Supplementary File

Table I Original features of a transaction dataset

Attributes name	Description
Id	The unique identity of a user
Ms_limit	The maximum allowable single transaction amount for a user
Md_limit	The maximum allowable daily transaction amount for a user
N_phone	The common mobile phone number of a user
C_ip	Is IP commonly used for transactions
Area	Transaction location
T_date	Transaction date
T_time	Transaction time
T_amount	Transaction amount
C_ablance	Balance prior to payment
T_object	Recipient ID (individual or business)
C_mac	The MAC address of the client during the transaction
Label	Fraudulent or Legitimate

Table II Data partitioning

Dataset	#L	#F	#S
D_1	656416	28175	666591
D_2	657899	33762	691661
D_3	226206	10601	264807
D_4	1229764	23271	1243035
D_5	1189117	27122	1216299
D_6	1017816	24898	1042714

Table III Classification confusion matrix

	Actual positive	Actual negative
Predicted positive	T_P	F_P
Predicted negative	F_N	T_N

Table IV Sensitivity of the length of transaction memory

Memory Length	P_r	R_e	F_1	AUC
10	0.969	0.886	0.926	0.942

20	0.978	0.893	0.933	0.946
30	0.985	0.900	0.941	0.950
40	0.982	0.909	0.944	0.954
50	0.982	0.913	0.946	0.956
60	0.980	0.912	0.945	0.955
70	0.979	0.916	0.946	0.956

Table V Notation

R	A transaction dataset
U	A user set
r_i	A transaction record
r_{i_j}	The *j*-th feature of the *i*-th transaction
m	The number of transaction features
n	The number of transactions
u	A user
n_u	The number of u' transactions
R_u	u's transaction records
Φ	A feature mapping function
$\mathcal{F}$	The original feature set
C	A classifier
s_i	The new transactional representation of r_i extracted by the feature-oriented extraction module
R^s	A set of s_i
v_i	The new transactional representation of r_i extracted by the transaction-oriented extraction module
R^v	A set of v_i
x_i	The new transactional representations of r_i extracted by the transactional representation interaction module
R^x	A set of x_i
g^u	The transaction groups of u
$\Delta T_{i-1,i}$	The time interval between $r_{i\text{-}1}$ and r_i
d	The length of transaction memory
*	The Hadamard product
tanh	The Tanh nonlinearities function
D_i	A test set
#L	The number of legitimate transactions in D_i
#F	The number of fraudulent transactions in D_i
#S	Total number of transactions in D_i
I_s	The average time needed to detect a transaction record
T_e	The average training time for a model
A_v	The average value of the results
A_r	The average ranking of all methods

P_r	The precision evaluation criterion
R_e	The recall evaluation criterion
F_1	The F_1-Score evaluation criterion