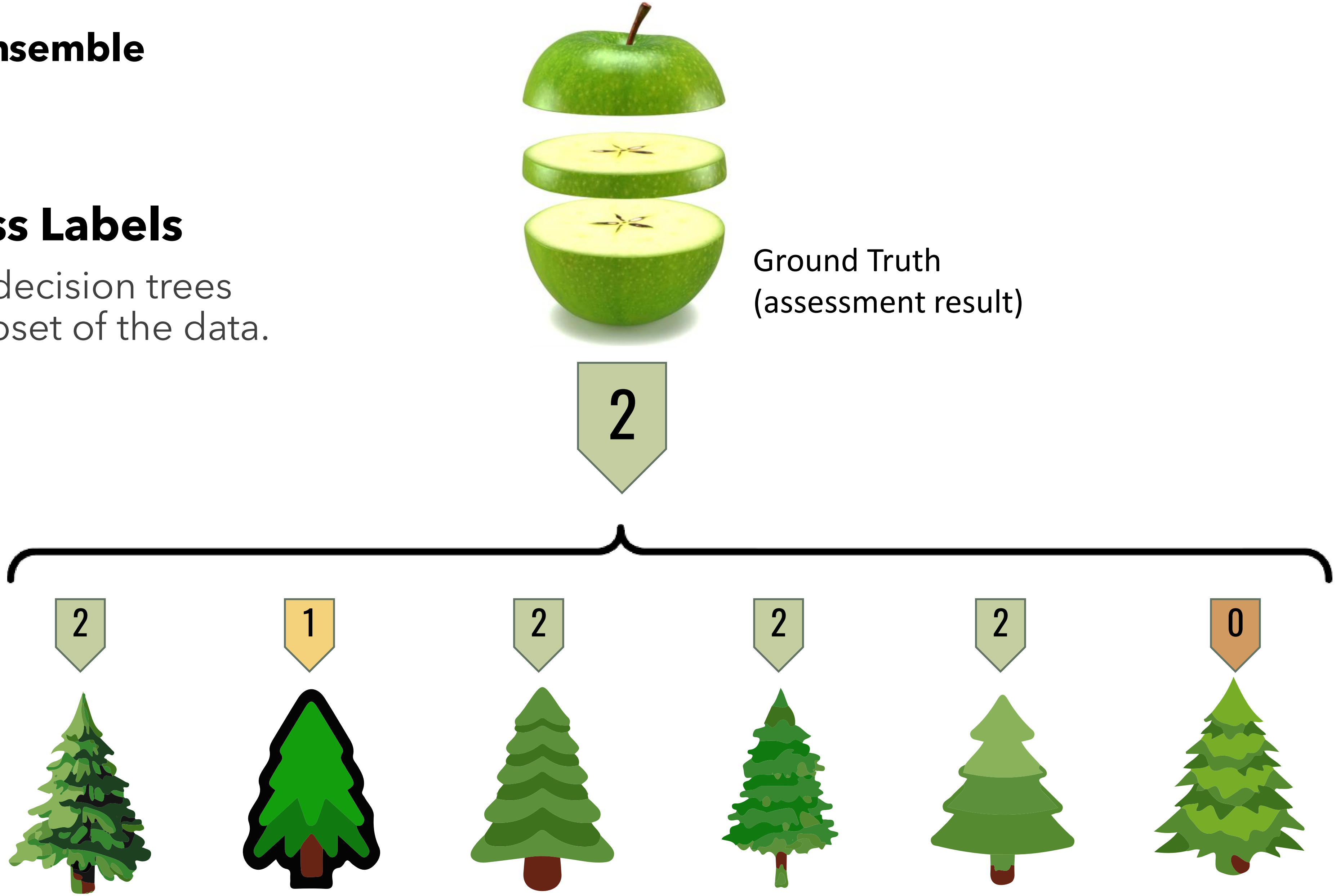
- A collection of decision trees trained on a subset of the data.



f1 = 7 cm
f2 = 2.95 pH
f3 = 60.73 g
f4 = 1.35

Predicting Class Labels

- A collection of decision trees trained on a subset of the data.

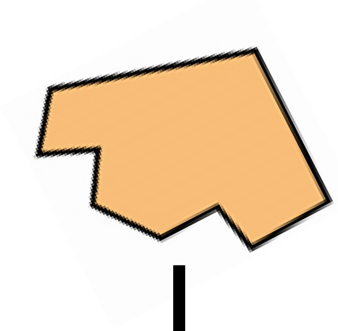


Feature Selection

Building Features?

- Individual measurable property, usually numeric.

Room Boundary



Numeric Representation

POLYGON ((-7.52200843305559632.1634921360940984, -7.7033628169541171 1.7828672356764850, -5.2128560162917577 0.5962283007732738, -5.1849553418458321 0.6547859777605991, -4.3669533927243158 0.2650368064689772, -4.3948540671702432 0.2064791294816519, -3.9849503282589644 0.0111744083601675))

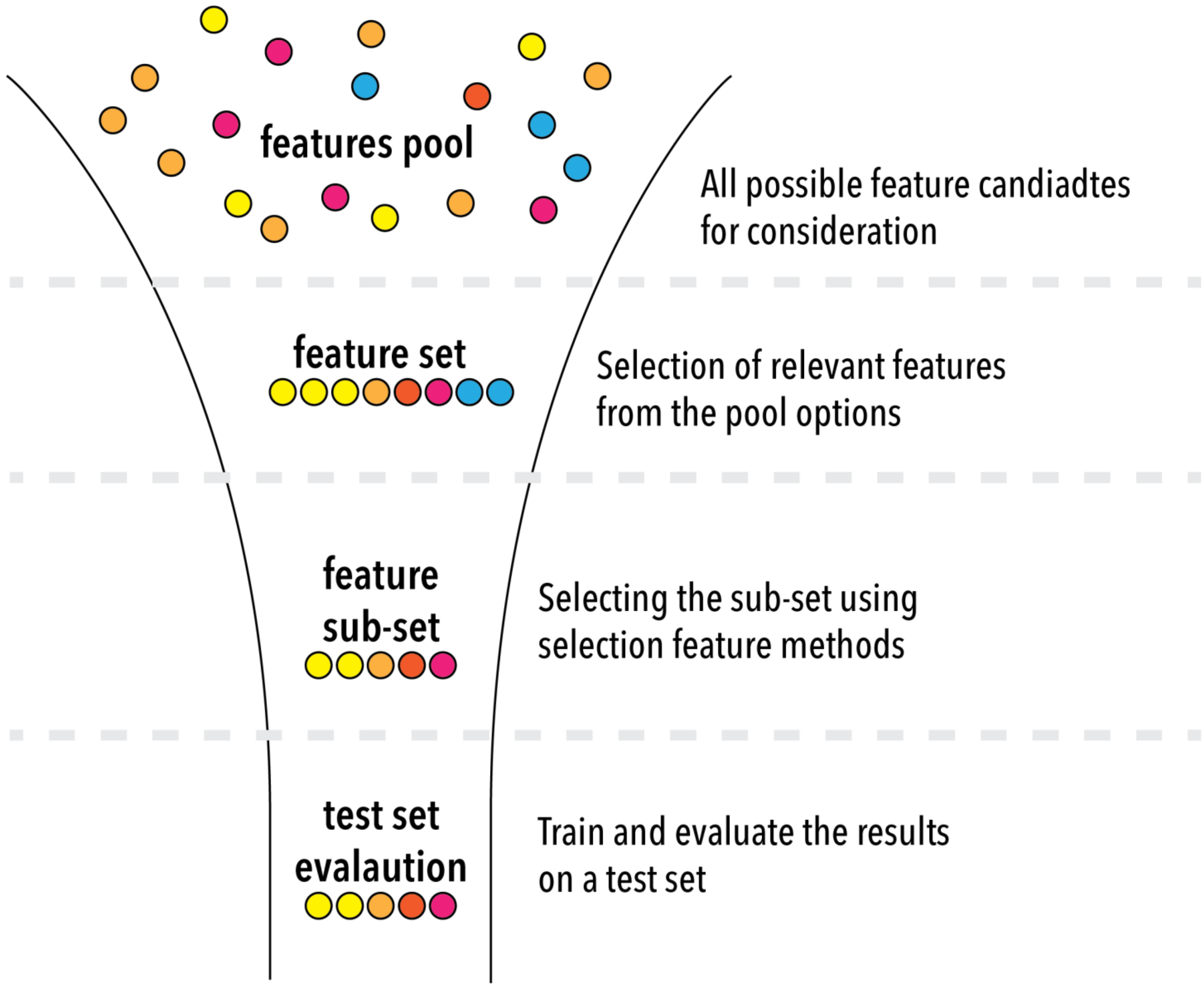
Features

f1 = Number of control points
f2 = Connected rooms
f3 = Number of doors
f4 = Area compactness
f5 = Width to depth ratio

Feature Selection

Choosing the Right Features

- Step-by-step approach to narrowing down the possible feature set combinations

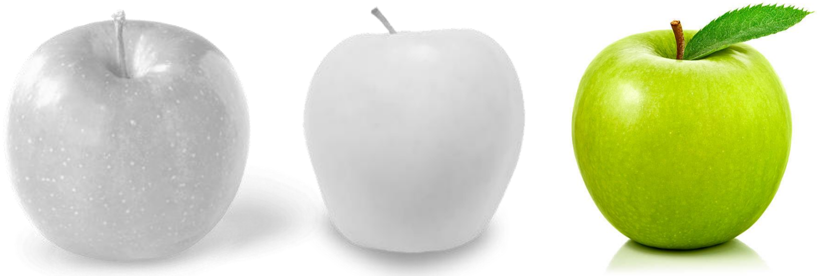


Feature Pool → Feature Set

Swiss Dwellings Features

layout_compactness
layout_mean_walllengths
layout_std_walllengths
layout_number_of_doors
layout_has_entrance_door
layout_perimeter
layout_door_perimeter
layout_connects_to_private_outdoor
layout_biggest_rectangle_length
layout_biggest_rectangle_width
view_isovist_max
view_isovist_mean
view_isovist_median
view_isovist_min
view_isovist_p20
view_isovist_p80
view_isovist_stddev
connectivity_eigen_centrality_max
connectivity_eigen_centrality_mean
connectivity_eigen_centrality_median
connectivity_eigen_centrality_min
connectivity_eigen_centrality_p20
connectivity_eigen_centrality_p80
connectivity_eigen_centrality_stddev
connectivity_entrance_door_distance_max
connectivity_entrance_door_distance_mean
connectivity_entrance_door_distance_median
connectivity_entrance_door_distance_min
connectivity_entrance_door_distance_p20
connectivity_entrance_door_distance_p80
connectivity_entrance_door_distance_stddev
connectivity_betweenness_centrality_max
connectivity_betweenness_centrality_mean
connectivity_betweenness_centrality_median
connectivity_betweenness_centrality_min
connectivity_betweenness_centrality_p20
connectivity_betweenness_centrality_p80
connectivity_betweenness_centrality_stddev
connectivity_closeness_centrality_max
connectivity_closeness_centrality_mean
connectivity_closeness_centrality_median
connectivity_closeness_centrality_min
connectivity_closeness_centrality_p20
connectivity_closeness_centrality_p80
connectivity_closeness_centrality_stddev
connectivity_bathroom_distance_max
connectivity_bathroom_distance_mean
connectivity_bathroom_distance_median
connectivity_bathroom_distance_min
connectivity_bathroom_distance_p20
connectivity_bathroom_distance_p80
connectivity_bathroom_distance_stddev
connectivity_kitchen_distance_max
connectivity_kitchen_distance_mean
connectivity_kitchen_distance_median
connectivity_kitchen_distance_min
connectivity_kitchen_distance_p20
connectivity_kitchen_distance_p80
connectivity_kitchen_distance_stddev

Feature Set → Feature Subset



Sequential Feature Selector

Round 1

f1 → Train classifier → Get Performance
f2 → Train classifier → Get Performance
f3 → Train classifier → Get Performance
f4 → Train classifier → Get Performance

→ f2
Select best feature

Round 2

f2 f1 → Train classifier → Get Performance
f2
f2 f3 → Train classifier → Get Performance
f2 f4 → Train classifier → Get Performance

→ f2 f4

Feature Set → Feature Subset

connectivity_kitchen_distance_p20

connectivity_kitchen_distance_p80

layout_perimeter

layout_biggest_rectangle_width

connectivity_bathroom_distance_p20

connectivity_entrance_door_distance_p80

layout_biggest_rectangle_length

connectivity_bathroom_distance_p80

layout_biggest_rectangle_length

connectivity_bathroom_distance_p80

connectivity_closeness_centrality_p20

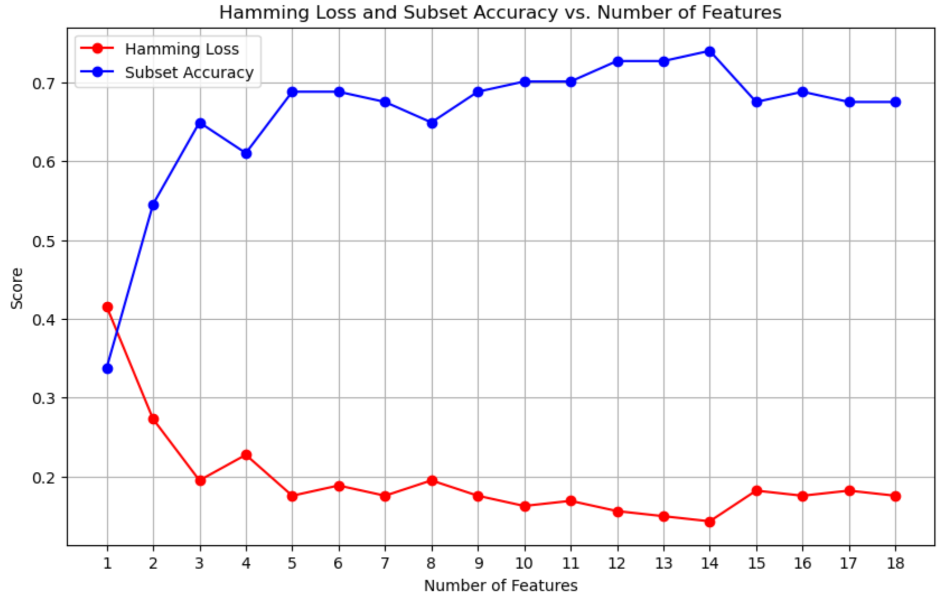
connectivity_closeness_centrality_p80

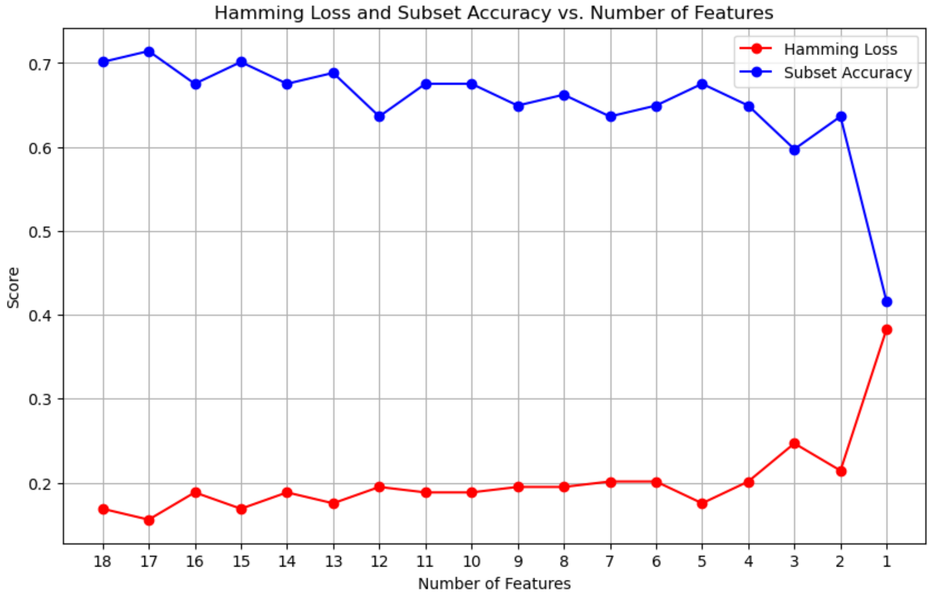
connectivity_betweenness_centrality_p80

layout_compactness

layout_std_walllengths

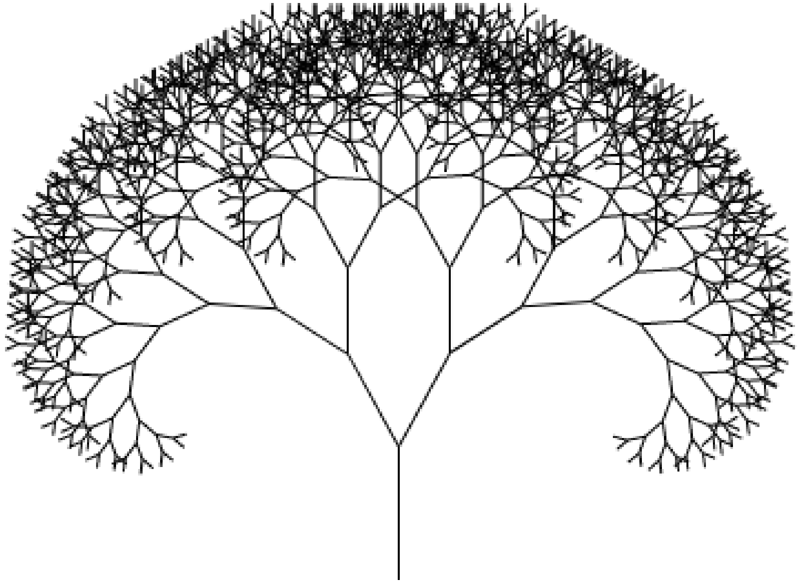
layout_door_perimeter





Hyperparameter Tuning

Number of trees in the forest = 100 to 500 at 25 intervals
Maximum depth = none, 10, 20, 30, 40
Min sample split = 2, 5, 10
Min sample leaf = 1, 2, 3
....



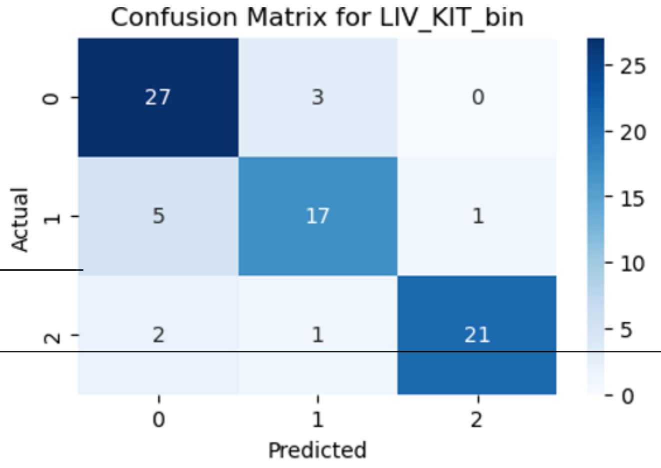
Fitting 5 folds for each of 1620 candidates, totaling 8100 fits

Image source: Wikipedia: 'Simple Fractles.png'

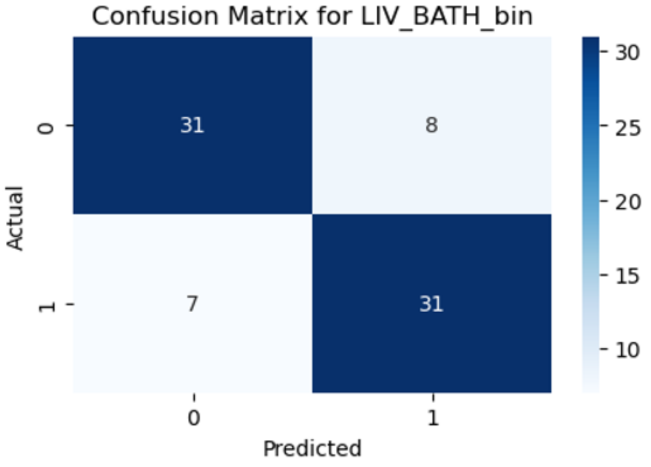
Model Evaluation

Confusion Matrix

Output Accuracy




```
Accuracy for LIV_KIT_bin: 0.8441558441558441
Classification Report for LIV_KIT_bin:
               precision    recall  f1-score   support

0_insufficient      0.79      0.90      0.84        30
  1_sufficient      0.81      0.74      0.77        23
   2_preferred      0.95      0.88      0.91        24

      accuracy                          0.84        77
     macro avg      0.85      0.84      0.84        77
  weighted avg      0.85      0.84      0.84        77
```

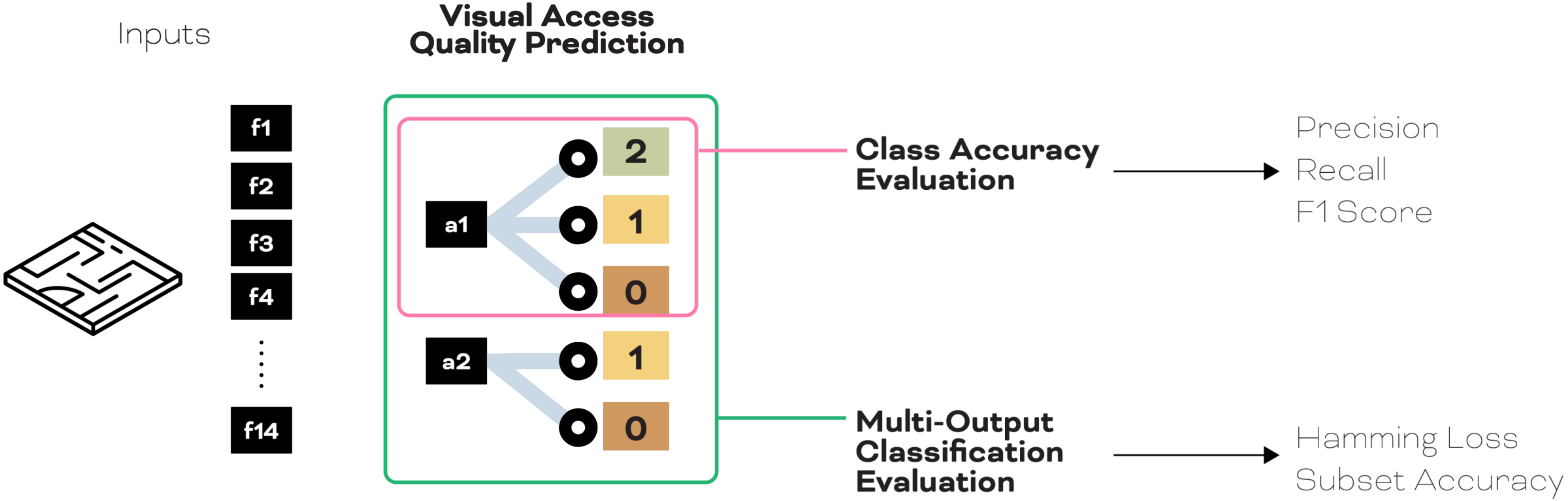



```
Accuracy for LIV_BATH_bin: 0.8051948051948052
Classification Report for LIV_BATH_bin:
               precision    recall  f1-score   support

0_insufficient      0.82      0.79      0.81        39
  1_sufficient      0.79      0.82      0.81        38

      accuracy                          0.81        77
     macro avg      0.81      0.81      0.81        77
  weighted avg      0.81      0.81      0.81        77
```

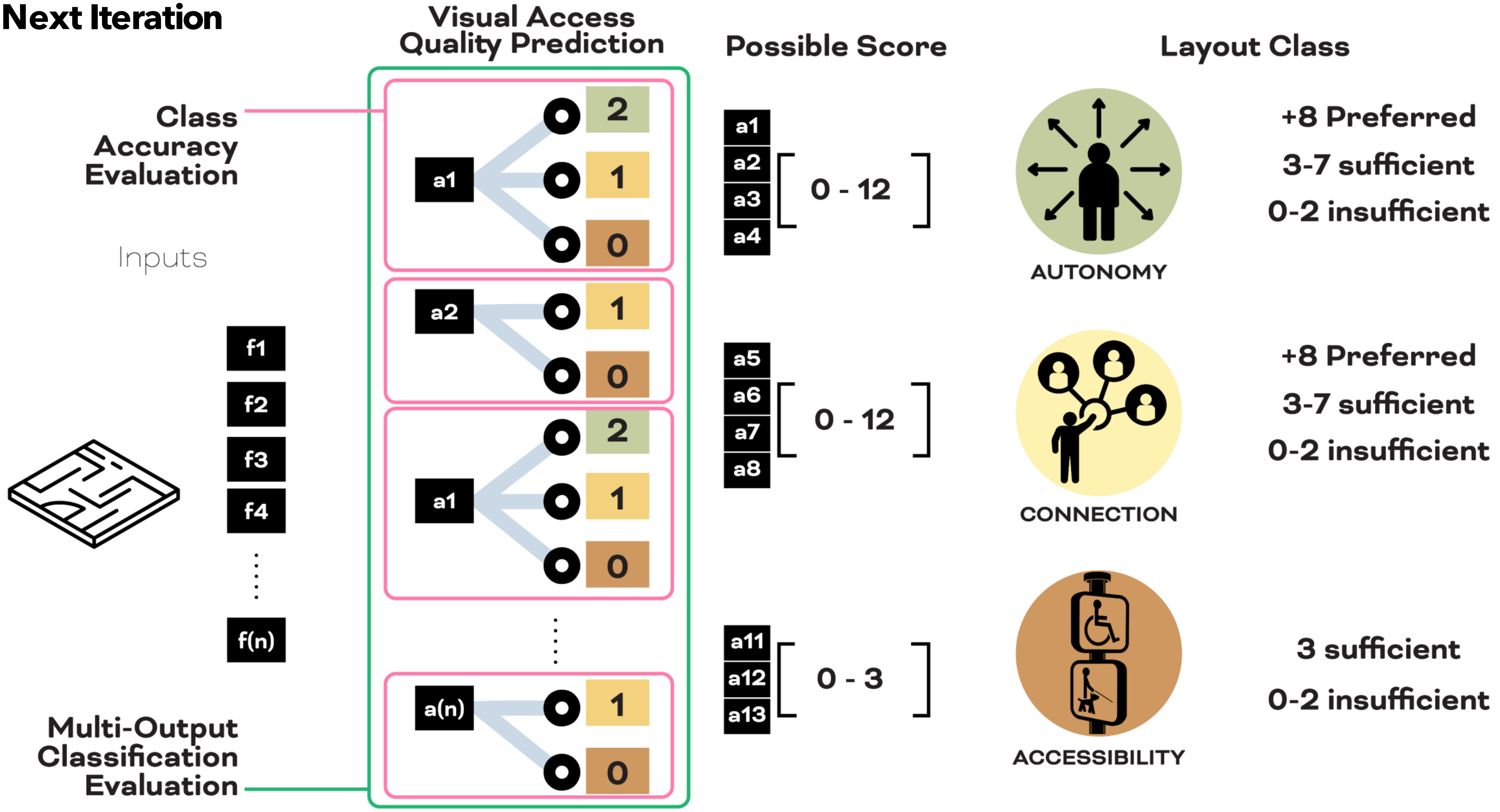
Multi-Output Accuracy and Error Fraction

```
Hamming Loss: 0.16883116883116883
Subset Accuracy: 0.7142857142857143
```

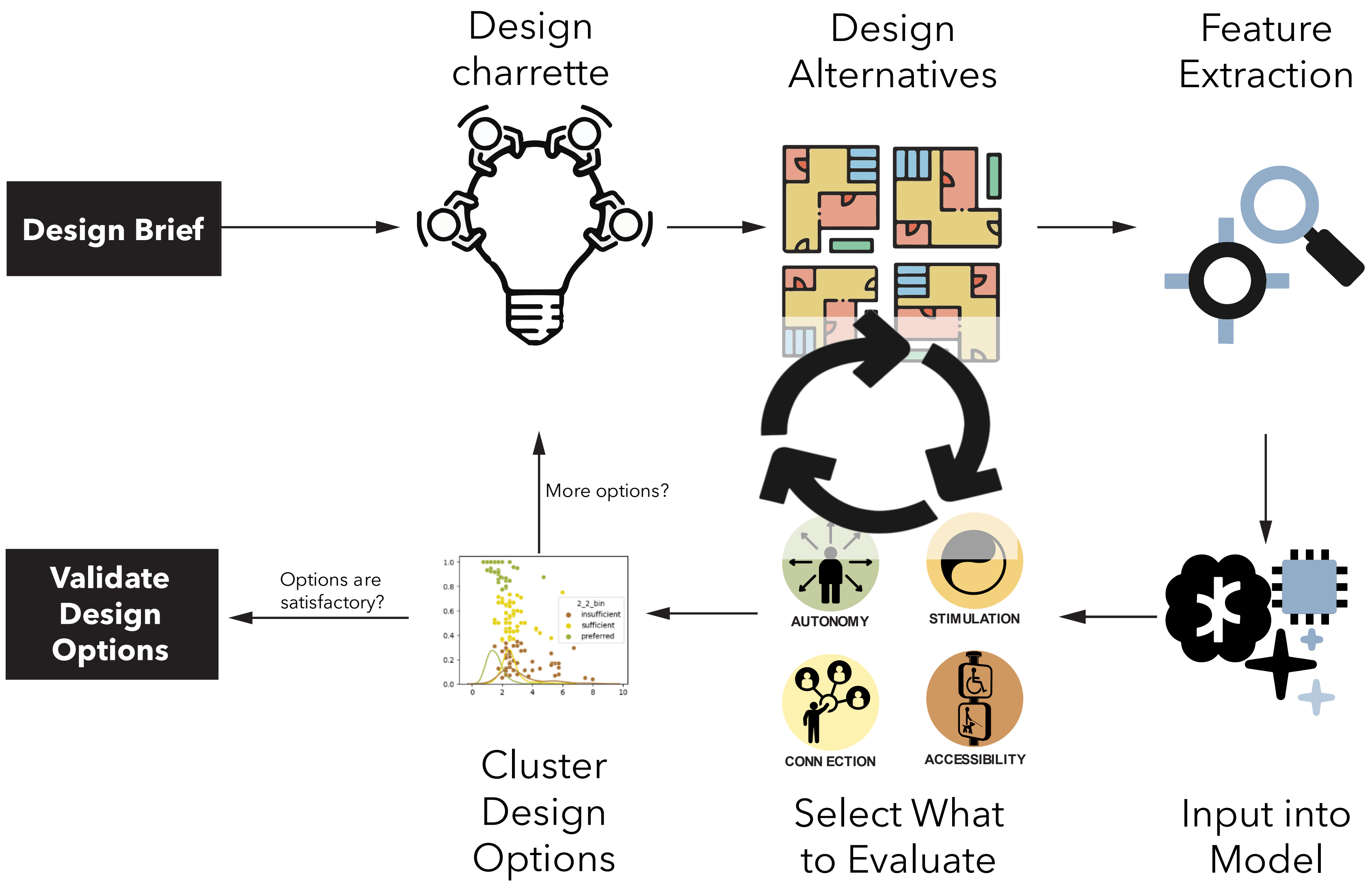
Current Model



Next Iteration

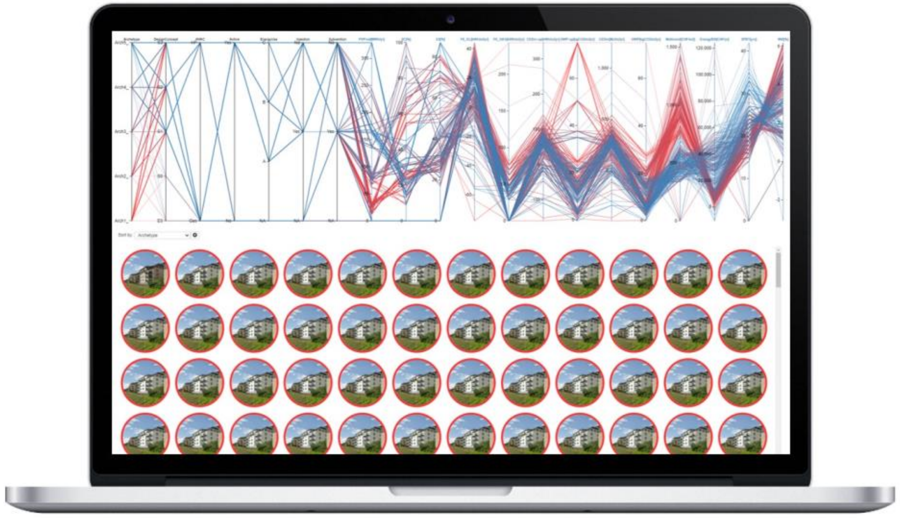


Early-Stage Design Process

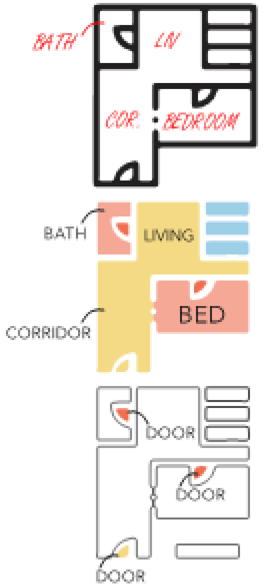


Design Tool Integration

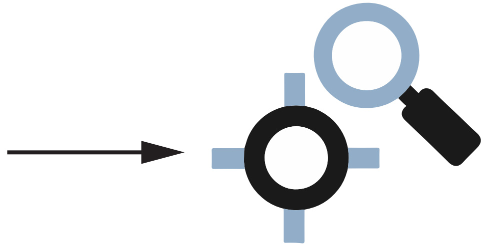
Digital Model Analytics

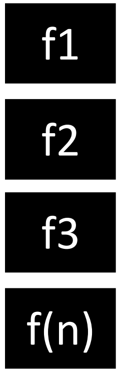


Hand-Sketch to Geometry



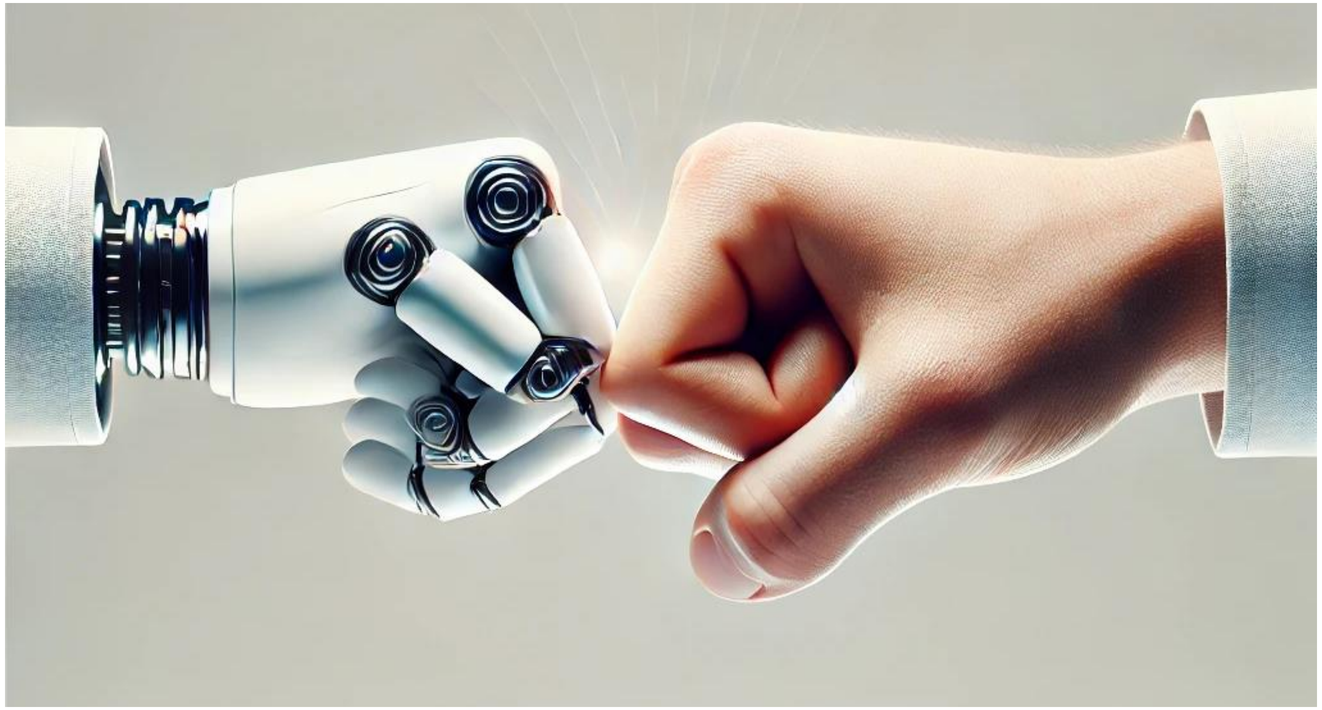
Vectorized





Source: DesignExplorer - https://design-explorer.epfl.ch/

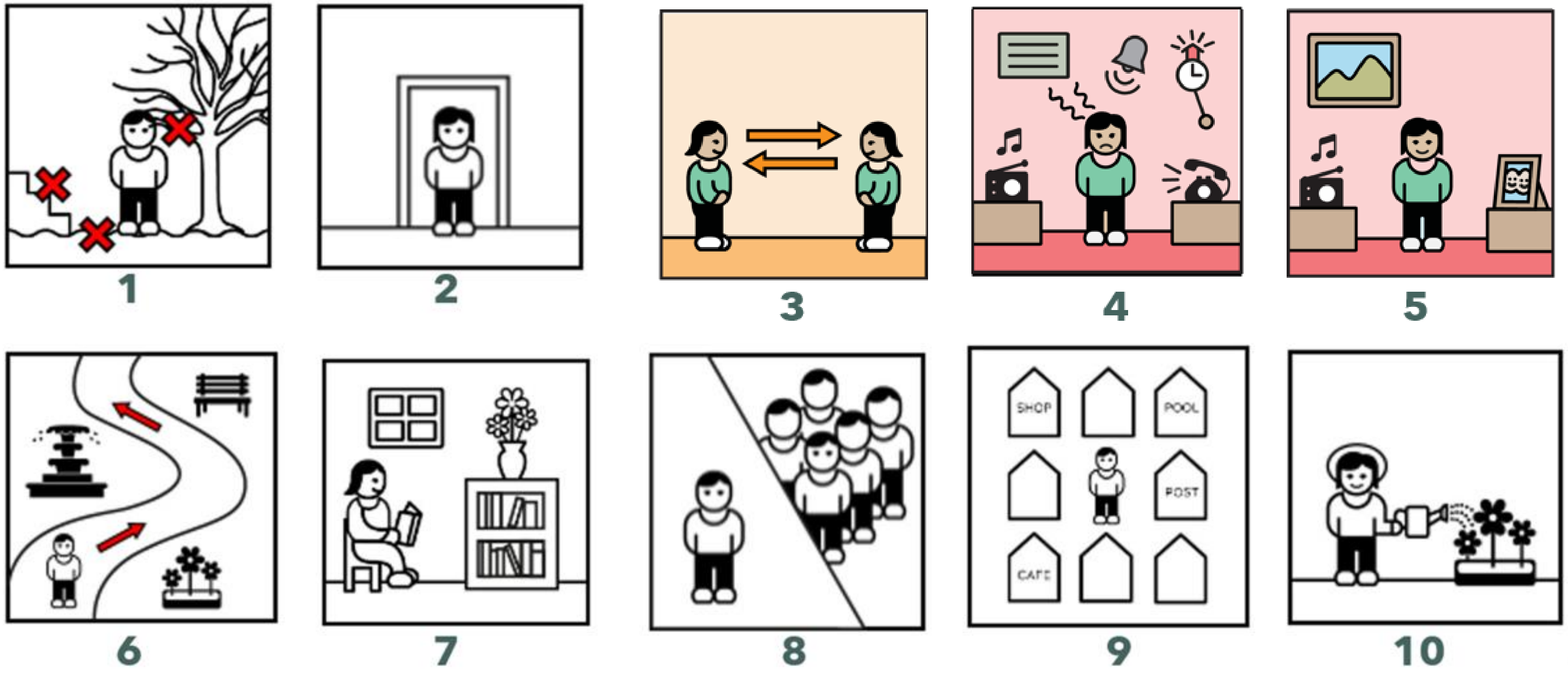
Role of AI in Architectural Design



AI as a design specialist to bridge the gap between expert validation and early stages of concept design

[in conclusion]

Potential Research Recommendations



1. Unobtrusively reduce risks
2. Provide a human scale
3. Allow people to see and be seen
4. Reduce unhelpful stimulation
5. Optimize helpful stimulation
6. Support movement and engagement
7. Create a familiar space
8. Provide opportunities to be alone or with others
9. Provide links to the community
10.Respond to a vision for way of life.

Roadmap: Testing New Feature Sets

Inputs

f1
f2
f3
f4
⋮
f(n)

[More] Assessment

DDP 2: provide a human scale
a1 a2 a3 a(n) [Score Range]

DDP 3: see and be seen
a1 a2 a3 a(n) [Score Range]

DDP 5: optimize helpful stimulation
a1 a2 a3 a(n) [Score Range]

DDP 4: reduce unhelpful stimulation
a1 a2 a3 a(n) [Score Range]

DDP 8: provide opportunities to be alone and with others
a1 a2 a3 a(n) [Score Range]

DDP 6: support movement and engagement
a1 a2 a3 a(n) [Score Range]

Layout Quality Label

Spatial Design Features from the Architect

Dementia Design Principles Assessment by Care Professional

Architect Features		
Feature Name	**Feature Categpry**	**Feature Description**
f1	Distance-based features	Distance between test area to all doors
f2		Angle between test area to all doors
f3		Route length between test area to target area
f4	Wall-to-Opening Ratio	Solid vs void amount in the test area
f5	Area Ratios	Test area divided by target area
f6		Test area divided by layout total area
f7		Test area divided by corridor areas
f8	Nearest Distance	Shortest path to a toilet
f9	Shape Complexity	Corridor moments of decisions
f10	Perimeter Length	Perimeter length
f11		Perimeter number of control points
f12	Compactness	Test area compactness
f13		Test area compactness / target area compactness
f14	Doors Positioning	Number of doors along the corridor
f15		Number of doors between test and target areas
f16	Occupancy Density	Test area size divided by number of users

Dementia Care Professional Features		
Feature Name	**Feature Categpry**	**Feature Description**
a1	Sightlines	Visual sightlines between entrance and living
a2		Visual sightlines between living and corridor
a3		Visual sightlines between sanitary room from the bed
a4	Landmark Positions	
a5	Path of Travel	Sequence of spaces
a6		Location of entance door
a7		Location of living room
a8		Length of route between bedroom to living room
a9		Acticity space at the end of the corridor
a10	Corridor Properties	Number of doors along the corridor
a11		Corridor width
a12		Shape of the corridor
a13		Moments of decisions along the corridor
a14	Natural daylight access	Daylight access along the corridor

Roadmap: Expand the Dataset

How can AI support the design of dementia-friendly architecture?

Answers

- By **identifying relevant decisions** in early stages with **high impact** on DDP compliance.
  - Ease of wayfinding promotes autonomy and sense of connection.
- **Collecting** a dataset of floor plans and performing an assessment to **numerically describe DDP**
  - Isovist-based tests for visual access, set of criteria by the EAT checklist
- **Selecting the right features** for the classification model and validate the performance of the model
  - Floor plan geometry, assessment results, geometry features.
- By **testing the model** with an **unseen-before floor plans** and analysing the results
  - Using both individual class and multi-output evaluation metrics.

Limitations of Study

- Only 2 performance indicator
    1. Living → Kitchen sightlines
    2. Living → Bathroom sightlines
- Limited size and typology of the training set
- Limited feature pool and feature set

Potential Research Recommendations

- Expanding our understanding on the relationship between visual access and environmental stimuli on the effect ease of wayfinding for people living with dementia.
- Measuring non-visual wayfinding quality indicators and their effect on ease of navigation
- Feature extraction and selection on expanded models
- Sourcing more floor plan data

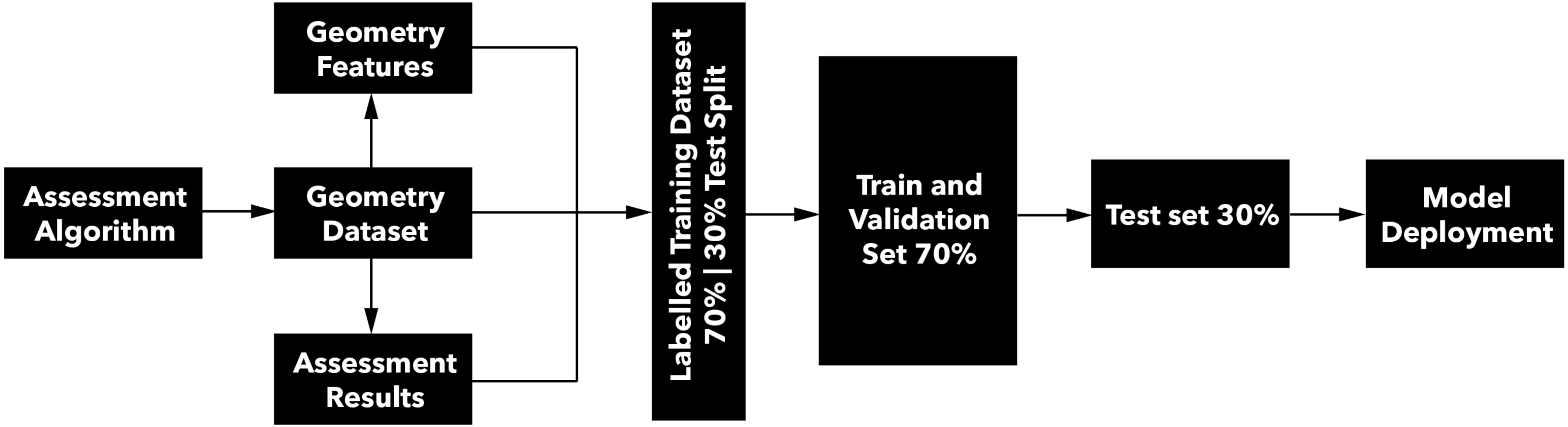
Objectives

- **Research** state-of-the-art of **dementia care** and narrowing the **scope of criteria** that is most relevant for early stages.
- Develop a **computational tool to measure dementia design principles** for data collection.
- Develop the **code environment to test ML models** using the collected dataset.
- **Evaluate the performance** of the model

THANK YOU

Main Mentor: Michela Turrin | **Second Mentor**: Martijn Lugten
Advisors: Lisa-Marie Mueller, Nadja Gaudilliere-Jami, Tangram Architekten
Student: Feras Alsaggaf - 5591031

Model Training and Test Split Method



Early-Stage Soft Design Criteria Scoring System

Dementia Design Principle Performance Indicators

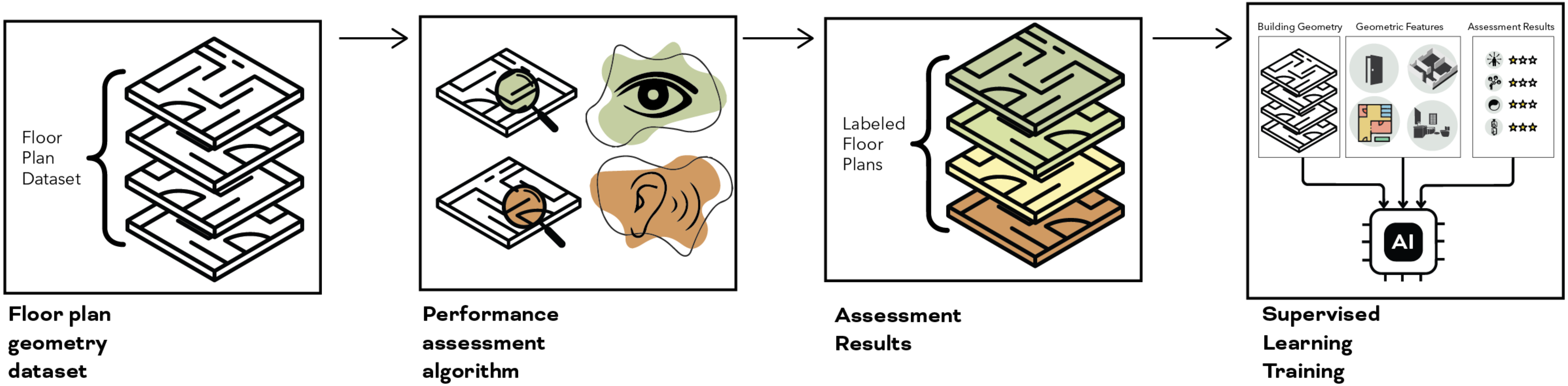
Appendix A: Soft Criteria Performance Indicators

Category	Criteria Name	Cr.ID	Method	Weight	Not Sufficient	Sufficient	Preferred	Notes
PERSONAL AGENCY	**Lounge to Bedroom Door Visibility** Clear line of sight between bedrooms and lounge areas	1.1	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	not sufficient = 0 points sufficient = 1 point preferred = 2 points
	Bedroom to Lounge Visibility The lounge room is identifiable when leaving the bedroom	1.2	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	
	Bedroom to Dining Visibility The dining is identifiable when leaving the bedroom	1.3	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	
	Lounge to Garden Exit Visibility Clear lines of sight to outside areas / door from lounge	1.4	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	
	Criteria Name	**Cr.ID**	**Method**	**Weight**	**Not Sufficient**	**Sufficient**	**Preferred**	**Notes**
SENSE OF CONNECTION	**Lounge between Dining Visibility (both ways)** Clear lines of sight to from dining to lounge room	2.1	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	not sufficient = 0 points sufficient = 1 point preferred = 2 points
	Lounge between Kitchen Visibility (both ways) Clear lines of sight to from lounge room to kitchen	2.2	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	
	Dining between Kitchen Visibility (both ways) Clear lines of path to from dining room to kitchen	2.3	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	
	Corridor to Lounge Visibility Visual connection between corridor to lounge	2.4	Isovist grid	1	0 - 0.35	0.35 - 0.75	>0.75	
	Criteria Name	**Cr.ID**	**Method**	**Weight**	**Under-Stimulated**	**Balanced**	**Over-Stimulated**	**Notes**
BALANCED STIMULATION	**Sound Separation between vibrant and quiet areas** Can the noise from kitchen reach the private areas?	3.1	Distance of public to private	1	<0	0	>0	Estimates the degree of sound separation from living to bedroom. It takes into acount the centroid distances of both areas and number of intersecting walls.
	Acoustic Wayfinding Cues Can resident kitchen acitivies be heard from bedrooms?	3.2	Received Sound	1	<20 dBA	20 - 30 dBA	>30 dBA	Estimates the presence of sound eminating from kitchen spaces received from the corridor
	Criteria Name	**Cr.ID**	**Method**	**Weight**		**No**	**Yes**	**Notes**
ACCESSIBILITY	**Dining to Toilet Visibility** Clear lines of path to from dining room to private toilet	4.1	Centered Isovist	1		0	1	
	Lounge to Toilet Visibility Clear lines of path to from living room room to private toilet	4.2	Centered Isovist	1		0	1	
	Toilet Door to Toilet Seat Visual connection between staff location to lounge	4.3	Centered Isovist	1		0	1	

Score Tally	Points possible	Not Sufficient	Fulfills All Criteria	Ideal
Personal Agency	10	0 - 3	4	0 - 8
Sense of Connection	14	0 - 3	4	0 - 8
Accessibility	3	0 - 2	3	

Balanced Stimulation	Points possible	Under-Stimulated	Balanced	Over-Stimulated
	-2 to 2	<-1	0	>1

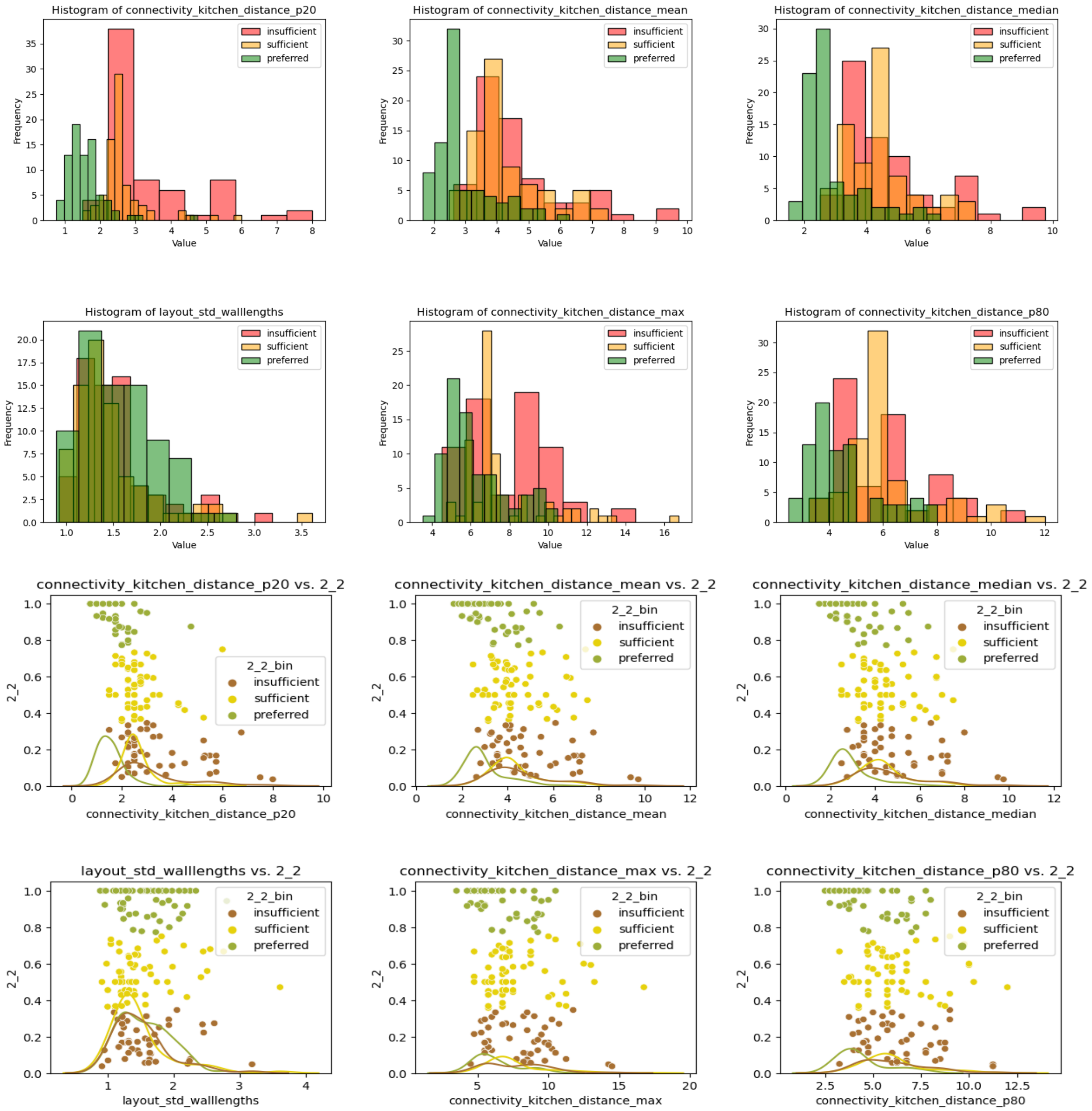
Machine Learning Framework



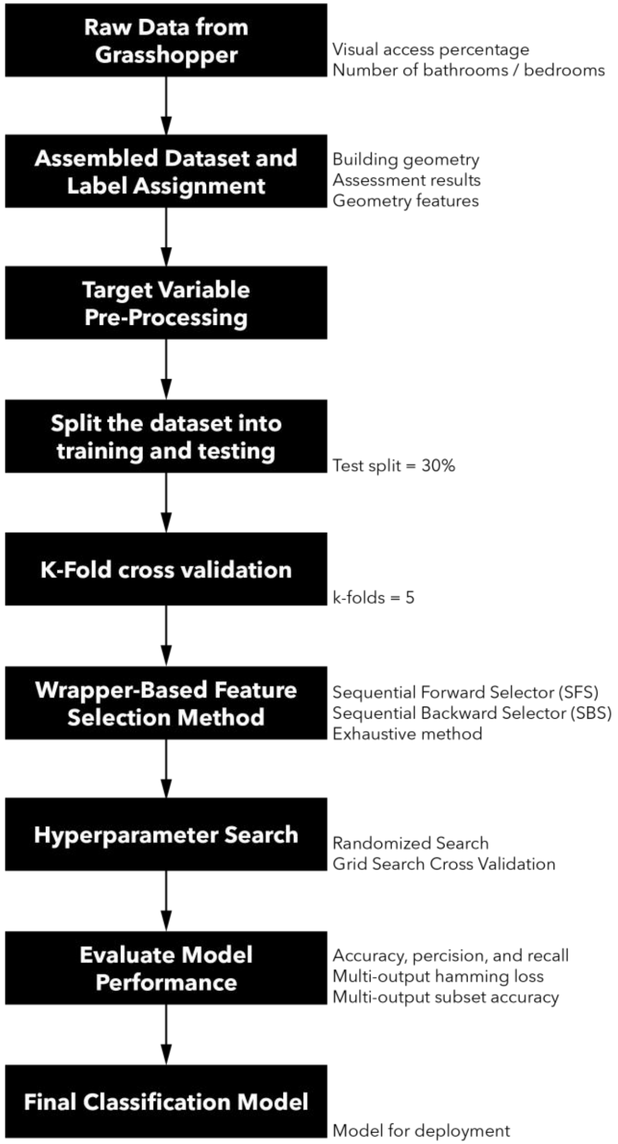
Exploratory Data Analysis

Swiss Dwellings Simulation Data

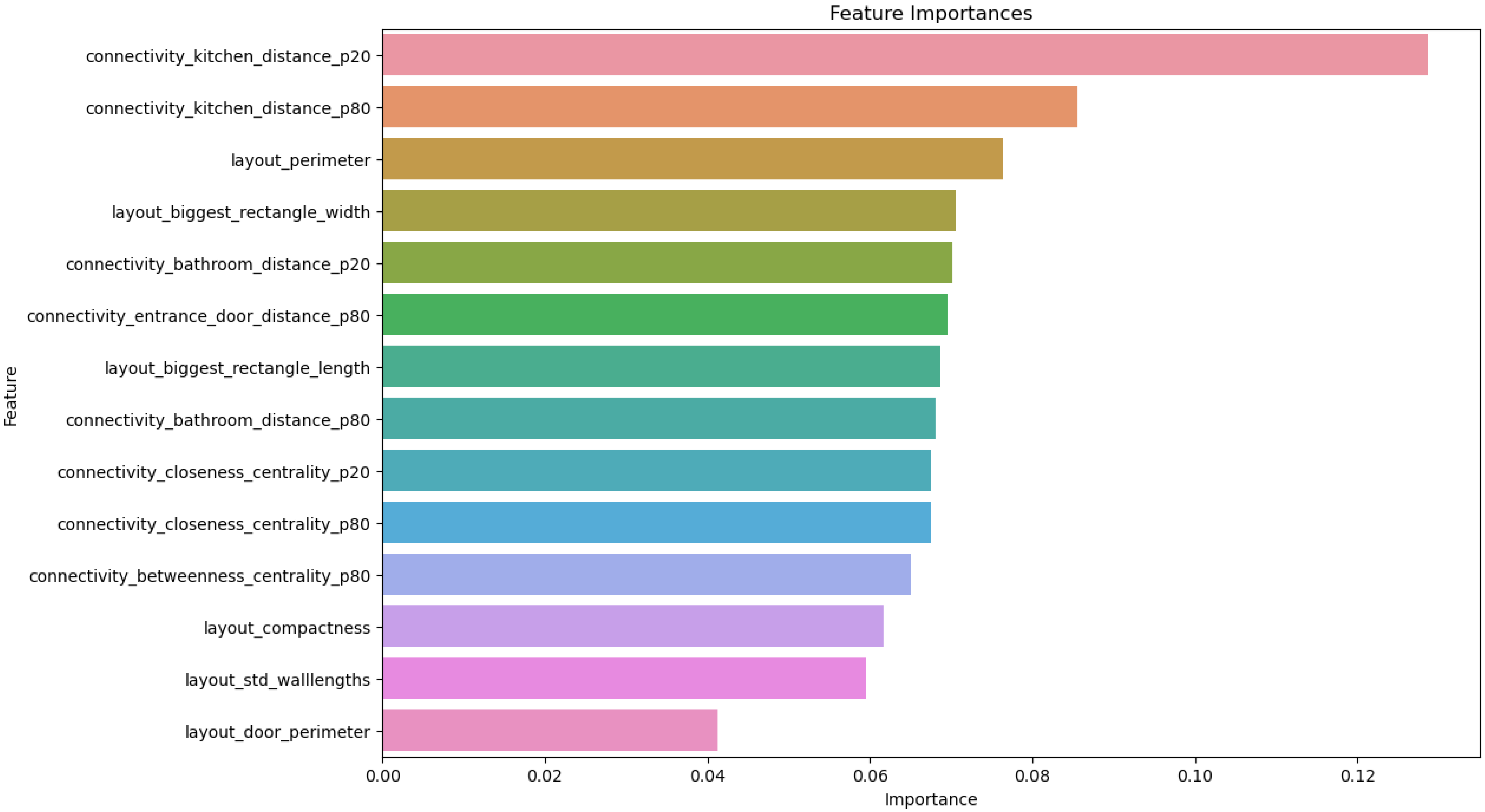
- Initial feature pool for consideration



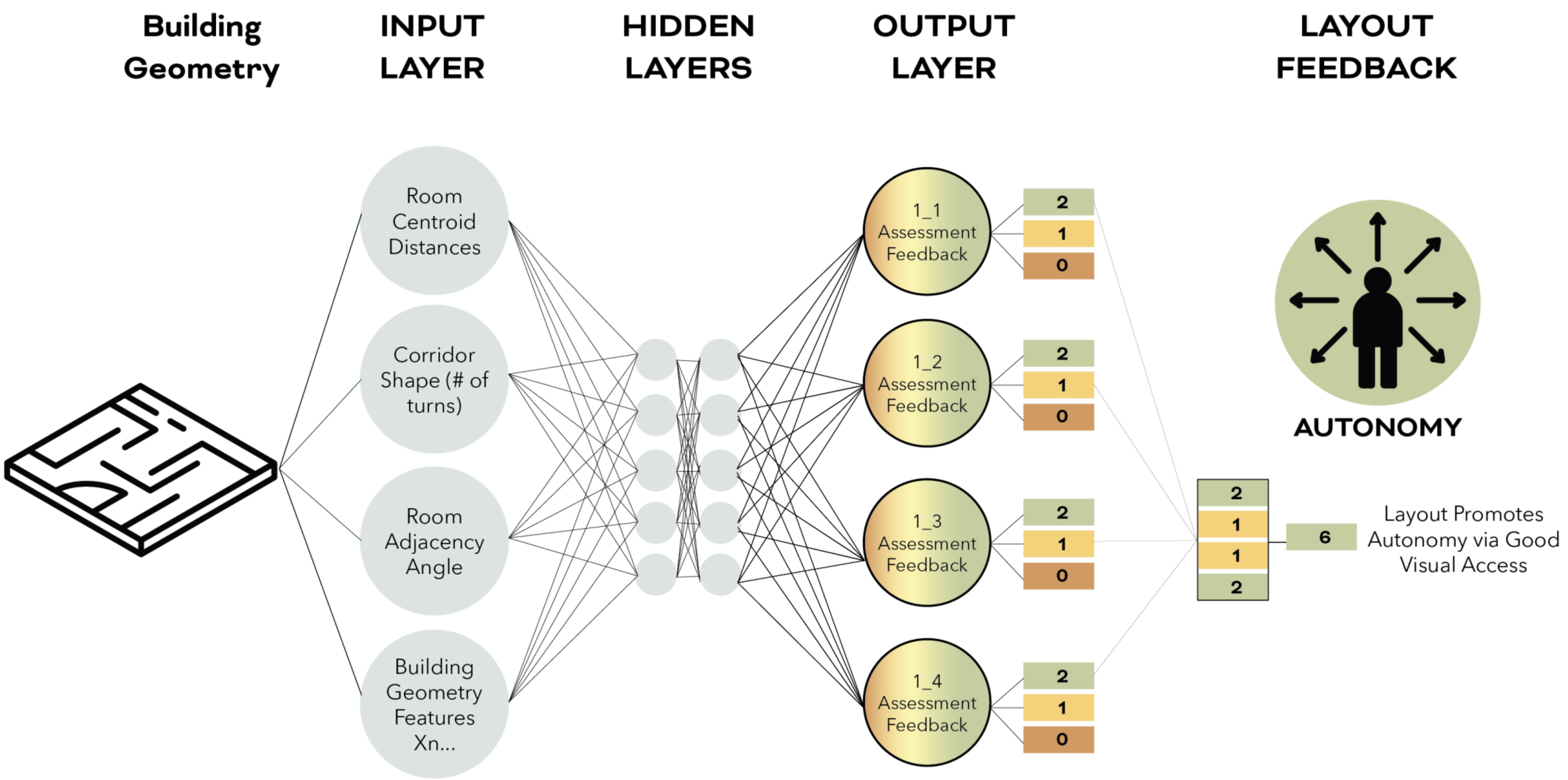
Model Training Framework



Random Forest Feature Importance Ranking



Model Objective



Visual Access