Web Programming with Python and JavaScript

Databases

origin	destination	duration
New York	London	415
Shanghai	Paris	760
Istanbul	Tokyo	700
New York	Paris	435
Moscow	Paris	245
Lima	New York	455

SQL

PostgreSQL

Data Types

- INTEGER
- DECIMAL
- SERIAL
- VARCHAR
- TIMESTAMP
- BOOLEAN
- ENUM
- ...

CREATE TABLE

```
CREATE TABLE flights (
    id SERIAL PRIMARY KEY,
    origin VARCHAR NOT NULL,
    destination VARCHAR NOT NULL,
    duration INTEGER NOT NULL
);
```

```
CREATE TABLE flights (
    id SERIAL PRIMARY KEY,
    origin VARCHAR NOT NULL,
    destination VARCHAR NOT NULL,
    duration INTEGER NOT NULL
);
```

```
CREATE TABLE flights (
    id SERIAL PRIMARY KEY,
    origin VARCHAR NOT NULL,
    destination VARCHAR NOT NULL,
    duration INTEGER NOT NULL
);
```

```
CREATE TABLE flights (
    id SERIAL PRIMARY KEY,
    origin VARCHAR NOT NULL,
    destination VARCHAR NOT NULL,
    duration INTEGER NOT NULL
);
```

```
CREATE TABLE flights (
    id SERIAL PRIMARY KEY,
    origin VARCHAR NOT NULL,
    destination VARCHAR NOT NULL,
    duration INTEGER NOT NULL
);
```

```
CREATE TABLE flights (
    id SERIAL PRIMARY KEY,
    origin VARCHAR NOT NULL,
    destination VARCHAR NOT NULL,
    duration INTEGER NOT NULL
);
```

```
CREATE TABLE flights (
    id SERIAL PRIMARY KEY,
    origin VARCHAR NOT NULL,
    destination VARCHAR NOT NULL,
    duration INTEGER NOT NULL
);
```

Constraints

- `NOT NULL`
- `UNIQUE`
- `PRIMARY KEY`
- `DEFAULT`
- `CHECK`
- `...`

INSERT

```
INSERT INTO flights
    (origin, destination, duration)
    VALUES ('New York', 'London', 415);
```

```
INSERT INTO flights
    (origin, destination, duration)
    VALUES ('New York', 'London', 415);
```

```
INSERT INTO flights
    (origin, destination, duration)
    VALUES ('New York', 'London', 415);
```

```
INSERT INTO flights
    (origin, destination, duration)
    VALUES ('New York', 'London', 415);
```

```
INSERT INTO flights
    (origin, destination, duration)
    VALUES ('New York', 'London', 415);
```

```
INSERT INTO flights
    (origin, destination, duration)
    VALUES ('New York', 'London', 415);
```

SELECT

```
SELECT * FROM flights;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT origin, destination FROM flights;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT origin, destination FROM flights;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights WHERE id = 3;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights WHERE id = 3;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights WHERE origin = 'New York';
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights WHERE origin = 'New York';
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights WHERE duration > 500;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights WHERE duration > 500;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE destination = 'Paris' AND duration > 500;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE destination = 'Paris' AND duration > 500;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE destination = 'Paris' OR duration > 500;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE destination = 'Paris' OR duration > 500;
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE origin IN ('New York', 'Lima');
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE origin IN ('New York', 'Lima');
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE origin LIKE '%a%';
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

```
SELECT * FROM flights
WHERE origin LIKE '%a%';
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

Functions

- `SUM`
- `COUNT`
- `MIN`
- `MAX`
- `AVG`
- `...`

UPDATE

```
UPDATE flights
    SET duration = 430
    WHERE origin = 'New York'
    AND destination = 'London';
```

DELETE

```
DELETE FROM countries
     WHERE destination = 'Tokyo';
```

Other Clauses

- `LIMIT`
- `ORDER BY`
- `GROUP BY`
- `HAVING`
- `...`

Foreign Keys

flights

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

flights

id	origin	origin_code	destination	destination_code	duration
1	New York	JFK	London	LHR	415
2	Shanghai	PVG	Paris	CDG	760
3	Istanbul	IST	Tokyo	NRT	700
4	New York	JFK	Paris	CDG	435
5	Moscow	SVO	Paris	CDG	245
6	Lima	LIM	New York	JFK	455

locations

id	code	name
1	JFK	New York
2	PVG	Shanghai
3	IST	Istanbul
4	LHR	London
5	SVO	Moscow
6	LIM	Lima
7	CDG	Paris
8	NRT	Tokyo

flights

id	origin_id	destination_id	duration
1	1	4	415
2	2	7	760
3	3	8	700
4	1	7	435
5	5	7	245
6	6	1	455

passengers

id	name	flight_id
1	Alice	1
2	Bob	1
3	Charlie	2
4	Dave	2
5	Erin	4
6	Frank	6
7	Grace	6

JOIN

Types of JOINs

- JOIN / INNER JOIN
- LEFT OUTER JOIN
- RIGHT OUTER JOIN
- FULL OUTER JOIN

CREATE INDEX

Nested Queries

flights

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

passengers

id	name	flight_id
1	Alice	1
2	Bob	1
3	Charlie	2
4	Dave	2
5	Erin	4
6	Frank	6
7	Grace	6

```
SELECT flight_id FROM passengers
GROUP BY flight_id HAVING COUNT(*) > 1;
```

```
SELECT flight_id FROM passengers
GROUP BY flight_id HAVING COUNT(*) > 1;
```

id	name	flight_id
1	Alice	1
2	Bob	1
3	Charlie	2
4	Dave	2
5	Erin	4
6	Frank	6
7	Grace	6

```
SELECT flight_id FROM passengers
GROUP BY flight_id HAVING COUNT(*) > 1;
```

id	name	flight_id
1	Alice	1
2	Bob	1
3	Charlie	2
4	Dave	2
5	Erin	4
6	Frank	6
7	Grace	6

flight_id
1
2
6

```
SELECT flight_id FROM passengers
GROUP BY flight_id HAVING COUNT(*) > 1;
```

flight_id
1
2
6

```
SELECT * FROM flights WHERE id IN
(SELECT flight_id FROM passengers
GROUP BY flight_id HAVING COUNT(*) > 1);
```

flight_id
1
2
6

```
SELECT * FROM flights WHERE id IN
(SELECT flight_id FROM passengers
GROUP BY flight_id HAVING COUNT(*) > 1);
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

flight_id
1
2
6

```
SELECT * FROM flights WHERE id IN
(SELECT flight_id FROM passengers
GROUP BY flight_id HAVING COUNT(*) > 1);
```

id	origin	destination	duration
1	New York	London	415
2	Shanghai	Paris	760
3	Istanbul	Tokyo	700
4	New York	Paris	435
5	Moscow	Paris	245
6	Lima	New York	455

flight_id
1
2
6

SQL Injection

Username:

Password:

```
SELECT * FROM users
    WHERE (username = username)
    AND (password = password);
```

Username:

alice

Password:

12345

```
SELECT * FROM users
    WHERE (username = username)
    AND (password = password);
```

```
SELECT * FROM users
    WHERE (username = 'alice')
    AND (password = '12345');
```

Username:

hacker

Password:

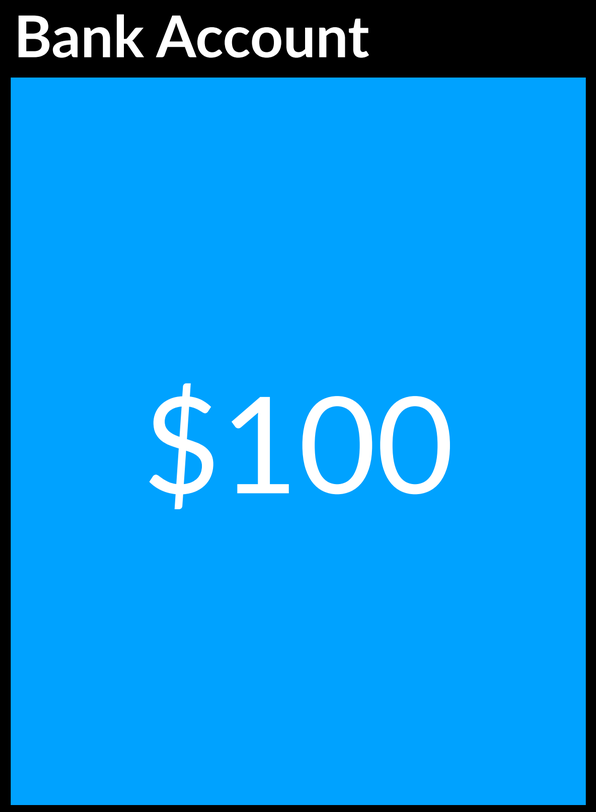
1' OR '1' = '1

```
SELECT * FROM users
    WHERE (username = username)
    AND (password = password);
```

```
SELECT * FROM users
    WHERE (username = 'hacker')
    AND (password = '1' OR '1' = '1');
```

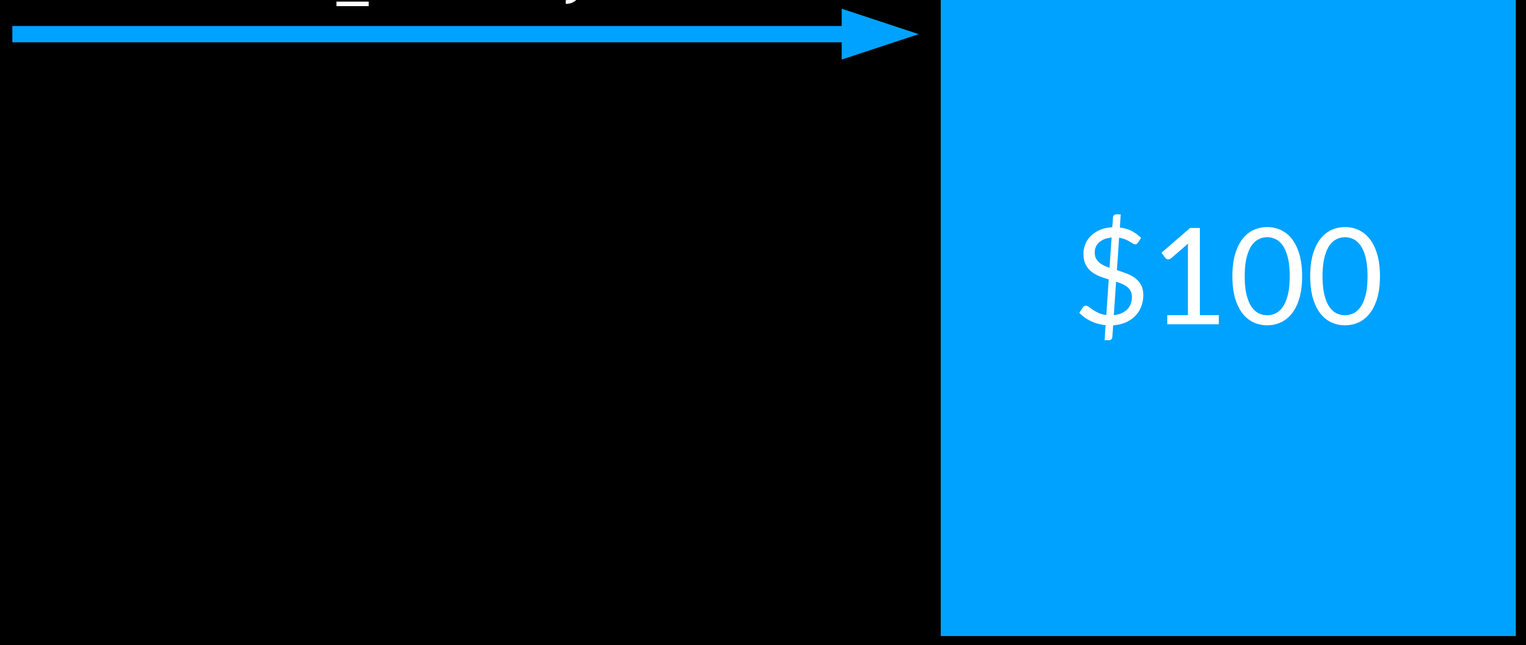
Race Conditions

Race Conditions



Race Conditions

```
SELECT balance FROM bank
WHERE user_id = 1;
```



Race Conditions

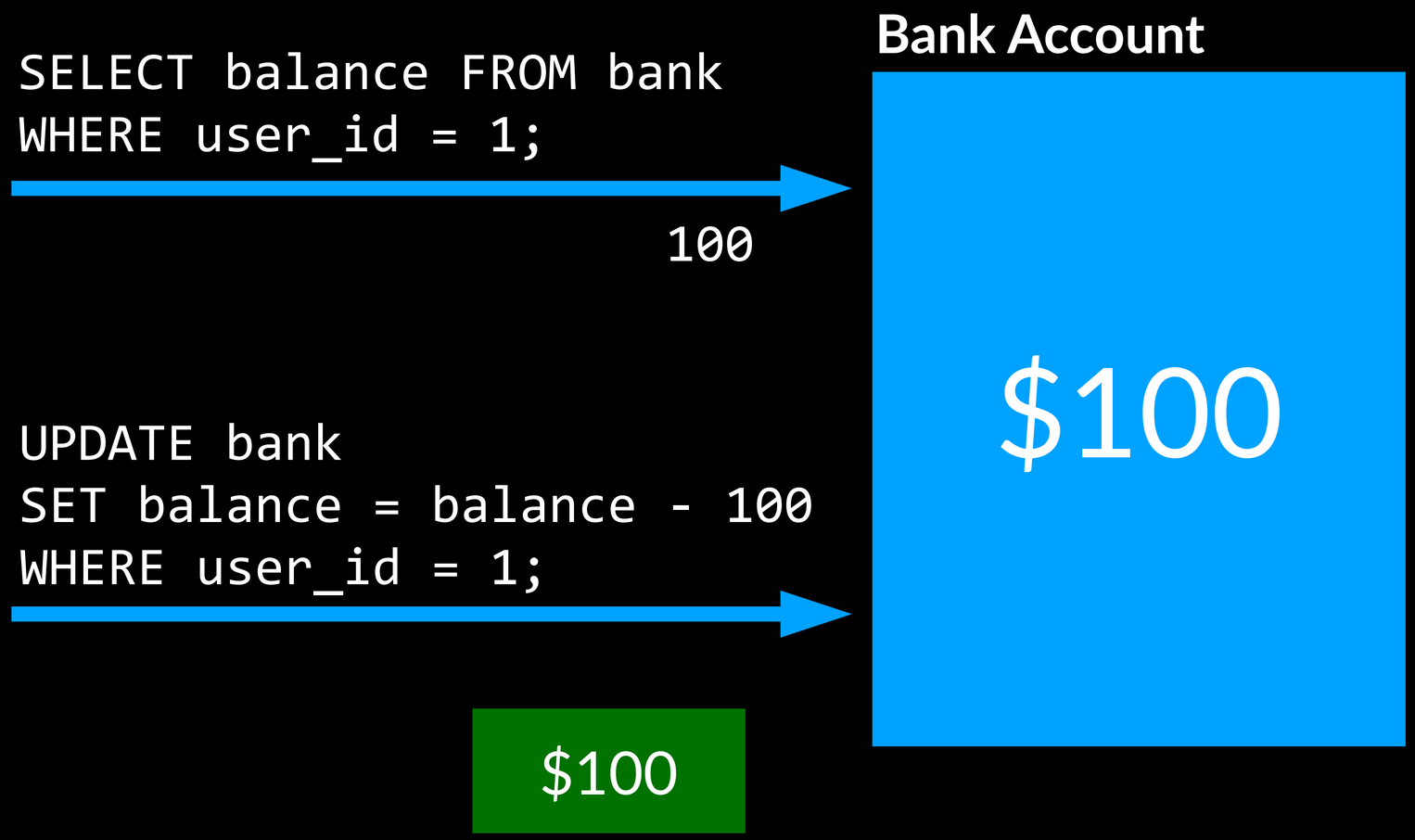
```
SELECT balance FROM bank
WHERE user_id = 1;
```

100

Bank Account

$100

Race Conditions



Race Conditions

```
SELECT balance FROM bank
WHERE user_id = 1;
```

100

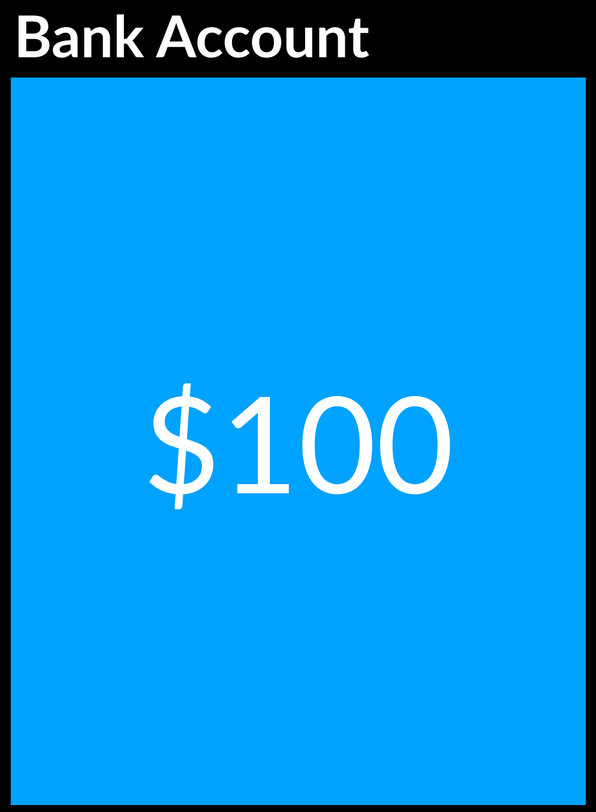
```
UPDATE bank
SET balance = balance - 100
WHERE user_id = 1;
```

$100

Bank Account

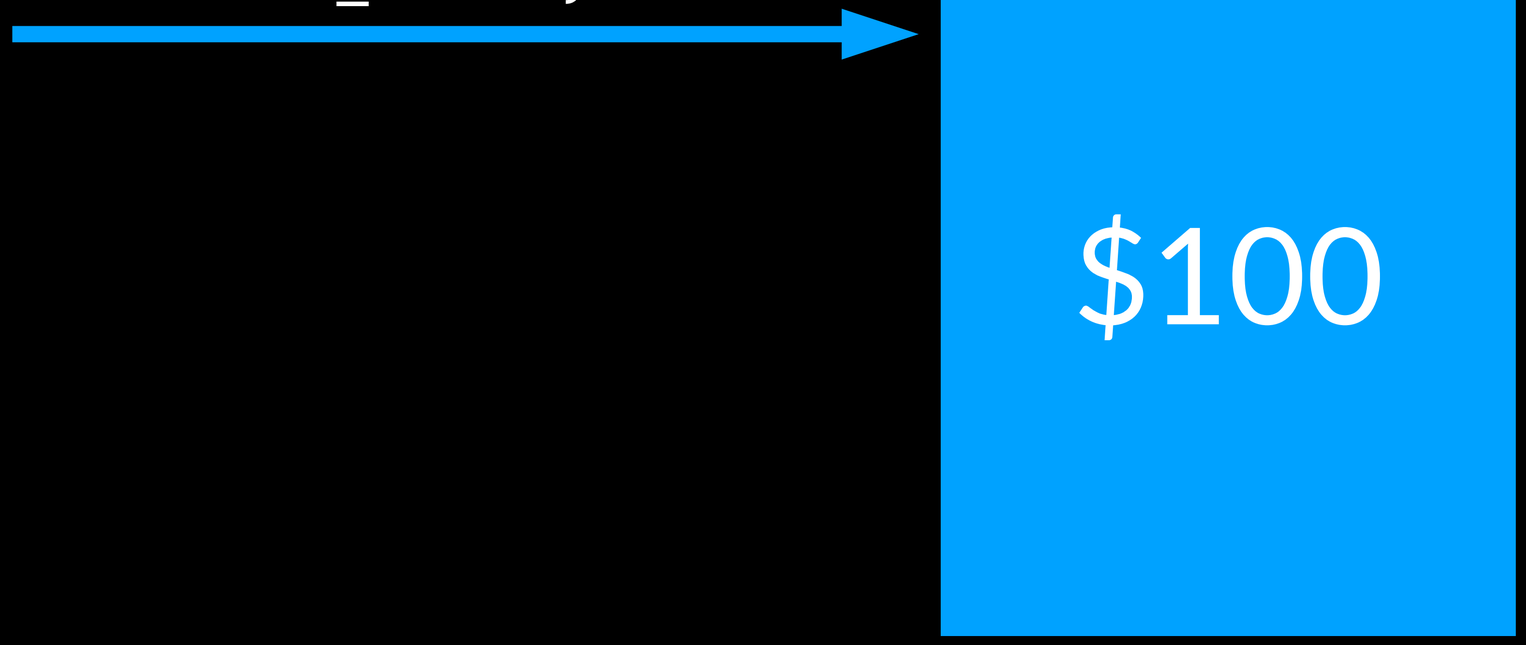
$0

Race Conditions



Race Conditions

```
SELECT balance FROM bank
WHERE user_id = 1;
```



Race Conditions

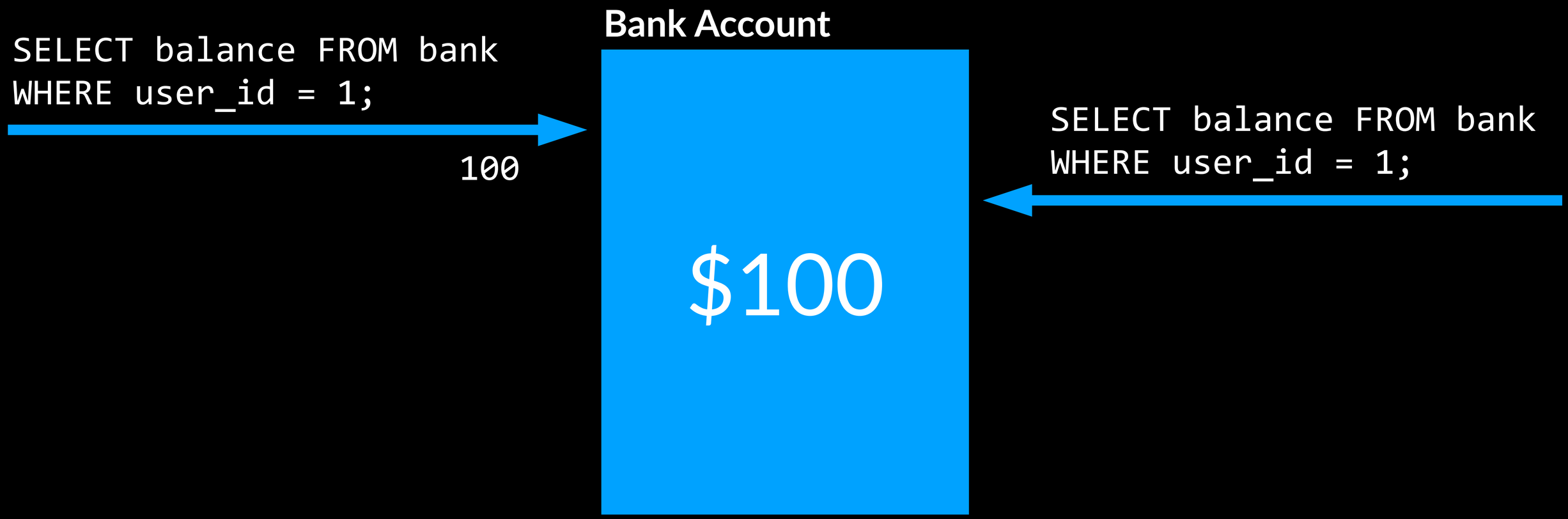
```
SELECT balance FROM bank
WHERE user_id = 1;
```

100

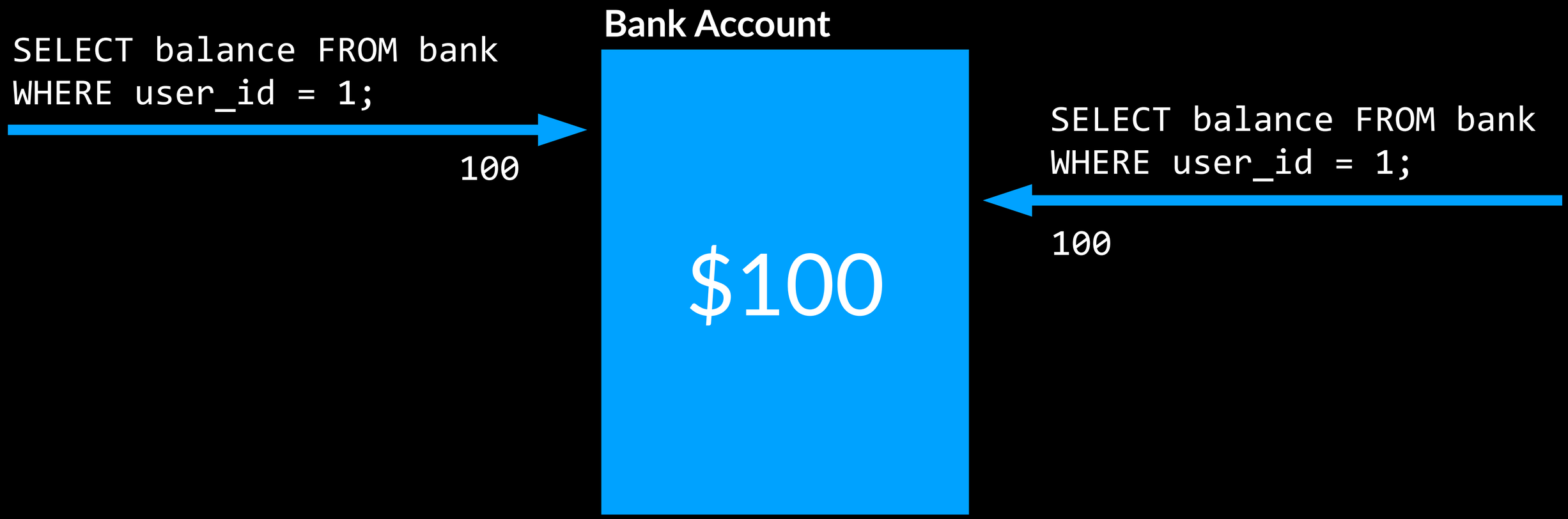
Bank Account

$100

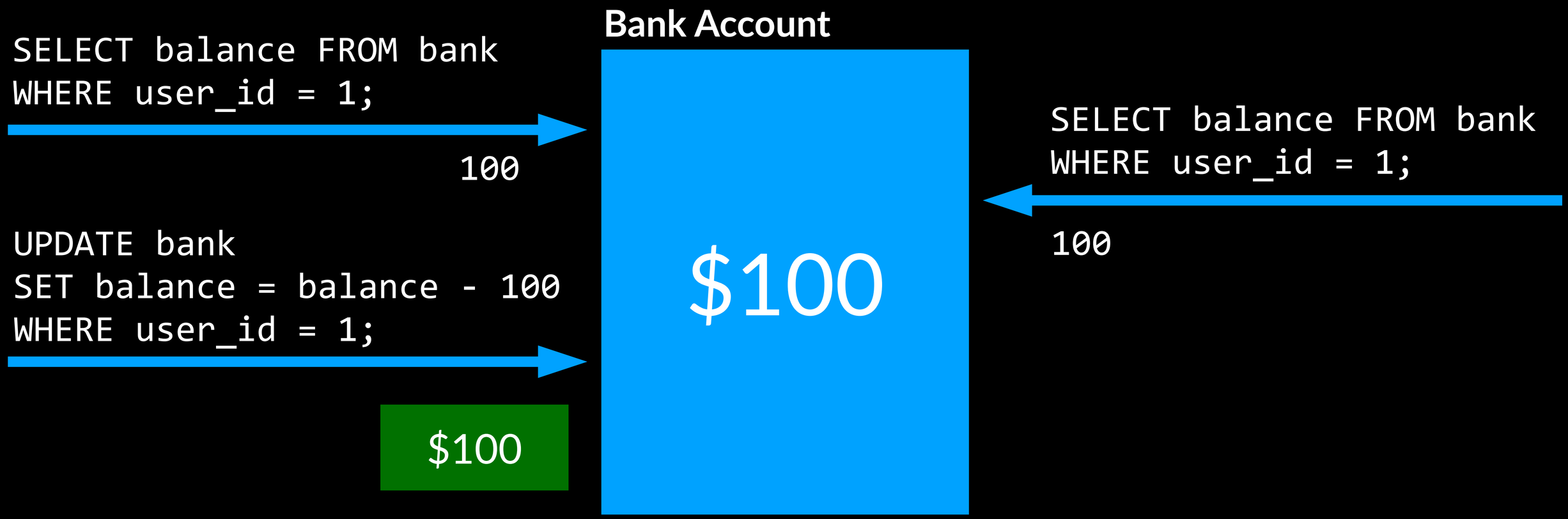
Race Conditions



Race Conditions



Race Conditions



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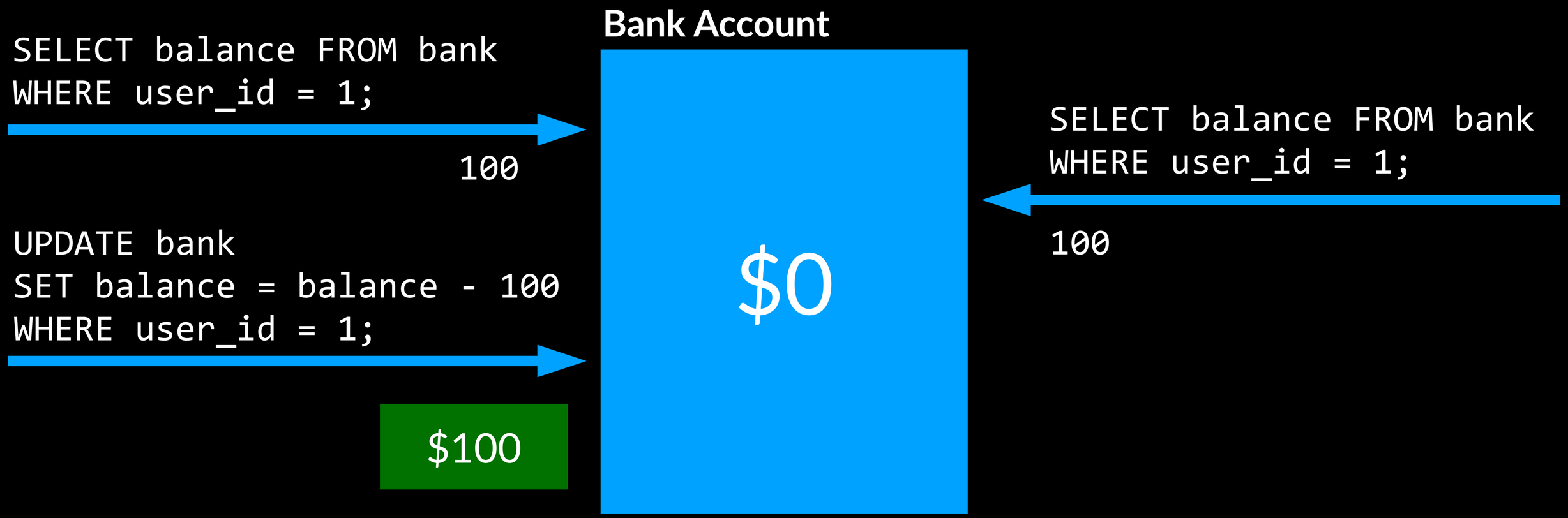
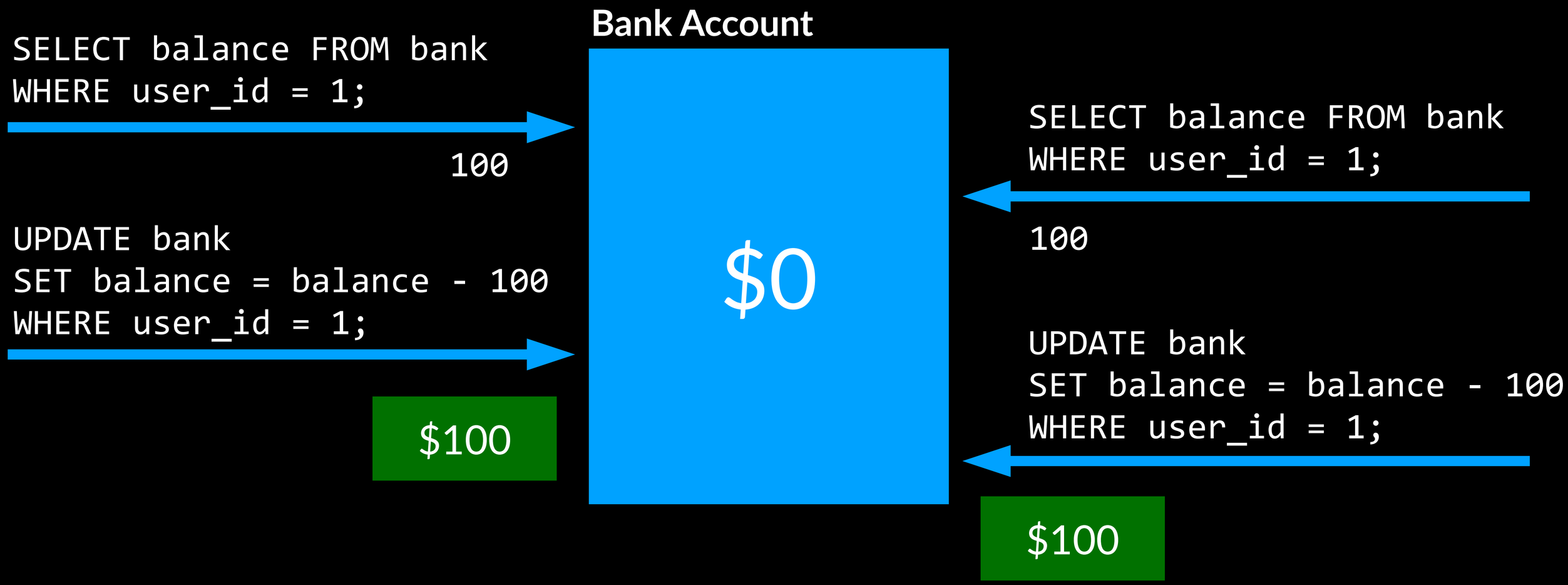
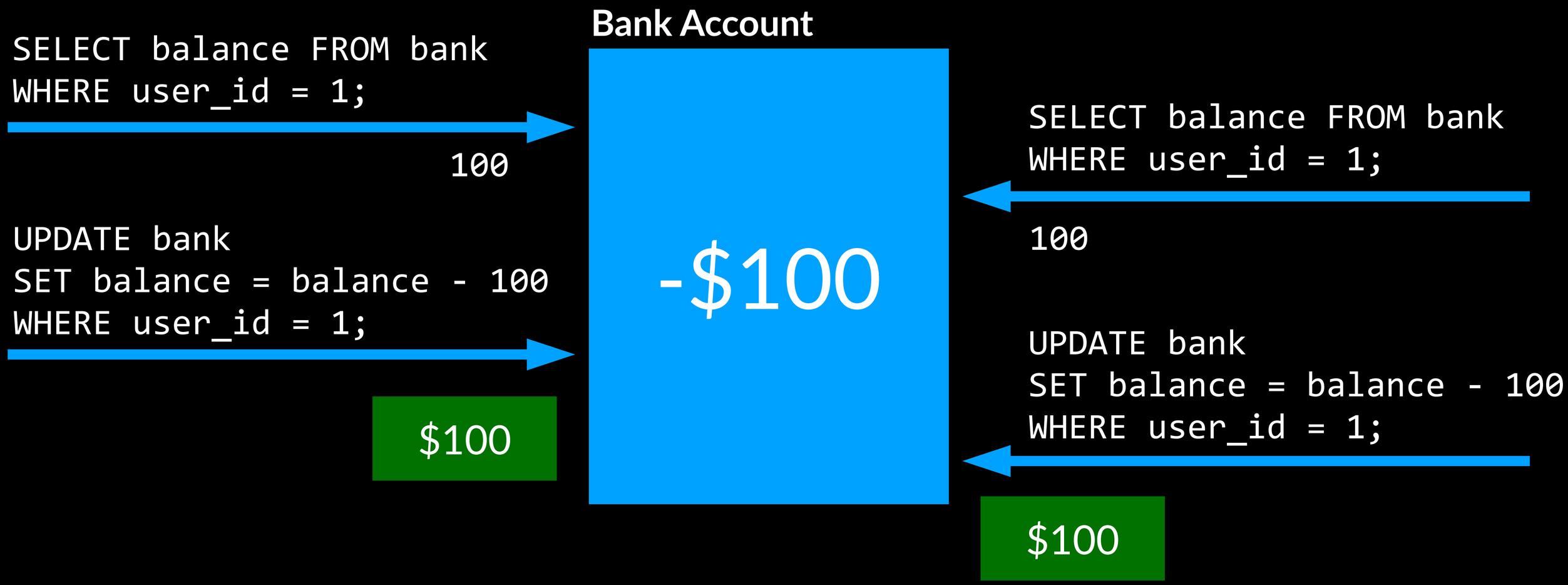


Race Conditions



Race Conditions



SQL Transactions

- `BEGIN`
- `COMMIT`

SQLAlchemy

Web Programming with Python and JavaScript