СБЕР

# Spring Data R2DBC. I’m telling you the last time

Mikhail Polivakha

# Поливаха Михаил

- **Active OpenSource member (including Spring projects)**
- **Technical Writer**
- **Spring Айо Community board member**

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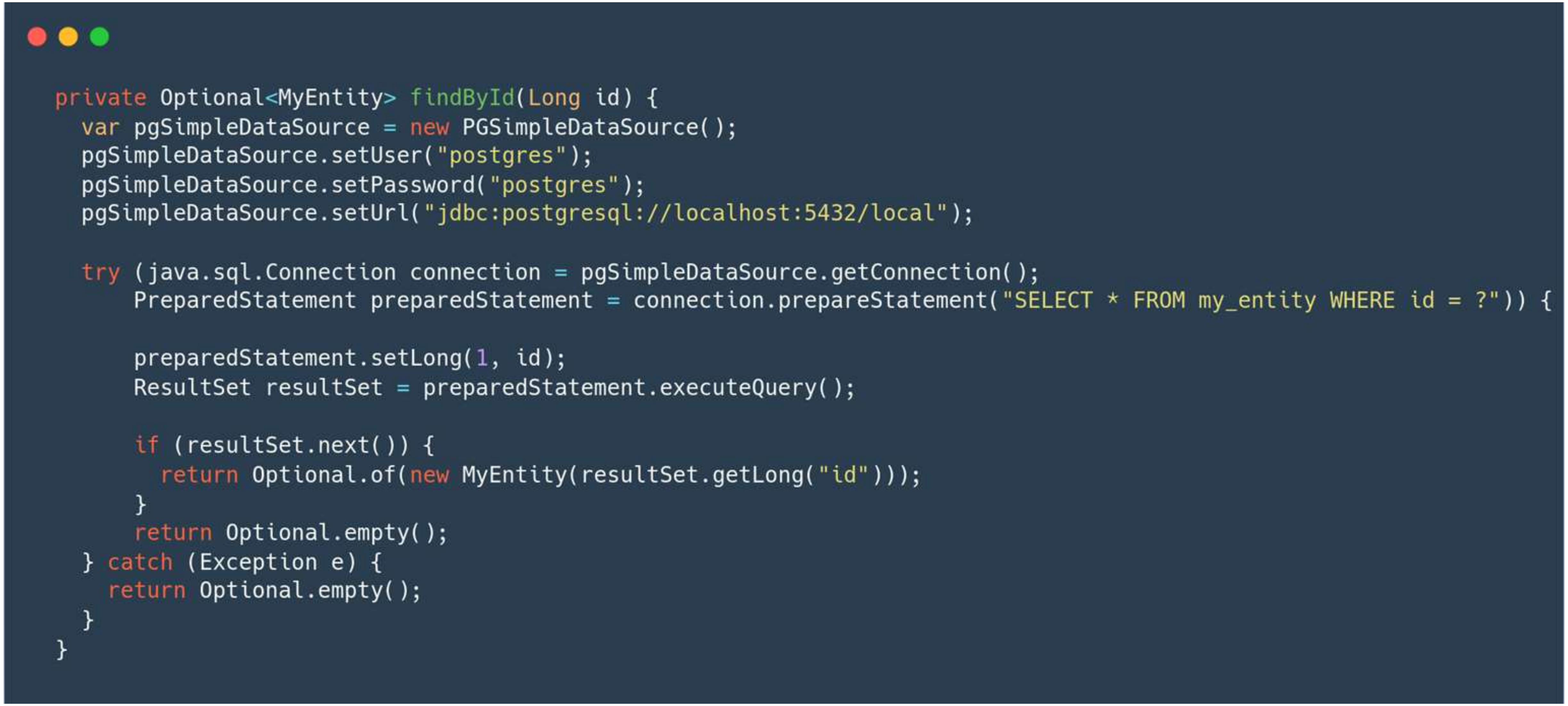
- **GitHub: mipo256**
- **Blog: mpolivaha.com**
- **Email: mikhailpolivakha@gmail.com**

# Agenda

- Review some other attempts to work with RDBMS reactively
- How typical R2DBC drivers work
- Reactive != Asynchronous
- We’re also going to talk about spring-data-r2dbc and challenges it faces
- What should you do?

## Evolution of Reactive RDBMS drivers

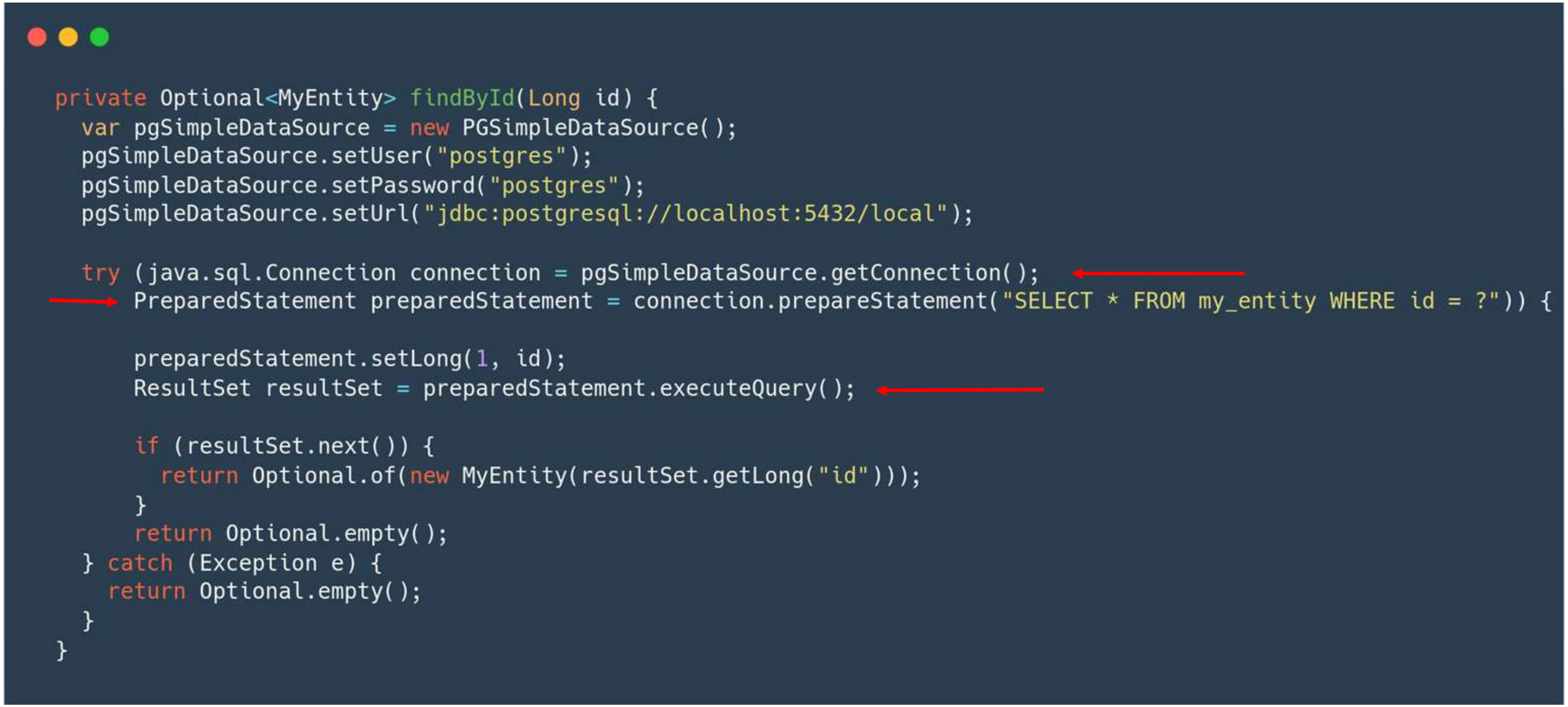


```java
private Optional<MyEntity> findById(Long id) {
  var pgSimpleDataSource = new PGSimpleDataSource();
  pgSimpleDataSource.setUser("postgres");
  pgSimpleDataSource.setPassword("postgres");
  pgSimpleDataSource.setUrl("jdbc:postgresql://localhost:5432/local");

  try (java.sql.Connection connection = pgSimpleDataSource.getConnection();
      PreparedStatement preparedStatement = connection.prepareStatement("SELECT * FROM my_entity WHERE id = ?")) {

      preparedStatement.setLong(1, id);
      ResultSet resultSet = preparedStatement.executeQuery();

      if (resultSet.next()) {
        return Optional.of(new MyEntity(resultSet.getLong("id")));
      }
      return Optional.empty();
  } catch (Exception e) {
    return Optional.empty();
  }
}
```



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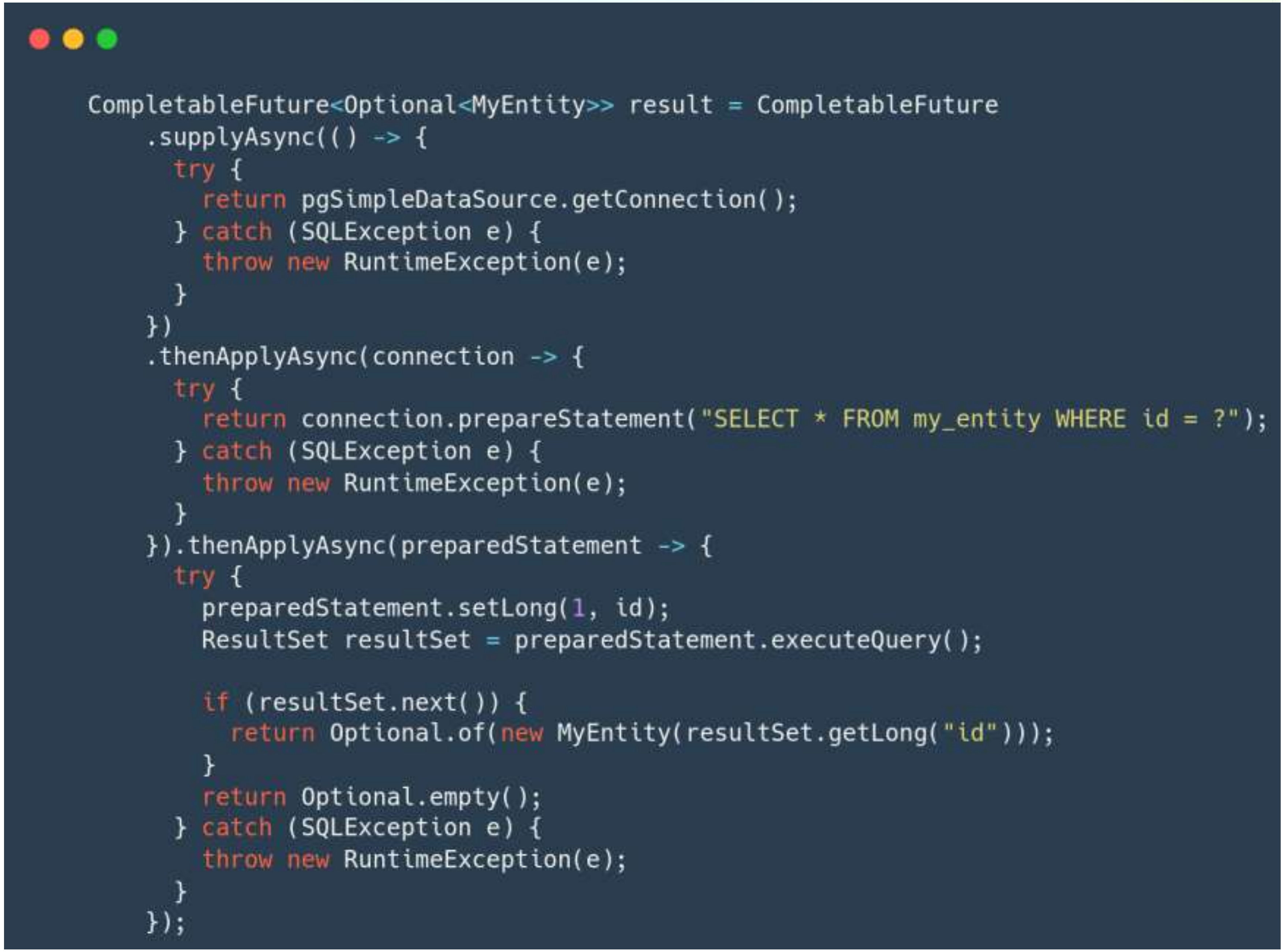
## An easy fix!



```
CompletableFuture<Optional<MyEntity>> result = CompletableFuture
    .supplyAsync(() -> {
      try {
        return pgSimpleDataSource.getConnection();
      } catch (SQLException e) {
        throw new RuntimeException(e);
      }
    })
    .thenApplyAsync(connection -> {
      try {
        return connection.prepareStatement("SELECT * FROM my_entity WHERE id = ?");
      } catch (SQLException e) {
        throw new RuntimeException(e);
      }
    }).thenApplyAsync(preparedStatement -> {
      try {
        preparedStatement.setLong(1, id);
        ResultSet resultSet = preparedStatement.executeQuery();

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          return Optional.of(new MyEntity(resultSet.getLong("id")));
        }
        return Optional.empty();
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      }
    });
```
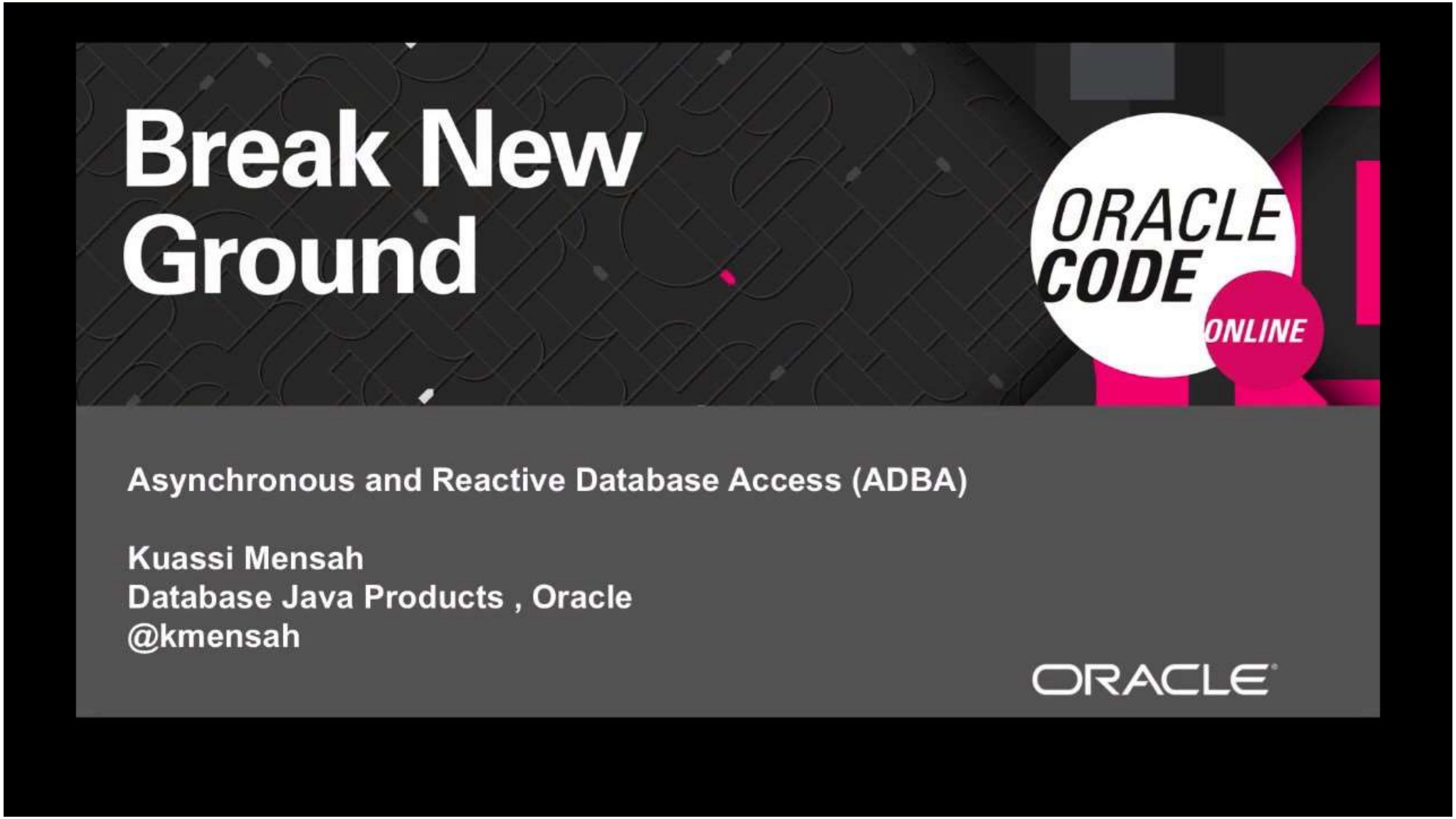

Just use the Java's Future, why always overcomplicate?

## ADBA - Asynchronous Database Access



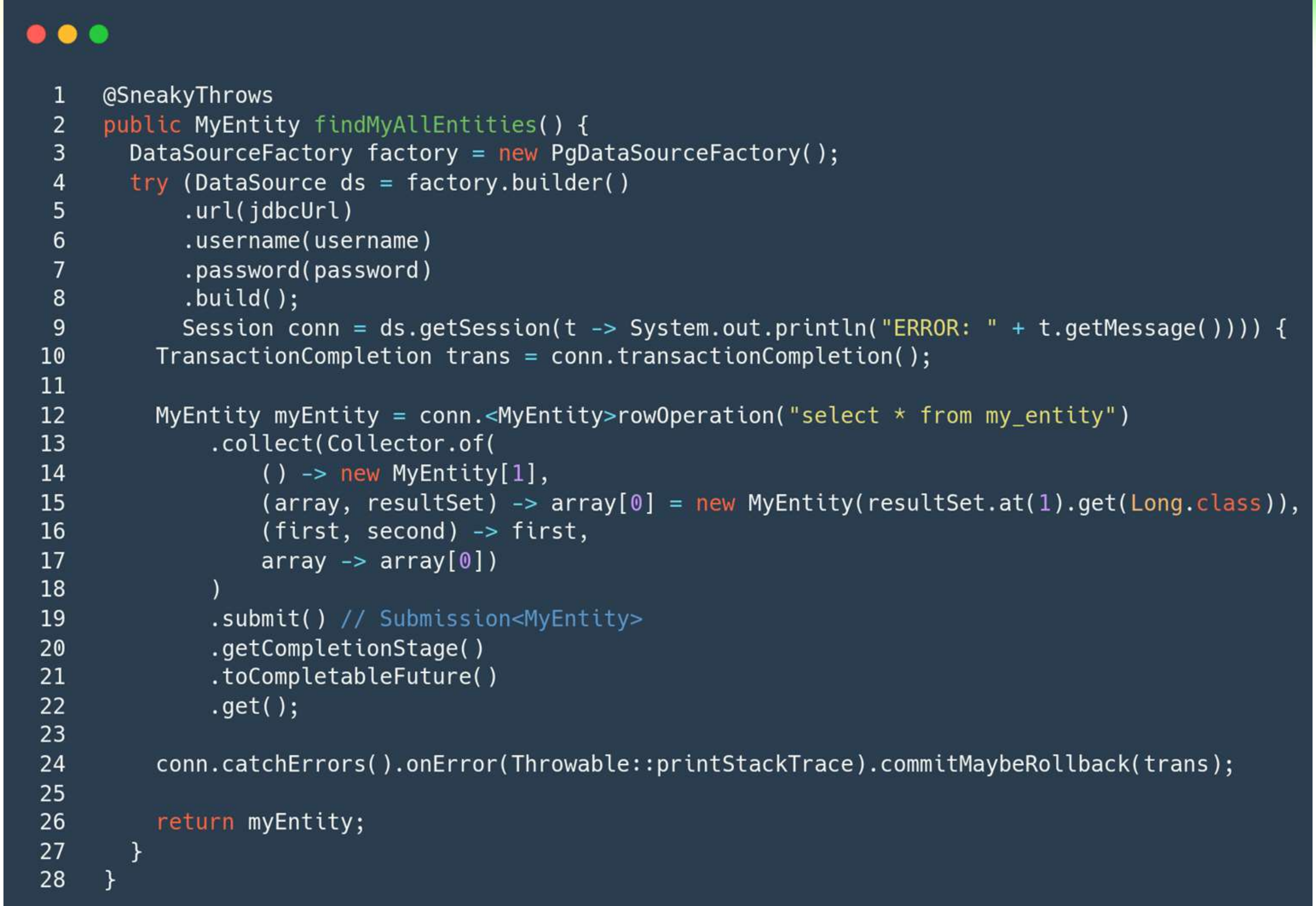
Break New Ground

ORACLE CODE ONLINE

Asynchronous and Reactive Database Access (ADBA)

Kuassi Mensah
Database Java Products , Oracle
@kmensah

ORACLE

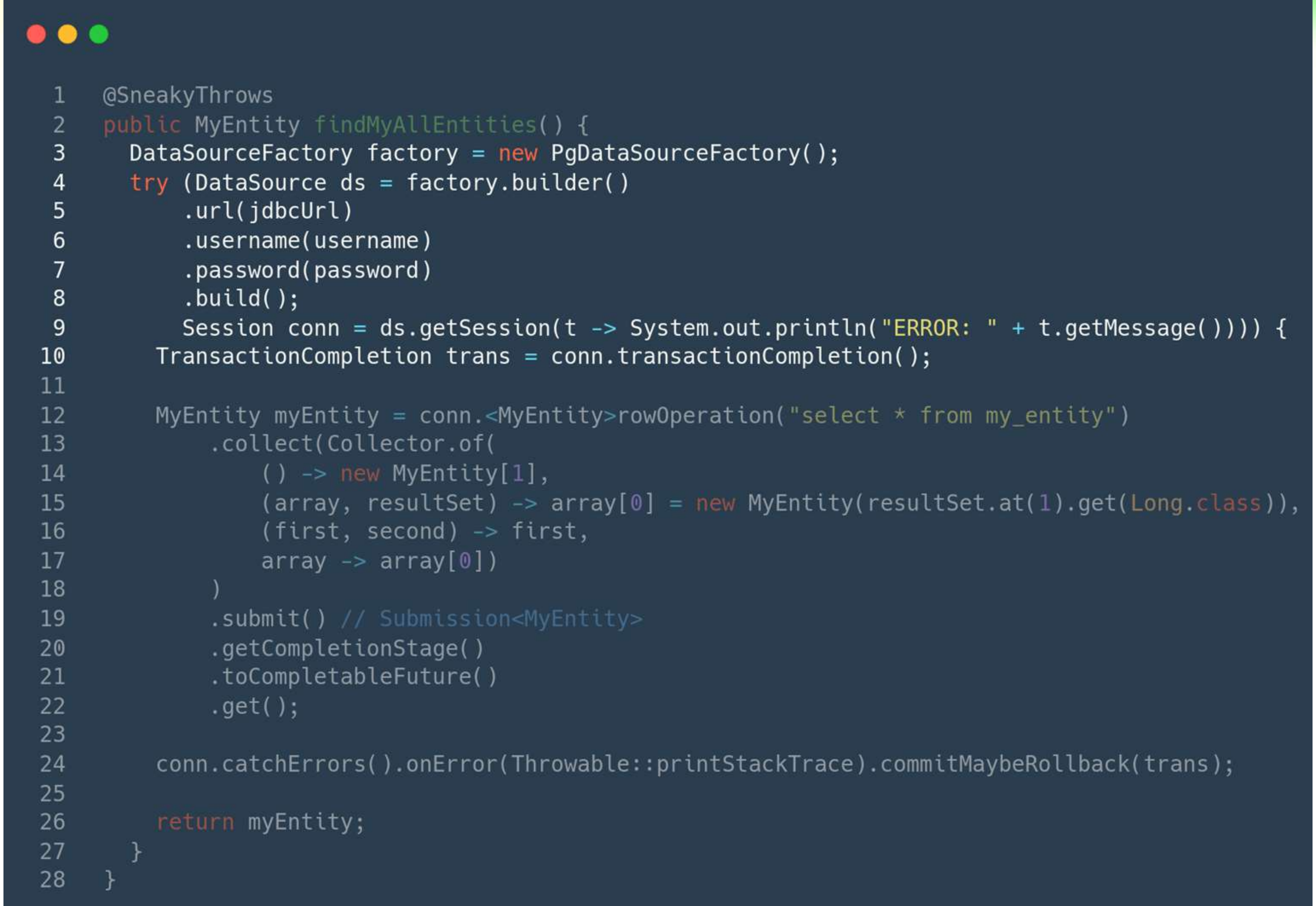


```java
@SneakyThrows
public MyEntity findMyAllEntities() {
  DataSourceFactory factory = new PgDataSourceFactory();
  try (DataSource ds = factory.builder()
        .url(jdbcUrl)
        .username(username)
        .password(password)
        .build();
        Session conn = ds.getSession(t -> System.out.println("ERROR: " + t.getMessage()))) {
    TransactionCompletion trans = conn.transactionCompletion();

    MyEntity myEntity = conn.<MyEntity>rowOperation("select * from my_entity")
        .collect(Collector.of(
            () -> new MyEntity[1],
            (array, resultSet) -> array[0] = new MyEntity(resultSet.at(1).get(Long.class)),
            (first, second) -> first,
            array -> array[0])
        )
        .submit() // Submission<MyEntity>
        .getCompletionStage()
        .toCompletableFuture()
        .get();

    conn.catchErrors().onError(Throwable::printStackTrace).commitMaybeRollback(trans);

    return myEntity;
  }
}
```



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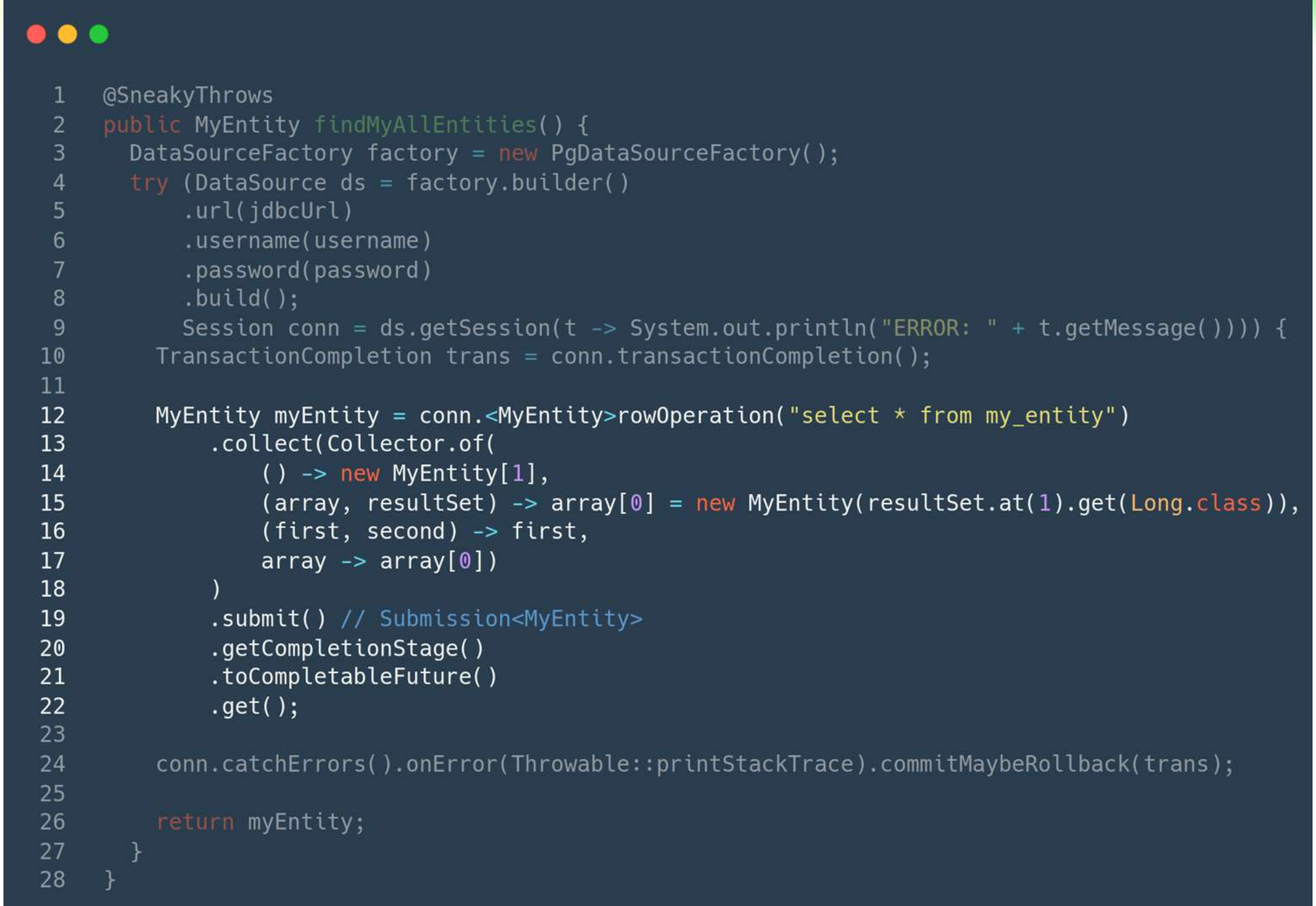

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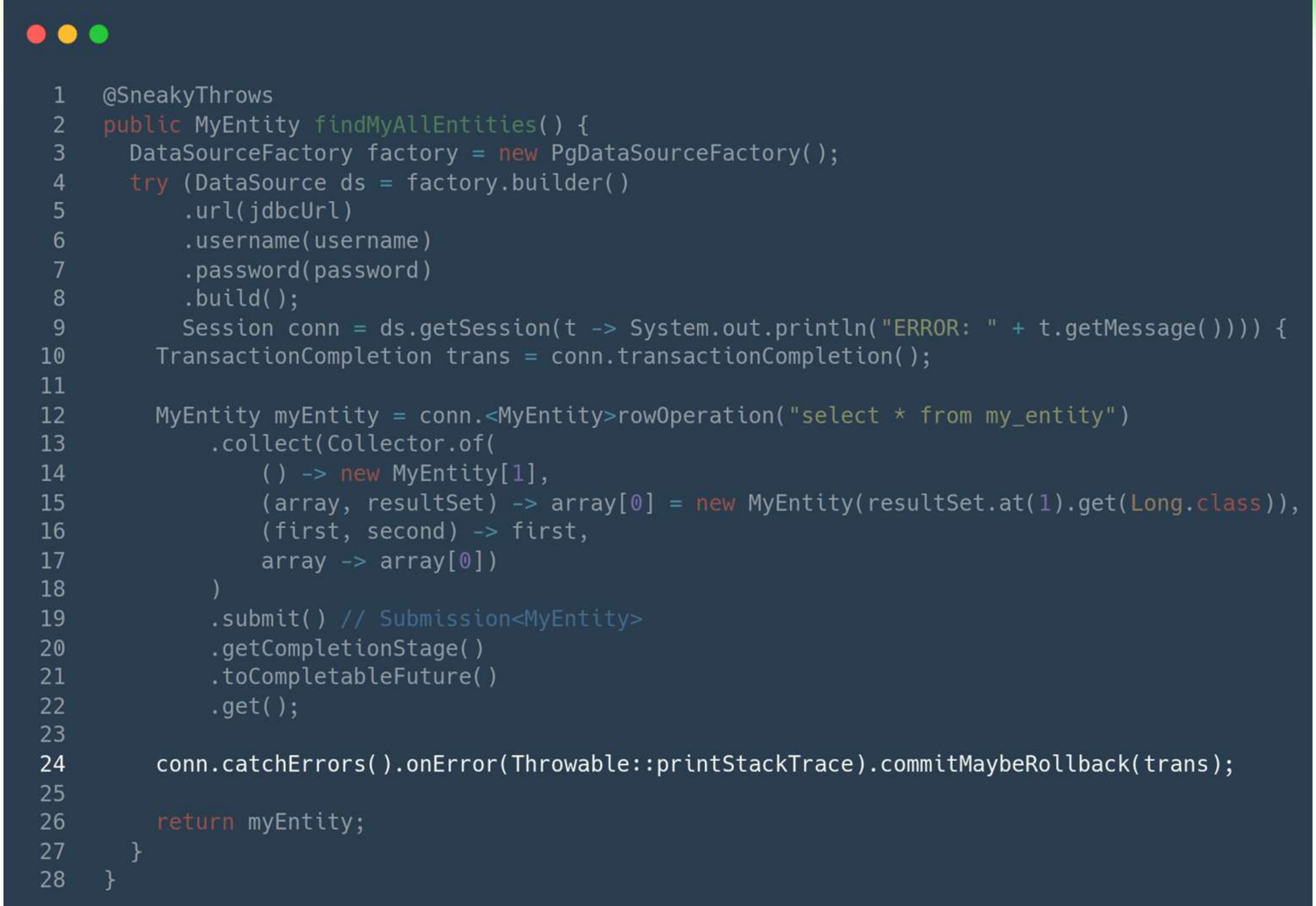

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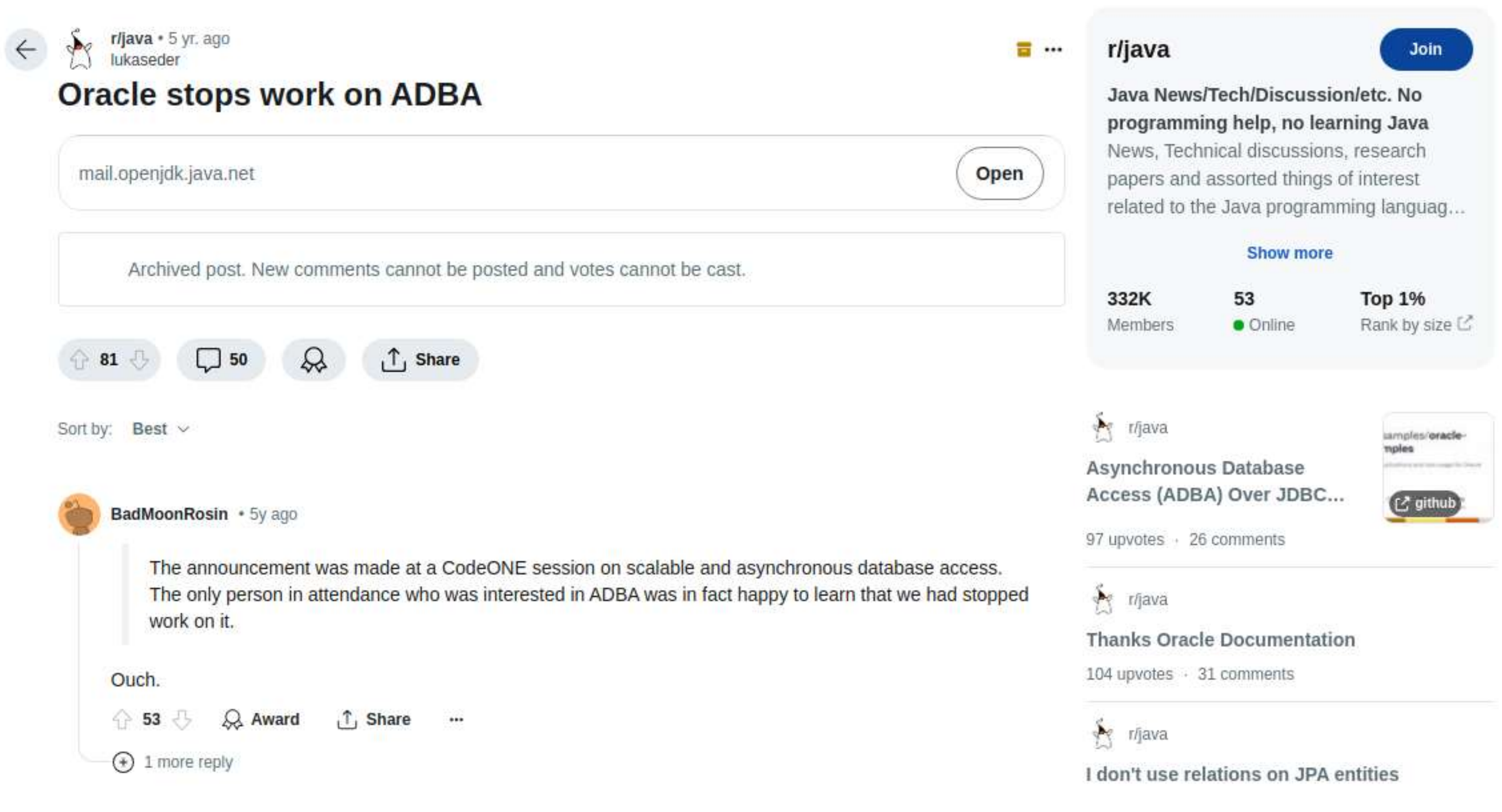

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Oracle stops work on ADBA

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BadMoonRosin • 5y ago

> The announcement was made at a CodeONE session on scalable and asynchronous database access. The only person in attendance who was interested in ADBA was in fact happy to learn that we had stopped work on it.

Ouch.

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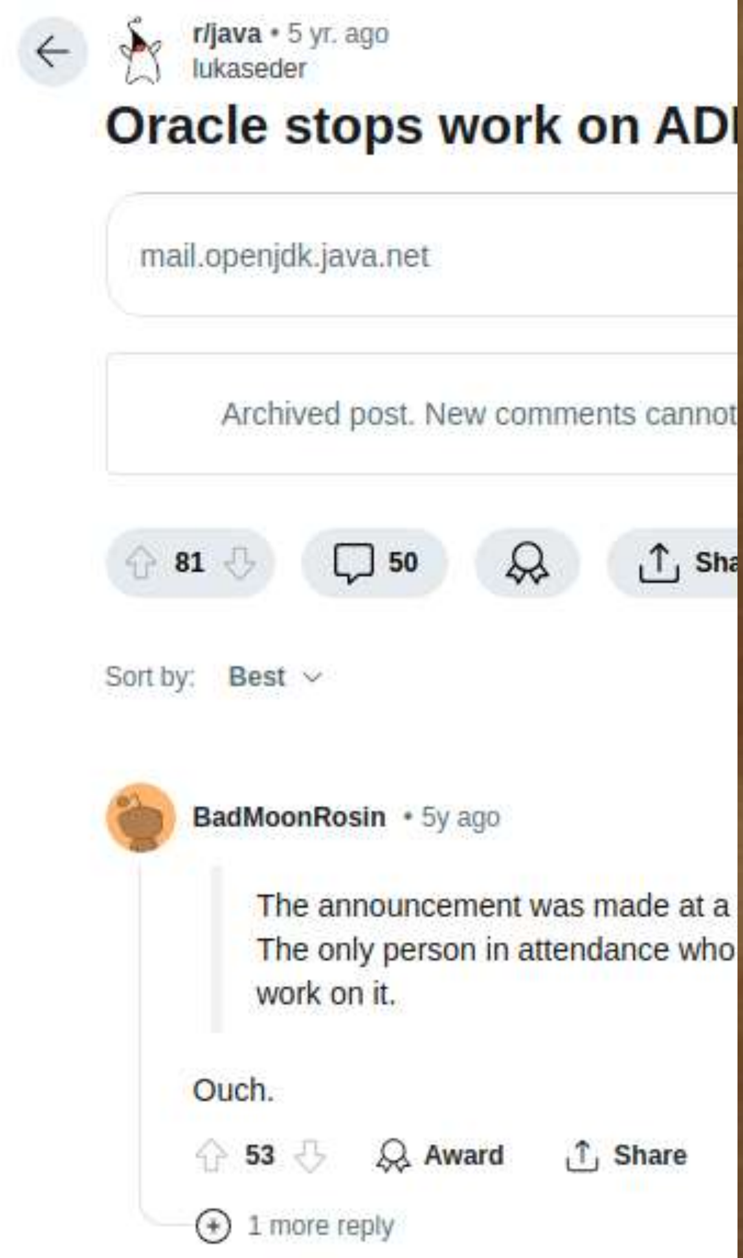

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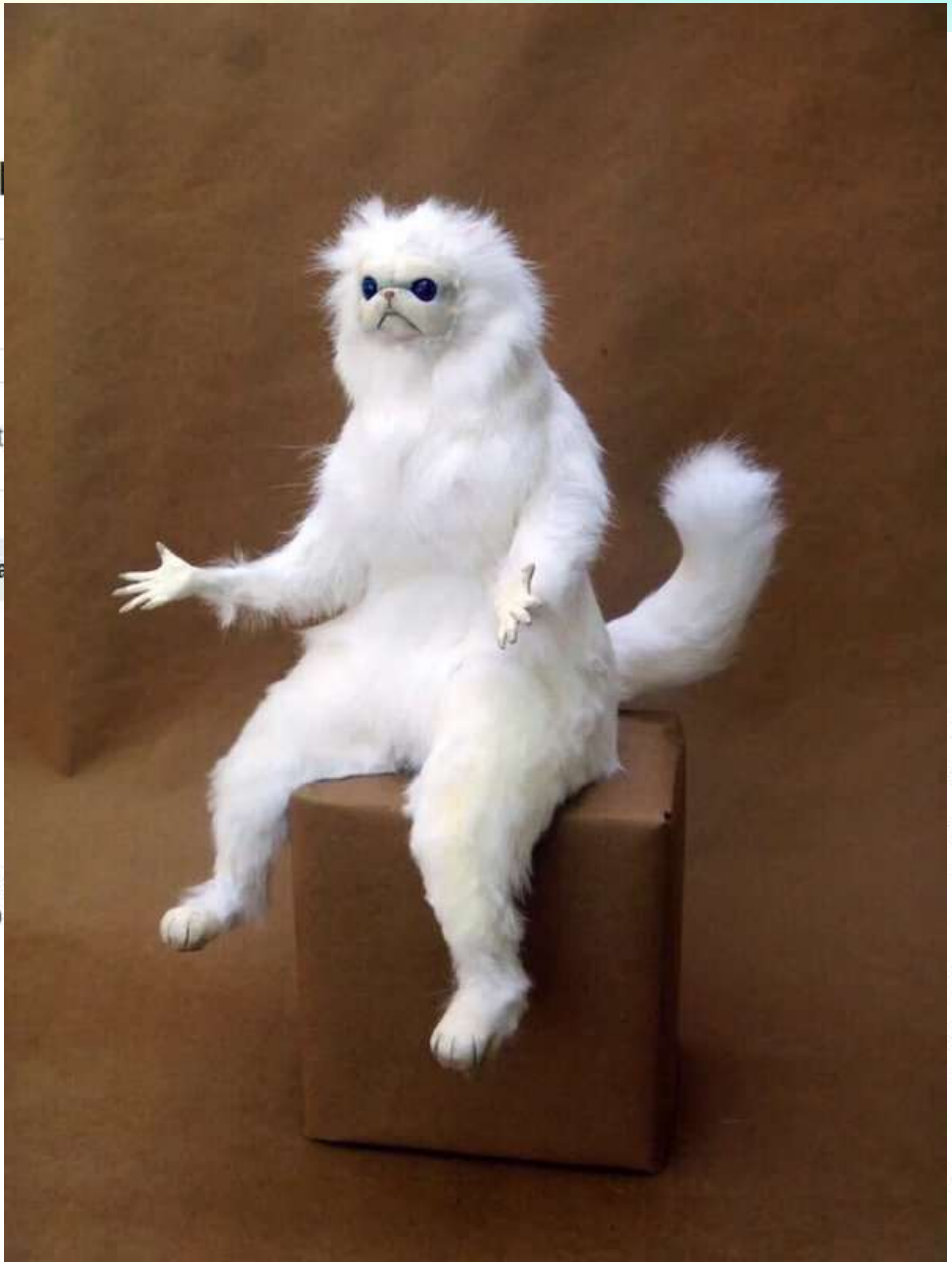

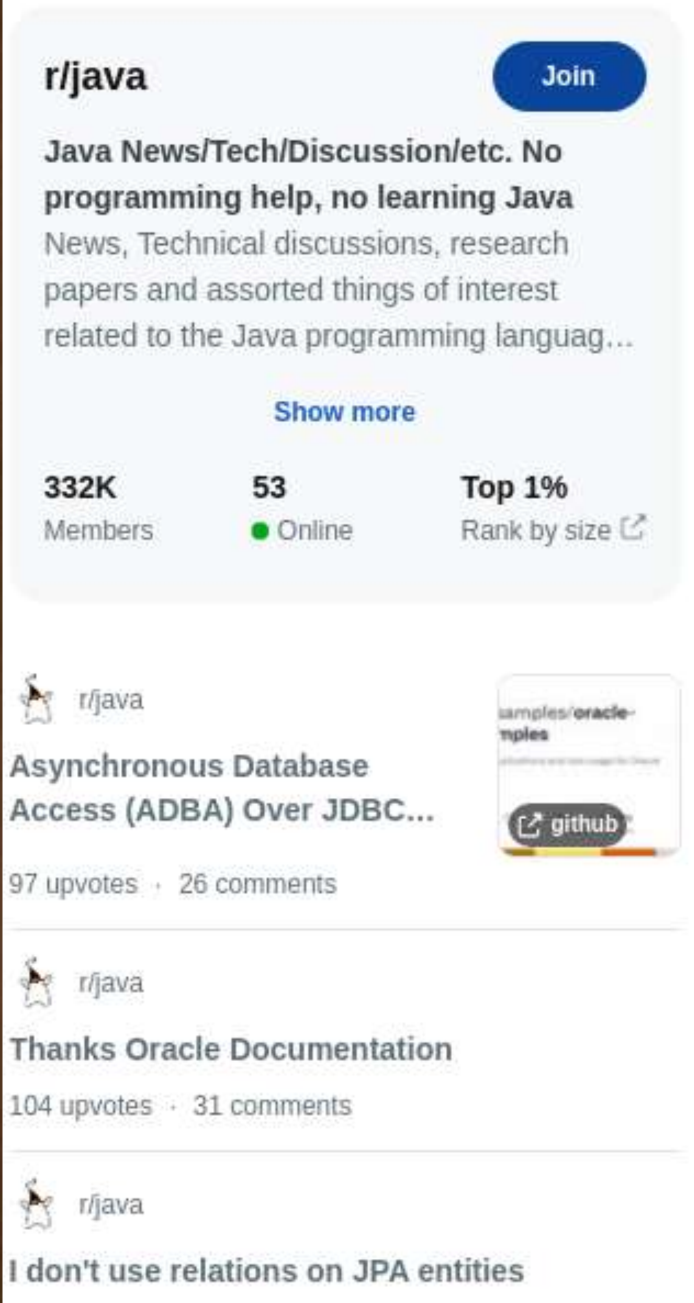

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github

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Thanks Oracle Documentation

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I don't use relations on JPA entities

## What happened to ADBA?[1]

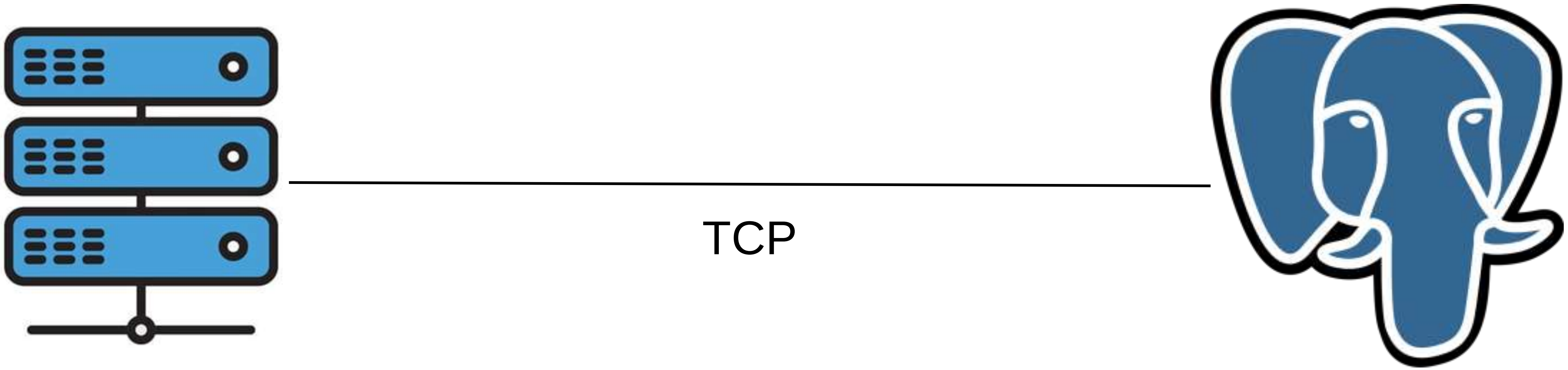
1. Project Loom Firbes solve a lot of problems that reactivity is targeting, *but not all.*

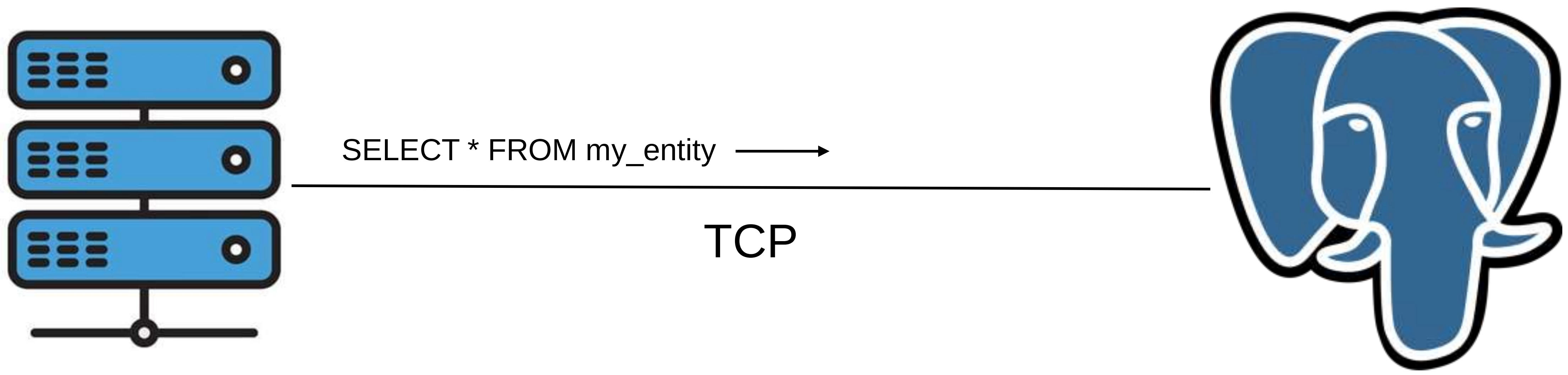
2. The cost for writing reactive applications is harder to “test, debug, maintain and understand”.

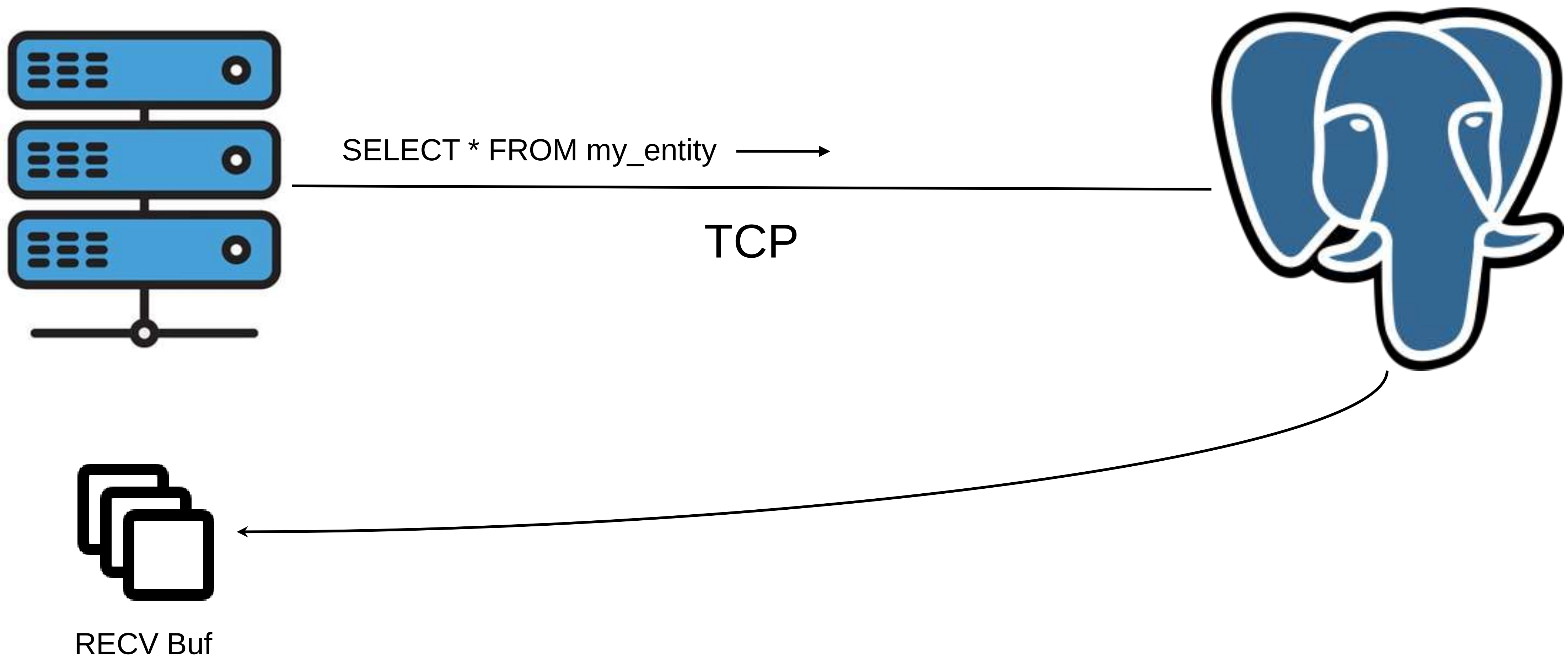
3. Considering the trade-offs, that just not worth it.

[1]https://mail.openjdk.org/pipermail/jdbc-spec-discuss/2019-September/000529.html

## Reactive APIs for Databases


TCP


SELECT * FROM my_entity
TCP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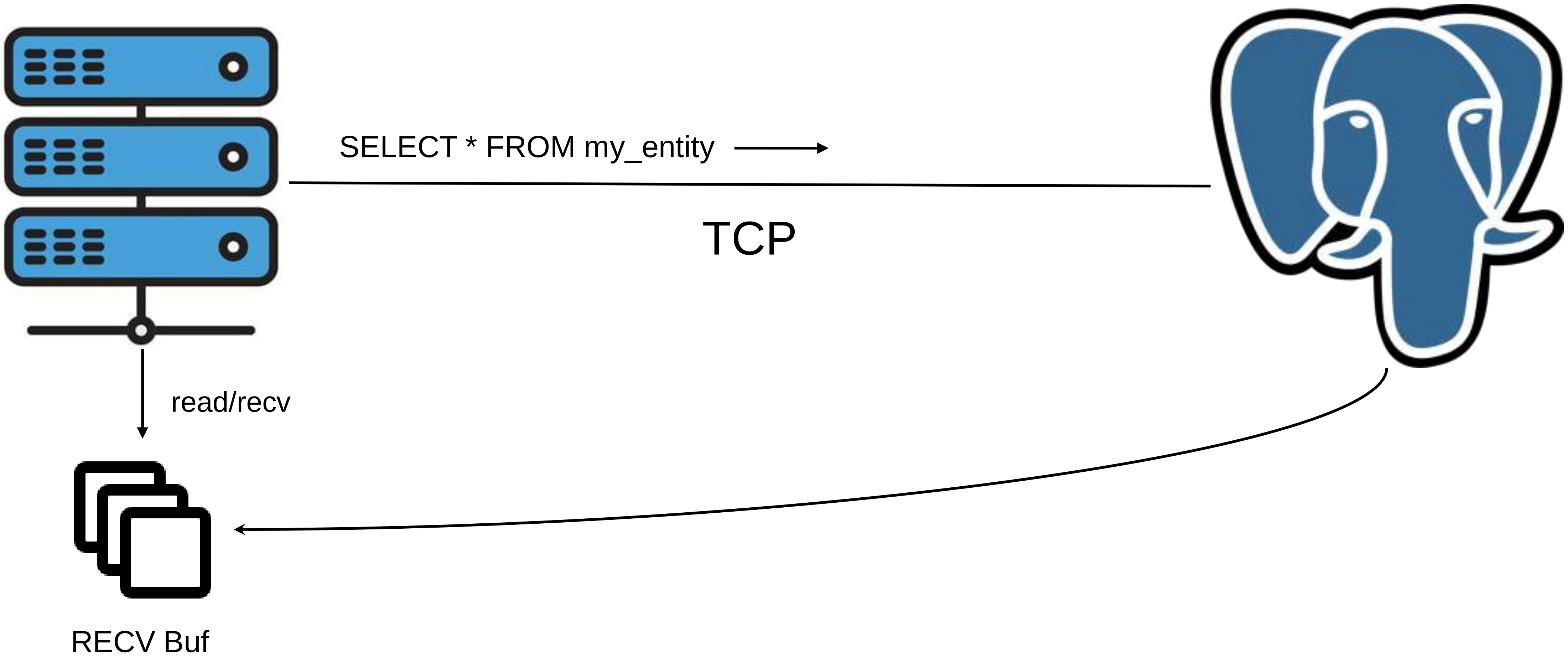
TCP
RECV Buf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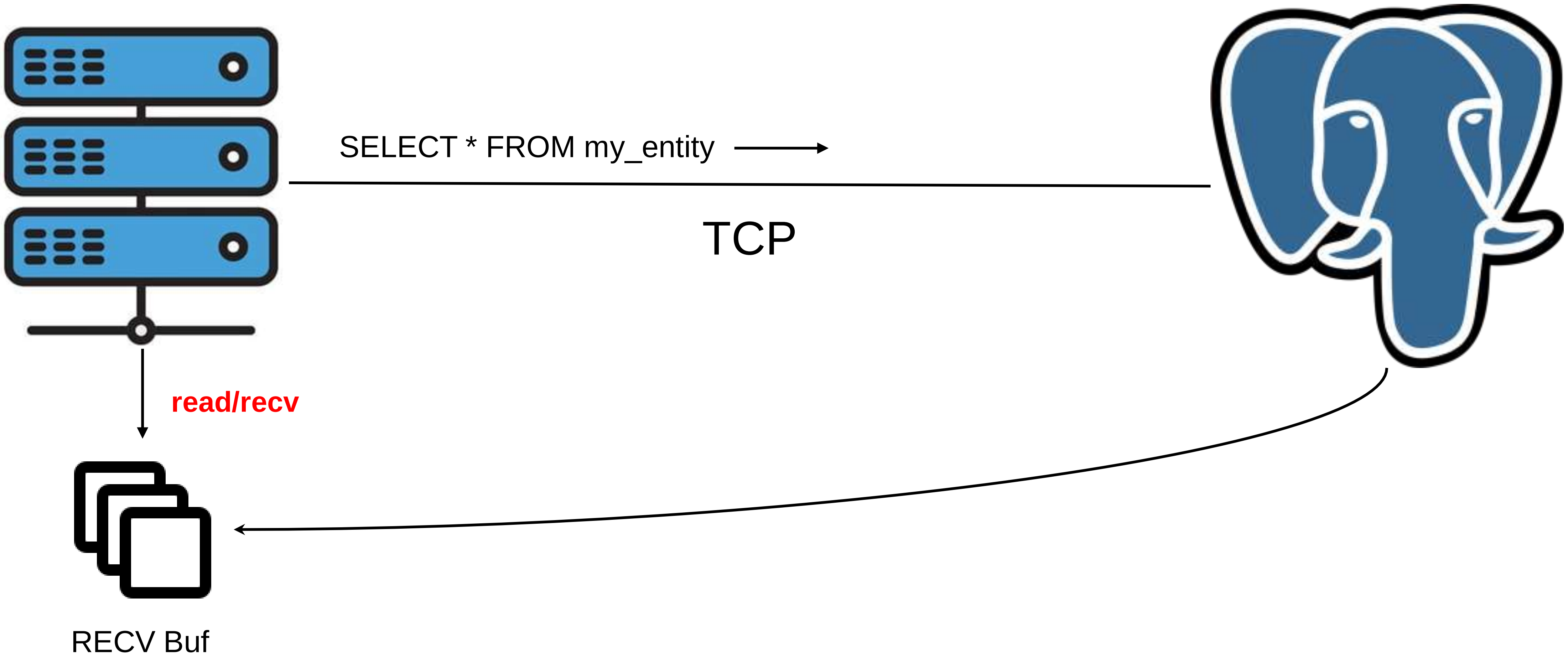
read/recv
RECV Buf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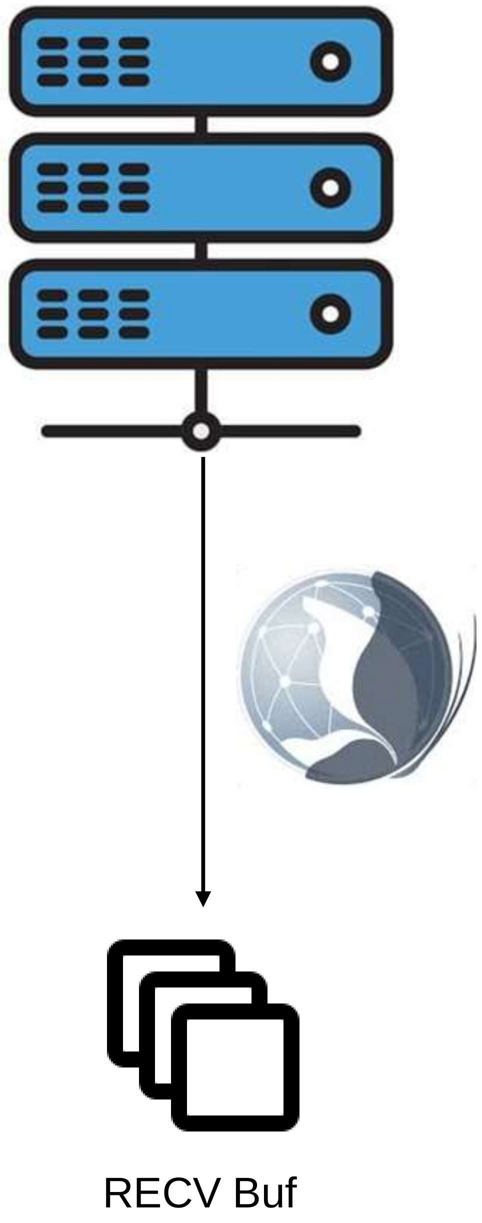
RECV Buf

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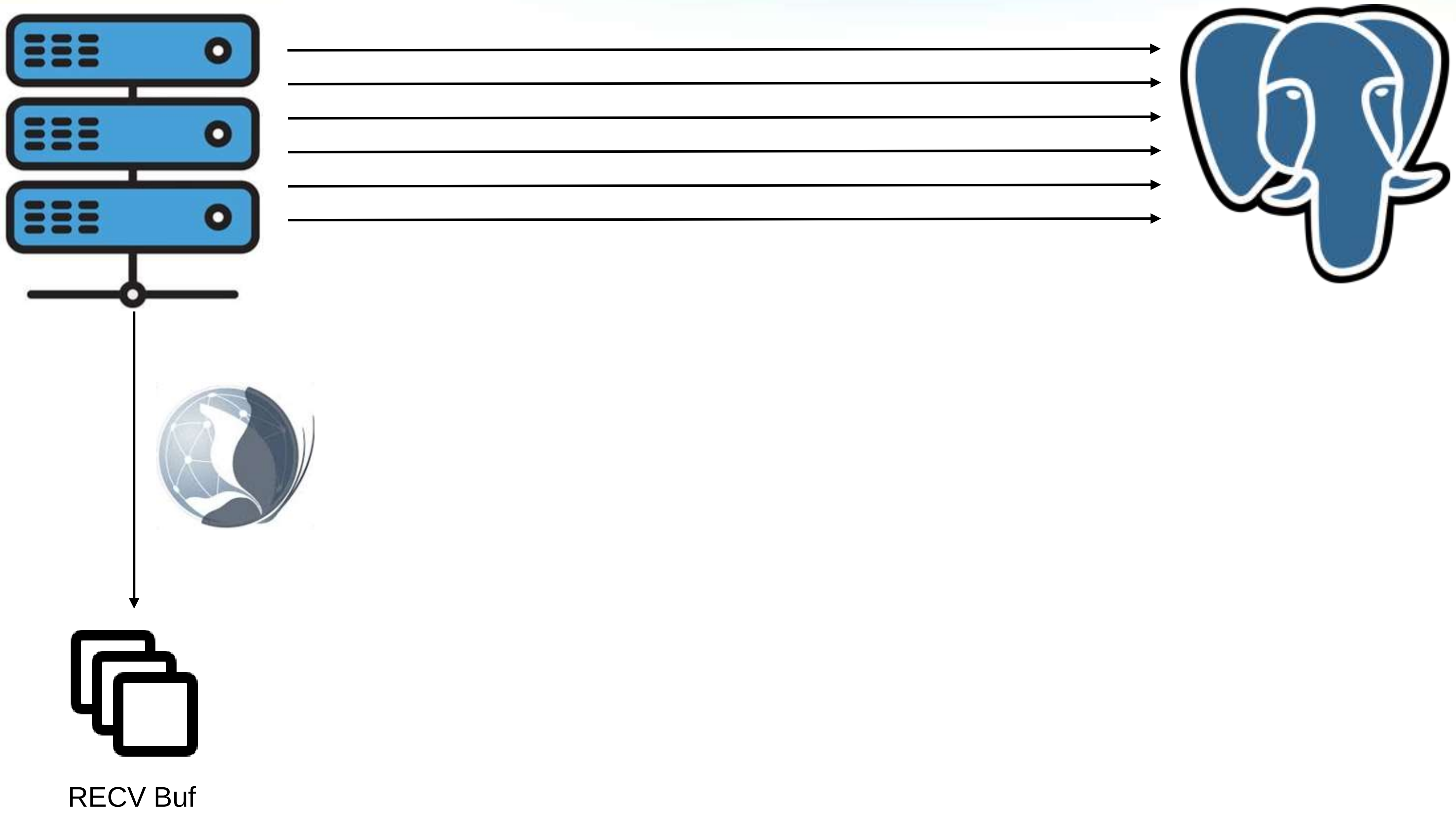
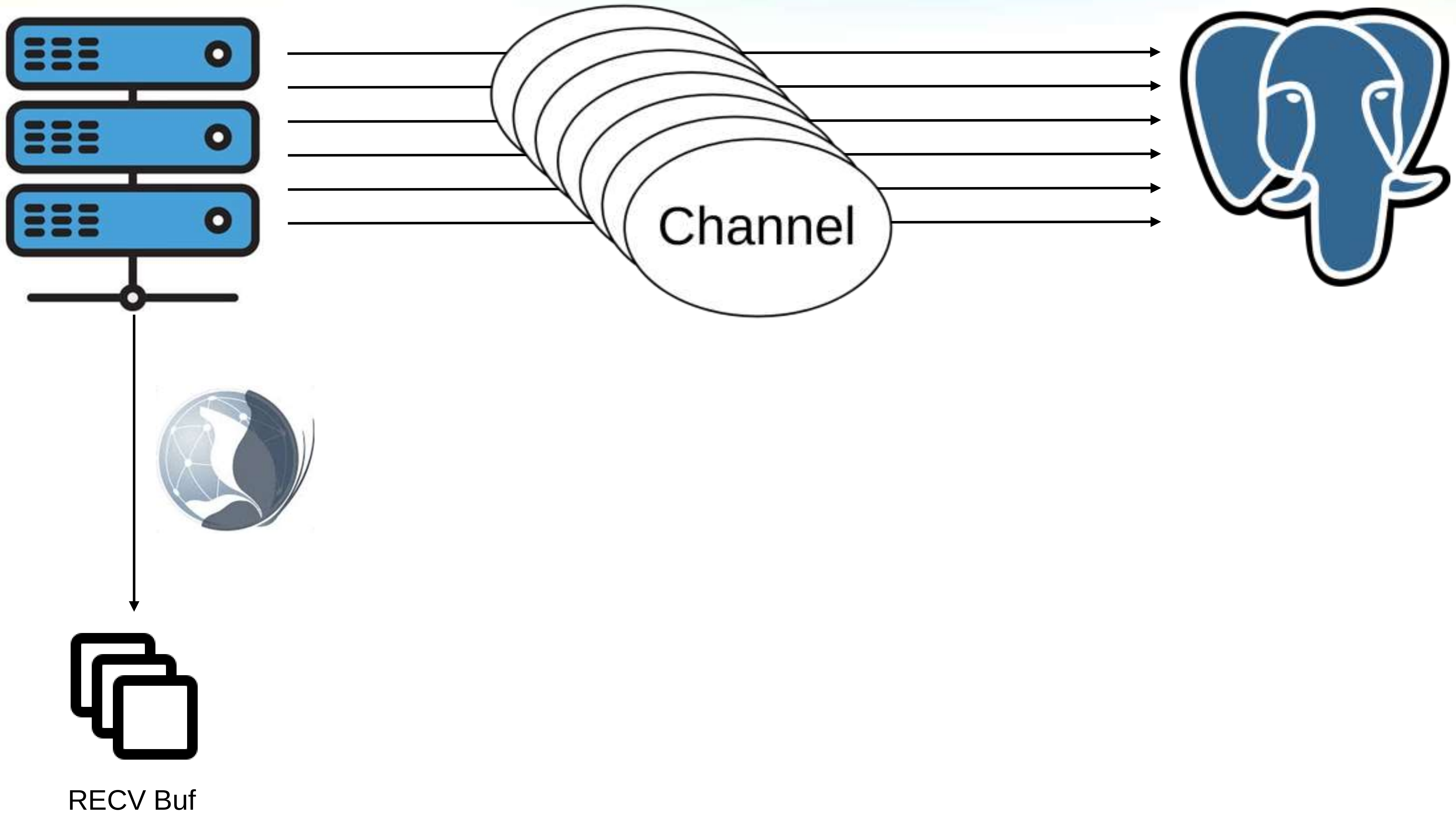
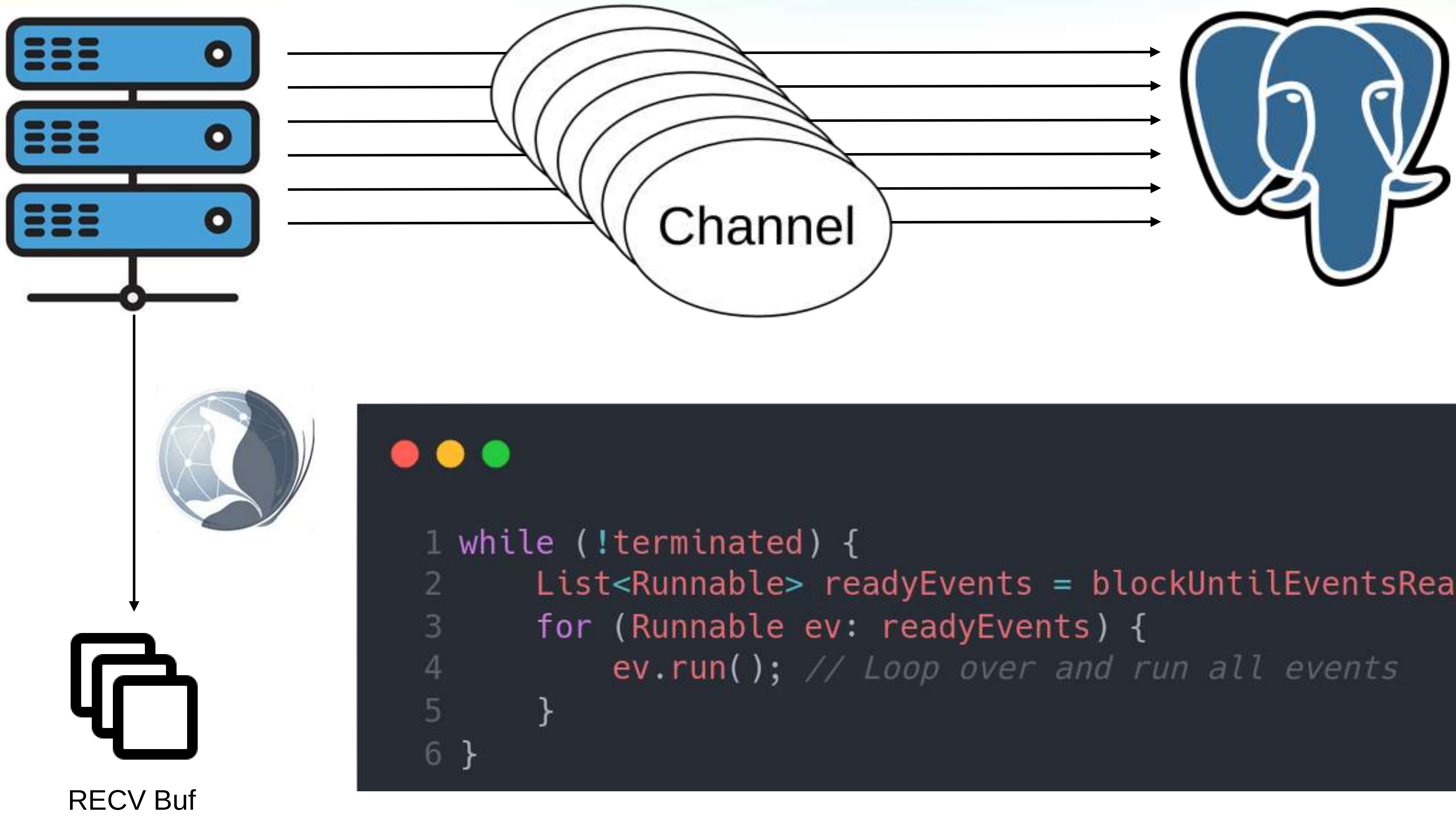
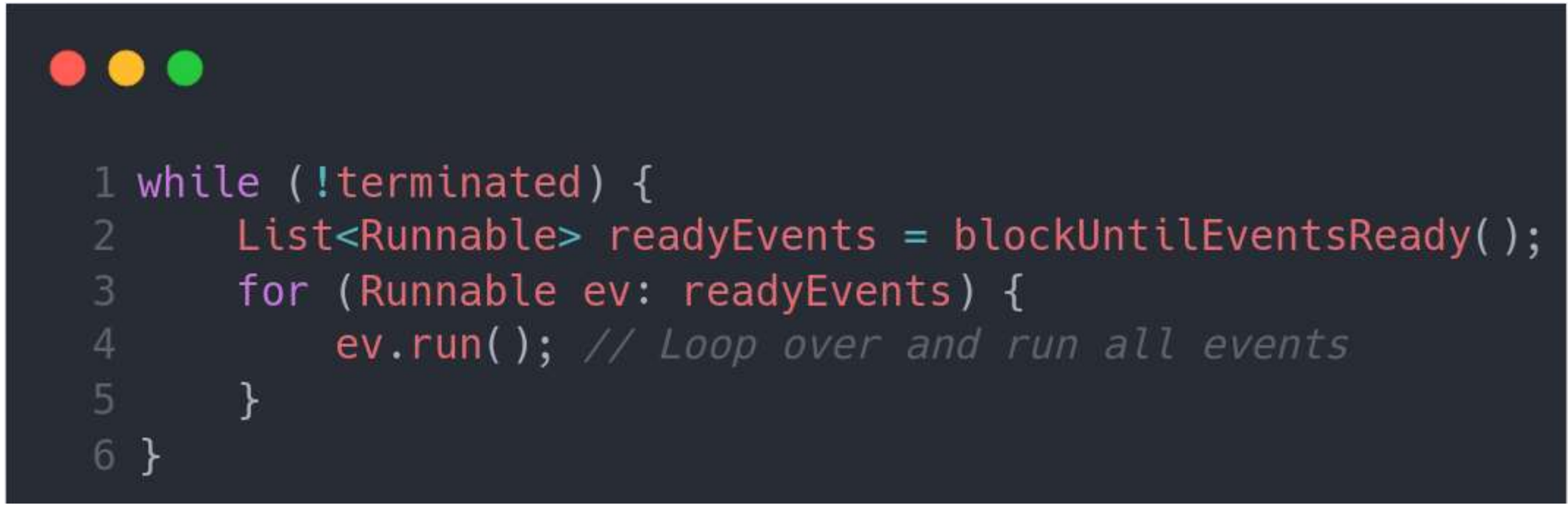
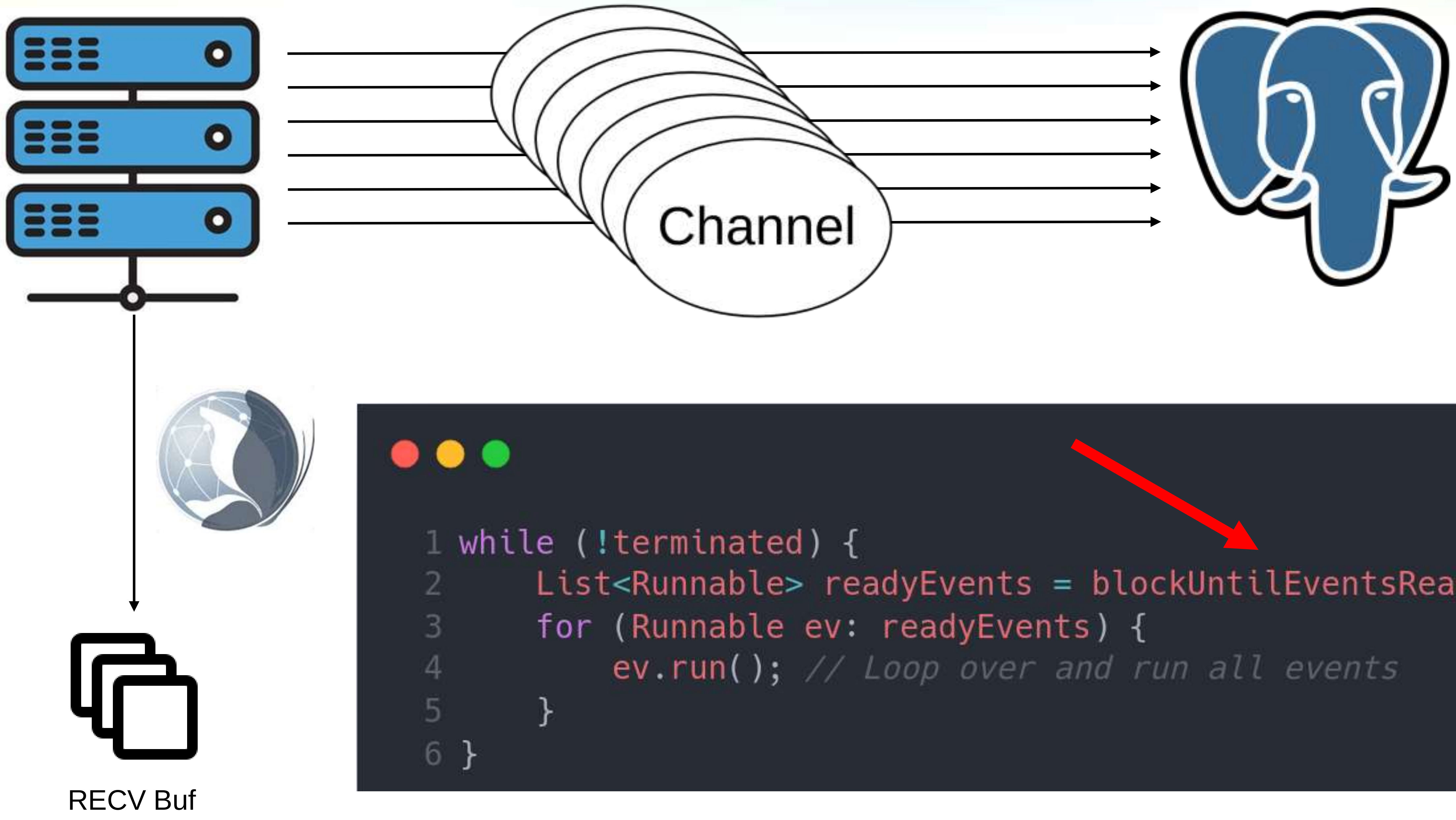

RECV Buf


Channel
RECV Buf





```
while (!terminated) {
    List<Runnable> readyEvents = blockUntilEventsReady();
    for (Runnable ev: readyEvents) {
        ev.run(); // Loop over and run all events
    }
}
```



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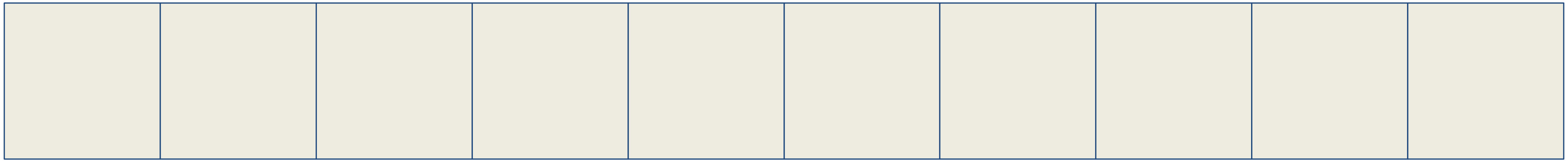
2. The EventLoop Thread is typically not the thread from the Schedulers pool used for reactive assembly pipeline

## recv buffer



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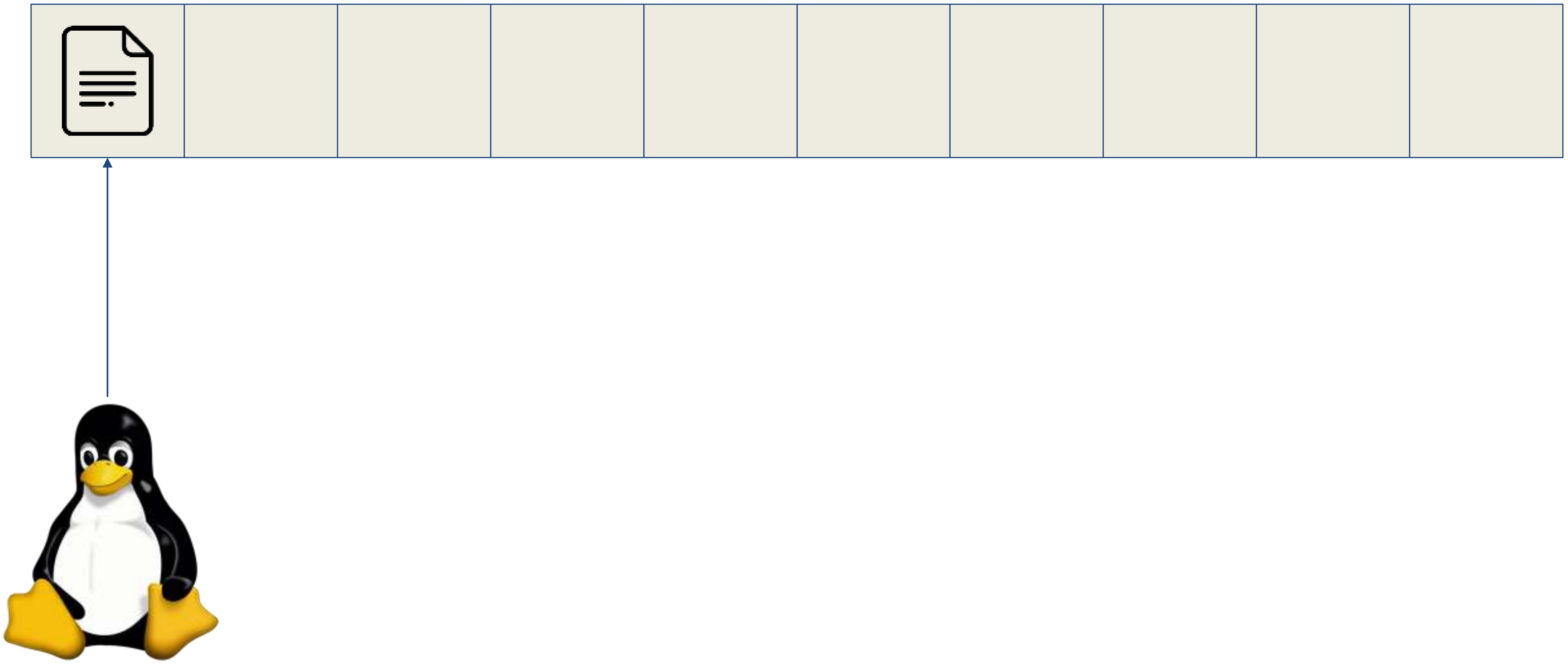

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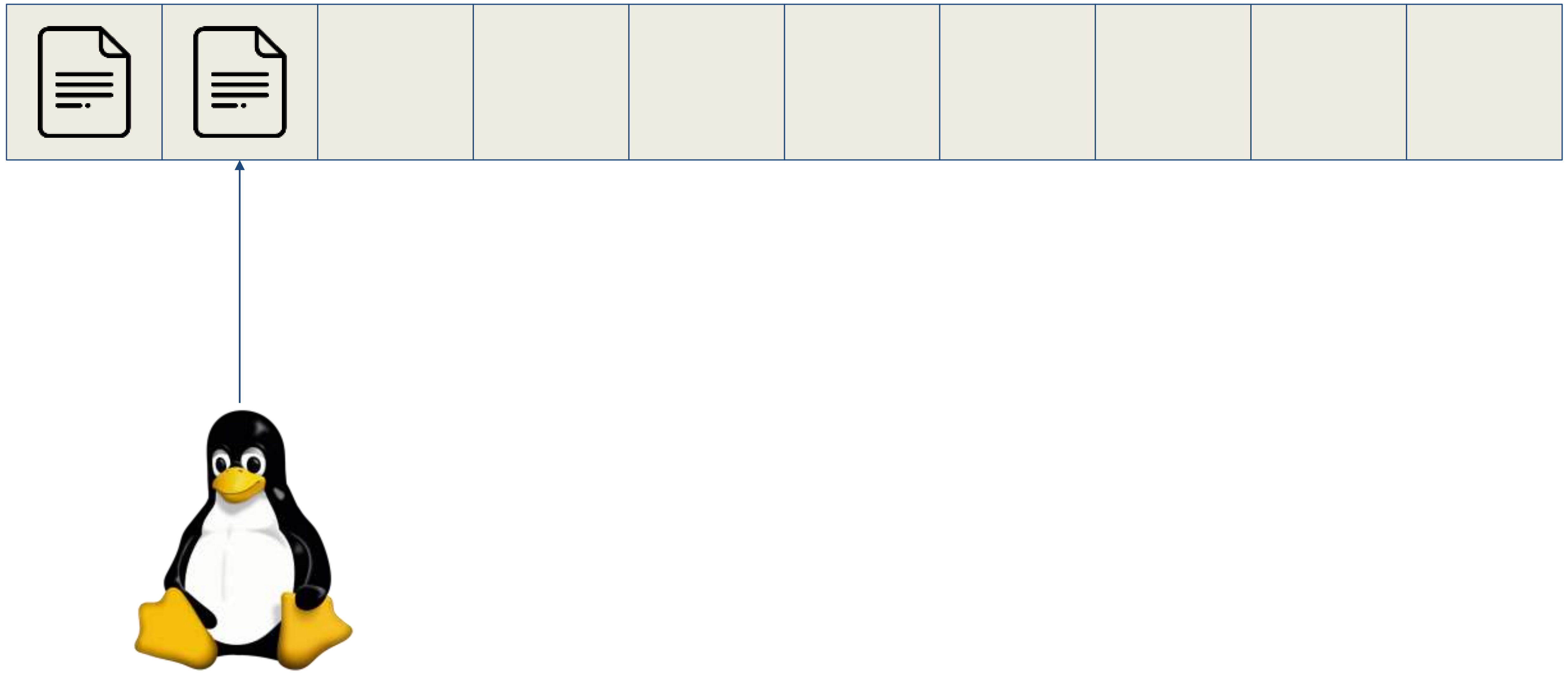

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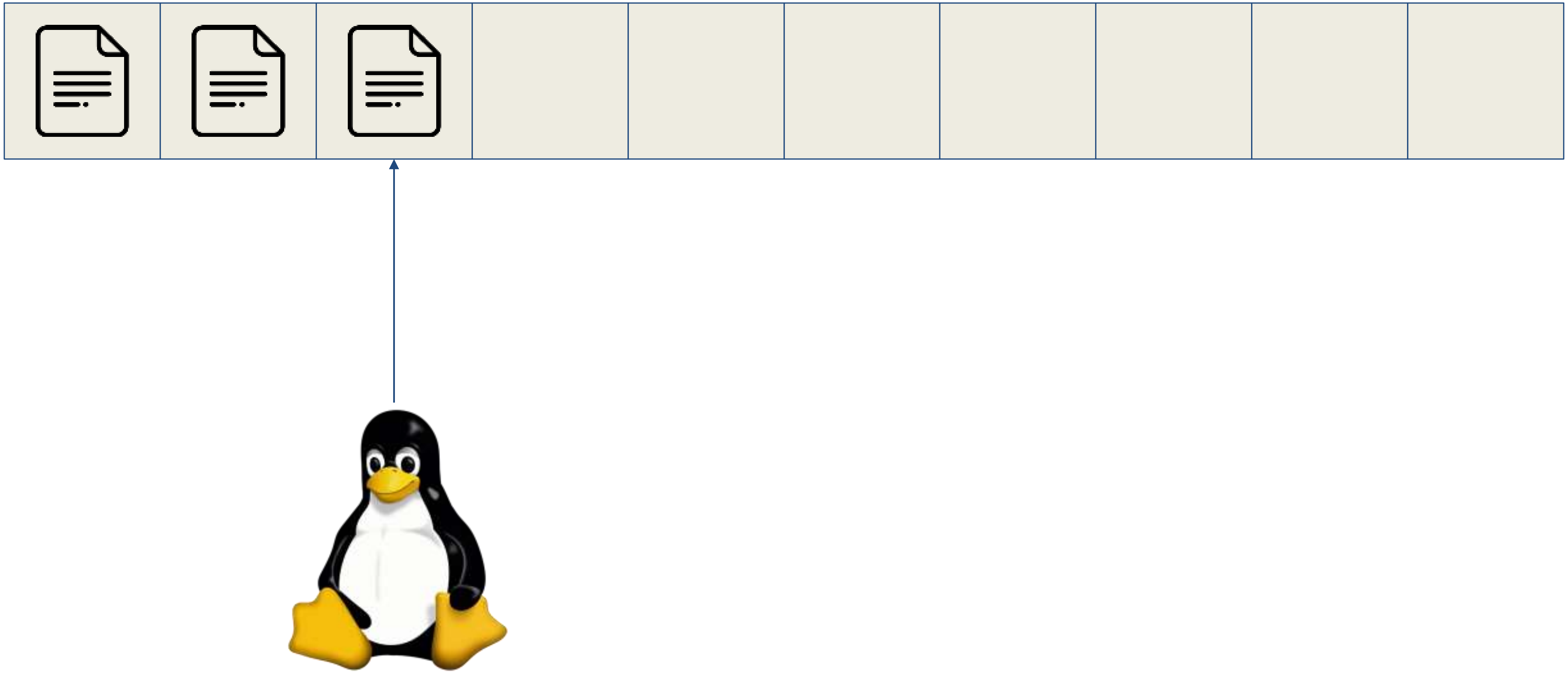

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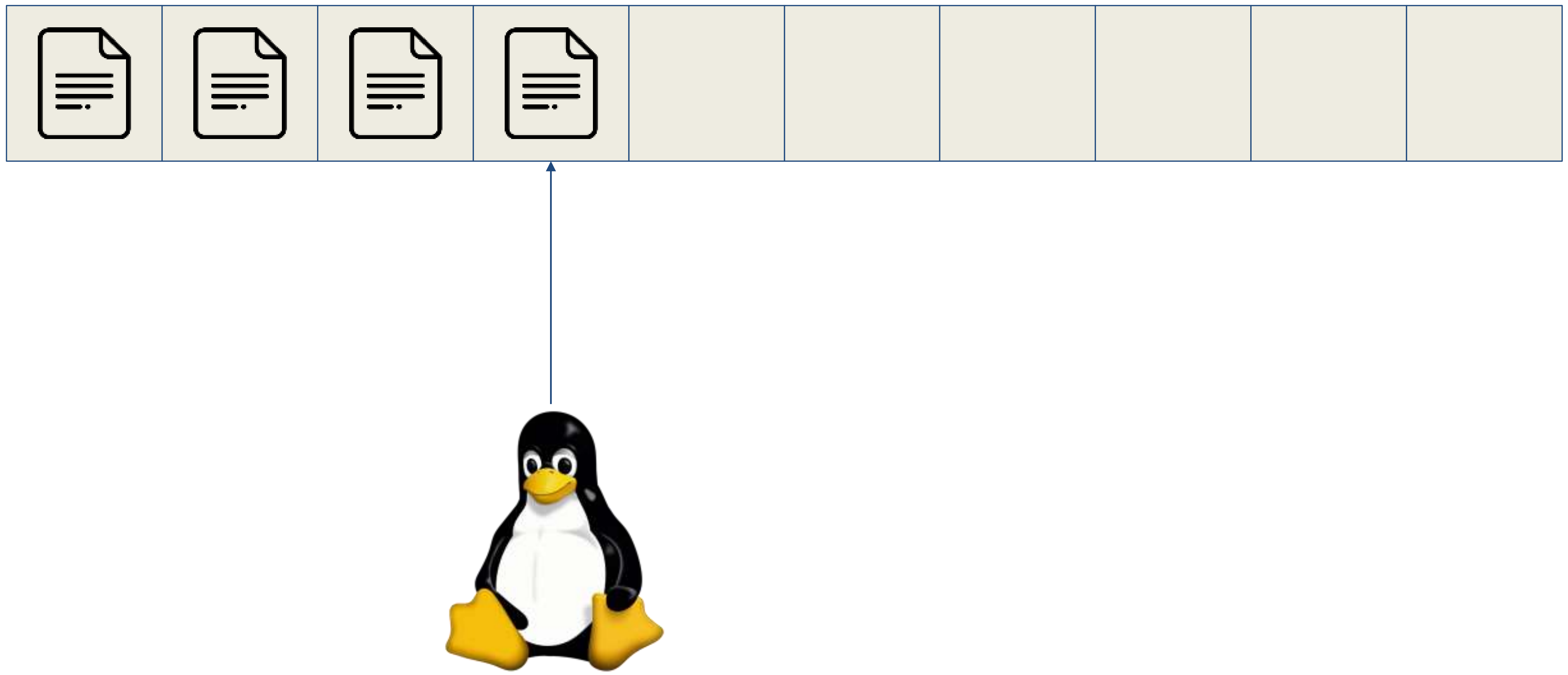

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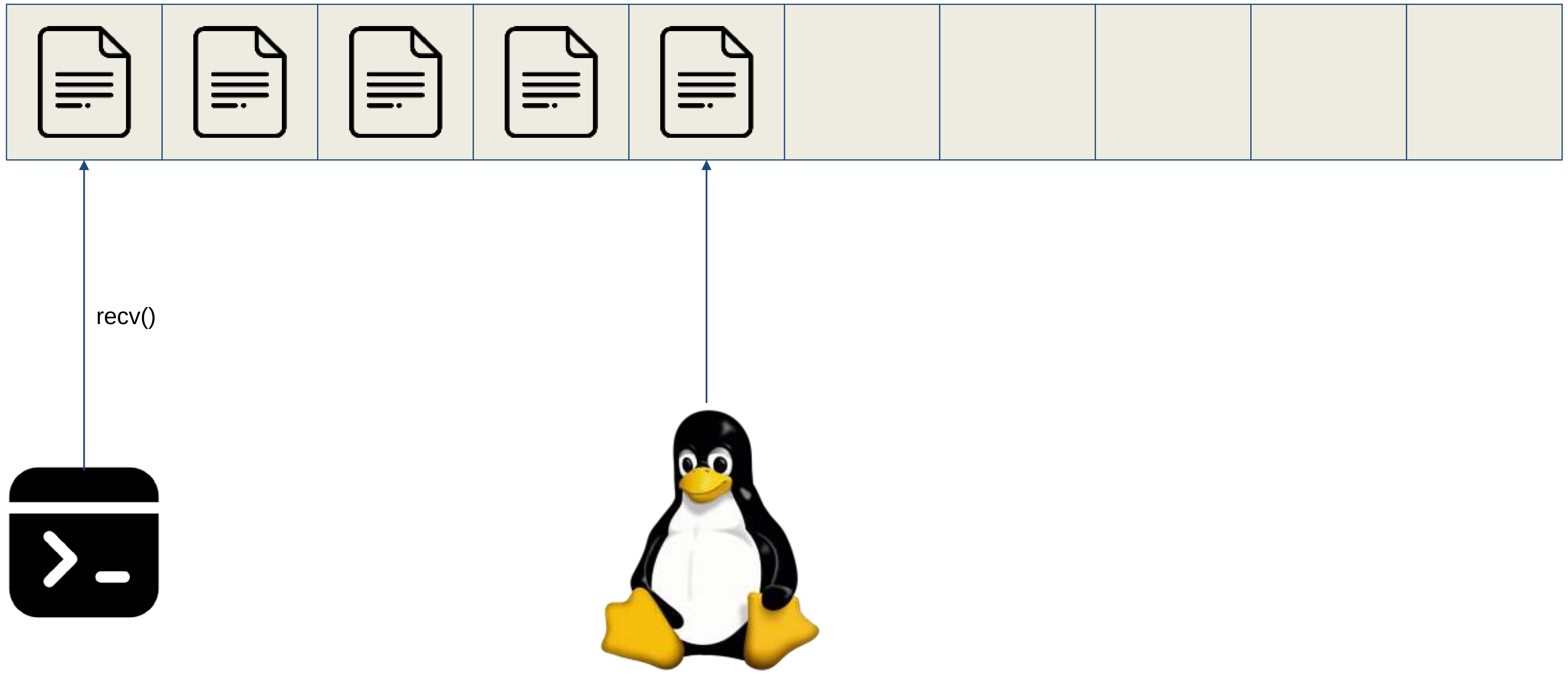

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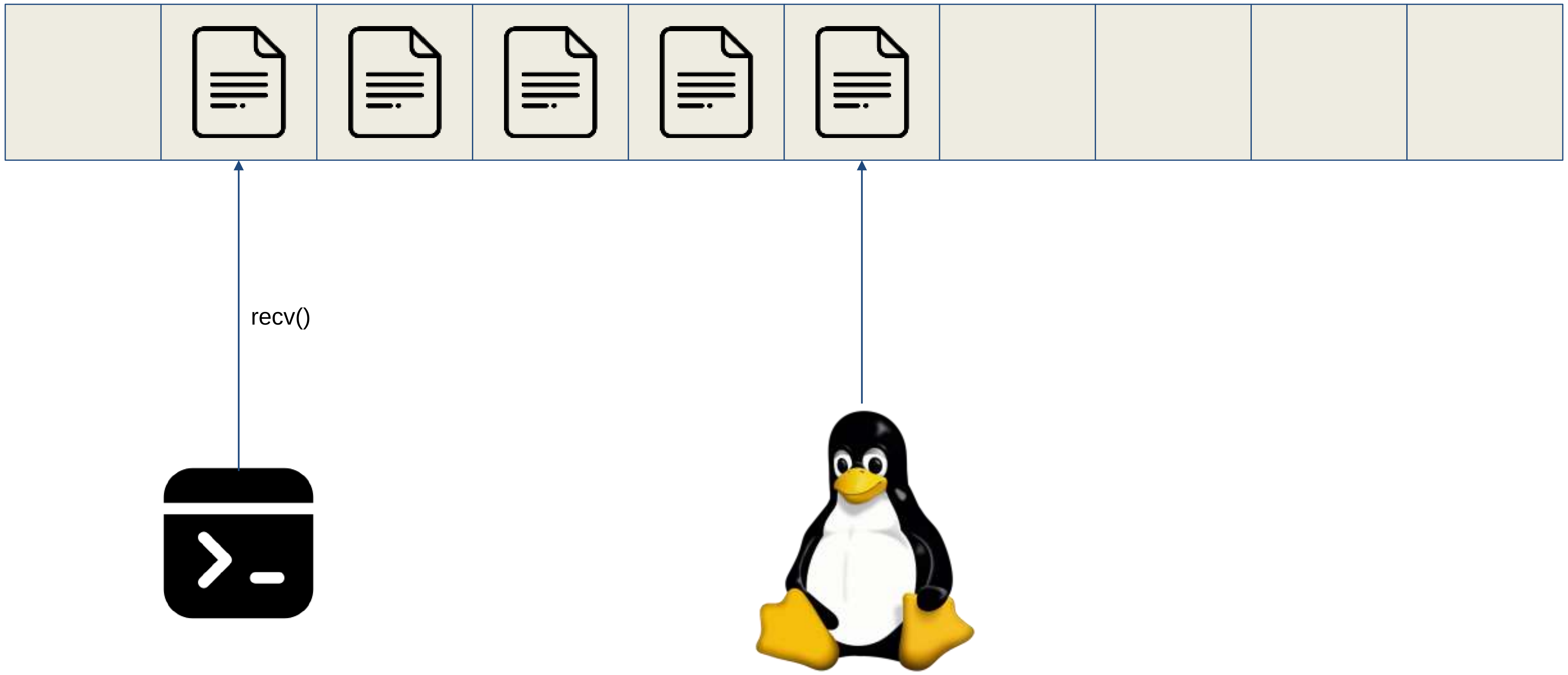

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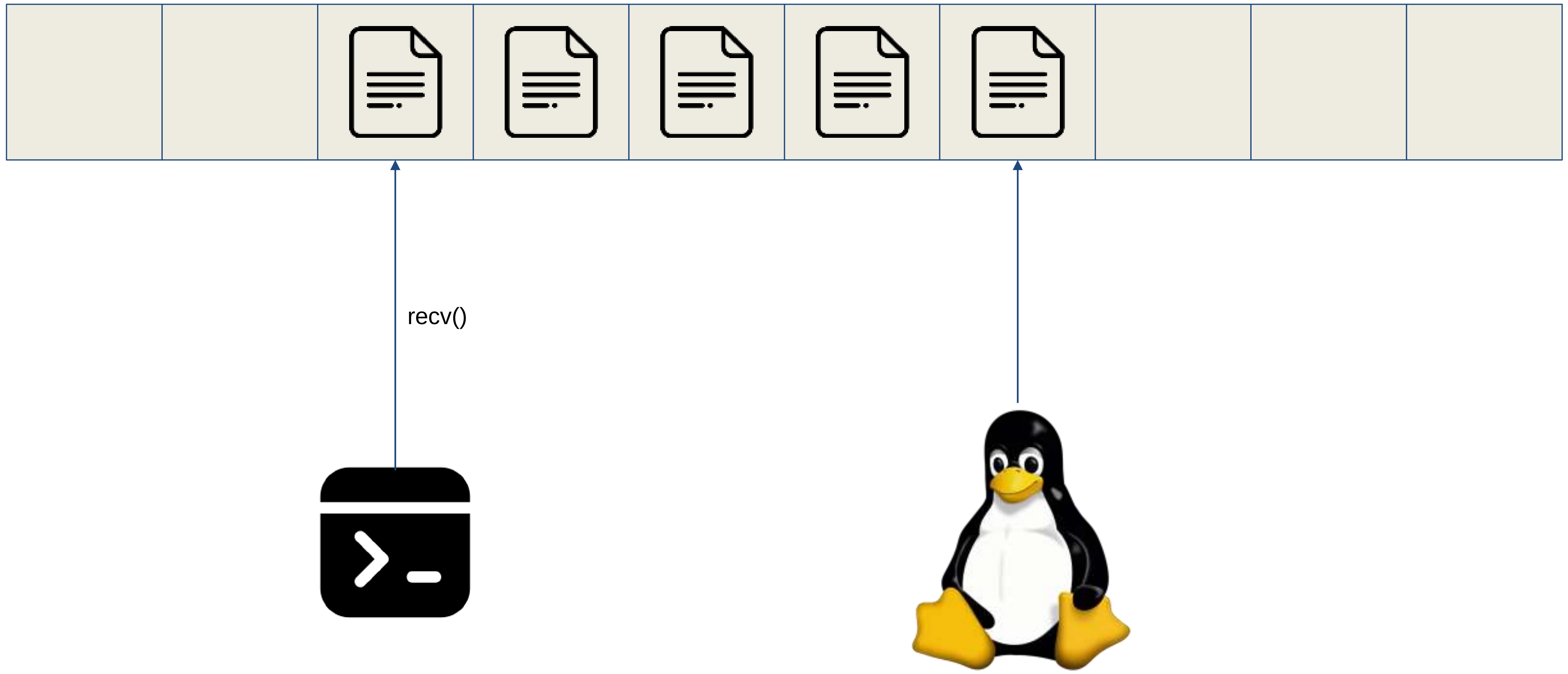

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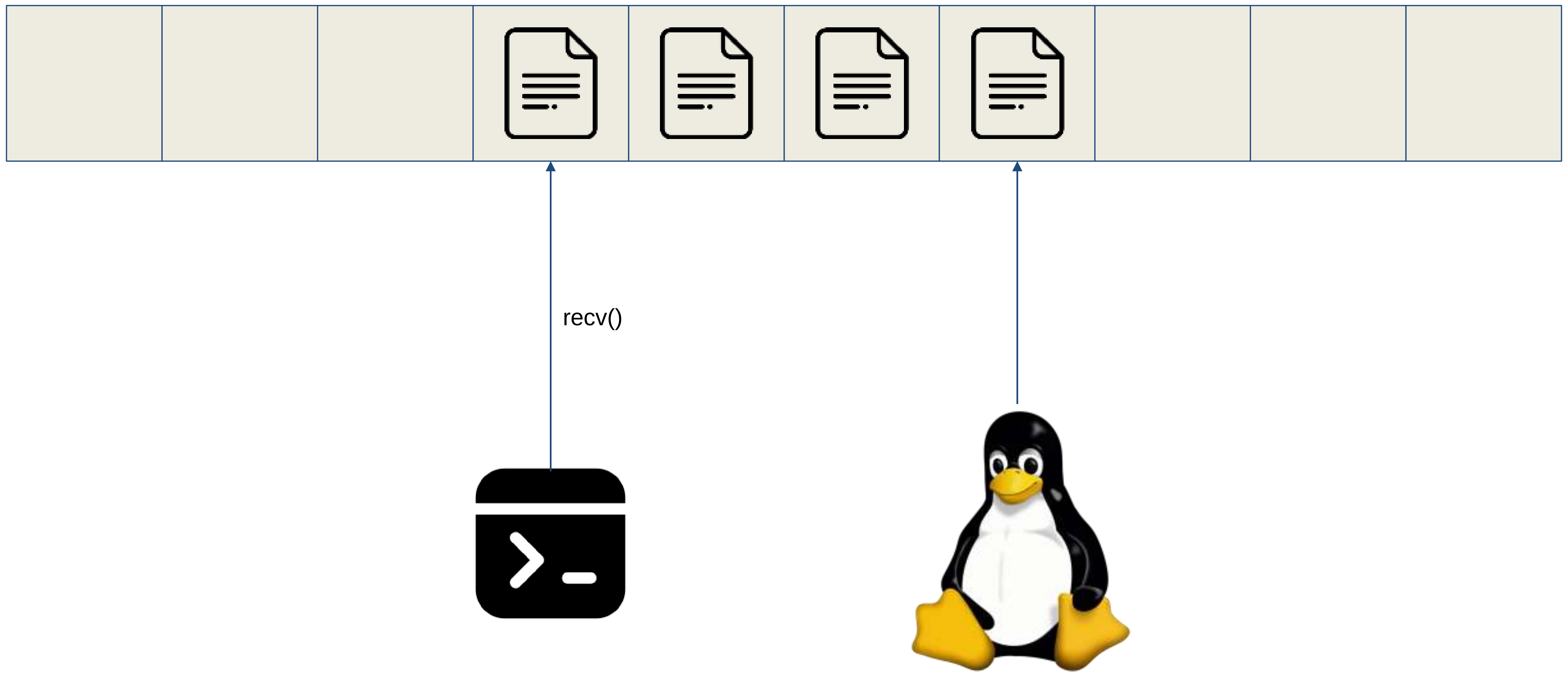

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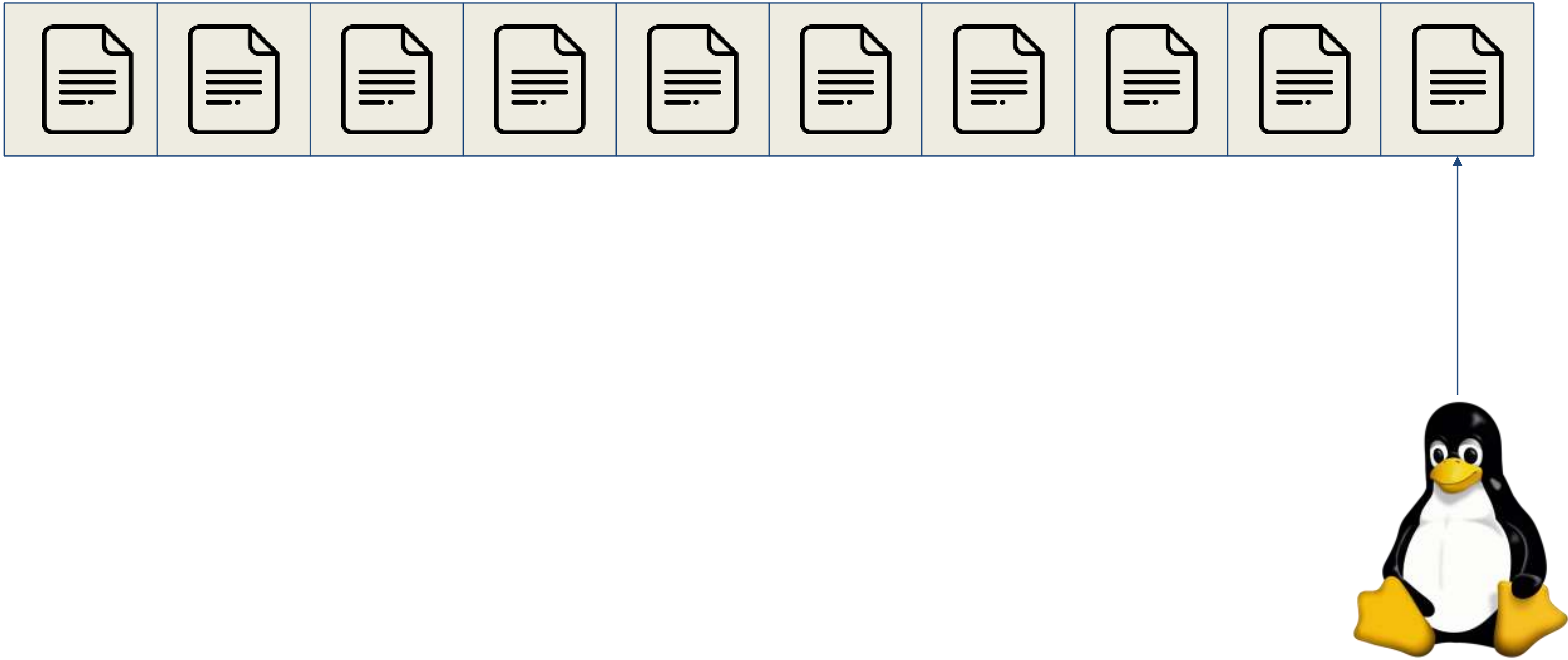
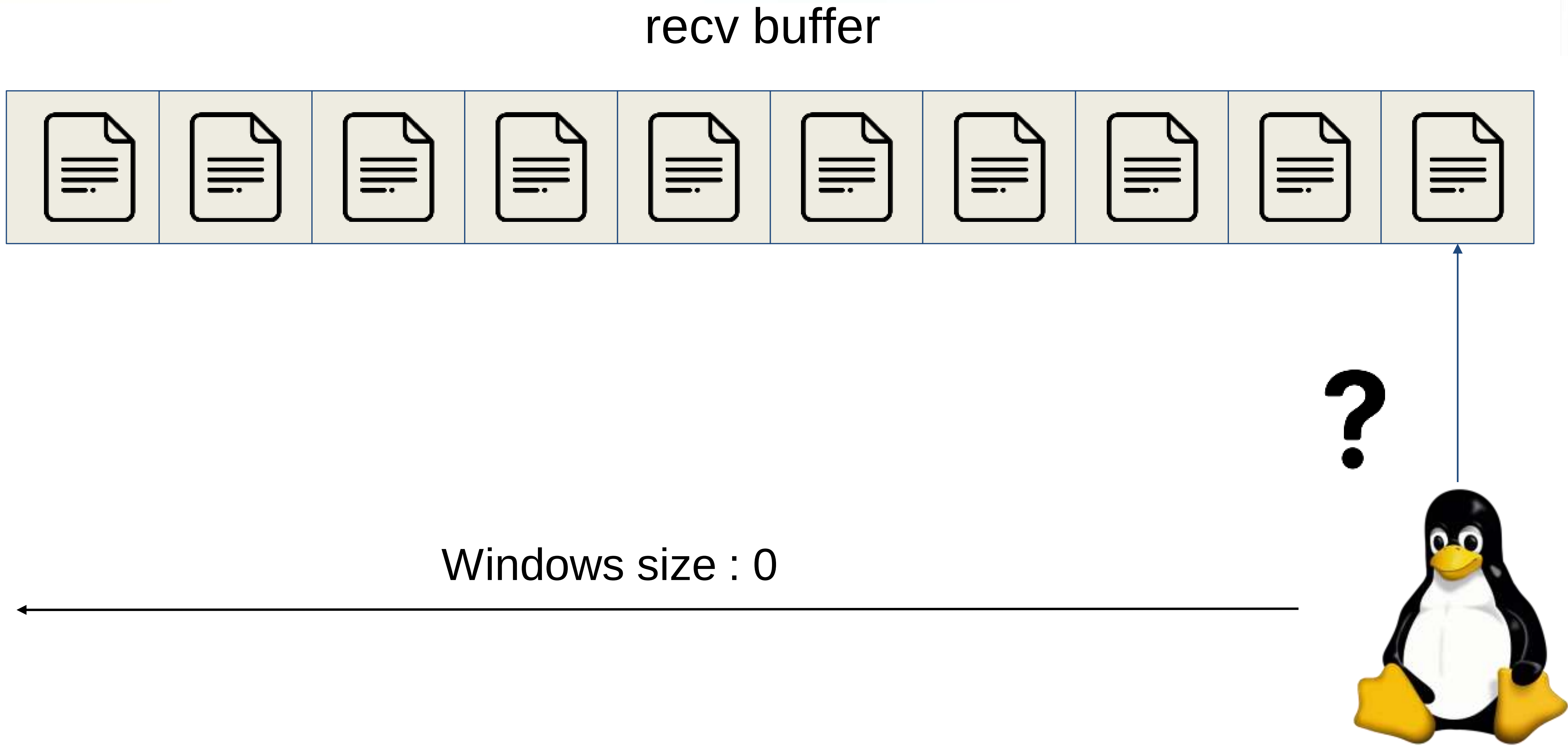
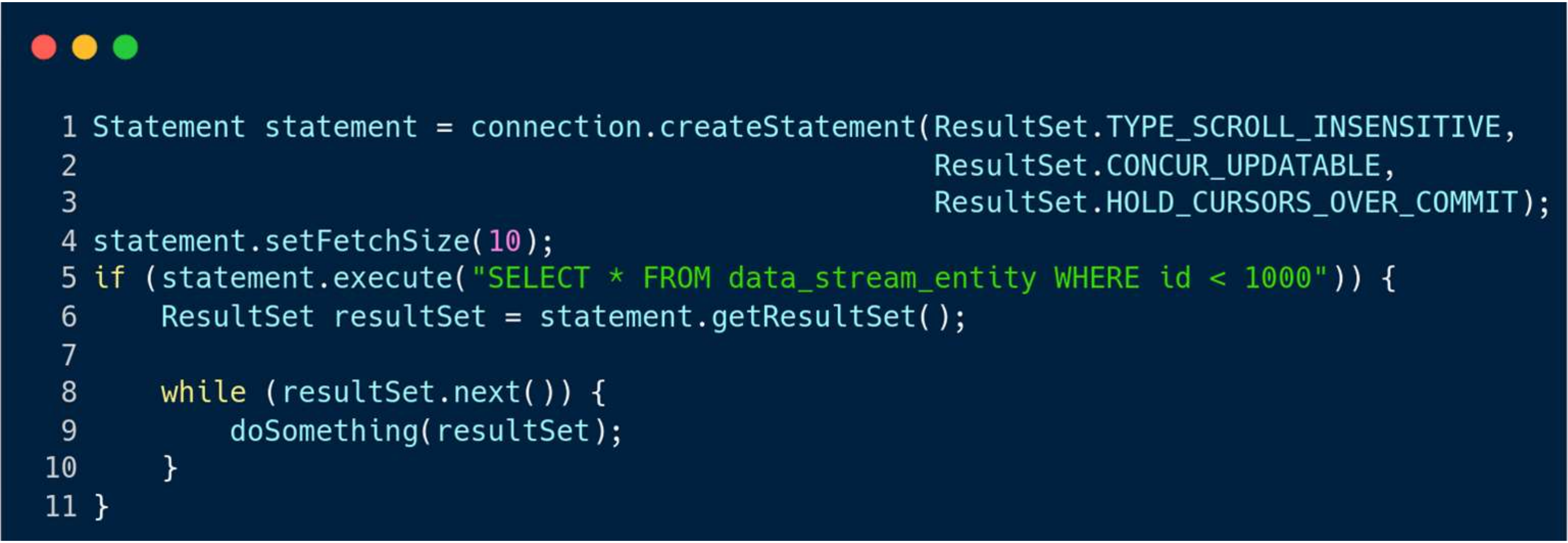



recv buffer
?
Windows size : 0

## We already have fetch size!



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Statement statement = connection.createStatement(ResultSet.TYPE_SCROLL_INSENSITIVE,
                                                 ResultSet.CONCUR_UPDATABLE,
                                                 ResultSet.HOLD_CURSORS_OVER_COMMIT);
statement.setFetchSize(10);
if (statement.execute("SELECT * FROM data_stream_entity WHERE id < 1000")) {
    ResultSet resultSet = statement.getResultSet();

    while (resultSet.next()) {
        doSomething(resultSet);
    }
}
```

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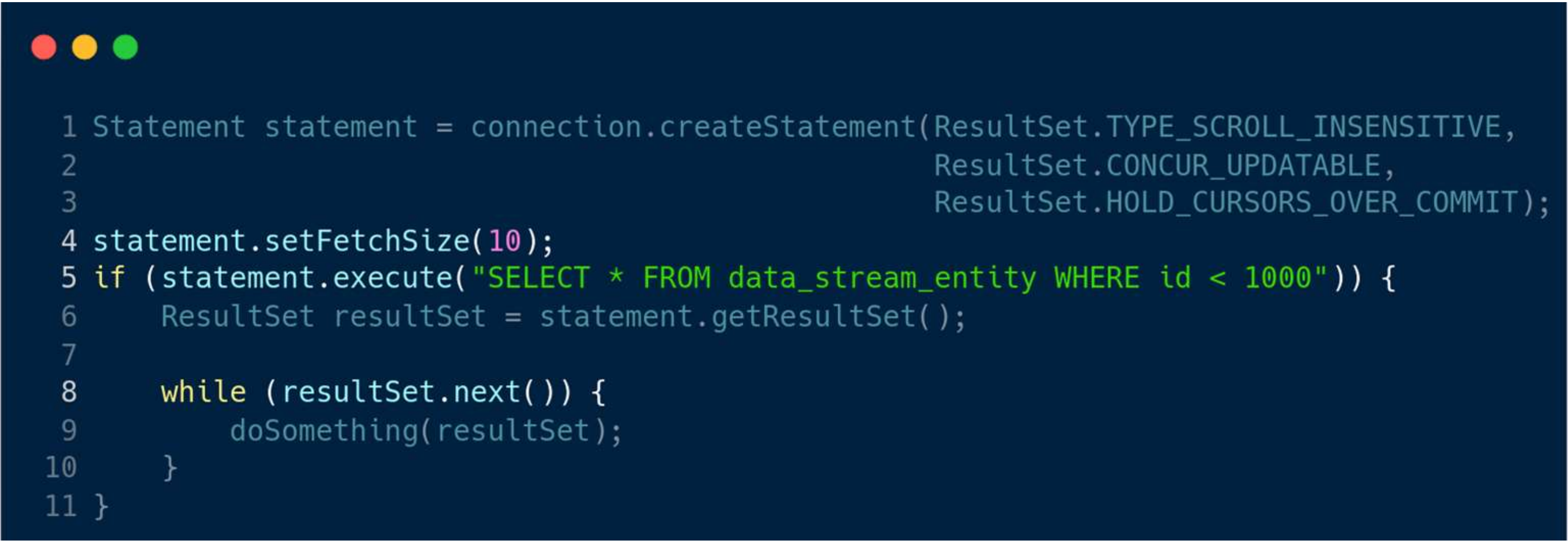

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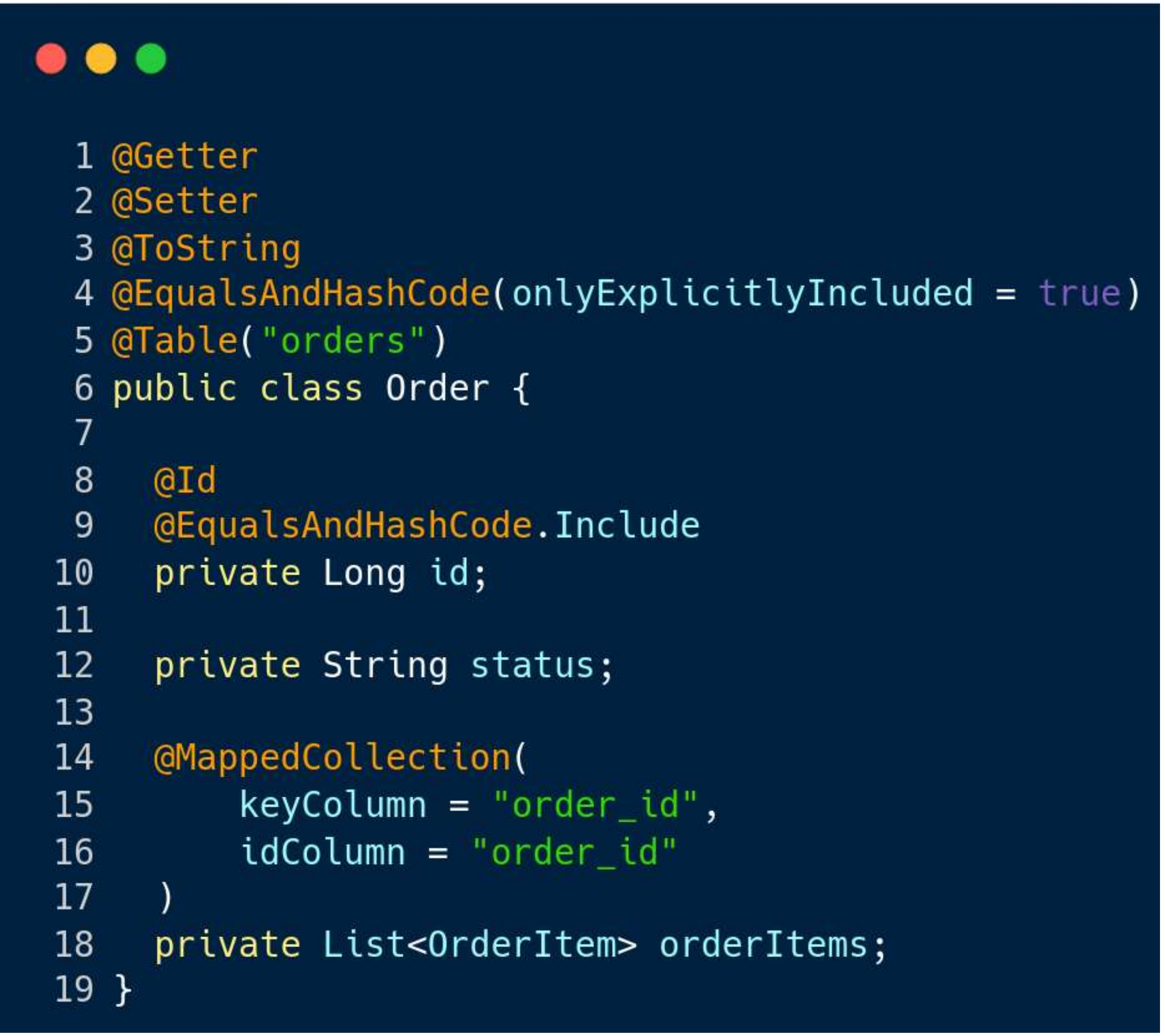
## Spring-Data-R2DBC restrictions

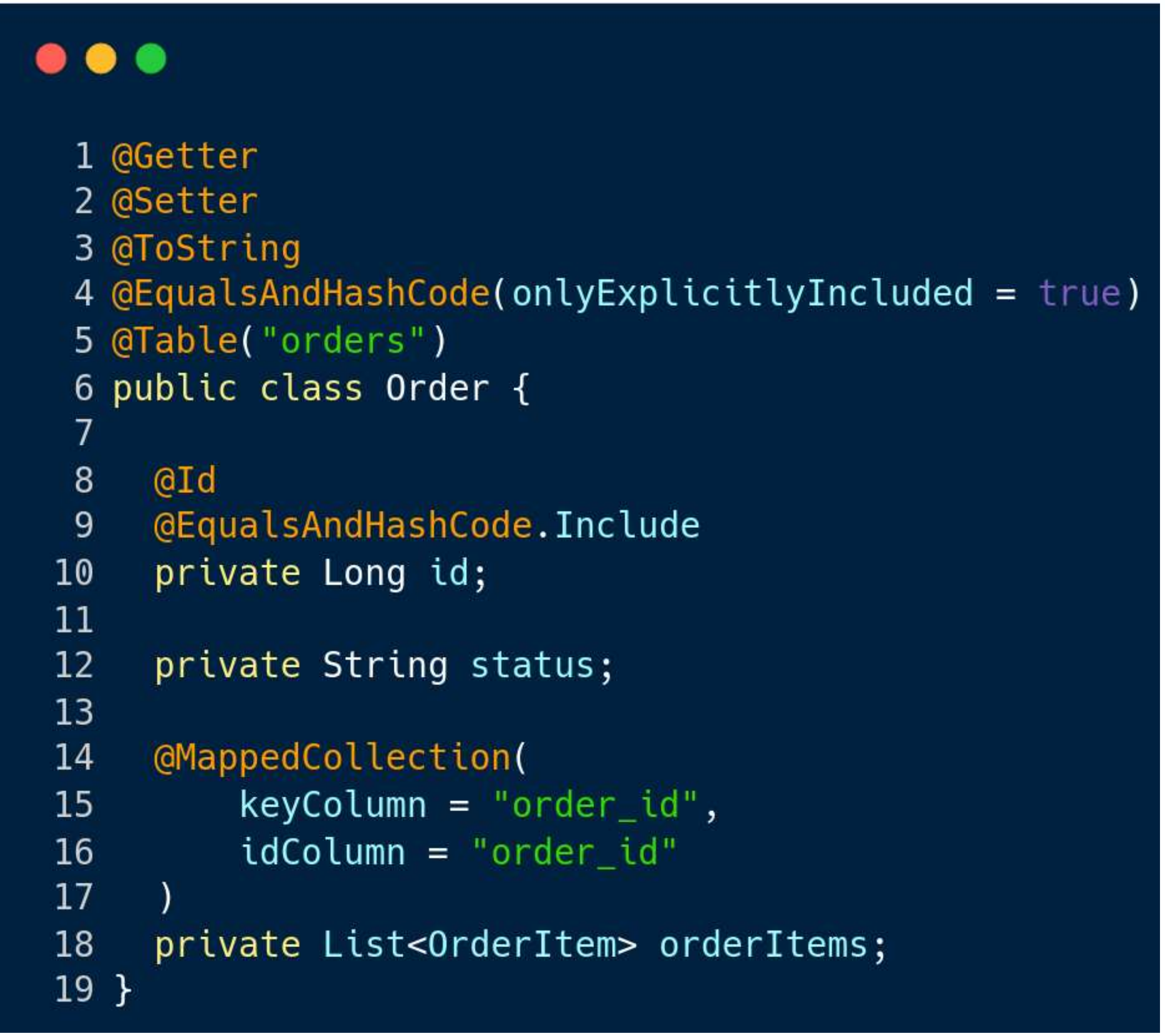


```java
@Getter
@Setter
@ToString
@EqualsAndHashCode(onlyExplicitlyIncluded = true)
@Table("orders")
public class Order {

  @Id
  @EqualsAndHashCode.Include
  private Long id;

  private String status;

  @MappedCollection(
      keyColumn = "order_id",
      idColumn = "order_id"
  )
  private List<OrderItem> orderItems;
}
```



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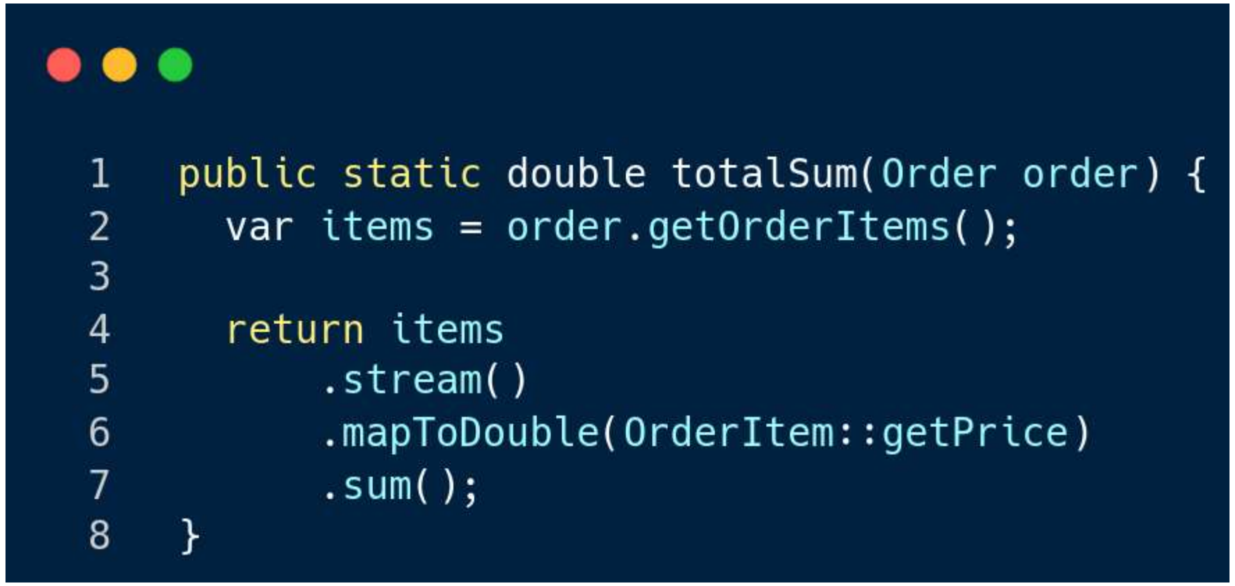
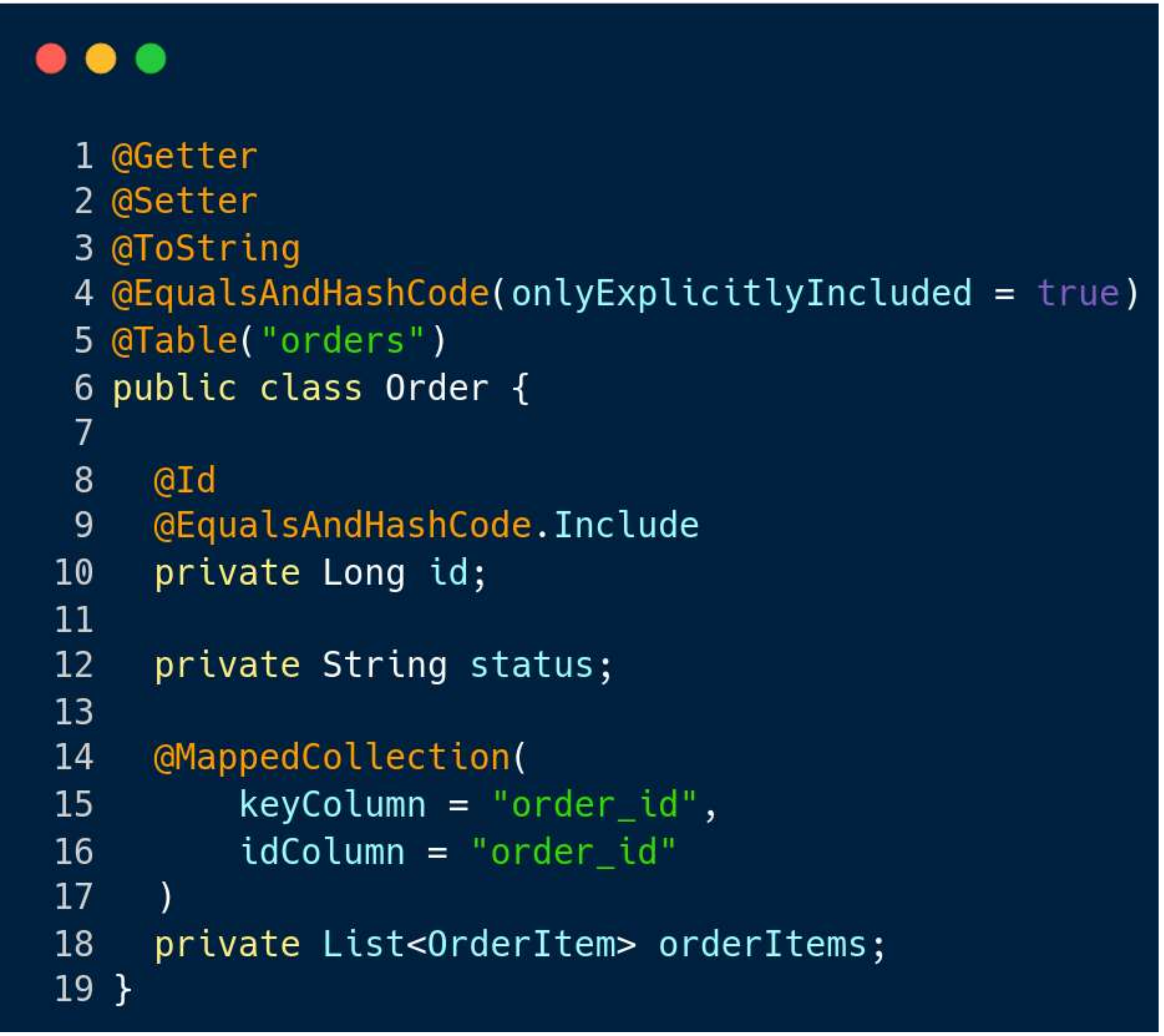


```java
public static double totalSum(Order order) {
  var items = order.getOrderItems();

  return items
      .stream()
      .mapToDouble(OrderItem::getPrice)
      .sum();
}
```



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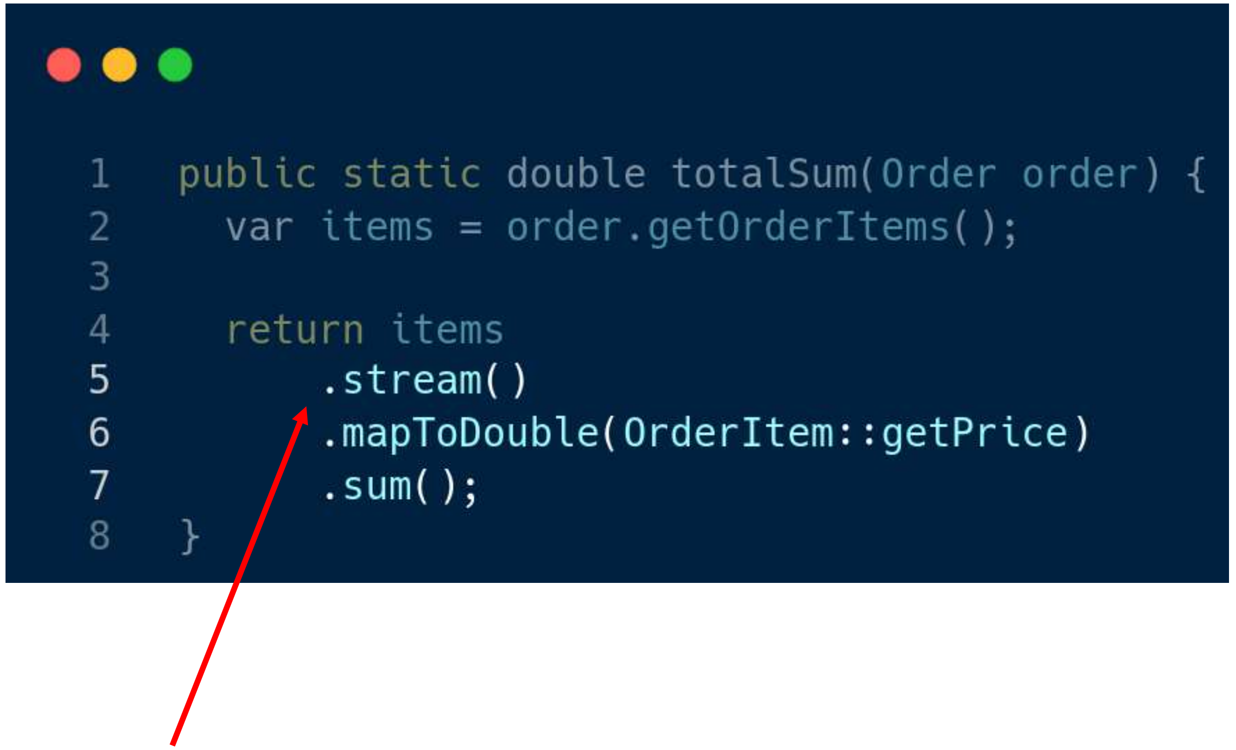
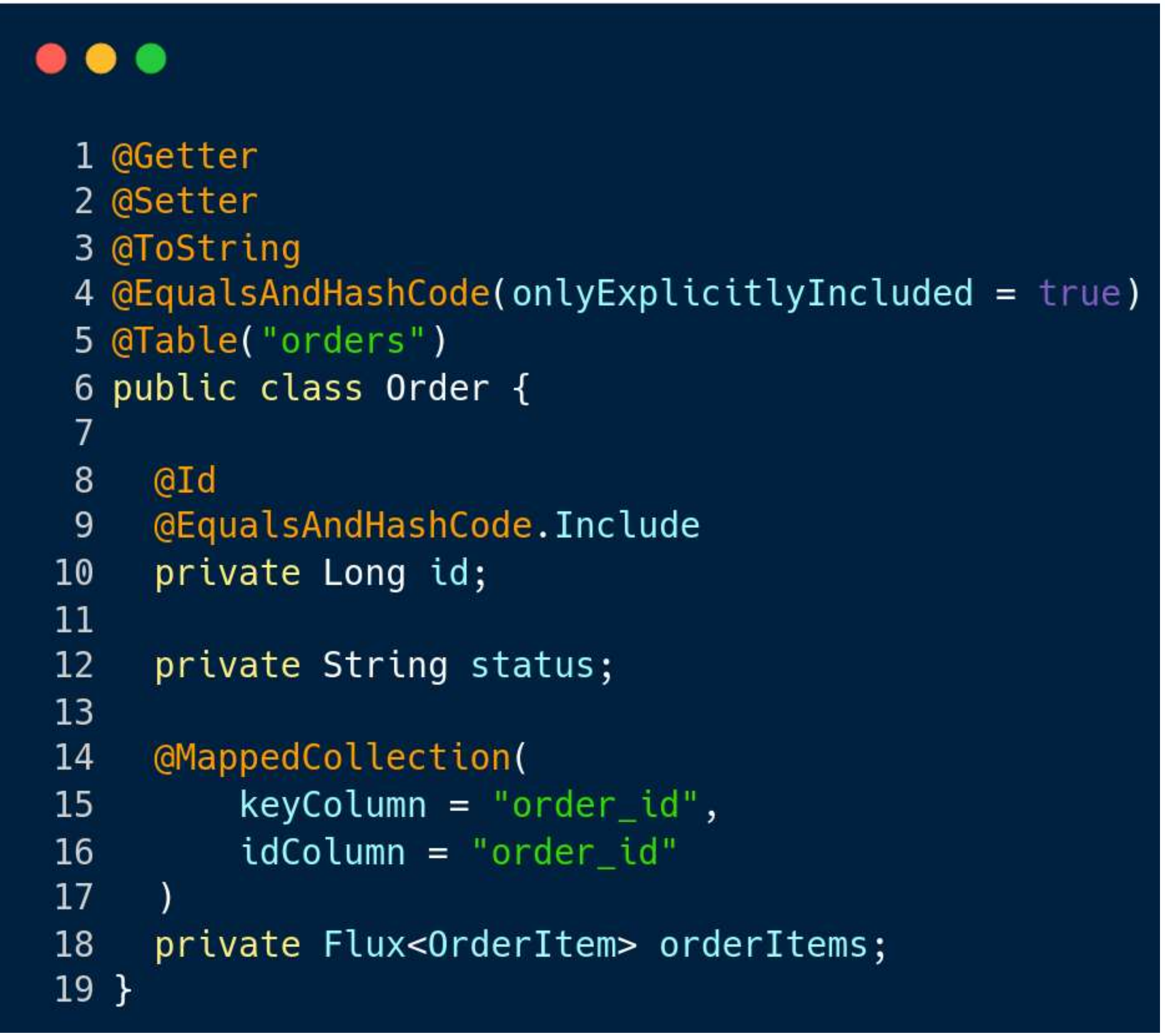


```java
public static double totalSum(Order order) {
  var items = order.getOrderItems();

  return items
        .stream()
        .mapToDouble(OrderItem::getPrice)
        .sum();
}
```

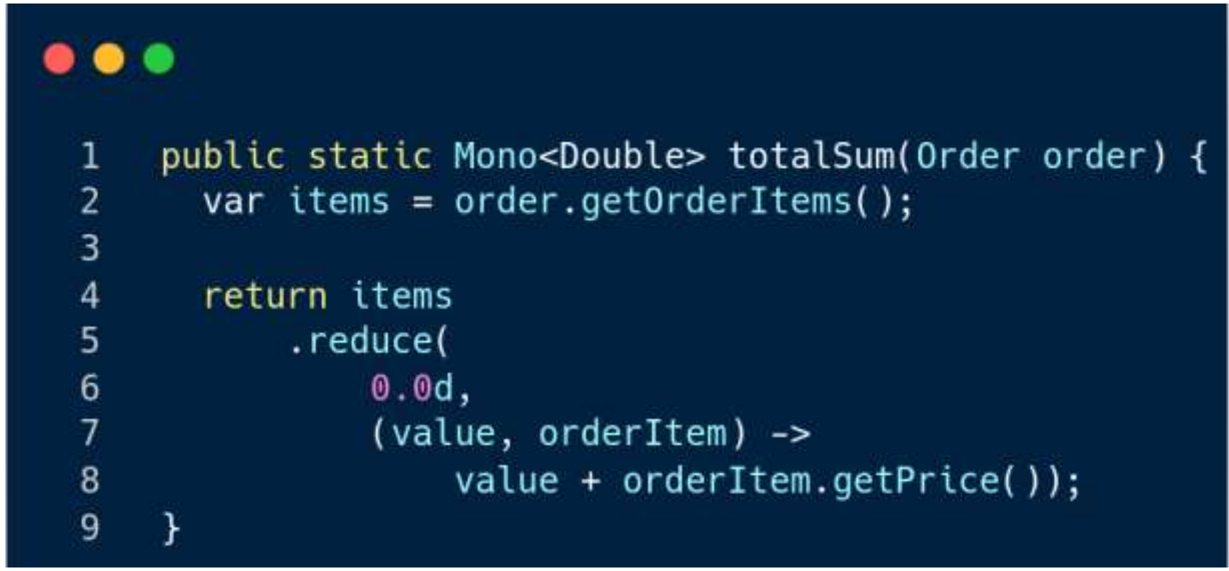


```java
@Getter
@Setter
@ToString
@EqualsAndHashCode(onlyExplicitlyIncluded = true)
@Table("orders")
public class Order {

  @Id
  @EqualsAndHashCode.Include
  private Long id;

  private String status;

  @MappedCollection(
      keyColumn = "order_id",
      idColumn = "order_id"
  )
  private Flux<OrderItem> orderItems;
}
```



```java
public static Mono<Double> totalSum(Order order) {
  var items = order.getOrderItems();

  return items
      .reduce(
          0.0d,
          (value, orderItem) ->
              value + orderItem.getPrice());
}
```

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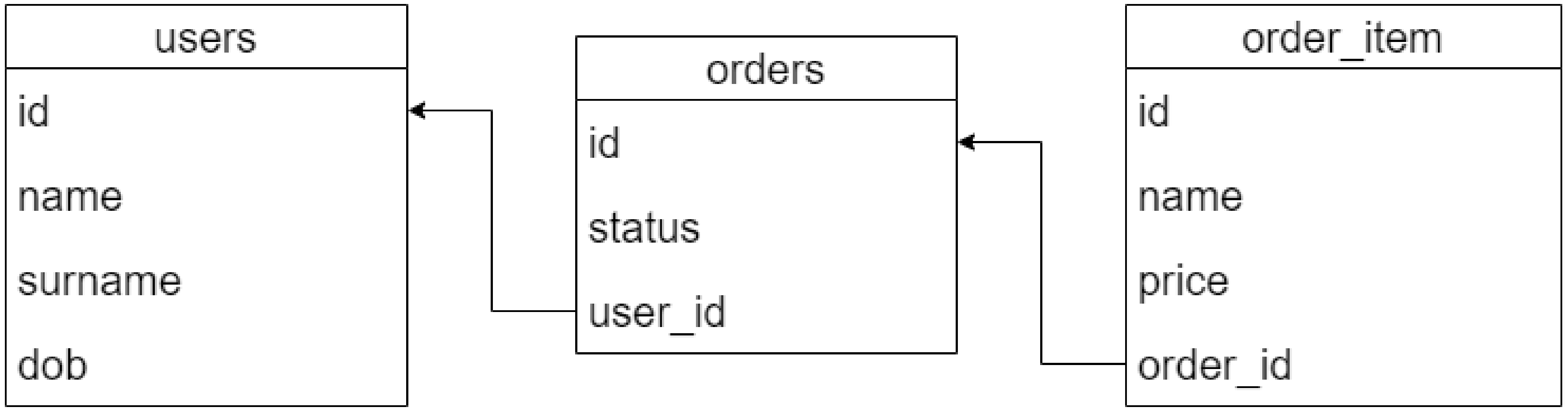
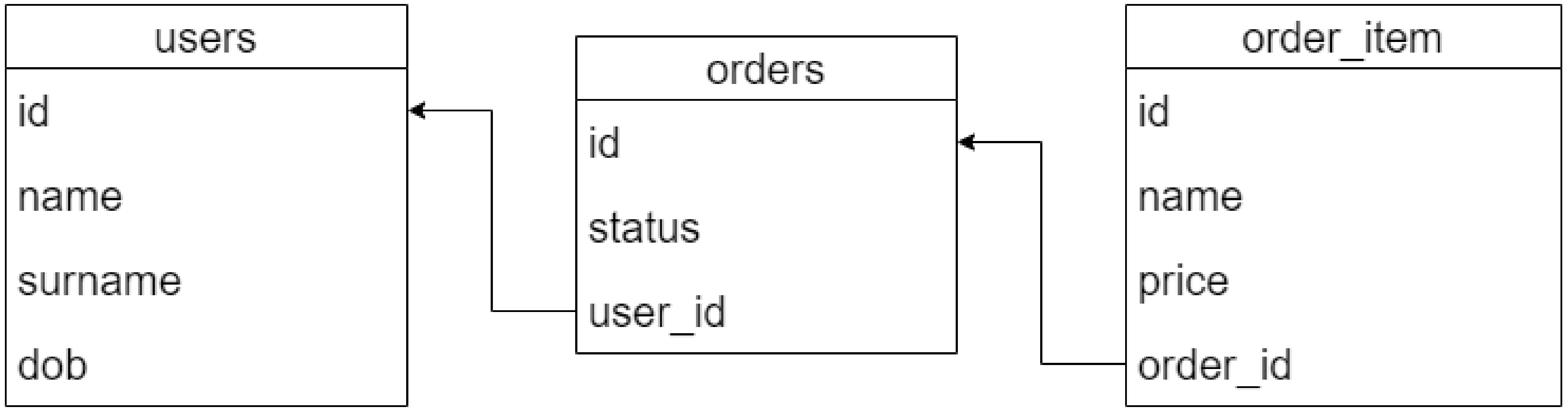
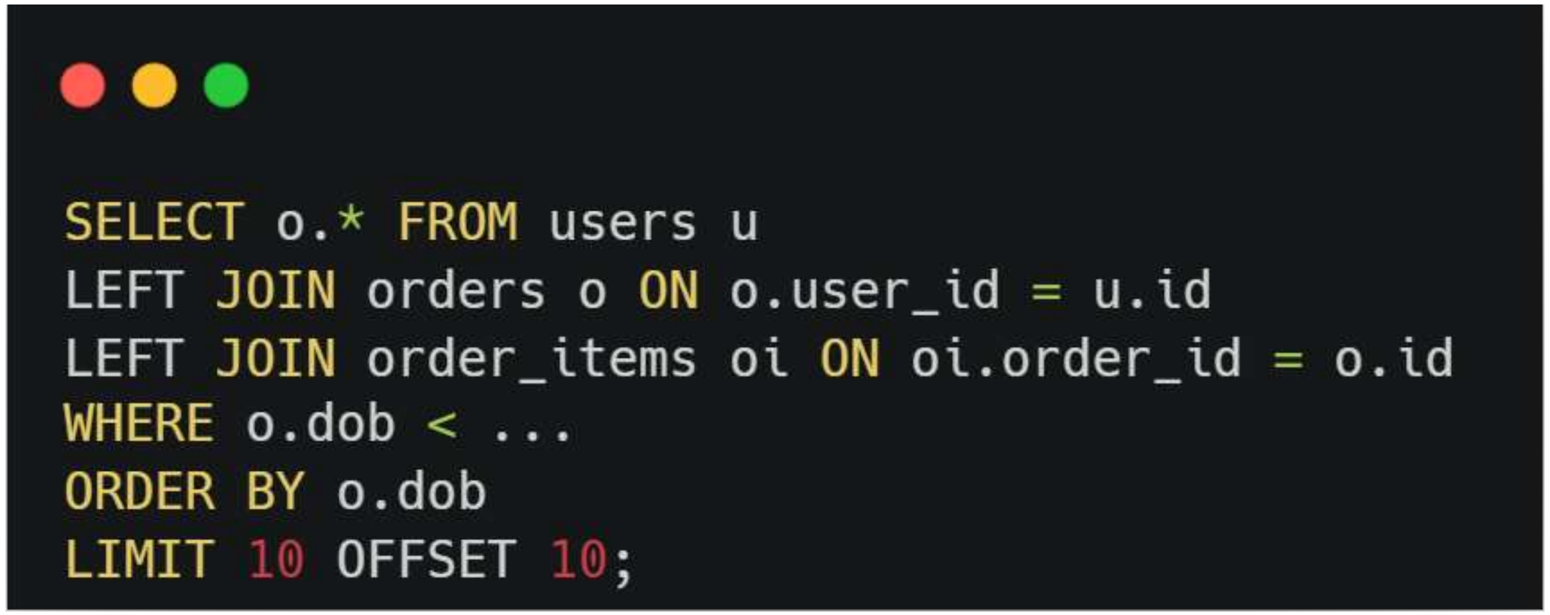
2. There is no clear mutation abilities. E.g. there is no way to add an element to a Flux.

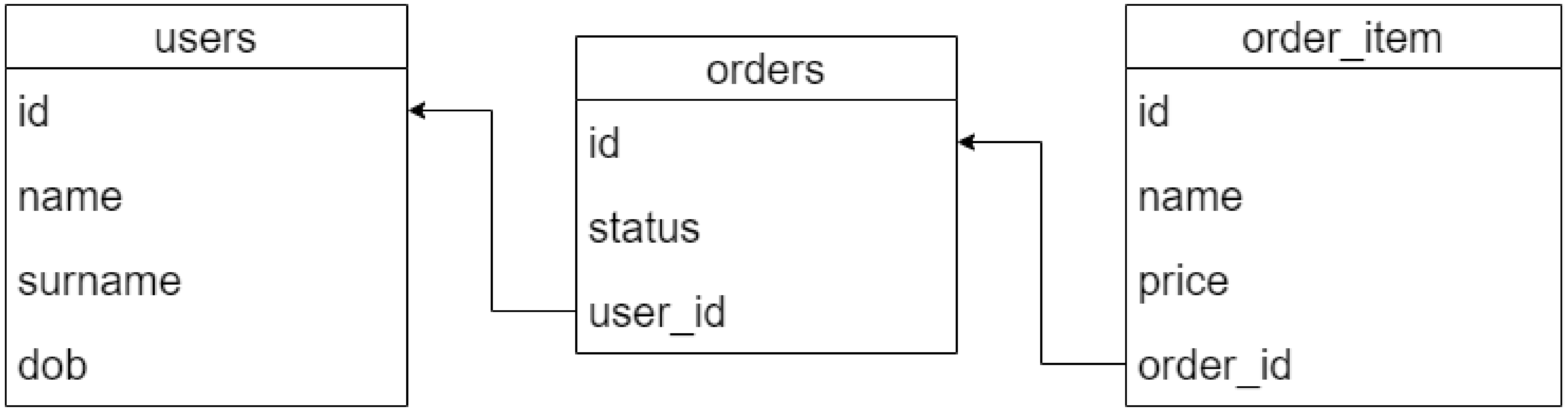
3. Transaction boundaries for reactive relations have to be honored. There is no out of the box solution for that.

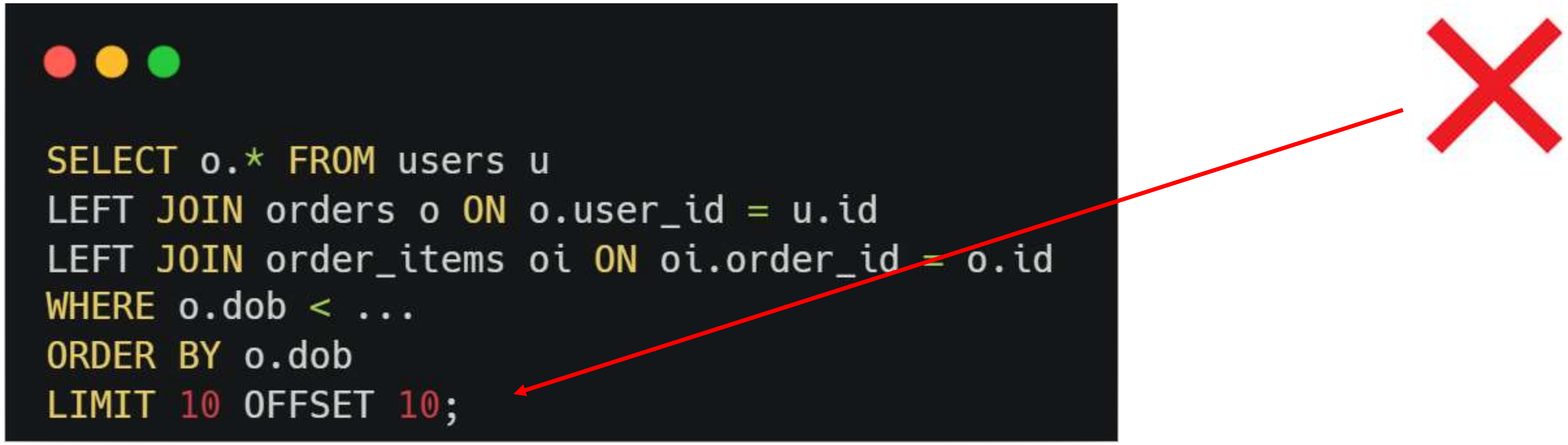

users
id
name
surname
dob
orders
id
status
user_id
order_item
id
name
price
order_id





```sql
SELECT o.* FROM users u
LEFT JOIN orders o ON o.user_id = u.id
LEFT JOIN order_items oi ON oi.order_id = o.id
WHERE o.dob < ...
ORDER BY o.dob
LIMIT 10 OFFSET 10;
```





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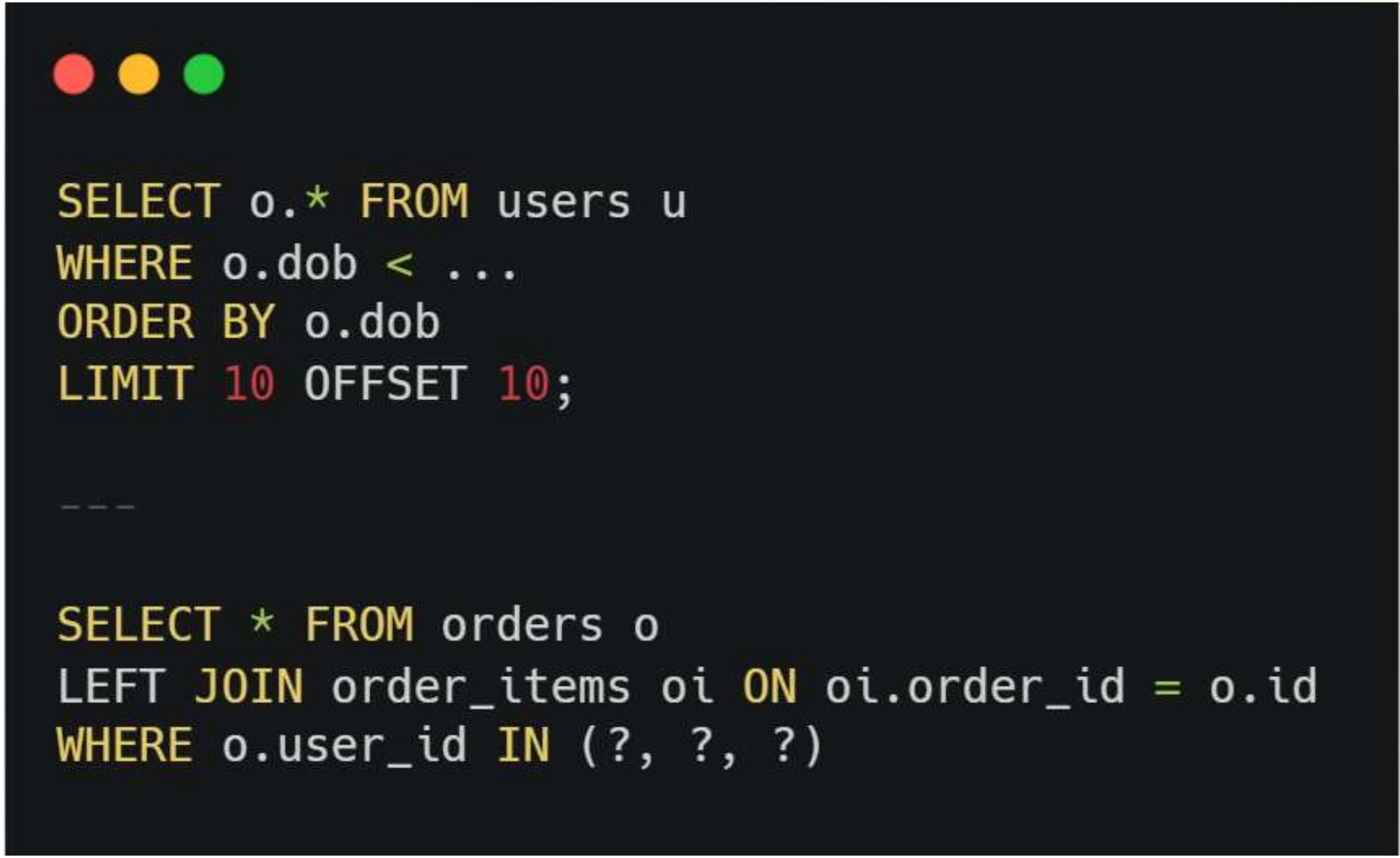

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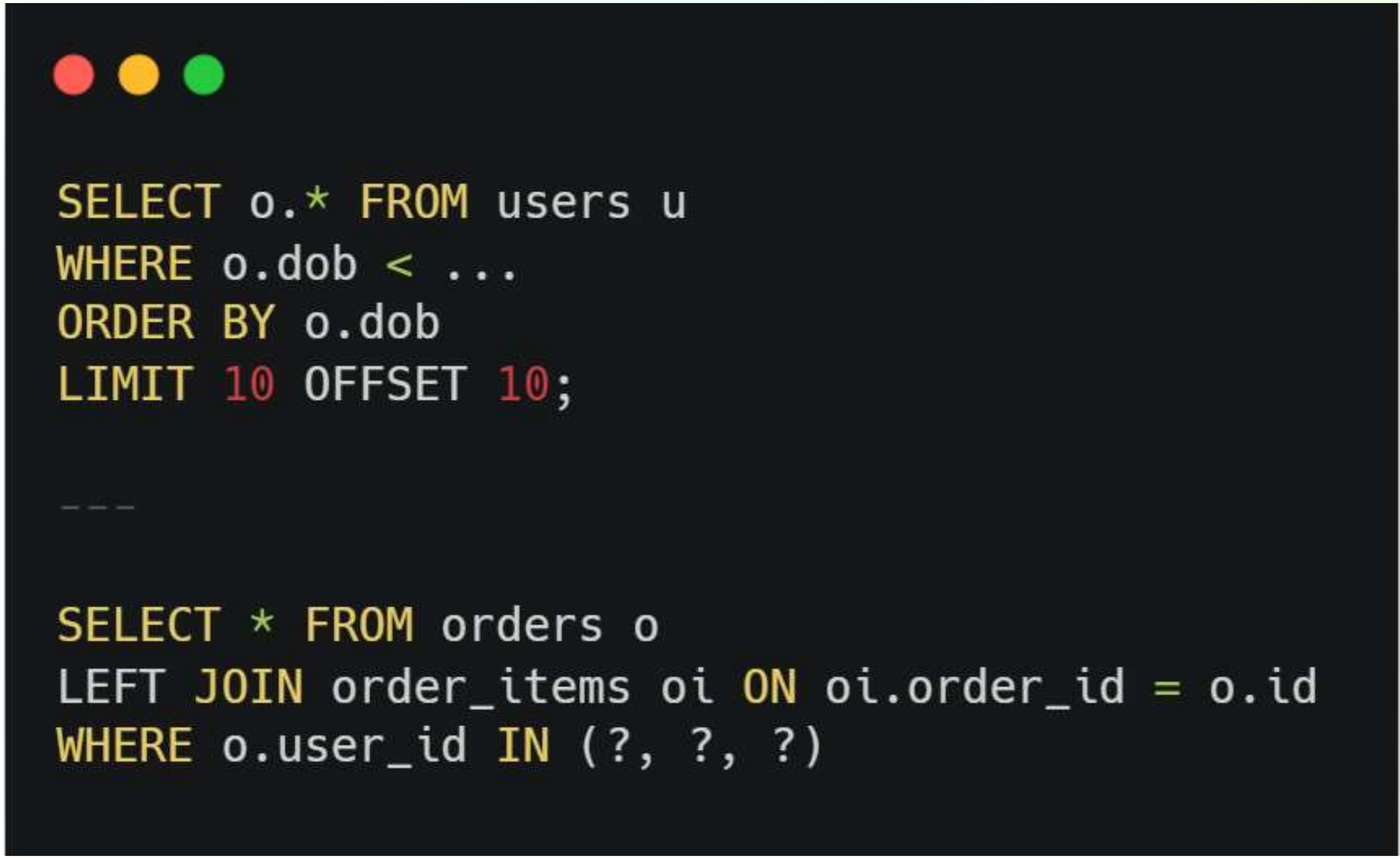
ORDER BY o.dob
LIMIT 10 OFFSET 10;

---

SELECT * FROM orders o
LEFT JOIN order_items oi ON oi.order_id = o.id
WHERE o.user_id IN (?, ?, ?)
```

Transaction



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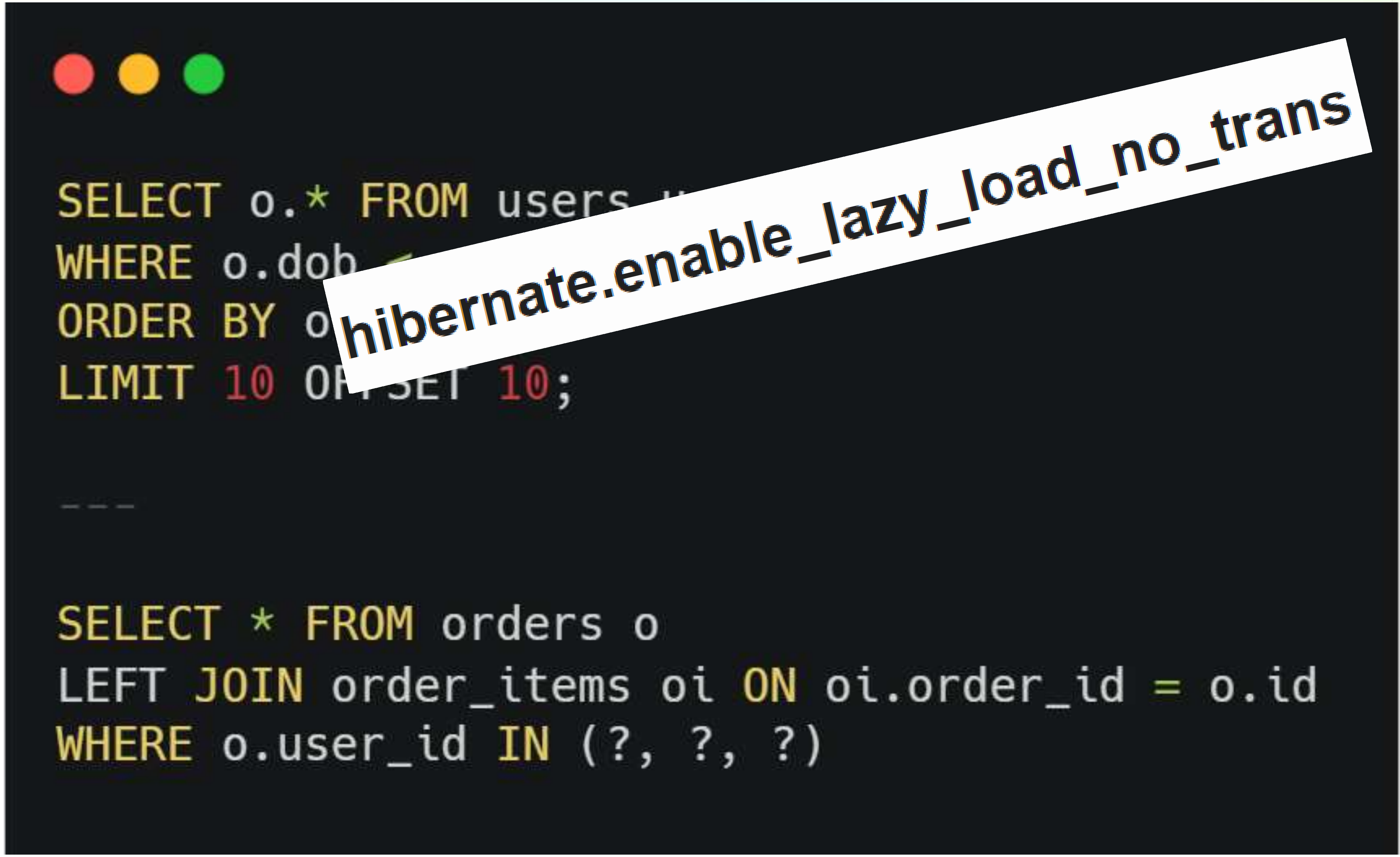
Transaction



hibernate.enable_lazy_load_no_trans

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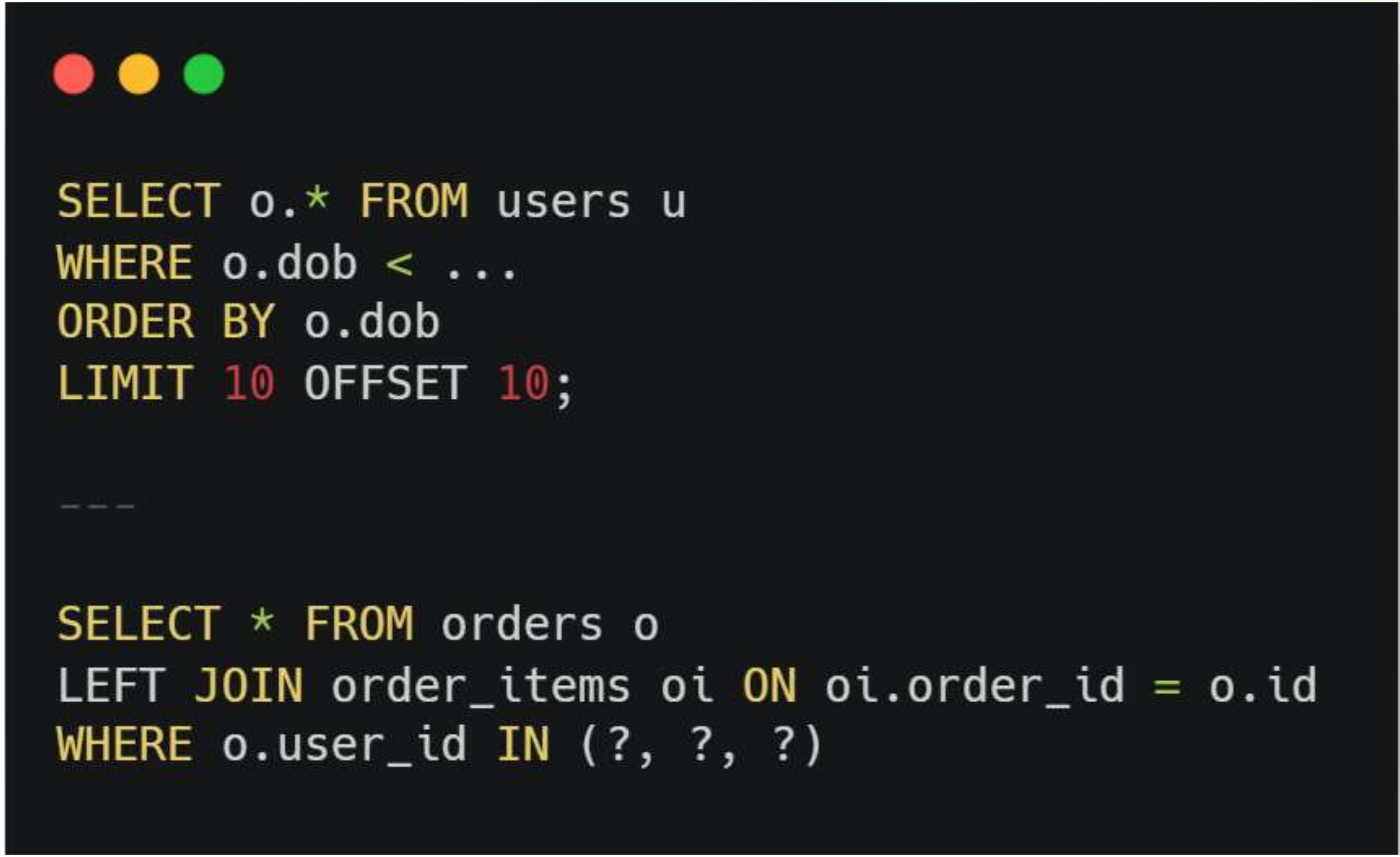
Transaction



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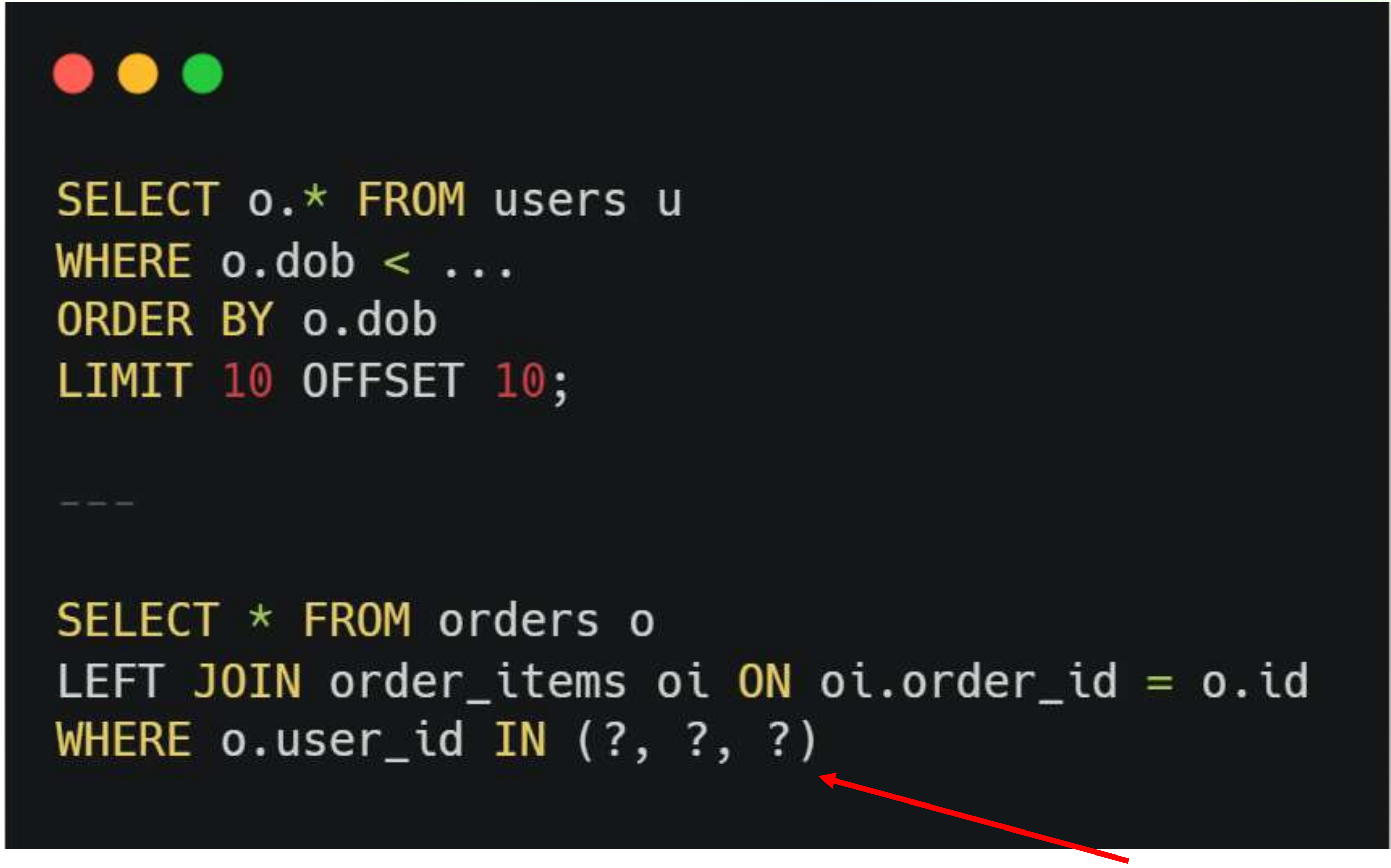
Transaction



```sql
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ORDER BY o.dob
LIMIT 10 OFFSET 10;

---

SELECT * FROM orders o
LEFT JOIN order_items oi ON oi.order_id = o.id
WHERE o.user_id IN (?, ?, ?)
```
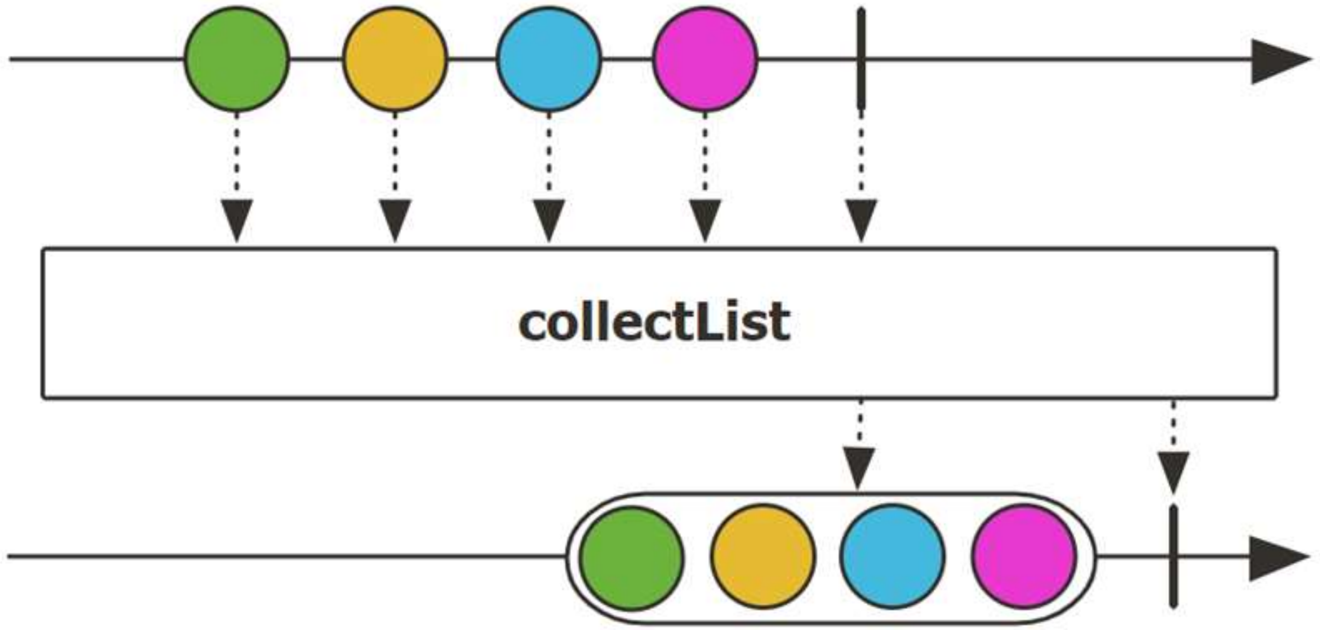

## collectList

```
public final Mono<List<T>> collectList()
```

Collect all elements emitted by this `Flux` into a `List` that is emitted by the resulting `Mono` when this sequence completes, emitting the empty `List` if the sequence was empty.



**Discard Support:** This operator discards the elements in the `List` upon cancellation or error triggered by a data signal.

**Returns:**

a `Mono` of a `List` of all values from this `Flux`

# Relations in Reactive World. Conclusion

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2. However, in general, it is possible to implement, but again, considering the trade-offs.

3. However, first level of nesting can be solved relatively easy

4. Virtual threads and Cursors can be a good option.

Thank you for your attention!

# Поливаха Михаил

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- Technical Writer
- Spring Айо Community board member

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