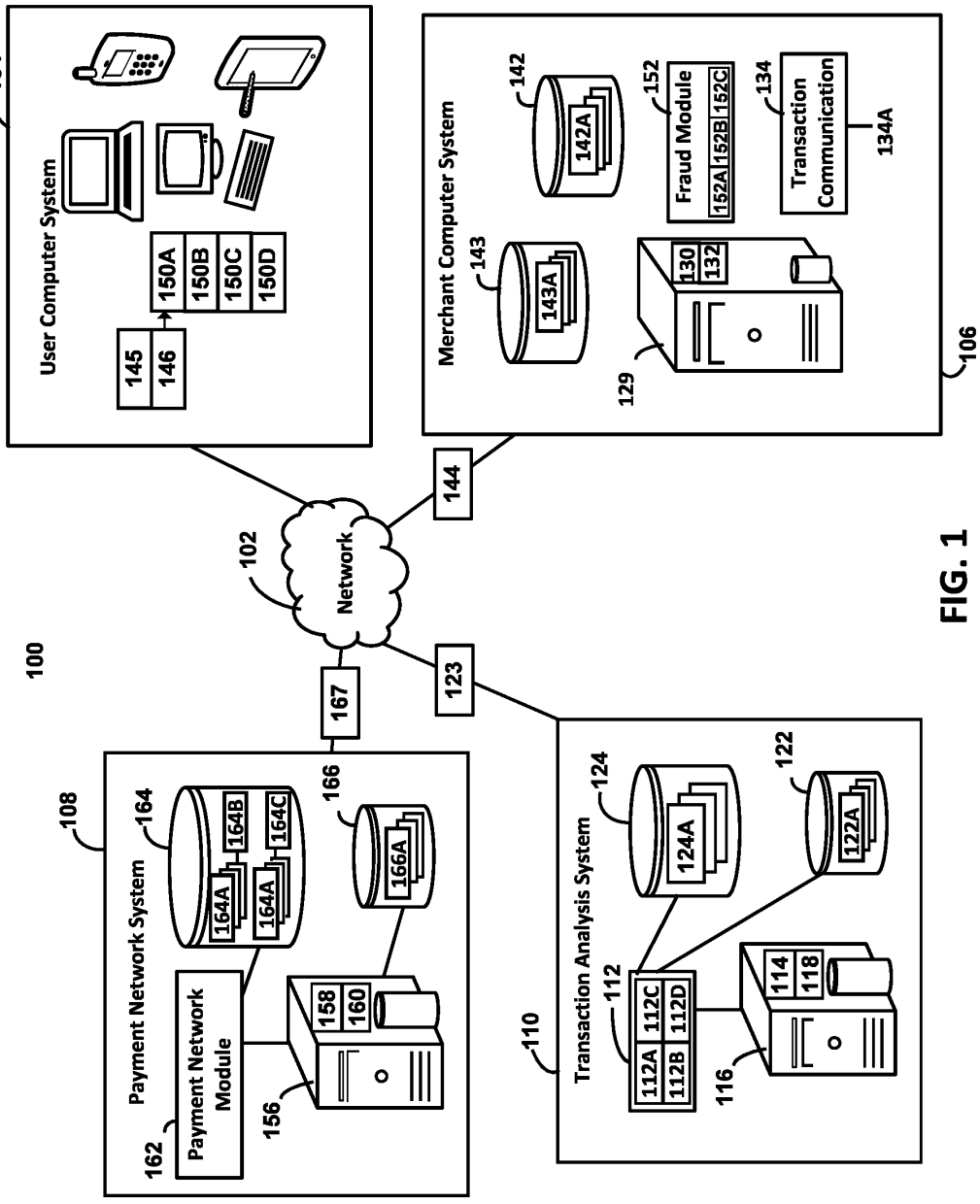
100
104
User Computer System
150A
150B
150C
150D
145
146
102
Network
144
123
167
106
Merchant Computer System
142
142A
143
143A
152
Fraud Module
152A
152B
152C
134
Transaction Communication
134A
130
132
129
108
Payment Network System
164
164A
164B
164C
166
166A
158
160
156
162
Payment Network Module
110
Transaction Analysis System
124
124A
122
122A
112
112A
112B
112C
112D
114
118
116

FIG. 1

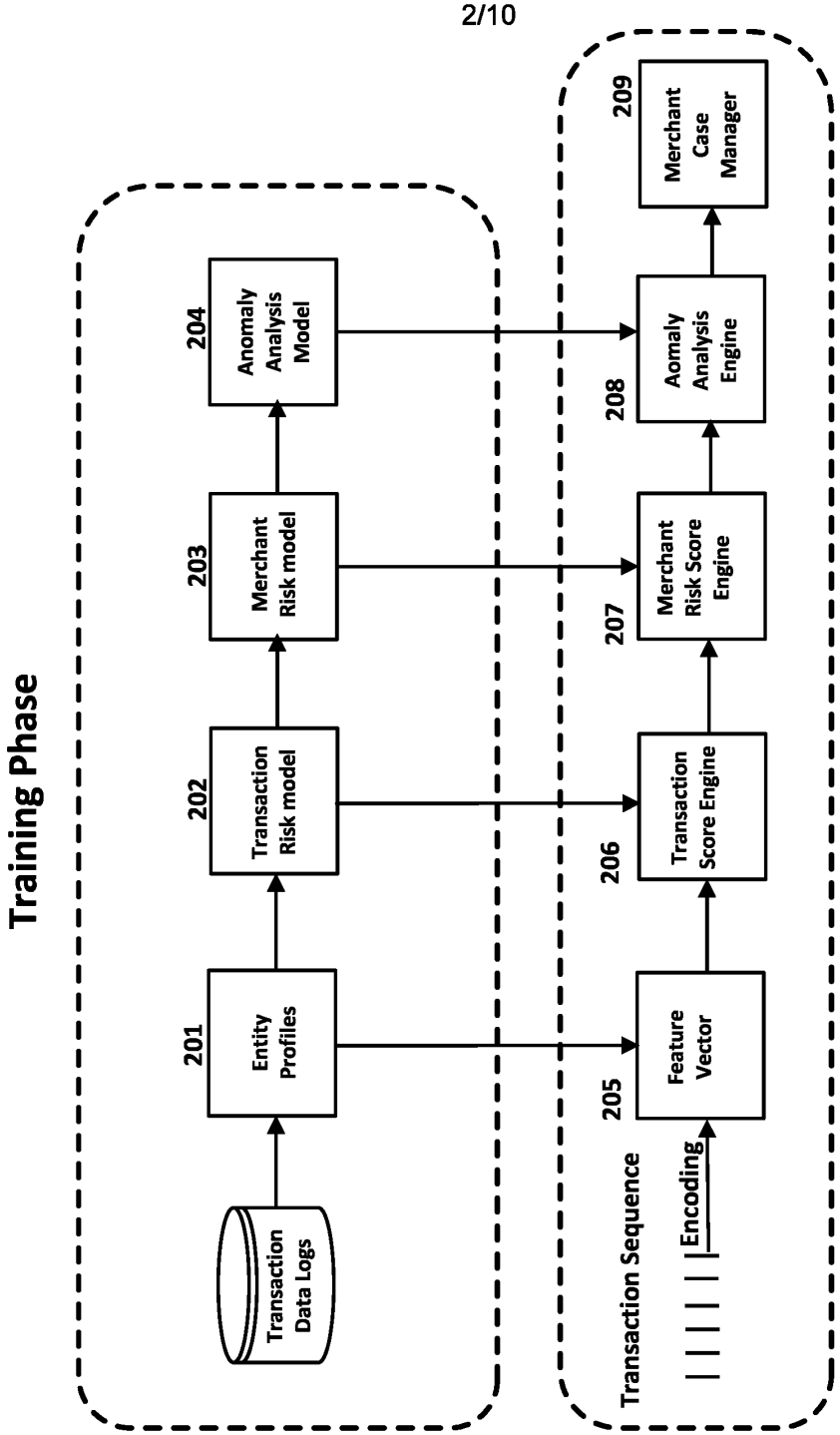
Training Phase
Inference Phase
Transaction Data Logs
201
Entity Profiles
202
Transaction Risk model
203
Merchant Risk model
204
Anomaly Analysis Model
Transaction Sequence
Encoding
205
Feature Vector
206
Transaction Score Engine
207
Merchant Risk Score Engine
208
Aomaly Analysis Engine
209
Merchant Case Manager

FIG. 2

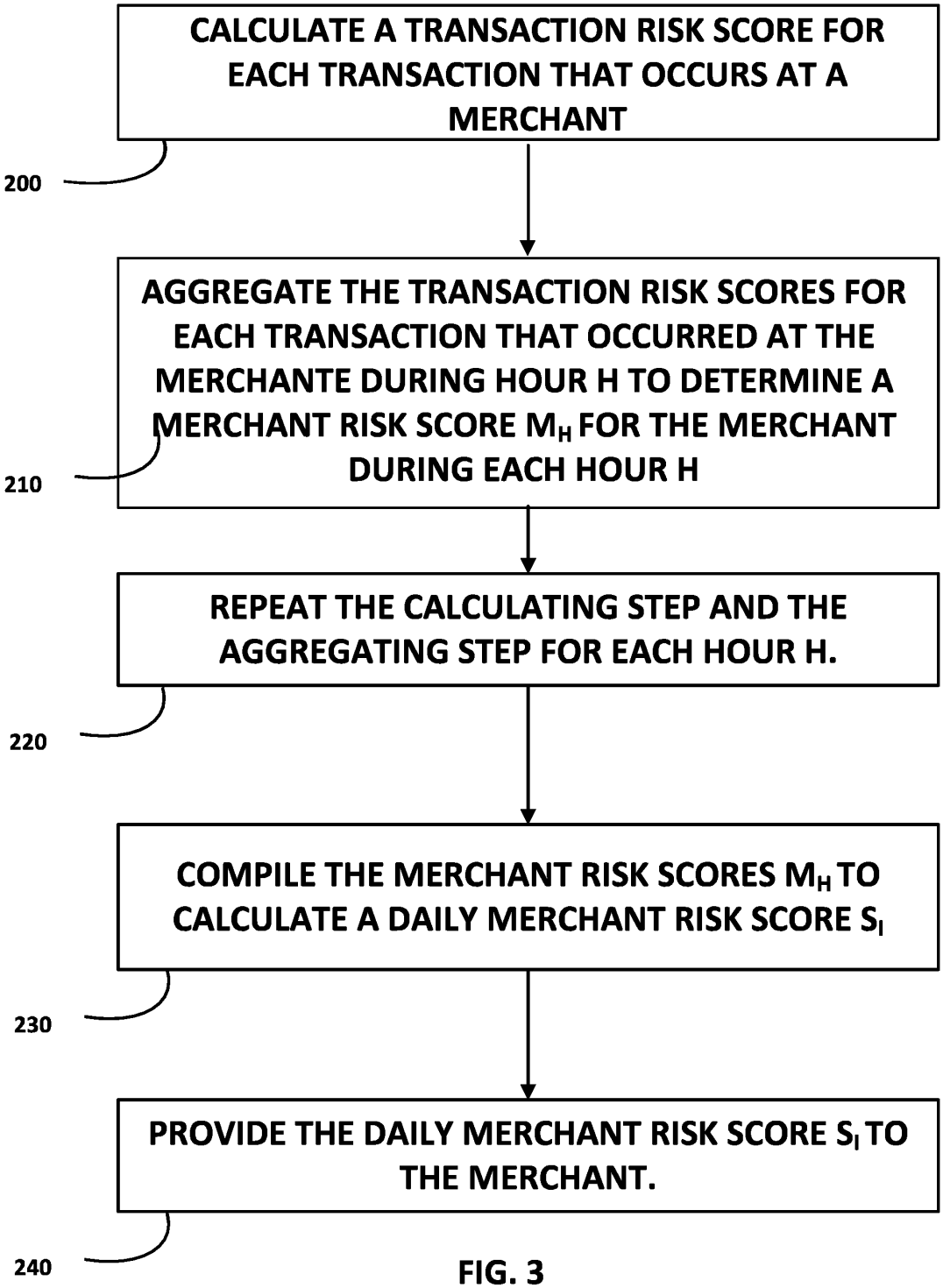
CALCULATE A TRANSACTION RISK SCORE FOR EACH TRANSACTION THAT OCCURS AT A MERCHANT
200
AGGREGATE THE TRANSACTION RISK SCORES FOR EACH TRANSACTION THAT OCCURRED AT THE MERCHANTE DURING HOUR H TO DETERMINE A MERCHANT RISK SCORE M_H FOR THE MERCHANT DURING EACH HOUR H
210
REPEAT THE CALCULATING STEP AND THE AGGREGATING STEP FOR EACH HOUR H.
220
COMPILE THE MERCHANT RISK SCORES M_H TO CALCULATE A DAILY MERCHANT RISK SCORE S_I
230
PROVIDE THE DAILY MERCHANT RISK SCORE S_I TO THE MERCHANT.
240

FIG. 3

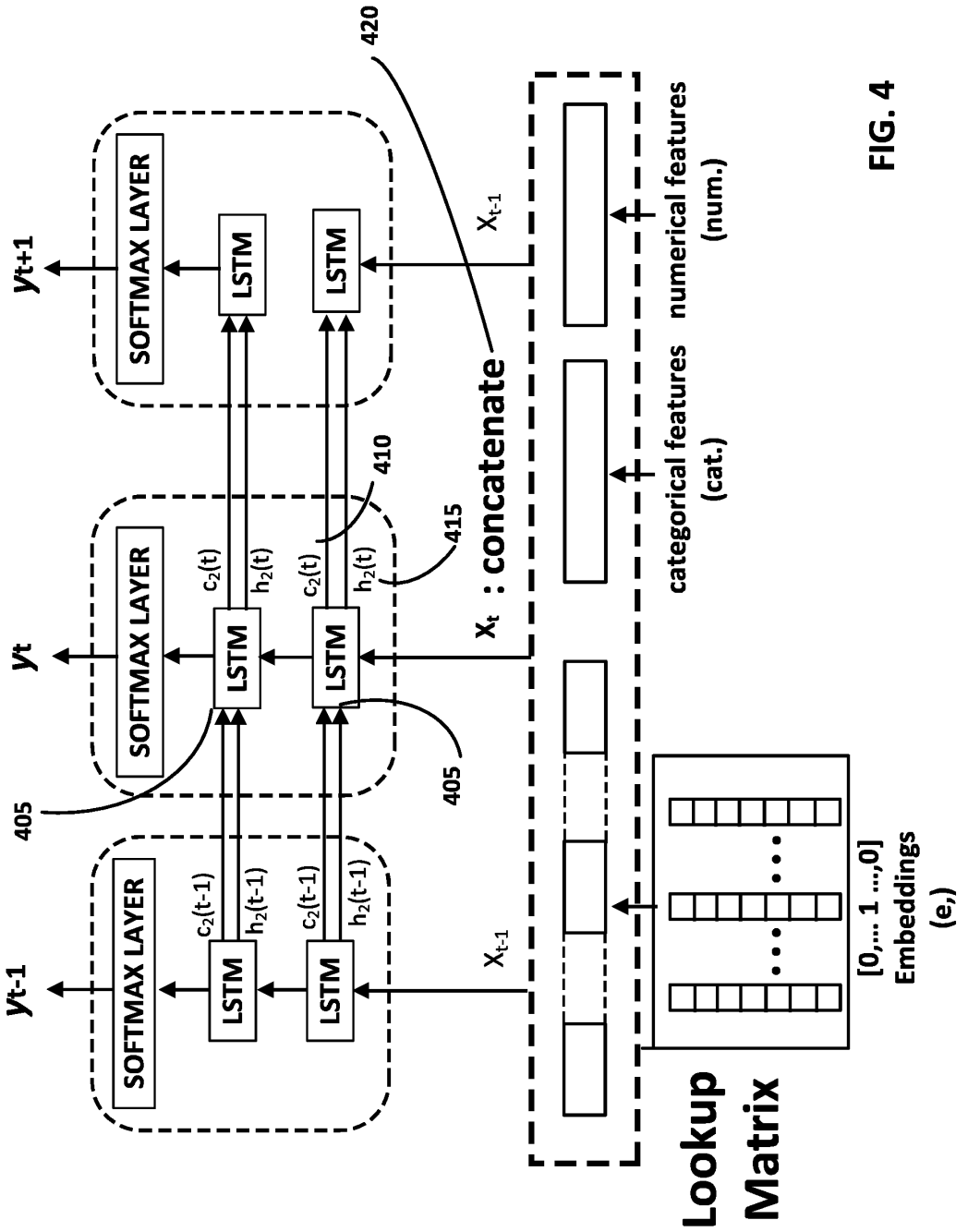
420
SOFTMAX LAYER
LSTM
LSTM
y_{t+1}
x_{t-1}
410
415
$c_2(t)$
$h_2(t)$
$c_2(t)$
$h_2(t)$
x_t : concatenate
categorical features (cat.)
numerical features (num.)
SOFTMAX LAYER
LSTM
LSTM
y_t
405
405
$c_2(t-1)$
$h_2(t-1)$
$c_2(t-1)$
$h_2(t-1)$
SOFTMAX LAYER
LSTM
LSTM
y_{t-1}
x_{t-1}
Lookup Matrix
[0,... 1 ...,0] Embeddings (e,)

FIG. 4

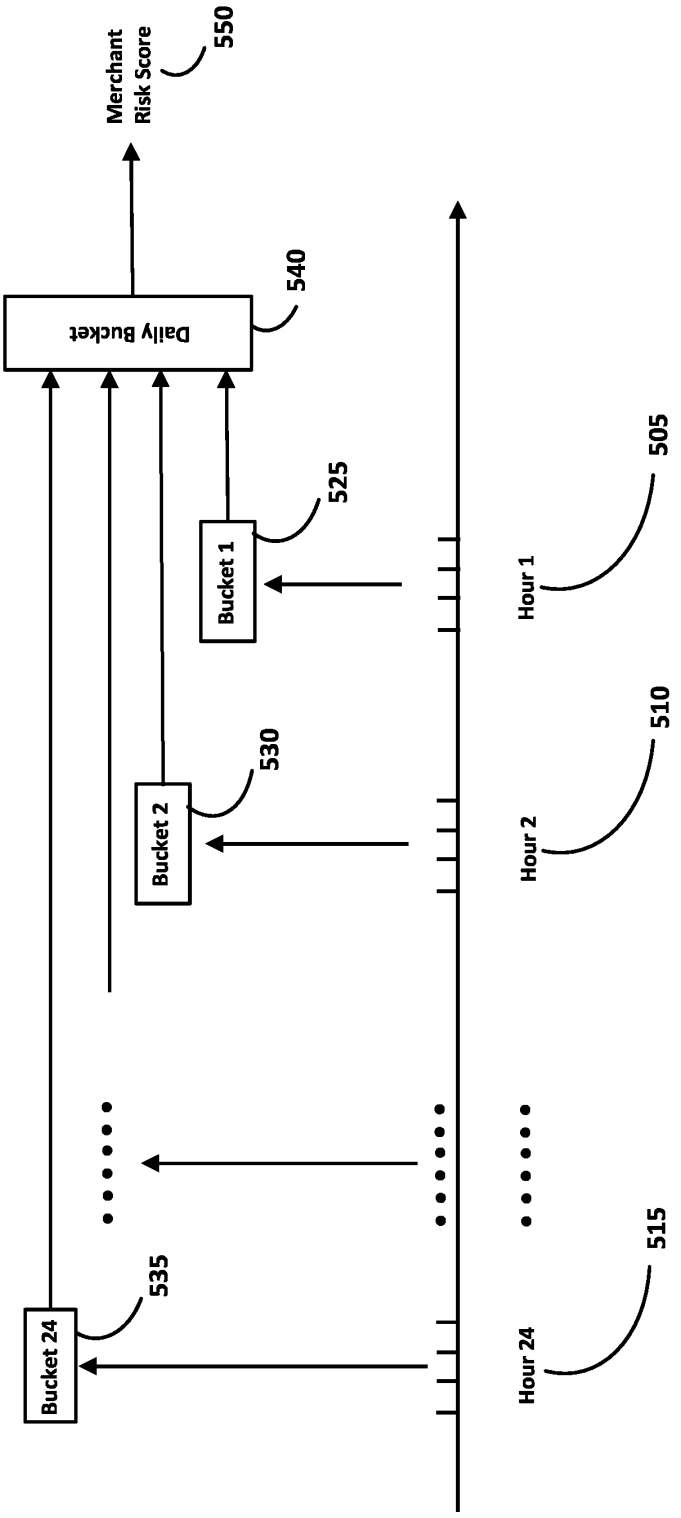
Merchant Risk Score
550
Daily Bucket
540
Bucket 1
525
Bucket 2
530
Bucket 24
535
Hour 1
505
Hour 2
510
Hour 24
515

FIG. 5

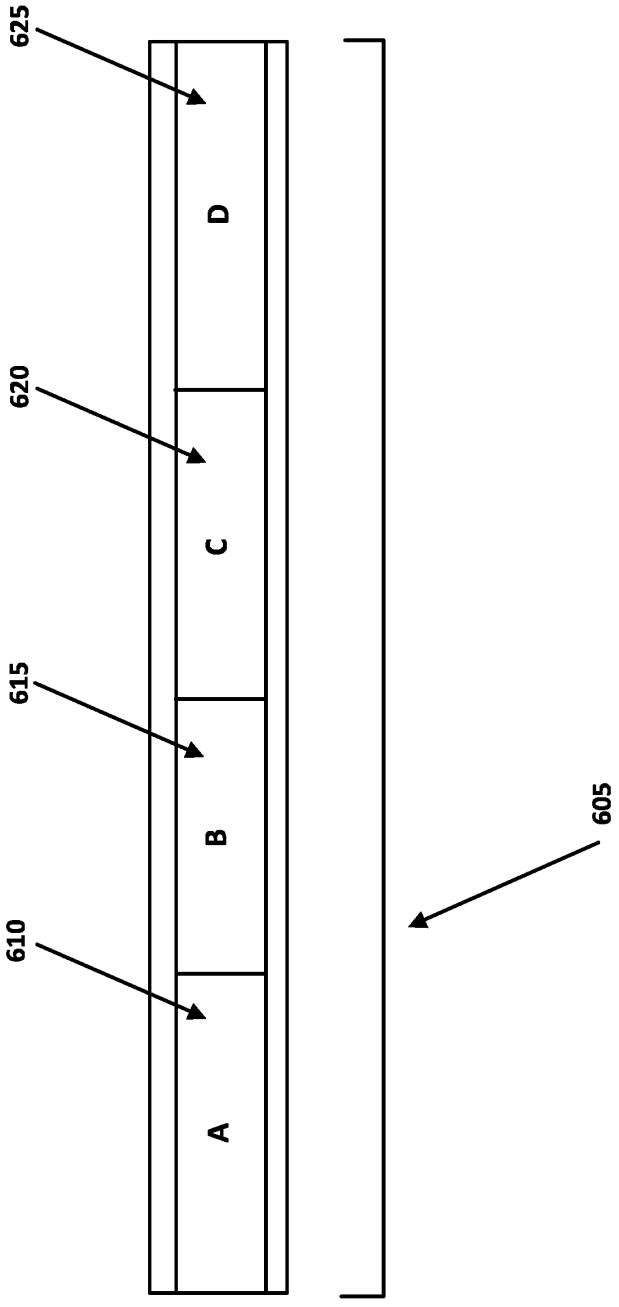

FIG. 6

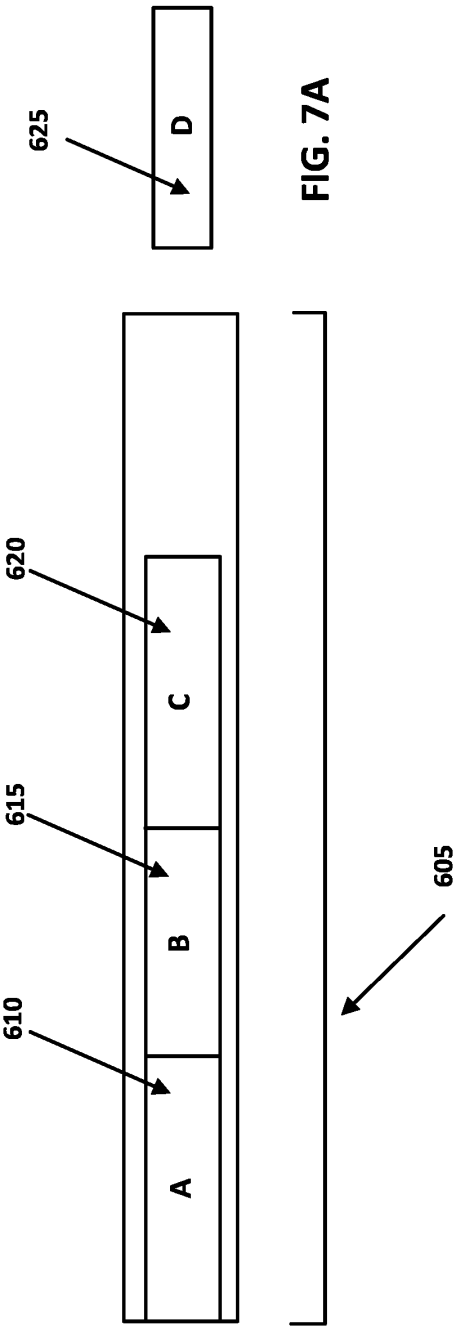

FIG. 7A

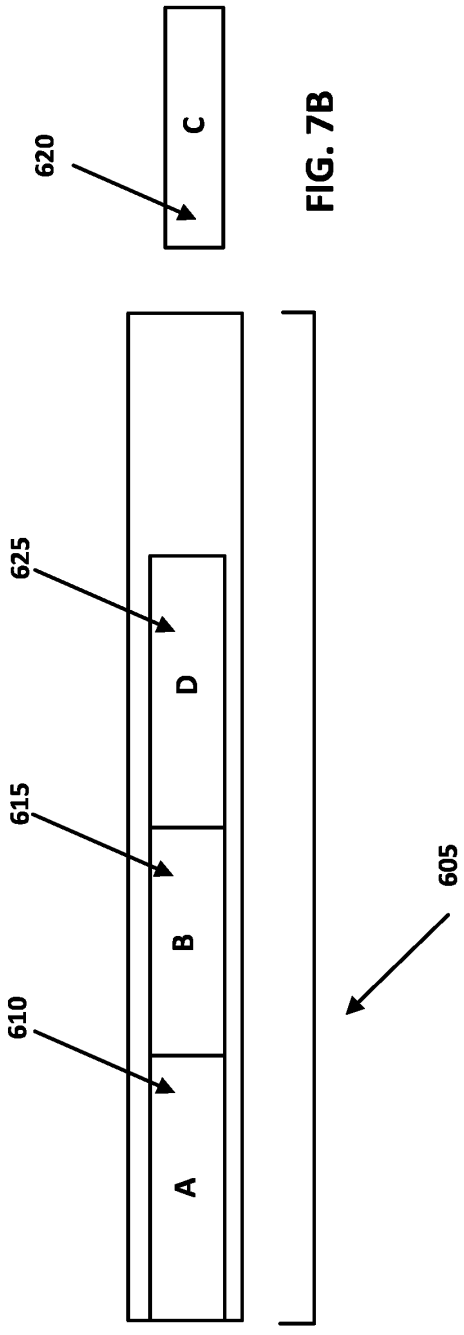

FIG. 7B

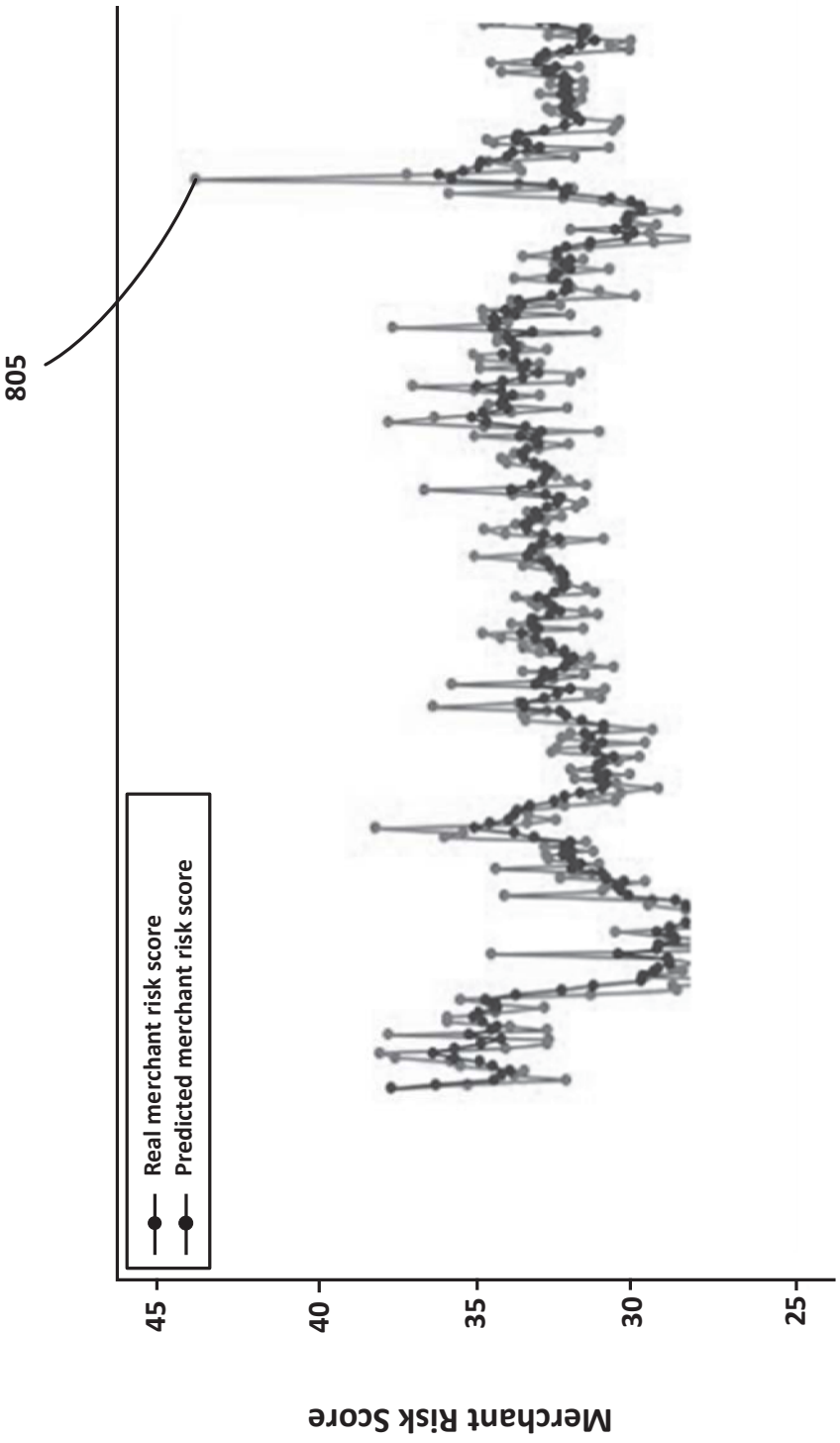
805
Real merchant risk score
Predicted merchant risk score
45
40
35
30
25
Merchant Risk Score

FIG. 8

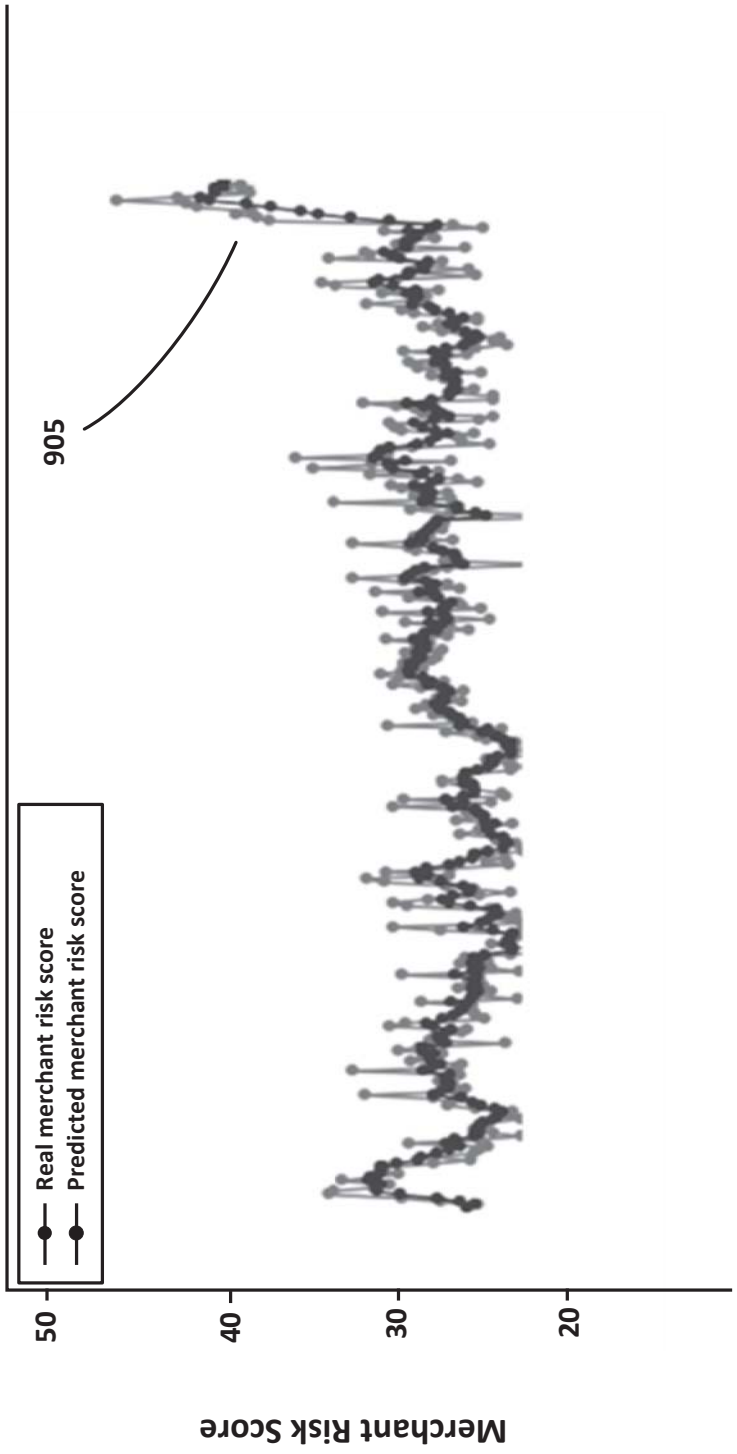
Real merchant risk score
Predicted merchant risk score
905
50
40
30
20
Merchant Risk Score

FIG. 9

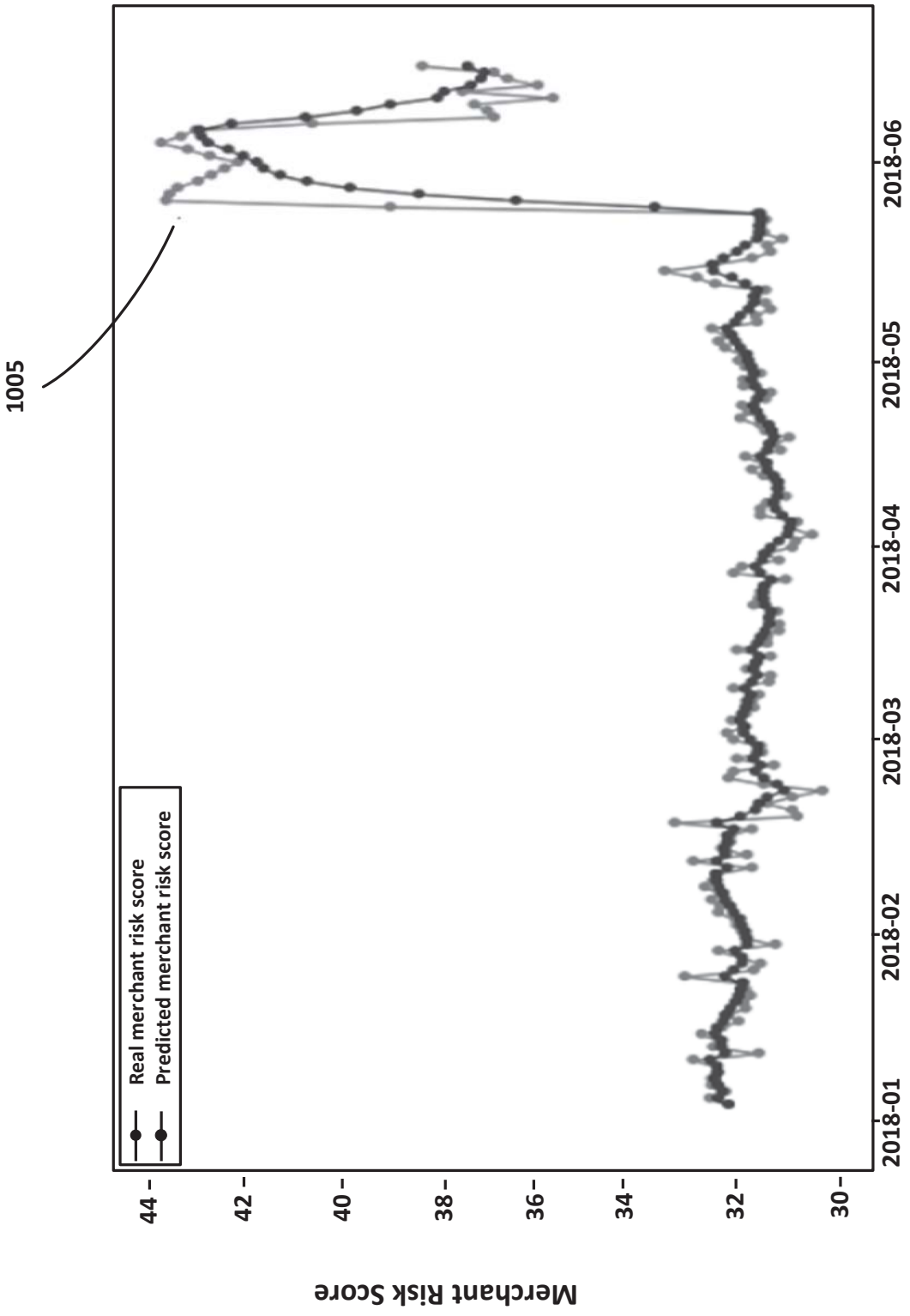
1005
Real merchant risk score
Predicted merchant risk score
Merchant Risk Score
44
42
40
38
36
34
32
30
2018-01
2018-02
2018-03
2018-04
2018-05
2018-06

FIG. 10