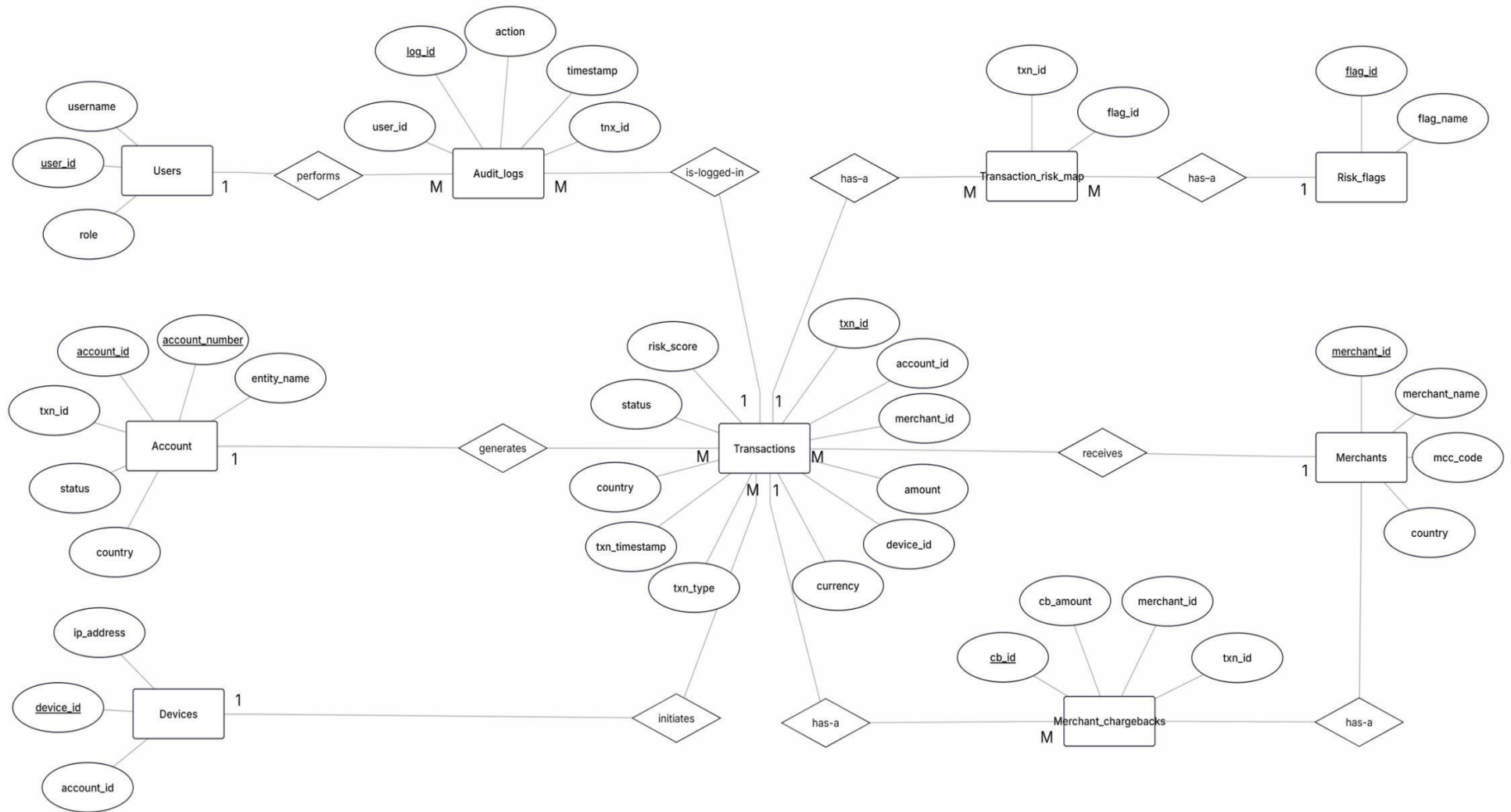# CASE STUDY 42: FINANCIAL TRANSACTION RECORD SYSTEM

By

SRUTHI-717823D156

DHAKSITA R -717823D114

ER Diagram:

Basic Queries:

1. SELECT * FROM Transactions WHERE amount > 10000;
Output:

	txn_id	account_id	merchant_id	device_id	amount	currency	status	country	txn_type	txn_time	risk_score
▶	9	5	6	5	25000.00	INR	SUCCESS	India	ECOM	2025-01-10 21:10:00	95
	19	11	6	5	50000.00	INR	SUCCESS	India	ECOM	2025-01-19 06:30:00	98
	26	13	11	9	15000.00	USD	SUCCESS	Cayman Islands	ECOM	2025-02-01 12:00:00	70
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

2. SELECT t.*
FROM Transactions t
JOIN Devices d
   ON t.device_id = d.device_id
WHERE d.ip_address LIKE '192.168.%';
Output:

	txn_id	account_id	merchant_id	device_id	amount	currency	status	country	txn_type	txn_time	risk_score
▶	1	1	1	1	25.50	USD	SUCCESS	USA	ECOM	2025-01-01 10:15:00	10
	3	2	1	1	1000.00	USD	SUCCESS	USA	ECOM	2025-01-05 09:05:00	70
	20	12	1	1	10.00	EUR	SUCCESS	Netherlands	ECOM	2025-01-20 17:00:00	5
	27	1	1	1	100.00	USD	SUCCESS	USA	ECOM	2025-12-25 09:00:00	20
	32	5	1	1	105.00	USD	SUCCESS	USA	ECOM	2025-02-10 10:01:00	35
	59	13	5	1	8330.54	USD	DECLINED	USA	ECOM	2025-04-17 15:05:36	66
	62	7	10	1	4669.75	INR	CHARGEBACK	UK	ECOM	2025-03-12 23:41:03	63
	67	4	2	1	113.33	GBP	REFUNDED	Australia	REFUND	2025-03-29 01:36:55	46
	68	2	1	1	9924.24	CAD	DECLINED	USA	POS	2025-03-15 08:27:08	36
	69	10	5	1	1526.34	EUR	CHARGEBACK	Germany	CASH	2025-03-23 23:39:52	27
	71	13	3	1	7390.85	EUR	DECLINED	Australia	REFUND	2025-03-26 18:22:29	6
	88	13	3	1	5463.73	GBP	REFUNDED	UK	ECOM	2025-02-09 01:15:24	97
	109	3	11	1	2707.76	INR	REFUNDED	Cayman Isl…	REFUND	2025-04-05 21:19:07	37

3. SELECT DISTINCT
   merchant_id,
   merchant_name,
   mcc_code,
   country
FROM Merchants
WHERE country = 'Cayman Islands';
Output:

	merchant_id	merchant_name	mcc_code	country
▶	11	Cayman Duty Free	5999	Cayman Islands
*	NULL	NULL	NULL	NULL

4. SELECT * FROM Accounts WHERE status = 'HIGH_RISK';
Output:

	acnt_id	account_number	entity_name	status	country
▶	13	ACCT0013	Offshore Holdings	HIGH_RISK	Cayman Islands
*	NULL	NULL	NULL	NULL	NULL

5. SELECT *FROM Transactions WHERE DATE(txn_time) = '2025-12-25';
Output:

	txn_id	account_id	merchant_id	device_id	amount	currency	status	country	txn_type	txn_time	risk_score
▶	27	1	1	1	100.00	USD	SUCCESS	USA	ECOM	2025-12-25 09:00:00	20
*	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

6. SELECT
  t.txn_id,
  t.amount,
  t.currency,
  t.status,
  t.txn_type,
  t.txn_time,
  a.entity_name AS account_holder,
  m.merchant_name
FROM Transactions t
JOIN Accounts a
  ON t.account_id = a.acnt_id
JOIN Merchants m
  ON t.merchant_id = m.merchant_id;
Output:

	txn_id	amount	currency	status	txn_type	txn_time	account_holder	merchant_name
▶	1	25.50	USD	SUCCESS	ECOM	2025-01-01 10:15:00	John Doe	Amazon Online
	3	1000.00	USD	SUCCESS	ECOM	2025-01-05 09:05:00	Jane Smith	Amazon Online
	20	10.00	EUR	SUCCESS	ECOM	2025-01-20 17:00:00	OnlineMart BV	Amazon Online
	27	100.00	USD	SUCCESS	ECOM	2025-12-25 09:00:00	John Doe	Amazon Online
	32	105.00	USD	SUCCESS	ECOM	2025-02-10 10:01:00	Ravi Kumar	Amazon Online
	43	4475.69	EUR	PENDING	ECOM	2025-04-13 08:26:49	John Doe	Amazon Online
	68	9924.24	CAD	DECLINED	POS	2025-03-15 08:27:08	Jane Smith	Amazon Online
	70	7151.01	USD	SUCCESS	REFUND	2025-02-16 14:46:16	Ravi Kumar	Amazon Online
	86	6388.40	EUR	REFUNDED	REFUND	2025-05-02 19:58:12	Acme Corp	Amazon Online
	94	7087.50	EUR	DECLINED	ECOM	2025-03-22 04:05:47	OnlineMart BV	Amazon Online
	116	6931.20	CAD	CHARGEB...	POS	2025-03-25 20:03:39	John Doe	Amazon Online
	129	5329.27	GBP	CHARGEB...	ECOM	2025-02-11 00:01:37	Olivia Brown	Amazon Online
	134	5532.52	GBP	PENDING	POS	2025-04-02 12:35:21	Priya Sharma	Amazon Online

7. SELECT
  t.account_id,
  a.entity_name AS account_holder,
  COUNT(DISTINCT t.merchant_id) AS distinct_merchants
FROM Transactions t
JOIN Accounts a
  ON t.account_id = a.acnt_id
GROUP BY
  t.account_id,
  a.entity_name
HAVING
  COUNT(DISTINCT t.merchant_id) > 50;
Output:

	account_id	account_holder	distinct_merchants

8. SELECT
   t.txn_id,
   t.account_id,
   a.entity_name AS account_holder,
   t.merchant_id,
   m.merchant_name,
   t.amount,
   t.currency,
   t.status,
   t.txn_time,
   rf.flag_name
FROM Transactions t
JOIN Transaction_Risk_Map trm
   ON t.txn_id = trm.txn_id
JOIN RiskFlags rf
   ON trm.flag_id = rf.flag_id
JOIN Accounts a
   ON t.account_id = a.acnt_id
JOIN Merchants m
   ON t.merchant_id = m.merchant_id
WHERE
   rf.flag_name = 'Potential Money Laundering';

Output:

txn_id	account_id	account_holder	merchant_id	merchant_name	amount	currency	status	txn_time	flag_name
30	13	Offshore Holdings	11	Cayman Duty Free	9800.00	USD	SUCCESS	2025-02-03 08:00:00	Potential Money Laundering
43	1	John Doe	1	Amazon Online	4475.69	EUR	PENDING	2025-04-13 08:26:49	Potential Money Laundering
49	9	Carlos Fernandez	6	Air India	654.75	USD	PENDING	2025-03-15 02:06:42	Potential Money Laundering
63	3	Acme Corp	11	Cayman Duty Free	703.43	USD	PENDING	2025-04-28 15:56:14	Potential Money Laundering
71	13	Offshore Holdings	3	Walmart Store	7390.85	EUR	DECLINED	2025-03-26 18:22:29	Potential Money Laundering
95	9	Carlos Fernandez	7	Local Electronics	7791.04	EUR	SUCCESS	2025-04-05 02:20:16	Potential Money Laundering
100	1	John Doe	7	Local Electronics	8775.58	GBP	DECLINED	2025-02-22 06:52:00	Potential Money Laundering
111	4	Globex Ltd	7	Local Electronics	337.88	GBP	PENDING	2025-03-31 11:26:55	Potential Money Laundering
120	13	Offshore Holdings	2	Flipkart	9177.15	CAD	DECLINED	2025-02-10 05:56:27	Potential Money Laundering

9. SELECT
   t.device_id,
   d.ip_address,
   COUNT(DISTINCT t.account_id) AS distinct_accounts
FROM
   Transactions t
JOIN
   Devices d
   ON t.device_id = d.device_id
GROUP BY
   t.device_id
HAVING
   COUNT(DISTINCT t.account_id) > 1;

Output:

device_id	ip_address	distinct_accounts
1	192.168.0.10	12
2	192.168.0.11	12
3	10.0.0.5	10
4	10.0.0.6	11
5	172.16.5.20	12
6	172.16.5.21	13
7	203.0.113.10	10
8	198.51.100.25	12
9	192.168.55.200	12

10. SELECT DISTINCT
    u.user_id,
    u.username,
    u.role,
    a.txn_id,
    a.action,
    a.timestamp
FROM
    Audit_Logs a
JOIN
    Users u
    ON a.user_id = u.user_id
JOIN
    Transactions t
    ON a.txn_id = t.txn_id
JOIN
    Transaction_Risk_Map trm
    ON t.txn_id = trm.txn_id
WHERE
    u.role = 'COMPLIANCE_OFFICER'
    AND DATE(a.timestamp) = CURRENT_DATE();

Output:

user_id	username	role	txn_id	action	timestamp
9	comp_officer_1	COMPLIANCE_OFFICER	30	Reviewed flagged AML transaction	2025-12-04 14:12:48
10	comp_officer_2	COMPLIANCE_OFFICER	26	Reviewed high-value transaction	2025-12-04 14:12:48

Aggregation & Reports
11. SELECT
    m.merchant_id,
    m.merchant_name,
    SUM(t.amount) AS total_transaction_volume,
    COUNT(t.txn_id) AS total_transactions
FROM
    Transactions t
JOIN
    Merchants m
    ON t.merchant_id = m.merchant_id
GROUP BY

```
    m.merchant_id,
    m.merchant_name
ORDER BY
    total_transaction_volume DESC
LIMIT 5;
```

Output:

merchant_id	merchant_name	total_transaction_volume	total_transactions
6	Air India	171927.06	23
11	Cayman Duty Free	161194.25	24
5	Uber Rides	133158.01	30
10	Café Bonjour	102051.28	20
9	TravelWorld	97747.93	23

```
12. SELECT
    SUM(t.amount) AS total_cross_border_value,
    COUNT(*) AS total_cross_border_txns
FROM
    Transactions t
JOIN
    Accounts a
    ON t.account_id = a.acnt_id
WHERE
    t.country <> a.country;
```

Output:

total_cross_border_value	total_cross_border_txns
913110.94	191

```
13. SELECT
    HOUR(txn_time) AS txn_hour,
    COUNT(*) AS fraud_attempts
FROM
    Transactions
WHERE
    risk_score > 70
GROUP BY
    txn_hour
ORDER BY
    fraud_attempts DESC
LIMIT 1;
```

Output:

txn_hour	fraud_attempts
13	6

14. SELECT

```
    m.mcc_code,
    COUNT(t.txn_id) AS total_transactions,
    AVG(t.amount) AS avg_transaction_value,
    SUM(t.amount) AS total_transaction_value
FROM
    Transactions t
JOIN
    Merchants m
    ON t.merchant_id = m.merchant_id
GROUP BY
    m.mcc_code
ORDER BY
    avg_transaction_value DESC;
```

Output:

mcc_code	total_transactions	avg_transaction_value	total_transaction_value
4511	23	7475.089565	171927.06
5999	24	6716.427083	161194.25
5812	20	5102.564000	102051.28
5651	18	4683.472222	84302.50
4121	30	4438.600333	133158.01
4722	23	4249.910000	97747.93
5311	45	4125.244889	185636.02
5732	20	4066.473500	81329.47
5411	47	3564.802979	167545.74

15. SELECT currency,COUNT(*) AS transaction_count
FROM Transactions GROUP BY currency ORDER BY transaction_count DESC;

Output:

currency	transaction_count
USD	65
EUR	55
CAD	46
GBP	45
INR	37
AUD	2

Advanced Queries
16. SELECT
```
    t.account_id,
    COUNT(*) AS num_suspicious_deposits,
    SUM(t.amount) AS total_value,
    MIN(t.txn_time) AS first_deposit_time,
    MAX(t.txn_time) AS last_deposit_time
FROM
    Transactions t
WHERE
    t.txn_type = 'DEPOSIT'
    AND t.amount >= 9000
    AND t.amount < 10000
GROUP BY
    t.account_id
```

```
HAVING
    COUNT(*) > 5
ORDER BY
    num_suspicious_deposits DESC;
```

Output:

	account_id	num_suspicious_deposits	total_value	first_deposit_time	last_deposit_time

```
17. SELECT
    t.account_id,
    SUM(CASE WHEN t.txn_type IN ('DEPOSIT') THEN t.amount ELSE 0 END) AS
total_inflow,
    SUM(CASE WHEN t.txn_type IN ('WITHDRAWAL','PAYMENT','TRANSFER') THEN
t.amount ELSE 0 END) AS total_outflow
FROM
    Transactions t
GROUP BY
    t.account_id
HAVING
    total_outflow > (total_inflow * 5)
    AND total_inflow > 0
ORDER BY
    total_outflow DESC;
```

Output:

	account_id	total_inflow	total_outflow

```
18. SELECT
    t1.txn_id AS txn_id_1,
    t1.account_id,
    t1.country AS country_1,
    t1.txn_time AS time_1,
    t2.txn_id AS txn_id_2,
    t2.country AS country_2,
    t2.txn_time AS time_2,
    TIMESTAMPDIFF(SECOND, t1.txn_time, t2.txn_time) AS time_diff_seconds
FROM
    Transactions t1
JOIN
    Transactions t2
    ON t1.account_id = t2.account_id
    AND t2.txn_time > t1.txn_time
    AND TIMESTAMPDIFF(SECOND, t1.txn_time, t2.txn_time) <= 60
WHERE
    t1.country <> t2.country
ORDER BY
    t1.account_id,
    t1.txn_time;
```

Output:

txn_id_1	account_id	country_1	time_1	txn_id_2	country_2	time_2	time_diff_seconds
31	5	India	2025-02-10 10:00:00	32	USA	2025-02-10 10:01:00	60

19. SELECT
  m.merchant_id,
  m.merchant_name,
  COUNT(t.txn_id) AS total_transactions,
  COUNT(c.txn_id) AS total_chargebacks,
  (COUNT(c.txn_id) / COUNT(t.txn_id)) * 100 AS chargeback_rate_percent
FROM
  Merchants m
JOIN
  Transactions t
  ON m.merchant_id = t.merchant_id
LEFT JOIN
  Chargebacks c
  ON t.txn_id = c.txn_id
GROUP BY
  m.merchant_id,
  m.merchant_name
HAVING
  (COUNT(c.txn_id) / COUNT(t.txn_id)) > 0.01
ORDER BY
  chargeback_rate_percent DESC;

Output:

merchant_id	merchant_name	total_transactions	total_chargebacks	chargeback_rate_percent
8	Global Fashion	18	1	5.5556
7	Local Electronics	20	1	5.0000
1	Amazon Online	23	1	4.3478
6	Air India	23	1	4.3478
9	TravelWorld	23	1	4.3478
11	Cayman Duty Free	24	1	4.1667
5	Uber Rides	30	1	3.3333

20. CREATE VIEW TransactionOverview AS
SELECT txn_id, txn_time, amount, risk_score, status
FROM Transactions;
SELECT * FROM TransactionOverview;
Output:

	txn_id	txn_time	amount	risk_score	status
▶	1	2025-01-01 10:15:00	25.50	10	SUCCESS
	2	2025-01-02 11:20:00	120.00	20	SUCCESS
	3	2025-01-05 09:05:00	1000.00	70	SUCCESS
	4	2025-01-06 14:30:00	45.75	40	DECLINED
	5	2025-01-06 14:32:00	45.75	30	SUCCESS
	6	2025-01-07 16:10:00	500.00	80	SUCCESS
	7	2025-01-08 18:45:00	150.00	25	SUCCESS
	8	2025-01-09 09:01:00	800.00	60	DECLINED
	9	2025-01-10 21:10:00	25000.00	95	SUCCESS

Indexing & Query Optimization
CREATE INDEX idx_trx_date ON Transactions(txn_time);
CREATE INDEX idx_trx_acct_fk ON Transactions(account_id);
CREATE INDEX idx_trx_merchant_fk ON Transactions(merchant_id);
SHOW INDEXES FROM Transactions;
Output:

	Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Inc
▶	transactions	0	PRIMARY	1	txn_id	A	250	NULL	NULL		BTREE		
	transactions	1	device_id	1	device_id	A	9	NULL	NULL	YES	BTREE		
	transactions	1	idx_acnt	1	account_id	A	13	NULL	NULL	YES	BTREE		
	transactions	1	idx_merch	1	merchant_id	A	11	NULL	NULL	YES	BTREE		