Predicting Purchasing Intent from User Behaviour on e-Commerce Platform

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Agenda

- Industry Context
- The Problem
- The Data
- Feature Engineering & Selection
- Key Performance Indicators
- Model Training & Validation
- Marketing Strategy

The Industry

USD 4.2 trillion

2021 projected online sales

50% digital

2020-2025 global retail growth

22 billion

June 2020 retail website visits

2.19%

2020 shopper conversion rate

Source: Forbes, Statista

2.19%

2020 shopper conversion rate

What?

Ratio of purchases to visits, expressed as a percentage

So what?

418 million visits across 6 SEA nations in 2020

0.1% conversion rate increase – USD $13.38 million

Who cares?

They do, so we have to

Their 0.1%, our whole business - everyone is a stakeholder

Source: Economic Development Board Singapore, iPrice, SimilarWeb, AppsFlyer

The Problem

- Visit ≠ Purchasing intent
  - Just browsing (Low intent)
- Purchasing intent ≠ Purchase
  - Cheaper competitor (High intent, but alternative cheaper)
  - High checkout fees (High intent, but final price increased)
- User feelings unknown, but user activity known

Business question: Can we identify users with purchasing intent from their user session activity to apply targeted marketing strategies and increase purchases?

Data question: What features and model best predict user purchasing intent from user session data?

The Data

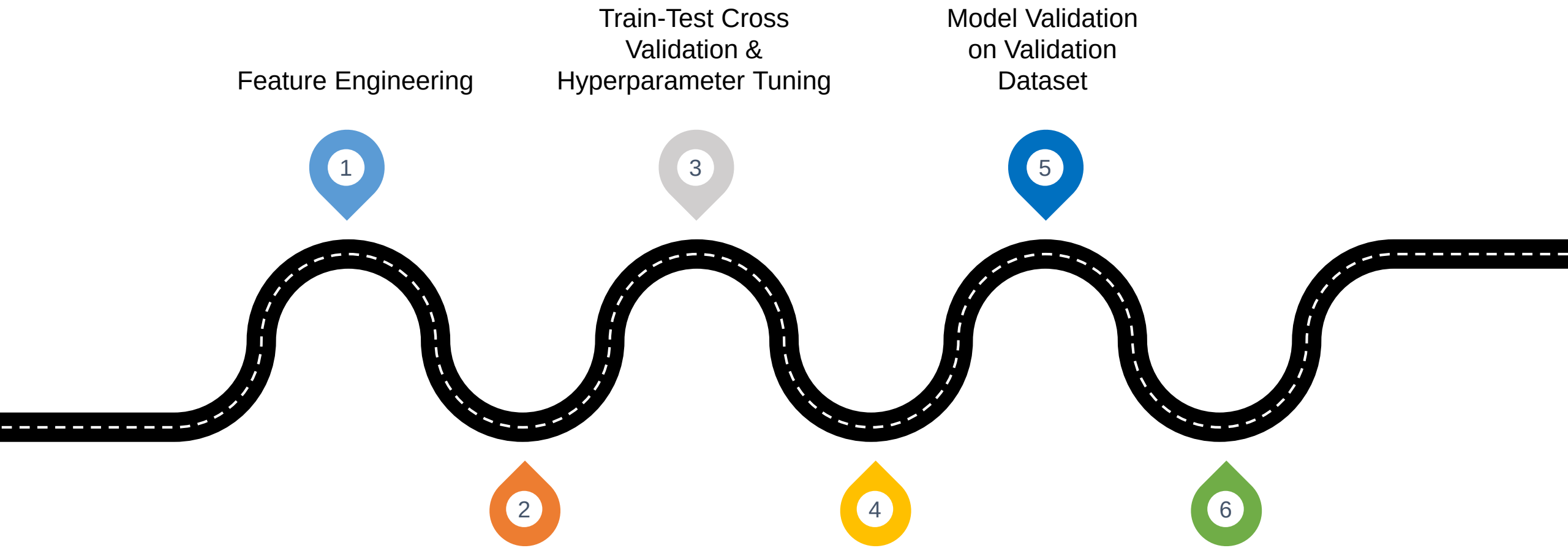
Oct 2020 event activity for Electronics e-Commerce store in Singapore (assumed)

- 161,544 records, 9 variables

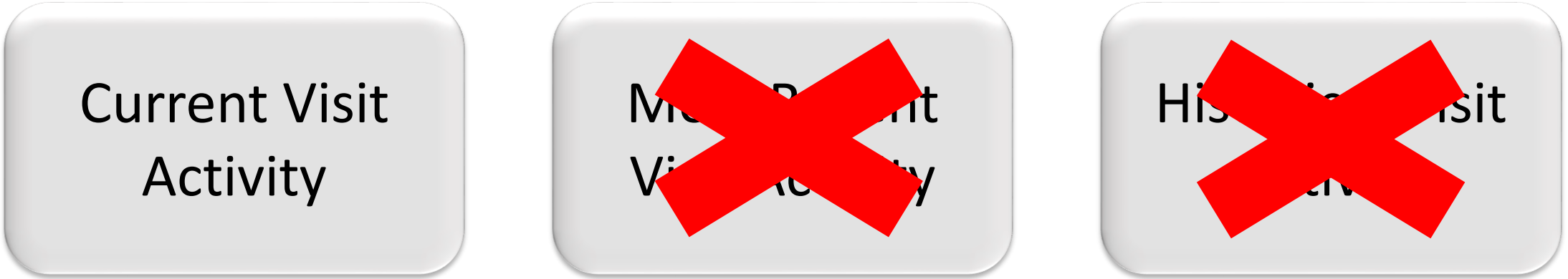
Event Time	Event Type	Product ID	Category ID	Category Code	Brand	Price	User ID	User Session
2020-10-01 00:33:34+00:00	purchase	1168166	2144415927049912542	electronics.video.tv	starwind	105.87	1515915625521281104	SJUH0TBLGD

- Event Types: view, cart, purchase
- “User Session” can be open for days – unreliable
- Daily user activity used as visits
  - 92,277 visits – 3,983 purchases; 88,294 no purchases

Workflow


Feature Engineering
Train-Test Cross Validation & Hyperparameter Tuning
Model Validation on Validation Dataset
1
2
3
4
5
6
80-20 Train-Test Validation Split
KPI Comparison & Model Selection
Final Performance Evalulation

Feature Engineering & Selection



- Most Recent and Historical Visit Activity metrics biased against new users
  - Feature engineering limited to Current Visit Activity
  - Past Visit Activity useful for other applications e.g. customer profiling, rewards program

Feature Engineering & Selection

Feature engineering based on inferred interest

- Time investment
- Repeated product engagement (‘view’ and ‘cart’)
- Pre-purchase action (‘cart’)

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Daily User Session (Index)	Duration in Seconds	Count of ‘Views’ and ‘Carts’ for most frequently browsed Category ID	Cart Quantity	Purchased (Target)	Purchase Value	Cart Value
1515915625521281104 _2020-10-01	1560	4	1	1	105.87	105.87

Key Performance Indicators

- High Recall score – Accurate prediction of purchasing intent
- Model training time

Note: False Positives not model failure

- Predicted purchasing intent, but outcome was no purchase
- Remember: Purchasing intent ≠ Purchase
- Essential target group for marketing strategy

Train-Test Results

- All models had practical training time
- XGBoost highest in Recall score
- Hyperparameter tuning boosted Recall score to 92.9%
  → Selected for validation

Algorithm	Mean Train-Test Recall	Mean Model Train Time (seconds)
Logistic Regression	28.2%	0.332
Support Vector Machine	33.5%	47.8
Naïve Bayes	60.2%	0.0195
Decision Tree	60.9%	0.0419
Random Forest	65.5%	1.91
AdaBoost	80.7%	0.965
XGBoost	89.2%	1.60
XGBoost (tuned)	92.9%	

Validation

- Recall score: 93.0%

→ Highly accurate purchasing intent prediction

→ All 56 FN were purchases without ‘cart’ event

- Feature Importance (normalized):

1. Cart Quantity (0.895)
2. Count of ‘Views’ and ‘Carts’ for most frequently browsed Category ID (0.104)
3. Duration in Seconds (0.001)

Predicted Outcome

Actual Outcome

	No Purchase	**Purchase**
No Purchase	17,280 (TN)	379 (FP)
Purchase	56 (FN)	741 (TP)

Marketing Strategy

- Adding items to cart key indicator of purchasing intent

Focus strategy on top causes of cart abandonment:

1. Just browsing/Not ready to buy – 58.6%
2. Extra costs too high (shipping, tax, fees) – 20.3%

Predicted Outcome

Actual Outcome

	No Purchase	**Purchase**
No Purchase	0.01% Cart Quantity >0	100% Cart Quantity >0
Purchase	0% Cart Quantity >0	100% Cart Quantity >0

Source: Baymard Institute

Marketing Strategy

Focus area: Cart abandonment due to extra costs too high – 20.3%

Focus Segment

→ 20.3% * (242 + 379) = 126 additional purchases

Cost: Apply average $5 discount – taken up by focus segment + confirmed purchases

→ $5 * (126 + 741) = $4,335

Average cart amount = $141

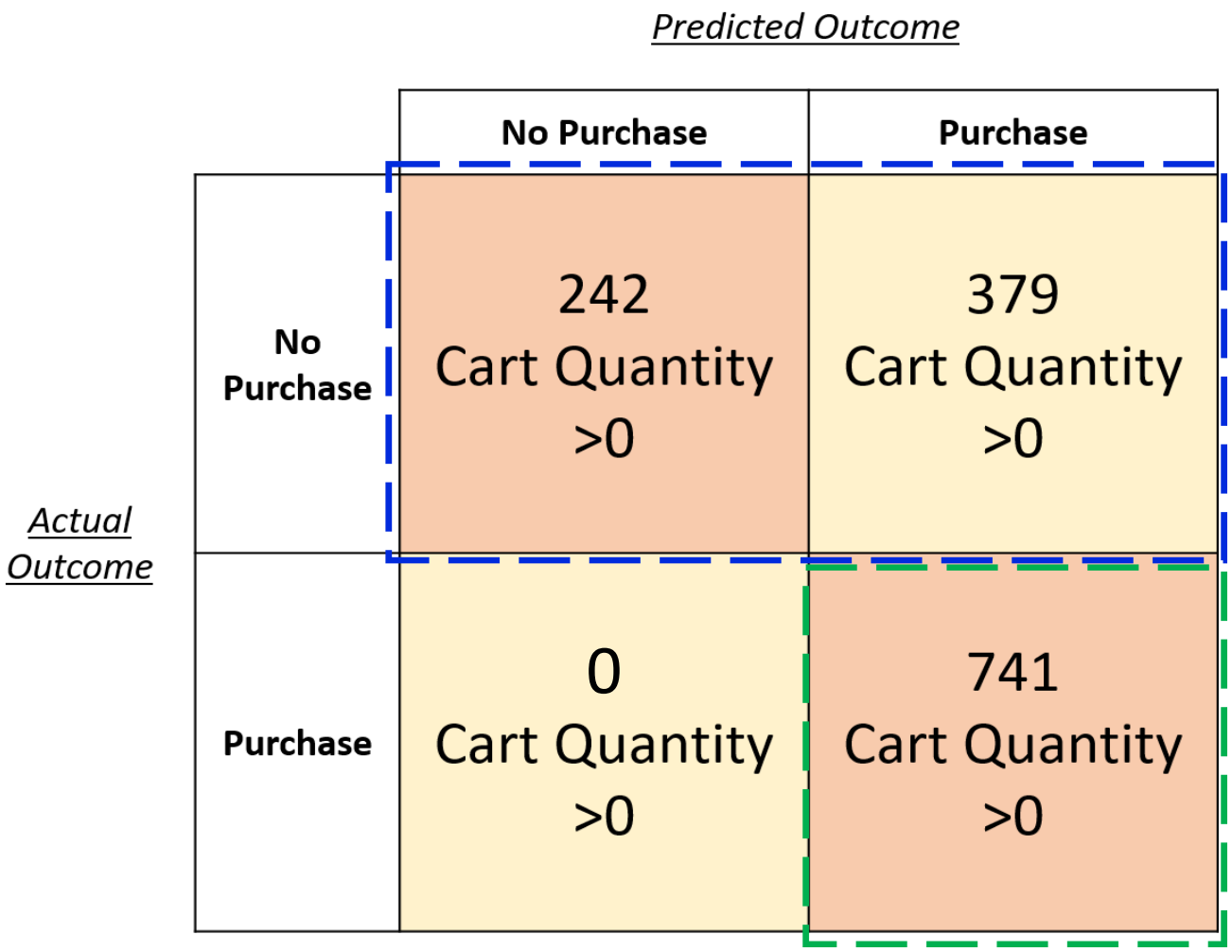
Additional revenue

→ 126 * $141 = $17,766

Assume 5% of monthly revenue for marketing budget

→ 5% * $562,590 = $28,129

Strategy is within budget and brings more revenue than cost



Conclusion

1. *Adding items to cart is a key indicator of purchasing intent*
2. *Tuned XGBoost model attained 93.0% recall score for predicting purchasing intent*
3. *Marketing strategies can be applied to users with predicted purchasing intent to prevent cart abandonment and increase conversion rate*

Future steps

- Validate marketing strategy with trial
- User activity can be enriched with more variables

Thank You

Appendix

Data Source:

https://www.kaggle.com/mkechinov/ecommerce-purchase-history-from-electronics-store

Forbes:

https://www.forbes.com/sites/joanverdon/2021/04/27/global-ecommerce-sales-to-hit-42-trillion-as-online-surge-continues-adobe-reports/?sh=14404f7150fd

https://www.forbes.com/sites/michelleevans1/2021/03/25/global-e-commerce-market-to-expand-by-us1-trillion-by-2025/?sh=5f3df336cc02

Statista:

https://www.statista.com/statistics/1112595/covid-19-impact-retail-e-commerce-site-traffic-global/

https://www.statista.com/statistics/439576/online-shopper-conversion-rate-worldwide/

Appendix

Google Analytics:

https://support.google.com/analytics/answer/6014873?hl=en#zippy=%2Cin-this-article

Economic Development Board Singapore, iPrice, SimilarWeb, AppsFlyer:

https://www.edb.gov.sg/en/business-insights/insights/how-did-the-pandemic-affect-online-shopping-behaviour-in-2020.html

Baymard Institute:

https://baymard.com/lists/cart-abandonment-rate