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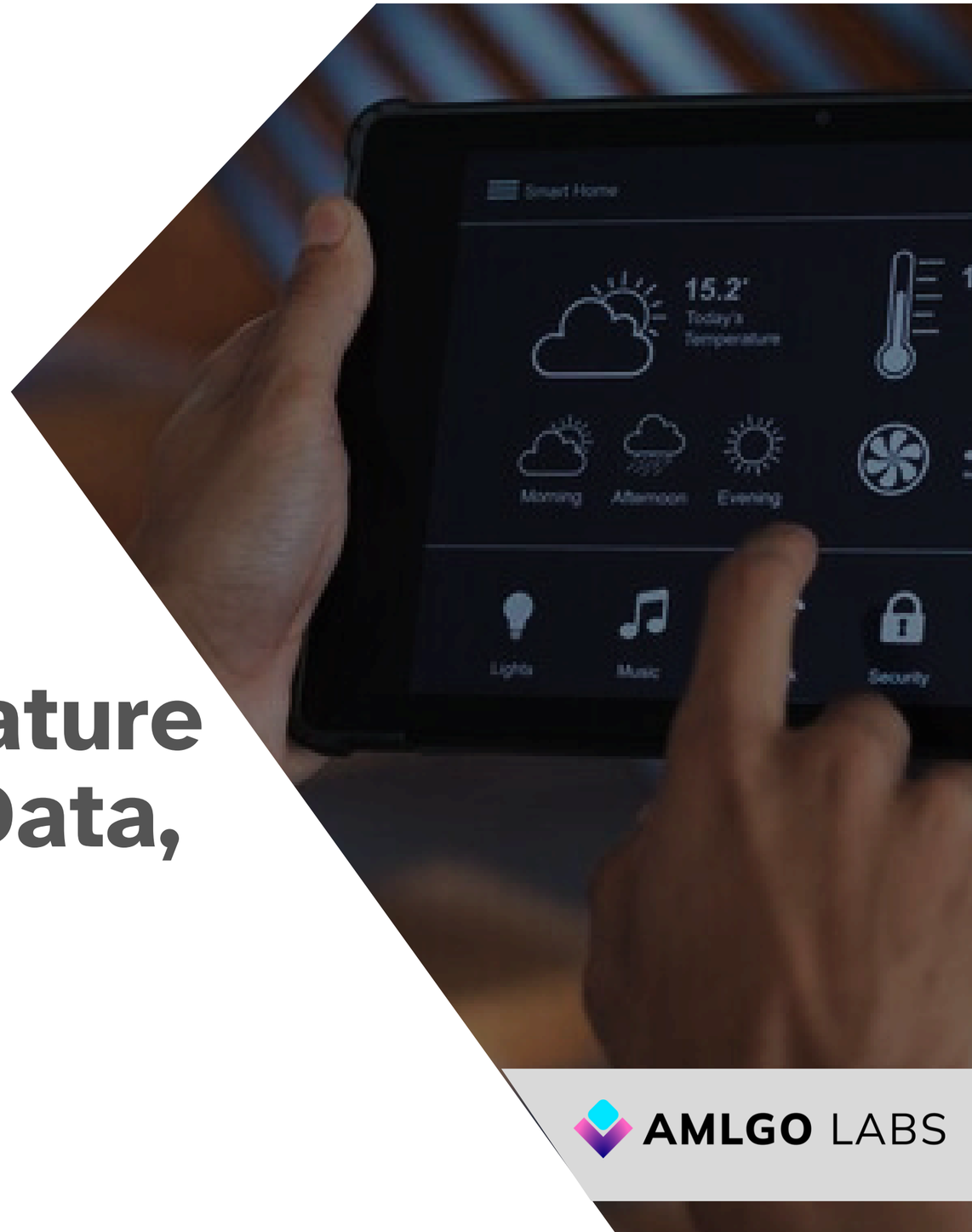
Ensuring Scalability, Governance & Innovation



IoT-enabled AC temperature controller system (IoT Data, and ML/AI)

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Background which led to the problem statement

Large AC Manufacturer IoT platform MirAIe powers a range of appliances such as air conditioners, washing machines, refrigerators and many other connected devices.

In the case of AC, using MirAIe app user can control all the features of AC from anywhere in the world. MirAIe also allows user to define their sleep profile by defining their own temperature setting for the entire sleep duration. This profile can be activated with the touch of a button.

At present, MirAIe also recommends similar cohort users AI-defined sleep profiles, so users don't have to take the pain of randomly tweaking sleep profiles. This feature has been very well appreciated by the users.

However, the Large AC Manufacturer wants its AC to be fully autonomous by bringing in comfortable sleep and living based on users occupying a space (room/bedroom/office). And exploring the option to auto-adjust the AC's cooling based on both external climatic factor and internal occupancy/movement so that, for instance, when it rains outside and the ambient temperature is down, the AC can bring down the cooling temperature accordingly.

Problem statement and Proposed Solution

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PROBLEM	Regulate a comfortable AC configuration throughout the day.
SOLUTION	Predict the optimal AC temperature, AC mode, and fan speed at every 5 minutes using **machine learning**

Proposed Solution

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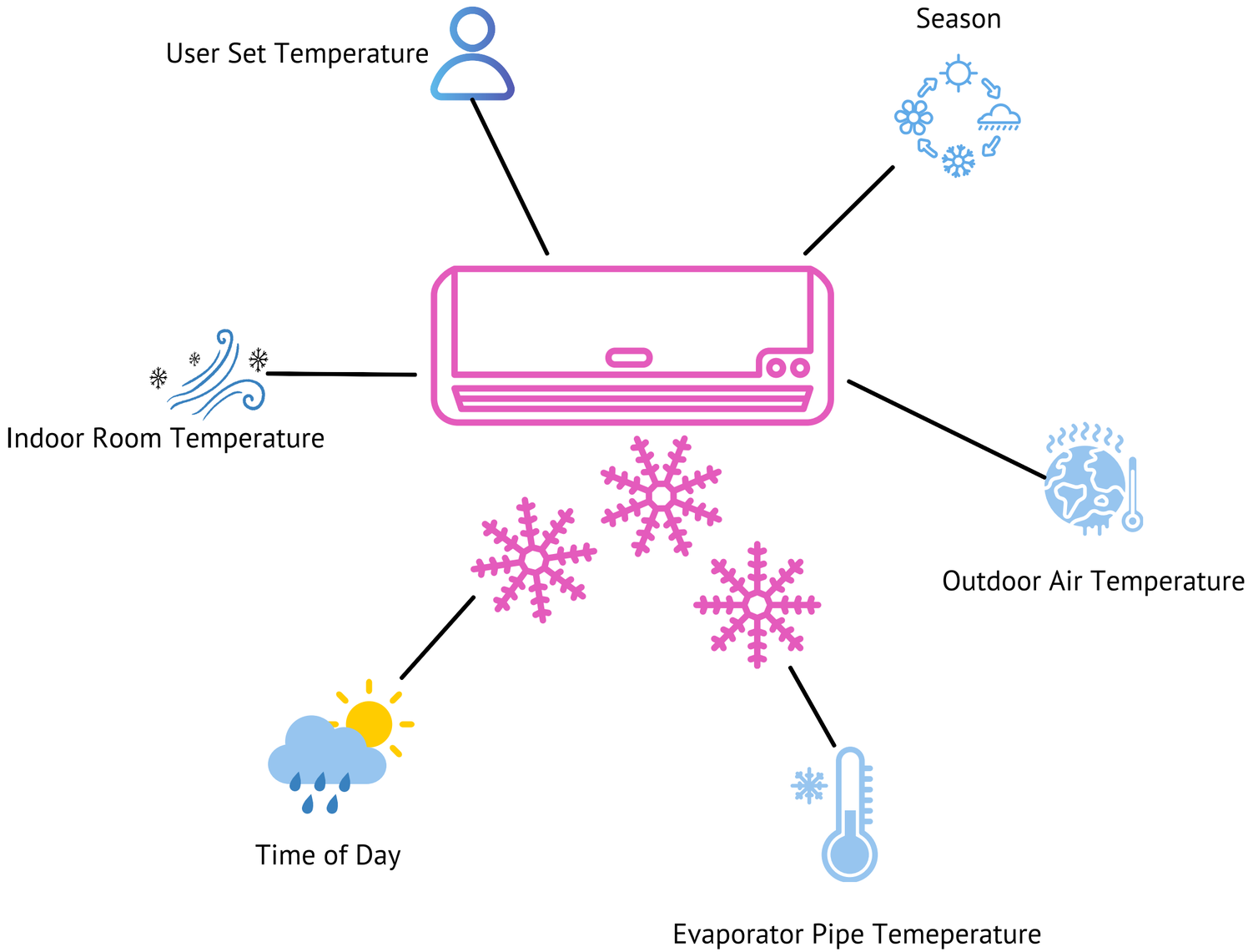
Input Features

- Diagnostic Data Readings
- Derived Features Based on Timestamp

Target variables

- Temperature Change (Increase/Same/Decrease)
- AC Mode (Auto/Cool/Dry/Fan)
- Fan Speed (Auto/Quiet/Low/



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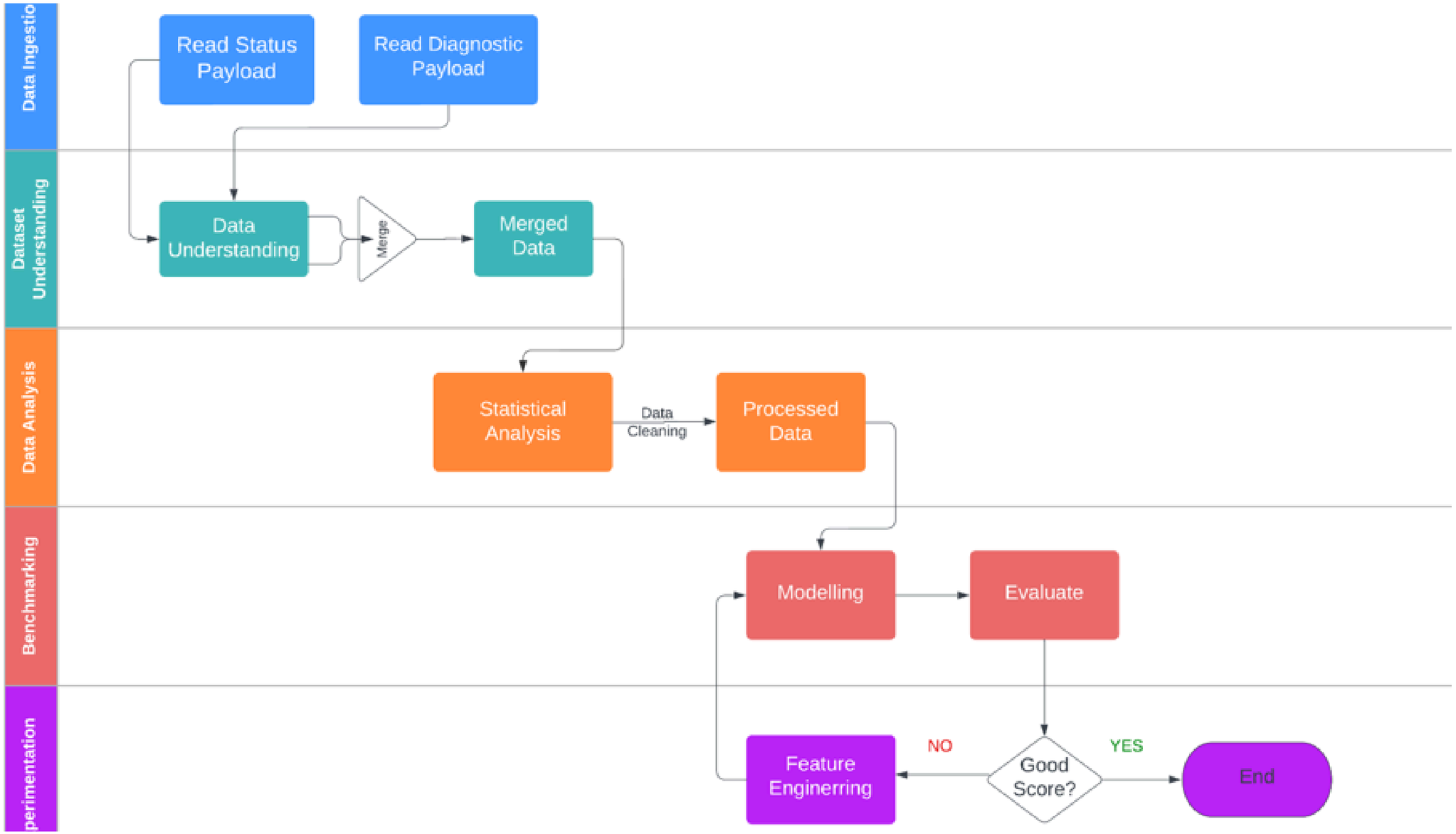
Approach taken towards creating the solution



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Technology Snapshot

- We use python for all data manipulation and modelling purposes.
  Example: Merging **diagnostic** and **status** data

- Used various ML models for training:
  - Logistic
  - KNN
  - Random Forest
  - XGBoost, etc


```
: bisect

.nd_index(arr, x):
 'Binary Search to find the required index'''
idex = bisect.bisect_right(arr, x)
: index: # row found
   return index-1
.se:     # row not found
   return -1

.nd_row(diag, time):
 'Find the required row to merge diagnostic and payload'''
lx = find_index(diag['ts_date'], time)
: idx != -1: # row found
   return diag.iloc[idx][COLS].to_frame().T
.se:         # row not found
   return pd.DataFrame(columns=COLS)
```

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Solution Demonstration and Results

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Target **Predictions**

Tr_i	Te_i	Ta_o	Tu_i	time of day	season	temp change	ac mode	fan speed
24	11	26	26	2	2	same	cool	medium

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Target **Predictions**

Tr_i	Te_i	Ta_o	Tu_i	time of day	season	temp change	ac mode	fan speed
24	11	26	26	2	2	same	cool	medium
26	12	28	26	2	2	decrease	cool	medium

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Target **Predictions**

Tr_i	Te_i	Ta_o	Tu_i	time of day	season	temp change	ac mode	fan speed
24	11	26	26	2	2	same	cool	medium
26	12	28	26	2	2	decrease	cool	medium
21	13	28	21	2	2	same	cool	medium

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Target **Predictions**

Tr_i	Te_i	Ta_o	Tu_i	time of day	season	temp change	ac mode	fan speed
24	11	26	26	2	2	same	cool	medium
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21	13	28	21	2	2	same	cool	medium
21	12	27	21	2	2	same	cool	medium

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Target **Predictions**

Tr_i	Te_i	Ta_o	Tu_i	time of day	season	temp change	ac mode	fan speed
24	11	26	26	2	2	same	cool	medium
26	12	28	26	2	2	decrease	cool	medium
21	13	28	21	2	2	same	cool	medium
21	12	27	21	2	2	same	cool	medium
19	10	22	21	3	2	increase	fan	low

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Target **Predictions**

Tr_i	Te_i	Ta_o	Tu_i	time of day	season	temp change	ac mode	fan speed
24	11	26	26	2	2	same	cool	medium
26	12	28	26	2	2	decrease	cool	medium
21	13	28	21	2	2	same	cool	medium
21	12	27	21	2	2	same	cool	medium
19	10	22	21	3	2	increase	fan	low
22	10	22	22	3	2	same	fan	low

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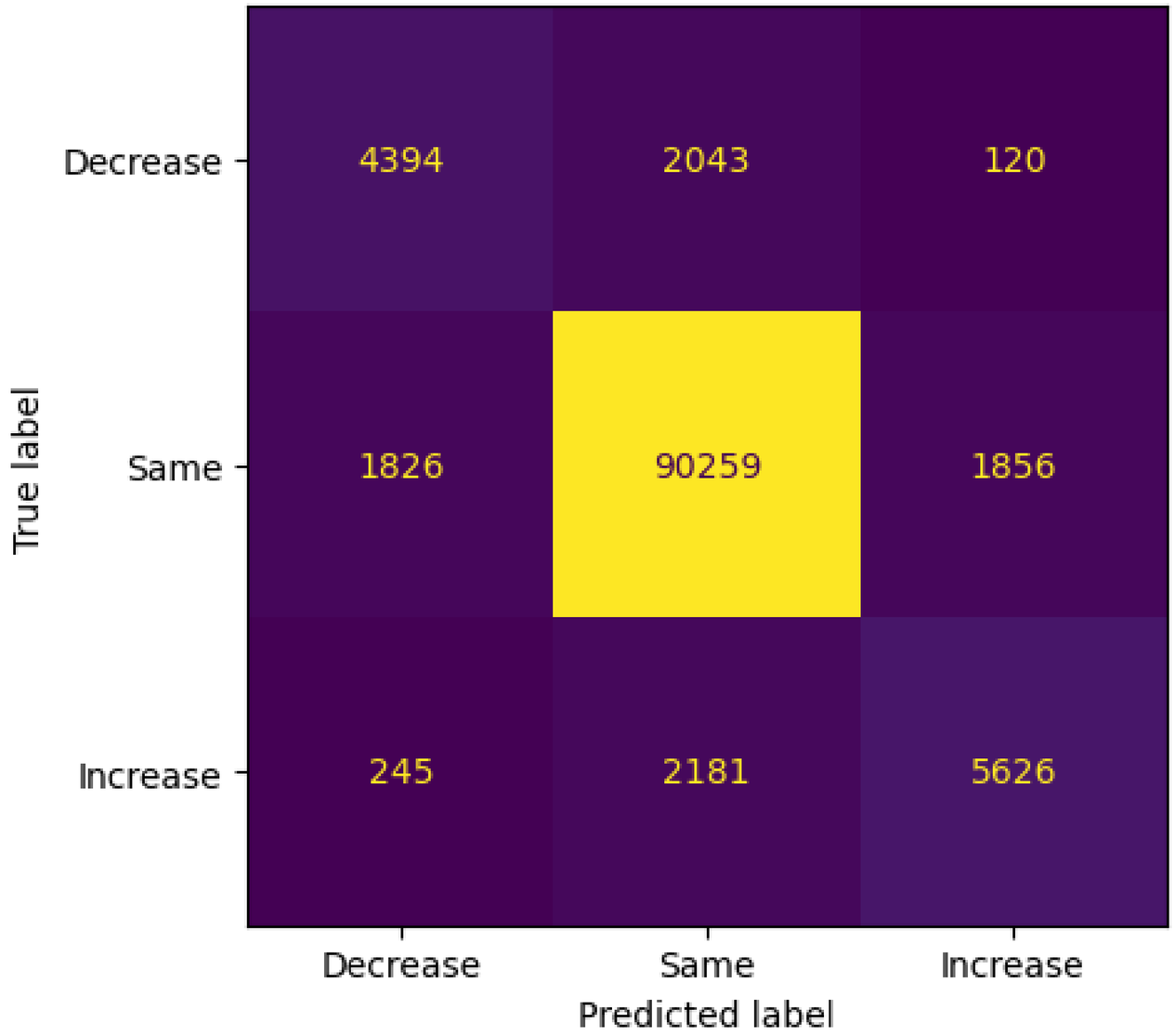
Model **Evaluation Metrics**

Confusion Matrix

The model performance on Temp Change



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Model **Evaluation Metrics**

Scores

The model performance on Temp Change

	precision	recall	f1-score	support
Decrease	0.68	0.67	0.67	6557
Same	0.96	0.96	0.96	93941
Increase	0.74	0.70	0.72	8052
accuracy			0.92	108550
macro avg	0.79	0.78	0.78	108550
weighted avg	0.92	0.92	0.92	108550

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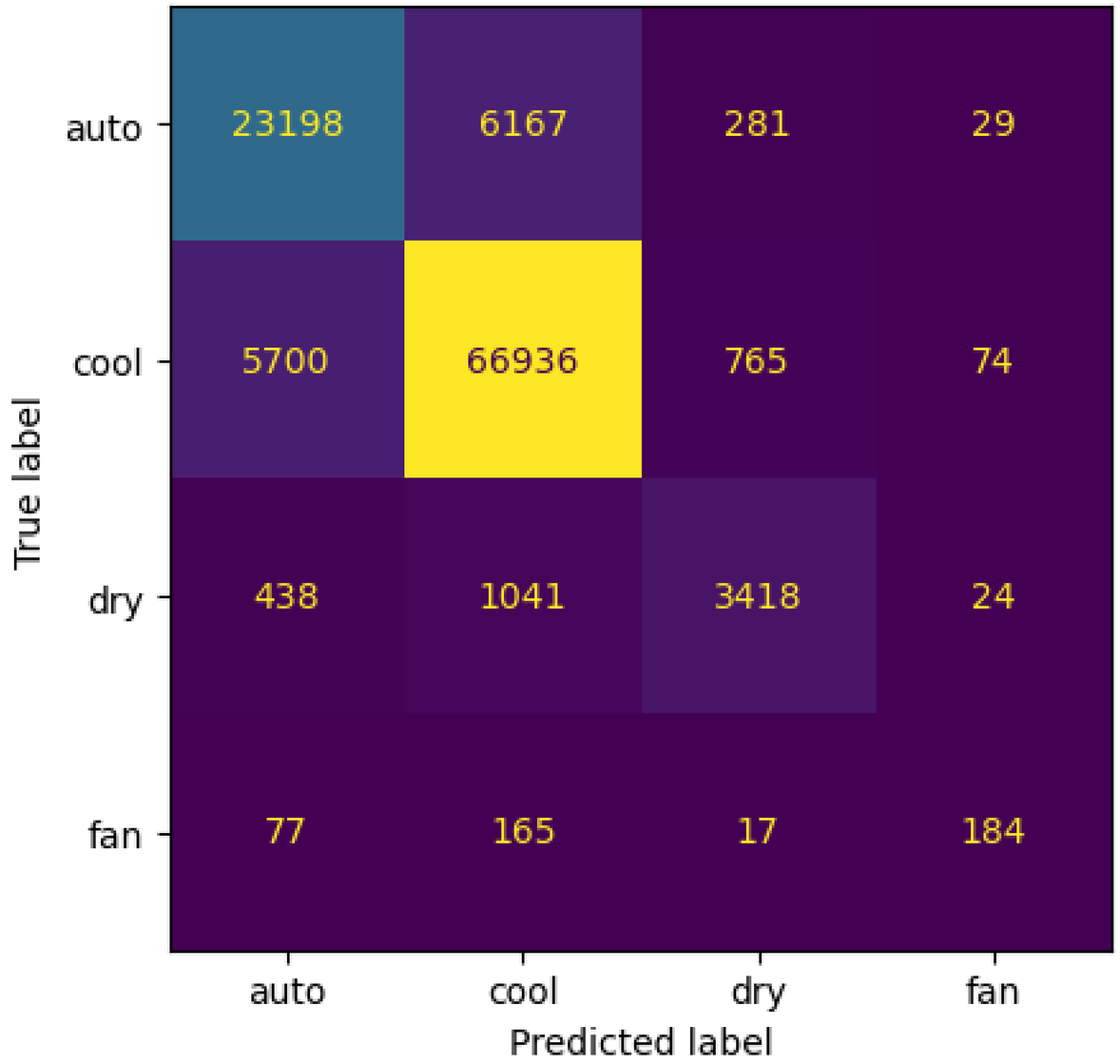
Model **Evaluation Metrics**

Confusion Matrix

The model performance on AC Mode



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Model **Evaluation Metrics**

Scores

The model performance on AC Mode

	precision	recall	f1-score	support
auto	0.79	0.78	0.79	29675
cool	0.90	0.91	0.91	73475
dry	0.76	0.69	0.73	4921
fan	0.59	0.42	0.49	443
accuracy			0.86	108514
macro avg	0.76	0.70	0.73	108514
weighted avg	0.86	0.86	0.86	108514

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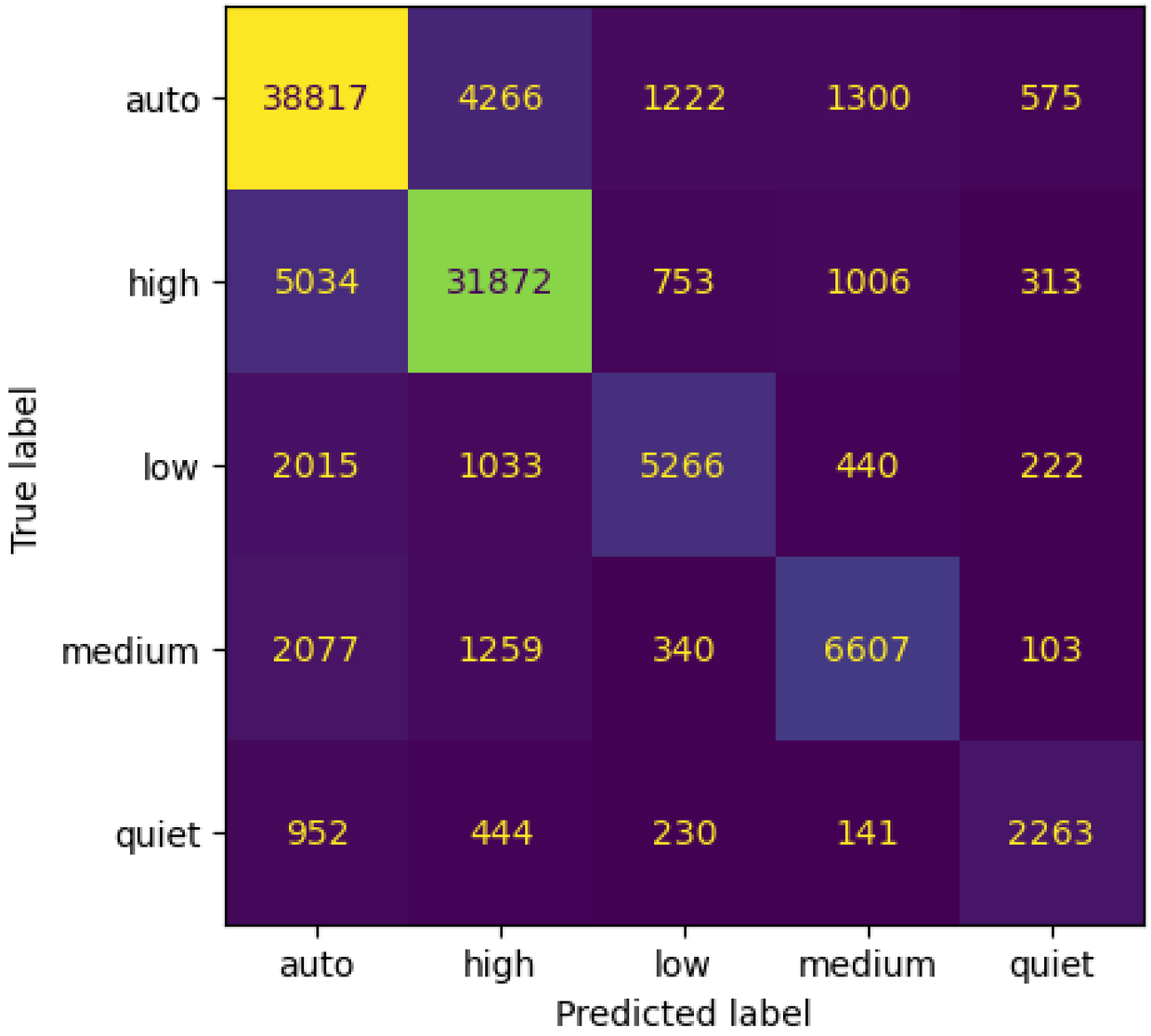
Model **Evaluation Metrics**

Confusion Matrix

The model performance on Fan Speed



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Model **Evaluation Metrics**

Scores

The model performance on Fan Speed

	precision	recall	f1-score	support
auto	0.79	0.84	0.82	46180
high	0.82	0.82	0.82	38978
low	0.67	0.59	0.63	8976
medium	0.70	0.64	0.66	10386
quiet	0.65	0.56	0.60	4030
accuracy			0.78	108550
macro avg	0.73	0.69	0.71	108550
weighted avg	0.78	0.78	0.78	108550

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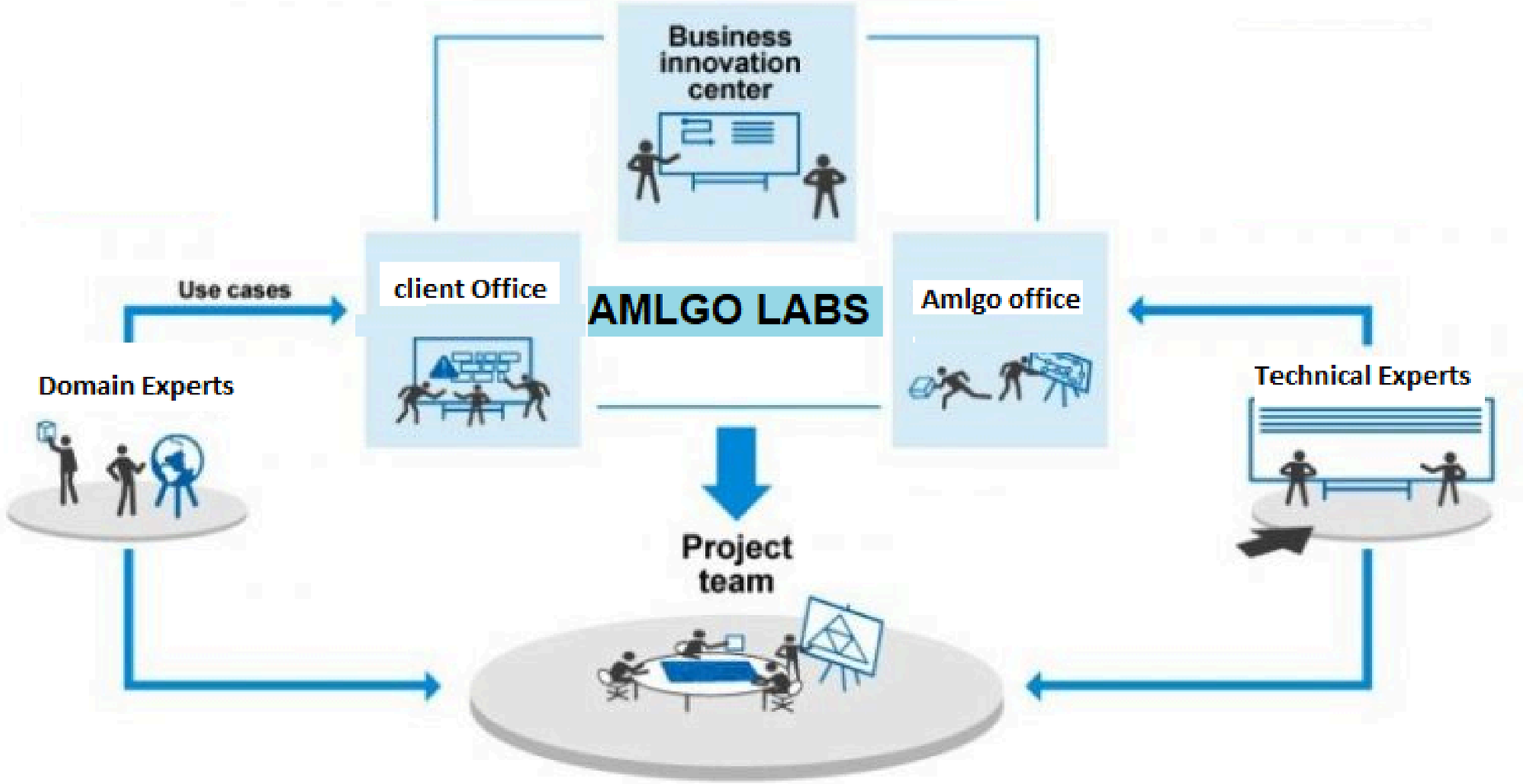
Business Model with Enterprises



B2B Services in data driven technologies.

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