УНИВЕРЗИТЕТ У БЕОГРАДУ  
ФАКУЛТЕТ ОРГАНИЗАЦИОНИХ НАУКА  
КАТЕДРА ЗА СОФТВЕРСКО ИНЖЕЊЕРСТВО

СЕМИНАРСКИ РАД

**Софтверски процес**

Тема:

Развој игре “Минско поље”

применом Ларманове методе

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# Кориснички захтеви

## Вербални опис

Потребно је развити софтверски систем за играње игре „Минско поље”. Учеснику у игри је потребно омогућити пријављивање на систем уношењем корисничког имена и лозинке. Уколико корисник нема налог, региструје се уношењем корисничког имена и лозинке које жели да користи и имејл адресе. Када се корисник улогује на систем потребно је омогућити започињање нове игре. Корисник мора имати више начина да започне креирање игре, првенствено преко дугмета на почетном екрану које приличи игри „Минско поље“.

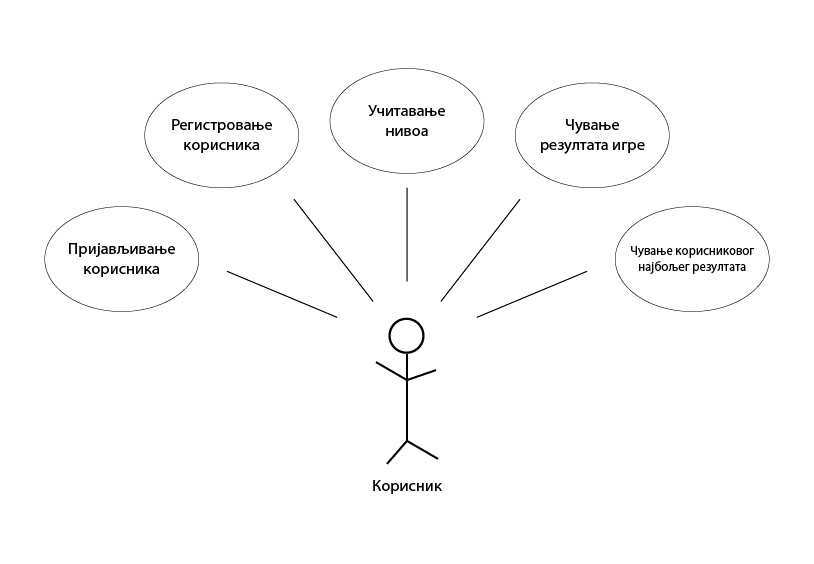
Када корисник изабере креирање нове игре, поставља се „нормална“ тежина игре. Неопходно је обезбедити да корисник може променити тежину игре на „лако“ или „тешко“ уколико је тренутна претешка или прелака. Када корисник одабере тежину, започиње се игра.

Потребно је да се бележи резултат игре, уколико је корисник победио. У том случају, потребно је и за самог корисника да се чува његов најбољи резултат.

## Модел случајева коришћења

У конкретном случају су идентификовани следећи случајеви коришћења:

1. Пријављивање корисника
2. Регистровање корисника
3. Учитавање нивоа
4. Чување резултата игре
5. Чување корисниковог најбољег резултата



Слика 1. Дијаграм случаја коришћења

## Случајеви коришћења

### СК1: Случај коришћења - Пријављивање корисника

**Назив СК**

Пријављивање корисника

**Актори СК**

Корисник

**Учесници СК**

Корисник и систем (програм)

**Предуслов:** Систем је укључен и приказује форму за пријављивање играча.

**Основни сценарио СК:**

1. **Корисник** уноси податке за пријављивање. (АПУСО)
2. **Корисник** контролише да ли је коректно унео податке. (АНСО)
3. **Корисник** позива систем да изврши пријављивање корисника. (АПСО)
4. **Систем** врши пријављивање корисника. (СО)
5. **Систем** приказује кориснику поруку: „Login successful!” и омогућава приступ систему. (ИА)

**Алтернативна сценарија:**

* 1. Уколико систем не пронађе корисника са унетим подацима, приказује кориснику поруку: „Login unsuccessful!”. (ИА)

### СК2: Случај коришћења - Регистровање корисника

**Назив СК**

Регистровање корисника

**Актори СК**

Корисник

**Учесници СК**

Корисник и систем (програм)

**Предуслов:** Систем је укључен и приказује форму за регистровање играча.

**Основни сценарио СК:**

1. **Корисник** уноси податке за регистрацију. (АПУСО)
2. **Корисник** контролише да ли је коректно унео податке. (АНСО)
3. **Корисник** позива систем да изврши регистрацију корисника. (АПСО)
4. **Систем** врши регистрацију корисника. (СО)
5. **Систем** приказује кориснику поруку: „Registration successful!” и омогућава приступ систему. (ИА)

**Алтернативна сценарија:**

* 1. Уколико систем не може да региструје корисника са унетим подацима, приказује кориснику поруку: „Registration unsuccessful!”. (ИА)

### СК3: Случај коришћења – Учитавање нивоа

**Назив СК**

Учитавање нивоа

**Актори СК**

Корисник

**Учесници СК**

Корисник и систем (програм)

**Предуслов:** Систем је укључен. Корисник је пријављен на систем и приказује форму за бирање тежине.

**Основни сценарио СК:**

1. **Корисник** бира тежину нивоа која му одговара. (АПУСО)
2. **Корисник** контролише да ли бира коректну тежину. (АНСО)
3. **Корисник** позива систем да учита ниво. (АПСО)
4. **Систем** врши учитавање игре. (СО)
5. **Систем** приказује играчу поруку: „Your game has started!”. (ИА)

**Алтернативна сценарија:**

* 1. Уколико систем не може да започне игру, приказује поруку: „Your game cannot start.”. (ИА)

### СК4: Случај коришћења – Чување резултата игре

**Назив СК**

Чување резултата игре

**Актори СК**

Корисник

**Учесници СК**

Корисник и систем (програм)

**Предуслов:** Систем је укључен. Корисник је пријављен на систем и игра је успешно креирана и започета.

**Основни сценарио СК:**

1. **Корисник** позива систем да сачува резултат. (АПСО)
2. **Систем** чува резултат игре. (СО)
3. **Систем** приказује кориснику резултат и поруку: „Your game record has been saved“. (ИА)

**Алтернативна сценарија:**

* 1. Уколико систем не може да сачува резултат, приказује поруку: „System cannot save the game record”. (ИА)

### СК5: Случај коришћења – Чување корисниковог најбољег резултата

**Назив СК**

Чување корисниковог најбољег резултата

**Актори СК**

Корисник

**Учесници СК**

Корисник и систем (програм)

**Предуслов:** Систем је укључен. Корисник је пријављен на систем и игра је успешно завршена.

**Основни сценарио СК:**

1. **Корисник** позива систем да сачува нови најбољи резултат корисника. (АПСО)
2. **Систем** чува резултат игре. (СО)
3. **Систем** приказује кориснику резултат и поруку: „Your highscore has been saved“. (ИА)

**Алтернативна сценарија:**

* 1. Уколико систем не може да сачува резултат, приказује поруку: „System cannot save your highscore”. (ИА)

# Анализа

Фаза анализе описује логичку структуру и понашање софтверског система (пословну логику софтверског система).

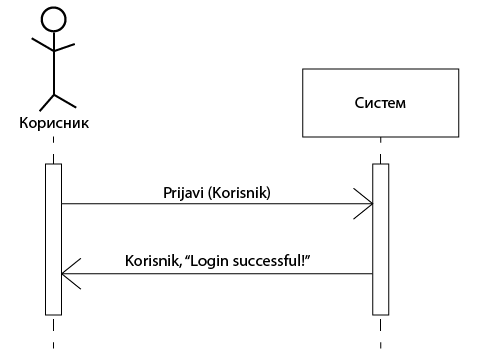
Понашање софтверског система је описано помоћу системских дијаграма секвенци који се праве за сваки случај коришћења, и помоћу уговора о системским операцијама, које се добијају на основу системских дијаграма секвенци.

Структура софтверског система се описује помоћу концептуалног и релационог модела.

## Понашање софтверског система - Системски дијаграм секвенци

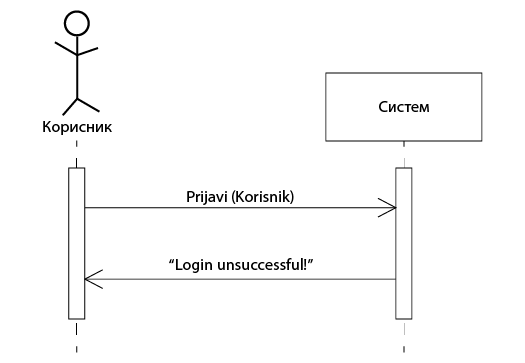
### Дијаграм секвенци случаја коришћења 1 - Пријављивање корисника

**Основни сценарио СК:**

1. **Корисник** позива систем да изврши пријављивање корисника. (АПСО)
2. **Систем** приказује кориснику поруку: „Login successful!” и омогућава приступ систему. (ИА)

Слика 2. Основни сценарио СК1

**Алтернативна сценарија:**

* 1. Уколико систем не пронађе корисника са унетим подацима, приказује кориснику поруку: „Login unsuccessful!”. (ИА)

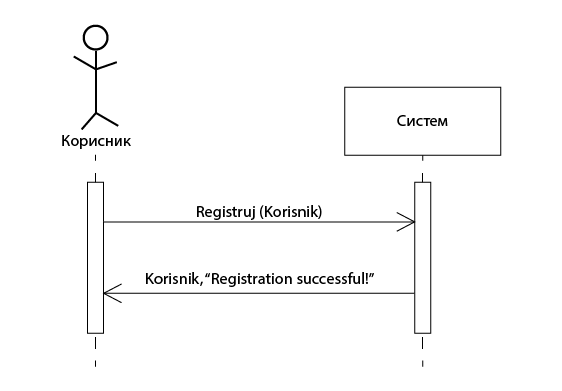
Слика 3. Први алтернативни сценарио СК1

Са наведених секвенцних дијаграма уочава се једна системска операција коју треба пројектовати:

1. Сигнал Prijavi(Korisnik);

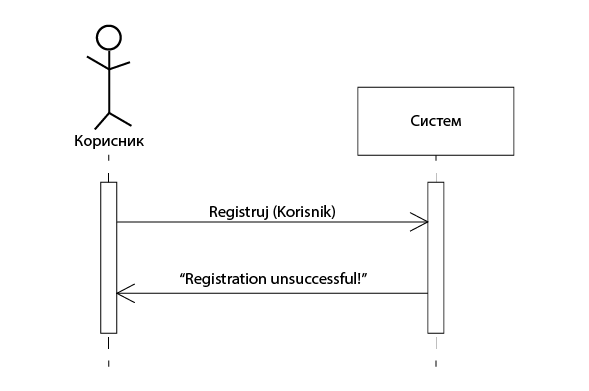
### Дијаграм секвенци случаја коришћења 2 – Регистровање корисника

**Основни сценарио СК:**

1. **Корисник** позива систем да изврши регистрацију корисника. (АПСО)
2. **Систем** приказује кориснику поруку: „Registration successful!” и омогућава приступ систему. (ИА)

Слика 4. Основни сценарио СК2

**Алтернативна сценарија:**

* 1. Уколико систем не може да региструје корисника са унетим подацима, приказује кориснику поруку: „Registration unsuccessful!”. (ИА)

Слика 5. Први алтернативни сценарио СК2

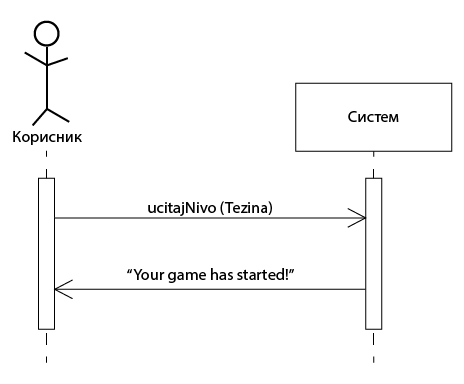
Са наведених секвенцних дијаграма уочава се једна системска операција коју треба пројектовати:

1. Сигнал Registruj(Korisnik)

### Дијаграм секвенци случаја коришћења 3 - Учитавање нивоа

**Основни сценарио СК:**

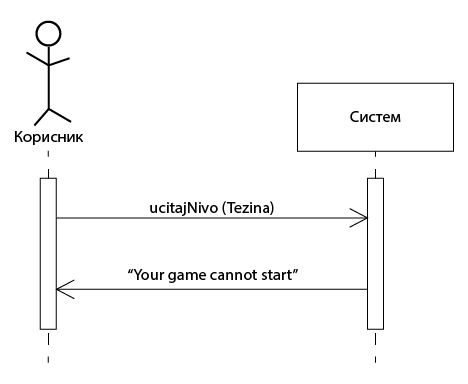
1. **Корисник** позива систем да учита ниво. (АПСО)
2. **Систем** приказује кориснику поруку: „Your game has started!”. (ИА)



Слика 6. Основни сценарио СК3

**Алтернативна сценарија:**

* 1. Уколико систем не може да започне игру, приказује поруку: „Your game cannot start.”. (ИА)



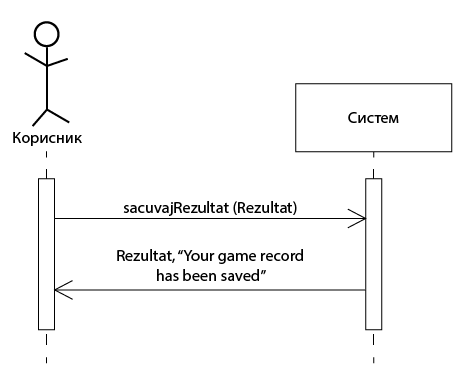
Слика 7. Први алтернативни сценарио СК3

Са наведених секвенцних дијаграма уочава се једна системска операција коју треба пројектовати:

1. Сигнал ucitajNivo(Tezina);

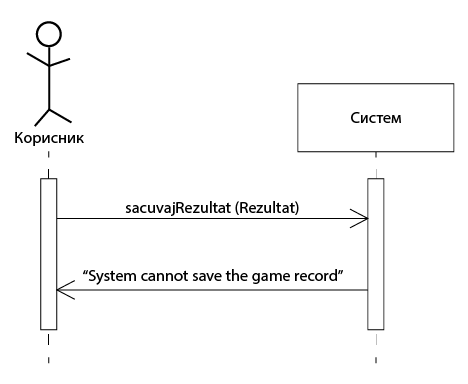
### Дијаграм секвенци случаја коришћења 4 – Чување резултата игре

**Основни сценарио СК:**

1. **Корисник** позива систем да сачува резултат. (АПСО)
2. **Систем** приказује кориснику резултат и поруку: „Your game record has been saved“. (ИА)

Слика 8. Основни сценарио СК4

**Алтернативна сценарија:**

* 1. Уколико систем не може да сачува резултат, приказује поруку: „System cannot save the game record”. (ИА)

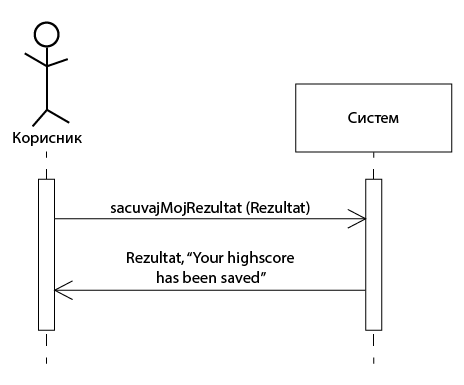
Слика 9. Први алтернативни сценарио СК4

Са наведених секвенцних дијаграм уочава се једна системска операција коју треба пројектова:

1. Сигнал SacuvajRezultat(Rezultat)

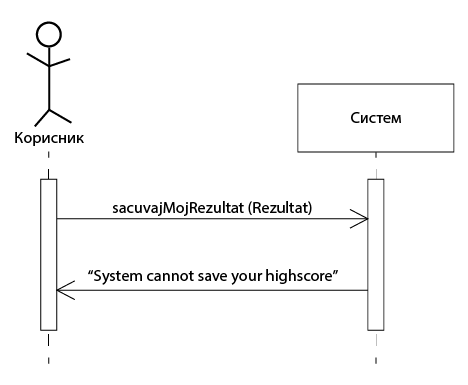
### Дијаграм секвенци случаја коришћења 5 – Чување корисниковог најбољег резултата

**Основни сценарио СК:**

1. **Корисник** позива систем да сачува нови најбољи резултат корисника. (АПСО)
2. **Систем** приказује кориснику резултат и поруку: „Your highscore has been saved“. (ИА)

Слика 10. Основни сценарио СК5

**Алтернативна сценарија:**

* 1. Уколико систем не може да сачува резултат, приказује поруку: „System cannot save your highscore”. (ИА)

Слика 11. Први алтернативни сценарио СК5

Са наведених секвенцних дијаграм уочава се једна системска операција коју треба пројектова:

1. Сигнал SacuvajMojRezultat(Rezultat)

Након анализе сценарија случајева коришћења уочено је 6 системских операција које треба пројектовати:

1. Сигнал Prijavi(Korisnik)
2. Сигнал Registruj(Korisnik)
3. Сигнал UcitajNivo(Tezina)
4. Сигнал SacuvajRezultat(Rezultat)
5. Сигнал SacuvajMojRezultat(Rezultat)

## Понашање софверског система - Дефинисање уговора о системским операцијама

1. **Уговор УГ1: *Prijavi***

**Операција**: *Prijavi(Korisnik):* сигнал

**Веза са СК**: СК1

**Предуслови**: /

**Постуслови**: Корисник је пријављен.

**2. Уговор УГ2: *Registruj***

**Операција**: *Registruj(Korisnik):* сигнал

**Веза са СК**: СК2

**Предуслови**: Вредносна и структурна ограничења над објектом *Korisnik* морају бити задовољена.

**Постуслови**: Корисник је регистрован.

**3. Уговор УГ3: *UcitajNivo***

Oперација: *UcitajNivo(Tezina):*сигнал

Веза са СК: СК3

Предуслови: Вредносна и структурна ограничења над објектом *Tezina* морају бити задовољена.

Постуслови: Игра је почела.

**4. Уговор УГ4: *SacuvajRezultat***

Операција: *SacuvajRezultat(Rezultat):* сигнал

Веза са СК: СК4

Предуслови: Вредносна и структурна ограничења над објектом *Rezultat* морају бити задовољена.  
Постуслови: Резултат је сачуван.

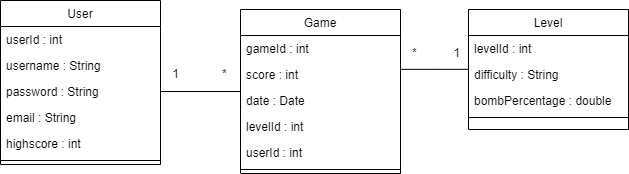
**5. Уговор УГ5: *SacuvajMojRezultat***

Операција: *SacuvajMojRezultat(Rezultat):* сигнал

Веза са СК: СК5

Предуслови: Вредносна и структурна ограничења над објектом *Rezultat* морају бити задовољена.  
Постуслови: Корисников најбољи резултат је сачуван.

## Структура софтверског система - Концептуални модел



Слика 12. Структура софтверског система - Концептуални модел

## Структура софтверског система - Релациони модел

User (userId, username, password, email, highscore)

Level (levelId, difficulty, bombPercentage)

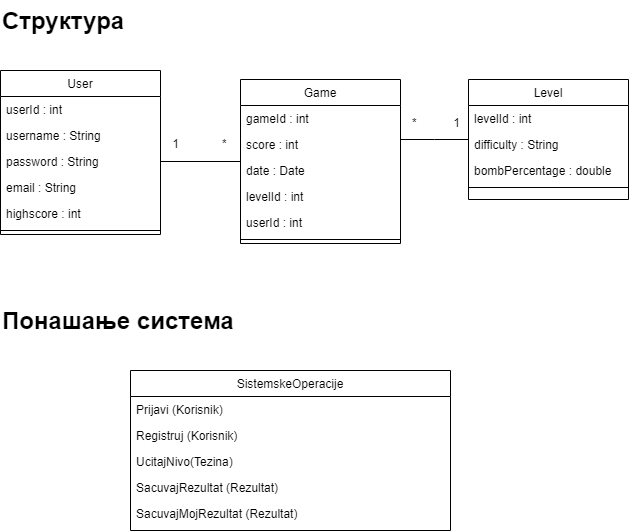
Game (gameId, score, date, *levelId, userId*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Табела User** | | **Просто вредносно ограничење** | | **Сложено вредносно ограничење** | | **Структурно ограничење** |
| **Атрибути** | **Име** | **Тип атрибута** | **Вредност атрибута** | **Међузав. Атрибута једне табеле** | **Међузав. Атрибута више табела** | INSERT /  UPDATE /  DELETE RESTRICT  User |
| userId | Integer | Not null and > 0 |  |  |
| username | String | Not null |  |  |
| password | String | Not null |  |  |
| email | String | Not null |  |  |
| highscore | String | Not null |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Табела Level** | | **Просто вредносно ограничење** | | **Сложено вредносно ограничење** | | **Структурно ограничење** |
| **Атрибути** | **Име** | **Тип атрибута** | **Вредност атрибута** | **Међузав. Атрибута једне табеле** | **Међузав. Атрибута више табела** | INSERT /  UPDATE /  DELETE CASCADE  Game |
| levelId | Integer | Not null and > 0 |  |  |
| difficulty | String | Not null |  |  |
| bombPercentage | Double | Not null |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Табела Game** | | **Просто вредносно ограничење** | | **Сложено вредносно ограничење** | | **Структурно ограничење** |
| **Атрибути** | **Име** | **Тип атрибута** | **Вредност атрибута** | **Међузав. Атрибута једне табеле** | **Међузав. Атрибута више табела** | INSERT  RESTRICT User Level  UPDATE RESTRICT User  Level  DELETE RESTRICT  User Level |
| gameId | Integer | Not null and > 0 |  |  |
| score | Integer | Not null |  |  |
| date | Date | Not null |  |  |
| userId | Integer | Not null and > 0 |  |  |
| levelId | Integer | Not null and > 0 |  |  |

Као резултат анализе сценарија СК и креирања концептуалног модела добија се логичка структура и понашање софтверског система:



Слика 13. Структура и понашање софтверског система

# Пројектовање

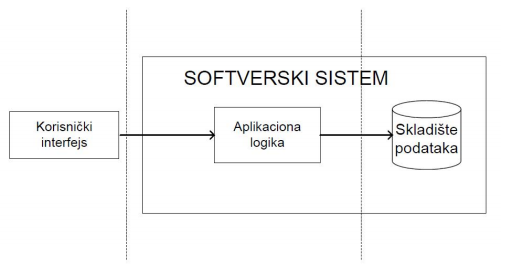
Фаза пројектовања описује физичку структуру и понашање софтверског система - архитектуру софтверског система.

## Архитектура софтверског система

Архитектура система је тронивојска и састоји се из следећих нивоа:

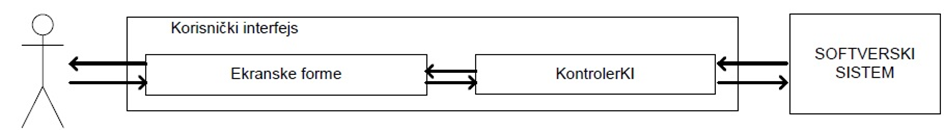
* Кориснички интерфејс
* Апликациона логика
* Складиште података

Кориснички интерфејс се налази на страни клијента, а апликациона логика и складиште података на страни сервера. Уколико постоји потреба, и серверска страна може поседовати кориснички интерфејс.



Слика 14. Тронивојска архитектура

## Пројектовање корисничког интерфејса

Пројектовање корисничког интерфејса представља реализацију улаза и/или излаза софтверског система. Екранска форма има улогу да прихвати податке које корисник уноси, прихвата догађаје које прави корисник, позива контролера корисничког интерфејса како би му проследила податке и приказује податке добијене од контролера корисничког интерфејса.

Слика 15. Структура корисничког интерфејса

### СК1: Случај коришћења - Пријављивање корисника

**Назив СК**

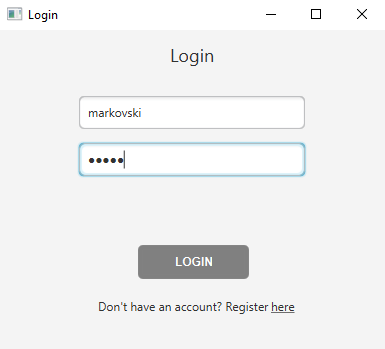
Пријављивање корисника

**Актори СК**

Корисник

**Учесници СК**

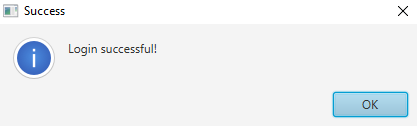
Корисник и систем (програм)

**Предуслов:** Систем је укључен и приказује форму за пријављивање играча.

Слика 16. Пријављивање корисника - форма

**Основни сценарио СК:**

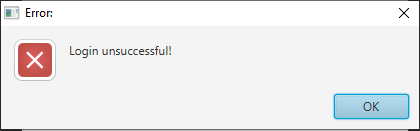
1. **Корисник** уноси податке за пријављивање. (АПУСО)
2. **Корисник** контролише да ли је коректно унео податке. (АНСО)
3. **Корисник** позива систем да изврши пријављивање корисника. (АПСО)
4. **Систем** врши пријављивање корисника. (СО)
5. **Систем** приказује кориснику поруку: „Login successful!” и омогућава приступ систему. (ИА)



Слика 17. Пријављивање корисника – основни сценарио

**Алтернативна сценарија:**

* 1. Уколико систем не пронађе корисника са унетим подацима, приказује кориснику поруку: „Login unsuccessful!”. (ИА)



Слика 18. Пријављивање корисника – алтернативни сценарио

### СК2: Случај коришћења - Регистровање корисника

**Назив СК**

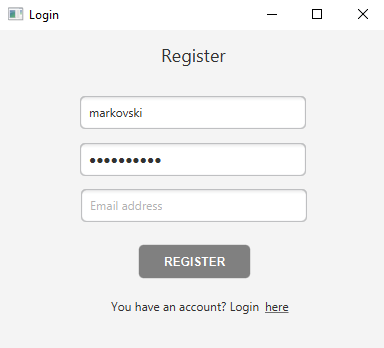
Регистровање корисника

**Актори СК**

Корисник

**Учесници СК**

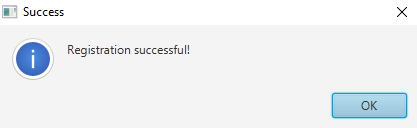
Корисник и систем (програм)

**Предуслов:** Систем је укључен и приказује форму за регистровање играча.

Слика 19. Регистровање корисника – форма

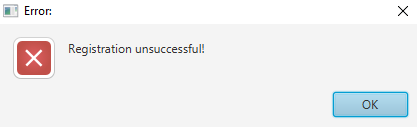
**Основни сценарио СК:**

1. **Корисник** уноси податке за регистрацију. (АПУСО)
2. **Корисник** контролише да ли је коректно унео податке. (АНСО)
3. **Корисник** позива систем да изврши регистрацију корисника. (АПСО)
4. **Систем** врши регистрацију корисника. (СО)
5. **Систем** приказује кориснику поруку: „Registration successful!” и омогућава приступ систему. (ИА)



Слика 20. Регистровање корисника – основни сценарио

**Алтернативна сценарија:**

* 1. Уколико систем не може да региструје корисника са унетим подацима, приказује кориснику поруку: „Registration unsuccessful!”. (ИА)

Слика 21. Регистровање корисника – алтернативни сценарио

### СК3: Случај коришћења – Учитавање нивоа

**Назив СК**

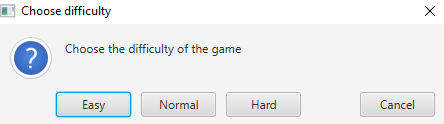
Учитавање нивоа

**Актори СК**

Корисник

**Учесници СК**

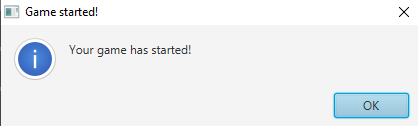
Корисник и систем (програм)

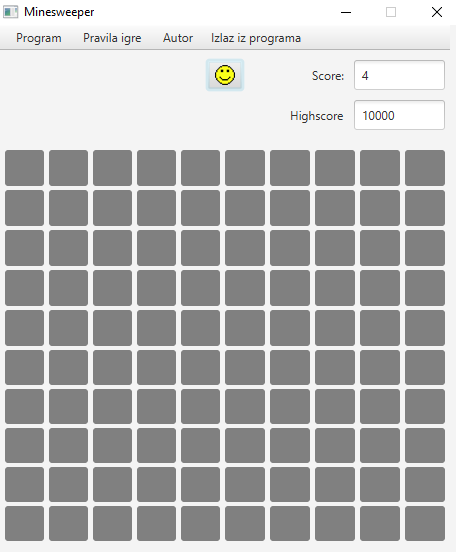
**Предуслов:** Систем је укључен. Корисник је пријављен на систем и приказује форму за бирање тежине.

Слика 22. Учитавање нивоа

**Основни сценарио СК:**

1. **Корисник** бира тежину нивоа која му одговара. (АПУСО)
2. **Корисник** контролише да ли бира коректну тежину. (АНСО)
3. **Корисник** позива систем да учита ниво. (АПСО)
4. **Систем** врши учитавање игре. (СО)
5. **Систем** приказује играчу поруку: „Your game has started!”. (ИА)

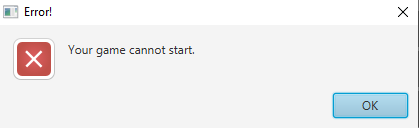


Слика 23. Учитавање нивоа – основни сценарио

Слика 24. Учитавање нивоа – основни сценарио

**Алтернативна сценарија:**

* 1. Уколико систем не може да започне игру, приказује поруку: „Your game cannot start.”. (ИА)



Слика 25. Учитавање нивоа – алтернативни сценарио

### СК4: Случај коришћења – Чување резултата игре

**Назив СК**

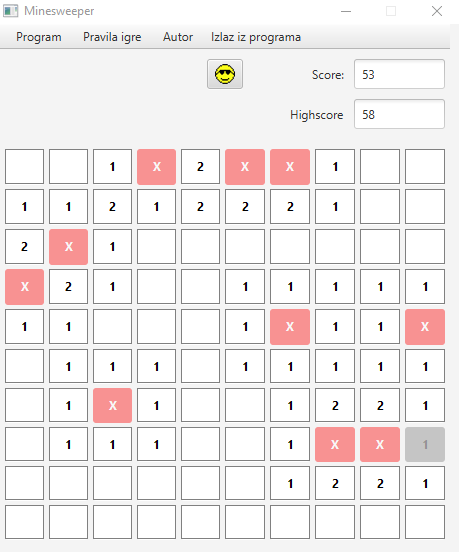
Чување резултата игре

**Актори СК**

Корисник

**Учесници СК**

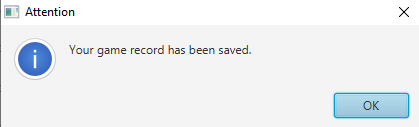
Корисник и систем (програм)

**Предуслов:** Систем је укључен. Корисник је пријављен на систем и игра је успешно креирана и започета.

Слика 26. Чување резултата игре – крај игре

**Основни сценарио СК:**

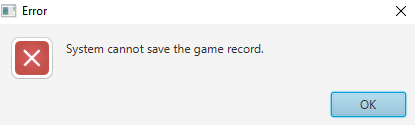
1. **Корисник** позива систем да сачува резултат. (АПСО)
2. **Систем** чува резултат игре. (СО)
3. **Систем** приказује кориснику резултат и поруку: „Your game record has been saved“. (ИА)



Слика 27. Чување резултата игре – основни сценарио

**Алтернативна сценарија:**

* 1. Уколико систем не може да сачува резултат, приказује поруку: „System cannot save the game record”. (ИА)



Слика 28. Чување резултата игре – алтернативни сценарио

### СК5: Случај коришћења – Чување корисниковог најбољег резултата

**Назив СК**

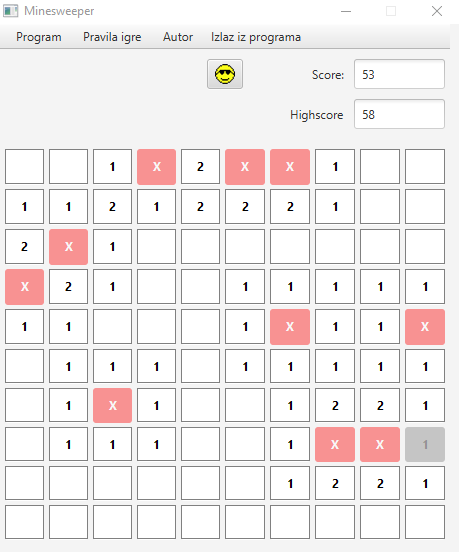
Чување корисниковог најбољег резултата

**Актори СК**

Корисник

**Учесници СК**

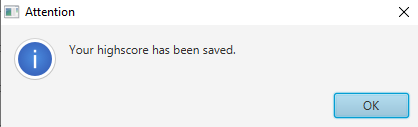
Корисник и систем (програм)

**Предуслов:** Систем је укључен. Корисник је пријављен на систем и игра је успешно завршена.

Слика 29. Чување корисниковог најбољег резултата

**Основни сценарио СК:**

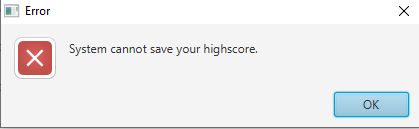
1. **Корисник** позива систем да сачува нови најбољи резултат корисника. (АПСО)
2. **Систем** чува резултат игре. (СО)
3. **Систем** приказује кориснику резултат и поруку: „Your highscore has been saved“. (ИА)



Слика 30. Чување најбољег корисниковог резултата – основни сценарио

**Алтернативна сценарија:**

* 1. Уколико систем не може да сачува резултат, приказује поруку: „System cannot save your highscore”. (ИА)



Слика 31. Чување најбољег корисниковог резултата – алтернативни сценарио

## Комуникација сервер - клијент

На серверској страни се покреће веб сервис и серверски сокет који ослушкује мрежу. Када клијент успешно изврши пријављивање на систем, успоставља се конекција између клијентског сокета и серверског. Тада сервер генерише посебну нит која је задужена за обраду корисничких захтева.

Слање и примање података се одвија помоћу класа *Request* и *Response.* Приликом слања потребно је у *Request* дефинисати системску операцију као и податке неопходне за њено извршење. Када сервер прими и обради захтев, он креира нову инстанцу *Response* klase и шаље одговор клијенту, који он даље обрађује.

public class Request implements Serializable {

private Game game;

private User user;

private Level level;

private int operation;

public Request() {

}

public Game getGame() {

return game;

}

public void setGame(Game game) {

this.game = game;

}

public User getUser() {

return user;

}

public void setUser(User user) {

this.user = user;

}

public Level getLevel() {

return level;

}

public void setLevel(Level level) {

this.level = level;

}

public int getOperation() {

return operation;

}

public void setOperation(int operation) {

this.operation = operation;

}

}

public class Response implements Serializable {

private ResponseStatus status;

private Object error;

private Game game;

private User user;

private Level level;

public Response() {

}

public ResponseStatus getStatus() {

return status;

}

public void setStatus(ResponseStatus status) {

this.status = status;

}

public Object getError() {

return error;

}

public void setError(Object error) {

this.error = error;

}

public Game getGame() {

return game;

}

public void setGame(Game game) {

this.game = game;

}

public User getUser() {

return user;

}

public void setUser(User user) {

this.user = user;

}

public Level getLevel() {

return level;

}

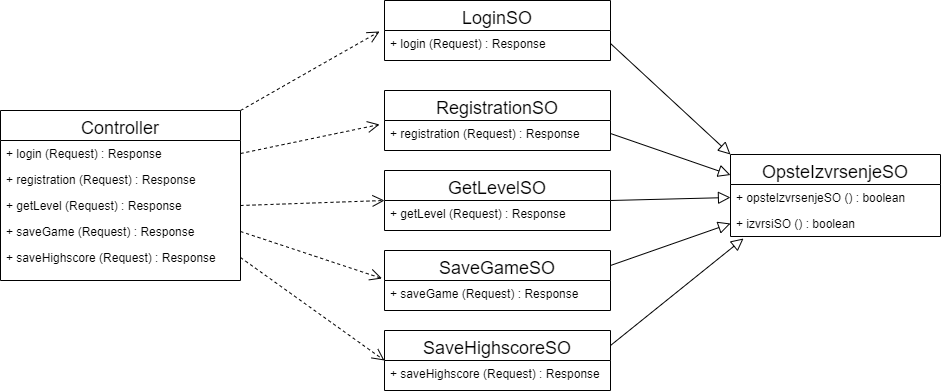
public void setLevel(Level level) {

this.level = level;

}

}

## Контролер апликационе логике

Контролер апликационе прихвата захтев за извршење системске операције од нити клијента и даље га преусмерава до класе које су одговорне за извршење конкретних системских операција. Након извршења системске операције контролер апликационе логике прихвата резултат и прослеђике га позиваоцу, односно нити која је задужена за обраду клијентских захтева.

Слика 32. Приказ зависности контролера и класа одговорних за изврешење системских операција

Све класе које се задужене за извршење системских операција наслеђују класу **OpsteIzvrsenjeSO**, па самим тим и имплементирају методу **izvrsiSO**, која је апстрактна. Метода **opsteIzvrsenjeSO** није апстрактна, па представља шаблон по ком редоследу се операције морају извршавати, а све подкласе, дају конкретну имплементацију апстрактне методе.

public abstract class OpsteIzvrsenjeSO {

static public BrokerBazePodataka bbp = new BrokerBazePodataka1();

GeneralDObject gdo;

synchronized public boolean opsteIzvrsenjeSO() {

bbp.makeConnection();

boolean signal = izvrsiSO();

if (signal == true) {

bbp.commitTransation();

} else {

bbp.rollbackTransation();

}

bbp.closeConnection();

return signal;

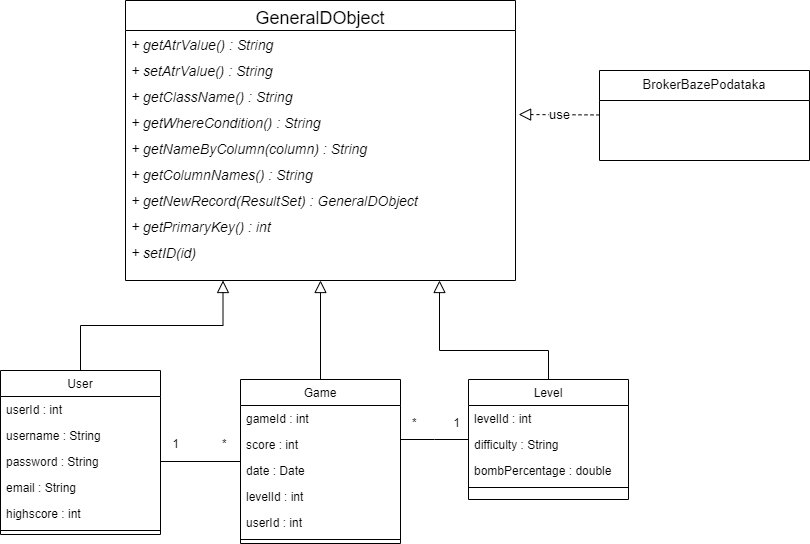
}

abstract public boolean izvrsiSO();

}

## Пројектовање структуре софтверског система - Доменске класе

Све доменске класе имплементирају интерфејс **GeneralDObject**, који се користи као параметар у методама брокера базе података, како би се обезбедила инверзија зависности и омогућила имплементација генеричких метода.



Слика 33. Доменске класе и зависност брокера од GeneralDObject

public class Game extends GeneralDObject implements Serializable {

private int gameId;

private int score;

private Date date;

private int levelId;

private int userId;

public Game() {

gameId = 0;

score = 0;

SimpleDateFormat sm = new SimpleDateFormat("yyyy-MM-dd");

date = new Date();

date = java.sql.Date.valueOf(sm.format(date));

levelId = 0;

userId = 0;

}

public Game(int gameId, int score, Date date, int levelId, int userId) {

this.gameId = gameId;

this.score = score;

this.date = date;

this.levelId = levelId;

this.userId = userId;

}

// primarni kljuc

public Game(int gameId) {

this.gameId = gameId;

}

public void setID(int id) {

this.gameId = id;

}

public int getPrimaryKey() {

return this.gameId;

}

public int getScore() {

return score;

}

public void setScore(int score) {

this.score = score;

}

public Date getDate(Date date) {

SimpleDateFormat sm = new SimpleDateFormat("yyyy-MM-dd");

this.date = java.sql.Date.valueOf(sm.format(date));

return this.date;

}

public void setDate(Date date) {

this.date = date;

}

public int getLevel() {

return levelId;

}

public void setLevel(int level) {

this.levelId = level;

}

public int getUserId() {

return userId;

}

public void setUserId(int userId) {

this.userId = userId;

}

@Override

public GeneralDObject getNewRecord(ResultSet rs) throws SQLException {

return new Game(rs.getInt("gameId"), rs.getInt("score"), rs.getDate("date"), rs.getInt("levelId"), rs.getInt("userId"));

}

@Override

public String getAtrValue() {

return score + ", " + "'" + date + "'" + ", " + levelId + ", " + userId;

}

@Override

public String setAtrValue() {

return "gameId=" + gameId + ", " + "score=" + score + ", " + "date=" + "'" + getDate(date) + "'" + ", " + "levelId=" + levelId + ", " + "userId=" + userId;

}

@Override

public String getClassName() {

return "Game";

}

@Override

public String getWhereCondition() {

return "gameId = " + gameId;

}

@Override

public String getNameByColumn(int column) {

String names[] = {"gameId", "score", "date", "levelId", "userId"};

return names[column];

}

@Override

public String getColumnNames() {

return " (score, date, levelId, userId) ";

}

}

public class Level extends GeneralDObject implements Serializable {

public int levelId;

public String difficulty;

public double bombPercentage;

public Level() {

levelId = 0;

difficulty = "";

bombPercentage = 0;

}

public Level(int levelId, String difficulty, double bombPercentage) {

this.levelId = levelId;

this.difficulty = difficulty;

this.bombPercentage = bombPercentage;

}

// primarni kljuc

public Level(int levelId) {

this.levelId = levelId;

}

public void setID(int id) {

this.levelId = id;

}

public int getPrimaryKey() {

return this.levelId;

}

@Override

public GeneralDObject getNewRecord(ResultSet rs) throws SQLException {

return new Level(rs.getInt("levelId"), rs.getString("difficulty"), rs.getDouble("bombPercentage"));

}

@Override

public String getAtrValue() {

return levelId + ", " + (difficulty == null ? null : "'" + difficulty + "'") + ", " + bombPercentage;

}

@Override

public String setAtrValue() {

return "levelId=" + levelId + ", " + "difficulty=" + (difficulty == null ? null : "'" + difficulty + "'") + ", " + "bombPercentage=" + bombPercentage;

}

@Override

public String getClassName() {

return "Level";

}

@Override

public String getWhereCondition() {

return "difficulty = '" + difficulty + "'";

}

@Override

public String getNameByColumn(int column) {

String names[] = {"levelId", "difficulty", "bombPercentage"};

return names[column];

}

@Override

public String getColumnNames() {

return " (difficulty, bombPercentage) ";

}

}

public class User extends GeneralDObject implements Serializable {

public int userId;

public String username;

public String password;

public String email;

public int highscore;

public User() {

userId = 0;

username = "";

password = "";

email = "";

highscore = 0;

}

public User(int userId, String username, String password, String email, int highscore) {

this.userId = userId;

this.username = username;

this.password = password;

this.email = email;

this.highscore = highscore;

}

@Override

public int getPrimaryKey() {

return userId;

}

@Override

public void setID(int id) {

userId = id;

}

public String getUsername() {

return username;

}

public void setUsername(String username) {

this.username = username;

}

public String getPassword() {

return password;

}

public void setPassword(String password) {

this.password = password;

}

public String getEmail() {

return email;

}

public void setEmail(String email) {

this.email = email;

}

public int getHighscore() {

return highscore;

}

public void setHighscore(int highscore) {

this.highscore = highscore;

}

@Override

public GeneralDObject getNewRecord(ResultSet rs) throws SQLException {

return new User(rs.getInt("userId"), rs.getString("username"), rs.getString("password"), rs.getString("email"), rs.getInt("highscore"));

}

@Override

public String getAtrValue() {

return (username == null ? null : "'" + username + "'") + "," + (password == null ? null : "'" + password + "'") + "," + (email == null ? null : "'" + email + "'") + "," + "'" + highscore + "'";

}

@Override

public String setAtrValue() {

return "username=" + (username == null ? null : "'" + username + "'") + ", " + "password=" + (password == null ? null : "'" + password + "'") + ", " + "email=" + (email == null ? null : "'" + email + "'") + ", " + "highscore=" + highscore;

}

@Override

public String getClassName() {

return "User";

}

@Override

public String getWhereCondition() {

return "username='" + username + "' and password='" + password + "'";

}

@Override

public String getNameByColumn(int column) {

String names[] = {"userId", "username", "password", "email", "highscore"};

return names[column];

}

@Override

public String getColumnNames() {

return " (username, password, email, highscore) ";

}

}

## Пројектовање пословне логике

**У фази анализе** одредили смо уговоре о системским операцијама, при чему смо рекли да један уговор описује понашање једне системске операције, тако што описује **ШТА** операција треба да ради, **али НЕ и КАКО**.

**У фази пројектовања** за сваки од уговора се пројектује концептуално решење (реализација) СО. То значи да ћемо за сваку класу одговорну за извршење СО дефинисати **КАКО** како ће се СО извршити.

Аспекти реализације који се односе на конекцију са базом, перзистентност и трансакције треба избећи у почетку пројектовања СО.

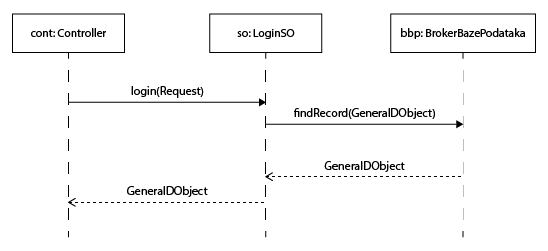
1. **Уговор УГ1: *Prijavi***

**Операција**: *Prijavi(Korisnik):* сигнал

**Веза са СК**: СК1

**Предуслови**: /

**Постуслови**: Корисник је пријављен.



Слика 34. Уговор УГ1

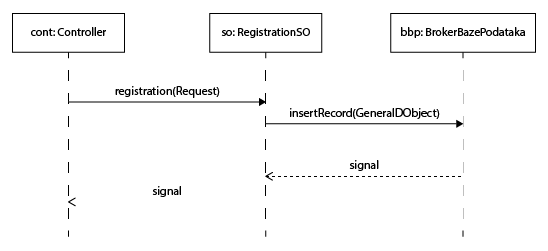
1. **Уговор УГ2: *Registruj***

**Операција**: *Registruj(Korisnik):* сигнал

**Веза са СК**: СК2

**Предуслови**: Вредносна и структурна ограничења над објектом *Korisnik* морају бити задовољена.

**Постуслови**: Корисник је регистрован.



Слика 35. Уговор УГ2

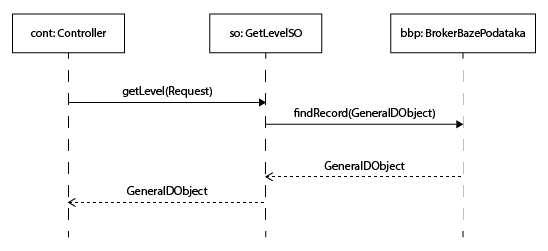
1. **Уговор УГ3: *UcitajNivo***

Операција: *UcitajNivo(Tezina):* сигнал

Веза са СК: СК3

Предуслови: Вредносна и структурна ограничења над објектом *Tezina* морају бити задовољена.

Постуслови: Игра је почела.



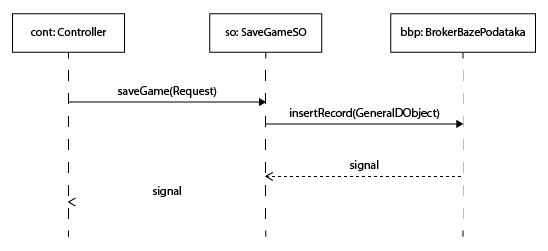
Слика 36. Уговор УГ3

1. **Уговор УГ4: *SacuvajRezultat***

Операција: *SacuvajRezultat(Rezultat):* сигнал

Веза са СК: СК4

Предуслови: Вредносна и структурна ограничења над објектом *Rezultat* морају бити задовољена.  
Постуслови: Резултат је сачуван.



Слика 37. Уговор УГ4

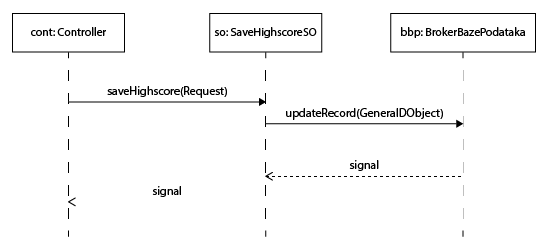
1. **Уговор УГ5: *SacuvajMojRezultat***

Операција: *SacuvajMojRezultat(Rezultat):* сигнал

Веза са СК: СК5

Предуслови: Вредносна и структурна ограничења над објектом *Rezultat* морају бити задовољена.

Постуслови: Корисников најбољи резултат је сачуван.



Слика 38. Уговор УГ5

## Пројектовање брокера базе података

Класа *BrokerBazePodataka* је пројектована како би обезбедила перзистенцију објеката доменских класа и након завршетка рада програма.

Методе ове класе су генерички пројектоване, јер као параметар примају **GeneralDObject**, па самим тим и све подкласе. Методе брокера базе података су:ж

public abstract boolean makeConnection();

public abstract boolean insertRecord(GeneralDObject odo);

public abstract boolean updateRecord(GeneralDObject odo,GeneralDObject odoold);

public abstract boolean updateRecord(GeneralDObject odo);

public abstract boolean deleteRecord(GeneralDObject odo);

public abstract boolean deleteRecords(GeneralDObject odo,String where);

public abstract GeneralDObject findRecord(GeneralDObject odo);

public abstract List<GeneralDObject> findRecord(GeneralDObject odo,String where);

public abstract boolean commitTransation();

public abstract boolean rollbackTransation();

public abstract boolean increaseCounter(GeneralDObject odo,AtomicInteger counter);

public abstract void closeConnection();

public abstract GeneralDObject getRecord(GeneralDObject odo,int index);

public abstract int getRecordsNumber(GeneralDObject odo);

Свака од наведених метода при извршењу позивају методе класе **GeneralDObject**, чије подкласе обезбеђују сопствене имплементације. Методе класе **GeneralDObject**:

abstract public String getAtrValue();

abstract public String setAtrValue();

abstract public String getClassName();

abstract public String getWhereCondition();

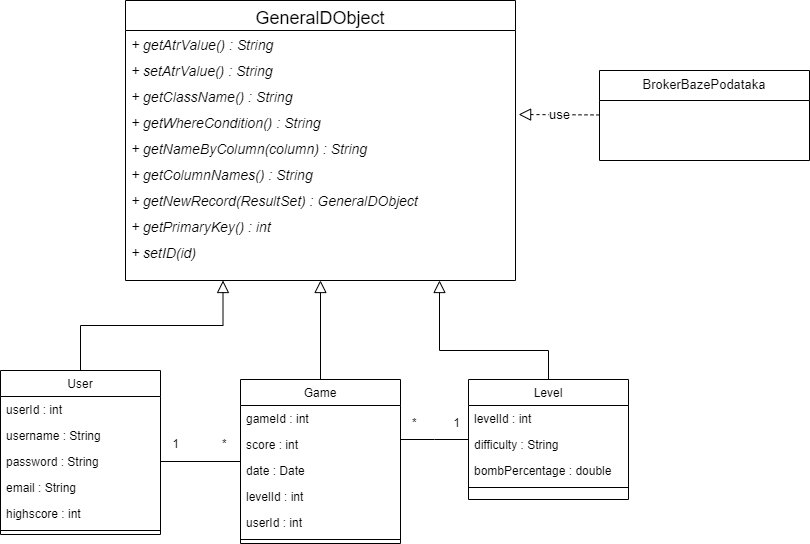
abstract public String getNameByColumn(int column);

abstract public String getColumnNames();

abstract public GeneralDObject getNewRecord(ResultSet rs) throws SQLException;

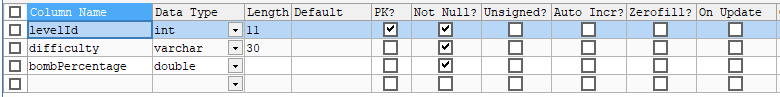
abstract public int getPrimaryKey();

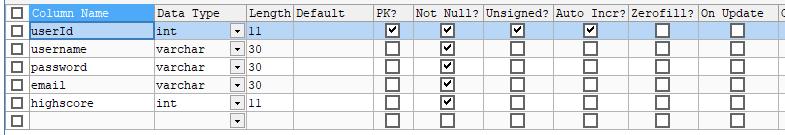
abstract public void setID(int id);

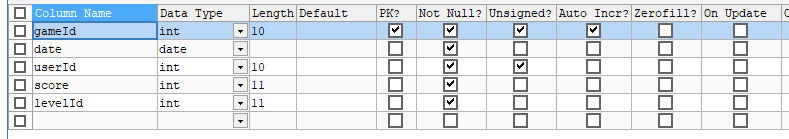


Слика 39. Веза брокера базе података са доменским класама

## Пројектовање складишта података

На основу софтверских класа структуре пројектоване су табеле (складишта података) релационог система за управљање базом података. У овом раду коришћен је СУБП „МySQL”:

Слика 40. Табела *Level*

Слика 41. Табела *User*

Слика 42. Табела *Game*

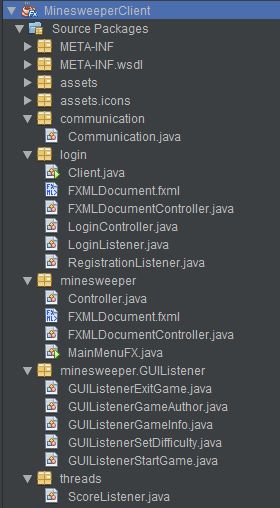
# Имплементација

Софтверски систем који је описан у овом раду, имплементиран је у програмском језику *Јава* као клијент-сервер систем.

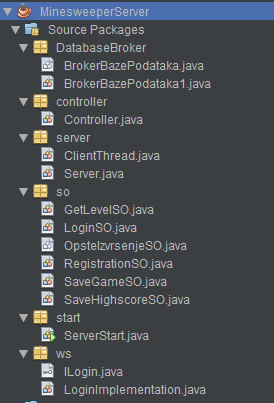
Као развојно окружење коришћен је *NetBeans 8.2*. Као систем за управљање базом података коришћен је *MySQL* систем за управљање базом података.

Систем се састоји из три пројекта: серверског дела апликације, клијентског дела и заједничке библиотеке.

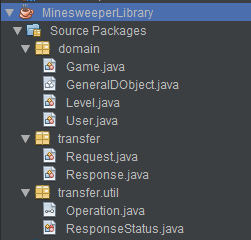
Клијентски пројекат користи *JavaFX* платформу која омогућава олакшан рад и креирање графичких компонената.



Слика 43. Имплементација клијентског дела апликације

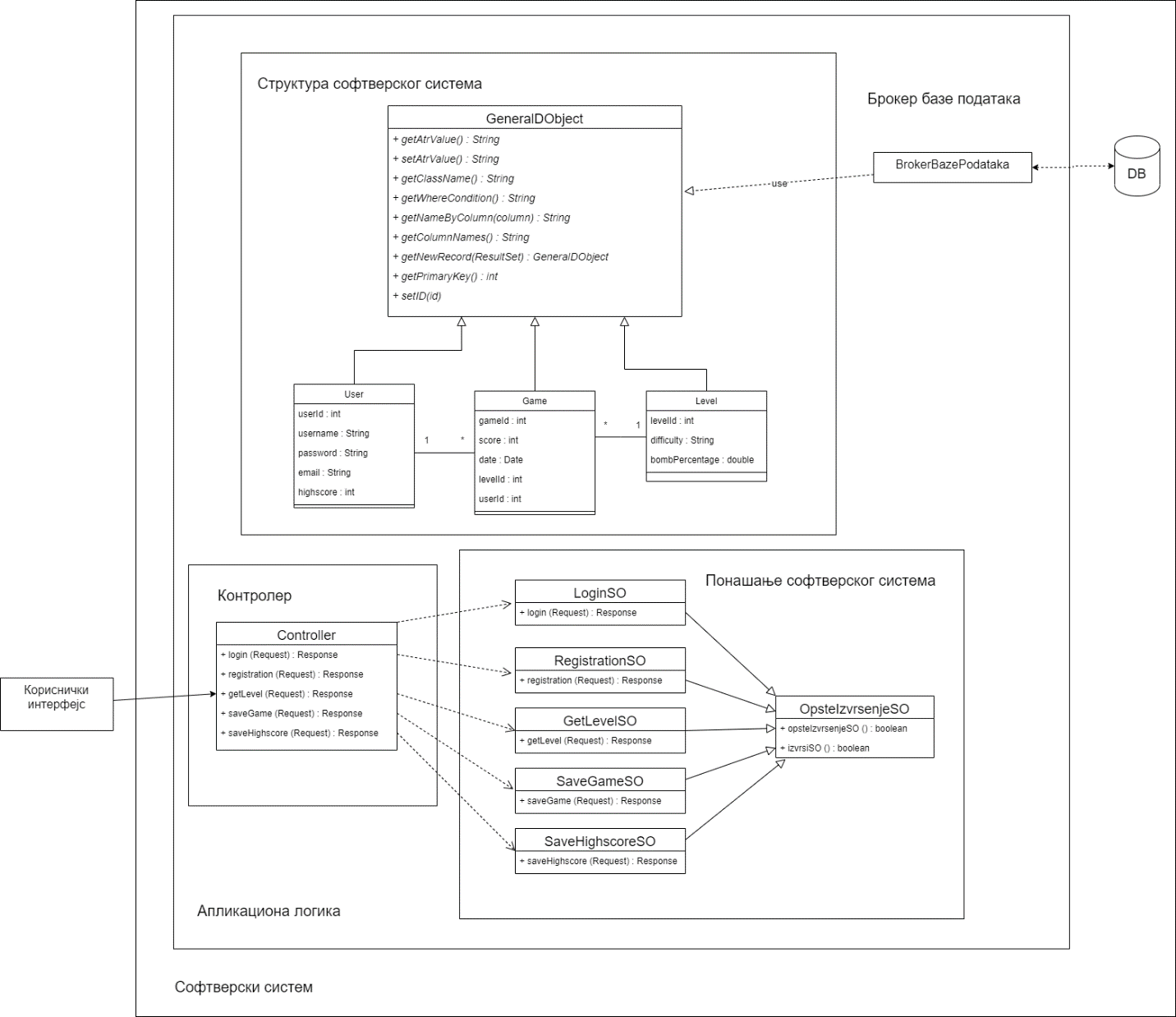


Слика 44. Имплементација серверског дела апликације



Слика 45. Имплементација заједничке библиотеке

Након фазе пројектовања, добијамо целокупну архитектуру софтверског система:



Слика 46. Архитектура софтверског система

## 4.1. Механизам рефлексије

Механизам рефлексије представља начин испитивања или модификовања понашања метода, класа или интерфејса у време извршења програма. Овај механизам се реализује помоћу метаподатака класа.

На следећем примеру извршења системске операције се може видети употреба рефлексије у класи FXMLDocumentController.

@FXML

public void initialize() throws NoSuchFieldException, IllegalArgumentException, IllegalAccessException {

ms = new Controller(this);

for (int x = 0; x < fieldRows; x++) {

for (int y = 0; y < fieldColumns; y++) {

String nazivDugmeta = "p" + x + y;

Class cls = this.getClass();

Field field = cls.getDeclaredField(nazivDugmeta);

Button b = (Button) field.get(this);

b.setDisable(true);

b.setOnMouseClicked(e -> {

if (e.getButton() == MouseButton.PRIMARY) {

ms.open((Button) e.getSource());

} else if (e.getButton() == MouseButton.SECONDARY) {

ms.setFlag((Button) e.getSource());

}

});

}

}

}

public Button getButton(int x, int y) throws NoSuchFieldException, IllegalArgumentException, IllegalAccessException {

Button b = null;

String nazivDugmeta = "p" + x + y;

Class cls = this.getClass();

Field field = cls.getDeclaredField(nazivDugmeta);

b = (Button) field.get(this);

return b;

}

На овај начин се добија објекат доменске класе преко рефлексије поља класе *FXMLDocumentController*. Овакав приступ је од великог значаја када је потребно позвати објекат кад имамо само координате поља која су „погођена“.

# Тестирање

Сваки од имплементираних случајева коришћења је тестиран. Приликом тестирања сваког случаја коришћења, поред унетих правилних података, уношени су и неправилни подаци да би се утврдило какав ће бити резултат извршења.

На основу извршених тестирања отклоњени су уочени недостаци.

# Закључак

Кроз овај рад је описан поступак развоја софтверског система помоћу упрошћене Ларманове методе, која се састоји од пет фаза:

1. Прикупљање захтева од корисника
2. Анализа
3. Пројектовање
4. Имплементација
5. Тестирање

Приликом развоја разматрани су принципи, методе као и стратегије пројектовања софтвера. Да би софтверски систем могао лако да се одржава и надграђује, коришћени су узори пројектовања, који раздвајају генералне делове од специфичних. Показан је пример MVC макро-архитектуре. Такође, коришћен је и механизам рефлексије.

Овако изграђен систем представља модуларан систем који је надградив, једноставнији за одржавање и који треба да омогући ефикасно вођење евиденције о играчима и самој игри.

# Принципи, методе и стратегије пројектовања софтверског система

## Принципи пројектовања софтверског система

### Апстракција

*“Aпстракција је процес свесног заборављања информација, тако да ствари које су различите могу бити третиране као да су исте”.*

Под апстракцијом подразумевамо издвајање општих, генеричких особина, не обраћајући пажњу на детаље и специфичности.

Можемо приметити да се и коришћена метода развоја софтвера, упрошћена Ларманова метода, заснива на принципу апстракције. Кроз све фазе развоја, крећемо се од генералног описа система, интеракција корисника и система, да би у каснијим фазама постепено уводили специфичности које се тичу самих акција, изгледа екранских форми, системских операција.

У контексту пројектовања софтвера, постоје два кључна механизма апстракције:

1. Параметризација
2. Спецификација

Апстракција спецификацијом води до три главне врсте апстракција:

1. Процедурална апстракција
2. Апстракција података
3. Апстракција контролом

*Параметризација* је апстракција која издваја из неког скупа елемената њихова општа својства која су представљена преко параметара.

Постоји пет случајева параметризације:

1. Параметризација скупа елемената простог типа
2. Параметризација скупа елемената сложеног типа
3. Параметризација скупа операција
4. Параметризација скупа процедура
5. Параметризација скупа наредби
6. Параметризација скупа елемената простог типа

Уколико посматрамо скуп целих бројева 1,2,3... њих можемо представити преко неког општег представника скупа целих бројева. На пример помоћу параметра х. У приказаном случају, програмски би то записали као: **int x**;

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generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzkzAACSkgACAAAAAzkzAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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hpanN0dXZ3eHl6g4SFhoeIiYqSk5SVlpeYmZqio6Slpqeoqaqys7S1tre4ubrCw8TFxsfIycrS09TV1tfY2drh4uPk5ebn6Onq8fLz9PX29/j5+v/EAB8BAAMBAQEBAQEBAQEAAAAAAAABAgMEBQYHCAkKC//EALURAAIBAgQEAwQHBQQEAAECdwABAgMRBAUhMQYSQVEHYXETIjKBCBRCkaGxwQkjM1LwFWJy0QoWJDThJfEXGBkaJicoKSo1Njc4OTpDREVGR0hJSlNUVVZXWFlaY2RlZmdoaWpzdHV2d3h5eoKDhIWGh4iJipKTlJWWl5iZmqKjpKWmp6ipqrKztLW2t7i5usLDxMXGx8jJytLT1NXW19jZ2uLj5OXm5+jp6vLz9PX29/j5+v/aAAwDAQACEQMRAD8A+kKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAoo6VBdXcFlbtPdzJDCgyzyMFAH1NAE9FcZefFjwfbXBtrbVf7Tuu1vpcD3Tn2+QED8TVRfG3i7UkJ0P4fXqqWwsurXkVooHqVyzn8BQB31FcKLX4m6l/wAfGp+H9EQjpa2st3Ivtl2Vfxx+FL/wgOt3jFtX+IXiCbLAhbIQ2gHt8iZoA7jNU7rWNPsm23l5Dbnn/WuEHHXk8Vyo+EvhmTJ1JtV1R25Y32qTyBj7rvCn8qs2vwq8C2jK0PhbTSyjAMkO/wDPdnNAGlJ418LxKTJ4j0lcet9F/wDFVSl+JvgaCRkl8WaQrJ94fbEOP1q3F4G8Jw48rwzo6bTkEWEfH6VoDRdLAwNNswP+vdP8KAOe/wCFseAf+hu0n/wJWpF+KPgRyAvi7RyW4H+mJ/jW9/Y2mf8AQOtP/AdP8KT+xdL/AOgbZ/8AgOn+FAFJPGnheRdyeItKIzgH7bHyf++qs2viHSL6Qx2WpW1ywOD5MocfmKpS+BfCs9zLPP4e0yWSX75ktUYH3wRgH3qhc/CvwLdbjL4V0sFhjKW4TH/fOMUAdaD/AJxS1ww+EHhSLP8AZ8eo6b/dFjqc8Kp7hQ+P0oHw81O0OdI8f+Jbc4AxcyxXQ/KRDQB3NFcLFpPxI0qMC18R6LrIxyNQ097dj3zujc89umKQeLPGumD/AInvgV7qMHBn0W/SfHv5b7W/LNAHd0VxMPxa8Ki6W11a4utDum48jVrSS3wf98jZ+INdbY6jZ6nbC4067gu4G6SwSCRT+IoAs0UUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUmfY/lRn6/lQAtFFJmgBaKTOOtLQAUUUgP1/KgBaKTNBP1/KgBaKTP+cUZ57/lQAtFID9fyoz/AJxQAtFIT9fwFGfr+VAC0Umfr+VLQAUUlGf84oAWikz9fypc8d/yoAKKTP1/KjP+cUALRSZ/zijNAC0UUUAFFFFABRRRQAUUUUAFFFFABRRRQAUVHPPFbQPNcSJFFGpZ3dgqqB1JJ6D3rhrj4h3mvTPafDjSf7YKsUfVbljFYREdfn6yf8ABHvQB3UkqQxtJK6oijLMxwAPc9q4q5+Kmjz3DWnha2vPE16DgxaZFujQ+jynCL+ZqKH4bPrMguPiFrM/iGTORZKDBYx+whU/P9XJzXa2VjaadaJa2FrDa26DCxQoEVfwHFGgHGC3+IviIA3F3p/hS1cHMdqv2y6H/AANsIp+gNOg+Evh+SZbjxG994luV5EmsXLTKD7R8IPyruaKYFax02x0y3EGm2cFpCOkdvGI1/IYqzRRSAMUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUARXNtBdwNDdQRzxMMNHIoZSPcHiuOv/hR4VuJTcaZazaFdk5+0aPO1q34hTtP4iu2ooA4IaN8QPD53aRr1p4it1zm31iLyZj6ATRjGfqtLD8UINOm+z+N9IvvDUucCe4j8y1Y9OJ0yoH+9iu8pksMc0TRTRrJG4wyMoIb6g9aYEdreW19apcWVxFcQuMrLE4dW+hHBqeuGvvhfYW94+oeDL658LX7ZLGwwbeY/9NID8hH0wfeq6+NPEHhNvL+IWk77JeBrekoZIP8Aelj+/F7nlaLAeg0VV0/UrPVrCO90y6huraUZSWFw6sPqKtCkAUUUUAFFFFABTZEEkbI3RgQcHFOpkj7I2bBO0E4UZJ+lAHiXw2t5dZ+JnjrS9U1HUrmy0u9WOzie/m/crvfgEMD0AHOelT/By4u9R+IXjWPUNQvbqLTL4w2cU11I6RIWYYCk4PAHXNTfDXTtX0b4leNtV1XQtRtrTV7nz7SRoR86qznkBjg4IwKj+FWn6z4e8ZeNNQ1fQNTtrfVLo3NqzQg71DMcYDHDYIwKoRqfGTxvqnhKLSL3SAWtbHUIZdUKvg+U2VVD6hvmJ+i+tdn4kMGreBL26t55RG1k1xBNbytGw+QsrBlIPpXKX/h2Xxl4E1mTVDrNlJqauZdPMS5RuBGAvO7GF6HnFZfgK48S6f8ABu70HxL4d1SO+sraS2ttsSubhGBCYw3BGcHPYCjSw1ucPYeI9Wj+CWja1o2u6hP4wkvCkcKXD3DXKlyCrxEkbcY5wPrXvWoanqFn4PFw0Kf2vLbqkdvuwrXDLwufTd39Aa5L4G6Td6J8O7TTtY0ifT9Qti4kM8KqXDMSMMCc8Vv6ibvWfF0dj5OqWFrZIZI72KNRHLKQQQGJPAX1HJY+lAkYvwU8X3Hiz4eouqytJqumytaXm9suWBOGPuR/I1x/i3UdU+HPxQ03xBHqt7J4au742F5ZTXDyRwFlB3AEnHXP4GrPhzSNc8E/HPVprDSdVvvD+tKDcXLRr+7n678ZGRnOTjo3tXSeKPD3/CwfCvifQ7jTb20kkl86ymuYgqu6qNjLz6gjnHBp6XBdiL44arf2fw01GfRr2azktkjnNzbyFG5kCqoI7EEn8K5L4jS3mjfs66NrWm6nqMGpMlq73S3su9zIgL5+bnJ/LtWn4p8N+I2/Z5j8PTWN1qfiC6toFlWFFOwoV+Vmzj5VGM98VW+IWja3r3wC0jw5pmg6lJqkSWySQtEF2GJAGyd2MZ6dc0aAjrfDNrpmtrp02i6tdm90xbae8aO/kljlLx5aOQFiDkEnHY4rnfjXY3Phb4baprWnavqSajNqCyLOLyRfKR3/ANWqg7QoHHSuj0m8k0mxs49G8L6iupXaWtveO1qsSRBVCmRznB2jPTOaqfHnStS1/wCG82kaJpt1f3k08cirBHkKqMCckkYo0uC2NbRfDEVxoGn6j9u1AfaNKVbmM3spErMitv5bKsD3GOteOaB4gvT8FdU1ceItSPie31Fo7ApdvNNJhgAnlZIZSC3Vfxr3bQ7qS3+Htm02n3qTW9kkT2xh/ellQKQFzzz71xXwG0a/0PwzeWOu6Lc2F6t7LMr3ECjKNjADgn8qLh0RznxLu/EMOj+ANRvr290vVNSuYbfU4La5eNX3AEgqDgHr09ad8XtQu7Lxv4VtNDvdQs7Ka+Syu3gv5FE2GXKYz1VTgt1ycVsfHLSdc8RXXh210DSNQuv7Pvxd3FzbxqRGoGBt3EZbqce1UvijoF/fal4KHh3QdSuLXSb1bm5ZYeVVmViTkjLEgkj1qk46Cseg+K7OwsND1G41bWprCxS02W+LtojCyq3zhs5Zunc9OlUPg1qPiXVPhxa3PjJZTemRvKknXbJLFxtZh+f1Ard8QXsT6LL9p0G61RJYiUtlt1dnJU/KVYjae3NeefDzR/F3gT4Y3FprVrfXl3e3JFrZW5EzWMTDBJYtjjk4BPP1qOgy1B8QL63+Py6PqD7ND1axCaYxfKySIxy492O4c+gpP2hJrvTPAlvq2lahe2F5FeRxeZa3Dx7kbOVIBwf58Vk/FnwHqlx4c0LUvC51jUNX0u4SS0idVzGgAzu6YOQp/OrXxcGv+NPhVptrp3hnUjqNxcRT3FuY1H2fZndk7sHnGPUHNNWumBX+N/2nQPh/oN5oupajY3H2qK3aSG9kBdGUkhsnk55z1pfjk11oPgfw7daLqWoWM7XcNq8kN5IC8bKSQeeTnnPWk+MsepeKfh/ptpouhatPNZXUU84NqV2oiHceTyfYZpnxc+2+Pfhv4bbwdpt9qStPFeCWKD5URVK87iPmz29qNLICp8cdRuNHttCh8OajqFmYrxLO7mgvpBncu4RnJO5sZJPUZHrx6r4v0+O2+HOpxW8tzEbOxlkglS5cSKyISp35yTn1zXmnxc8P6prHhPw5Z+HtE1S9mt75b25ZoArEkHcXyfvk9q6zxU/iy9uNSNrbzTaDqGhyQW9ktuvnLdtlRvycqMHOelJ6oOpV+AFzdan8L7fU9TvLq9vbmeUSTXM7SEhWwAMnAH0qC0+IN/b/AB8/sPVMR6Nq1kBpbeYCrujNlvqxDDHsvrU/g/RdW+Hfwe07RZLC7u9TmLCVbFBL9nMjfMxyQPlU59yOKwfiz4F1SfR9B1bwu2rahrGk3CS2kLKvyRjBIJGNpGB+tGlxLY9u68iis7QtRm1XQ7a8u7GewnkQGW2nXa0bdx1PGeh9K0akoKKKKACiiigAooooAKKKM0AFcz4r8bWfhlobOG3m1TWboH7JpdmA00v+0eyIO7His7xL4xvZ9c/4RTwSsdzrjLuubl/mh0yM/wDLST1Y/wAKdT34rU8KeC9P8LRzTRvJfapd/NeandHfPcN7t2X0UcCn6gYNt4H1XxXPHqHxLulmjVg8Og2jkWkHp5h6zMPf5fau+hhighWKCNY40GFRFACj0AHSn0UmAUUUUAFFFFABRRRQAUVyPxD1jU9E0nT7rSblIDJqVrby7oQ5ZJJQrAZPHHeuuFABRRRQAUUUUAFFFFABRRRQAUUUUAFFV78XbWUi6e0aXDDCPKMqnuR3x6d64zTbvxDoPxDtNC1PVW1uw1KzmuVllgSOW1eMrkZTgo27jPIIppXA7uiiikAUUUUAFNZQykMAQeCCOtOooA4XUfh5Jp+pPrPw+vV0HUHJaa12brK8PX95EPuk/wB9cH61c8PeOkvtVGg+I7JtE8Qqu77JM2Y7kDq8EnSRfb7w7iuurH8S+FtK8W6X9h1m3LqrB4po22SwOOjo45Vh6in6gbAorz/SfEmqeEdZi8OeO5xNBOwj0rXCNq3PpFN2WUevRvrXoFFrAFFFFIAoqlq99Lpmk3F5b2NxqEsS5W1tgDJIfRckD8zXHf8ACxta/wCiceKP++YP/jlAHfUYrgf+Fja1/wBE48Uf98wf/HKP+Fja1/0TjxR/3zB/8coA76jFcD/wsbWv+iceKP8AvmD/AOOUf8LG1r/onHij/vmD/wCOUAd9iiuB/wCFja1/0TjxR/3zB/8AHKP+Fja1/wBE48Uf98wf/HKAO+xRXA/8LG1r/onHij/vmD/45R/wsbWv+iceKP8AvmD/AOOUAd9RXA/8LG1r/onHij/vmD/45R/wsbWv+iceKP8AvmD/AOOUAd7S1wP/AAsbWv8AonHij/vmD/45R/wsbWv+iceKP++YP/jlAHfUYrgf+Fja1/0TjxR/3zB/8co/4WNrX/ROPFH/AHzB/wDHKAO+wKMVwP8AwsbWv+iceKP++YP/AI5R/wALG1r/AKJx4o/75g/+OUgO+orgf+Fja1/0TjxR/wB8wf8Axyj/AIWNrX/ROPFH/fMH/wAcpgd9ijFcD/wsbWv+iceKP++YP/jlH/Cxta/6Jx4o/wC+YP8A45SA77FQ21rBZwiG1iWKIEkIgwAScnj61w//AAsbWv8AonHij/vmD/45R/wsbWv+iceKP++YP/jlMDvsUhrgv+Fja1/0TjxR/wB8wf8Axyj/AIWNrX/ROPFH/fMH/wAcpAd20iK4VmUFugJ60+vlf48+ONek1jw/e2+l614ZmtxI0ZuZEQyMGU5ARiDj39a6T4Q/G3xd4kvYtJ1fQJ9aVSFfULOMI0Y4G6TPynr2wfanYD6EooooAKKKKACiiigAooooAK4/xr4kv4Lm18M+Fdj+INTVikjcrYwj71w49B0A7tiuh1vWLTQNDvNV1KTy7WzhaaRvYD+fYe5rmfh3ol7Ha3XibxCD/bevFZpkP/LtCB+5gH+6p59yaEBseEvCen+ENH+xWG+WWVzNdXcxzLdSn70jt3J/QcCt2iigAooooAKKKKACiiigAooooA4L4tzrH4d01Csrv/a9pLtiieQhElDM2FB4A5ruoZUmhSWM7kcblPqD0p9FHQOoUUUUAFFFFABRRRQAUUUUAFFFFAFLV9Ut9F0q41C880w26bmEMTSOfYKoJJ+lcr4a8W6Lq+vboft02p3a7cPptxElvEvOzfIijGTknPJNdvRTAPrRRRSAKKKKACiiigAooooAz9c0TT/Eei3Gl6xbLc2lwu142/Qg9iDyCOhrk/CWr6j4f17/AIQnxTctdzBGk0jUZBg3sC9Vb/pqnAPqOa7yub8b+F/+Em0HbaP9n1WycXWm3Q4aGdeVOf7p+6w7gmnfSwHSUVgeCvEq+LPCdpqZi8i4bMV1b55gmQ7ZEP0YH8MVv0gCk2j0H5UtFACbR6D8qNo9B+VLRQAm0eg/KjaPQflS0UAJtHoPyo2j0H5UtFACbR6D8qNo9B+VLRQAm0eg/KjaPQflS0UAJtHoPyo2j0H5UtFACbR6D8qNo9B+VLRQAm0eg/KjaPQflS0UAJtHoPyo2j0H5UtFACbR6D8qNo9B+VLRQAm0eg/KjaPQflS0UAJtHoPyo2j0H5UtFAHG+MfhhoPjvW9NvvESzTxaejKlqjbEkLEHLEc9uma6fTdKsNGsI7LSrOG0toxhYoUCqPwFW6KYBRRRSAKKKKACivJ/E2nR+H/Ftw6T3A8OawscGrN5kh/s193yOjZ+RXPDY+7kNXqdtBHbW0cMA2xRqFQZJwAOOT1oAlooooA4P4hhdb1rw54QbPlandG7u8f88LfEhX/gT7BXdjiuGRI7z48TSYDmw0BF+9naZZyenbISu6oEgooooGFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFB6UUhyFOBk+lAHnl5BHp3xD0iHT/F8ratcTlr+wurwMk9vtYkLF0VgSu3bg49RXolcJqWkHxu2jXN1oU2l32nanHcSyXKKHiEfJCOPvhsAccY64xXd0AFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABSUtFAHBaLu8PfGDWtJ+VLLXLVdVt1AxiZCI5wPUn5GNd7XC+MmFr8RvA94ufMe8uLM+6PAWI/NBXcj7ooAWiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigDBn8F6Bc6fqNjPYl7bVJvOvImmkxK/cn5v0GBxWrp9hb6Xp8FjYx+Xb26CONNxbao6DJJNWaKACiiigDh4Qtn8dLkHav2/QY2BIwWMU5B574D13FcH4+H9jeJfC/isL+6srs2N42fuwXA2bj2wJAhru/rQIWiiigYUUUUAFFFFABRRRQAUUUUAFFcr471S5t/DmpWulTvBeDT57hriPrboqE7h/tEgAfie1XvBcrzeA9ClmdpJH06BnZmyWJjGST60AblFFFABRRRQAUUUUAFFFFABRRRQAUVV1Ka6t9LuZdPt/tV0kTNDDuC+Y+OBk8DnvXlnw4hgtPG0tv4kttc03xQ0DzeRfak1xbXKkjfJDj5eCcY6qKAPXaKKKACiiigAooooAKKKKACiijNAHB+NQLj4i+BbRNxlW+uLogDIEaQEEn05ZR+Nd2OlcHpT/8JD8ZtWvh81p4ds106I5yDcSkSSkfRQi13tABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAGd4g0S08R+H73SNRTfbXkLRSDOOCOo9wcH8K574d67dXmlz6Drr/8T3QnFpe5GPOGP3cw9VdQDn1zXZVxvjXQr+O6t/FfhWLzNc05Nj22cDULbOWgPv3U9m+tAHZUVj+GPE2n+K9Di1LS5GKMSkkUg2yQSDho3X+FgeorYoAKKKKACiiigAooooAKKKKAOD8WfD+71O21y607xHrkc99BJtsYriNYXbyyqphl4U8Dr3rb8DaJd+H/AAXp2n6jdXVxcxwJ5ouZFcxNsAMaleNqkYHX610NFABRRRQAUUUUAFFFFABRRRQAUUUUAVtQnuLawmmsrQ3k6LlLdZFQyH03NwPxrn7axv8AW/E1hrOqaYdMTTYpRBFLKkkrvKAGJ2EqoAHYnJNdTRQAUUUUAFFFFABRRRQAUUUUAFc9418UL4V8OvdRRG5v53FtYWq8tcXD8IuPTPJ9ADWtqep2ejaZcajqlzHa2lshkllkbAUVxPhXT73xjr8fjXxHbS2sEAZNE06YYMMbdbhx2lcdB/CuPWgDoPBPhxvDHhW3sp5PPvZC1xezk586eQ7pG/M4HsBXQ0UUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAHDeIfCup6Xrz+K/AgiXUZABqGmyPsh1JB05/hlHZ+/Q1t+FPF2m+LtPeexLw3MDeXd2NwNs9rIOqOvb69D2rerlPFHgaHW7xNX0i8k0XxDAu2HU7YDLD+5KvSRPY9O2KAOrorgNO8fXeg3kGjfEi0XS7pz5dvqsbE2V6fUOf8AVMf7r/ga71JFkRXRgysMqwOQR6igB1FFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFITigBay/EXiLTfC2izaprNwsFvEOB1aRuyIvVmPYCue1j4hRtqMmi+DLP/hIdaU7ZI4ZMQWnvNL0Xp90ZY+lGheAX/tePxB40vRreurzFlcWtl/swRnpj++fmPtQBR0vRtX8d6pBrnjO1ax0i3kEum6DJ94sPuzXI6Fu4TovU816H2oooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAgvbG11KzltNQtorm2lG2SGZA6uPQg8GuF/4QTWfCTNN8OtX8u1zuOh6mzS2p9on+9D+GRz0r0GigDhbH4nW1pMLPxxplz4WvN20PefNaynp8lwPlOffBrtoLiG5hSa2lSWJxlJEYMrD2I4NNu7O2v7WS2vreK4glGHilQMrD3B4NcTcfC22spHn8F6zqHhqViCYLV/MtG+sDZUA99uKAO8orz7+2viJ4ewmr+H7PxFbKMG70eXypvqYJOD/wABar+m/FXwpe3QtL29k0a+Jx9k1aFrWQH0+fCn8CaAOyoqOC4hubdZ7aVJonGVkjYMrD2I4p+aAFooooAKKKKACiiigAooooAKKKKACiiigAooooAKM013WONndgqKMsxOAB65rkdW+Kfg/SJTbvrEd5efw2lgpuZW7YCx5/XFAHYZprOqqWY4CjJJ7VwI8U+OPEBA8NeExpVsxx9t1+XyzjsRAmWP0JFPj+G1zrLrN488R3utkdLK3JtLQcdPLQ5b/gRoAs6j8T9GS8OneHI5/Emq/wDPppi+YEPbzJPuRj3JqkPDHivxkyP42v00jTMHdoukTNmXtiafgkf7K4HvXaaZo+naLZLaaTY29lboOIoIwi/kKu0AUNI0TTNA09LHRbGCytkHyxQoFH1Pqfc81foooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAo60UUAJiq19ptlqcBg1G0gu4T1jniDr+RFWqKAOGn+Efhpbh7jRPt/h+4bnfpF68AB552Z2d8dKjXwr430ZB/YHjKG+iQfJbazYK2frLGVb8SDXe0UAcDJrXxLsGH2zwrpWpRqwLSaZqG1mHskoH/oVPb4nixONd8I+JNNAODKLH7RGD/vRFs/hXd0mPagDiR8YfBCvsu9ZNi/929tJrc/+PqK0bb4jeD7vPk+JdKIHdrtF/ma6R0V1w6hh6HmsyXwvoE7s82iadI7nLM1pGST6k4oAmi1zSp13QanZyKP4kuEI/nVlbuB2ASaNiRkbXBrmpvhd4GuGZpvCmlMzHJP2Vf6Uq/DLwbHaNaw+H7SGBm3NFEGRSfXAI5oA6jzE/vL+Ypj3MMePMlRc9MsK5b/hVfgr/oAW/wD32/8A8VUlt8M/B1pM01voNssjIY2bLHKnqvJ6H0oA3ZNZ0yJSZdQtEC9S06jH61k3XxB8JWaFpvEmlYGeFvIyf51Vj+FfgSL7nhPSfxtVP861IvCHhuFQsegaYAOg+xx8f+O0CMA/GPwLuCRa6k8pBPlW0Ekz/kimhvihbXBC6J4a8SaqSSFaLTHiTI7FpNuPrXaRwxQqFhjSNQMAIMD9KfigEcGviT4hagxGneCLWwQniXVNTUYH+5EGJ/MU9tB+IOqof7T8V6dpKsOYtK07zCP+2kpP/oNdziloGcLH8JtEuH8zxHfav4ic/eXU753jPH/PNcL+ldTpOgaToVuING021sYh/DbwqmfyHtWjRQAmKWiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigD//2Q==)

Слика 47. Параметризација скупа елемената простог типа

1. Параметризација скупа елемената сложеног типа

Уколико посматрамо неки скуп сложених објеката, нпр. скуп играча: (1, “markovski”, ”sifra” ), (2, “pera”, ”pera123”), тада параметризацијом добијамо општа својства тог скупа, односно њихове атрибуте: *ID*, корисничко име и лозинку. Наведени скуп објеката означићемо са S, а елементе скупа са s1,s2.

Параметризација

|  |  |
| --- | --- |
| S1 | S2 |
| 1 | 2 |
| markovski | pera |
| sifra | pera123 |

id

Спецификација

корисничко име

лозинка

* Параметризацијом добијамо општа својства елемената скупа
* Пример је класа у објектно оријентисаним програмским језицима, јер представља представника неког скупа, а параметризацијом долазимо до његових својстава, односно атрибута класе
* Спецификација следи параметризацију, јер наводи општа својства елемената скупа, односно користити резултате параметризације
* Апстракција је дефинисана именом и спецификацијом скупа:

*Корисник (id, корисничко име, лозинка)*.

1. Параметризација скупа операција:

Уколико посматрамо неки *S,* скуп операција: { (3+2), (1+6), (2+9) }, уочавамо општу операцију сабирања над два елемента и можемо је дефинисати са **x+y**. Бројеви **x** и **y** представљају операнде над којима се операција извршава, док **+** представља оно што операција ради. Наведени скуп елемената означен је са О1, О2 и О3:

|  |  |  |
| --- | --- | --- |
| О1 | О2 | О3 |
| 3 | 1 | 2 |
| + | + | + |
| 2 | 6 | 9 |

Параметризација

х

Спецификација

+

у

* Специфицирањем општих својстава операције, добијамо њене елементе:

операнде и оператор

* Специфицирањем неког скупа операција, из њега добијамо општу операцију.
* Спецификацијом операције, за наведени пример, се добија општа операција за сабирање два броја.

1. Параметризација скупа процедура

Уколико посматрамо неки скуп *S* процедура:

s1: *boolean insertRecord(GeneralDObject gdo)* – метода која чува игру

s2*: boolean insertRecord(GeneralDObject gdo)* – метода која чува корисника.

Уочавамо да параметризацијом добијамо општу процедуру:

*boolean insertRecord(GeneralDObject gdo).* Елементи који чине процедуру су:

повратна вредност процедуре, назив процедуре, аргументи (параметри) процедуре и тело процедуре.

|  |  |  |
| --- | --- | --- |
|  | S1 | S2 |
| Повратна вредност процедуре | boolean | boolean |
| назив | *insertRecord* | *insertRecord* |
| аргументи | GeneralDObject | GeneralDObject |
| Тело процедуре | Метода која чува игру | Метода која чува играча |

*insertRecord*

boolean

Спецификација

GeneralDObject

* Навођење општих својстава процедуре представља спецификацију процедуре
* Спецификацијом процедуре се добија општа процедура над неким скупом процедура
* Резултат спецификације процедуре је њен потпис
* Као такав, потпис процедуре представља процедуралну апстракцију неког скупа процедура.

У нашем примеру добијамо следећи потпис: *boolean insertRecord(GeneralDObject gdo).*

1. Параметризација скупа наредби

Уколико посматрамо скуп *S* наредби:

1. S1: System.out.println(“Korisnik ”+users[0].getUsername()+” se prikljucio igri!”);
2. S2: System.out.println(“Korisnik ”+users[1].getUsername()+” se prikljucio igri!”);

Уочићемо да се параметризацијом истичу општа својства ових наредби, а то су:

* System.out.println(
* “Igrac “
* +igraci[i].getKorisnickoIme()+
* “ se prikljucio igri!”
* );

|  |  |
| --- | --- |
| S1 | S2 |
| System.out.printl( | System.out.printl( |
| “Korisnik ” | “Korisnik ” |
| +users[0].getUsername()+ | +users[1].getUsername()+ |
| “ se prikljucio igri!” | “ se prikljucio igri!” |
| ); | ); |

Параметризација:

Спецификација

---------------> System.out.printl(

--------------->“Korisnik ”

------------>+users[0].getUsername()+

------------->” se prikljucio igri!”

*-------------> “);”*

Навођење општих својстава наредбе представља спецификацију наредбе.

Као резултат спецификације наредбе добија се:

for(int i=0;i<2;i++){ System.out.println(“Korisnik ”+users[i].getUsername()+” se prikljucio igri!”);}

Спецификацијом наредби из скупа наредби, добијамо општу наредбу.

* Спецификација наредби представља апстракцију наредби, један од облика **апстакције контролом**.

*Спецификација* је апстракција која издваја из неког скупа елемената њихова општа својства, која могу бити представљена преко процедуре, податка или контроле.

1. **Процедурална апстракција**

Процедуралном апстракцијом издвајамо из неког скупа процедура оно што су њихова општа својства:

* Тип повратне вредности
* име процедуре
* аргумент процедуре

Као што је већ речено, ретултат процедуралне апстракције је потпис процедуре. Њен резултат, поред потписа, могу бити додатне информације о процедури, као што су услови извршења и/или додатни опис шта она ради.

Предности процедуларне апстракције су да се фокусира на то шта процедура ради, не бави се детаљима њене имплементације и начином реализације.

1. **Апстракција података**

* Апстракцијом података издвајамо општа својства неког датог скупа података

Уколико имамо нпр. скуп играча {(1, “markovski”,”sifra”), (2,”pera”,”pera123”)},

Тада се параметризацијом добијају општа својства скупа: ид, корисничко име, лозинка.

Параметризацију следи спецификација, па се навођењем ових општих својстава добија спецификација скупа.

Апстракција података је дефинисана именом (Korisnik) скупа и спецификацијом скупа: ид, корисничко име, лозинка.

Уколико елементи скупа имају и структуру и понашање – објекти, тада се над њима ради и процедурална апстракција и апстракција података. Резултат примене ових апстракција је класа која има своја стања – *атрибуте* и понашање-*методе*. Уколико елементи скупа имају само понашање, резултат процедуралне апстракције ће бити интерфејс који садржи скуп потписа процедура.

1. **Апстракција контролом**

Постоје два вида апстракције контролом:

1. Апстракција наредби

Овом апстракцијом се из неког скупа наредби издваја оно што је опште и представља се помоћу контролне структуре и опште наредбе.

1. Апстракција структура података

Овом апстракцијом се из неког скупа структура издвајају њихове опште особине и представљају се помоћу итератора који контролише пролазак кроз структуру података.

*Спојеност* (coupling) *и кохезија* (cohesion)

Оно чему се тежи при развоју софтверских система је остваривање:

* Што веће кохезије – *high cohesion*
* Што мање повезаних класа – *low coupling*

***Кохезија***

Класа X треба да обезбеди неко понашање m1().

*class X{*

*public m1(){}*

*}*

Уколико се при извршењу *m1* позивају друге методе класе X, *m11*,*m12* и *m13*:

*class X {*

*public m1() {*

*m11();*

*m12();*

*m13();*

*}*

*private m12(){…}*

*private m13(){…}*

*}*

онда се може рећи да наведена класа има високу кохезију. Кохезија нам говори о томе колико су методе унутар класе међусобно повезане.

Губитак кохезије значи да је нека класа одговорна да обезбеди више различитих понашања, која између себе нису повезана.

*class Y{*

*public m1(){*

*m11(); m12(); m13();*

*}*

*public m2(){*

*m21(); m22(); m23();*

*}*

*public m3(){*

*m31(); m32(); m33();*

*}*

*private m12(){…}*

*private m13(){…}*

*private m21(){}*

*}*

Оваква класа је тешка за одржавање и надградњу.

У овом примеру видимо да међу приватним методама које спадају под извршење једне операције постоји повезаност (m11,m12,m13), али да између метода које припадају различитим извршењима (m12, m23), не постоји повезаност.

Самим тим, закључујемо да треба правити класе које имају високу кохезију, ради лакше надградње и одржавања,

***Повезаност – Coupling***

Повезаност – купловање значи да класе међусобно зависе једна од друге. То значи да класа не може да обави неку операцију без присуства друге класе.

На пример, класа X, има методу m1, која при извршењу позива методу m2, класе Y.

У том случају, класа X зависи од класе Y.

*class X{*

*Y y;*

*public m1(){*

*y=new Y(); y.m2();*

*}*

*}*

*class Y{*

*public m2(){..}*

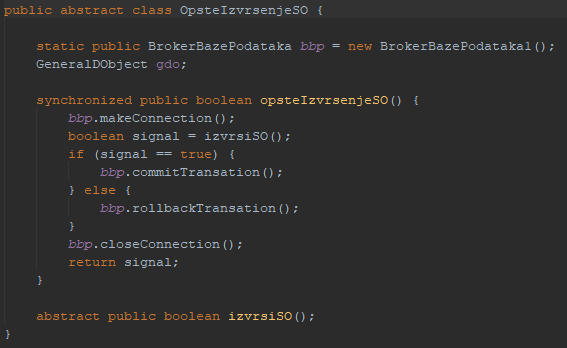
*}*

Купловање представља меру повезаности класе са другим класама, којом се утврђује колико је једна класа зависна од других.

Класа која јако зависи од других класа је класа са снажном повезаношћу – *High/strong coupling.*

Закључак је да треба правити класе са слабом повезаношћу са другим класама, иако је прихваћено да је међусобна повезаност класа неизбежна.

Пример међусобне повезаности класа је класа *OpsteIzvrsenjeSO,* која у својој *template* методи, иако добро пројектованој, приказује зависност од класе *BrokerBazePodataka*.



Слика 48. Повезаност класа *OpsteIzvrsenjeSO* и *BrokerBazePodataka*

Међутим, овакав ниво повезаности је низак, прихватљив и неизбежан, јер класа *OpsteIzvrsenjeSO* зависи само од једне друге класе.

***Декомпозиција и модуларизација***

Декомпозиција представља процес рашчлањивања, процес који полазни проблем дели у скуп потпроблема, који се независно решавају. Када су потпроблеми решени на тај начин, омогућавају да се полазни проблем лакше реши.

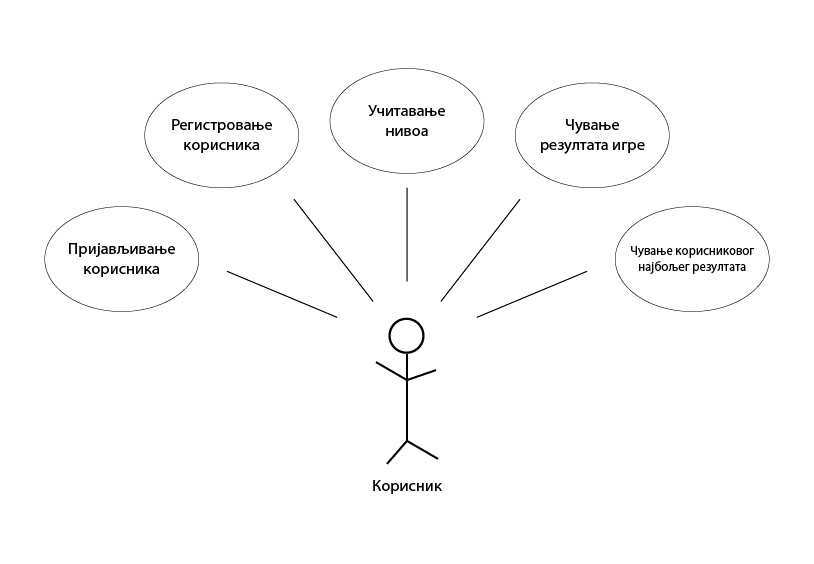
Уколико примењујемо принцип декомпозиције при развоју софтверског система, доћи ће до модуларизације софтверског система.

Закључак је да модуларизација софтверског система настаје као последица процеса декомпозиције.

Декомпозиција може бити објашњена са више аспеката при развоју софтвера:

1. Декомпозиција код прикупљања захтева

Кориснички захтев се код прикупљања декомпонује на скуп захтева који се описују преко случајева коришћења: Пријављивање, регистровање, учитавање нивоа, чување резултата игре, чување корисниковог најбољег резултата.



Слика 49. Декомпозиција код прикупљања захтева

1. Декомпозиција код пројектовања софтвера

При развоју софтверског система, применом Ларманове методе се, у трећој фази - фази пројектовања, врши пројектовање архитектуре софтверског система која је модуларна:

1. Модул – кориснички интерфејс
2. Модул – апликациона логика
3. Модул – складиште података

![A screenshot of a social media post

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzg2AACSkgACAAAAAzg2AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Слика 50. Декомпозиција код пројектовања софтвера

Сваки модул је добијен декомпозицијом, може се независно пројектовати и имплементирати.

Постоје принципи који морају бити испуњени да би софтверски систем могао да се декомпонује у модуле:

* Модули треба да имају јаку кохезију *(high cohesion)*
* Модули треба буду што је могуће слабије везани *(low coupling)*
* Сваки модул треба да чува своје интерне информације *(information hiding)*

Резултат процеса декомпозиције је софтверски систем који је модуларизован.

1. Декомпозиција функција (метода)

Функција – метода неке класе која је сложена, може бити декомпонована на више подфункција. Ове подфункције се независно решавају да би се на крају све интегрисале у једну целину како би се реализовала почетна функција.

У примеру, метода брокера базе података *insertRecord*.

A screenshot of a cell phone

Description automatically generated

Слика 51. Декомпозиција функција

***Учаурење – енкапсулација / Сакривање информација – information hiding***

Учаурење је процес којим се раздвајају:

* Особине модула – класе, које су јавне за друге модуле
* Од особина модула које су скривене за друге модуле система

Особине које су јавне, могу користити други модули, за разлику од оних које нису јавне.

Сакривање информација представља резултат енкапсулације, јер се сакривају информације које други модули не смеју користити.

Као пример ће послужити класа *Controller*:



Слика 52. Енкапсулација

Ова класа је имплементирана као *Singleton* класа, што значи да ће само једном бити инстанцирана при првом позиву њене јавне методе *getInstance().*

Наиме, она ставља на располагање своју јавну методу другим класама којима је потребна њена инстанца, али им не дозвољава креирање. Као што је приказано на слици 52. , конструктор ове класе је приватан, што значи да друге класе којима је потребна инстанца класе *Controller*, не знају да ли је она тог тренутка била креирана или не. Оно што је сигурно, је, да ће ту инстанцу добити и да ће инстанца бити јединствена током целог њеног постојања.

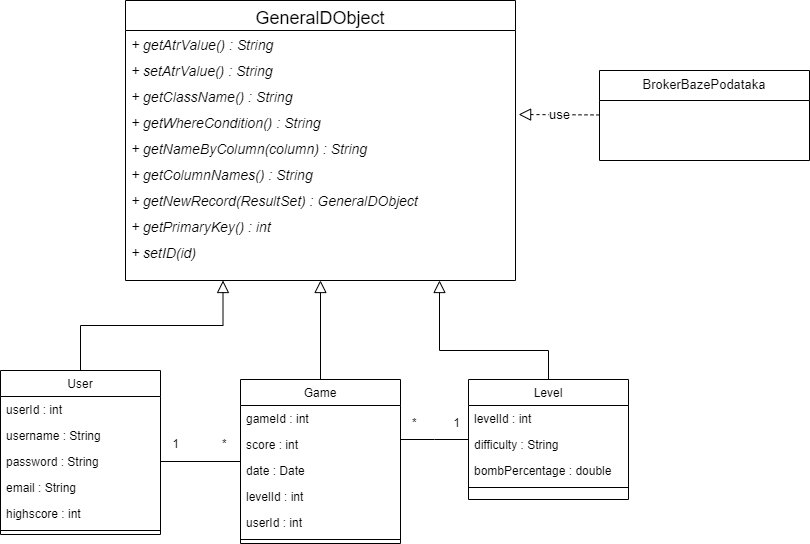
За енкапсулацију можемо рећи да је такође апстракција, јер раздваја нешто што је опште (јавно) од специфичног (приватно).

Такође, применом Ларманове методе у фази анализе описујемо системске операције на високом нивоу апстракције, односно енкапсулирамо начин имплементације који у том моменту још увек не знамо, од онога што у том моменту знамо, а то је – шта та системска операција треба да ради.

***Одвајање интерфејса од имплементације***

Интерфејс се одваја од имплементације и излаже се клијенту.

Клијент не треба да зна како су операције имплементиране. У примеру, клијент је класа *BrokerBazePodataka,* а сервер је класа *GeneralDObject.*



Слика 53. Одвајање интерфејса од имплементације

Брокер је тај који позива методе класа које имплементирају класу *GeneralDObject,*

не знајући како су методе имплементиране.

***Довољност, комлетност и једноставност***

Довољност, комплетност и једноставност указују на особине софтверске компоненте коју карактерише једноставан начин одржавања као и надградње, а са друге стране је довољна и комплетна да обезбеди функционалност.

## Стратегије пројектовања

Најпознатије стратегије пројектовања су:

1. Подели и победи
2. С врха на доле
3. Одоздо на горе
4. Итеративно-инкрементални приступ

***Подели и победи* – *divide and conquer***

Ова стратегија се занива на претходно поменутом принципу декомпозиције који разлаже полазни проблем на потпроблеме, који се независно решавају како би се полазни проблем лакше решио.

Ова стратегија се најчешће примењује у прве три фазе развоја софтвера:

1. *Прикупљање корисничких захтева* – захтеви се описују преко скупа независних случајева коришћења
2. *Анализа* – структура се описује помоћу концептуалног модела, а понашање преко скупа независних системских операција.
3. *Пројектовање* – архитектура софтверског система се дели на три дела: **кориснички интерфејс**, **апликациону логику** и **складиште података**. Кориснички интерфејс се даље дели на екранске форме и контролер корисничког интерфејса, а апликациона логика на: контролер апликационе логике, пословну логику и складиште података.

***С врха на доле – top down***

Ова стратегија се заснива на принципу декомпозиције функција и дели почетну фукнцију на више подфункција.

Ове подфункције се независно решавају како би олакшале решавање полазне функције.

Пример који је дат се односи на класу *OpsteIzvrsenjeSO*:

public abstract class OpsteIzvrsenjeSO {

static public BrokerBazePodataka bbp = new BrokerBazePodataka1();

GeneralDObject gdo;

synchronized public boolean opsteIzvrsenjeSO() {

bbp.makeConnection();

boolean signal = izvrsiSO();

if (signal == true) {

bbp.commitTransation();

} else {

bbp.rollbackTransation();

}

bbp.closeConnection();

return signal;

}

abstract public boolean izvrsiSO();

}

***Одоздо на горе***

Ова стратегија се заснива на принципу генерализације, који у некој сложеној функцији уочава једну или више логичких целина, које проглашава за функције.

На тај начин је сложена функција декомпонована на више независних функција.

Композиција тих функција треба да обезбеди исту функционалност као и сложена функција.

У овој стратегији као и у претходној, добићемо исто решење. Оно што се разликује је начин доласка до решења. У претходној стратегији уочавамо одмах генералне делове, односно сложене функције које морамо разложити, док у оваквом приступу прво полазимо од веома специфичних делова.

Након што уочимо логичке делове који су специфични, можемо их прогласити за функције.

***Итеративно-инкрементални приступ***

У итеративно-инкременталном приступу је циљ да се релативно брзо реализује решење, које није неопходно да буде сасвим комплетно. Циљ је да корисник може да види готов производ, поједине функционалности и да изрази своје задовољство односно незадовољство, што би значило да се та функционалност мора мењати.

Овакав приступ је свакако боља опција од тога да се стигне до краја пројекта и да се касно схвати да можда кориснички захтеви нису добро прикупљени или схваћени, што би резултирало незадовољством корисника и великим проблемом у смислу измене целог пројекта.

Како би се проблеми избегли, систем који се развија се дели на више делова (потпројеката), који могу представљати системске операције које се развијају или потпуно независне случајеве коришћења. Сваки део система, подпројекат, пролази кроз више **итерација** и као резултат једне итерације, добија се **инкремент** за систем.

На крају се сви потпројекти интегришу у један софтверски систем.

Пример: Прикупљањем корисничких захтева, уочили смо системске операције које треба пројектовати тако да су потпуно независне једна од друге. На овакав начин омогућавамо и појаву нових системских операција које неће утицати на постојеће, као и измену постојећих, а да се измене не одразе на друге системске операције.

## Методе пројектовања

Најважније методе пројектовања су:

1. Функционо оријентисано пројектовање
2. Објектно оријентисано пројектовање
3. Пројектовање засновано на структури података
4. Пројектовање засновано на компонентама
5. **Функционо оријентисано пројектовање:**

Проблем се посматра из перспективе његовог понашања, функционалности.

На овај начин се прво уочавају функције система, затим се одређују структуре података над којима се извршавају те функције.

1. **Објектно оријентисано пројектовање:**

Засновано је на објектима (класама). Објекти могу да представљају и структуру и понашање софтверског система. Код објектно оријентисаног пројектовања паралелно се развијају и структура и понашање.

Тежи се раздвајању структуре и понашања, јер се жели постићи ефекат независног извршења системских операција над независном структуром система.

1. **Пројектовање засновано на структури података:**Проблем посматра из перспективе структуре. Прво се уочава структура система, а затим се дефинишу функције које се извршавају над том структуром.
2. **Пројектовање засновано на компонентама:**Проблем посматра из перспективе постојећих компоненти које се могу (поново) користити у решавању проблема. Прво се уочавају делови проблема који се могу реализовати постојећим компонентама, а након тога се имплементирају они делови за које није постојало решење.

## Принципи објектно оријентисаног пројектовања (Principles of object orientied class design)

Постоје следећи принципи код објектно оријентисаног пројектовања класа:

1. Принцип отворено затворено
2. принцип замене Барбаре Лисков
3. принцип инверзије зависности
4. принцип уметања зависности
5. принцип издвајања интерфејса
6. ***Принцип отворено затворено (Open – closed principle) :***

Модул треба да буде отворен за проширење, али и затворен за модификацију.

Пример је класа *AbstractGenericOperation,* која као што је већ речено, има *template* методу, у којој даје редослед извршења операција на вишем нивоу апстракције, а детаље извршења оставља подкласама.

На овај начин, редослед извршења операција је непроменљив, а оно што је отворено за промене је апстрактна метода која дозвољава подкласама да је прошире. Приметићемо да постоји директна веза између *Template Method patterna* и *open-closed* принципа, односно можемо рећи да је *template method pattern* заснован на *open-closed* принципу.

public abstract class OpsteIzvrsenjeSO {

static public BrokerBazePodataka bbp = new BrokerBazePodataka1();

GeneralDObject gdo;

synchronized public boolean opsteIzvrsenjeSO() {

bbp.makeConnection();

boolean signal = izvrsiSO();

if (signal == true) {

bbp.commitTransation();

} else {

bbp.rollbackTransation();

}

bbp.closeConnection();

return signal;

}

abstract public boolean izvrsiSO();

}

1. ***Принцип замене Барбаре Лисков (The Liskov substitution principle)***:

подкласе треба да буду заменљиве са њиховим надкласама.

Пример се односи на доменске класе Game, *User* и *Level*, које могу бити заменљиве њиховом надкласом *GeneralDObject*. Ово се конкретно види у методама брокера базе података који као параметар прима *GeneralDObject.*

Обезбеђивањем оваквог параметра, обезбеђујемо да нам класа брокера базе података не буде чврсто везана за све доменске класе, већ за њихову апстракцију, што је основна идеја свих патерна пројектовања.

Брокер базе података:

public GeneralDObject findRecord(GeneralDObject odo) {

ResultSet rs = null;

Statement st = null;

String upit = "SELECT \* FROM " + odo.getClassName() + " WHERE " + odo.getWhereCondition();

boolean signal;

try {

st = conn.prepareStatement(upit);

rs = st.executeQuery(upit);

signal = rs.next(); // rs.next() vraca true ako ima postoji rezultat upita.

if (signal == true) {

odo = odo.getNewRecord(rs);

} else {

odo = null;

}

} catch (SQLException ex) {

Logger.getLogger(BrokerBazePodataka1.class.getName()).log(Level.SEVERE, null, ex);

} finally {

close(null, st, rs);

}

return odo;

}

Системска операција GetLevelSO:

public class GetLevelSO extends OpsteIzvrsenjeSO {

Request request;

Response response;

public Response getLevel(Request request) {

this.request = request;

this.response = new Response();

opsteIzvrsenjeSO();

return response;

}

@Override

public boolean izvrsiSO() {

System.out.println(request.getLevel().getWhereCondition());

Level level = (Level) bbp.findRecord(request.getLevel());

response.setLevel(level);

return true;

}

}

Клијентски контролер:

Level getLevel(String difficulty) {

Request request = new Request();

level = new Level();

level.difficulty = difficulty;

request.setLevel(level);

request.setOperation(Operation.OPERATION\_GET\_LEVEL\_DIFFICULTY);

Communication.getInstance().sendRequest(request);

Response response = Communication.getInstance().readResponse();

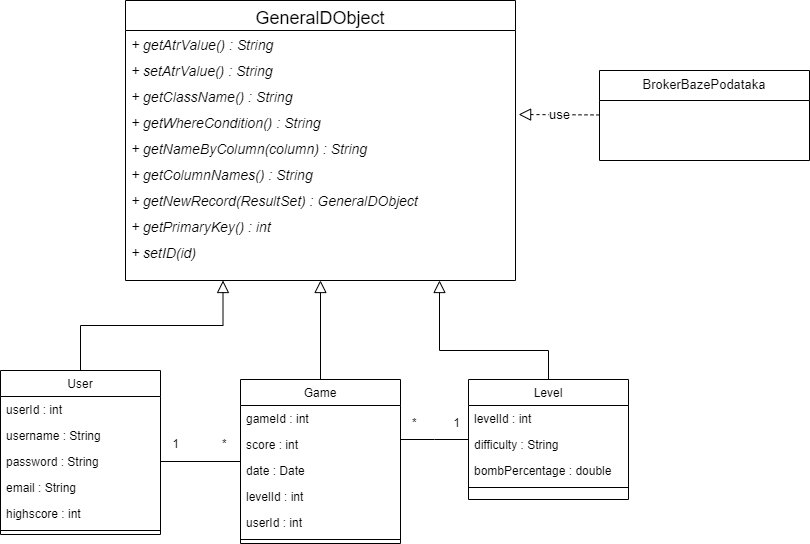
return response.getLevel();

}

1. ***Принцип инверзије зависности* – *The Dependancy inversion principle***

* Принцип инверзије зависности: зависи од апстракције а не од конкретизације.
* Модули вишег нивоа не треба да зависе од модула нижег нивоа
* Оба треба да зависе од апстракције
* Апстракције не треба да зависе од детаља
* Детаљи треба да зависе од апстракције

У нашем примеру се избегава зависност модула вишег нивоа: Брокера базе података од модула нижег нивоа – доменских класа. Повезаност се остварује преко класе *GeneralDObject,* коју реализују све доменске класе. На тај начин се брокер базе података посредно повезује са свим доменским класама које реализују класу *GeneralDObject.*



Слика 54. Пример принципа инверзије зависности

У општем случају:

![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzE3AACSkgACAAAAAzE3AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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j4ittfs7x5dT1HTV0iwj1K6trWa1urlRLOSVHLhl3Kzxj94QeDn5WfBpF1puk+JbTSV8QQX8uuQPv8y7cNbvcxktG7kofkL7ipJx97pTt71vX80v1/MT0/D8Vf8/0PVqK8s1i21HSF1PTI4vEE+nPqUQtbv7TqNw9optss+YW8+ZN4I2bwoZuSuK7HwCdSPgfTxrbXD3qiRHa5jdJGAkYKSHJflQv3iT6knmktVcHo0joqKKKACiiigAooooAKKKKAOb1v/ke/C/8A29/+ihXSVzet/wDI9+F/+3v/ANFCukoAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigCtHptjFcLPFZ26TIZCsixKGXeQXwcZ+YgE+pAzVmue8d3DW3g29ljs9RvZRtEUGnSXEcrOWAB3QfvAoJy23J2g8HpXm+tNq0Wm2FtoL+KHubOyjkh1G4h1V2vZPMfejRZVIyCud0+7Kso2kYNC10CWiue01Fa3dvfWkd1Y3EVzbyrujmhcOjj1BHBFcVcxeIP+E3bRom1A6VcXcep/bgzbYolX57YOOmZVQ7e6O4HA4wtJ/tmK68KTai2vXt21jax3FjIt/CsD5YvO8y/uXbH3ophk4GGHCsul/wCv6voD0v5f1/wf+Cenahptjq1k9nqtlb31rJjfBcxLIjYORlWBBwQDVkDAwOBXm3hTTddsj4Zu5Z9akurzSZv7SW/uZpI1mCxmPcjkrG2dw4Ck85zzWXp6apNZ2wt7vxZZag+m3A124uoL2VIpTHw0Mb/IzCXlRb/w5xgYpvS67f8AB/y/IfU9Ze4hjnjgkmjWWUExxswDPjrgd8ZGaa93bRXcVrJcRJcTKzRQs4DyBcbiq9SBkZx0yK8p0/TWn1bw1qN/ZeIlhtbye388XGpuZcouyVopCZYkZtwIfKjGCzKQT13i6W8g1q1lW31W502PSr9rmDTWlVpHHk+WoMZBEh+cLgg9cd6Hp/XlcUfedjqZrW3uHhe4gjlaB/MiZ0DGN8Eblz0OGIyOxPrUteU+HtKvNUfRrae78ULaSw3suoCW41C38qYmBo4hJLtkKqCwU5+ba/qwqO2sPF9poGm3Omz63JrF94cuTdC8mkkVLtVh8r93Idkb8vgALuwc55NO1v69f8vyHFc1j1qsjSfFmga9qF5Y6LrFnf3NiQLiO3lDmPP06+mR0PB54rziwt9bi8O6k9rrGvXkLSWn2i3/ALM1K2nii83980T3UskjMY8giI8bQQNxGZNPS60jVLjVNNt/En9kf23BK5uILua4mt/sjIco4MzqJSvDAkYB6AUddf62/wA/z7C3X9f1c9R/syw/tT+0/sVv9v8AK8j7X5S+b5ec7N+M7c84zjNWa4WKfWrn4a+KZ401SO+lbUHsFkSRLgKdxh2KfmHG3aOo4GAeKx9X8OarENeFle+JW8rQkvLPbqN0d1/++yF+bk8J+6Hycj5elLp8vzV/68yrXene34pfr9x6lVW81G1097VLuXy2u5xbwjaTvkIJA4HHCnk8cV5rq51iXUtS8z/hJBrv2i3/ALH+yi6Wy8vbGT5mz9xjf5u/zece22o47O9u/E+mPeQ+IpdXt9elkujKLk2SW370Rsmf3GNpj5T5uTn+Kh6Nf12/z17EX0b/AK2f+XzPWCcDmqum6ja6vpdtqOnS+da3UYlhk2ldykZBwQCPxrg/CmoazdXXhiyu4daEljYTxarJd208cbzgIFy7gCUkhyGG4e/Ncpcp4gtPCug2VjZa5p+o2OkWrxyQxahIs0gLboTFCVhRl25LTbshgNpFNb29P1/yG9E32PaLHULXUY5Xs5fMEMzwSfKQVdG2spB56j8RgjIINWa5rwyh/wCEm8WSxjFu+oRhcdGcW0Qcj8cA+4NdLS6J+gdQooooAKKKKACiiigAooooA5vW/wDke/C//b3/AOihXSVzet/8j34X/wC3v/0UK6SgAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAIre1t7RGS1gjgV3aRljQKGdjlmOO5JJJ7k1LRRQAUVT1h2j0O+eNijrbSFWU4IO08iuU8N+BvDt34V0m5ubAyTTWUMkjtcS5ZigJJ+b1oA7eiub/4V74Y/wCgZ/5MS/8AxVH/AAr3wx/0DP8AyYl/+KoA6Siub/4V74Y/6Bn/AJMS/wDxVH/CvfDH/QM/8mJf/iqAOkorm/8AhXvhj/oGf+TEv/xVH/CvfDH/AEDP/JiX/wCKoANb/wCR78L/APb3/wCihXSVy7fDjwo8qSPpILx52MZ5crnr/FUn/CvfDH/QM/8AJiX/AOKoA6Siub/4V74Y/wCgZ/5MS/8AxVH/AAr3wx/0DP8AyYl/+KoA6Siub/4V74Y/6Bn/AJMS/wDxVH/CvfDH/QM/8mJf/iqAOkorm/8AhXvhj/oGf+TEv/xVH/CvfDH/AEDP/JiX/wCKoA6SiuY8BxLbaXqVrEX8m21W6ihVnLbEEhwoJJOK6egAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAKOt/8AIA1D/r1k/wDQTVbwn/yJeif9g+D/ANFrVnW/+QBqH/XrJ/6CareE/wDkS9E/7B8H/otaANeiiigAooooAKKKKACiiigAooooAKKKKACiiigDm/Bf/HvrP/Yau/8A0ZXSVzfgv/j31n/sNXf/AKMrpKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAo63/yANQ/69ZP/AEE1W8J/8iXon/YPg/8ARa1Z1v8A5AGof9esn/oJqt4T/wCRL0T/ALB8H/otaANeiiigAooooAKKKKACivEV8S+O7PQNa8at4stbmxsdSubWHQbjS4wsoScxIizIQ+48beDzjOa9sRi8asylSQCVPUe1C1SYPR2/rQdRRRQAUUUUAFFFFAHN+C/+PfWf+w1d/wDoyukrm/Bf/HvrP/Yau/8A0ZXSUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQBR1v/kAah/16yf8AoJqt4T/5EvRP+wfB/wCi1qzrf/IA1D/r1k/9BNVvCf8AyJeif9g+D/0WtAGvRRRQAUUUUAFFFFAHgS6HpKeD/EFpeeB9Su/FNzqd6bK5g0OVJld52MEouygVVGVbdv4A79K9t0CC/tvDemwazKJtQitYkupAc75QoDHPfnNaFFEdI29PwVv+HB6u/r+IUUUUAFFFFABRRRQBzfgv/j31n/sNXf8A6MrpK5vwX/x76z/2Grv/ANGV0lABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAUdb/5AGof9esn/AKCareE/+RL0T/sHwf8Aotas63/yANQ/69ZP/QTVbwn/AMiXon/YPg/9FrQBr0UUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAc34L/499Z/7DV3/wCjK6Sub8F/8e+s/wDYau//AEZXSUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQBR1v/kAah/16yf+gmq3hP8A5EvRP+wfB/6LWtSeFLm3kgmXdHKhRxnGQRg1zNv4FitLWK3tvEGvxwwoEjRb7hVAwAPl9KAOporm/wDhDf8AqY/EH/gd/wDY0f8ACG/9TH4g/wDA7/7GgDpKK5v/AIQ3/qY/EH/gd/8AY0f8Ib/1MfiD/wADv/saAOkorm/+EN/6mPxB/wCB3/2NH/CG/wDUx+IP/A7/AOxoA6Siub/4Q3/qY/EH/gd/9jR/whv/AFMfiD/wO/8AsaAOkorm/wDhDf8AqY/EH/gd/wDY0f8ACG/9TH4g/wDA7/7GgDpKK5v/AIQ3/qY/EH/gd/8AY0f8Ib/1MfiD/wADv/saAOkorm/+EN/6mPxB/wCB3/2NH/CG/wDUx+IP/A7/AOxoAPBf/HvrP/Yau/8A0ZXSVnaJoltoNg1raSTyh5XmkluJC7yO5yxJrRoAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAP/Z)

Слика 55. Принцип инверзије зависности – општи случај

Модул А је модул вишег нивоа и он у првом делу слике зависи од модула нижег нивоа – модула B, што је противно овом принципу.

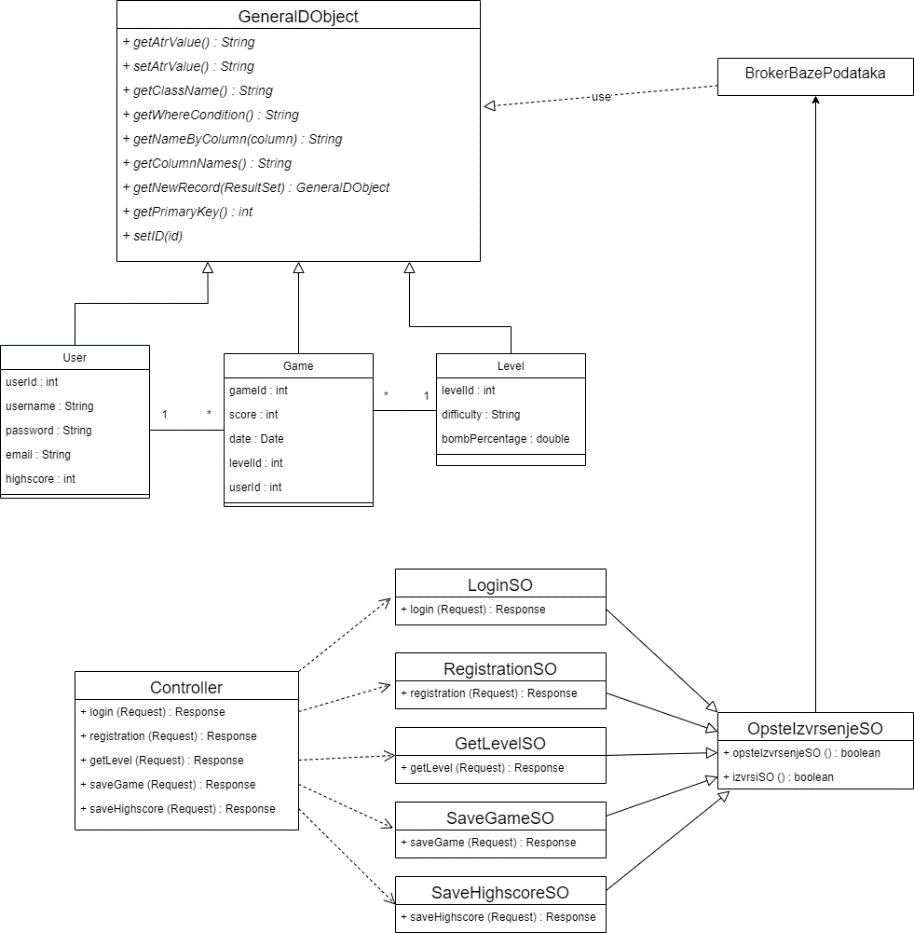
Директна веза између модула A и B се прекида и између њих се поставља модул вишег нивоа – модул Ba.

Можемо да закључимо да постоји велика сличност између принципа инверзије зависности и опште дефиниције патерна.

1. ***Принцип уметања зависности – The dependency injection principle*** *:*

Зависности између две компонентне програма се успостављају у време извршења програма преко неке треће компоненте.

У наведеном примеру, веза између брокера базе података и конкретних доменских класа се успоставља у време извршења програма, преко класа које реализују класу AbstractGenericOperation*.*



Слика 56. Принцип уметања зависности

Општи случај:

![A screenshot of a social media post

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzkxAACSkgACAAAAAzkxAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Слика 57. Принцип уметања зависности – општи случај

# Примена патерна у пројектовању

## 8.1 Увод у патерне

Прве дефиниције патерна настају опажањем структура градова и грађевина, дакле у грађевинарству, заслугом Кристофера Александера који је и дао први значајан допринос у дефинисању патерна.

Једна од његових дефиниција гласи: “*Сваки патерн је троделно правило, које успоставља релацију између неког проблема, његовог решења и његовог контекста.*

*Патерн је у исто време и ствар, која се дешава у стварности, и правило које говори када и како се креира наведена ствар*”.

Оно што је Александер открио је да се за сваки проблем који се више пута понавља на различит начин, постоји неко решење које је применљиво за цео скуп сличних проблема.

Оно што изводимо као закључак је да је патерн “троделно правило” које успоставља корелацију између одређеног контекста као система ограничења, проблема који делује у том контексту и решења, као структуре софтверског система која омогућава да односи између елемената тог система буду поново употребљиви.

## 8.2 Општи облик GOF патерна пројектовања

Када говори о претходно наведеним дефиницијама патерна, Кристофер Александер инсистира и на особини поновне употребљивости патерна и каже: “*Сваки патерн описује проблем који се јавља изнова (непрестано) у нашем окружењу, а затим описује суштину решења тог проблема на такав начин да ви можете користити ово решење милион пута а да никада то не урадите на два пута на исти начин* ”[2], што значи да се већ једном пронађено решење може применити на више различитих проблема, који су из истог контекста.

Патерн као процес, трансформацијом структуре проблема у структуру решења обезбеђује дугорочност, стабилност, флексибилност и могућност даљег развоја, што и јесте примарна дефиниција одрживости, у контексту софтверских система.

Оваквом трансформацијом, раздвајају се специфичности које обезбеђују различитости у софтверском систему, и које су на самом почетку развоја софтверског система биле помешане са генералним деловима, које програму обезбеђују универзалност, што и јесте нешто чему временом тежи сваки софтверски систем.

![A screenshot of a cell phone

Description automatically 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Слика 59. Општи облик GOF патерна пројектовања

Постоје патерни *макро* архитектуре и *микро* архитектуре.

Макро архитектура описује структуру и организацију софтверског система на највишем нивоу.

*MVC* je макроархитектурни патерн који дели софтверски систем на три дела:

1. **View** – обезбеђује кориснику интерфејс (екранску форму) помоћу које ће корисник да унесе податке и позива одговарајуће операције које треба да се изврше над моделом
2. **Controller** – ослушкује и прихвата захтев од клијента за извршење операције.

Након тога позива операцију која је дефинисана у моделу. Уколико модел промени стање, *controller* извештава *view* о томе.

1. **Model** – представља стање система. Стање модела мењају неке од операција модела.

![A picture containing screenshot

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzg2AACSkgACAAAAAzg2AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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3/AMJ/oH/PTUP/AAU3X/xuj/hP9A/56ah/4Kbr/wCN10lFAHBa74r0rV9U8OW1i12Zf7Yib97YTxDHlyfxOgHf1rva5vxh/wAfHhz/ALDUX/ouSukoAK8wfTbXx58aNasvEcK32leGba2Ftp0+GgeeZWYzNH0YhflG4EDJ716fXD614V8QWfjweK/Bdxp5mu4Y7XU9P1EukdxGhJV1kRWKyAHbypGD7YIviTf9f1/weg/stf1ujI8d6Pp3hDwzBpPhOEaEvijW7axuXs2MaxCTh2Rc7UJRNvygcnPXml8b/DPwrpXw6v7vw9o1ppGo6LaNd2N/ZxiO4jkhQspMg+Z8453E5zk881q6r4U8SeL/AA1e23iW/wBO06+W6judKbTI3lWxeJy0bs8mDIx4B+VRgHA5qrq2h/ELxZoMeg67LoGlWd0hi1S802eaaaWM9VhR41Ee4ZUlmfAOR0pNPlaW/wDwFb7tf0GuXmTe3X79fv8A+HKPxHuf+El+Altc3yY/tMac8yKcf6yaIsAfxNc9rWo3Nj8IvFPgnWpfM1Lw8II4pWzm5s2lTyZfc4+U46FfevSfGfhSXXPBCaFoxgt/KltTEJiVRUilRscAn7qYHFYfxX+G9942t7W58PXkFjqcQ+zzNOSI7i1LK7RsQrHhkVhx6+tVdczts3/lZ/L8rkRvyq+6X/D/AH/nYzPix4T8OiLw9eDQNL+1XniSxS5n+xx751dzuV2xlge4PWrvxU0PRdC+Et7a6XpFnZWT31o81vZ2iqsmbiIHKIPmJAx0JPSui8b+GbzxLZ6JFYywRtp+sWt/KZmIDRxNlguAfm9M4HuKl8e+HrvxT4TfTNPkhjma5t5Q07ELiOZHPQE5wpxx1pLa3978Pd/yY+3p+Opwvh620e5+NEM3gHSDodpptjImtobX7CLkOAYFFswV8g7jvKAcYyeBVn4b+GtD8ceH5vGXinTLPWtR1m5lbdfwrOLaFJXSOGMMCECgc4AySc54rrNa8L3dx8QNC8T6RJBFLaRy2eoLKSDPauMgDCnLK4DAHA5PNY+k+G/GXgyTUtP8Lf2JqOiTyyXFjFqFxLby2UkjFmT5I3EkYYkgfKeSM9KFtr5/nf8AH/gA/wDL8rfmV/h5D/YOteNPCFo0h0vR5opLCOSQuYI54d5iBPO0MCRz3Navwf8A+SQeHP8Ar0H/AKEateEPCd3oVlql1rF7Hfa5rU32i+niTZErbQqxxg87EAwM8nk98VzXgTQfij4WtdJ0W+fwjLodliORoWujcmPJOQSAu7n0Aprez7R/C9we115nI+Fbzwydb1ix1n4Z6hr1zN4hu0OrR6BHdQIGnIG6VuQF78cV1vxEj0Z/ih4QXxFpf9p2P2O+zb/2a97ziLB8pEc8euOK1PDmj+MfC0ep2trpmh30F1qdzexyyatNCwWWQsFKi2YAgf7RrX1Lw9eX3xA0DXkeBbfTrW6injLHeWlCbdvGCBtOckdqmO0PJf8Ato38Un5v8zmPg5BGy+IdT0OA2Phi/vg+lWBkUmEhcTNsUnygz/wHBGOgr0yuW8PeF7vw/wCM/EV5byQf2NrDx3awAkPFdY2ynGMbWAU5znOeK6mq6L0X4aC6sK888E+NNFsfB9nbXD3oljMobZptw4z5jdGWMg/ga9Drm/h7/wAiJp//AG1/9GtSAP8AhP8AQP8AnpqH/gpuv/jdH/Cf6B/z01D/AMFN1/8AG66SigDm/wDhP9A/56ah/wCCm6/+N0f8J/oH/PTUP/BTdf8AxuukooA5v/hP9A/56ah/4Kbr/wCN0f8ACf6B/wA9NQ/8FN1/8brpKKAOb/4T/QP+emof+Cm6/wDjdH/Cf6B/z01D/wAFN1/8brpKKAOb/wCE/wBA/wCemof+Cm6/+N0f8J/oH/PTUP8AwU3X/wAbrpKKAOb/AOE/0D/npqH/AIKbr/43Vbwtex6r4u8Q6haR3AtZY7VEkntpId5VX3AB1BOMj8662igAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAOb8Yf8fHhz/sNRf+i5K6Sub8Yf8fHhz/sNRf8AouSukoAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigArm/h7/AMiJp/8A21/9GtXSVzfw9/5ETT/+2v8A6NagDpKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigDm/GH/Hx4c/7DUX/AKLkrpK5vxh/x8eHP+w1F/6LkrpKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAK5v4e/8AIiaf/wBtf/RrV0lc38Pf+RE0/wD7a/8Ao1qAOkooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAjnuYLWMSXU0cKM6RhpHCgs7BVXJ7lmAA7kgd6krm/Hn/Iu2v/AGGtK/8AThb10lABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAHK+Oru3sV8P3N7PFbwR6zEXlmcIqDy5OSTwKv/wDCa+Fv+hl0f/wPi/8Aiq2ZIo5oykyLIh6qwyKg/s2x/wCfO3/79L/hQBm/8Jr4W/6GXR//AAPi/wDiqP8AhNfC3/Qy6P8A+B8X/wAVWl/Ztj/z52//AH6X/Cj+zbH/AJ87f/v0v+FAGb/wmvhb/oZdH/8AA+L/AOKo/wCE18Lf9DLo/wD4Hxf/ABVaX9m2P/Pnb/8Afpf8KP7Nsf8Anzt/+/S/4UAZv/Ca+Fv+hl0f/wAD4v8A4qj/AITXwt/0Muj/APgfF/8AFVpf2bY/8+dv/wB+l/wo/s2x/wCfO3/79L/hQBm/8Jr4W/6GXR//AAPi/wDiqP8AhNfC3/Qy6P8A+B8X/wAVWl/Ztj/z52//AH6X/Cj+zbH/AJ87f/v0v+FAGb/wmvhb/oZdH/8AA+L/AOKo/wCE18Lf9DLo/wD4Hxf/ABVaX9m2P/Pnb/8Afpf8KP7Nsf8Anzt/+/S/4UAZv/Ca+Fv+hl0f/wAD4v8A4qj/AITXwt/0Muj/APgfF/8AFVpf2bY/8+dv/wB+l/wo/s2x/wCfO3/79L/hQBm/8Jr4W/6GXR//AAPi/wDiqP8AhNfC3/Qy6P8A+B8X/wAVWl/Ztj/z52//AH6X/Cj+zbH/AJ87f/v0v+FAGb/wmvhb/oZdH/8AA+L/AOKo/wCE18Lf9DLo/wD4Hxf/ABVaX9m2P/Pnb/8Afpf8KP7Nsf8Anzt/+/S/4UAZv/Ca+Fv+hl0f/wAD4v8A4qqnw6dZfAGmyRsrowkKspyCDI3INbv9m2P/AD52/wD36X/CrCIsaBI1CqowFAwBQAtFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAHN+PP+Rdtf+w1pX/pwt66So57aC6jEd1DHMiukgWRAwDIwZWwe4ZQQexAPapKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooA/9k=)

Слика 60. MVC патерн

Поглед (*view*) је задужен да омогући кориснику позив операција над моделом, има информације о моделу, док контролер има информацију и о погледу и о моделу. Он извршава промене над моделом које поглед захтева и обавештава поглед о тим променама.

Модел не мора да има било какву информацију о контролеру и погледу, он само служи да чува информације о својим стањима. Може се и рећи да модел представља апликациону логику, поглед екранску форму, а контролер представља “лепак” између њих.

Уколико говоримо у контексту клијента и сервера, код MVC патерна, модел би представљао сервер, док су контролер и поглед клијенти.

Микро архитектурни патерни се сврставају у три категорије:

* Креациони патерни
* Патерни структуре
* Патерни понашања

*Креациони патерни* апстрахују процес креирања објеката. Они дају велику флексибилност у томе шта ће бити креирано, ко ће то креирати, како и када.

У ову подврсту патерна се сврставају: *Abstract Factory, Builder, Factory Method, Prototype, Singleton.*

*Структурни патерни* описују сложене структуре међусобно повезаних класа и објеката. У њих се сврставају: *Adapter, Bridge, Composite, Decorator, Facade, Flyweght, Proxy* патерн.

*Патерни понашања* описују начин на који класе и објекти сарађују и распоређују одговорности. У њих се сврставају *Chain of responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template method, Visitor патерн*.

У наставку ће бити дати примери примена неких од наведених патерна:

***Singleton*** патерн

Захтев: Потребно је обезбедити јединствену комуникацију између клијента и сервера. Неопходно је да се клијент само једном повеже са сервером, остварујући комуникацију са сервером путем класе *Controller*. Онемогућити поновно повезивање у току једног покретања програма.

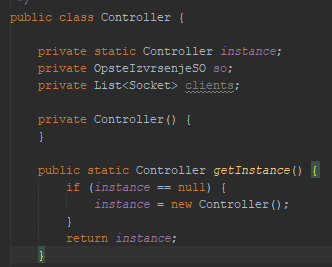
Решење: *Singleton* патерн обезбеђује класи само једно појављивање и јединствен приступ до ње. То омогућава статичка метода *Instance().*

![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzc0AACSkgACAAAAAzc0AADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Слика 61. Singleton патерн

У примеру је дата имплементација класе *Controller*:



Слика 62. Singleton патерн – Controller

Ова класа је имплементирана преко *Singleton* патерна и на тај начин је омогућено да се при сваком позиву методе *getInstance*(), добије једна иста инстанца ове класе, која ће бити креирана при првом позиву а помоћу које ће се вршити позивање системских операција.

***Bridge***патерн

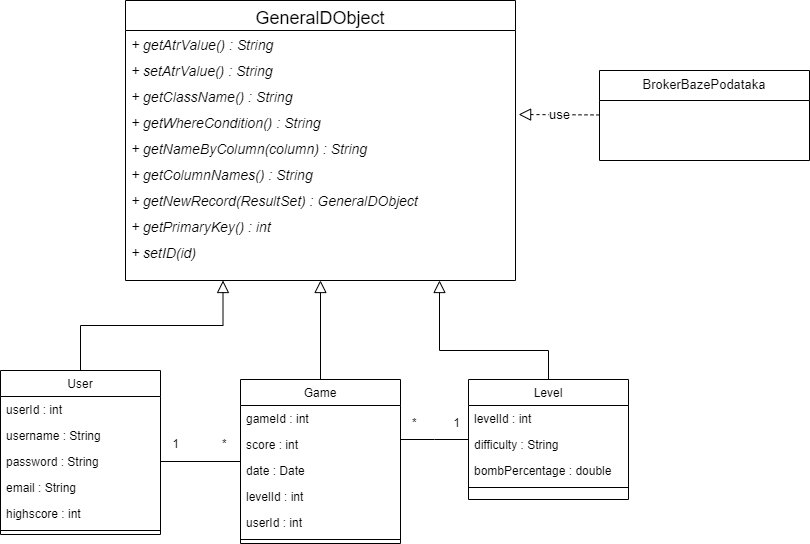
Захтев: Потребно је обезбедити апстрактне операције у класи брокера базе података, за које ће се тек у време извршења програма везати конкретне имплементације. Обезбедити генеричке методе за све доменске класе.

Решење: *Bridge* патерн - декуплује (одваја) апстракцију од њене имплементације, тако да се оне могу мењати независно.

![A picture containing screenshot

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzQzAACSkgACAAAAAzQzAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Слика 63: Bridge патерн

У примеру наводимо класу *BrokerBazePodataka*, која као параметар у својим методама прима генерички објекте класе *GeneralDObject,* над којима позива одређене методе при извршењу.

Слика 64. Bridge патерн – брокер базе података

Са приложених слика можемо закључити да је однос између брокера базе података и класе *GeneralDObject*, заправо однос између *Abstraction*-a и *Implementor-*a, односно закључујемо да брокер базе података има улогу *Abstraction*-a, а доменске класе улогу *ConcreteImplementora*-а.

***Facade*** патерн

Захтев: Потребно је обезбедити корисницима да помоћу екранских форми позивају различите операције система. Сервер треба да ослушкује повезивање клијента и креира посебну клијентску нит која ће наставити да ослушкује захтеве од повезаног клијента. На овај начин је потребно обезбедити да сервер само усмерава захтеве ка клијентској нити, не да их обрађује.

Решење: ***Facade*** патерн – обезбеђује јединствен интерфејс за скуп интерфејса неког подсистема. *Facade* патерн дефинише интерфејс високог нивоа који омогућава да се систем лакше користи.

![A screenshot of a cell phone

Description automatically 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Слика 65. Facade патерн

Овај патерн омогћава да се обезбеди јединствена тачка уласка у неки подсистем и на тај начин олакшава клијенту да не мора водити рачуна о ономе што се дешава иза те тачке. Све што је иза фасаде, клијент не треба да зна.

Пример који је дат се односи на класу *Server,* која представља јединствену тачку улаза у систем и у којој се делегирају захтеви ка одговорним класама за њихову обраду, тј. класи *ClientThread*.

public class Server extends Thread {

private boolean active = true;

private int i;

private List<ClientThread> clients;

private List<Socket> clientSocket;

private ServerSocket ss;

private static Server instance;

public List<ClientThread> getClients() {

return clients;

}

public void setClients(List<ClientThread> clients) {

this.clients = clients;

}

@Override

public void run() {

try {

ss = new ServerSocket(9000);

System.out.println("Server is up and running.");

clients = new LinkedList<>();

clientSocket = new LinkedList<>();

this.i = 0;

while(active){

Socket socket = ss.accept();

System.out.println("IP: " + socket.getInetAddress());

System.out.println("Socket port: " + socket.getPort());

ClientThread clientThread = new ClientThread(socket, this, i);

clientThread.start();

System.out.println("New Client");

i++;

clients.add(clientThread);

clientSocket.add(socket);

}

} catch (IOException ex) {

System.out.println("Server prestao sa radom!");

}

}

public void stopServer() {

try {

active = false;

ss.close();

for (Socket socket : clientSocket) {

socket.close();

}

System.out.println("Server socket is closed");

} catch (IOException ex) {

// Logger.getLogger(Server.class.getName()).log(Level.SEVERE, null, ex);

}

}

}

***Template method*** патерн

Захтев: Потребно је логички груписати све методе које се понављају при извршењу сваке системске операције у једну апстрактну методу и дефинисати редослед извршења. Неке методе је потребно имплементирати, јер је понашање исто за све системске операције, а неке методе је потребно оставити подкласама да имплементирају.

Решење: ***Template method*** патерн- Дефинише скелет алгоритма у операцији, препуштајући извршење неких корака операција подкласама. Овај патерн омогућава подкласама да редефинишу неке од корака алгоритма без промене алгоритамске структуре.

![A screenshot of a cell phone

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RDgRXhpZgAATU0AKgAAAAgABAE7AAIAAAAHAAAISodpAAQAAAABAAAIUpydAAEAAAAOAAAQyuocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEJvamFuYQAAAAWQAwACAAAAFAAAEKCQBAACAAAAFAAAELSSkQACAAAAAzQxAACSkgACAAAAAzQxAADqHAAHAAAIDAAACJQAAAAAHOoAAAAIAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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Слика 66. Template method патерн

На овај начин, апстрактна класа дефинише неку *template (*шаблон*)* операцију која садржи друге примитивне операције, које се проглашавају апстрактним како би се омогућило да их подкласе редефинишу. Примећујемо да на овај начин обезбеђујемо да ниједна подкласа не може променити редослед операција – затворен је за промену, али може проширити примитивне операције - отворене за проширења, што је заправо прави показатељ директне везе између *open-closed* принципа и *template method* патерна.

У примеру је приказана класа *OpsteIzvrsenjeSO* и њена *template* метода - opsteIzvrsenjeSO*():*

public abstract class OpsteIzvrsenjeSO {

static public BrokerBazePodataka bbp = new BrokerBazePodataka1();

GeneralDObject gdo;

synchronized public boolean opsteIzvrsenjeSO() {

bbp.makeConnection();

boolean signal = izvrsiSO();

if (signal == true) {

bbp.commitTransation();

} else {

bbp.rollbackTransation();

}

bbp.closeConnection();

return signal;

}

abstract public boolean izvrsiSO();

}

Класе које представљају конкретне системске операцију редефинишу само методу izvrsiSO*()* – примитивну операцију*.*

public class LoginSO extends OpsteIzvrsenjeSO {

Request request;

Response response;

public Response login(Request request) {

this.request = request;

this.response = new Response();

opsteIzvrsenjeSO();

return response;

}

@Override

public boolean izvrsiSO() {

System.out.println(request.getUser().getAtrValue());

User user = (User) bbp.findRecord(request.getUser());

response.setUser(user);

return true;

}

}

# Литература

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