Tips for writing a web server and beyond

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@toidiuCodes

content

- designing with lifetimes
- db management
- logging
- code hardening

working code available at:

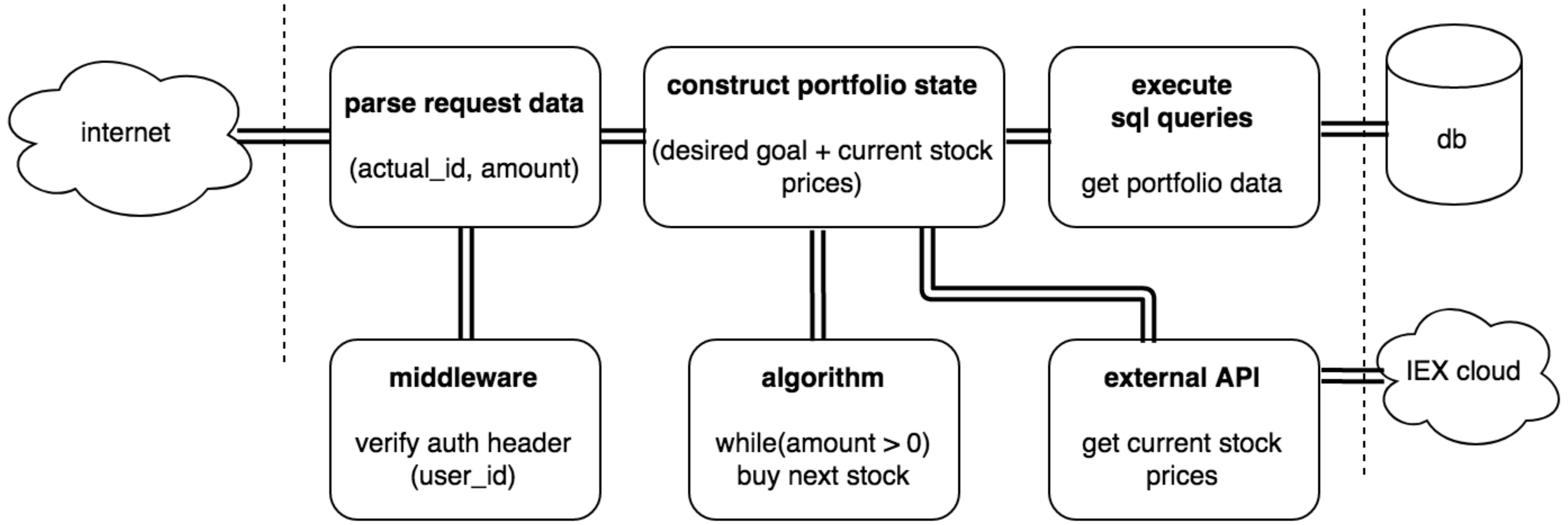
github.com/toidiu/fin-public

designing with lifetimes

designing with lifetimes(cont..)

system boundaries

GET: /portfolio/actual/buy?actual_port_id=5&amount=100



designing with lifetimes(cont..)

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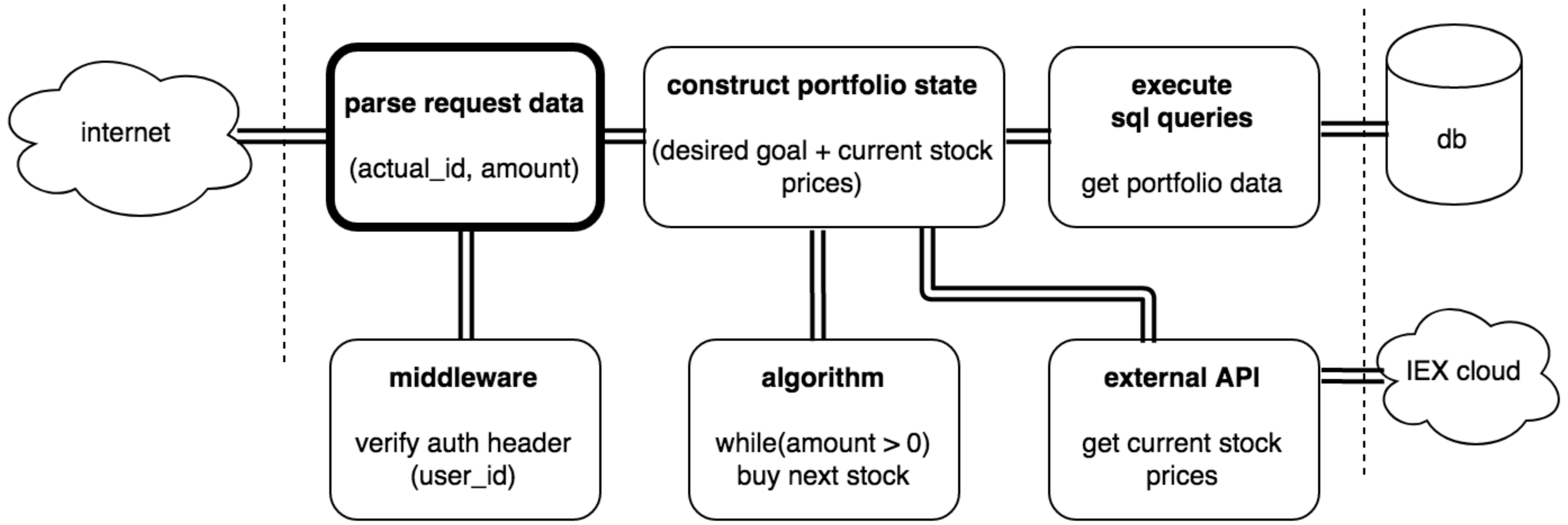

designing with lifetimes(cont..)

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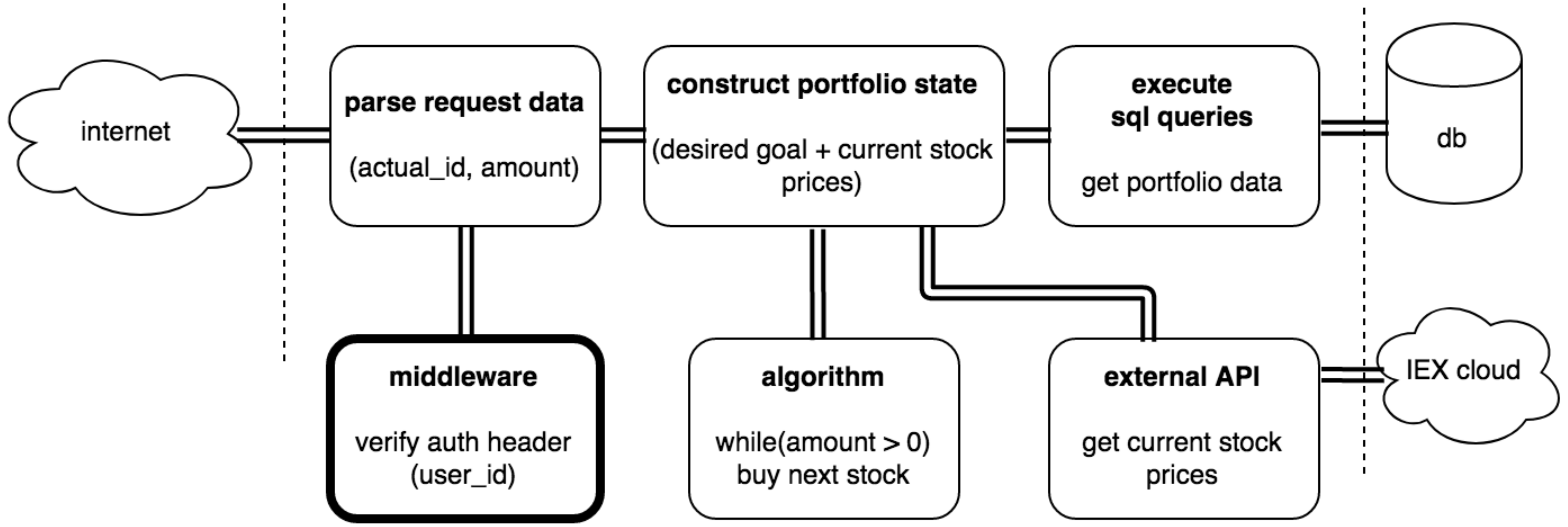
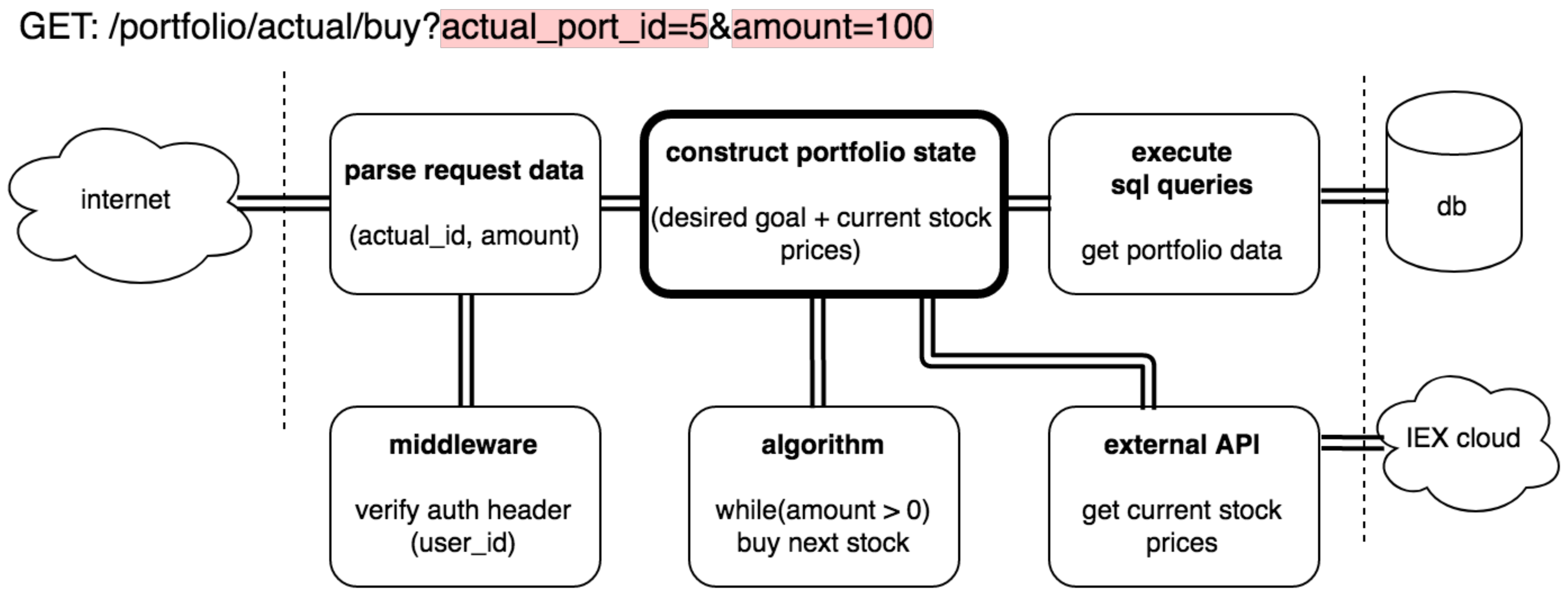


designing with lifetimes(cont..)

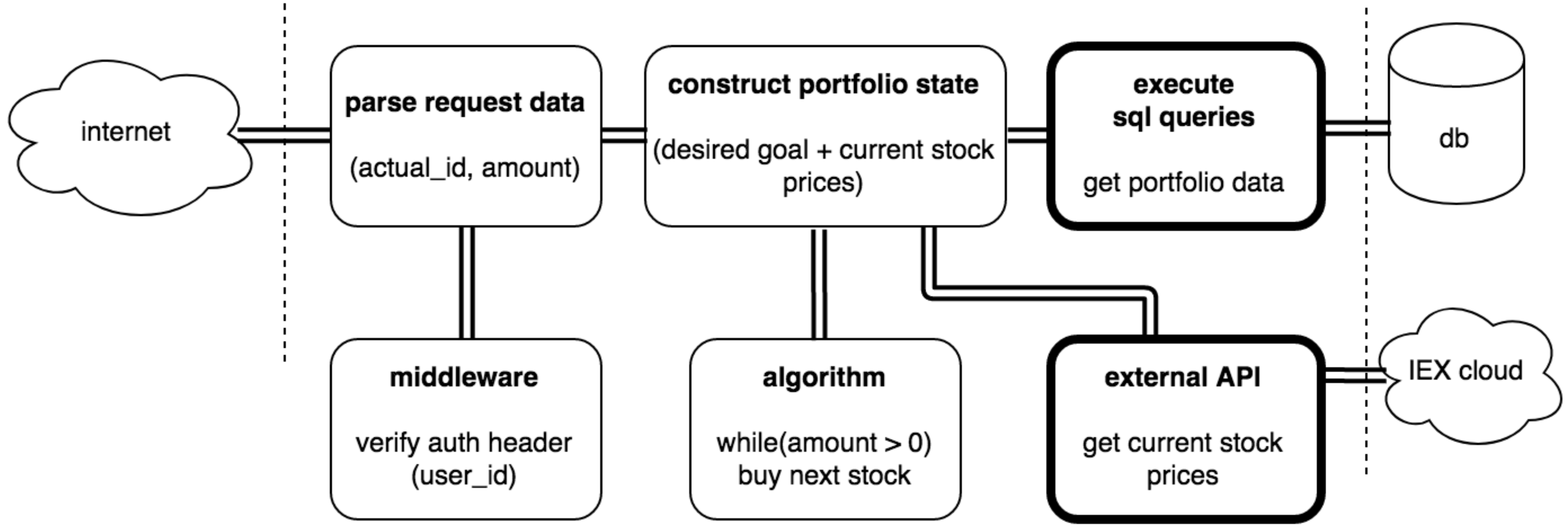
system boundaries


GET: /portfolio/actual/buy?actual_port_id=5&amount=100
internet
parse request data
(actual_id, amount)
construct portfolio state
(desired goal + current stock prices)
execute sql queries
get portfolio data
db
middleware
verify auth header (user_id)
algorithm
while(amount > 0) buy next stock
external API
get current stock prices
IEX cloud

designing with lifetimes(cont..)

system boundaries

GET: /portfolio/actual/buy?actual_port_id=5&amount=100



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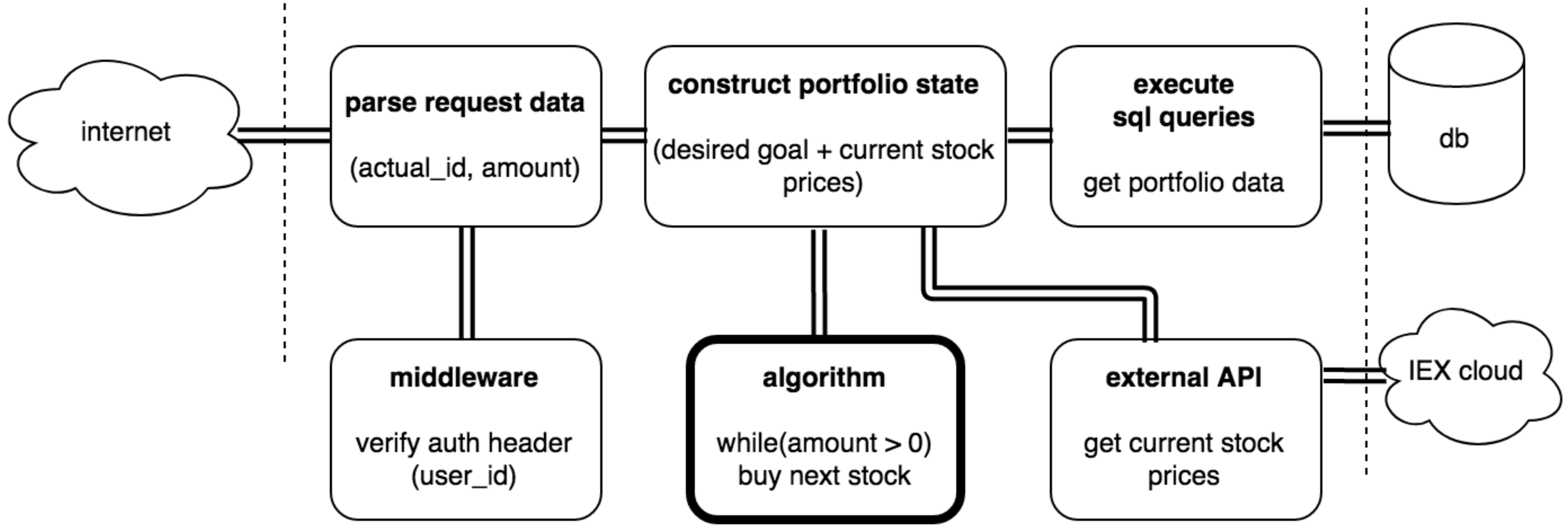

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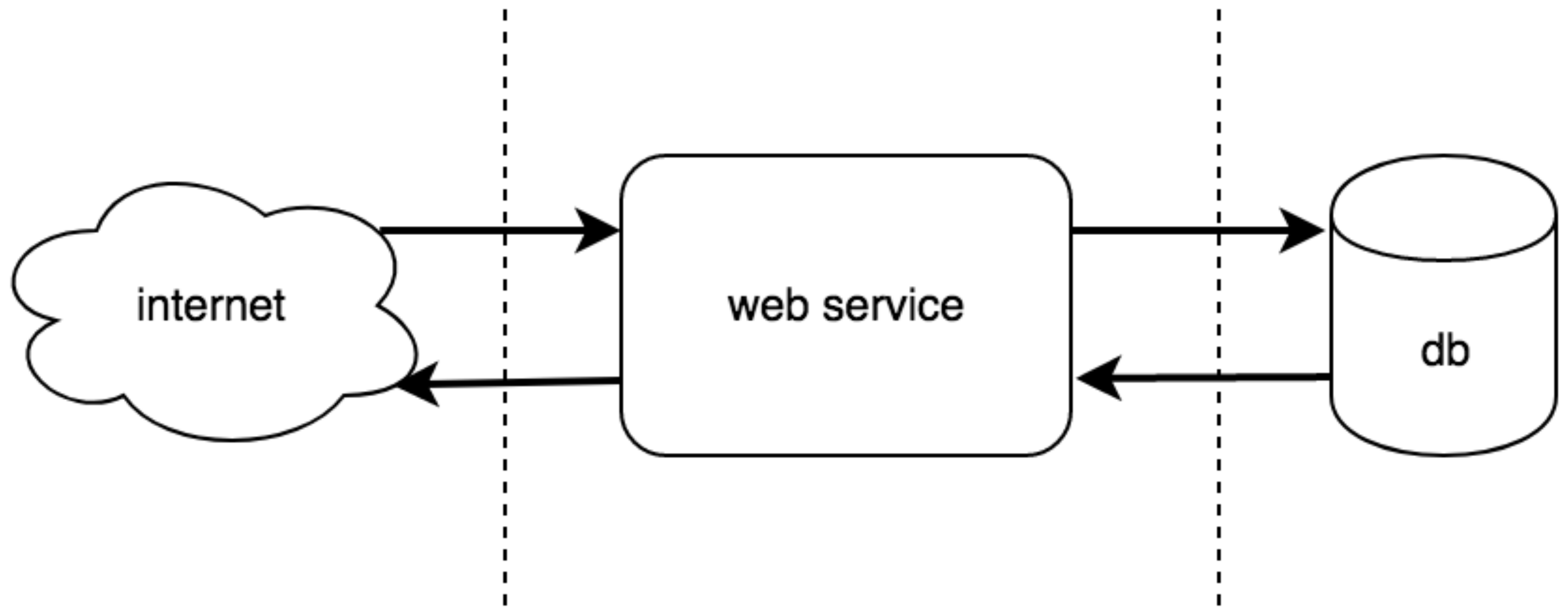
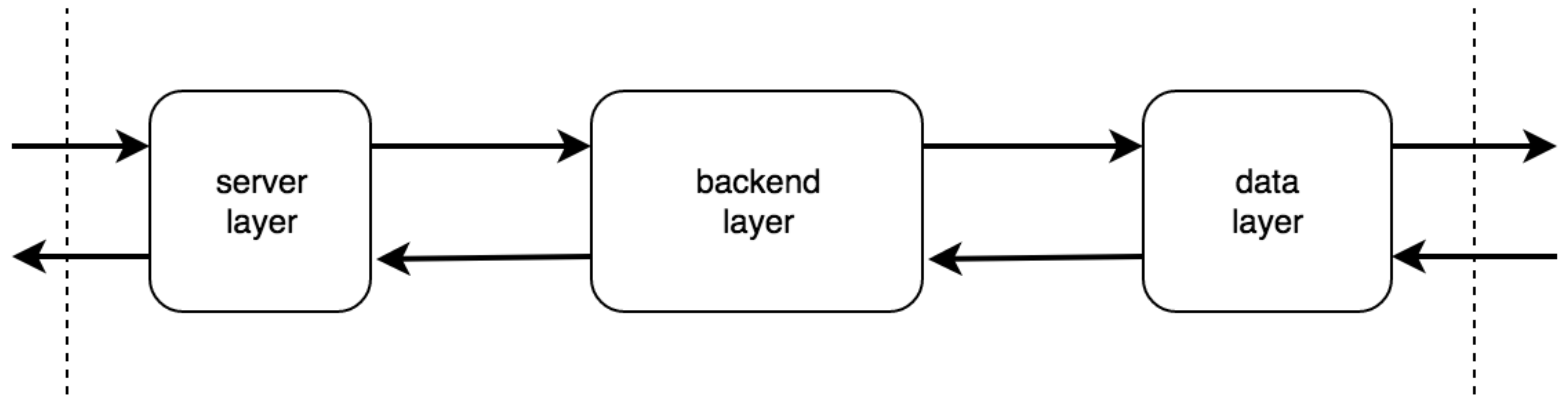
system boundaries(cont..)



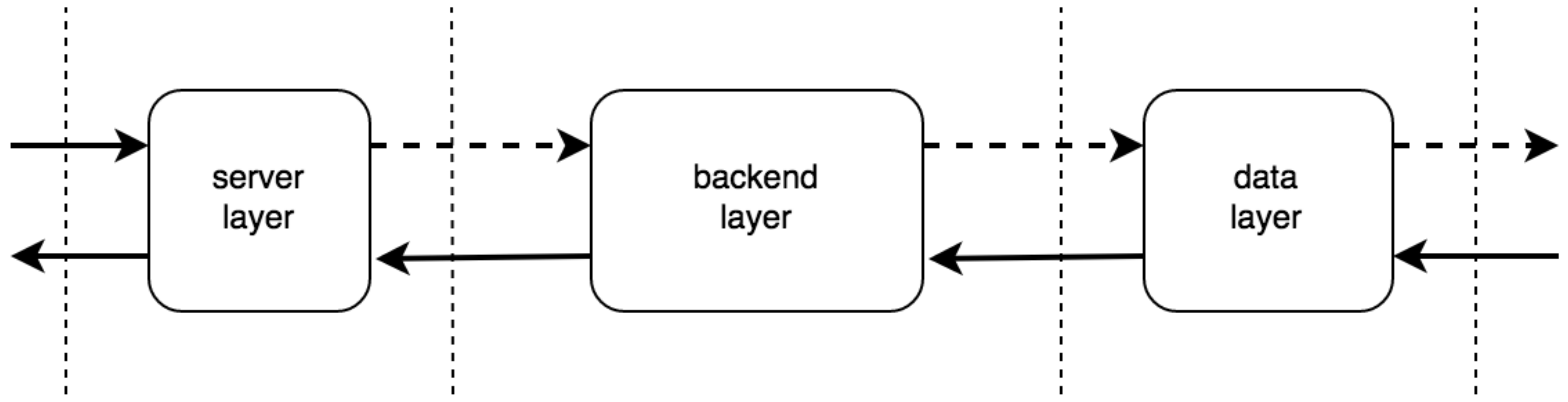
designing with lifetimes(cont..)

system boundaries(cont..)



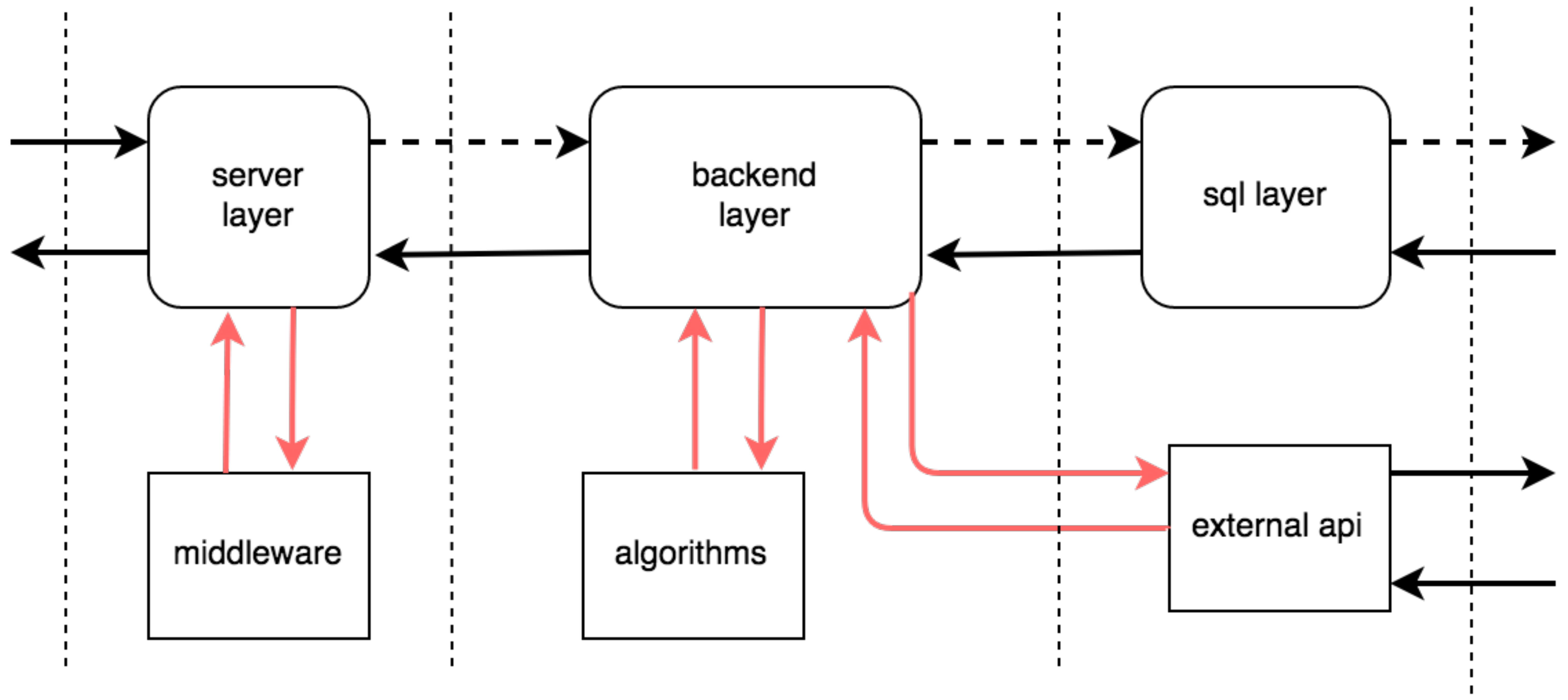
designing with lifetimes(cont..)

system boundaries(cont..)



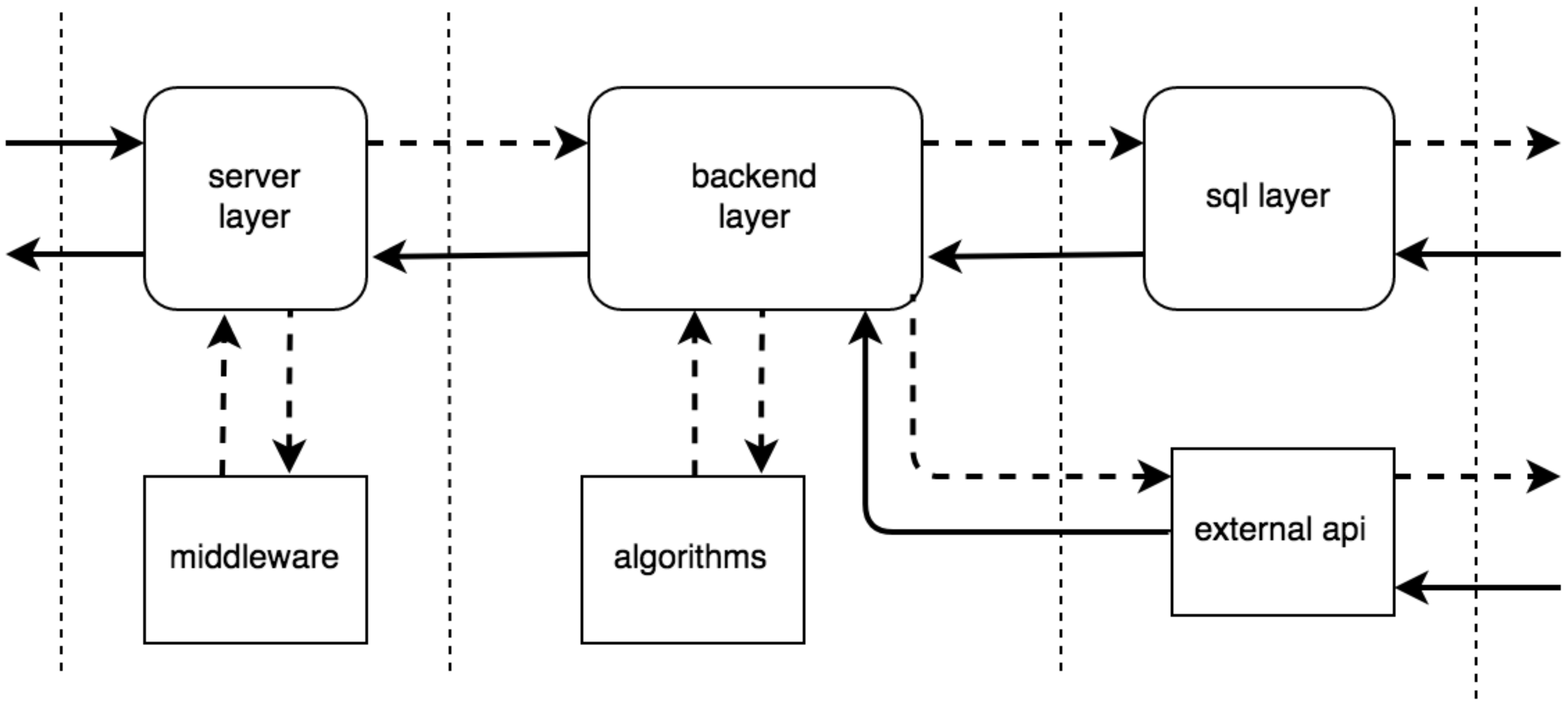
designing with lifetimes(cont..)

system boundaries(cont..)



designing with lifetimes(cont..)

system boundaries(cont..)



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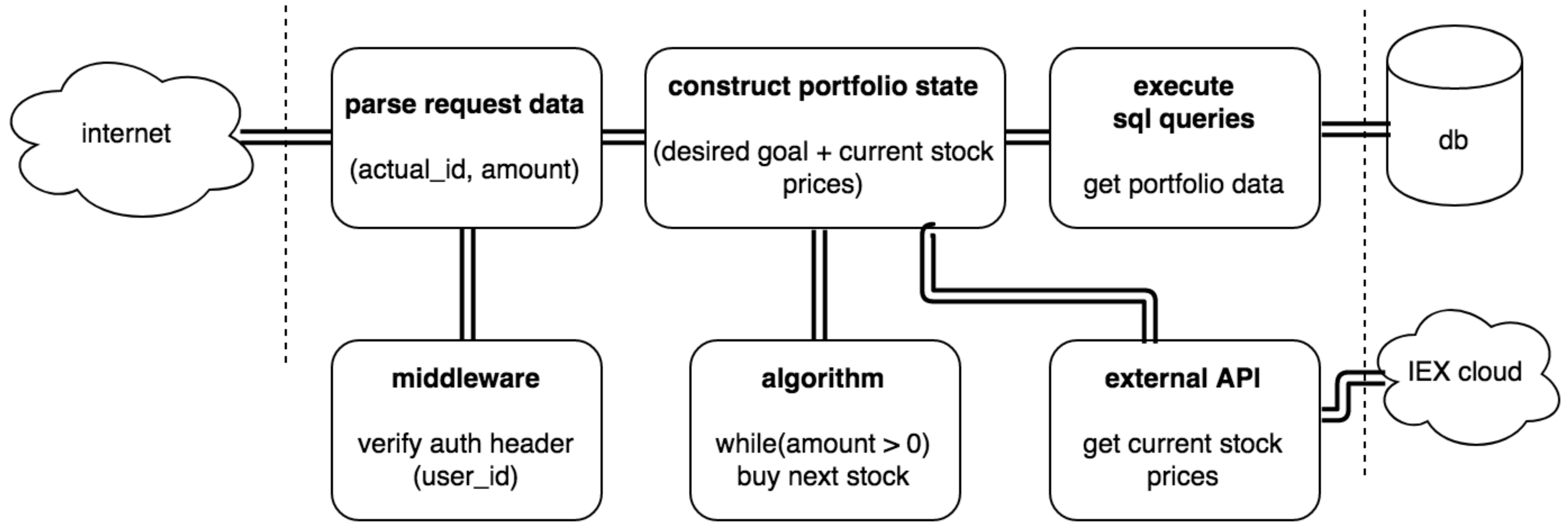

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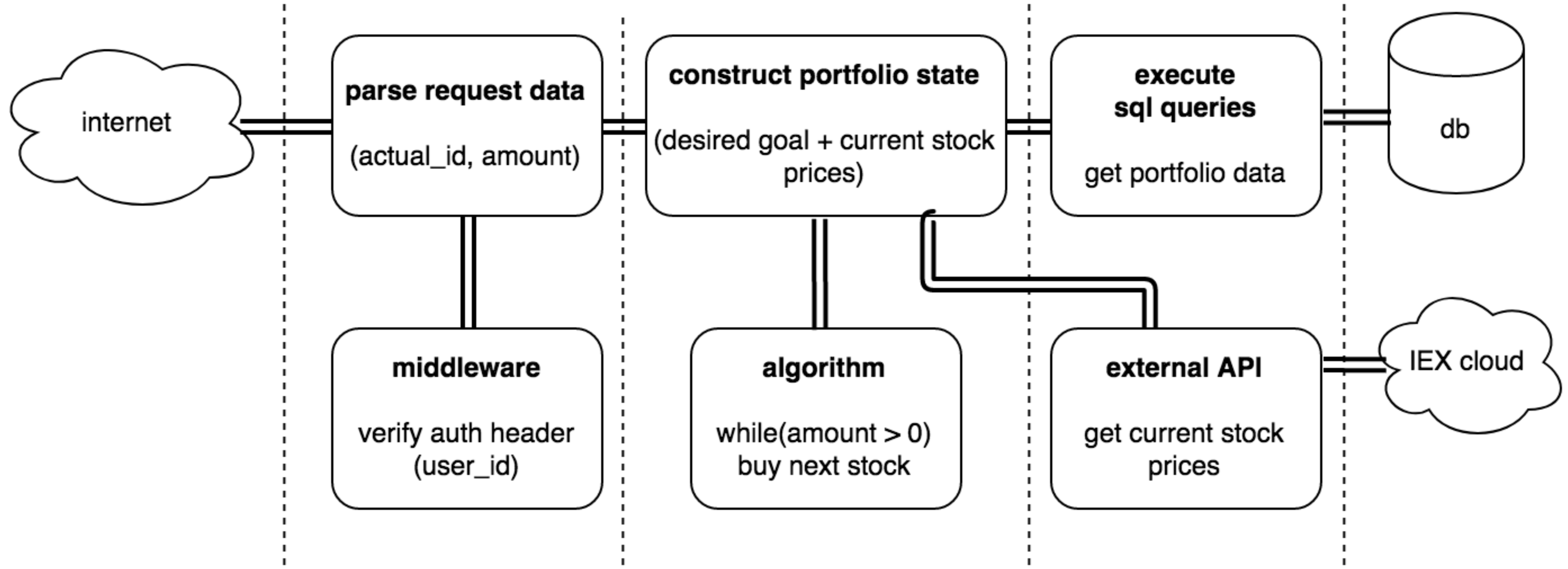
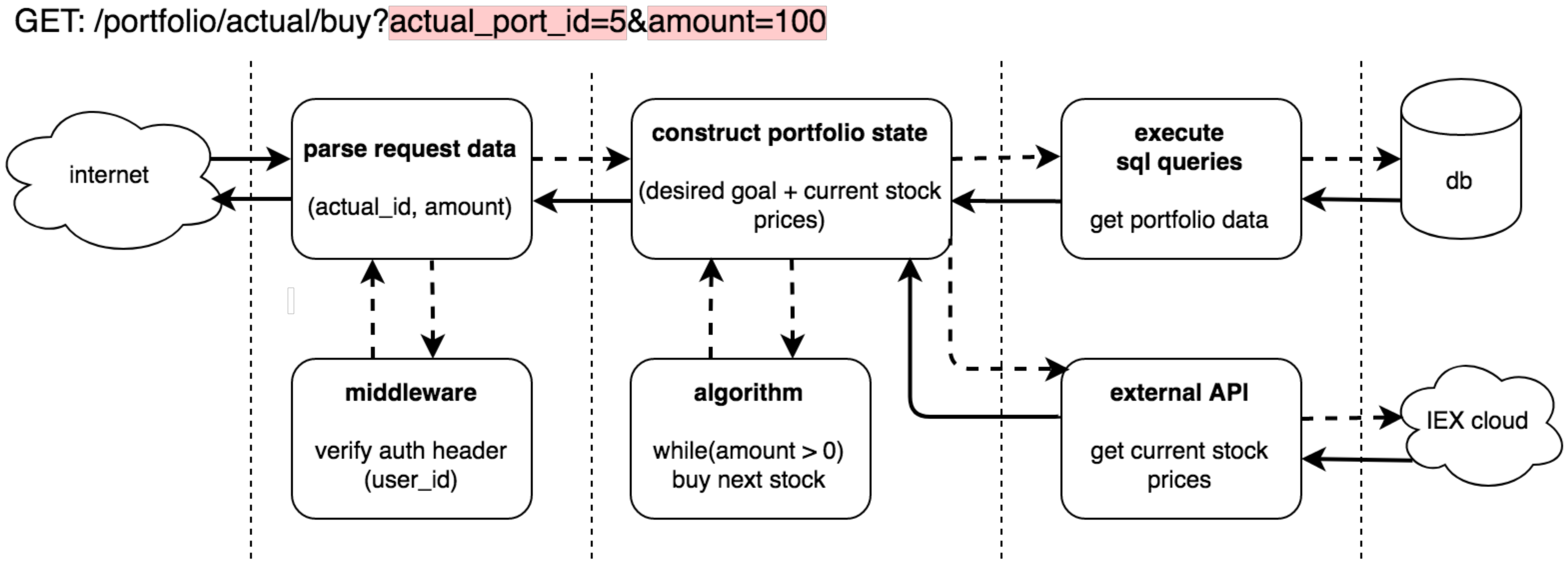


designing with lifetimes(cont..)

system boundaries

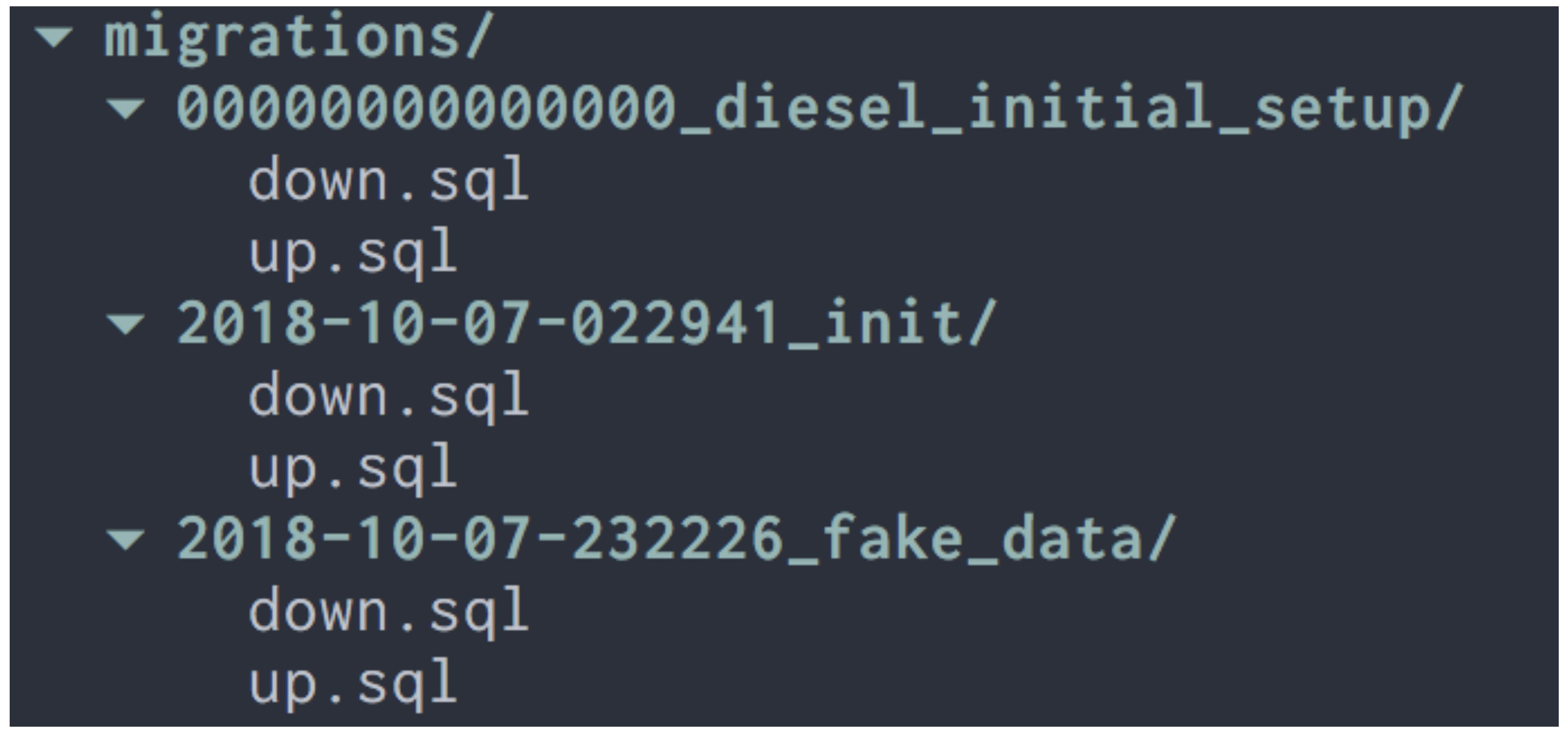


db management

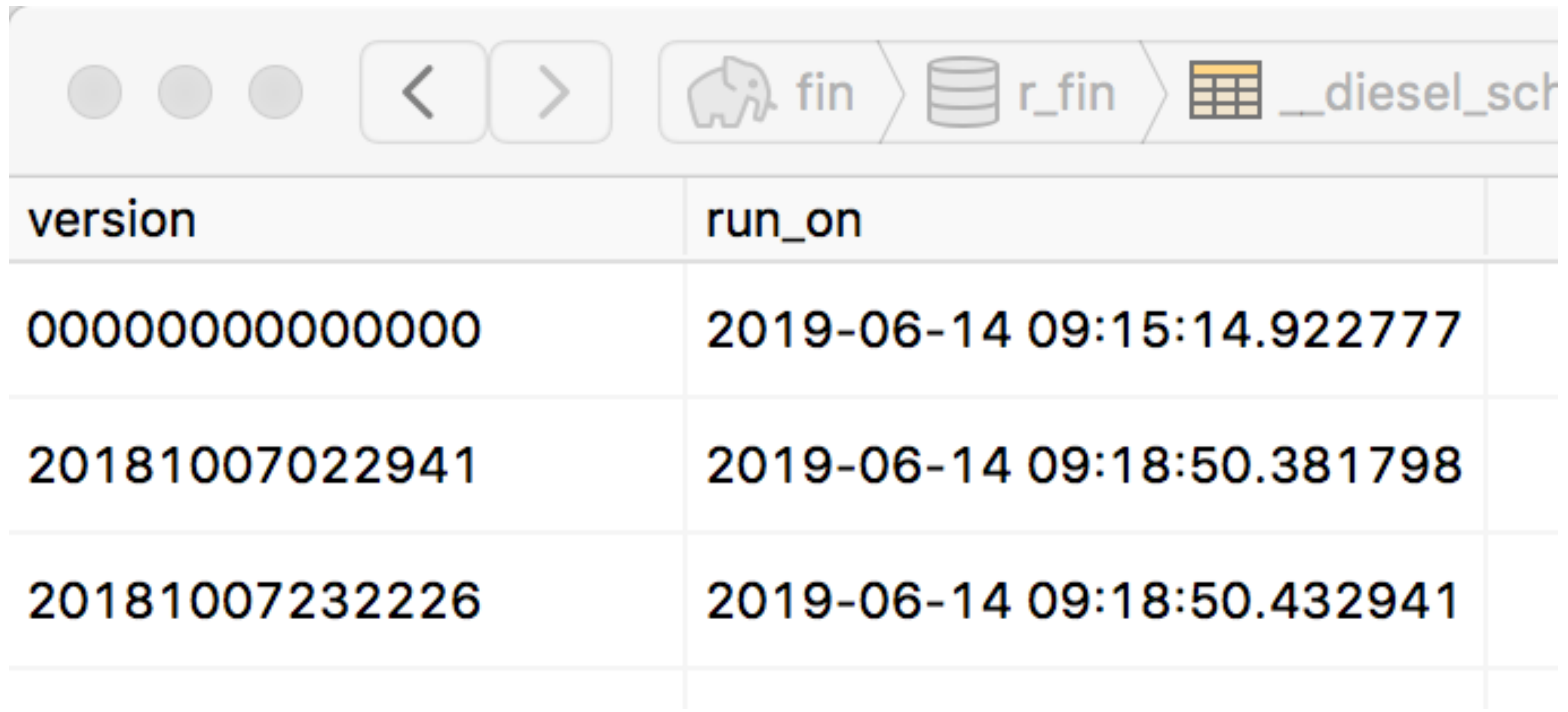
db management (cont..)

migrations with `diesel_cli`

- *manage database schema*
    - *evolve schema*
    - *code review and test schema changes*



```
▾ migrations/
  ▾ 00000000000000_diesel_initial_setup/
      down.sql
      up.sql
  ▾ 2018-10-07-022941_init/
      down.sql
      up.sql
  ▾ 2018-10-07-232226_fake_data/
      down.sql
      up.sql
```



version	run_on
00000000000000	2019-06-14 09:15:14.922777
20181007022941	2019-06-14 09:18:50.381798
20181007232226	2019-06-14 09:18:50.432941

db management (cont..)

ORM vs raw SQL

ORM (Diesel)	raw SQL
• pro: queries typed checked at compile time!	• pro: simply write the SQL you want
• con: can be difficult to write complex queries and need to learn a new framework	• con: need to write queries manually which can be error prone

db management (cont..)

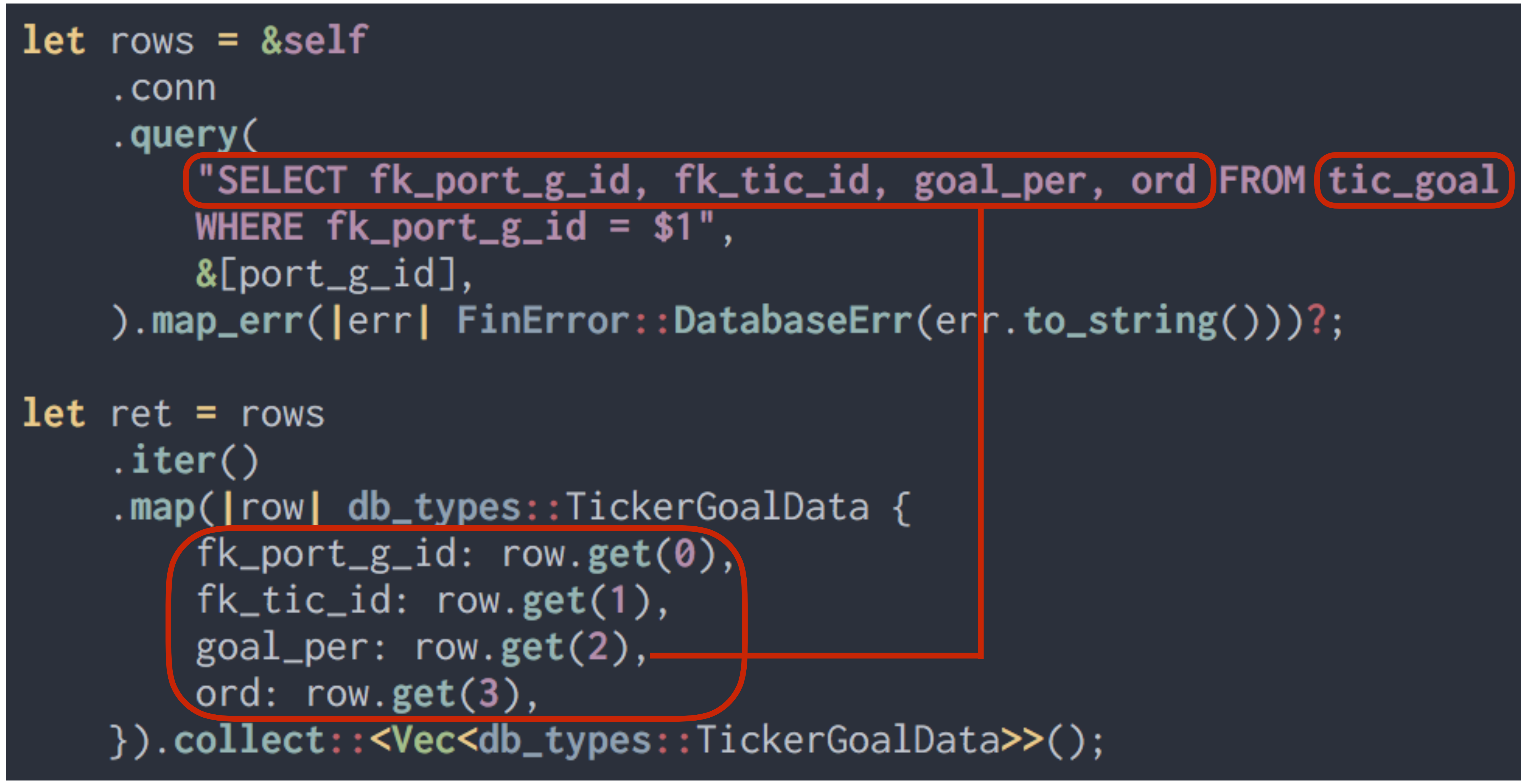
postgres crate

- flexibility of raw SQL

  but

- error prone

- difficult to maintain

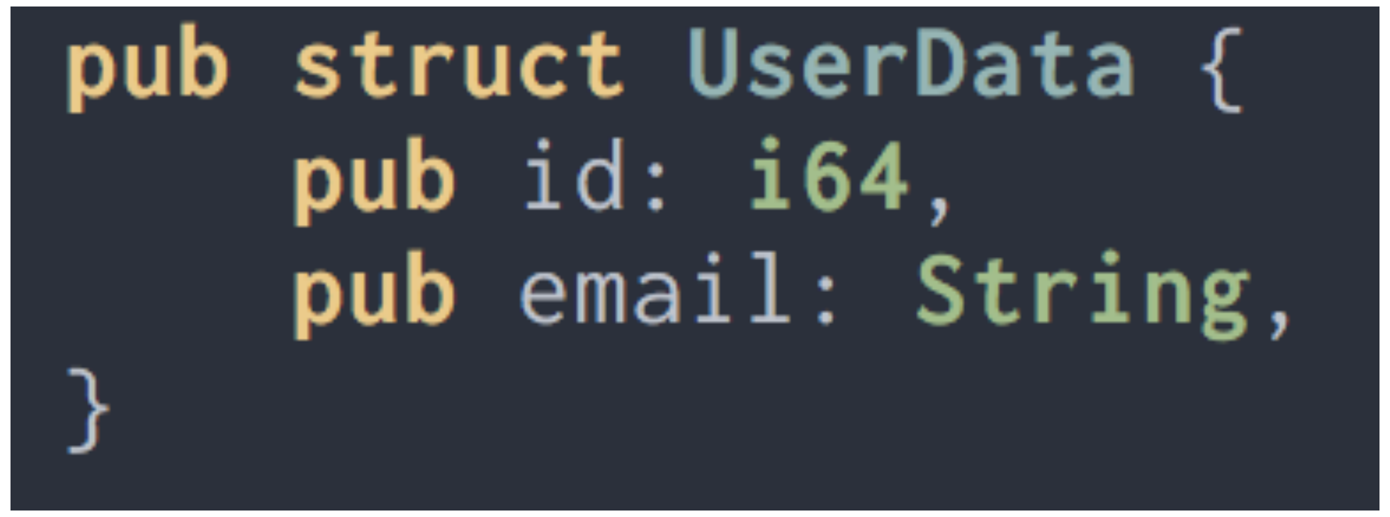


```
let rows = &self
    .conn
    .query(
        "SELECT fk_port_g_id, fk_tic_id, goal_per, ord FROM tic_goal
        WHERE fk_port_g_id = $1",
        &[port_g_id],
    ).map_err(|err| FinError::DatabaseErr(err.to_string()))?;

let ret = rows
    .iter()
    .map(|row| db_types::TickerGoalData {
        fk_port_g_id: row.get(0),
        fk_tic_id: row.get(1),
        goal_per: row.get(2),
        ord: row.get(3),
    }).collect::<Vec<db_types::TickerGoalData>>();
```

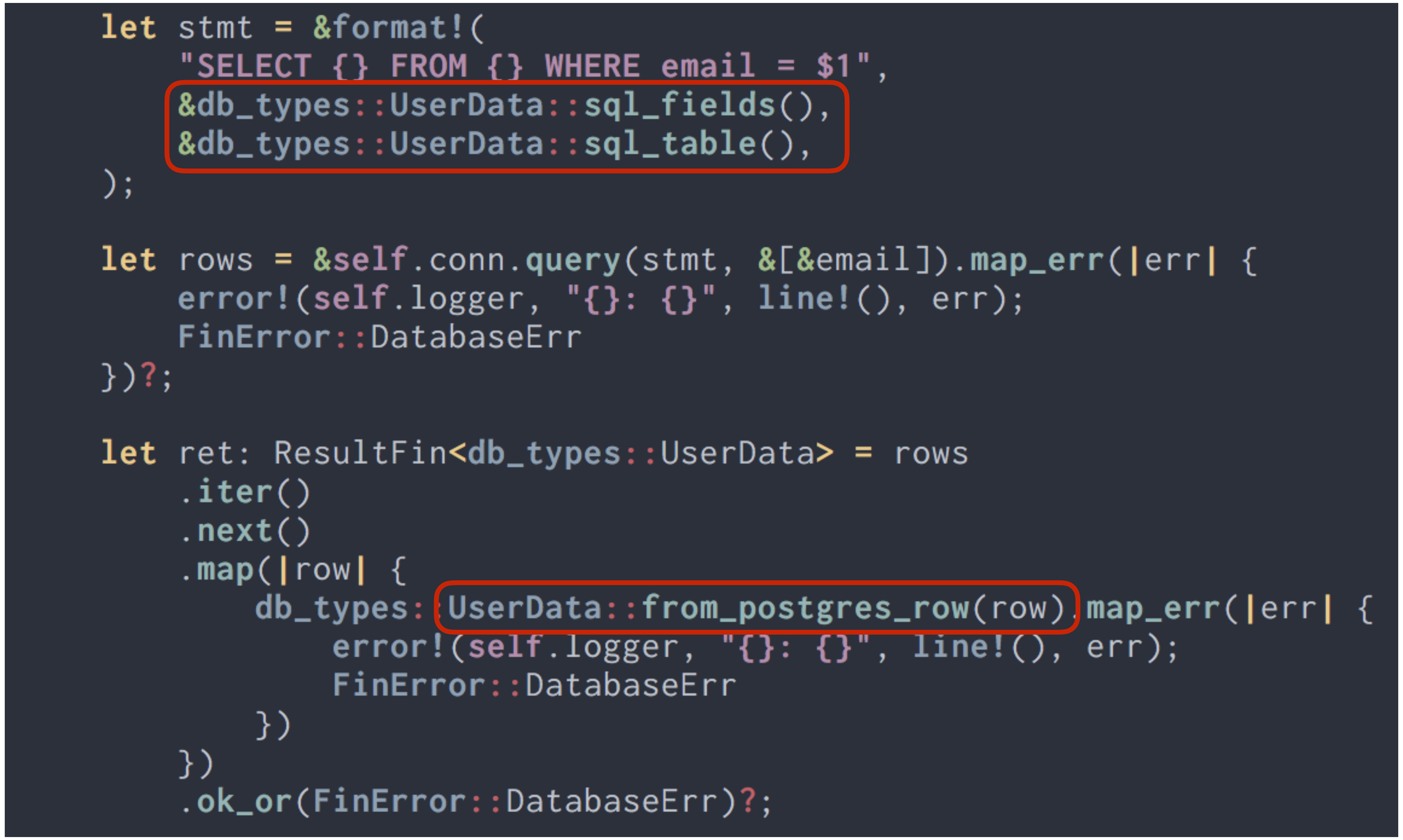
db management (cont..)

postgres crate

- ideal SQL



```rust
pub struct UserData {
    pub id: i64,
    pub email: String,
}
```

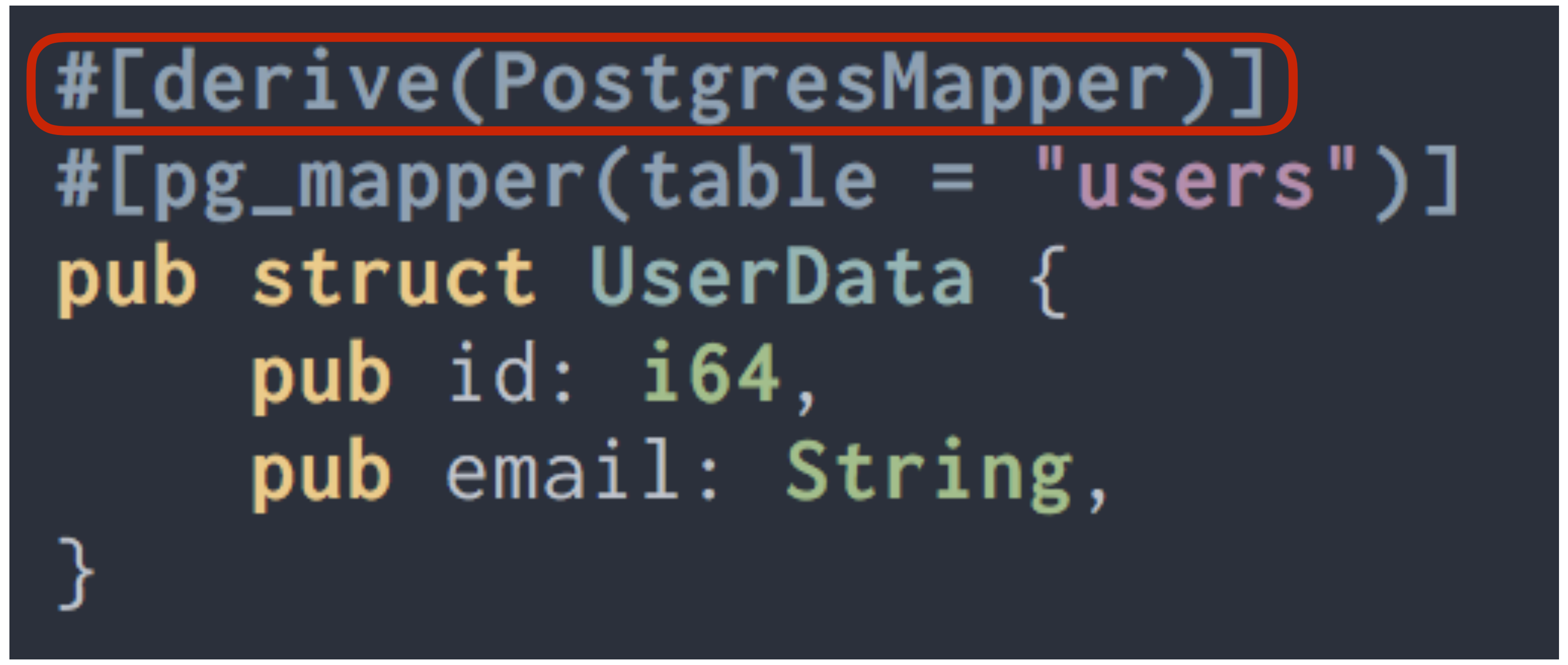


```rust
let stmt = &format!(
    "SELECT {} FROM {} WHERE email = $1",
    &db_types::UserData::sql_fields(),
    &db_types::UserData::sql_table(),
);

let rows = &self.conn.query(stmt, &[&email]).map_err(|err| {
    error!(self.logger, "{}: {}", line!(), err);
    FinError::DatabaseErr
})?;

let ret: ResultFin<db_types::UserData> = rows
    .iter()
    .next()
    .map(|row| {
        db_types::UserData::from_postgres_row(row).map_err(|err| {
            error!(self.logger, "{}: {}", line!(), err);
            FinError::DatabaseErr
        })
    })
    .ok_or(FinError::DatabaseErr)?;
```

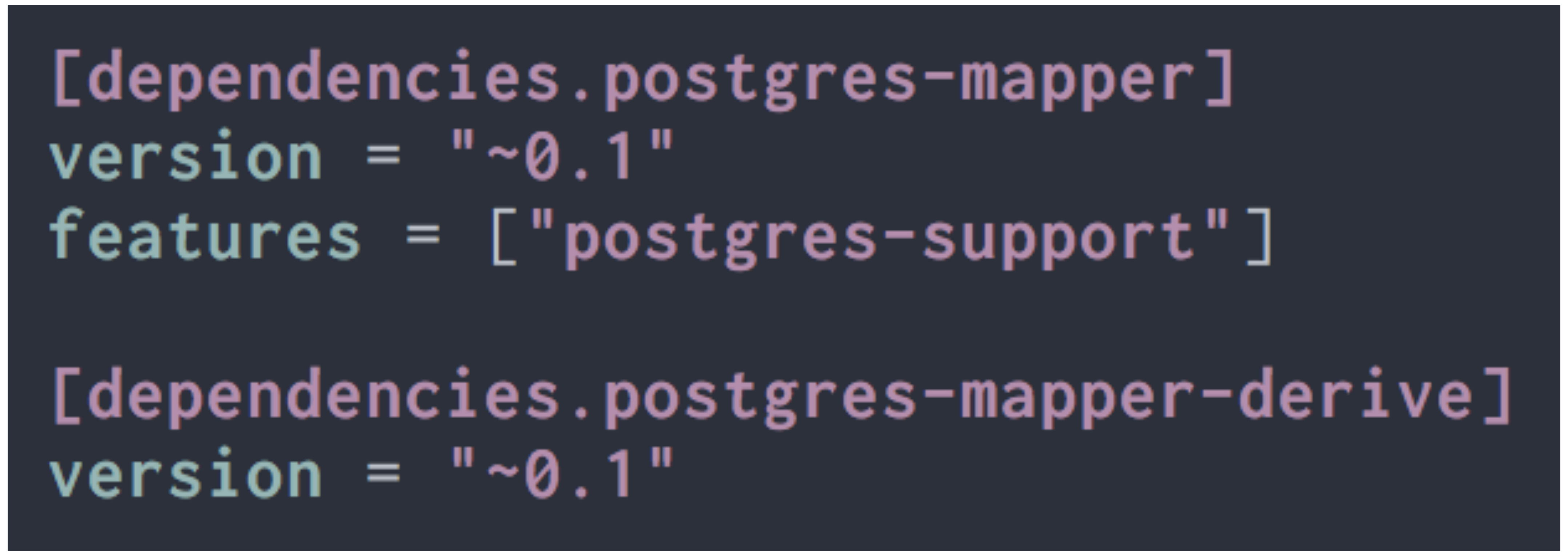
db management (cont..)

postgres-mapper

- derive procedural macro
  - UserData::**from_postgres_row**(row) -> **Result<UserData, _>**
- attribute procedural macro
  - UserData::sql_fields() -> users.id, users.email
  - UserData::sql_table() -> users



```rust
#[derive(PostgresMapper)]
#[pg_mapper(table = "users")]
pub struct UserData {
    pub id: i64,
    pub email: String,
}
```

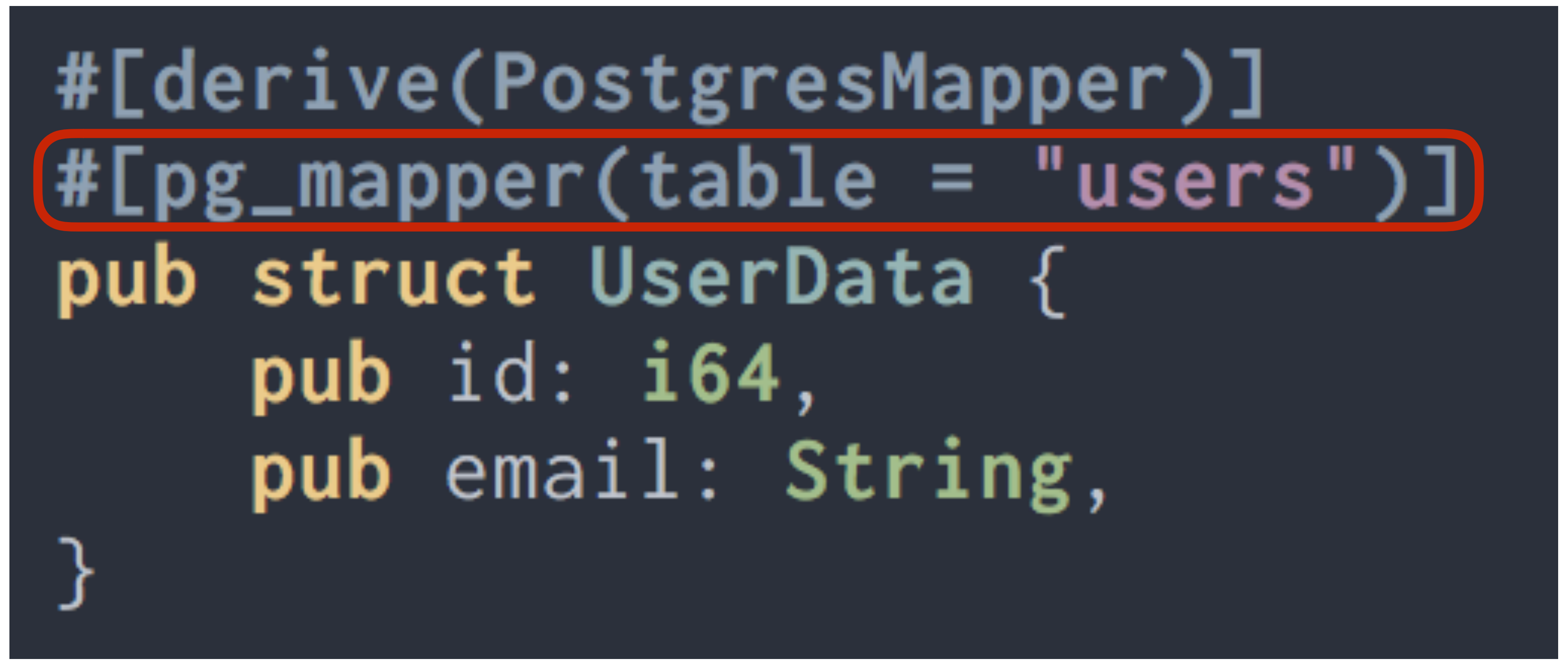


```toml
[dependencies.postgres-mapper]
version = "~0.1"
features = ["postgres-support"]

[dependencies.postgres-mapper-derive]
version = "~0.1"
```

db management (cont..)

postgres-mapper

- derive procedural macro
  - UserData::from_postgres_row(row) -> Result<UserData, _>
- attribute procedural macro
  - UserData::**sql_fields**() -> ”**users.id, users.email**”
  - UserData::**sql_table**() -> ”**users**”



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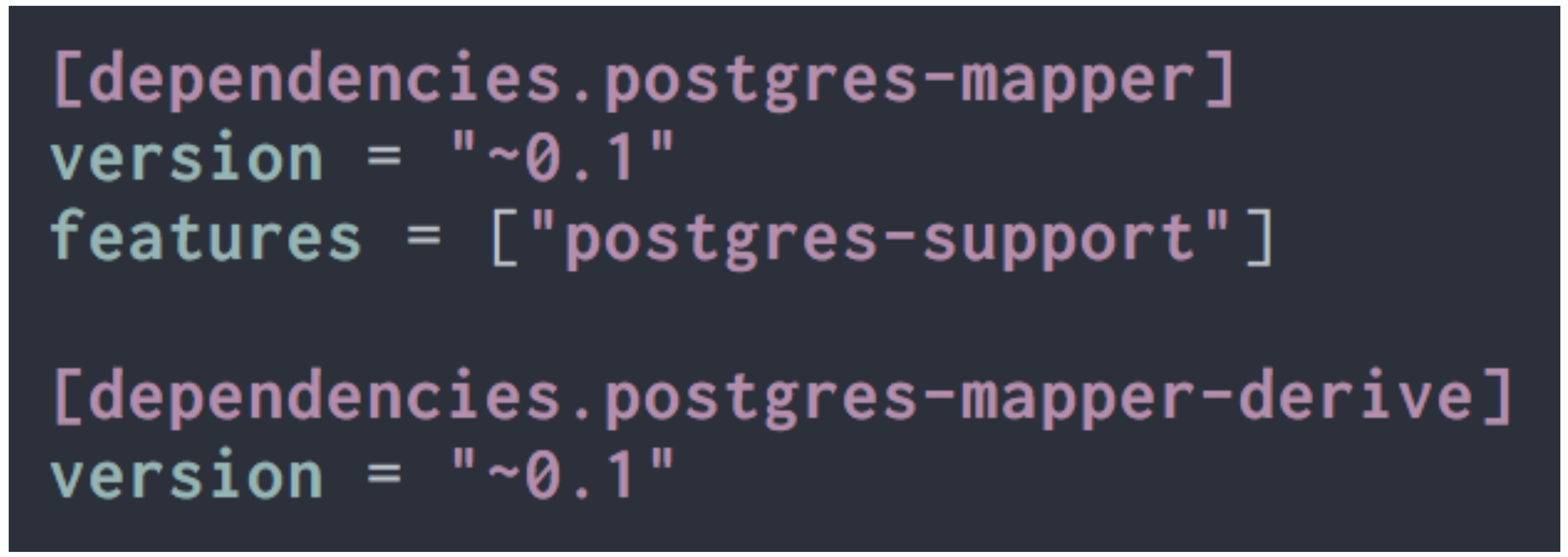

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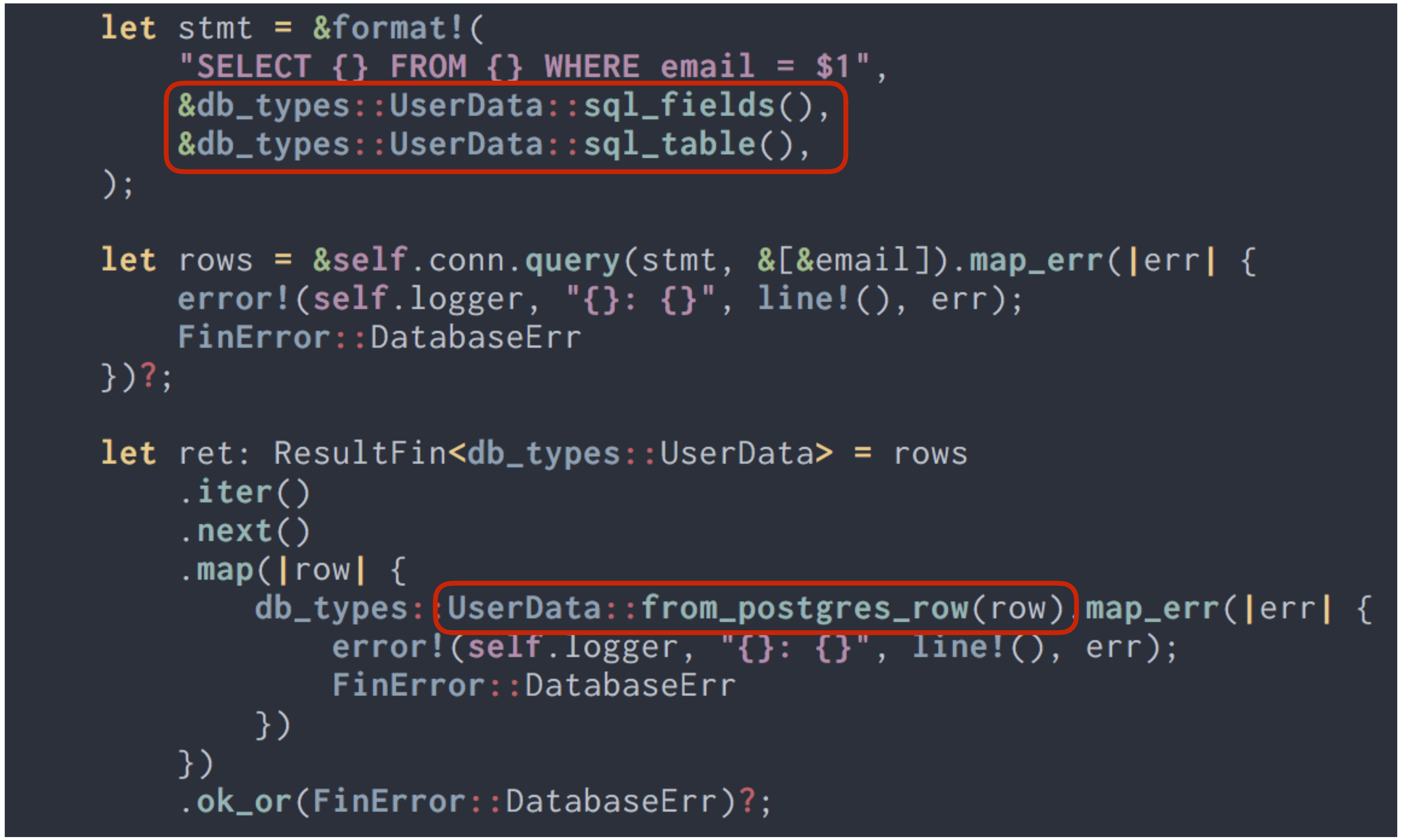
db management (cont..)

postgres crate



```rust
let stmt = &format!(
    "SELECT {} FROM {} WHERE email = $1",
    &db_types::UserData::sql_fields(),
    &db_types::UserData::sql_table(),
);

let rows = &self.conn.query(stmt, &[&email]).map_err(|err| {
    error!(self.logger, "{}: {}", line!(), err);
    FinError::DatabaseErr
})?;

let ret: ResultFin<db_types::UserData> = rows
    .iter()
    .next()
    .map(|row| {
        db_types::UserData::from_postgres_row(row).map_err(|err| {
            error!(self.logger, "{}: {}", line!(), err);
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        })
    })
    .ok_or(FinError::DatabaseErr)?;
```
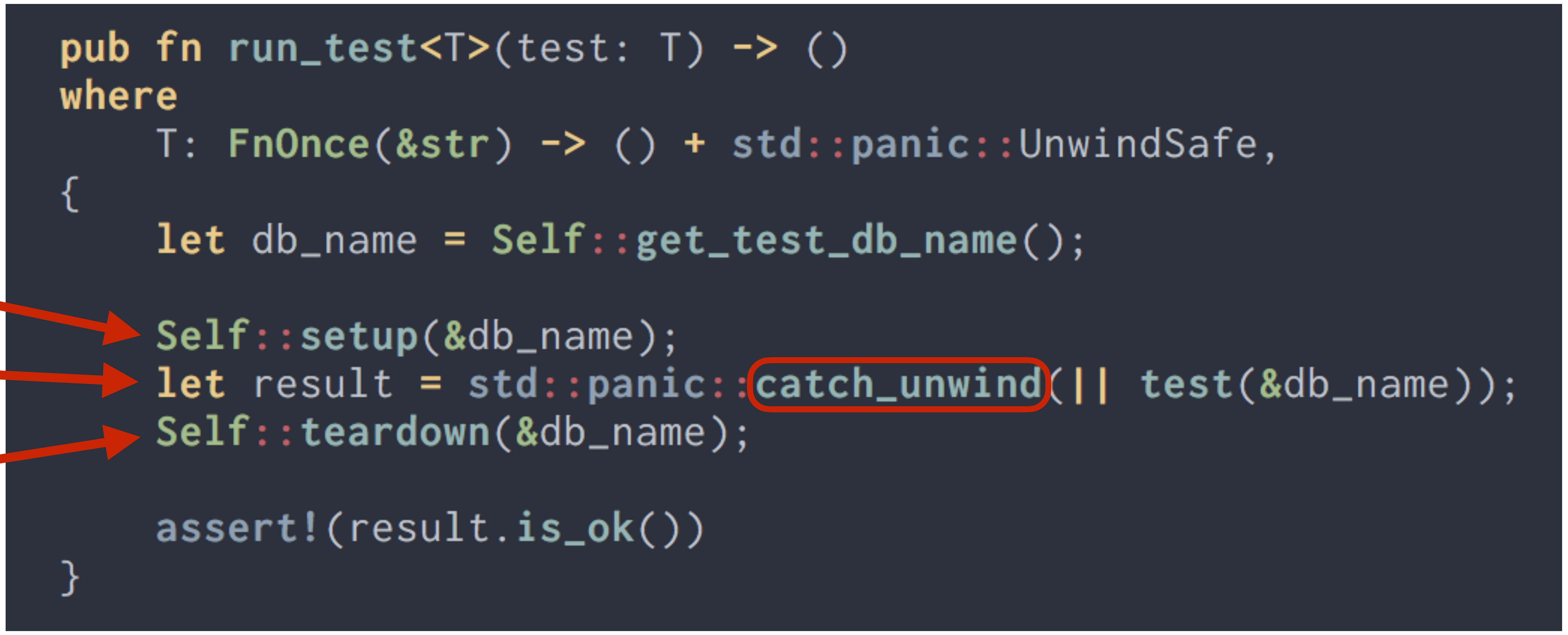
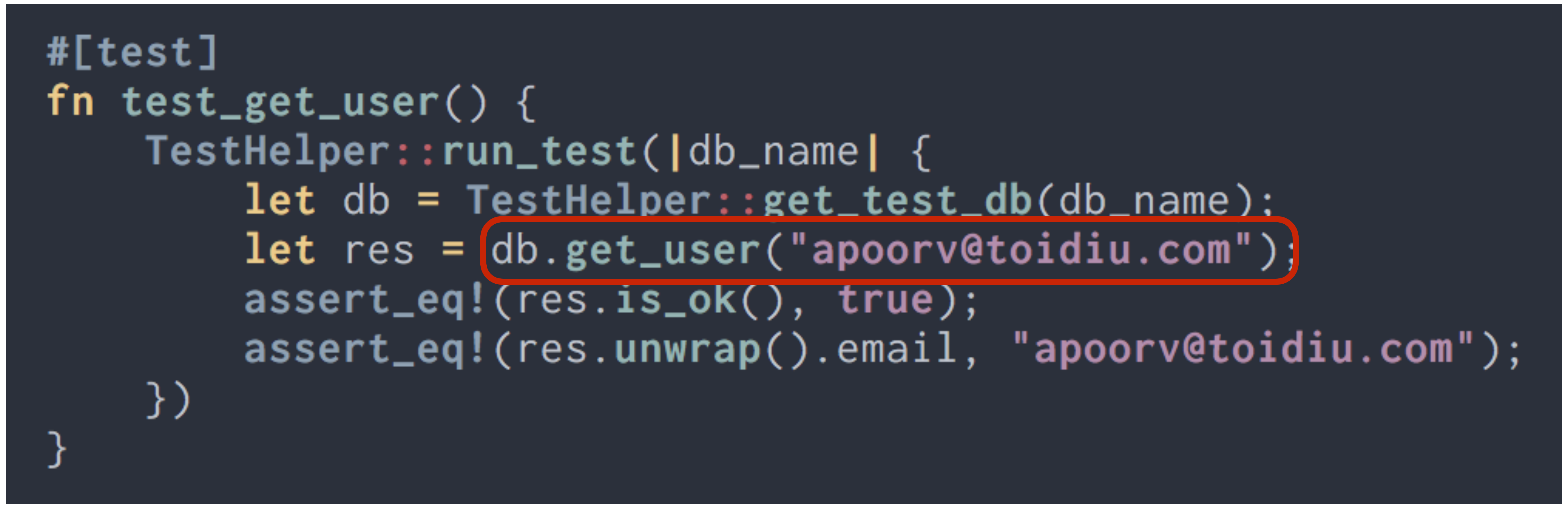

db management(cont..)

db testing

- setup
- run test
- teardown



```rust
pub fn run_test<T>(test: T) -> ()
where
    T: FnOnce(&str) -> () + std::panic::UnwindSafe,
{
    let db_name = Self::get_test_db_name();

    Self::setup(&db_name);
    let result = std::panic::catch_unwind(|| test(&db_name));
    Self::teardown(&db_name);

    assert!(result.is_ok())
}
```

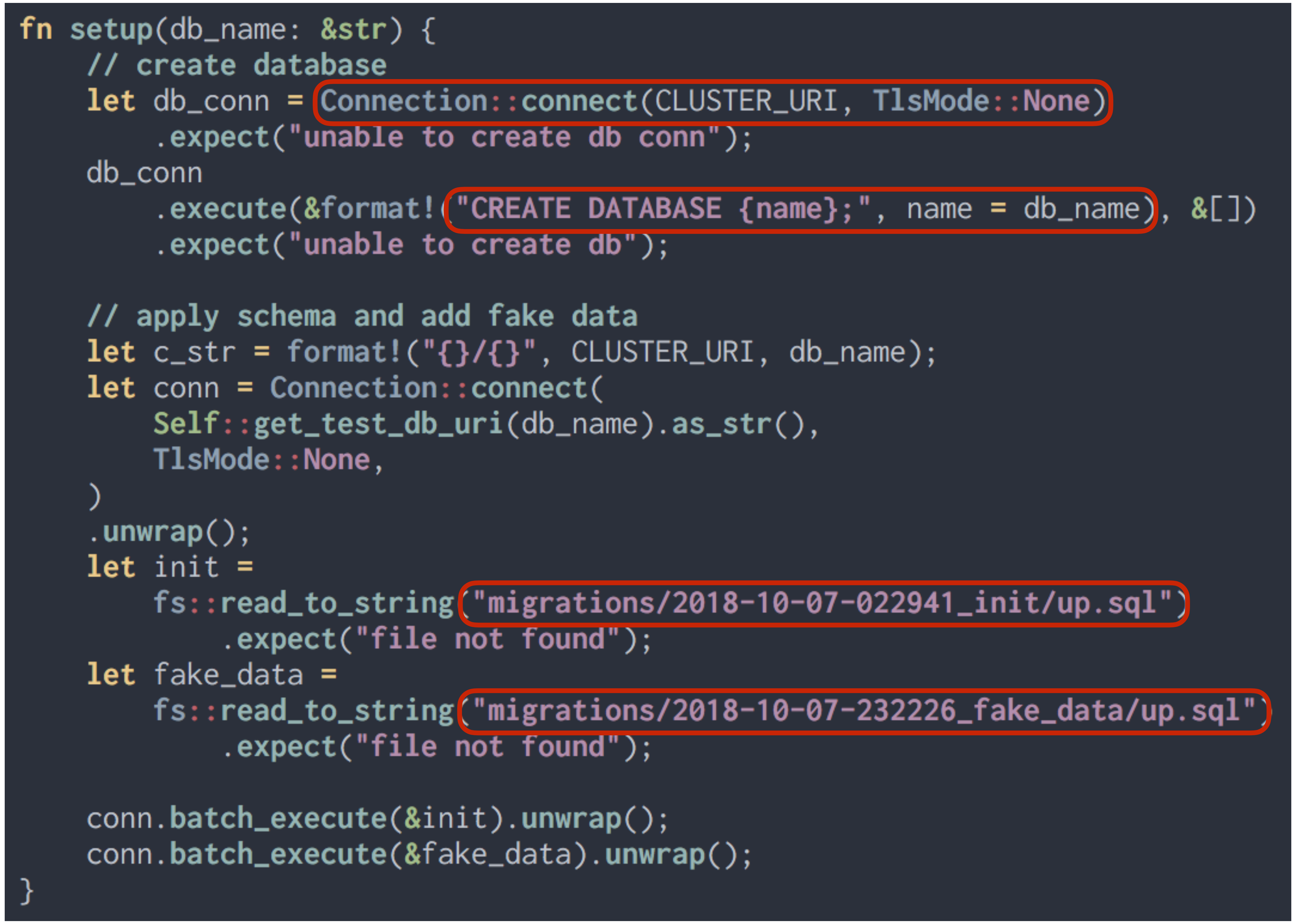


```rust
#[test]
fn test_get_user() {
    TestHelper::run_test(|db_name| {
        let db = TestHelper::get_test_db(db_name);
        let res = db.get_user("apoorv@toidiu.com");
        assert_eq!(res.is_ok(), true);
        assert_eq!(res.unwrap().email, "apoorv@toidiu.com");
    })
}
```

db management(cont..)

db testing

- setup DB for testing
  - get a connection (needs a real postgres instance)
  - re-use migration scripts!!



```rust
fn setup(db_name: &str) {
    // create database
    let db_conn = Connection::connect(CLUSTER_URI, TlsMode::None)
        .expect("unable to create db conn");
    db_conn
        .execute(&format!("CREATE DATABASE {name};", name = db_name), &[])
        .expect("unable to create db");

    // apply schema and add fake data
    let c_str = format!("{}/{}", CLUSTER_URI, db_name);
    let conn = Connection::connect(
        Self::get_test_db_uri(db_name).as_str(),
        TlsMode::None,
    )
    .unwrap();
    let init =
        fs::read_to_string("migrations/2018-10-07-022941_init/up.sql")
            .expect("file not found");
    let fake_data =
        fs::read_to_string("migrations/2018-10-07-232226_fake_data/up.sql")
            .expect("file not found");

    conn.batch_execute(&init).unwrap();
    conn.batch_execute(&fake_data).unwrap();
}
```

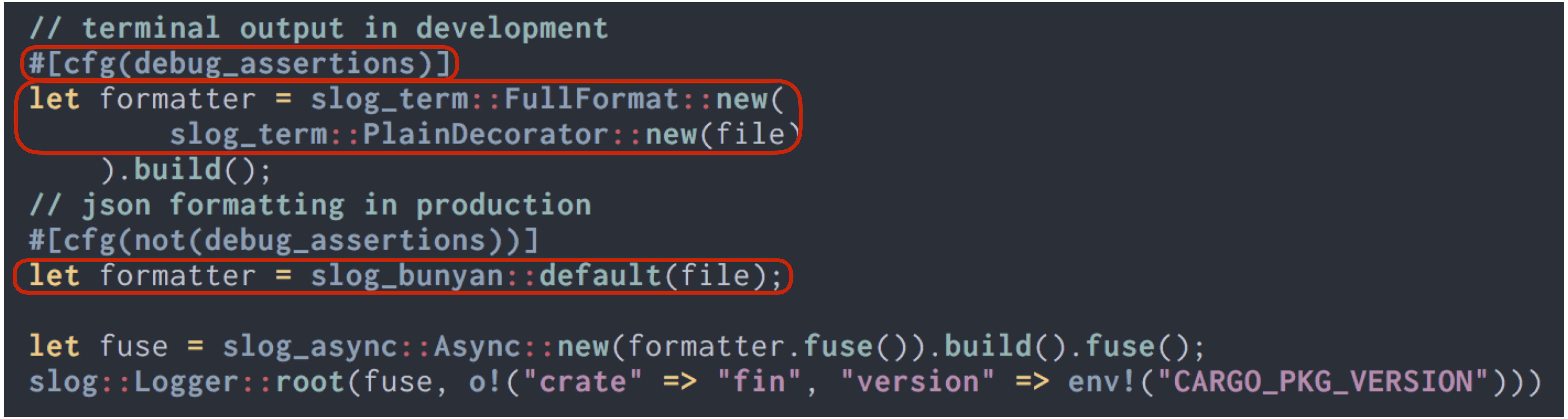
logging

logging(cont..)

slog composable

- composable plugin model `**trait Drain**`

json vs plain async vs sync file vs network



```
// terminal output in development
#[cfg(debug_assertions)]
let formatter = slog_term::FullFormat::new(
        slog_term::PlainDecorator::new(file)
    ).build();
// json formatting in production
#[cfg(not(debug_assertions))]
let formatter = slog_bunyan::default(file);

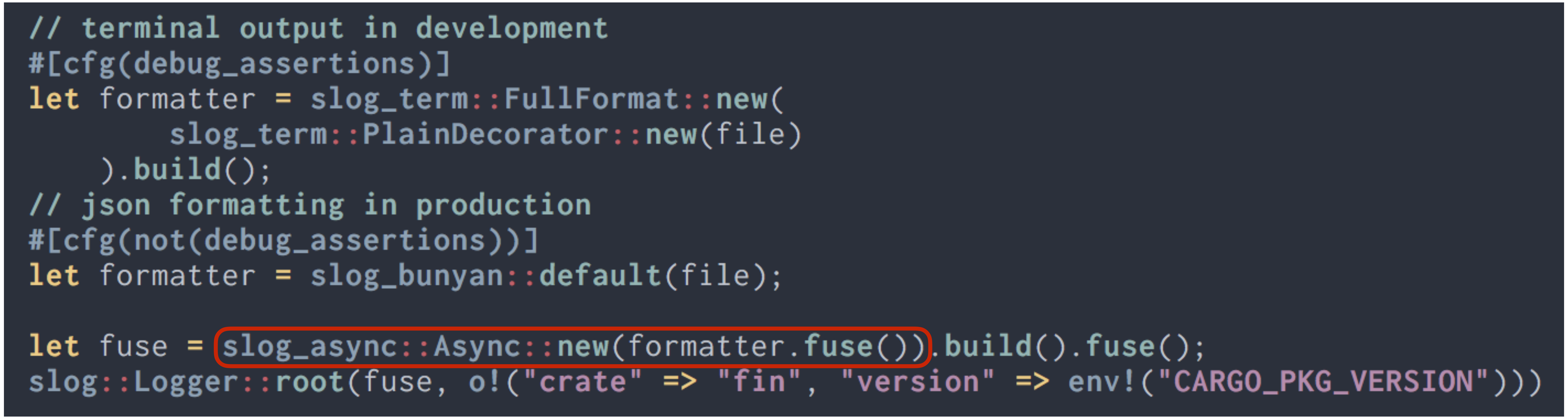
let fuse = slog_async::Async::new(formatter.fuse()).build().fuse();
slog::Logger::root(fuse, o!("crate" => "fin", "version" => env!("CARGO_PKG_VERSION")))
```

logging(cont..)

slog composable

- composable plugin model `**trait Drain**`

json vs plain **async vs sync** file vs network



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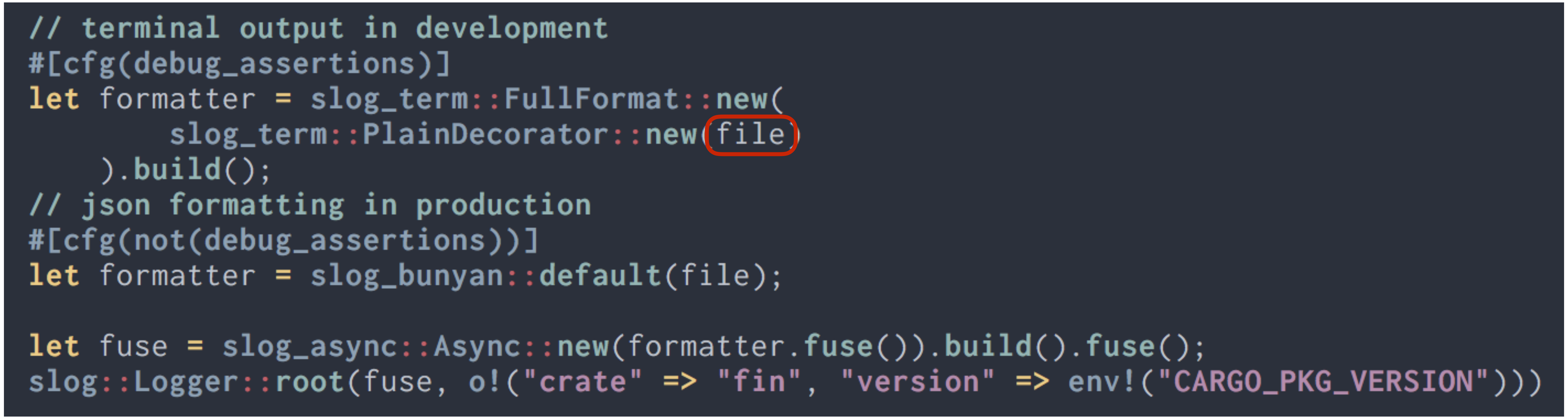
logging(cont..)

slog composable

- composable plugin model `**trait Drain**`

json vs plain   async vs sync   **file vs network**



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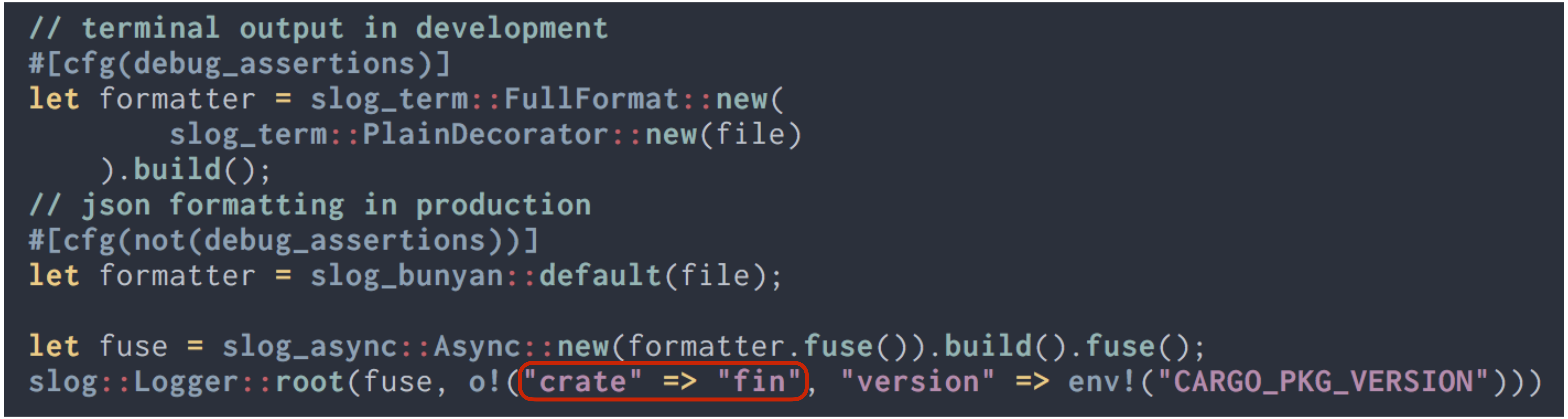
```

logging(cont..)

slog structured

- log data should be **machine searchable vs writing complex regex**
  - think key-value pairs
  - ex: filter logs by 'error codes', 'app version', 'req id'



```
// terminal output in development
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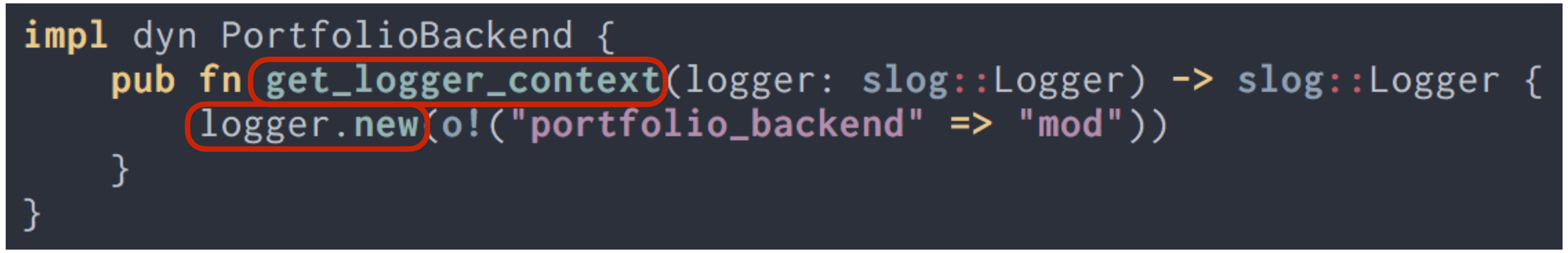
let formatter = slog_term::FullFormat::new(
        slog_term::PlainDecorator::new(file)
    ).build();
// json formatting in production
#[cfg(not(debug_assertions))]
let formatter = slog_bunyan::default(file);

let fuse = slog_async::Async::new(formatter.fuse()).build().fuse();
slog::Logger::root(fuse, o!("crate" => "fin", "version" => env!("CARGO_PKG_VERSION")))
```

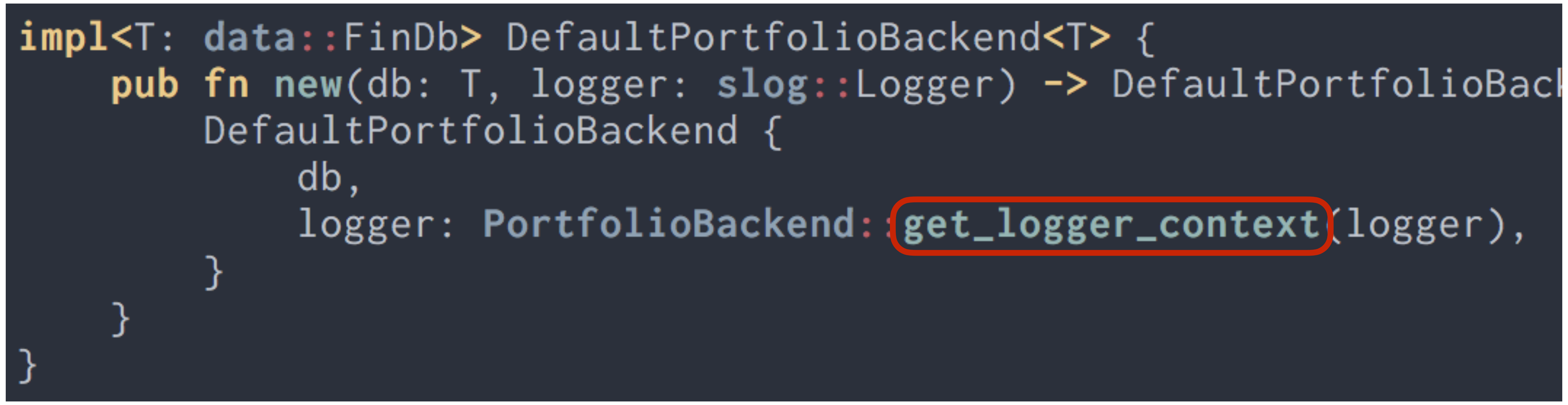
logging(cont..)

slog contextual

- give context around error
- trace code path
- Logger is cheap to clone



```
impl dyn PortfolioBackend {
    pub fn get_logger_context(logger: slog::Logger) -> slog::Logger {
        logger.new(o!("portfolio_backend" => "mod"))
    }
}
```

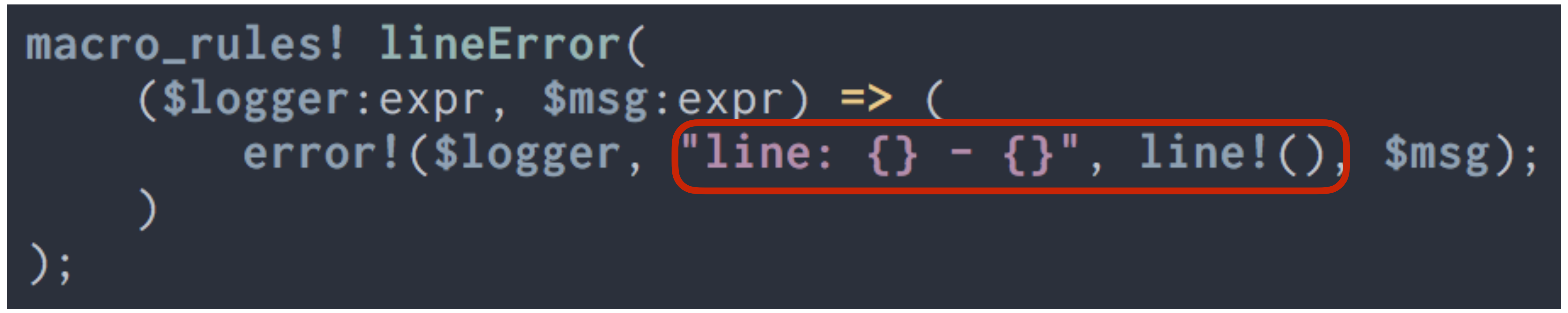


```
impl<T: data::FinDb> DefaultPortfolioBackend<T> {
    pub fn new(db: T, logger: slog::Logger) -> DefaultPortfolioBac
        DefaultPortfolioBackend {
            db,
            logger: PortfolioBackend::get_logger_context(logger),
        }
    }
}
```

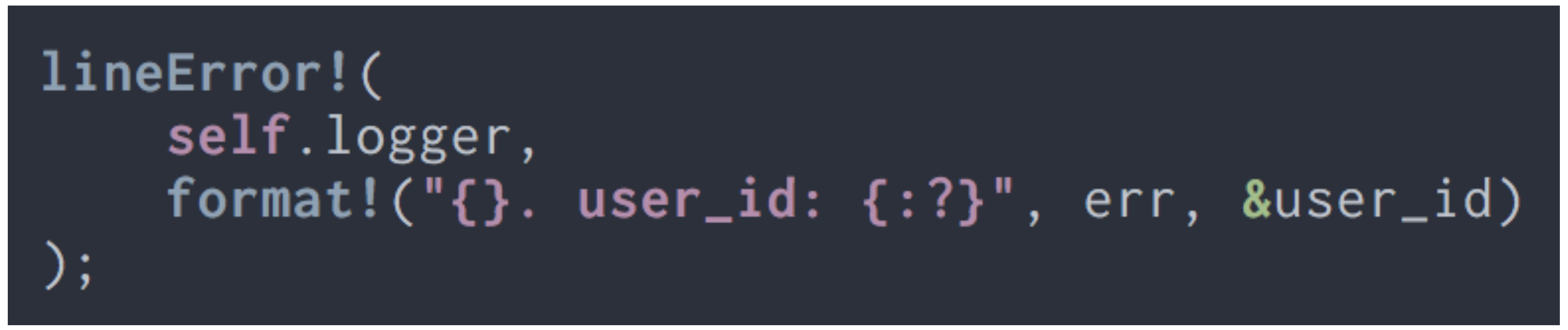
logging(cont..)

line!

- `lineError!` macro to get line info with your logging
    - works because macro expands to rust code at compile time



```
macro_rules! lineError(
    ($logger:expr, $msg:expr) => (
        error!($logger, "line: {} - {}", line!(), $msg);
    )
);
```



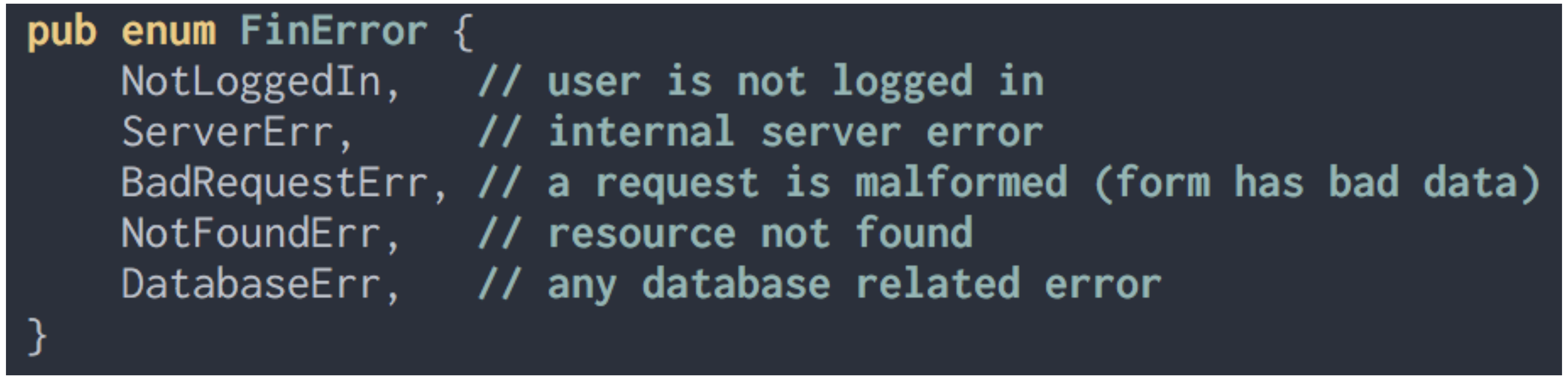
```
lineError!(
    self.logger,
    format!("{}. user_id: {:?}", err, &user_id)
);
```

code hardening

code hardening(cont..)

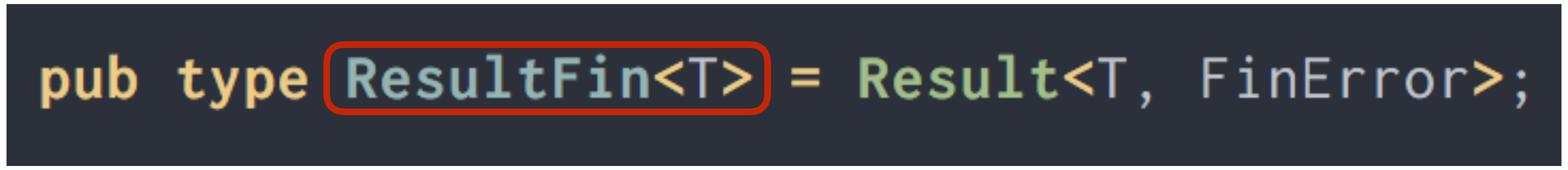
error handling

- declare global **AppError**(FinError) enum



```rust
pub enum FinError {
    NotLoggedIn,   // user is not logged in
    ServerErr,     // internal server error
    BadRequestErr, // a request is malformed (form has bad data)
    NotFoundErr,   // resource not found
    DatabaseErr,   // any database related error
}
```

- declare type alias **AppResult**(ResultFin)



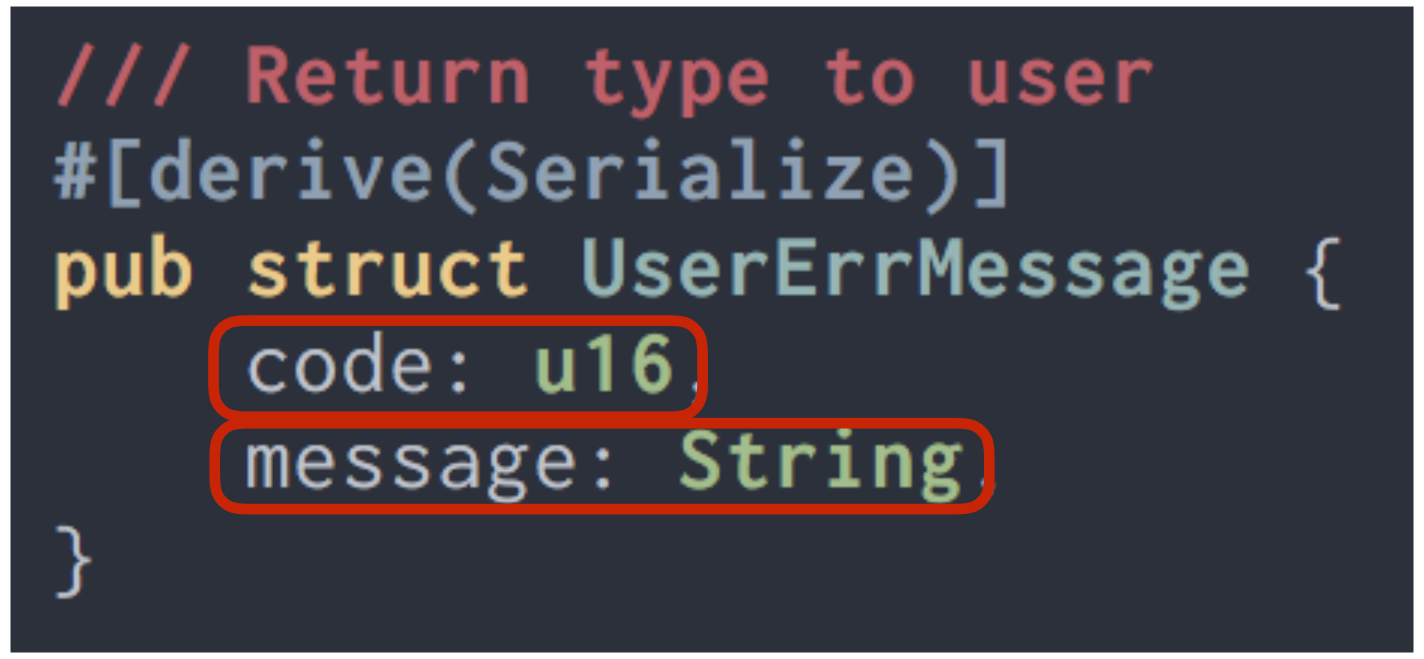
```rust
pub type ResultFin<T> = Result<T, FinError>;
```

- **all functions that return Result should only return AppResult!!**

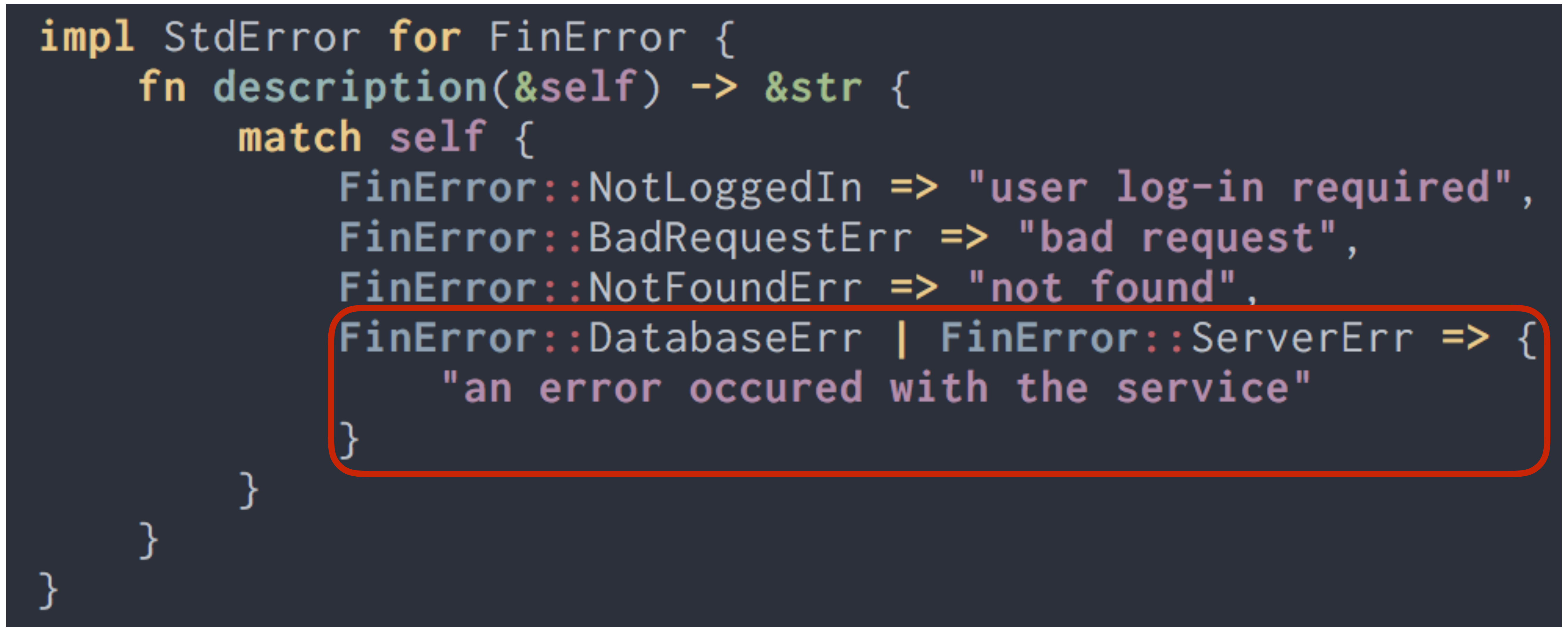
code hardening(cont..)

user error msg

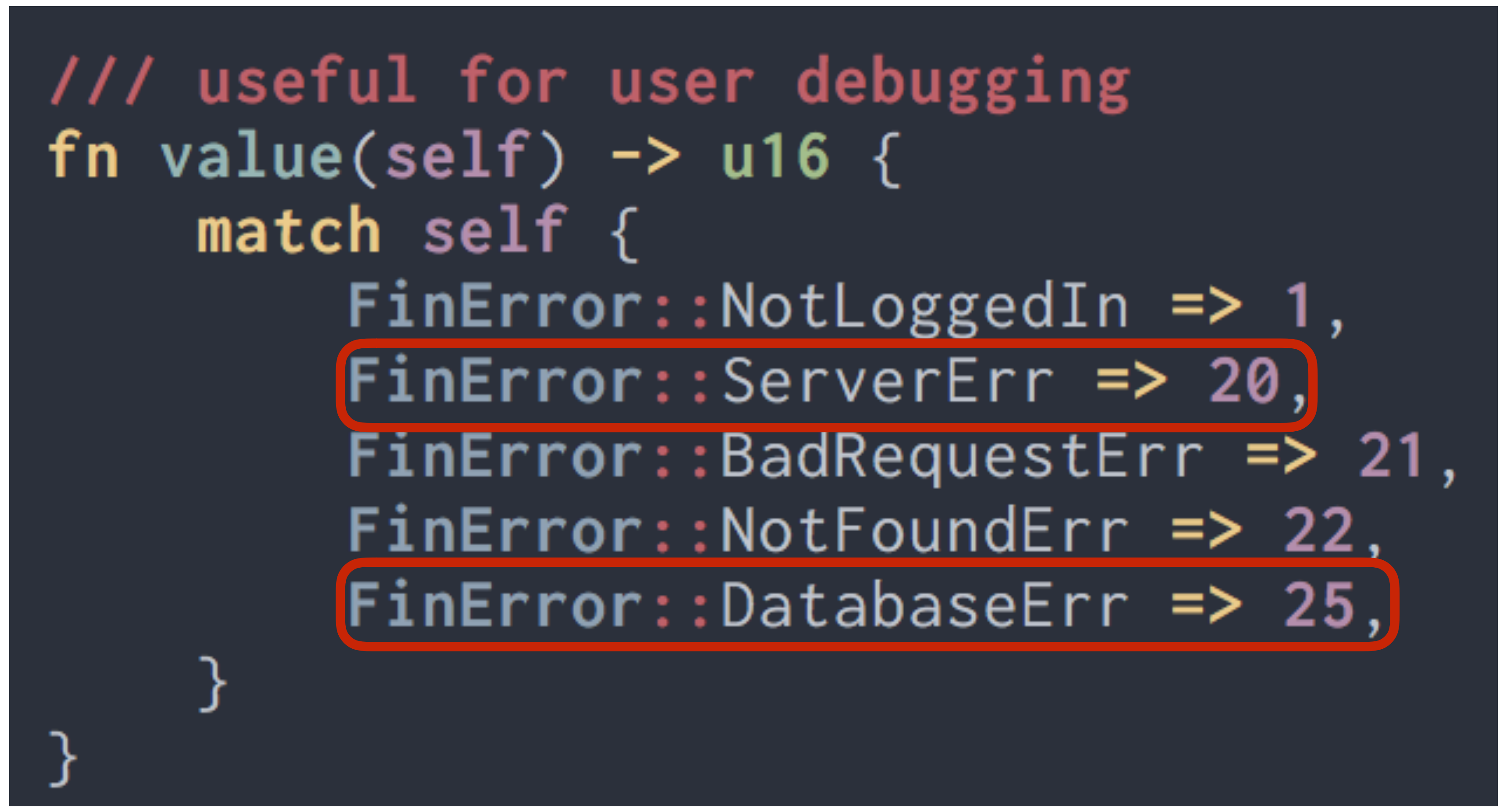
- declare a **user error** struct
  - code = info for developer
  - message = info for user



```rust
/// Return type to user
#[derive(Serialize)]
pub struct UserErrMessage {
    code: u16,
    message: String,
}
```



```rust
impl StdError for FinError {
    fn description(&self) -> &str {
        match self {
            FinError::NotLoggedIn => "user log-in required",
            FinError::BadRequestErr => "bad request",
            FinError::NotFoundErr => "not found",
            FinError::DatabaseErr | FinError::ServerErr => {
                "an error occured with the service"
            }
        }
    }
}
```



```rust
/// useful for user debugging
fn value(self) -> u16 {
    match self {
        FinError::NotLoggedIn => 1,
        FinError::ServerErr => 20,
        FinError::BadRequestErr => 21,
        FinError::NotFoundErr => 22,
        FinError::DatabaseErr => 25,
    }
}
```

Fin

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auth

auth(cont..)

password management

- libpasta <https://libpasta.github.io/>
  - **Easy-to-use** password storage with **strong defaults** (scrypt).
    - *`libpasta::hash_password(&password);`*
    - *`libpasta::verify_password(&user.password_hash, &password)`*
  - **Migration support** for passwords to new algorithms.
    - `new_algo (old_algo ( password ))`

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auth(cont..)

stateless session token

- paseto
  - paseto is JWT but with **sane defaults** and **smaller surface area**
    - you can specify `*version*` and `*purpose*`
    - only allows authenticated tokens

Fin

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