



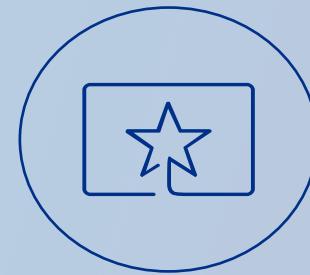
# Semi-Supervised Learning to Extend our Tagging Coverage

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October 7, 2018

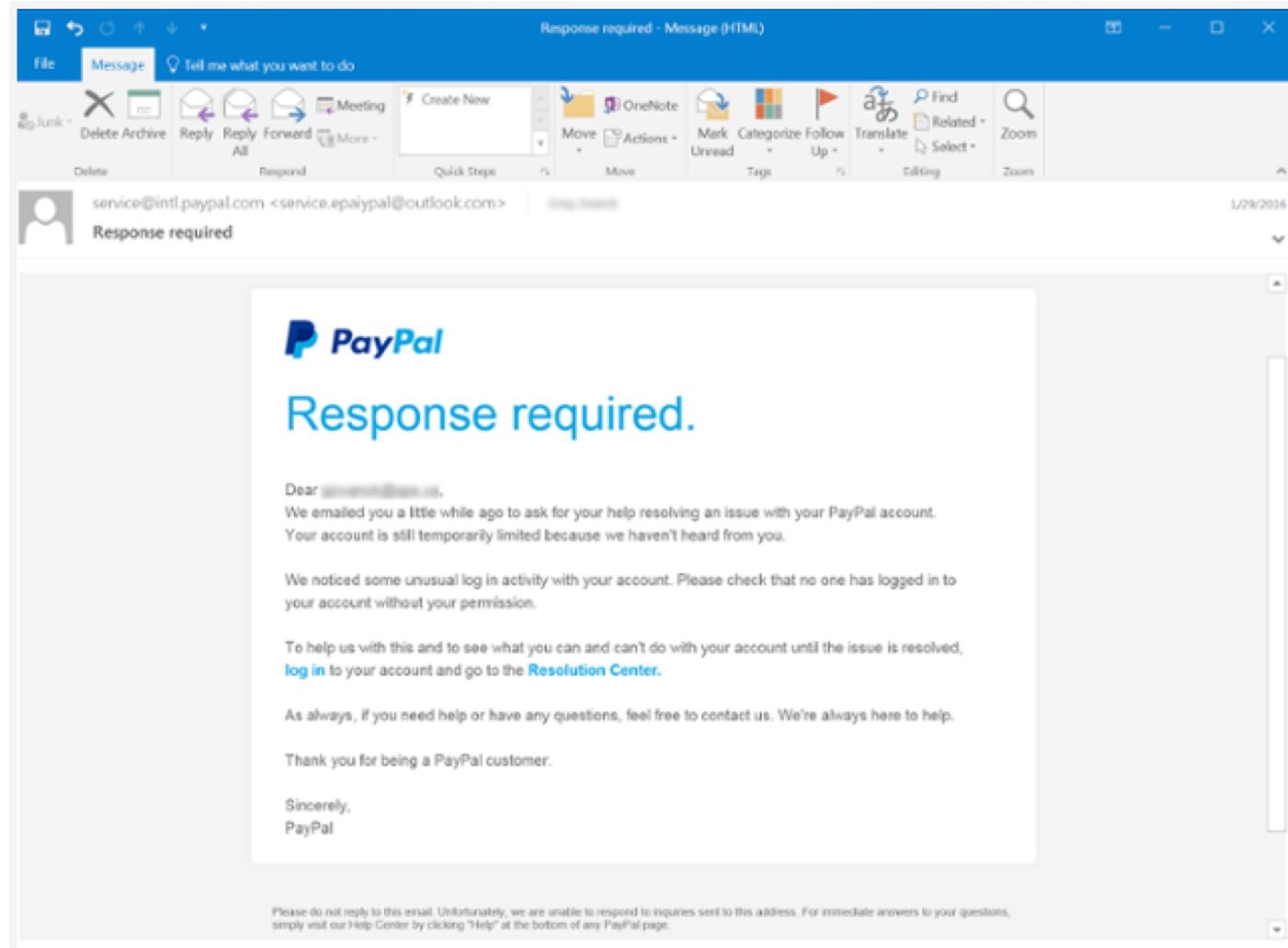


**CONSUMERS**



**MERCHANTS**

# Unauthorized Transactions



The screenshot shows an Outlook email window with the subject "Response required - Message (HTML)". The message is from "service@intl.paypal.com <service.epaypal@outlook.com>" and is titled "Response required". The body of the email is as follows:

**PayPal**

## Response required.

Dear [REDACTED],  
We emailed you a little while ago to ask for your help resolving an issue with your PayPal account.  
Your account is still temporarily limited because we haven't heard from you.

We noticed some unusual log in activity with your account. Please check that no one has logged in to your account without your permission.

To help us with this and to see what you can and can't do with your account until the issue is resolved, [log in](#) to your account and go to the [Resolution Center](#).

As always, if you need help or have any questions, feel free to contact us. We're always here to help.

Thank you for being a PayPal customer.

Sincerely,  
PayPal

Please do not reply to this email. Unfortunately, we are unable to respond to inquiries sent to this address. For immediate answers to your questions, simply visit our Help Center by clicking "Help" at the bottom of any PayPal page.

# Unauthorized Transactions

 **PayPal**    [Summary](#)    [Activity](#)    [Send & Request](#)    [Wallet](#)    [Shop](#)

**Report a problem**

What type of problem would you like to address?

**Item dispute:** I did not receive an item I purchased or the item I received is significantly not as described.  
[Learn more about opening a dispute](#)

**Unauthorized transaction:** I did not authorize a recent transaction.  
[Learn more about filing an unauthorized claim](#)

[Continue](#)    [Cancel](#)

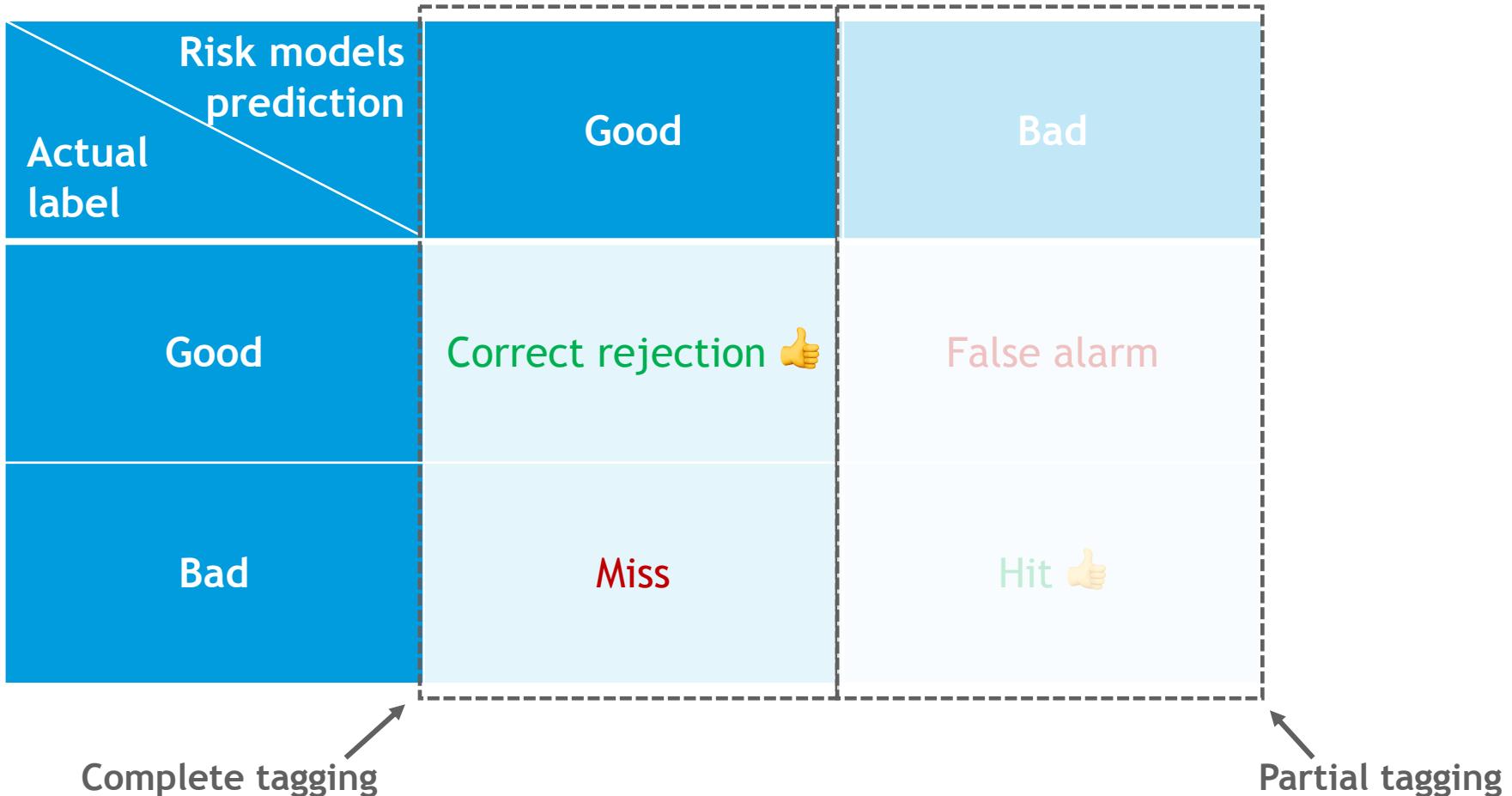
[Help](#)   [Contact](#)   [Security](#)

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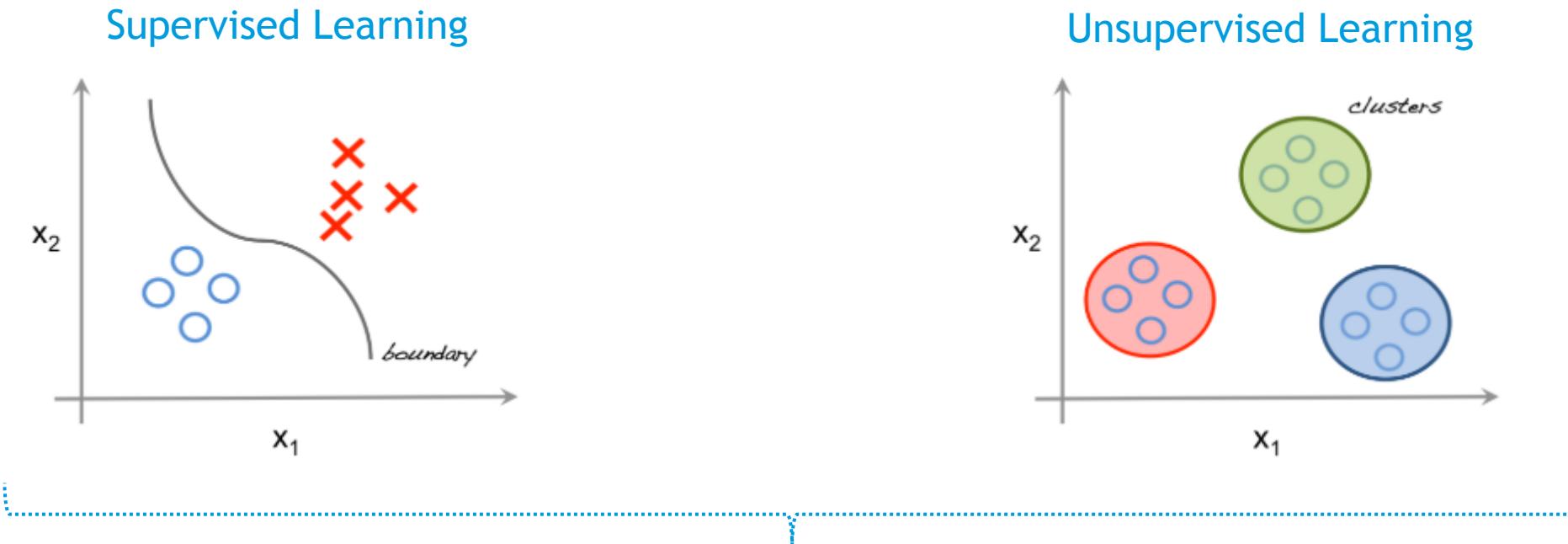
# Training a Model to Stop Unauthorized Transactions

Features				
Amount (\$)	Time of day	Time of Day consistency	...	Label
99.99	00:00	High		Good
135	00:00	Medium		Bad
82	00:00	Medium		Good
453.16	8:00	High		Good
102	8:00	Medium		Good
14.1	8:01	Low		Bad
55	10:05	Medium		???

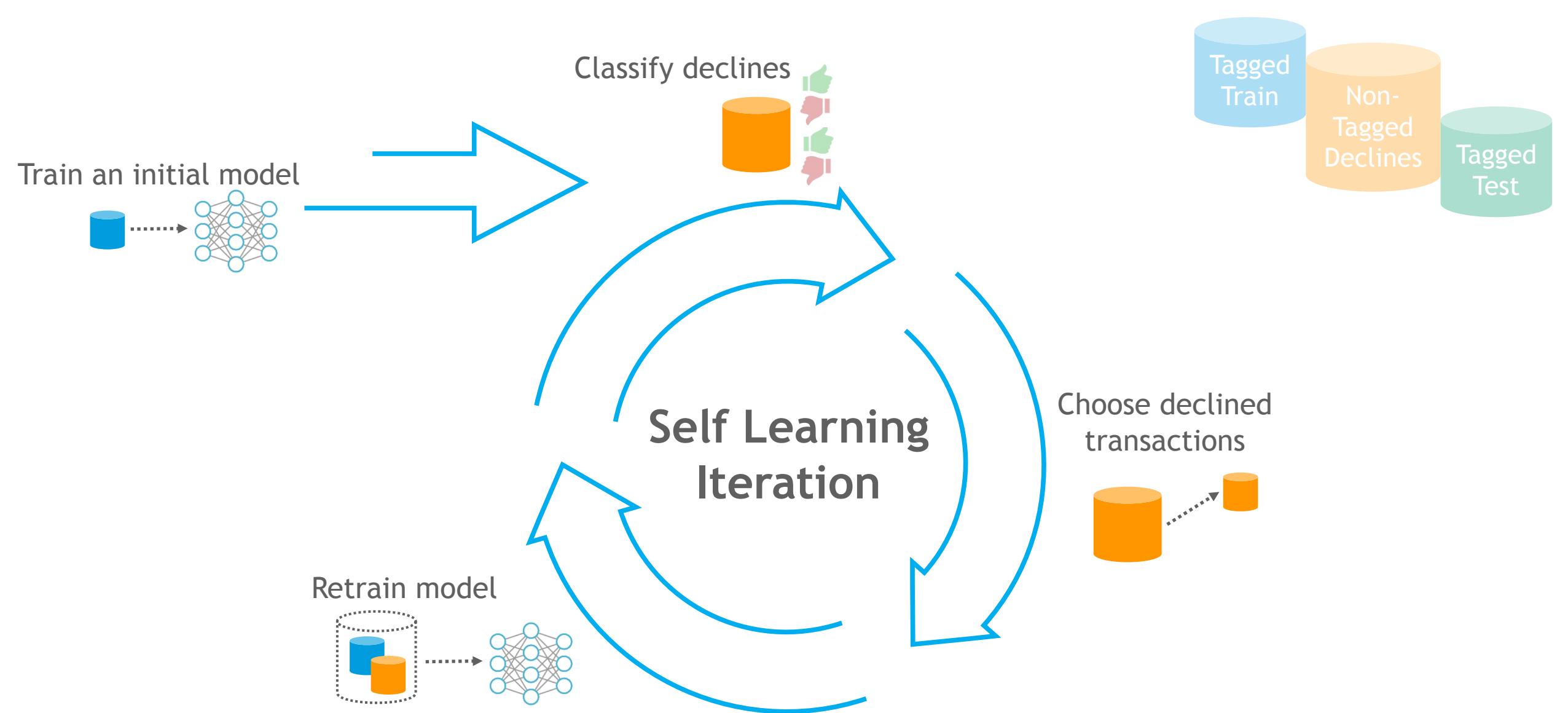
# Evaluating Model Performance



# Treating this problem as a semi-supervised problem



\*\*Images taken from [here](#)



# How do we choose declined transactions in each iteration?

Tagged  
Test



Amount (\$)	Time of day	Time of Day consistency	...	Label	Model's decision	Model bad probability
99.99	00:00	High		Good	Good	1%
135	00:00	Medium		Bad	Bad	87%
82	00:00	Medium		Good	Good	10%
453.16	8:00	High		Good	Good	7%
102	8:00	Medium		Good	Bad	55%
14.1	8:01	Low		Bad	Bad	97%
...	...	...	...	...	...	...

# How do we choose declined transactions in each iteration?

Tagged Test

Amount (\$)	Time of day	Time of Day consistency	...	Label
14.1	8:01	Low		Bad
135	0:00	Medium		Bad
102	8:00	Medium		Good
...	...	...	...	...
82	0:00	Medium		Good
453.2	8:00	High		Good
99.99	0:00	High		Good



Model's decision	Model bad probability ↓ )
Bad	97%
Bad	87%
Bad	55%
...	...
Good	10%
Good	7%
Good	1%



Model bad probability	Precision
97%	100%
87%	100%
55%	67%
10%	...
7%	...
1%	...

# How do we choose declined transactions in each iteration?



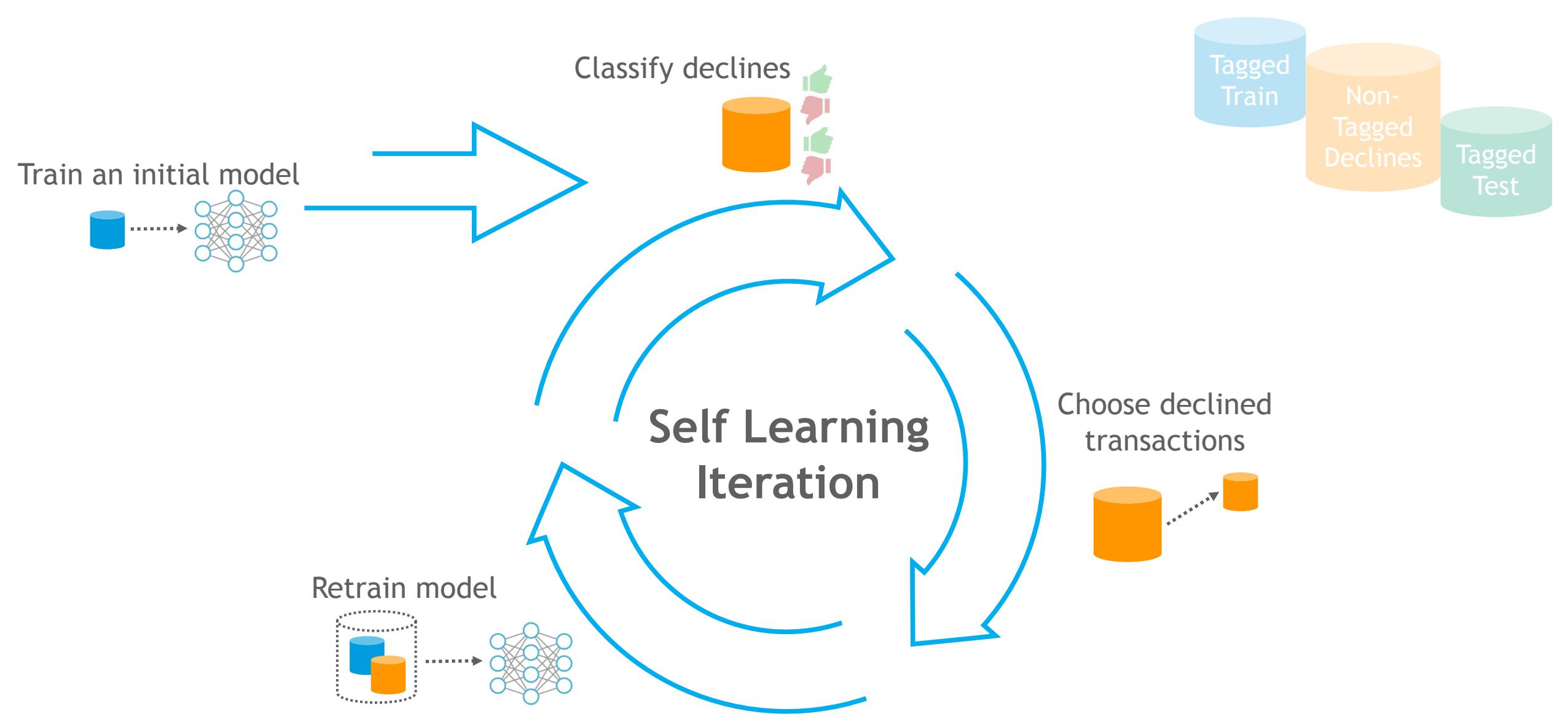
Amount (\$)	Time of day	Time of Day consistency	...	Label
500	7:10	Low		?
20.4	1:00	High		?
78	18:50	Medium		?
...	...	...	...	...
49	10:10	Medium		?
57.6	8:07	High		?
202	20:00	Medium		?



Model's decision	Model bad probability
Bad	99%
Bad	89%
Bad	85%
...	...
Good	21%
Good	6%
Good	3%

87%

7%



Initial results indicate a single Self-Learning iteration enables more than

**doubling train-set size**

and improving AUC by over 7%



Thanks for your attention!