



Opera

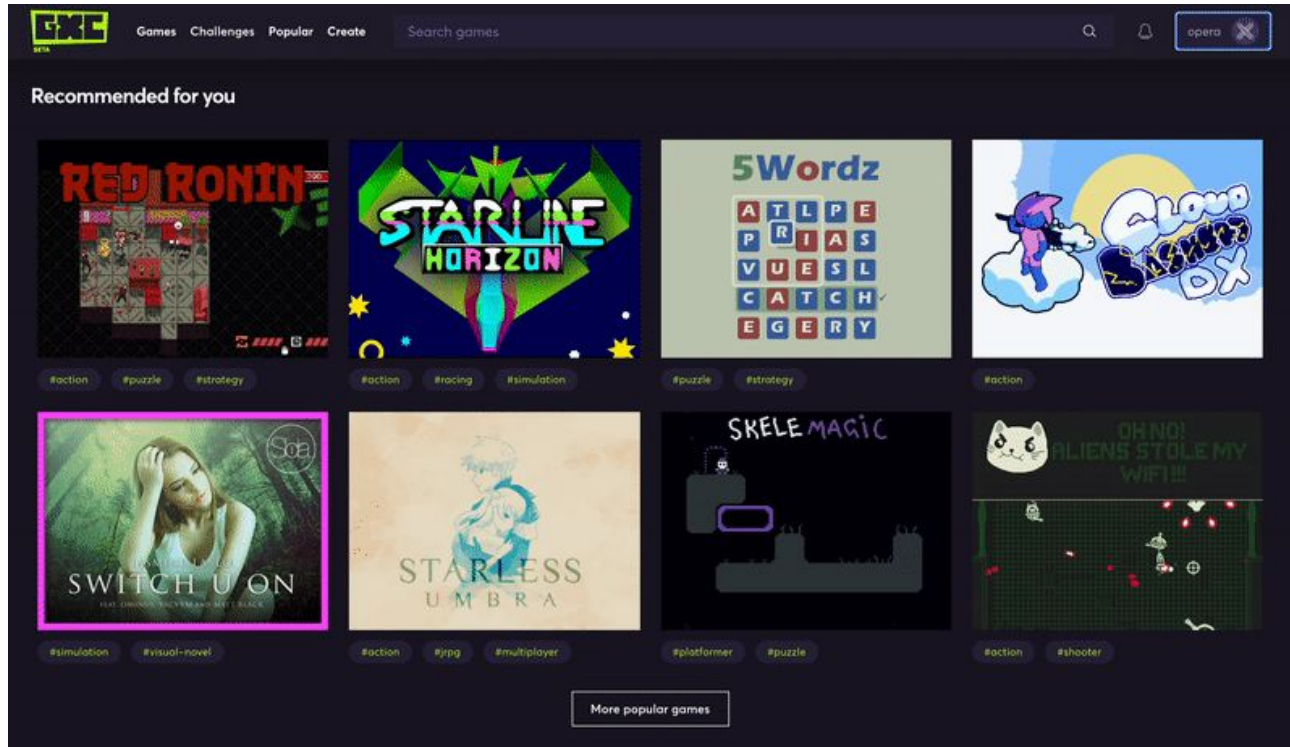
Concurrently writing into a data base without locks

Introduction

Denis Furian, d17



Introduction



Introduction

The screenshot shows the itch.io website interface. At the top, there are navigation links for 'Games', 'Challenges', 'Popular', and 'Create', along with a search bar. Below the navigation, there is a 'Recommended for you' section. The main content area displays a grid of game cards. The first card is 'STARLINE', a puzzle game. The second card is '5Wordz', a word game. The third card is 'Glow DX', a puzzle game. The fourth card is 'SWITCH U ON', a simulation game, which is highlighted with a pink border. The fifth card is 'STARLESS UMBRA', a puzzle game. The sixth card is 'SKELE MAGIC', a puzzle game. The seventh card is 'OH NO ALIENS STOLE MY WIFI!', a shooter game. At the bottom of the grid, there is a button labeled 'More popular games'.

- Share and play games
- Compete in challenges
- Follow favorite game/challenge/studios for updates

Introduction

The screenshot shows a website interface for game discovery. At the top, there are navigation links for 'Games', 'Challenges', 'Popular', and 'Create', along with a search bar. Below this, a 'Recommended for you' section displays several game cards. A red arrow points from the text 'Today's topic' to a specific game card titled 'SWITCH U ON'. The text 'Share and play games', 'Compete in challenges', and 'Follow favorite game/challenge/studios for updates' is overlaid on the top part of the interface.

- Share and play games
- Compete in challenges
- Follow **favorite** game/challenge/studios for updates

Today's topic

More popular games

Technicalities

Front end

~~NEXT~~.JS

Back end



Technicalities

Front end

~~NEXT~~.JS

Back end



Technicalities

Hibernate: maps OO model to a relational database

Technicalities

Hibernate: maps OO model to a relational database

USER_ID	NAME	EMAIL	FAVORITE_ID
1234-abcd-5678-efgh	Emilia Emilsson	emilia@chalmers.se	2132-asdf-5876-qazs
4321-swmm-3569-abdc	Someone Elsson	sum1@gu.se	3456-aeio-2468-lkio
3431-ghyu-5786-aade	Mikael Jacksson	thriller@chalmers.se	7890-gfea-4579-logt

Technicalities

Hibernate: maps OO model to a relational database

USER_ID	NAME	EMAIL	FAVORITE_ID
1234-abcd-5678-efgh	Emilia Emilsson	emilia@chalmers.se	2132-asdf-5876-qazs
4321-swmm-3569-abdc	Someone Elsson	someone1@gu.se	3456-aeio-2468-lkio
3431-ghyu-5786-aade	Mikael Jacksson	mikael@chalmers.se	

User

- String** userId
- String** name
- String** email
- String** favoriteId



Technicalities

Hibernate: maps OO model to a relational database

USER_ID	NAME	EMAIL	FAVORITE_ID
1234-abcd-5678-efgh	Emilia Emilsson	emilia@chalmers.se	2132-asdf-5876-qazs
4321-swmm-3569-abdc	Someone Elsson	sum1@gu.se	3456-aeio-2468-lkio
3431-ghyu-5786-aade	Mikael Jacksson	thriller@chalmers.se	7890-gfea-4579-logt


Technicalities

Hibernate: maps OO model to a relational database

USER_ID	NAME	EMAIL	FAVORITE_ID
1234-abcd-5678-efgh	Emilia Emilsson	emilia@chalmers.se	2132-asdf-5876-qazs
4321-swmm-3569-abdc	Someone Elsson	sum1@gu.se	3456-aeio-2468-lkio
3431-ghyu-5786-aade	Mikael Jacksson	thriller@chalm	

User

```
userId = "1234-abcd-5678-efgh"  
name = "Emilia Emilsson"  
email = "emilia@chalmers.se"  
favoriteId = "2132-asdf-5876-qazs"
```



Technicalities

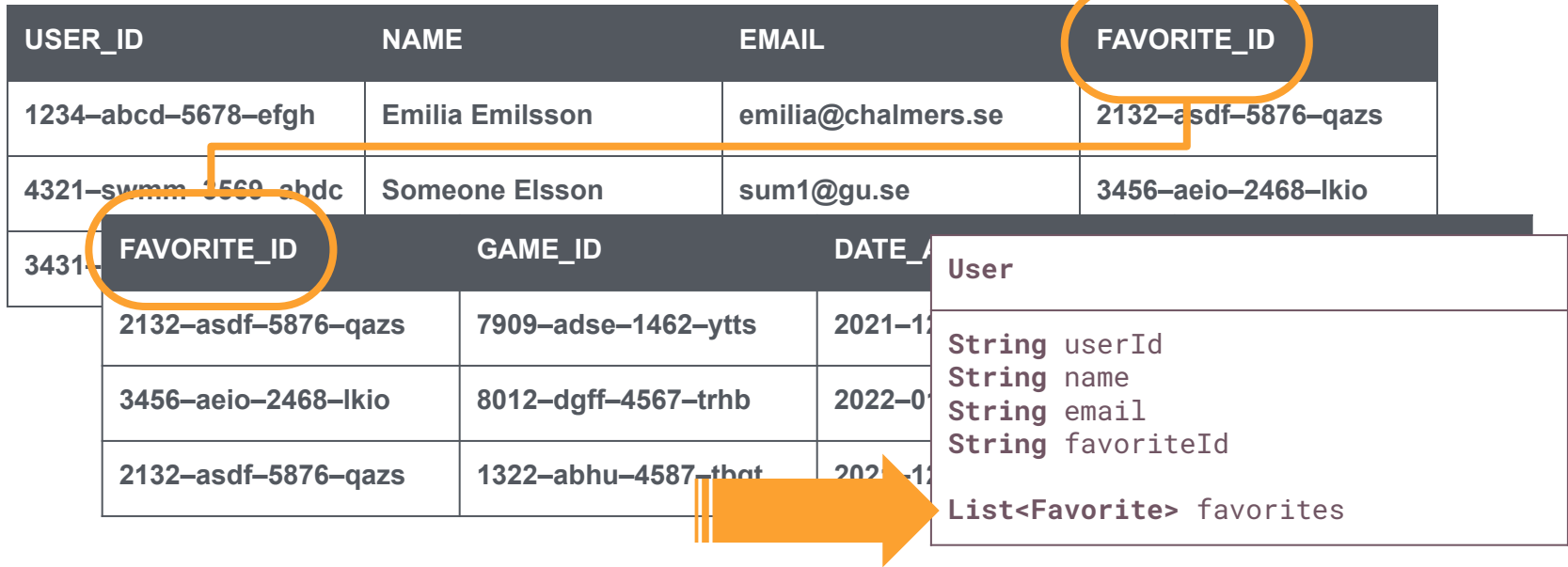
Hibernate: maps OO model to a relational database

USER_ID	NAME	EMAIL	FAVORITE_ID
1234-abcd-5678-efgh	Emilia Emilsson	emilia@chalmers.se	2132-asdf-5876-qazs
4321-summ-1569-abdc	Someone Elsson	sum1@gu.se	3456-aeio-2468-lkio

FAVORITE_ID	GAME_ID	DATE_ADDED	DISPLAY_ORDER
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
3456-aeio-2468-lkio	8012-dgff-4567-trhb	2022-01-03	0
2132-asdf-5876-qazs	1322-abhu-4587-tbgt	2021-12-13	1

Technicalities

Hibernate: maps OO model to a relational database



Technicalities

Hibernate: maps OO model to a relational database

USER_ID	NAME	EMAIL	FAVORITE_ID
1234-abcd-5678-efgh	Emilia Emilsson	emilia@chalmers.se	2132-asdf-5876-qazs
4321-swmm-3569-abdc	Someone Elsson	sum1@gu.se	3456-aeio-2468-lkio

FAVORITE_ID	GAME_ID	DATE_ADDED	DISPLAY_ORDER
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
3456-aeio-2468-lkio	8012-dgff-4567-trhb	2022-01-03	0
2132-asdf-5876-qazs	1322-abhu-4587-tbgt	2021-12-13	1

Technicalities

Hibernate: maps OO model to a relational database

USER_ID	NAME	EMAIL	FAVORITE_ID
1234-abcd-5678-efgh	Emilia Emilsson	emilia@chalmers.se	2132-asdf-5876-qazs
4321-swmm-3569-abdc	Someone Elsson	sum1@gu.se	3456-aeio-2468-lkio

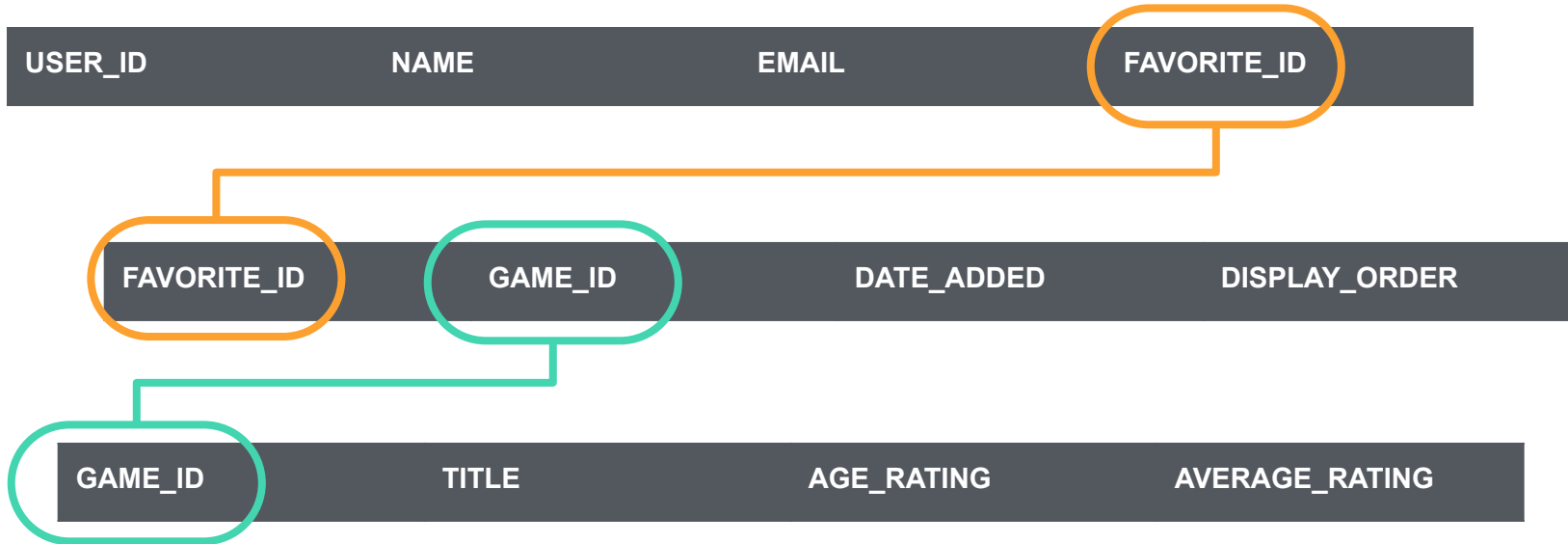
FAVORITE_ID	GAME_ID	DATE_...
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12
3456-aeio-2468-lkio	8012-dgff-4567-trhb	2022-01
2132-asdf-5876-qazs	1322-abhu-4587-tbgt	2021-12

User

```
userId = "1234-abcd-5678-efgh"  
name = "Emilia Emilsson"  
email = "emilia@chalmers.se"  
favoriteId = "2132-asdf-5876-qazs"  
favorites = [...]
```

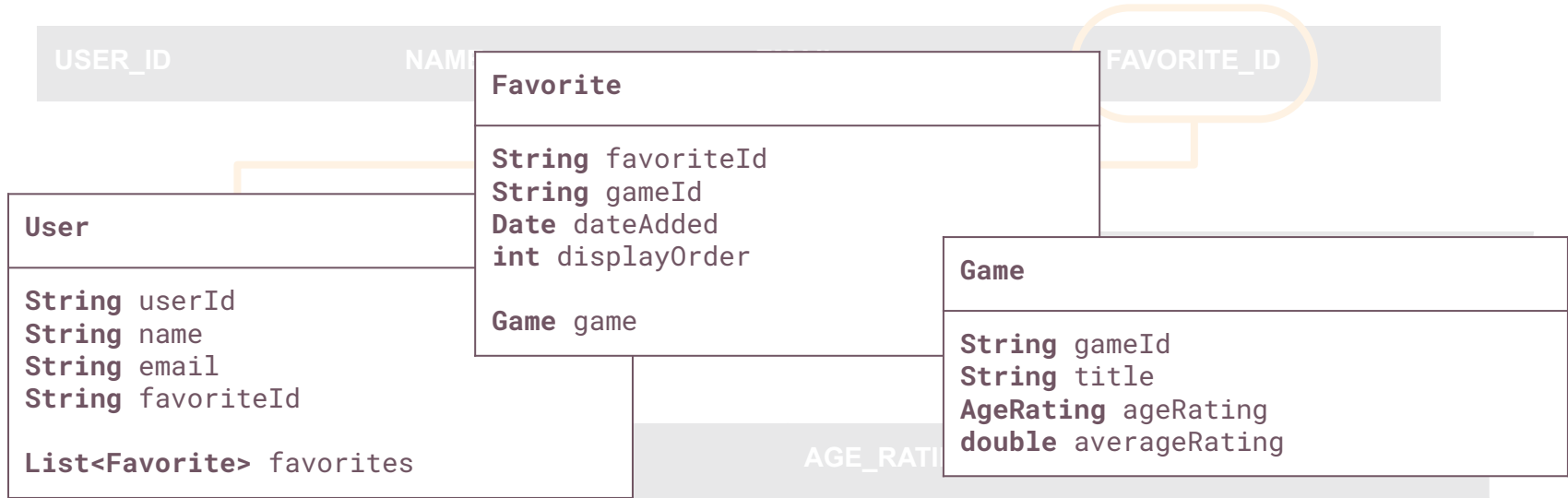
Technicalities

Hibernate: maps OO model to a relational database



Technicalities

Hibernate: maps OO model to a relational database



Technicalities

Hibernate: maps OO model to a relational database

FavoriteRepository

```
Page<Favorite> findByFavoriteId(String favoriteId, Pageable pageable)
List<Favorite> findByGameOrderByDisplayOrderAsc(Game game)
Optional<Favorite> findByFavoriteIdAndGame(String favoriteId, Game game)
long countByGame(Game game)
boolean existsByDateAddedNull()
Favorite save(Favorite favorite)
...
```

```
String email
String favoritesId

List<Favorite> favorites
```

Favorite

```
String favoriteId
String gameId
Date dateAdded
int displayOrder

Game game
```

Technicalities

Hibernate: maps OO model to a relational database

FavoriteRepository

```
Page<Favorite> findByFavoriteId(String favoriteId, Pageable pageable)
List<Favorite> findByGameOrderByDisplayOrderAsc(Game game)
Optional<Favorite> findByFavoriteIdAndGame(String favoriteId, Game game)
```

```
SELECT *
FROM favorites
WHERE game_id = :value
ORDER BY display_order ASC
```

```
String title
AgeRating ageRating
double averageRating
```

Technicalities

Hibernate: maps OO model to a relational database

FavoriteRepository

```
Page<Favorite> findByFavoriteId(String favoriteId, Pageable pageable)
List<Favorite> findByGameOrderByDisplayOrderAsc(Game game)
Optional<Favorite> findByFavoriteIdAndGame(String favoriteId, Game game)
long countByGame(Game game)
```

```
SELECT *
FROM favorites
WHERE game_id = :value
ORDER BY display_order ASC
```

Favorite

```
favoriteId = "1156-rtcf-6745-aski"
gameId = "9851-plgt-4673-frnh"
dateAdded = 2022-02-16
displayOrder = 3
game = {...}
```

Technicalities

Hibernate: maps OO model to a relational database

FavoriteRepository

```
Page<Favorite> findByFavoriteId(String favoriteId, Pageable pageable)
List<Favorite> findByGameOrderByDisplayOrderAsc(Game game)
Optional<Favorite> findByFavoriteIdAndGame(String favoriteId, Game game)
long countByGame(Game game)
boolean existsByDateAddedNull()
Favorite save(Favorite favorite)
...
```

```
SELECT *
FROM favorites
WHERE favorite_id = :value1
AND game_id = :value2
```

```
String title
AgeRating ageRating
double averageRating
```


Technicalities

Hibernate: maps OO model to a relational database

FavoriteRepository

```
Page<Favorite> findByFavoriteId(String favoriteId, Pageable pageable)
List<Favorite> findByGameOrderByDisplayOrderAsc(Game game)
Optional<Favorite> findByFavoriteIdAndGame(String favoriteId, Game game)
long countByGame(Game game)
boolean existsByDateAddedNull()
Favorite save(Favorite favorite)
...
```

```
SELECT *
FROM favorites
WHERE favorite_id = :value1
AND game_id = :value2
```

Favorite

```
String favoriteId
String gameId
Date dateAdded
int displayOrder
```

Game game

(nothing)

Technicalities

Spring: framework that handles transactions, object instantiations, ...

Technicalities

Spring: framework that handles transactions, object instantiations, ...

```
FavoritesService
```

```
FavoriteRepository favoriteRepository
```

```
Page<Favorite> getFavorites(User user, Pageable pageable)
```

```
Favorite addFavorite(User user, Game game)
```

```
void deleteFavorite(Favorite favorite)
```

```
...
```

Technicalities

Spring: framework that handles transactions, object instantiations, ...

```
FavoritesService
FavoriteRepository favoriteRepository ← Autowired
Page<Favorite> getFavorites(User user, Pageable pageable)
Favorite addFavorite(User user, Game game)
void deleteFavorite(Favorite favorite)
...
```

Technicalities

Spring: framework that handles transactions, object instantiations, ...

```
FavoritesService
FavoriteRepository favoriteRepository ← Autowired
Favorite addFavorite(User user, Game game) {
    Favorite newFavorite = new Favorite();
    ...
    favoriteRepository.save(newFavorite);
    ...
    return newFavorite;
}
...
```

Technicalities

Spring: framework that handles transactions, object instantiations, ...

```
GamesService
FavoriteRepository favoriteRepository ← Autowired
GameDetails getGameDetails(User user, Game game) {
    GameDetails details = new Details();
    details.setTitle(game.getTitle());
    ...
    Optional<Favorite> maybeFavoriteId =
        favoriteRepository.findByFavoriteIdAndGame(
            user.getFavoriteId(), game);
    if (maybeFavoriteId.isPresent()) {
        details.setFavoriteId(maybeFavoriteId.get());
    }
    ...
    return details;
}
...
```

Technicalities

Spring: framework that handles transactions, object instantiations, ...

```
GamesController
GamesService gamesService ← Autowired
Page<Game> getGames(Pageable pageable)
GameDetails getGameDetails(User user, Game game)
void playGame(Optional<User> maybeUser, Game game)
void rateGame(User user, Game game)
...
```

Technicalities

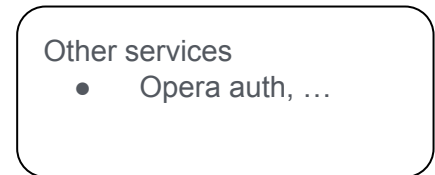
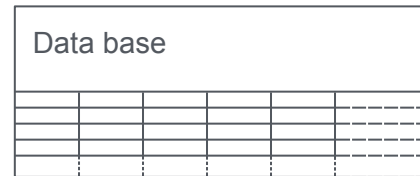
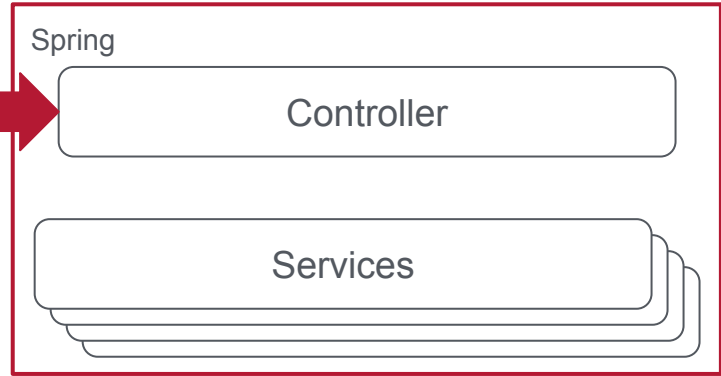
Putting everything together...

Technicalities

Front end

~~NEXT~~.JS

Back end

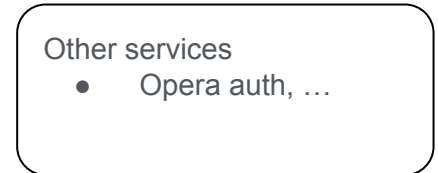
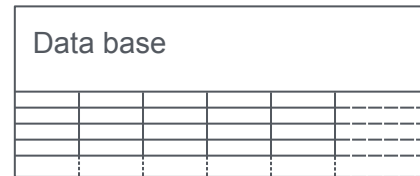
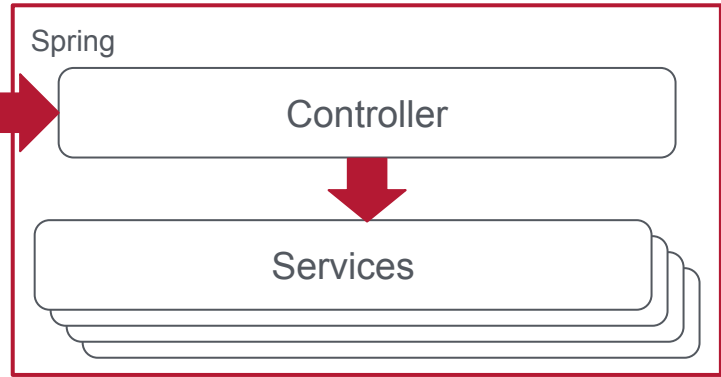


Technicalities

Front end

~~NEXT~~.JS

Back end

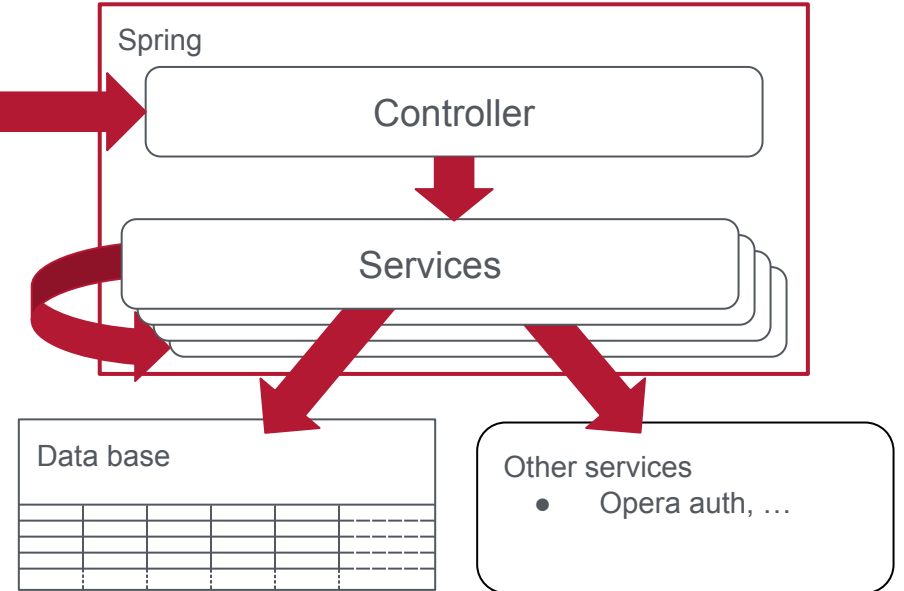


Technicalities

Front end

~~NEXT~~.JS

Back end

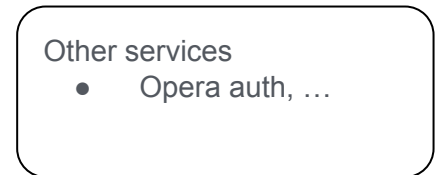
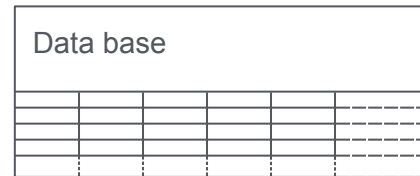
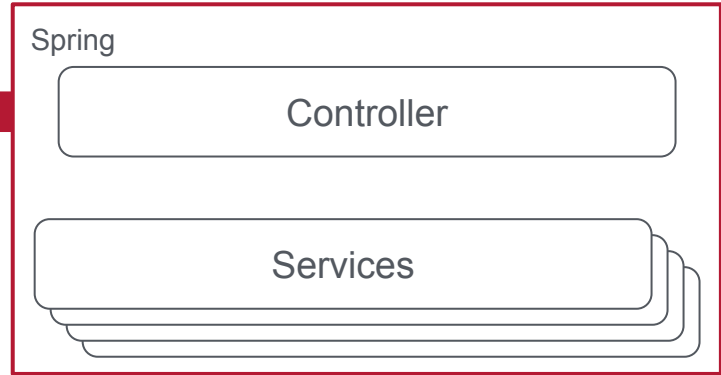


Technicalities

Front end

~~NEXT~~.JS

Back end

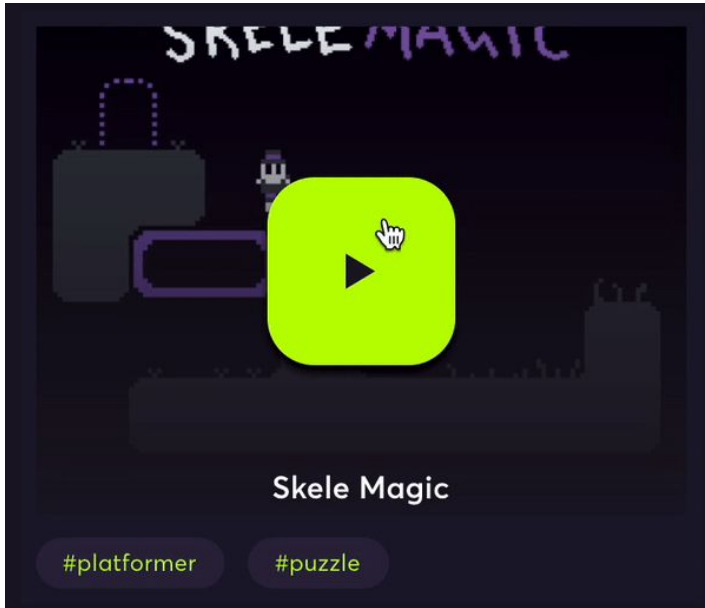


Technicalities

Example time!

Technicalities

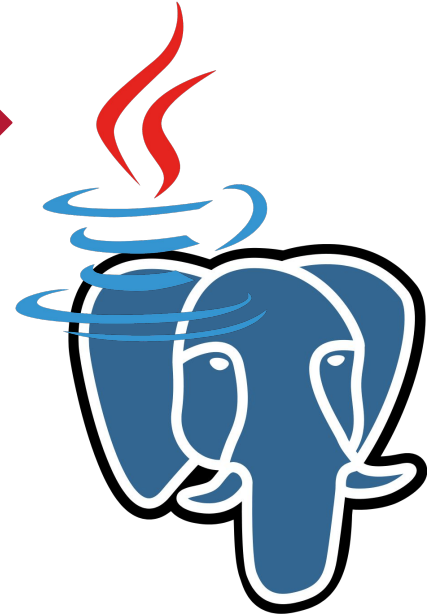
Front end



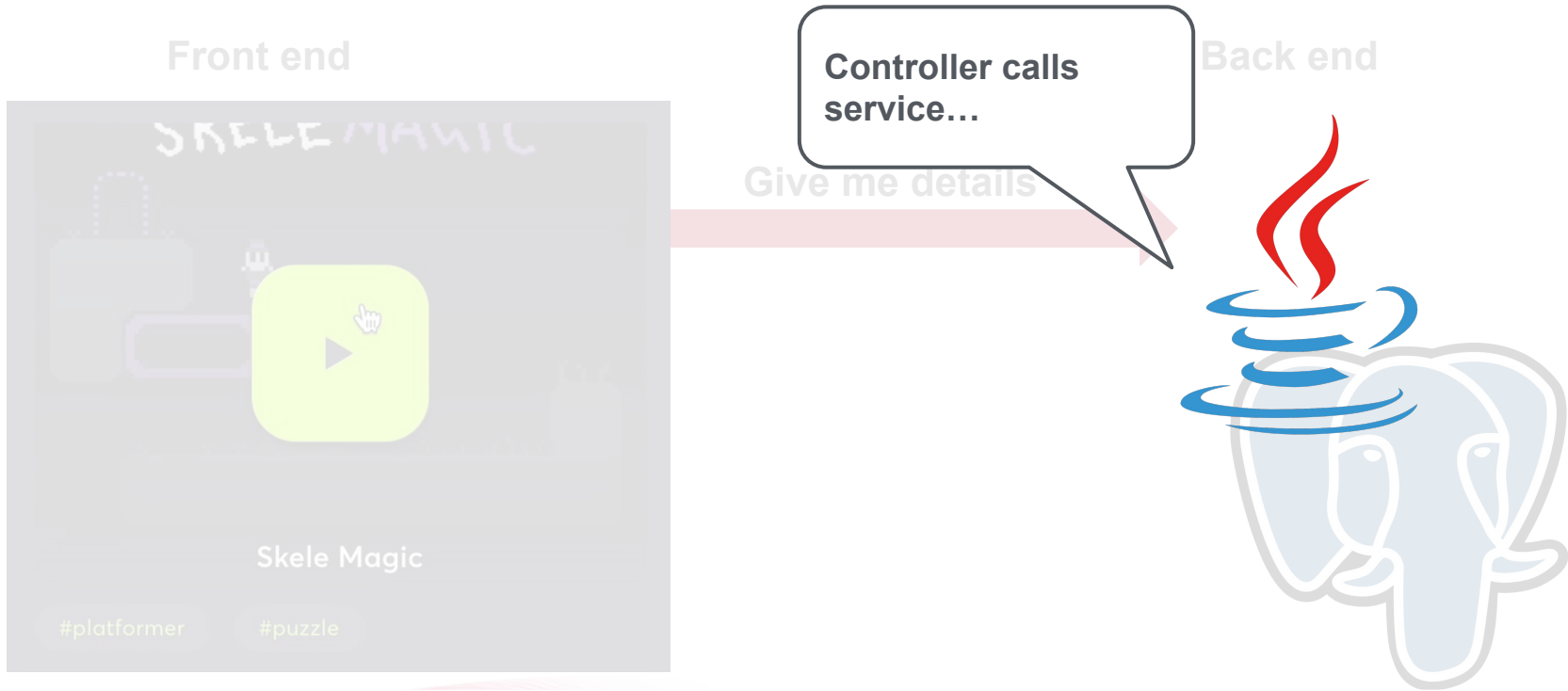
Give me details



Back end



Technicalities



Technicalities

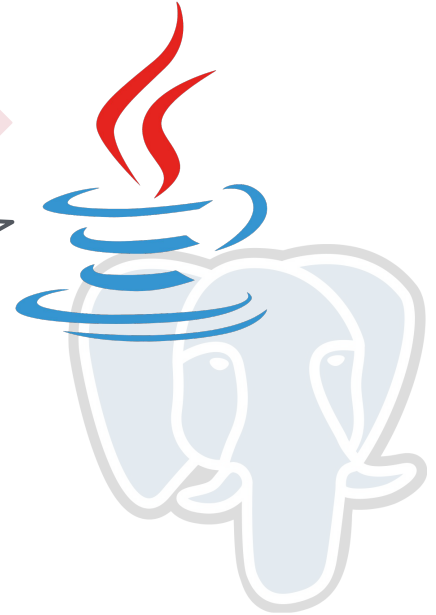
Front end



Give me details

Service calls game repository...

Back end



Technicalities

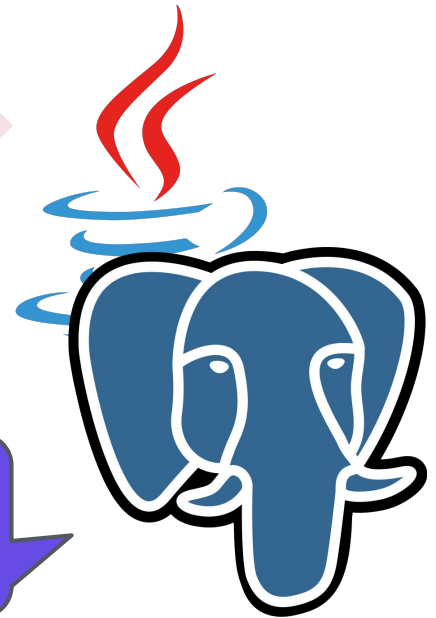
Front end



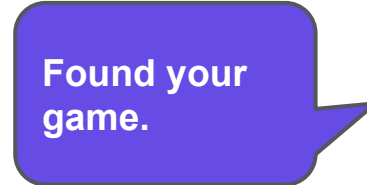
Give me details



Back end

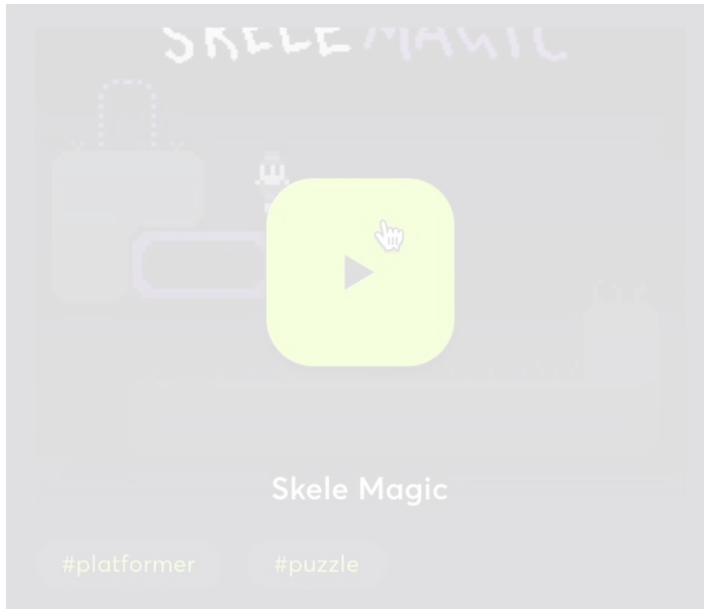


Found your game.



Technicalities

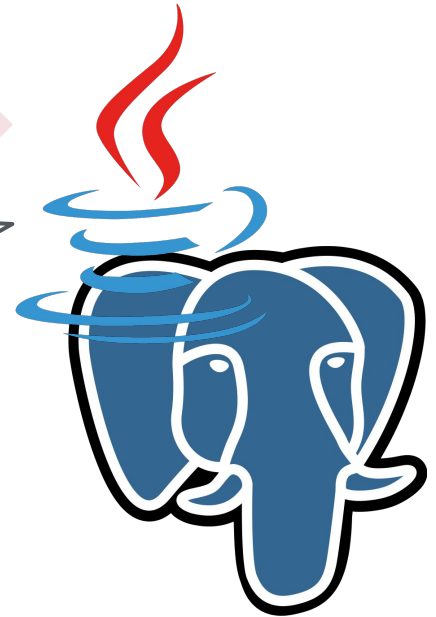
Front end



Give me details

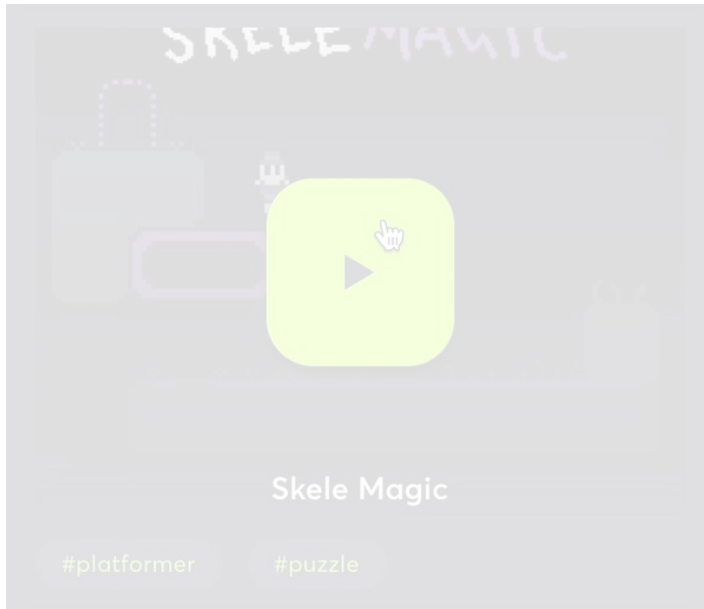
Need to know if
game is a favorite.

Back end



Technicalities

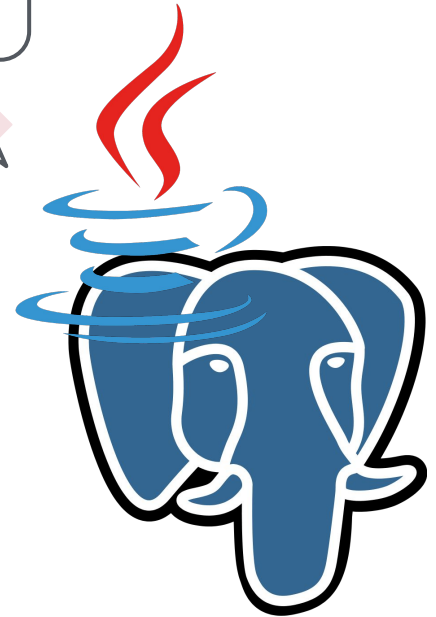
Front end



Service now queries
the favorites
repository...

Give me details

Back end



Technicalities

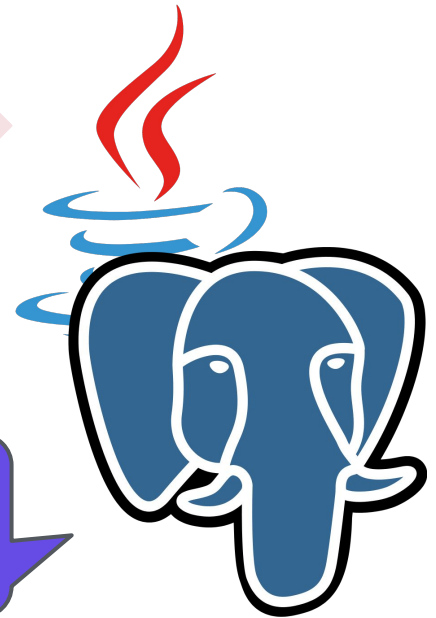
Front end



Give me details



Back end



Not found for this user.

Technicalities

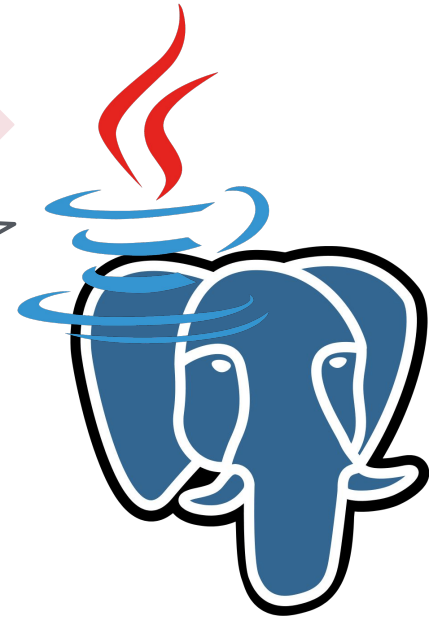
Front end



Give me details

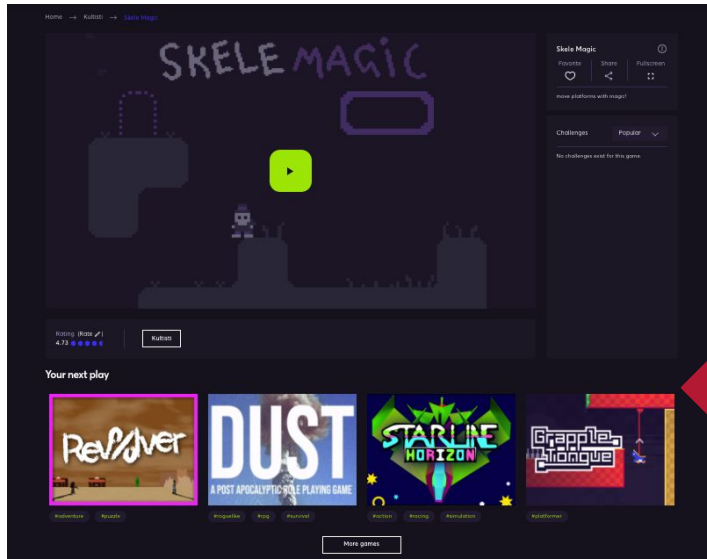
Then it's not a favorite!

Back end

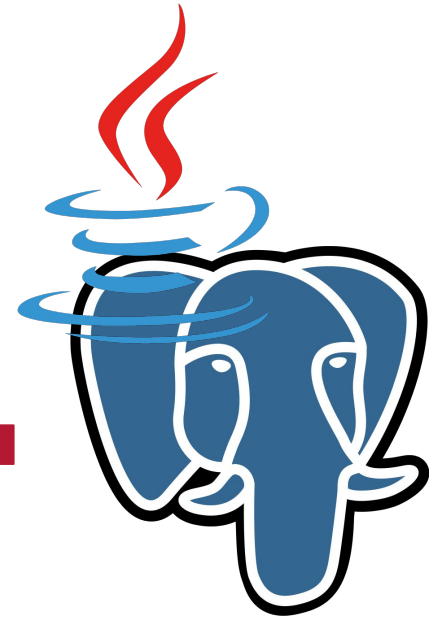


Technicalities

Front end



Back end

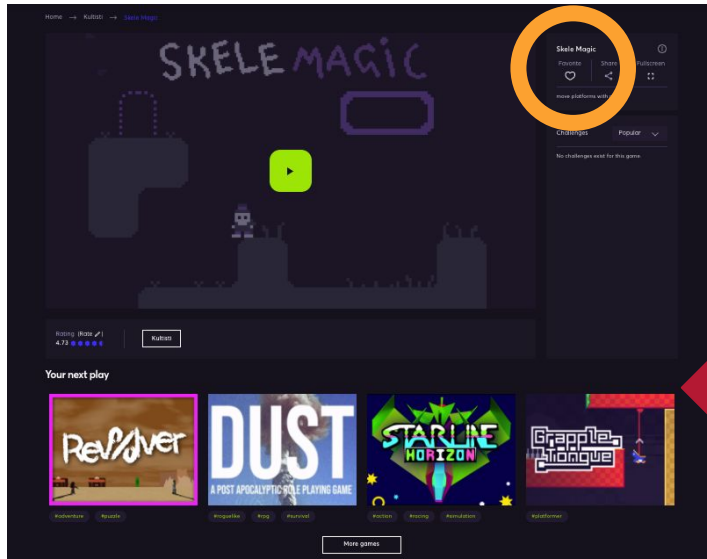


There you go!

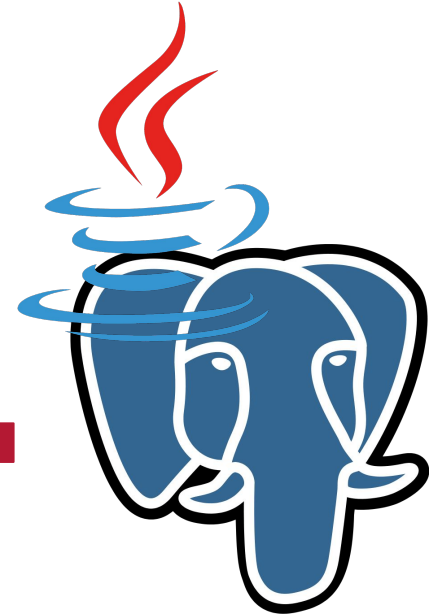


Technicalities

Front end



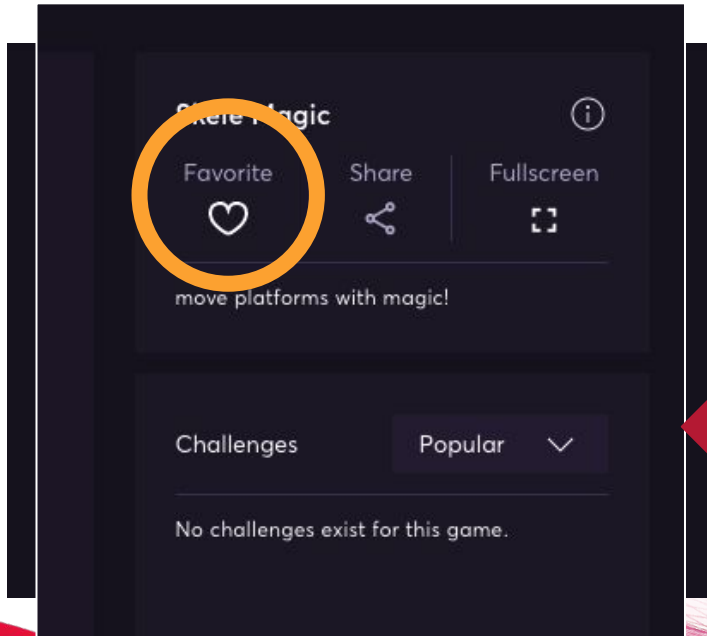
Back end



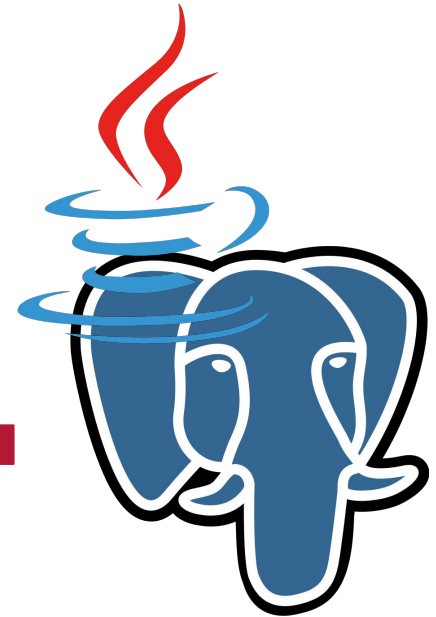
There you go!

Technicalities

Front end



Back end

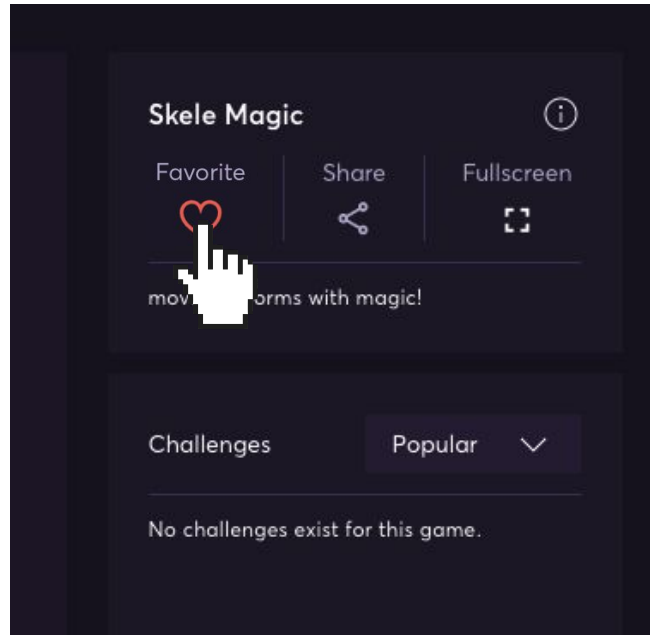


There you go!



Technicalities

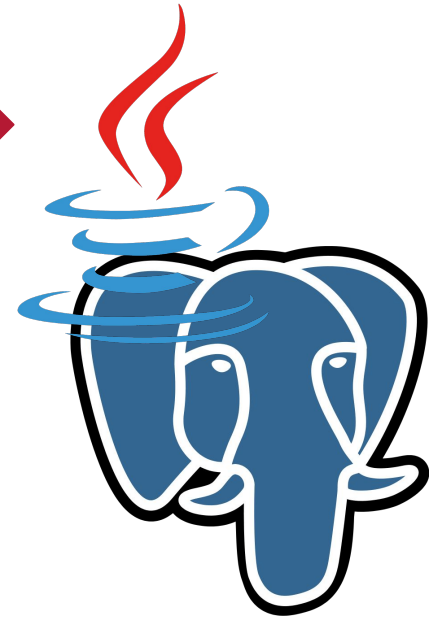
Front end



Add to favorites.

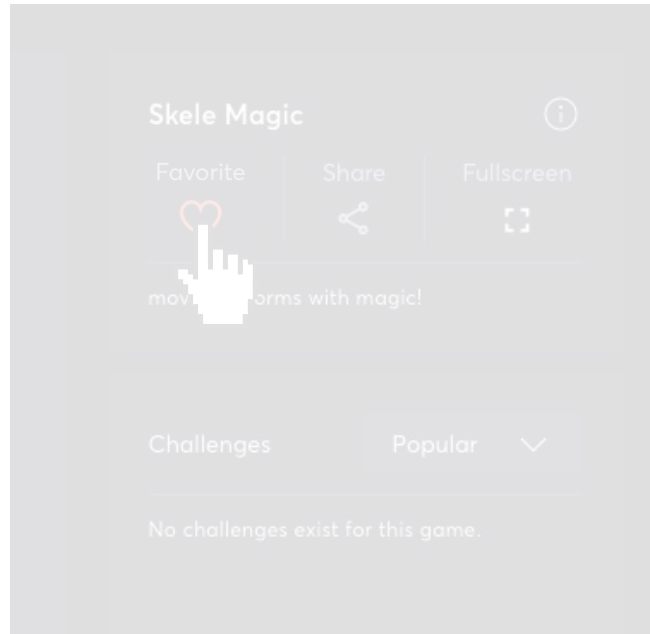


Back end



Technicalities

Front end



Add to favorites.

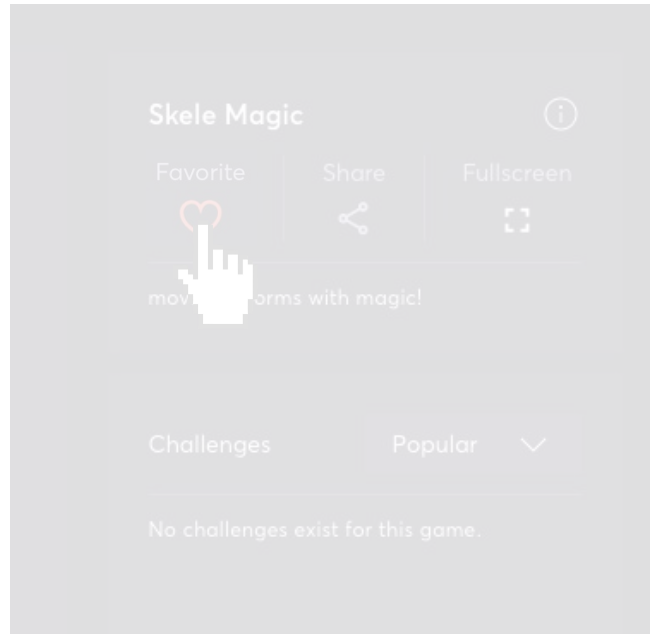
Controller calls service...

Back end



Technicalities

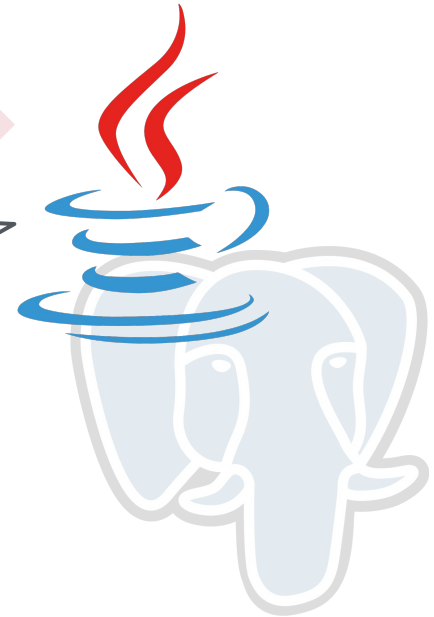
Front end



Add to favorites.

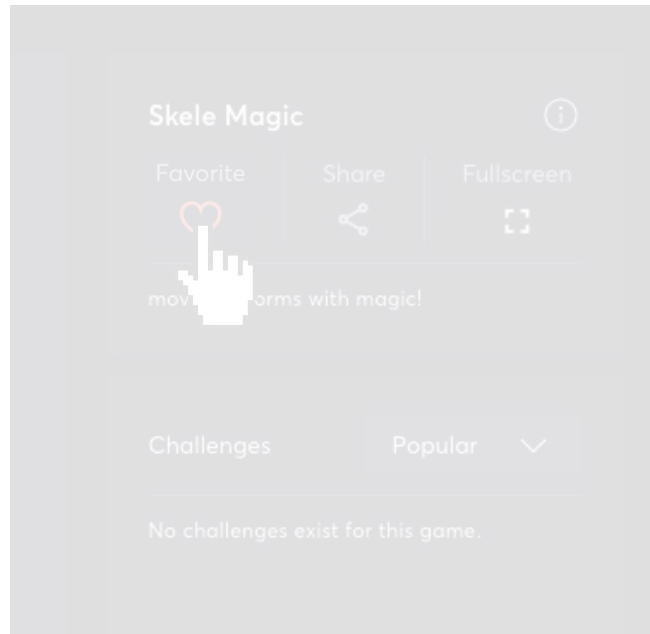
Service updates the user's favorites...

Back end



Technicalities

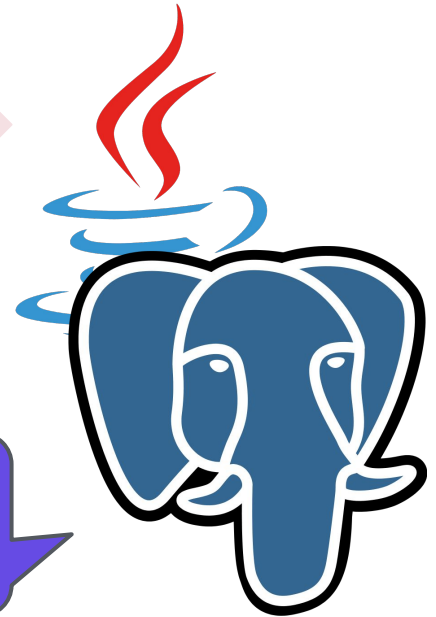
Front end



Add to favorites.



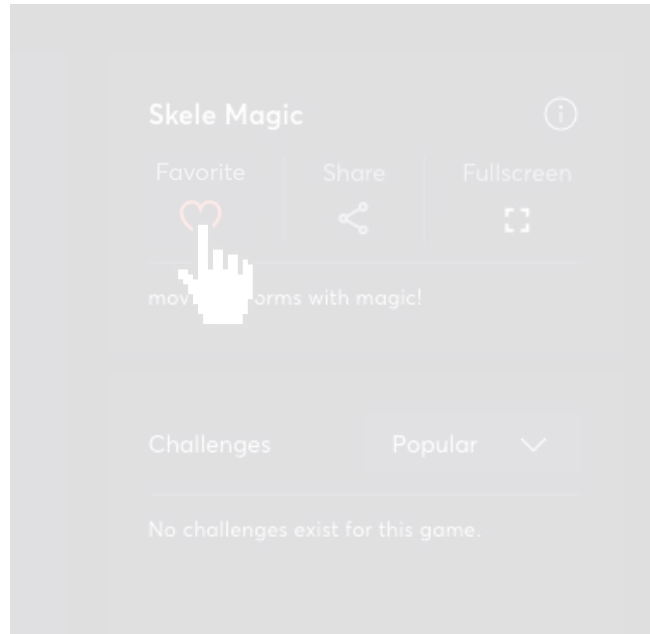
Back end



Everything saved!

Technicalities

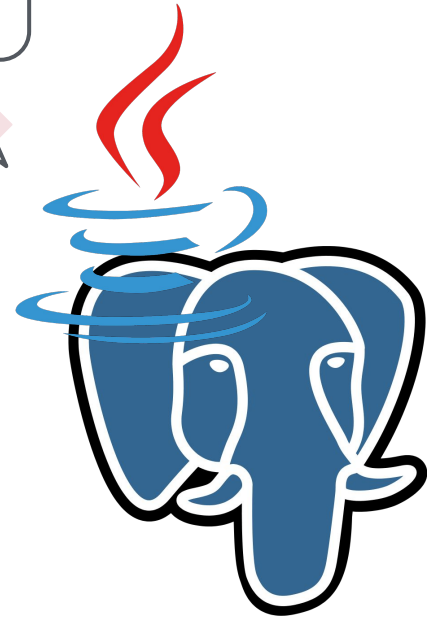
Front end



Add to favorites.

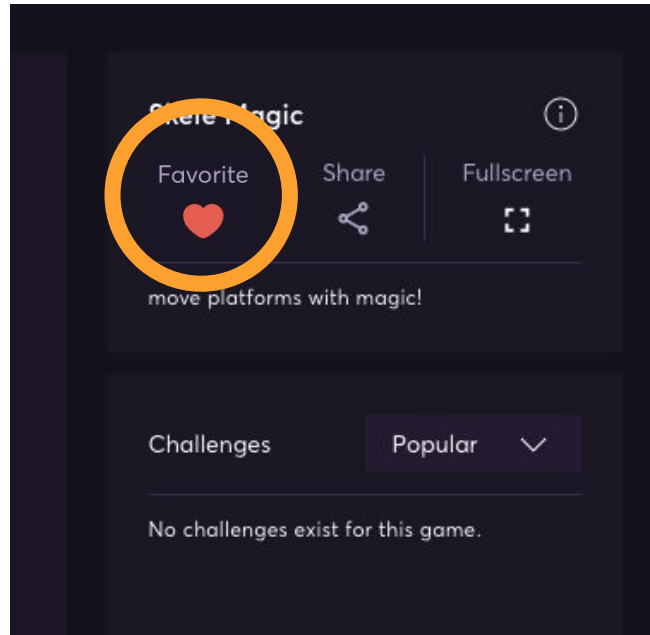
Added to favorites!

Back end

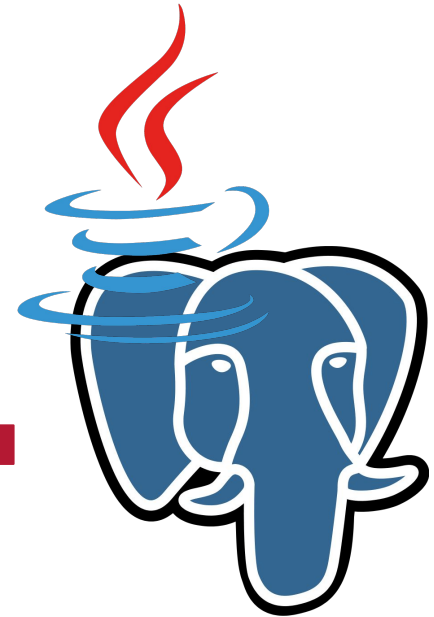


Technicalities

Front end



Back end



Done.



The problem

Front end

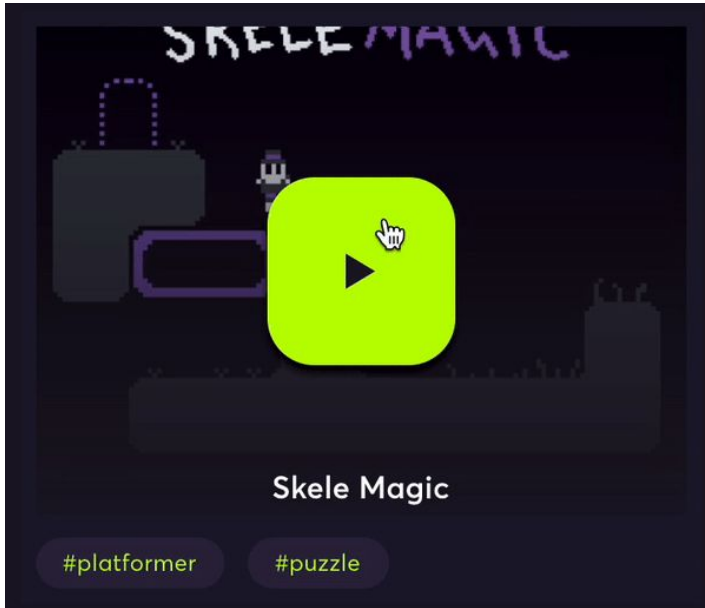
~~NEXT~~.JS

Back end



The problem

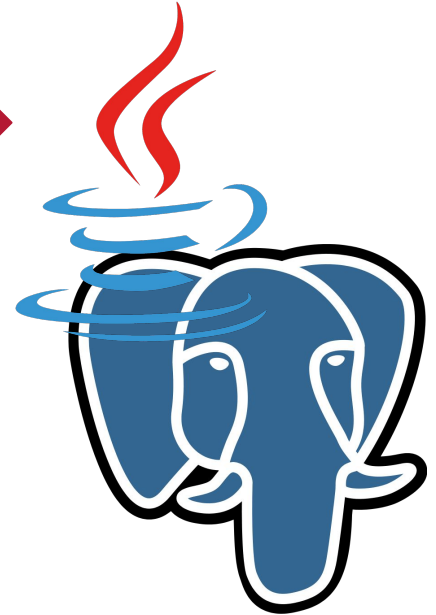
Front end



Give me details

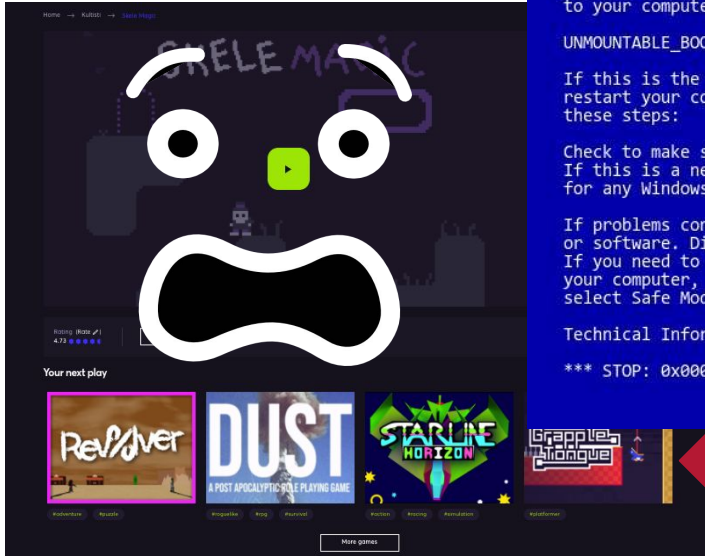


Back end



The problem

Front end



A problem has been detected and Windows has been shut down to prevent damage to your computer.

`UNMOUNTABLE_BOOT_VOLUME`

If this is the first time you've seen this error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any Windows updates you might need.

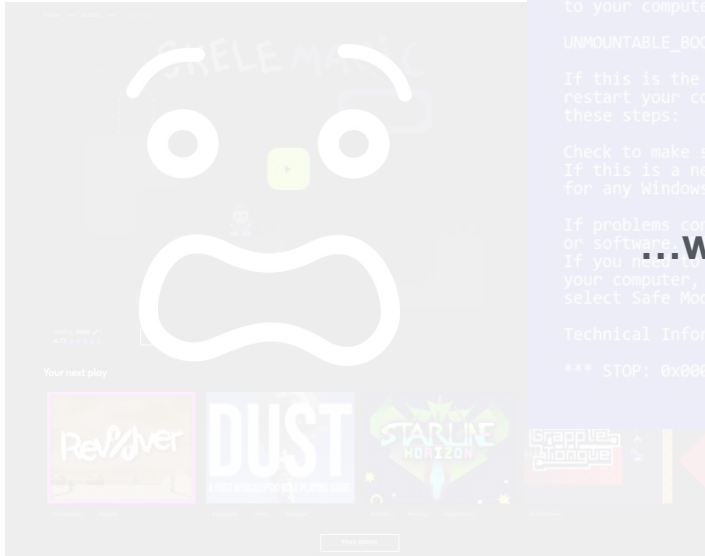
If problems continue, disable or remove any newly installed hardware or software. Disable BIOS memory options such as caching or shadowing. If you need to use Safe Mode to remove or disable components, restart your computer, press F8 to select Advanced Startup Options, and then select Safe Mode.

Technical Information:

`*** STOP: 0x000000ED (0x80F128D0, 0xc000009c, 0x00000000, 0x00000000)`

The problem

Front end



A problem has been detected and Windows has been shut down to prevent damage to your computer.

UNMOUNTABLE_BOOT_VOLUME

If this is the first time you've seen this error screen, restart your computer. If this screen appears again, follow these steps:

Check to make sure any new hardware or software is properly installed. If this is a new installation, ask your hardware or software manufacturer for any Windows updates you might need.

If problems continue, disable or remove any newly installed hardware or software. Disable any caching or shadowing. If you need to enable any of the disabled components, restart your computer, press F8 to select Advanced Startup Options, and then select Safe Mode.

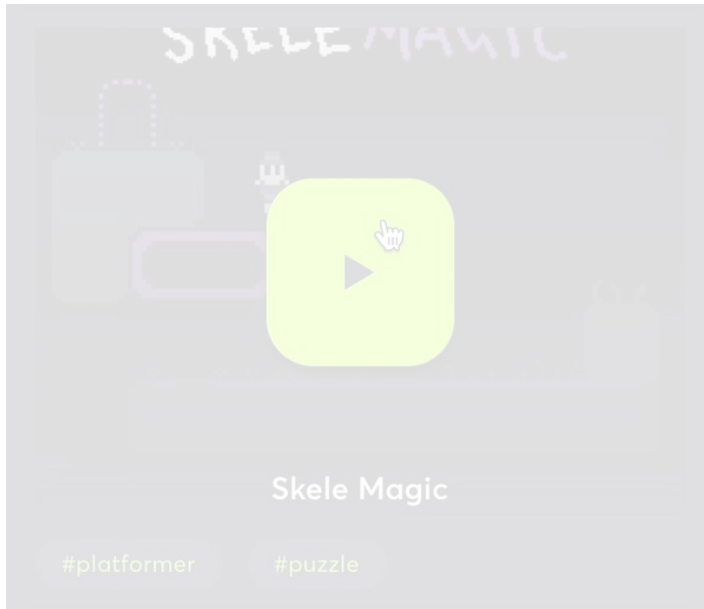
Technical Information:

*** STOP: 0x000000ED (0x80F128D8, 0xc000009c, 0x00000000, 0x00000000)

...what happened?

The problem

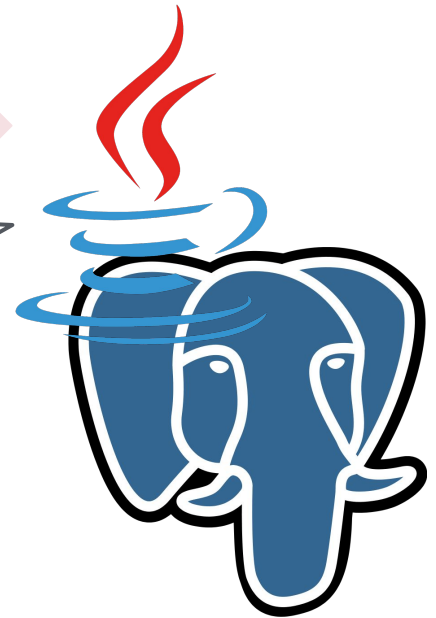
Front end



Give me details

Need to know if
game is a favorite.

Back end



The problem



The problem

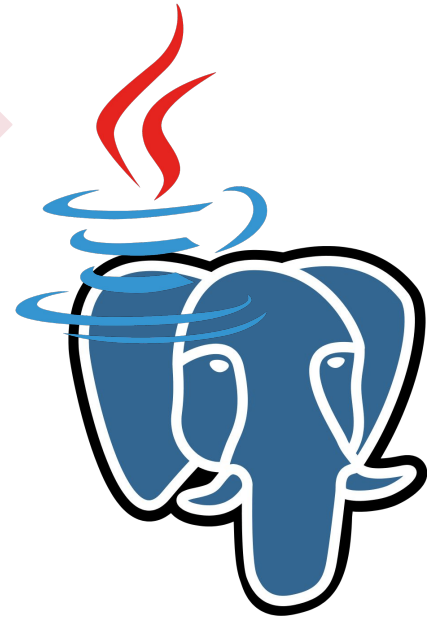
Front end



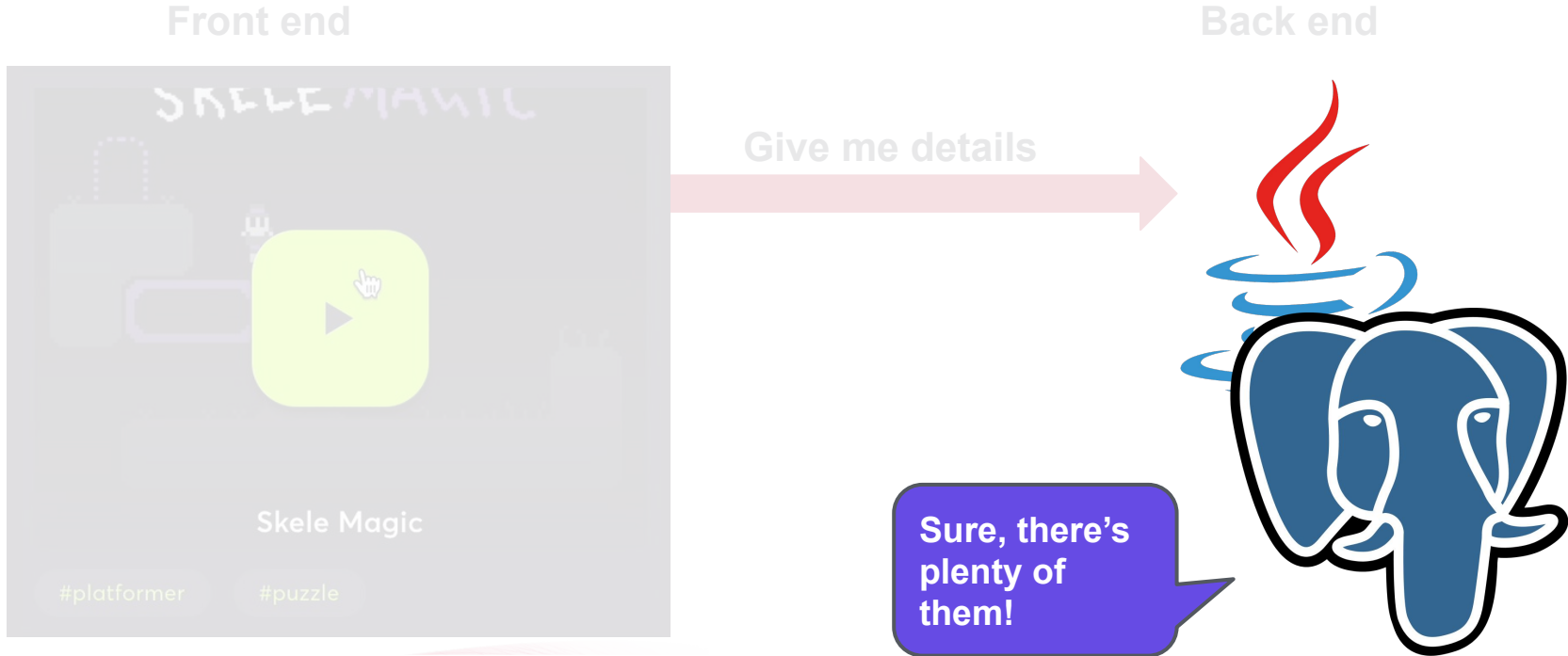
Give me details

Can you tell me the user favorite ID for this game?

Back end



The problem



The problem

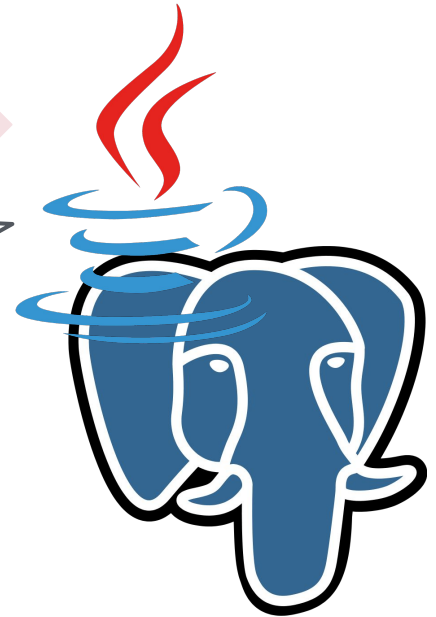
Front end



Give me details

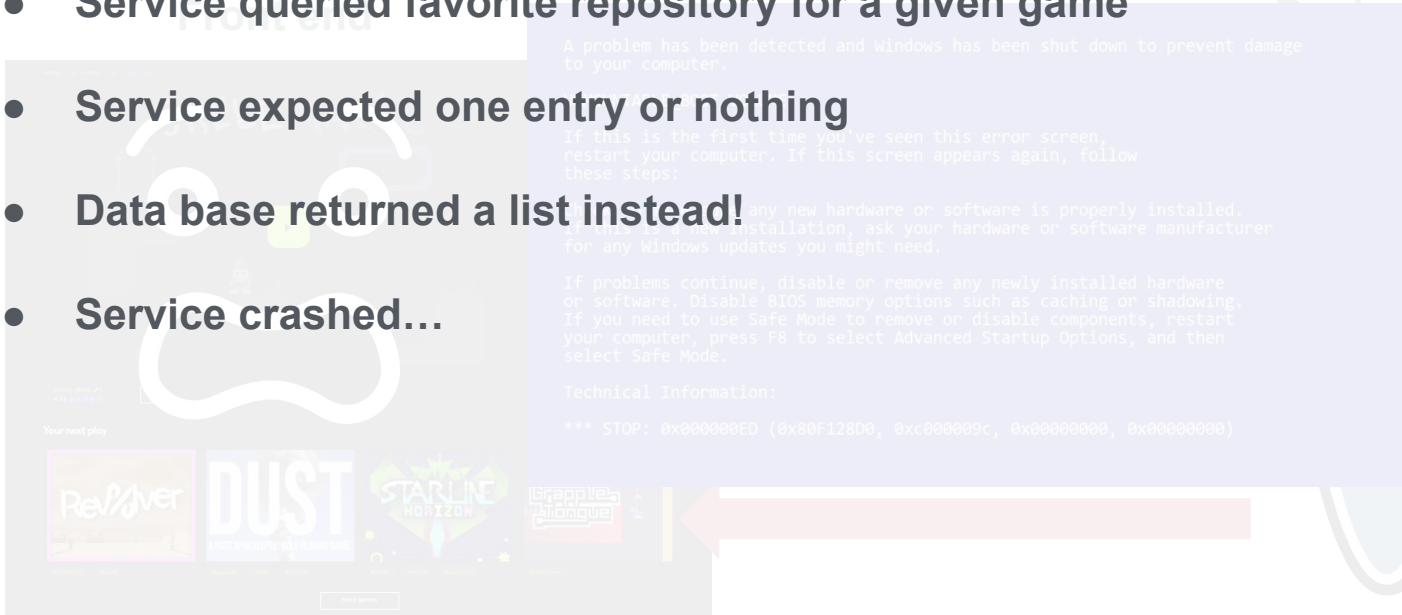
Wait wha—

Back end



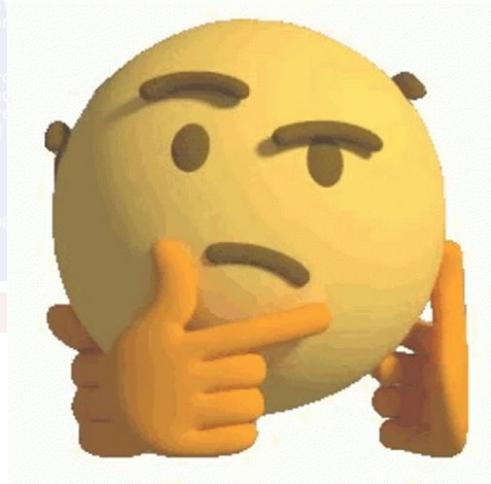
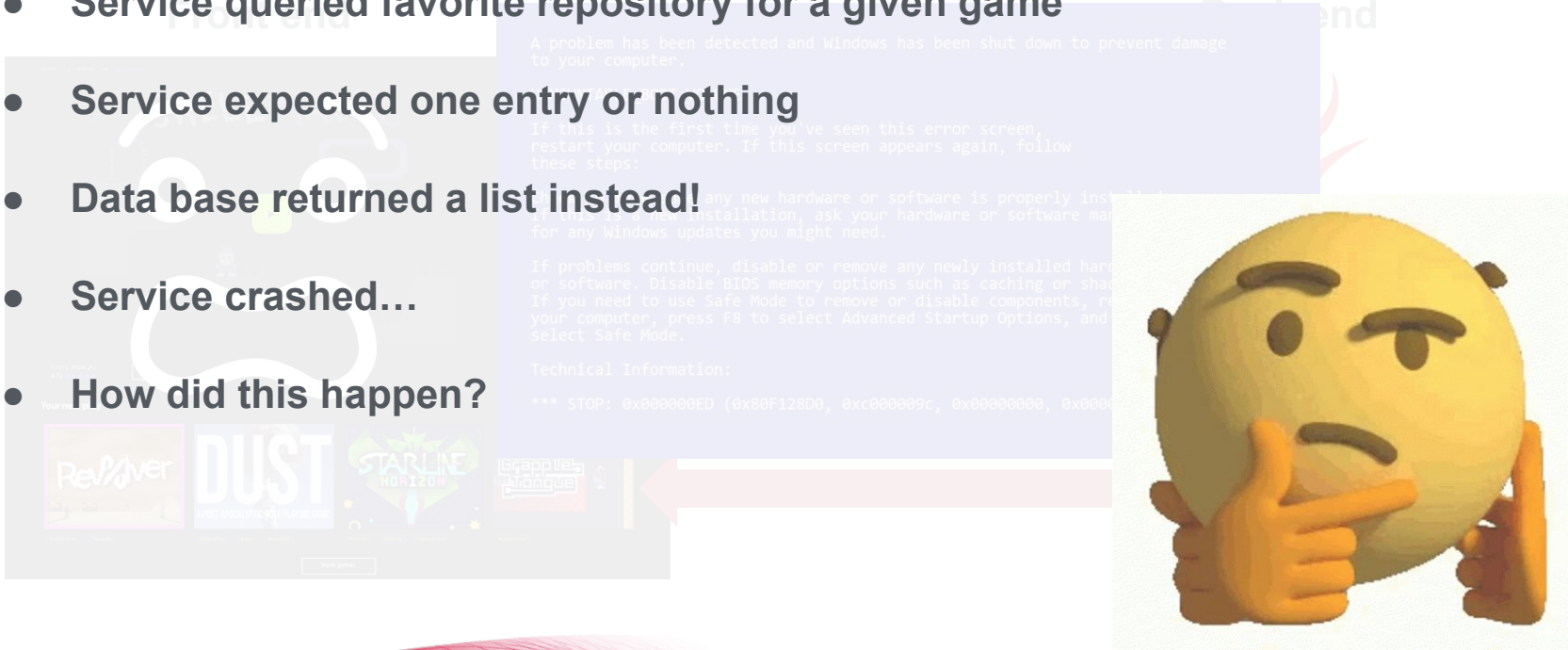
The problem

- Service queried favorite repository for a given game
- Service expected one entry or nothing
- Data base returned a list instead!
- Service crashed...



The problem

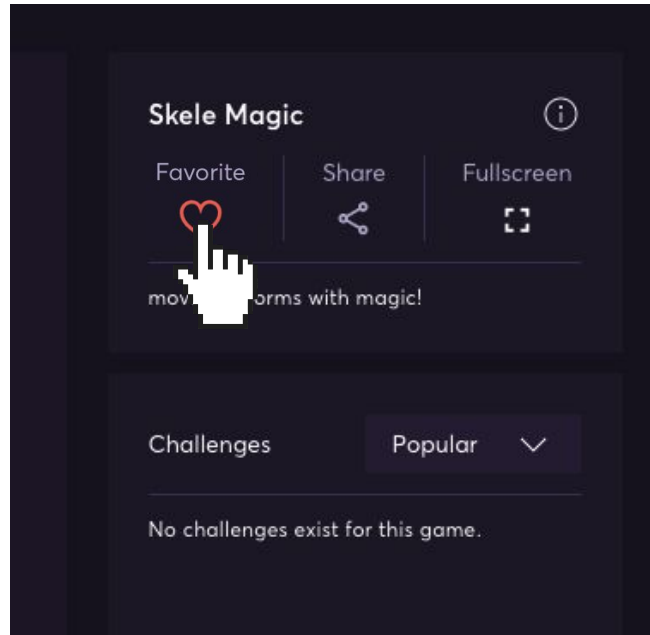
- Service queried favorite repository for a given game
- Service expected one entry or nothing
- Data base returned a list instead!
- Service crashed...
- How did this happen?



The race condition

The race condition

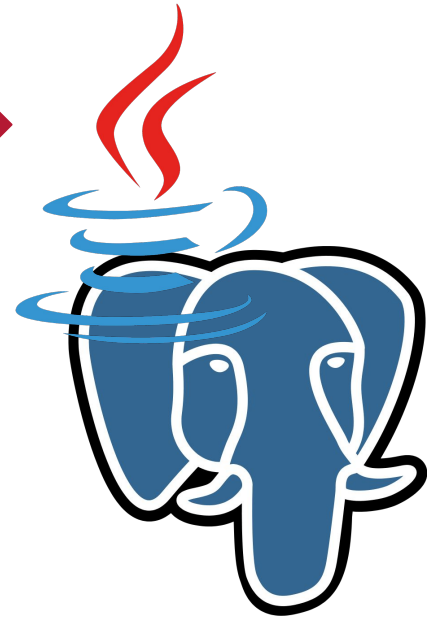
Front end



Add to favorites.

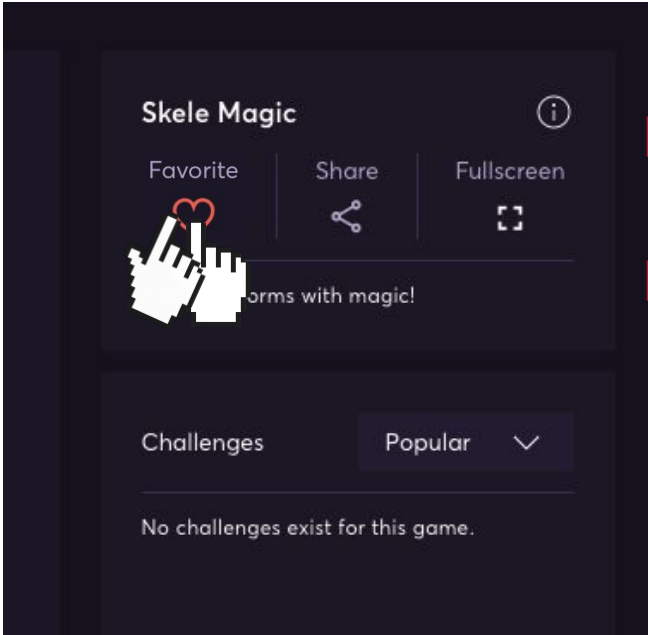


Back end



The race condition

Front end



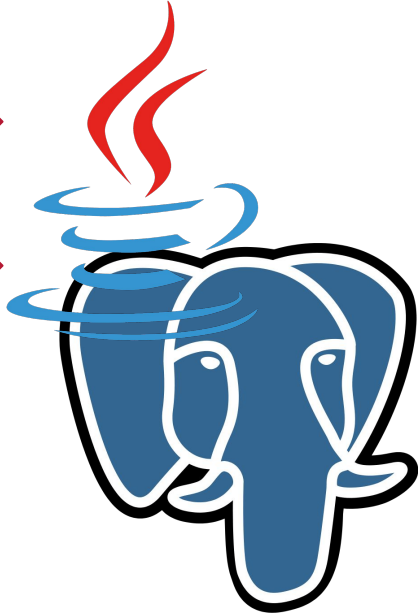
Add to favorites.



Add to favorites.



Back end

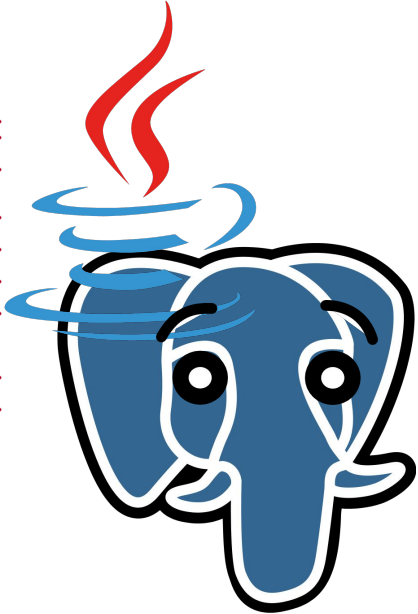


The race condition

Front end



Back end



The race condition

FAVORITE_ID	GAME_ID	DATE_ADDED	DISPLAY_ORDER
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
...

The race condition

FAVORITE_ID	GAME_ID	DATE_ADDED	DISPLAY_ORDER
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
...

Need to fix this...

Solution?

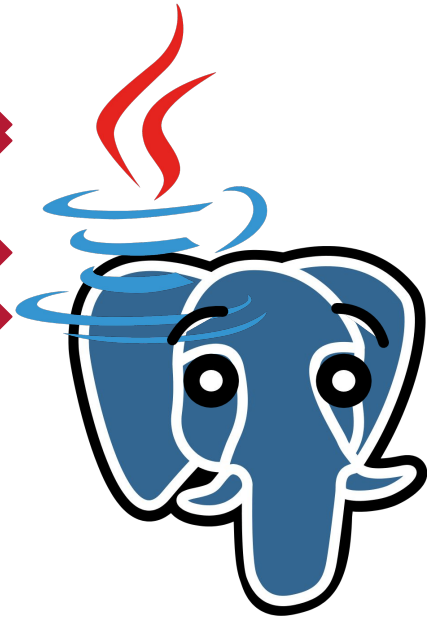
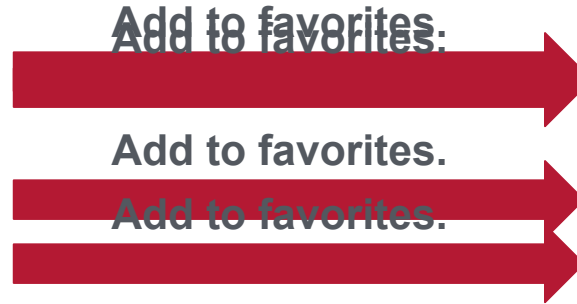
- Add FE script to prevent double clicks?

Solution?

Front end



Back end



Solution?

- ~~Add FE script to prevent double clicks?~~
- Change “favorites” table definition??

The race condition

Unique

FAVORITE_ID	GAME_ID	DATE_ADDED	DISPLAY_ORDER
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
...

~~Unique~~

The race condition

FAVORITE_ID	GAME_ID	DATE_ADDED	DISPLAY_ORDER
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
2132-asdf-5876-qazs	7909-adse-1462-ytts	2021-12-07	0
...

Solution?

- ~~Add FE script to prevent double clicks?~~
- ~~Change “favorites” table definition??~~
- Do something with Spring????

~~Technicalities~~ Solution

Spring: framework that handles transactions, object instantiations, ...

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Spring: framework that handles transactions, object instantiations, ...

EntityManager

```
void persist(Object entity)
void remove(Object entity)
T find(Class entityClass, Object primaryKey)
void refresh(Object entity, LockModeType lockMode)
void clear()
...
```


Technicalities Solution

Spring: framework that handles transactions, object instantiations, ...

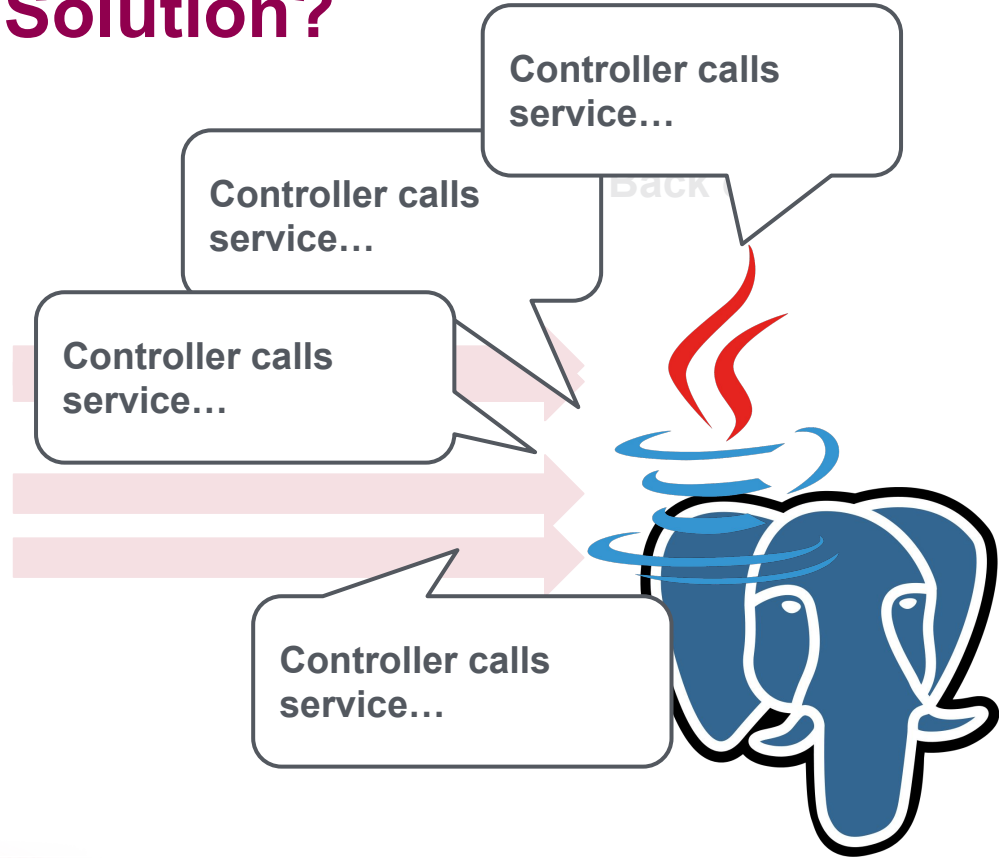
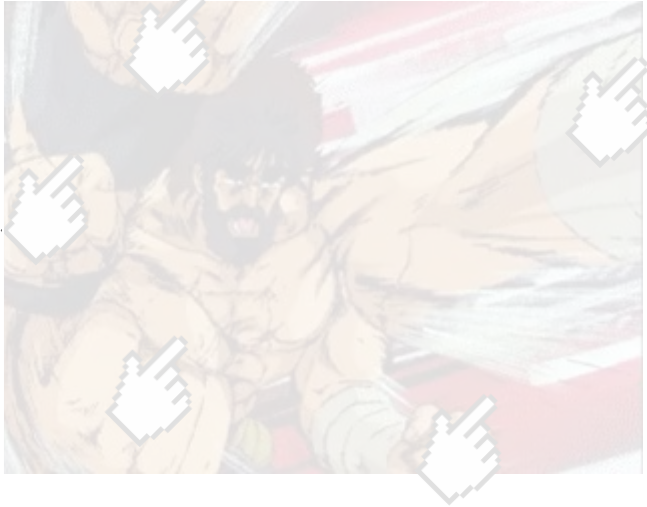
EntityManager

```
void persist(Object entity)
void remove(Object entity)
T find(Class entityClass, Object id)
void refresh(Object entity)
void clear()
...
```

1. Reloads entity from data base;
2. Applies a lock to the data base row;
3. Removes lock when transaction is committed.

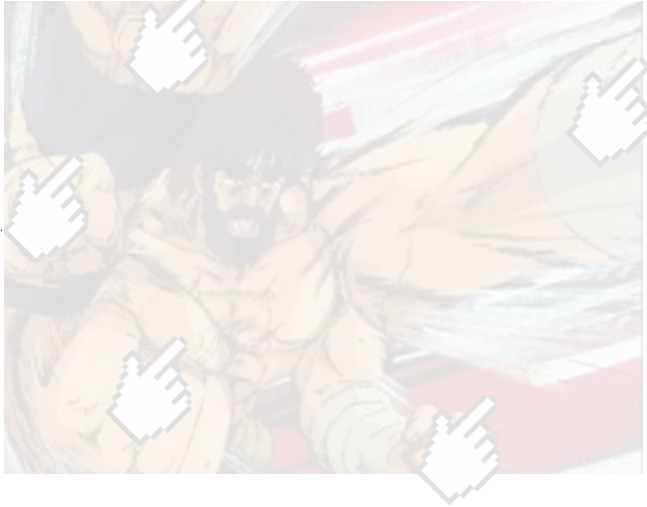
Solution?

Front end

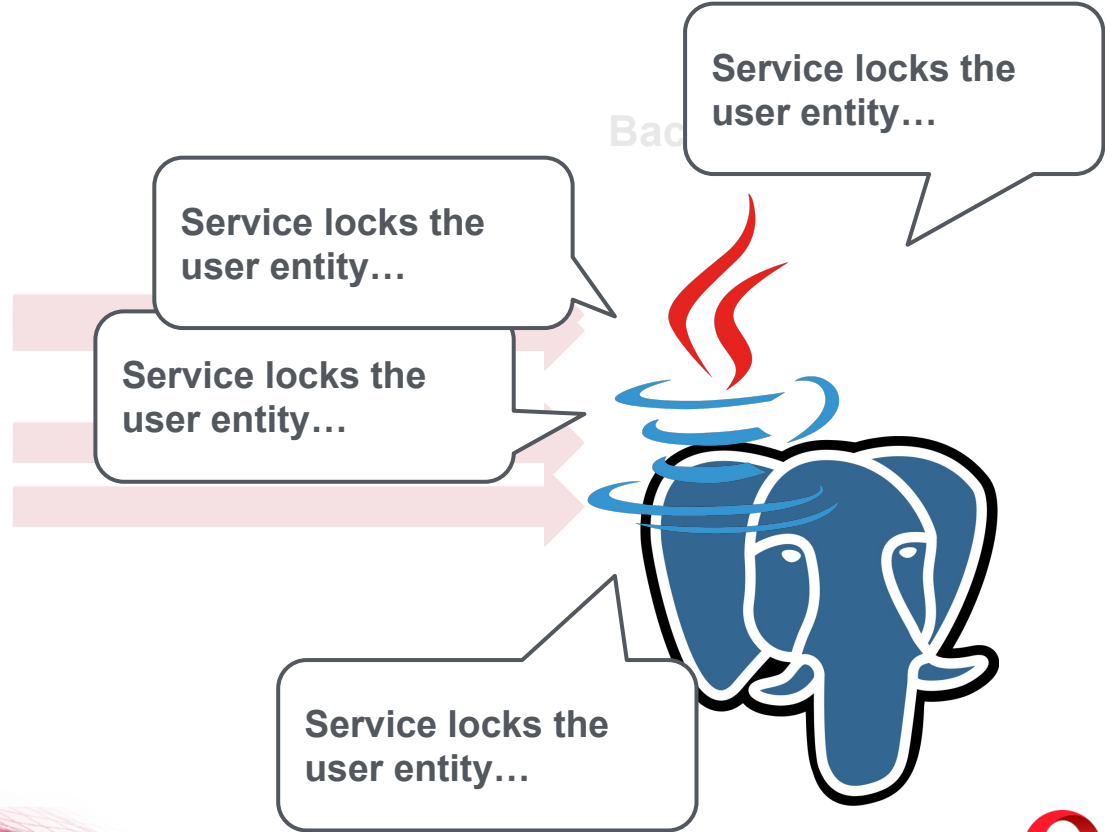


Solution?

Front end

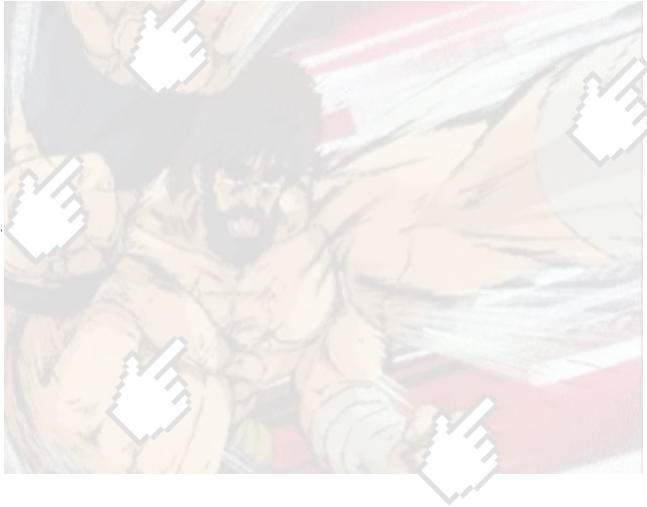


Back

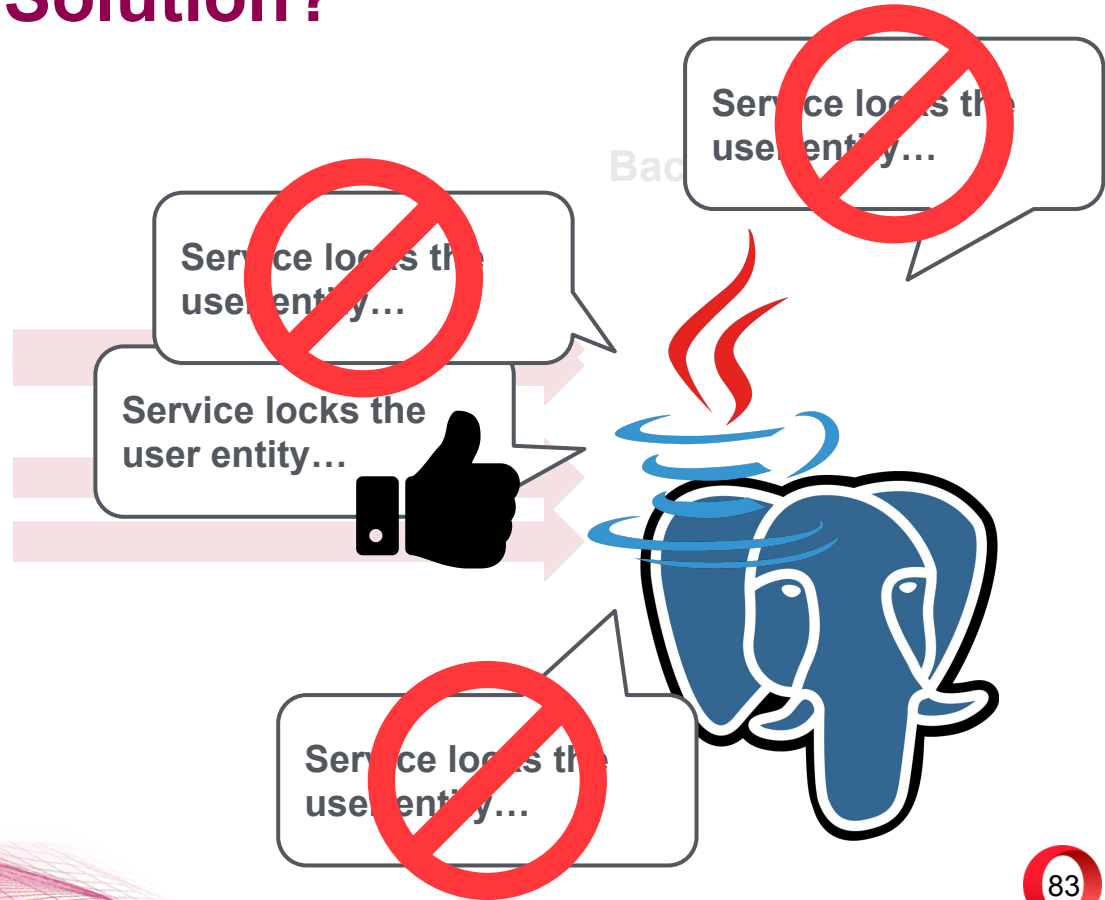


Solution?

Front end



Back

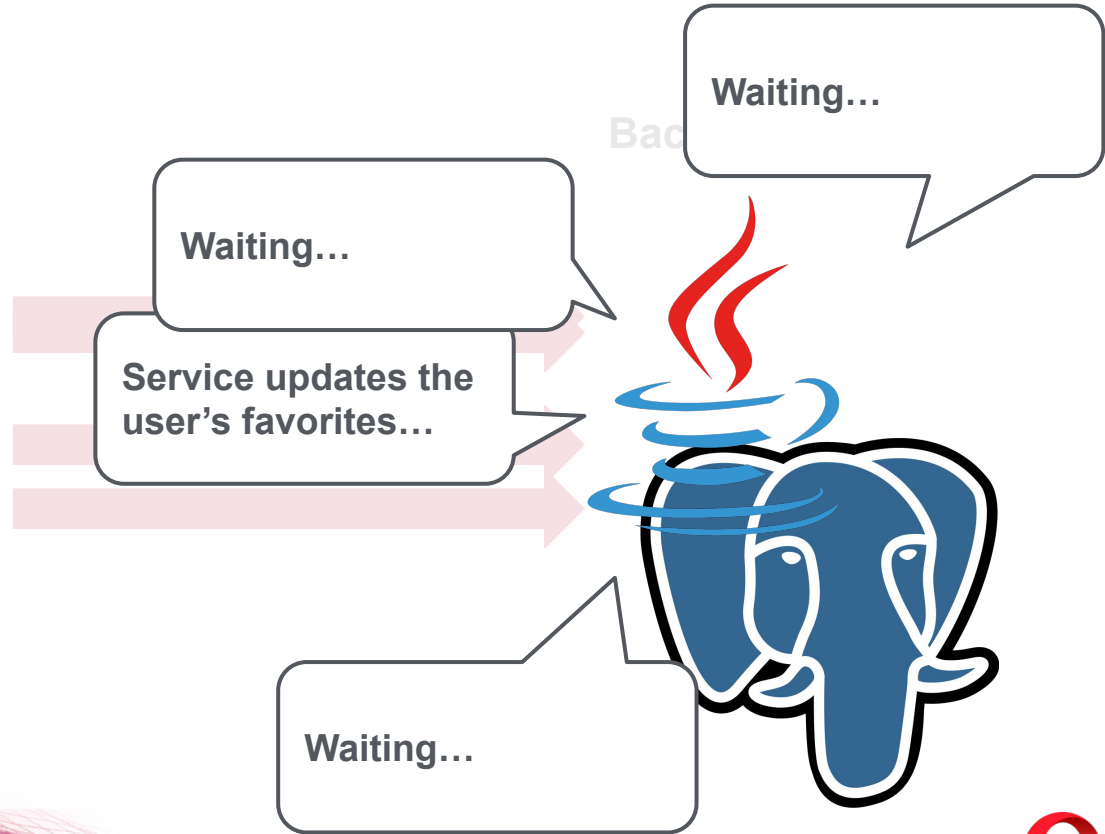


Solution?

Front end



Back end

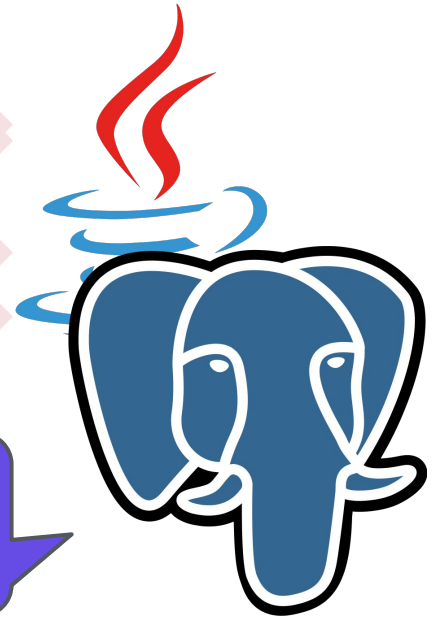


Solution?

Front end



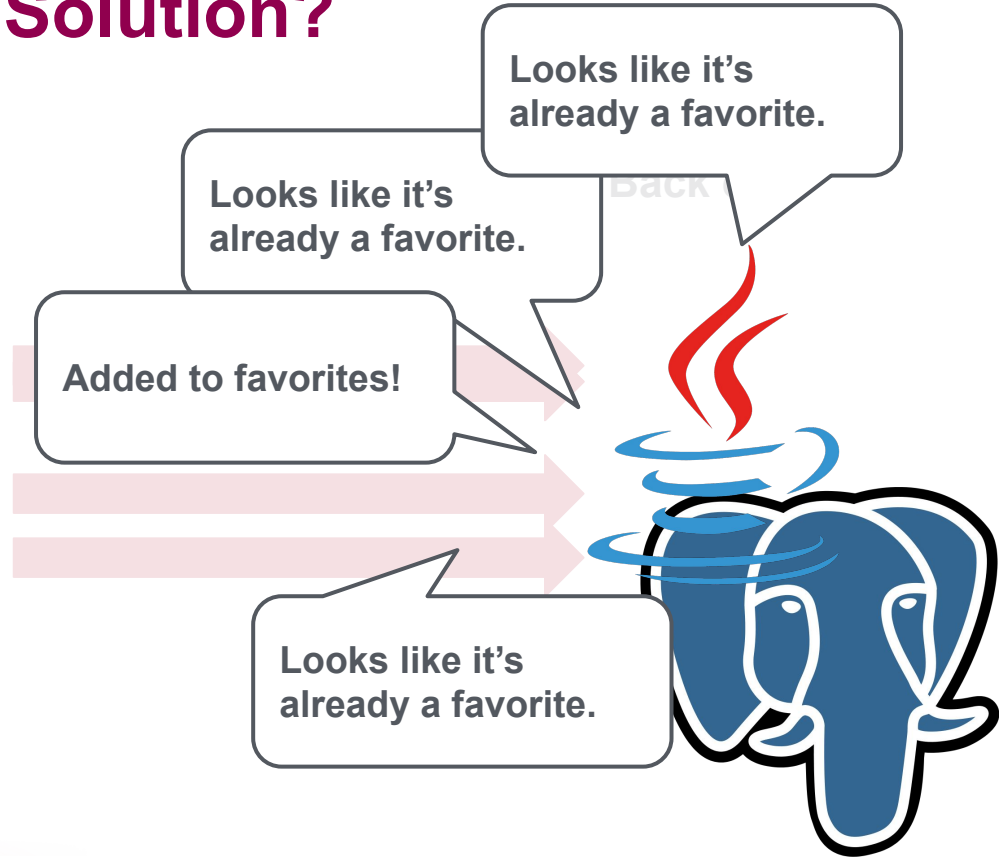
Back end



Everything saved!

Solution?

Front end



Solution?

- ~~Add FE script to prevent double clicks?~~
- ~~Change “favorites” table definition??~~
- Do something with Spring???? ✓

Solution?

- ~~Add FE script to prevent double clicks?~~
- ~~Change “favorites” table definition??~~
- Do something with Spring???? ✓
- Delete any existing duplicates.

Solution?

- ~~• Add FE script to prevent double clicks?~~
- ~~• Change “favorites” table definition??~~
- Do something with Spring???? ✓
- Delete any existing duplicates. ✓
- Change “favorites” table definition.

Solution?

- ~~• Add FE script to prevent double clicks?~~
- ~~• Change “favorites” table definition??~~
- Do something with Spring???? ✓
- Delete any existing duplicates. ✓
- Change “favorites” table definition. ✓

In summary...

A data base is a shared resource!

- **Locking a row before update is a good idea.**

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- **Locking a row before update is a good idea.**

Fixing a problem takes more time than preventing it!

- **Know the tools you're using.**

In summary...

A data base is a shared resource!

- Locking a row before update is a good idea.

Fixing a problem takes more time than preventing it!

- Know the tools you're using.

Learn from your mistakes!

- Today favorites, tomorrow...

Useful links

PosgreSQL: [postgresql.org](https://www.postgresql.org)

Hibernate: hibernate.org

Spring: spring.io

- **persistence:** [Spring data access reference](#)

...and, of course, gxc.gg 🕶️



**Thanks for
watching!**



Denis Furian
denisf@opera.com