BIM-GIS Oriented Inteligente Knowledge Discovery

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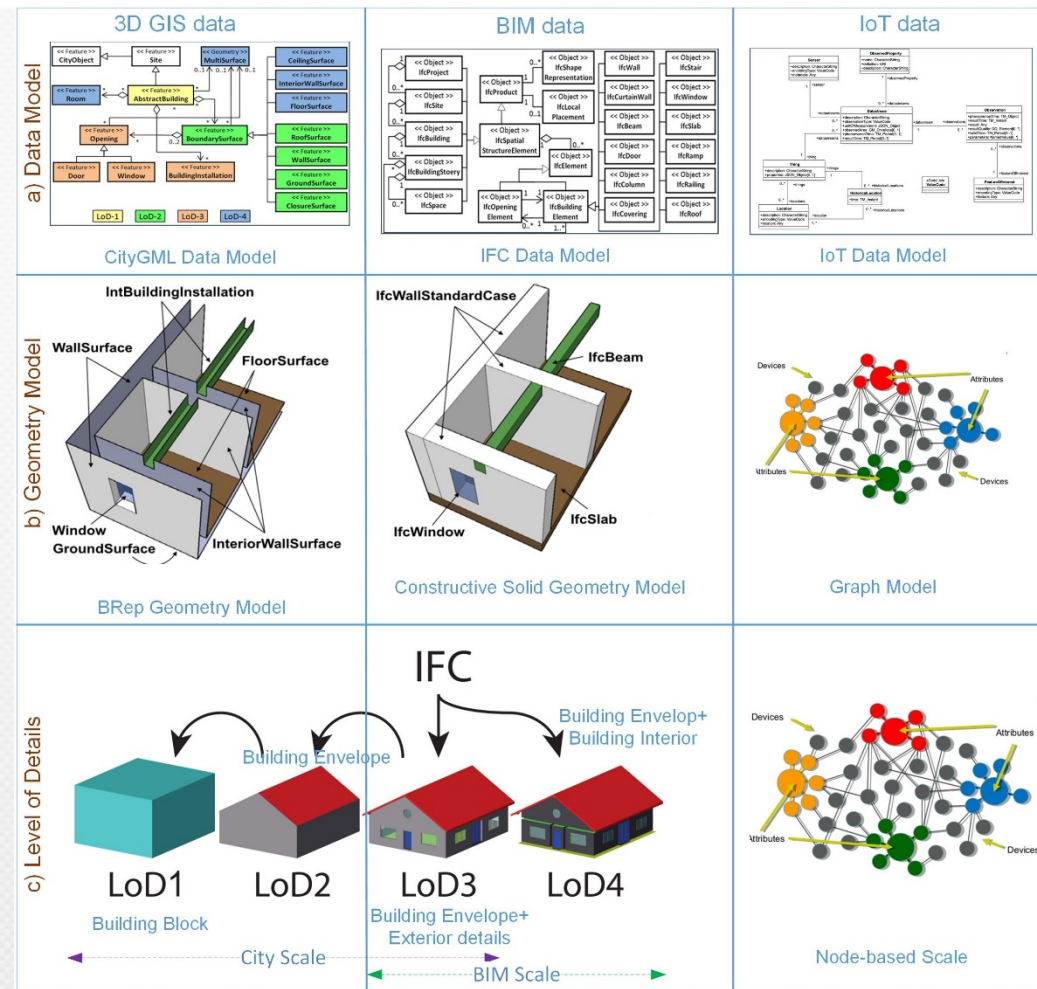
THE UNIVERSITY OF MELBOURNE

Our Mission

Propose an Geo-Spatial Smart Dashboard for multi buildings or campus to deliver an Intelligent Insights into different types of 2D and 3D data correspond to BIM, GIS and IoT.
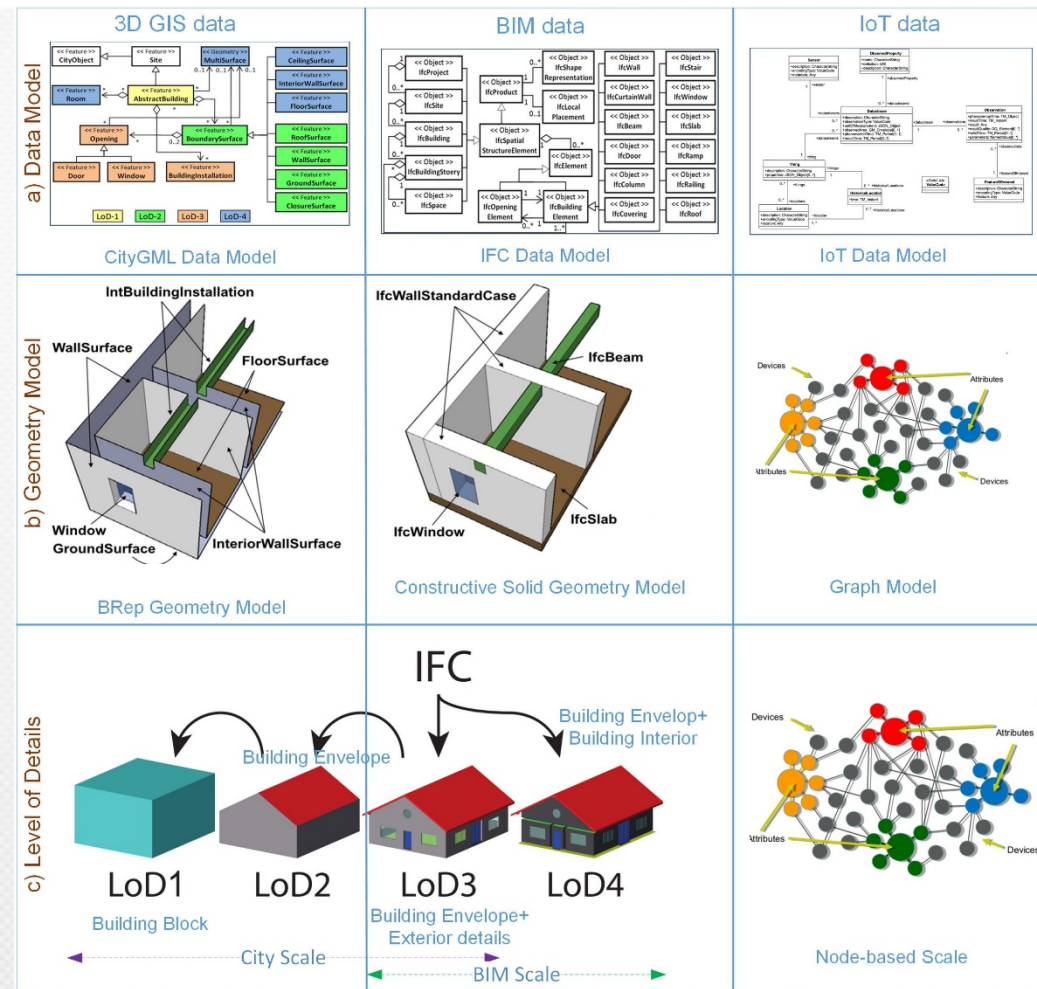
Why 3D Space is complicated…

☐ How Store and Deal with

➢ Structured,
➢ Semi Structured, &
➢ Unstructured Data

Why 3D Space is complicated…

❑ And different types of

➢ 2D and 3D geometry,
➢ Semantic,
➢ Level of details,
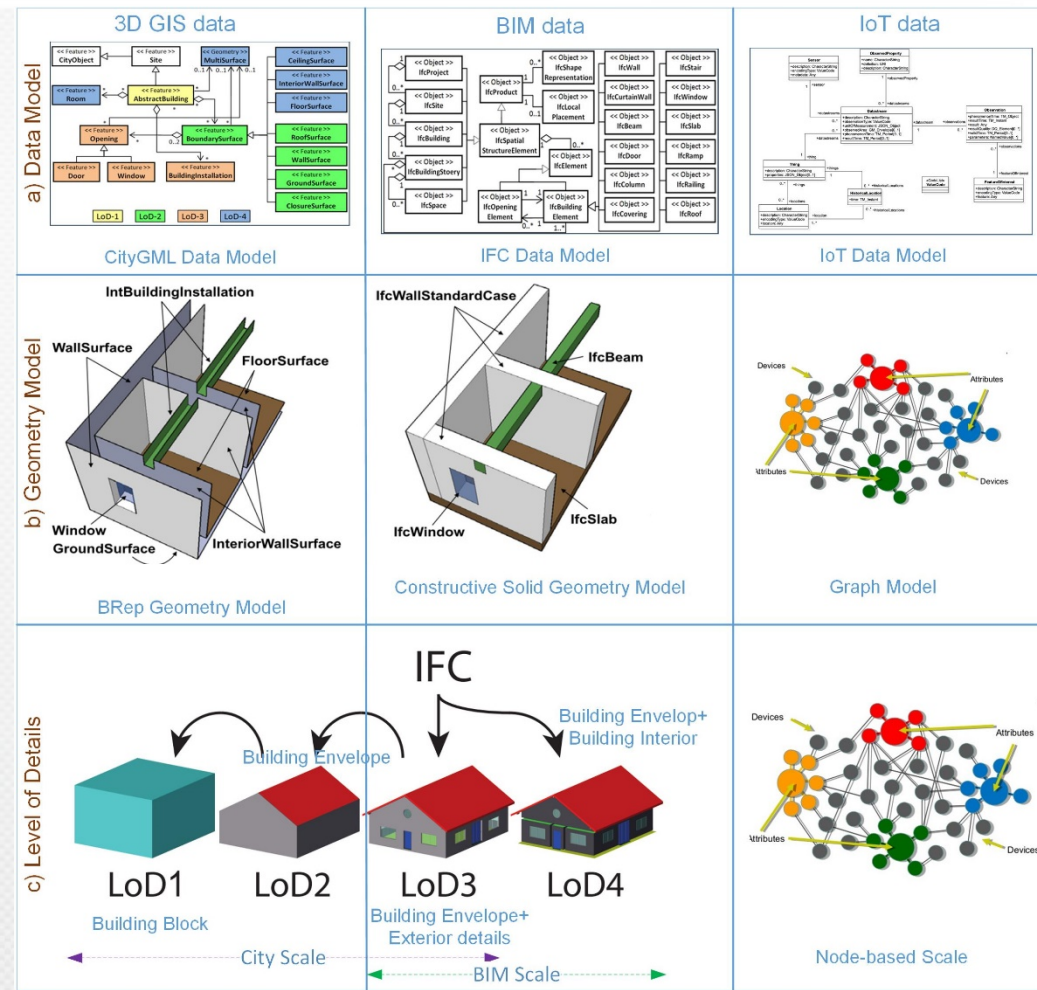➢ Live stream sensor data,
➢ Historical data,
➢ Blob files.

Why 3D Space is complicated…

❑ And also

➢ Inconsistency,
➢ Redundancy,
➢ Discrete & Continuous data in the data sets.

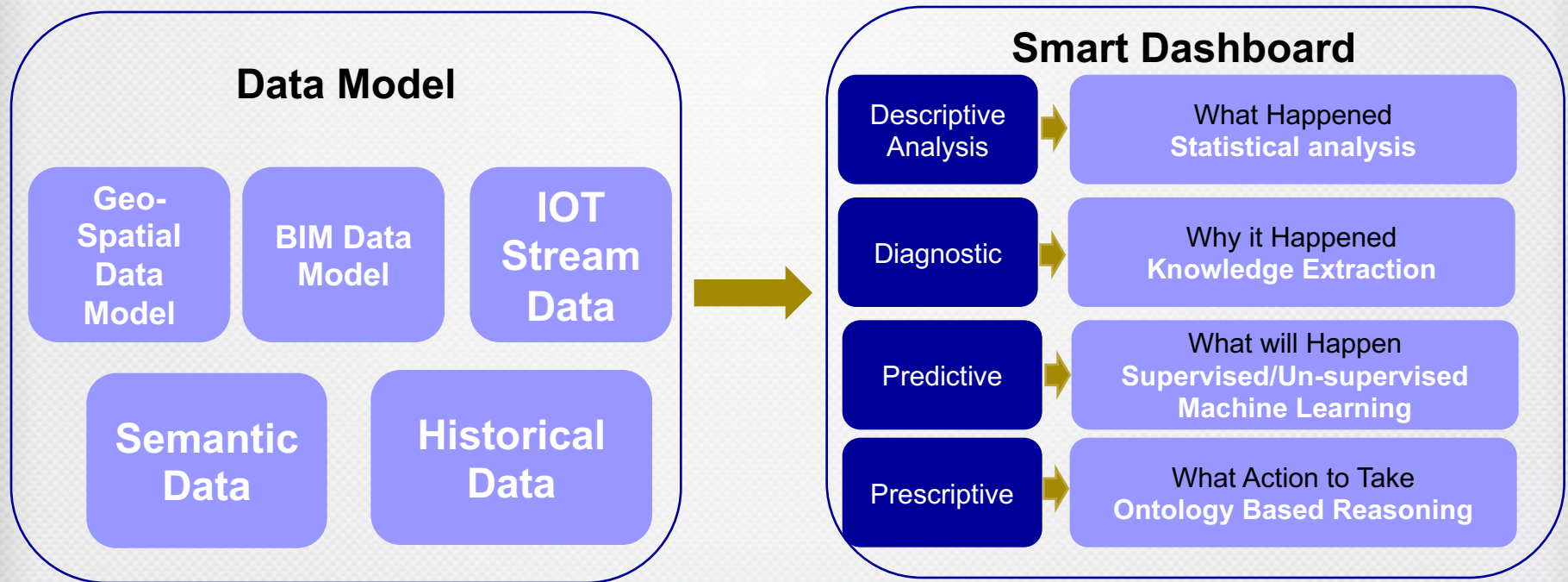All these …confuse Data Analytics and Decision Making.

Why Knowledge Discovery in 3D Space

- David, as a building Manager has to prepare well log report for owners about energy efficiency of building, controlling any crime in campus, lighting Management … . He has only few data from bills or reports and so on.

- Expectations: More Insights, and better decision to finalize report.

- The lake of a union framework and methodology in one place to have more insight and help decision maker in the realm of multi building.
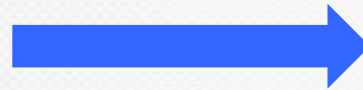
Proposed Solution

Data Model

- Geo-Spatial Data Model
- BIM Data Model
- IOT Stream Data
- Semantic Data
- Historical Data

Smart Dashboard

Descriptive Analysis	→	What Happened **Statistical analysis**
Diagnostic	→	Why it Happened **Knowledge Extraction**
Predictive	→	What will Happen **Supervised/Un-supervised Machine Learning**
Prescriptive	→	What Action to Take **Ontology Based Reasoning**

Proposed Solution

Spatial Smart Dashboard

Unified Rules Extraction and Decision Engine From Data Lake

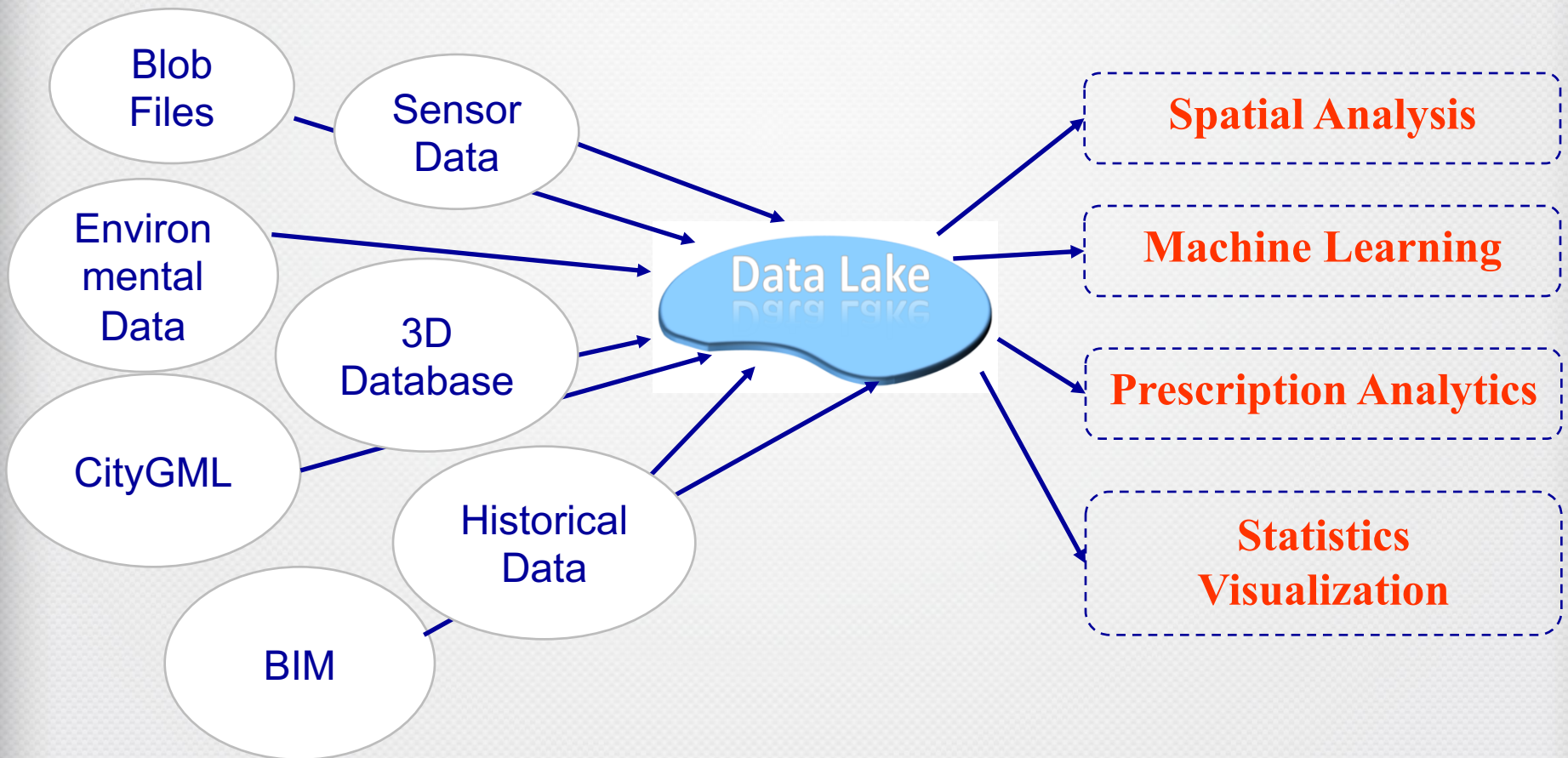| Smart Citizens	Decision Makers	Evacuation Plan	Energy Efficiency	Emergency Response

Data Architecture Model

Blob Files

Sensor Data

Environmental Data

3D Database

CityGML

Historical Data

BIM

Data Lake

Spatial Analysis

Machine Learning

Prescription Analytics

Statistics Visualization

Information Table

| Object	Age	Distance to Exit (m)	Floor (3D Information)	Age of Building	Disability	Decision
O_1	32	1	2	10	NO	Use Exit Stairs
O_2	52	1	4	15	Yes	Saviour Help
O_3	42	3	2	20	NO	Use Exit Stairs
O_4	50	2.5	2	20	NO	Use Exit Stairs
O_5	30	1	37	40	NO	Use Exit Stairs
O_6	30	2	1	12	NO	Saviour Help
O_7	30	1	37	40	NO	Saviour Help
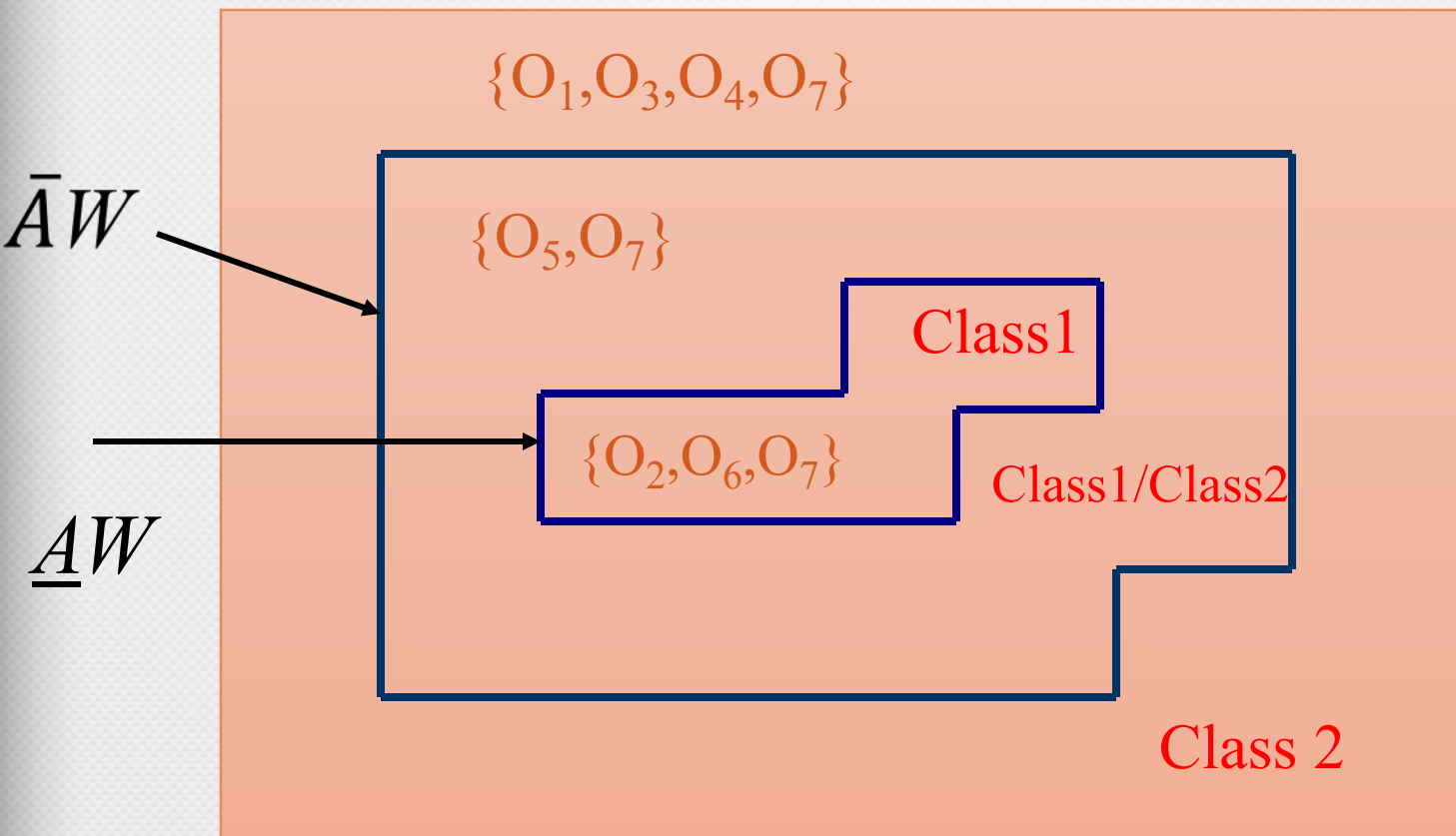
How do it better…
Proposed Fuzzy Granular Decision Tree

❑ **FGDT plays the role of global Optimization rather local optimization**

❑ **FGDT supports discrete and continuous attributes in 2D/3D geometry dataset and semantic data.**

How do it better…**Fuzzy Reasoning as Decision Making Engine**

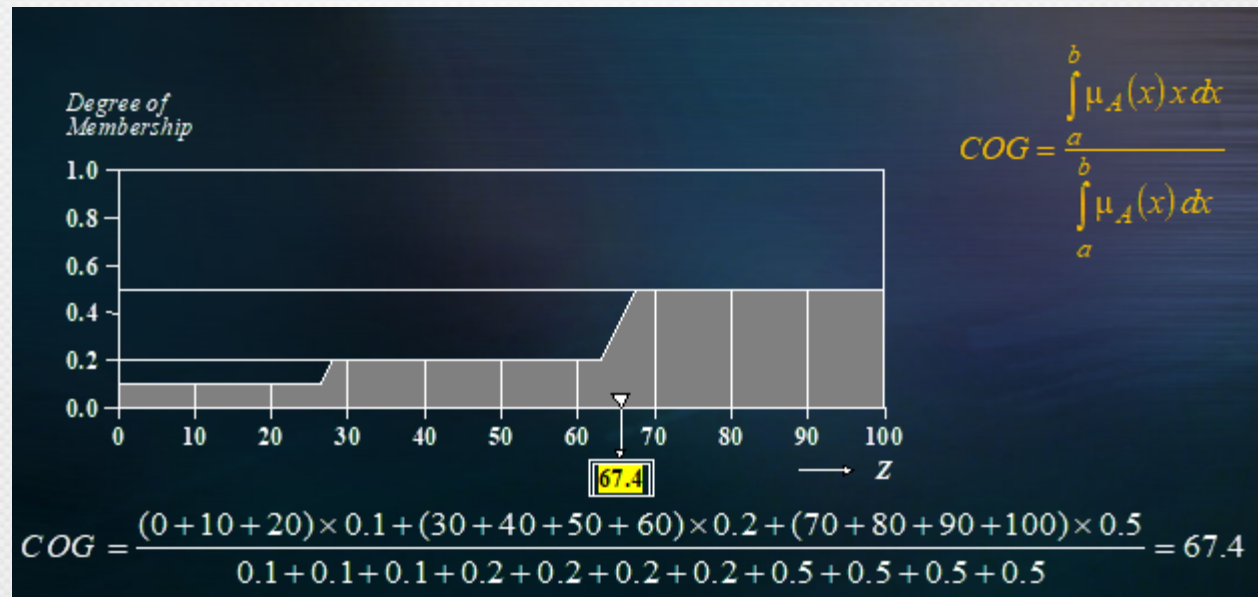**Rule 1 (2D &3D)** : Age = 50 AND Floor = 3 AND Disability = NO AND Distance to Exit Door = 8 m

Rule 2 (2D &3D) : Age = 35 AND Floor = 1 AND Disability = NO AND Distance to Exit Door = 5 m

Aggregated Function
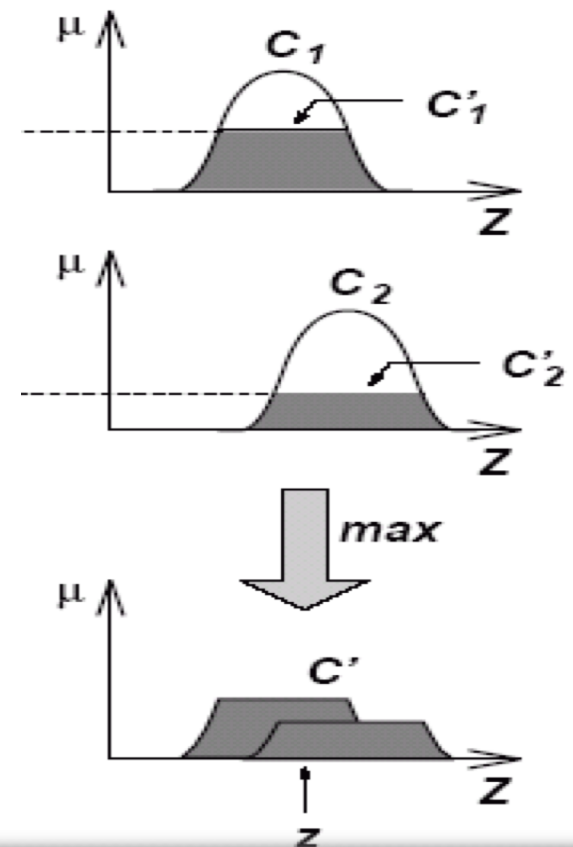
How do it better…Defuzzification

❑ **The input for the defuzzification process is the aggregate output fuzzy set and the output is a single number.**

❑ **Centroid defuzzification method finds a point representing the center of gravity of the aggregated fuzzy set A, on the interval [a, b]**

$$COG = \frac{\int_a^b \mu_A(x)\, x\, dx}{\int_a^b \mu_A(x)\, dx}$$

$$COG = \frac{(0+10+20)\times 0.1+(30+40+50+60)\times 0.2+(70+80+90+100)\times 0.5}{0.1+0.1+0.1+0.2+0.2+0.2+0.2+0.5+0.5+0.5+0.5} = 67.4$$

Stay Tune for next…

❑ **Manage different types of data (2D/3D Geo-DB, Semitics, Blob Files, sensor Data ,…) in the term of Storing and Analytics in a Data Lake (Azure Data Lake)**
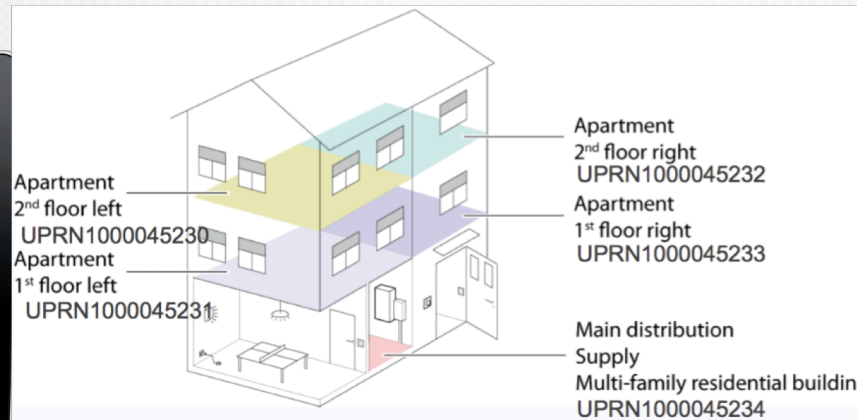
❑ **The Proposed Unified Rule Extraction and Decision Engine from 3D Geo-DB and BIM data Enhance proper Performance of different Applications.**

Stay Tune for next…

❑ **Design a Spatial Smart Dashboard (SSD) with four major types of analytics like Descriptive analytics to answer the question of what**
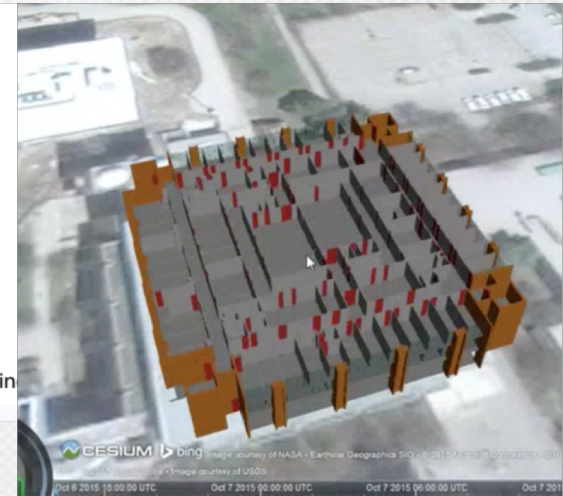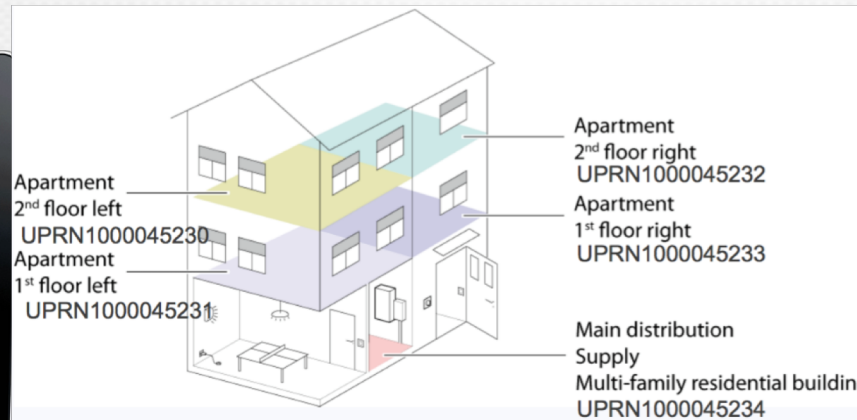
happened, Diagnostic analytics to determine why happened, Predictive analytics to predict the phenomena in a period of time and Prescriptive to what take action.

Thank you …