Gebze Technical University
Computer Engineering

CSE 222
2017 Spring

HOMEWORK 02 REPORT

ERCAN UCA
091044011

Course Assistant: Nur Banu Albayrak

1. System Requirements

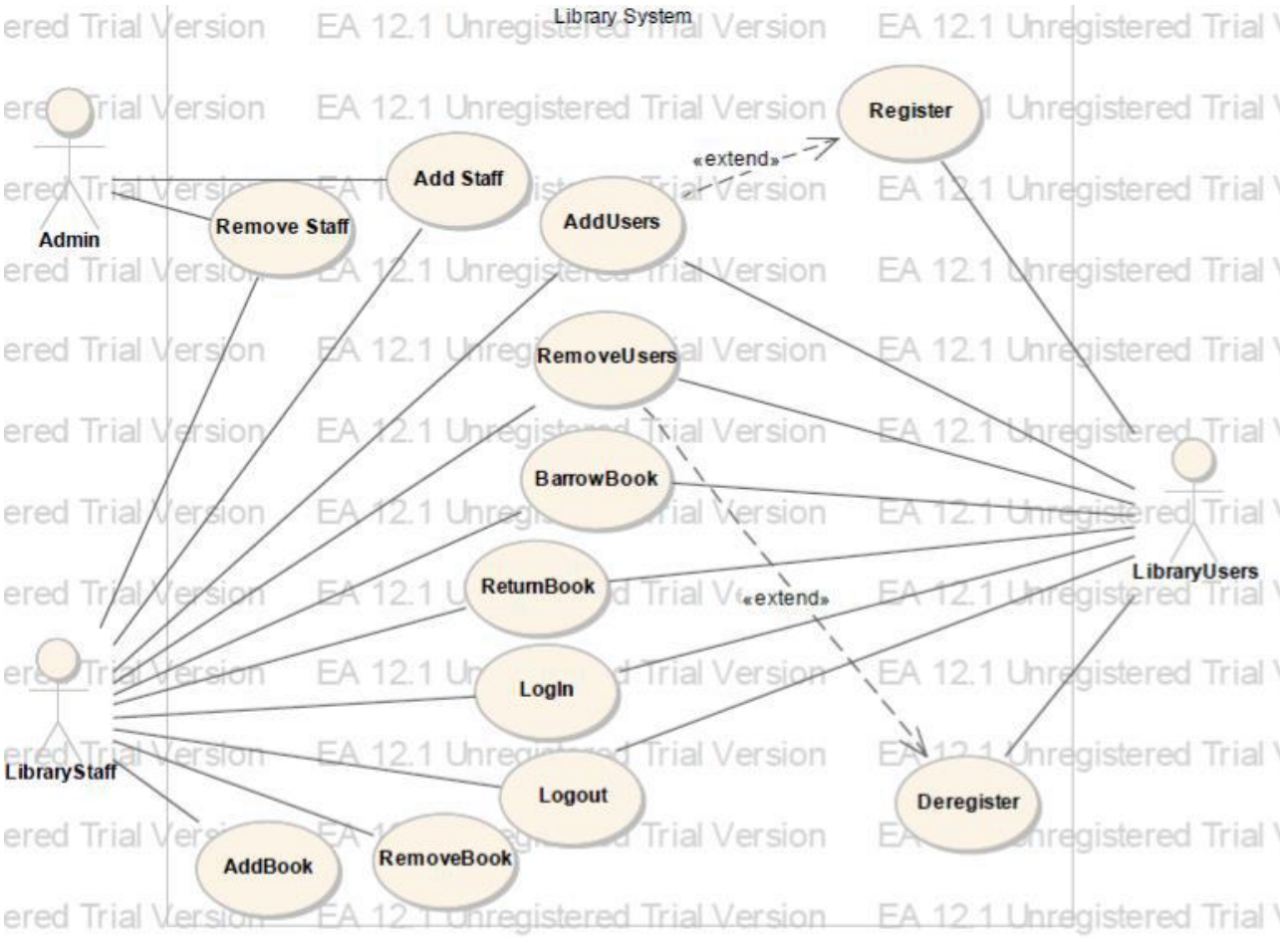
- Sistemim 8 classtan oluşuyor
- Classlarım:Admin, Users, LibraryStaff, LibraryUsers, Register, Books, LibrarySystemAbstract, ProcessLibrarySystem. Ve main Classtan oluşuyor.
- Admin Classım:
  - ✓ staffları add/remove

  yapabilir.
- Staff Classım:
  - ✓ User add/remove,
  - ✓ User register/deregister,
  - ✓ Book add/remove,
  - ✓ Barrow/return,
  - ✓ Log In/Log Out

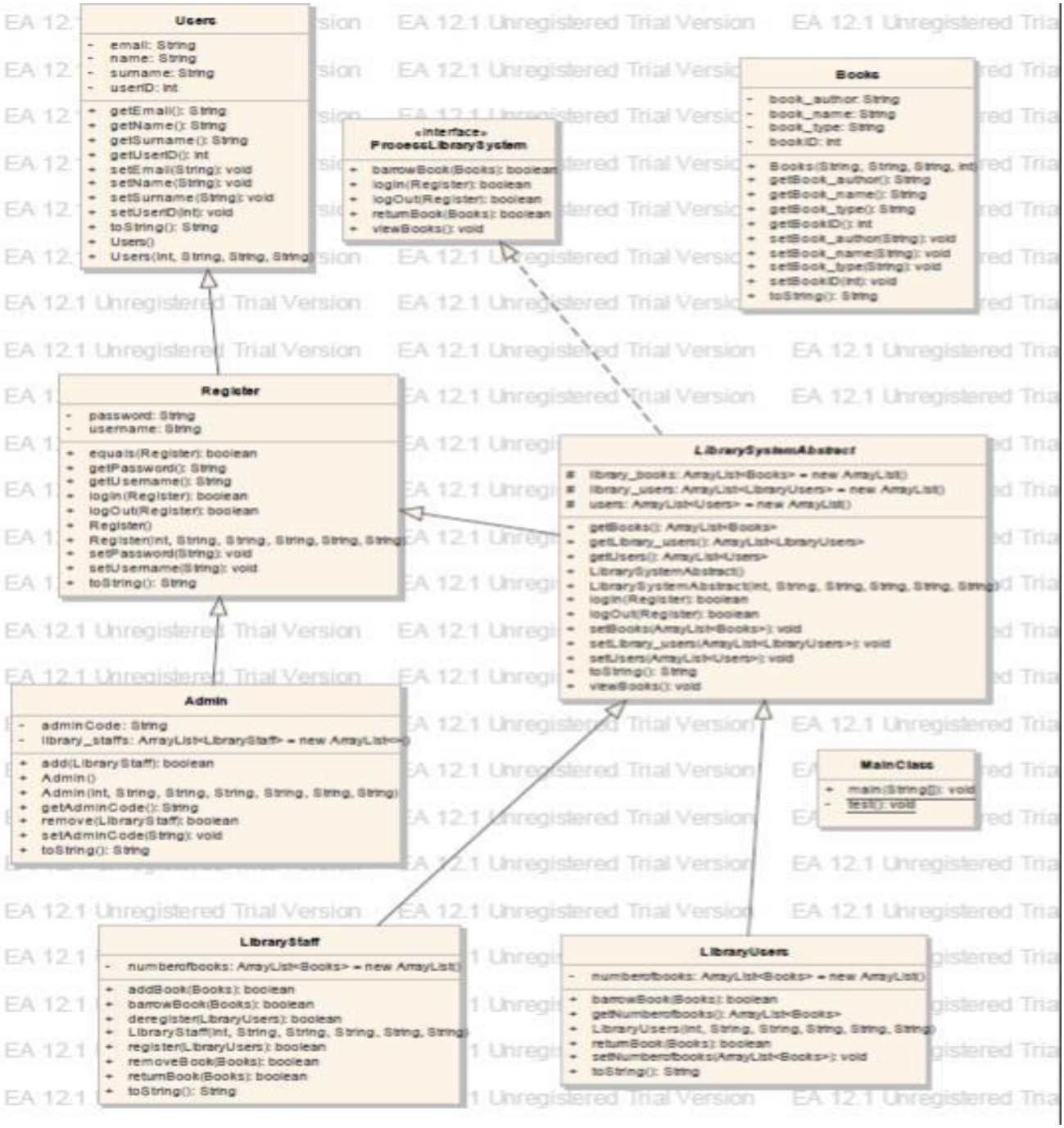
  yapabilir.
- User Classım:
  - ✓ Log in/log out,
  - ✓ Barrow/return

  yapabilir.

2. Use Case Diagrams



3. Class Diagrams



4. Other Diagrams

..

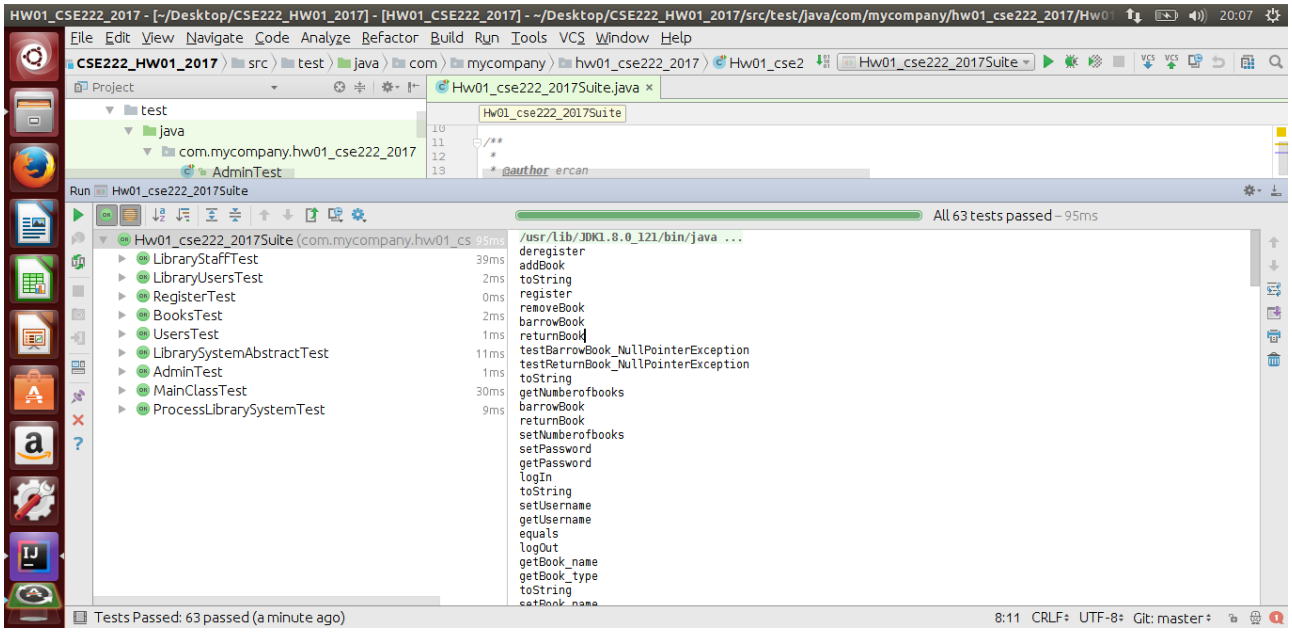
5. Problem Solutions Approach

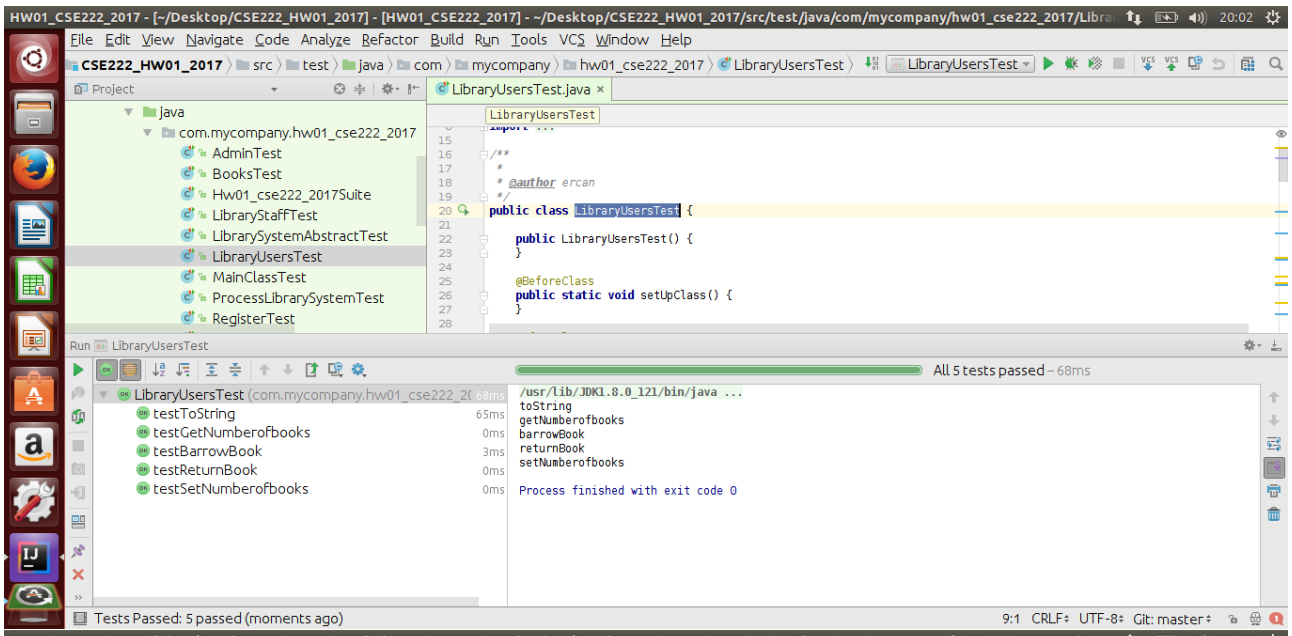
- ✓ LibrarySystemAbstract classım ile ortak yapılan işlemler (logIn/logOut veya Barrow/return) ları bu abstract classımda tanımladım.
- ✓ Ortak olmayanlar ise bu classı extend ederek.
- ✓ Kendi yapabildiklerini kendisinde yeniden implement edebilir yapıyı sağladım.
- ✓ Bu sayede polymorphizm sağlanmış oldu.
- ✓ User ve staffın ortak yaptıklarını ise yeniden implement edilebilir yapılırsa ovirrede yapılmış oldu.

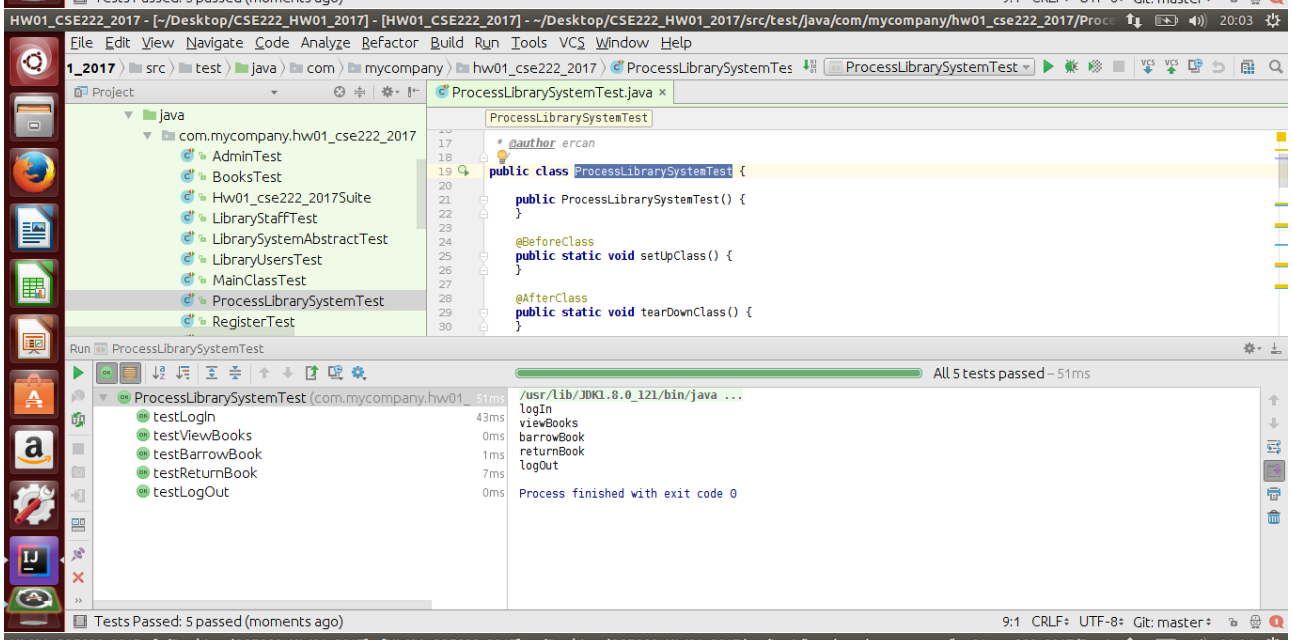
(Sistemin basit omurga yapısı.)

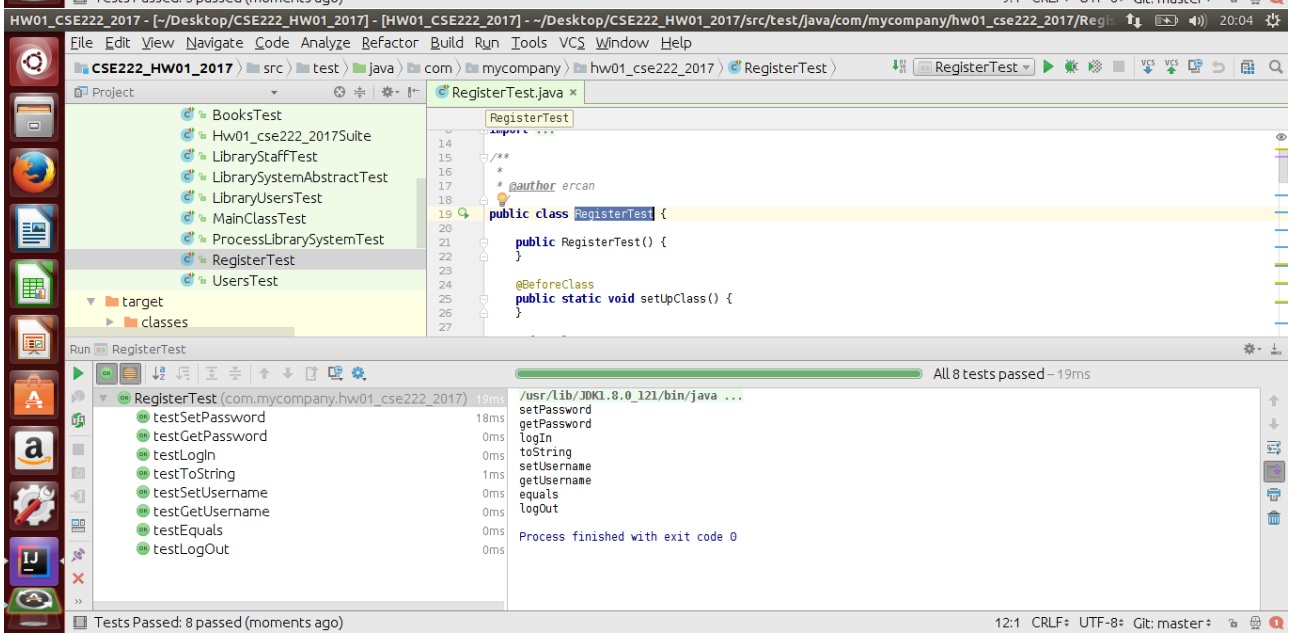
- ✓ Admin oluşturularak işleme başlandı.
- ✓ Admin staff oluşturdu.
- ✓ Staff log In yaptı.
- ✓ Staff da, register user/add user yaptı
- ✓ Ayrı olarak kitaplar oluşturuldu.
- ✓ Staff kitapları add yaptı.
- ✓ Register olan kullanıcı log in yaptı.
- ✓ Kullanıcı barrow book yaptı.
- ✓ Kitabı return book yaptı.
- ✓ Kullanıcı log out yaptı.
- ✓ Staff log out yaptı.

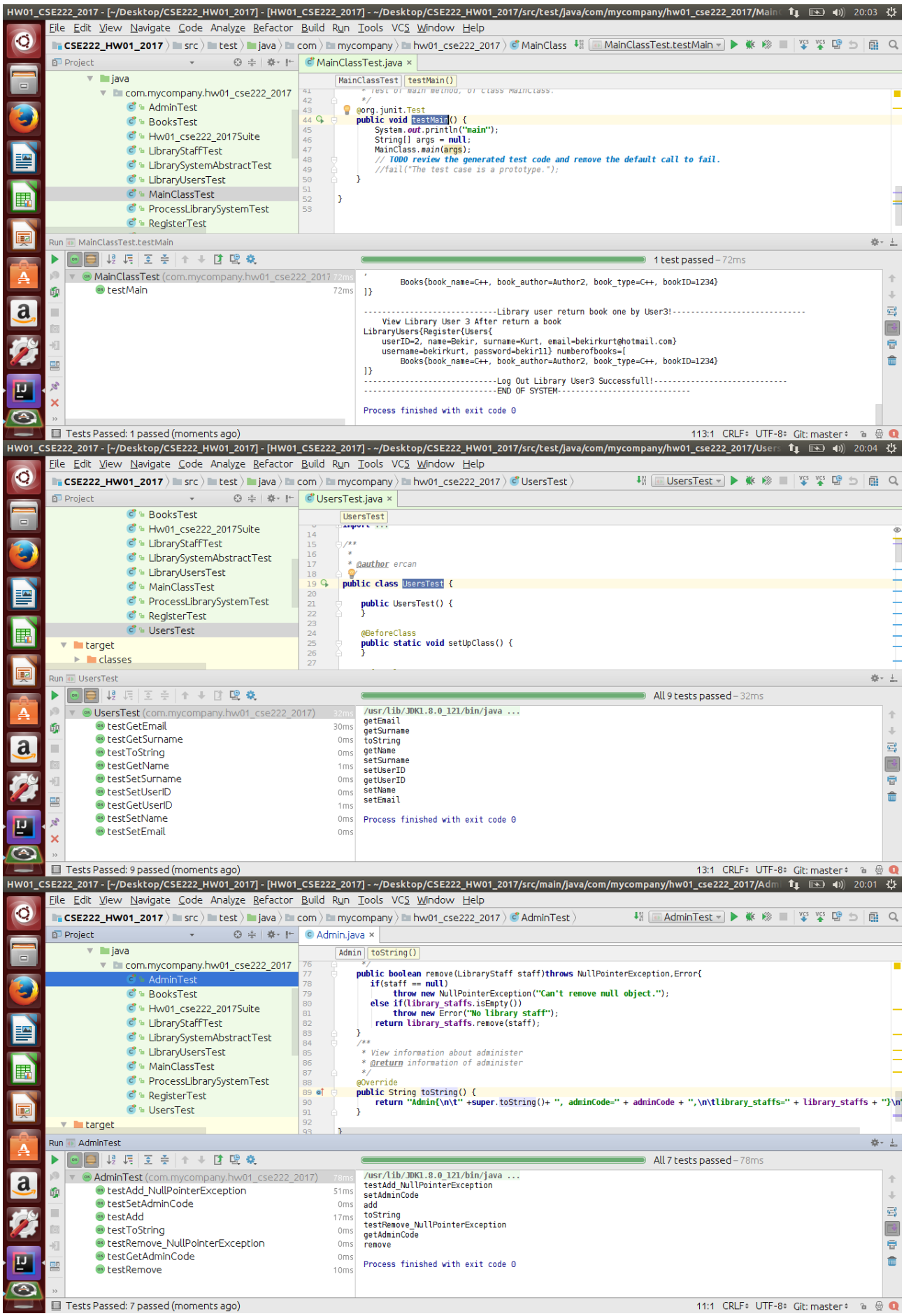
6. Test Cases

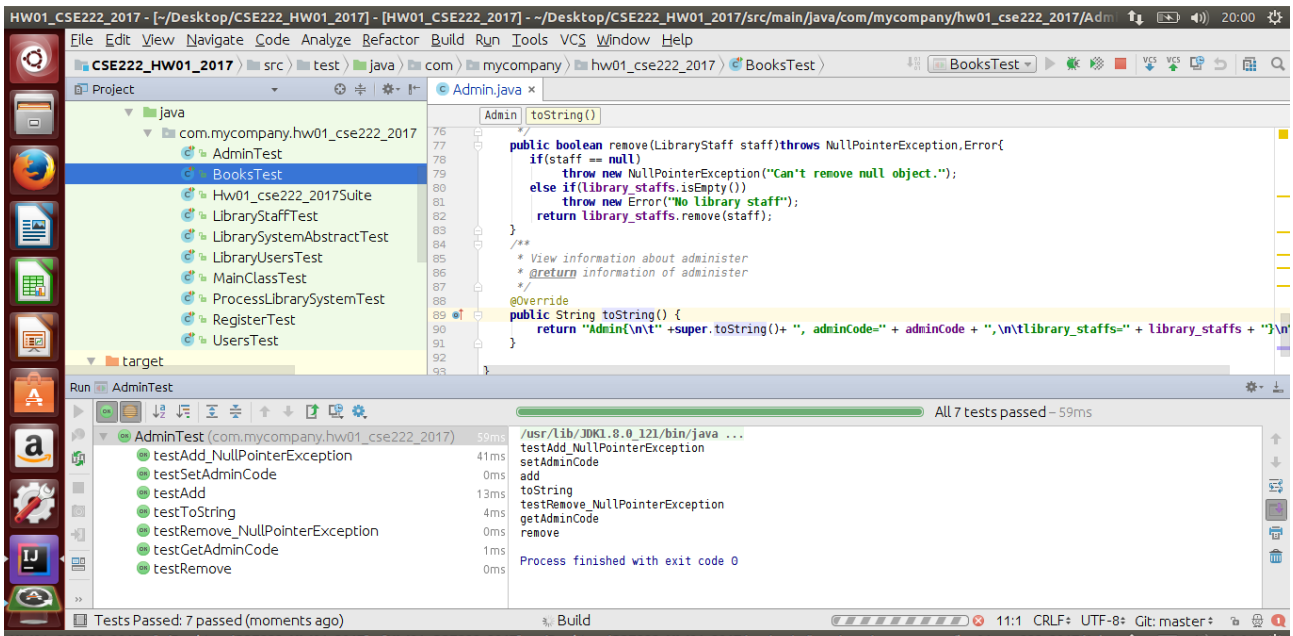


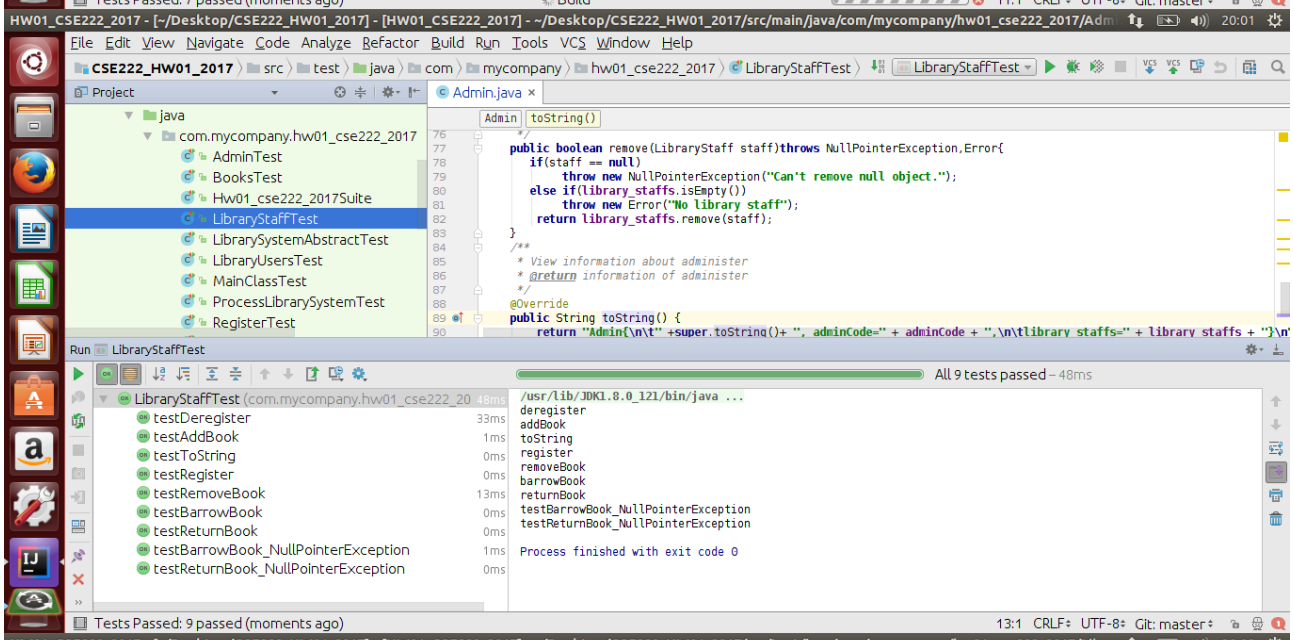

HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/test/java/com/mycompany/hw01_cse222_2017/LibraryUsersTest.java
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
CSE222_HW01_2017 src test java com mycompany hw01_cse222_2017 LibraryUsersTest
LibraryUsersTest.java
Project
java
com.mycompany.hw01_cse222_2017
AdminTest
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
public class LibraryUsersTest {
public LibraryUsersTest() {
@BeforeClass
public static void setUpClass() {
Run LibraryUsersTest
All 5 tests passed – 68ms
LibraryUsersTest (com.mycompany.hw01_cse222_2
testToString 65ms
testGetNumberofbooks 0ms
testBarrowBook 3ms
testReturnBook 0ms
testSetNumberofbooks 0ms
/usr/lib/JDK1.8.0_121/bin/java ...
toString
getNumberofbooks
barrowBook
returnBook
setNumberofbooks
Process finished with exit code 0
Tests Passed: 5 passed (moments ago)
9:1 CRLF: UTF-8: Git: master:

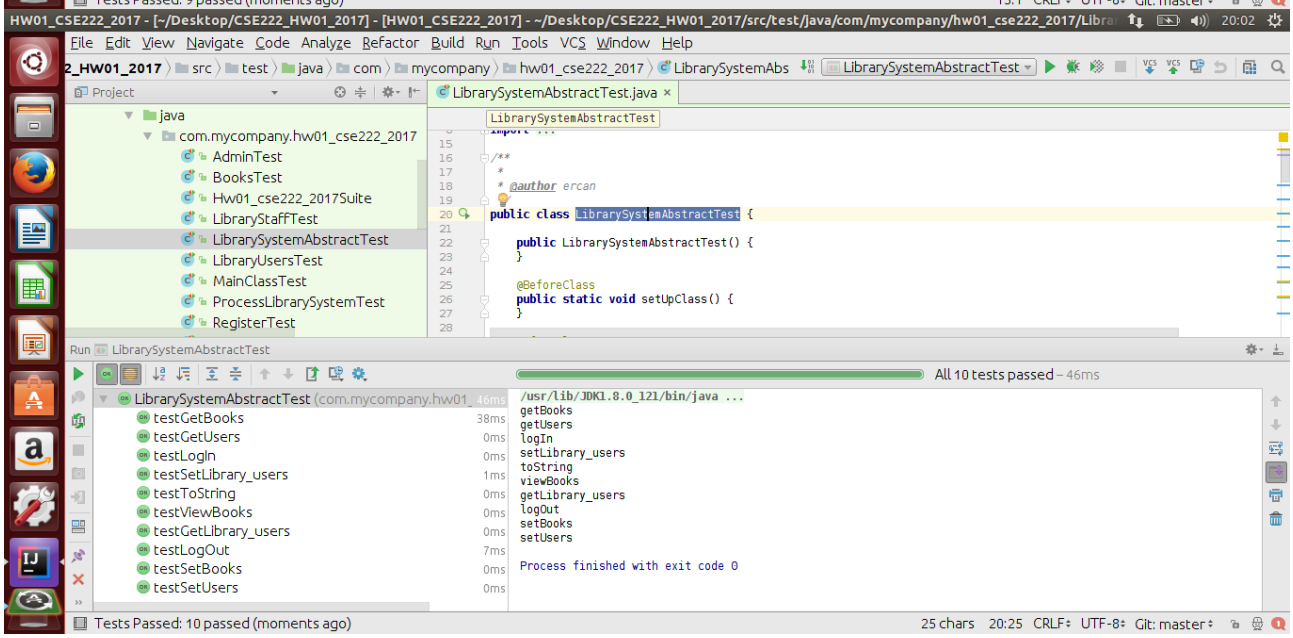

HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/test/java/com/mycompany/hw01_cse222_2017/ProcessLibrarySystemTest.java
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
ProcessLibrarySystemTest.java
Project
java
com.mycompany.hw01_cse222_2017
AdminTest
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
public class ProcessLibrarySystemTest {
public ProcessLibrarySystemTest() {
@BeforeClass
public static void setUpClass() {
@AfterClass
public static void tearDownClass() {
Run ProcessLibrarySystemTest
All 5 tests passed – 51ms
ProcessLibrarySystemTest (com.mycompany.hw01_
testLogIn 43ms
testViewBooks 0ms
testBarrowBook 1ms
testReturnBook 7ms
testLogOut 0ms
/usr/lib/JDK1.8.0_121/bin/java ...
logIn
viewBooks
barrowBook
returnBook
logOut
Process finished with exit code 0
Tests Passed: 5 passed (moments ago)
9:1 CRLF: UTF-8: Git: master:

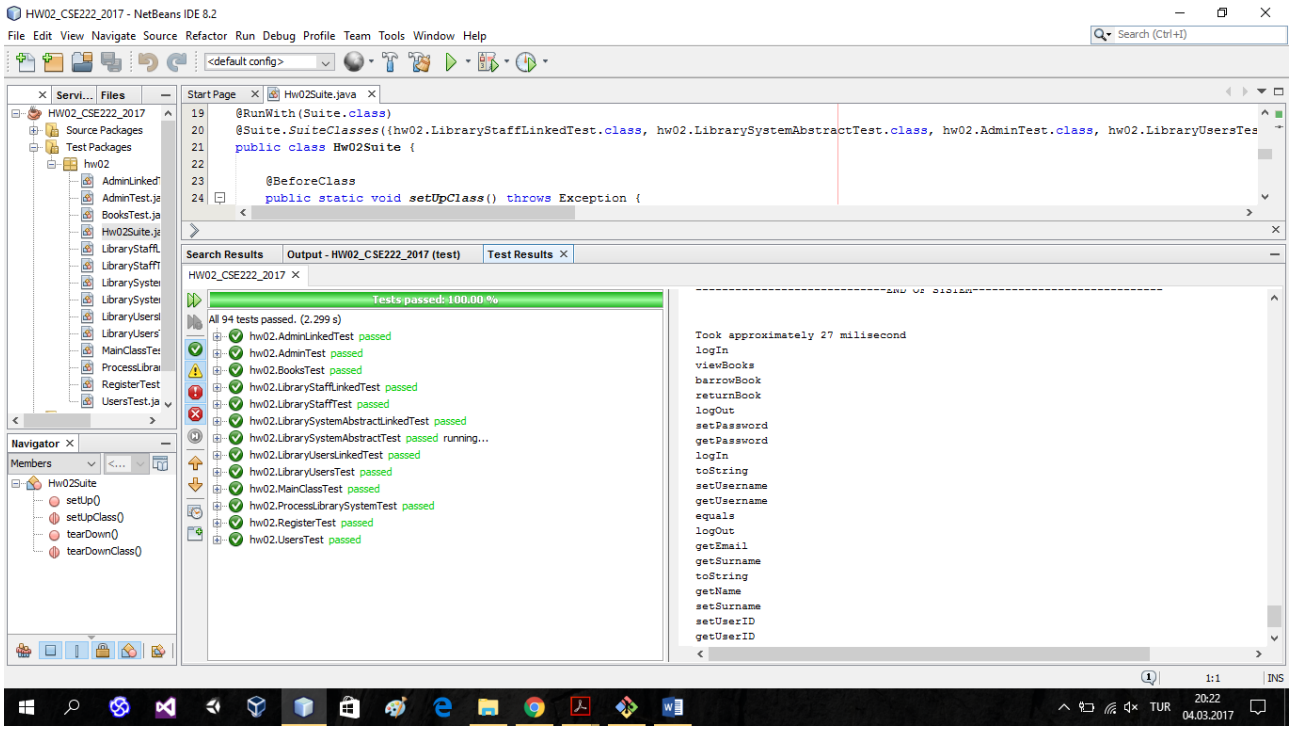

HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/test/java/com/mycompany/hw01_cse222_2017/RegisterTest.java
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
CSE222_HW01_2017 src test java com mycompany hw01_cse222_2017 RegisterTest
RegisterTest.java
Project
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
UsersTest
target
classes
public class RegisterTest {
public RegisterTest() {
@BeforeClass
public static void setUpClass() {
Run RegisterTest
All 8 tests passed – 19ms
RegisterTest (com.mycompany.hw01_cse222_2017)
testSetPassword 18ms
testGetPassword 0ms
testLogIn 0ms
testToString 1ms
testSetUsername 0ms
testGetUsername 0ms
testEquals 0ms
testLogOut 0ms
/usr/lib/JDK1.8.0_121/bin/java ...
setPassword
getPassword
logIn
toString
setUsername
getUsername
equals
logOut
Process finished with exit code 0
Tests Passed: 8 passed (moments ago)
12:1 CRLF: UTF-8: Git: master:


HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/test/java/com/mycompany/hw01_cse222_2017/MainClassTest.java
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
CSE222_HW01_2017 › src › test › java › com › mycompany › hw01_cse222_2017 › MainClass
MainClassTest.testMain
Project
java
com.mycompany.hw01_cse222_2017
AdminTest
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
MainClassTest.java
MainClassTest
testMain()
@org.junit.Test
public void testMain() {
System.out.println("main");
String[] args = null;
MainClass.main(args);
// TODO review the generated test code and remove the default call to fail.
//fail("The test case is a prototype.");
}
}
Run MainClassTest.testMain
1 test passed – 72ms
MainClassTest (com.mycompany.hw01_cse222_2017) 72ms
testMain 72ms
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]}
----------Library user return book one by User3!----------
View Library User 3 After return a book
LibraryUsers{Register{Users{
userID=2, name=Bekir, surname=Kurt, email=bekirkurt@hotmail.com}
username=bekirkurt, password=bekir11} numberofbooks=[
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]}
----------Log Out Library User3 Successfull!----------
----------END OF SYSTEM----------
Process finished with exit code 0
Tests Passed: 1 passed (moments ago)
113:1 CRLF: UTF-8: Git: master:
HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/test/java/com/mycompany/hw01_cse222_2017/UsersTest.java
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
CSE222_HW01_2017 › src › test › java › com › mycompany › hw01_cse222_2017 › UsersTest
UsersTest
Project
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
UsersTest
target
classes
UsersTest.java
UsersTest
/**
*
* @author ercan
*/
public class UsersTest {
public UsersTest() {
}
@BeforeClass
public static void setUpClass() {
}
Run UsersTest
All 9 tests passed – 32ms
UsersTest (com.mycompany.hw01_cse222_2017) 32ms
testGetEmail 30ms
testGetSurname 0ms
testToString 0ms
testGetName 1ms
testSetSurname 0ms
testSetUserID 0ms
testGetUserID 1ms
testSetName 0ms
testSetEmail 0ms
/usr/lib/JDK1.8.0_121/bin/java ...
getEmail
getSurname
toString
getName
setSurname
setUserID
getUserID
setName
setEmail
Process finished with exit code 0
Tests Passed: 9 passed (moments ago)
13:1 CRLF: UTF-8: Git: master:
HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/main/java/com/mycompany/hw01_cse222_2017/AdminTest.java
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
CSE222_HW01_2017 › src › test › java › com › mycompany › hw01_cse222_2017 › AdminTest
AdminTest
Project
java
com.mycompany.hw01_cse222_2017
AdminTest
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
UsersTest
target
Admin.java
Admin
toString()
public boolean remove(LibraryStaff staff)throws NullPointerException,Error{
if(staff == null)
throw new NullPointerException("Can't remove null object.");
else if(library_staffs.isEmpty())
throw new Error("No library staff");
return library_staffs.remove(staff);
}
/**
* View information about administer
* @return information of administer
*/
@Override
public String toString() {
return "Admin{\n\t" +super.toString()+ ", adminCode=" + adminCode + ",\n\tlibrary_staffs=" + library_staffs + "}\n
}
Run AdminTest
All 7 tests passed – 78ms
AdminTest (com.mycompany.hw01_cse222_2017) 78ms
testAdd_NullPointerException 51ms
testSetAdminCode 0ms
testAdd 17ms
testToString 0ms
testRemove_NullPointerException 0ms
testGetAdminCode 0ms
testRemove 10ms
/usr/lib/JDK1.8.0_121/bin/java ...
testAdd_NullPointerException
setAdminCode
add
toString
testRemove_NullPointerException
getAdminCode
remove
Process finished with exit code 0
Tests Passed: 7 passed (moments ago)
11:1 CRLF: UTF-8: Git: master:


HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/main/java/com/mycompany/hw01_cse222_2017/Adm
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
CSE222_HW01_2017 src test java com mycompany hw01_cse222_2017 BooksTest
BooksTest
Project
java
com.mycompany.hw01_cse222_2017
AdminTest
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
UsersTest
target
Admin.java
Admin toString()
public boolean remove(LibraryStaff staff)throws NullPointerException,Error{
if(staff == null)
throw new NullPointerException("Can't remove null object.");
else if(library_staffs.isEmpty())
throw new Error("No library staff");
return library_staffs.remove(staff);
}
/**
* View information about administer
* @return information of administer
*/
@Override
public String toString() {
return "Admin{\n\t" +super.toString()+ ", adminCode=" + adminCode + ",\n\tlibrary_staffs=" + library_staffs + "}\n
}
Run AdminTest
All 7 tests passed – 59ms
AdminTest (com.mycompany.hw01_cse222_2017) 59ms
testAdd_NullPointerException 41ms
testSetAdminCode 0ms
testAdd 13ms
testToString 4ms
testRemove_NullPointerException 0ms
testGetAdminCode 1ms
testRemove 0ms
/usr/lib/JDK1.8.0_121/bin/java ...
testAdd_NullPointerException
setAdminCode
add
toString
testRemove_NullPointerException
getAdminCode
remove
Process finished with exit code 0
Tests Passed: 7 passed (moments ago)
Build
11:1 CRLF: UTF-8: Git: master:


HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/main/java/com/mycompany/hw01_cse222_2017/Adm
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
CSE222_HW01_2017 src test java com mycompany hw01_cse222_2017 LibraryStaffTest
LibraryStaffTest
Project
java
com.mycompany.hw01_cse222_2017
AdminTest
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
Admin.java
Admin toString()
public boolean remove(LibraryStaff staff)throws NullPointerException,Error{
if(staff == null)
throw new NullPointerException("Can't remove null object.");
else if(library_staffs.isEmpty())
throw new Error("No library staff");
return library_staffs.remove(staff);
}
/**
* View information about administer
* @return information of administer
*/
@Override
public String toString() {
return "Admin{\n\t" +super.toString()+ ", adminCode=" + adminCode + ",\n\tlibrary_staffs=" + library_staffs + "}\n
Run LibraryStaffTest
All 9 tests passed – 48ms
LibraryStaffTest (com.mycompany.hw01_cse222_20 48ms
testDeregister 33ms
testAddBook 1ms
testToString 0ms
testRegister 0ms
testRemoveBook 13ms
testBarrowBook 0ms
testReturnBook 0ms
testBarrowBook_NullPointerException 1ms
testReturnBook_NullPointerException 0ms
/usr/lib/JDK1.8.0_121/bin/java ...
deregister
addBook
toString
register
removeBook
barrowBook
returnBook
testBarrowBook_NullPointerException
testReturnBook_NullPointerException
Process finished with exit code 0
Tests Passed: 9 passed (moments ago)
13:1 CRLF: UTF-8: Git: master:


HW01_CSE222_2017 - [~/Desktop/CSE222_HW01_2017] - [HW01_CSE222_2017] - ~/Desktop/CSE222_HW01_2017/src/test/java/com/mycompany/hw01_cse222_2017/Libra
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
2_HW01_2017 src test java com mycompany hw01_cse222_2017 LibrarySystemAbs LibrarySystemAbstractTest
LibrarySystemAbstractTest
Project
java
com.mycompany.hw01_cse222_2017
AdminTest
BooksTest
Hw01_cse222_2017Suite
LibraryStaffTest
LibrarySystemAbstractTest
LibraryUsersTest
MainClassTest
ProcessLibrarySystemTest
RegisterTest
LibrarySystemAbstractTest.java
LibrarySystemAbstractTest
/**
*
* @author ercan
public class LibrarySystemAbstractTest {
public LibrarySystemAbstractTest() {
}
@BeforeClass
public static void setUpClass() {
}
Run LibrarySystemAbstractTest
All 10 tests passed – 46ms
LibrarySystemAbstractTest (com.mycompany.hw01_ 46ms
testGetBooks 38ms
testGetUsers 0ms
testLogIn 0ms
testSetLibrary_users 1ms
testToString 0ms
testViewBooks 0ms
testGetLibrary_users 0ms
testLogOut 7ms
testSetBooks 0ms
testSetUsers 0ms
/usr/lib/JDK1.8.0_121/bin/java ...
getBooks
getUsers
logIn
setLibrary_users
toString
viewBooks
getLibrary_users
logOut
setBooks
setUsers
Process finished with exit code 0
Tests Passed: 10 passed (moments ago)
25 chars 20:25 CRLF: UTF-8: Git: master:



7. Running and Results

----------Created admin!----------

View Admin

Admin{

Register{Users{

userID=11, name=Ercan, surname=UCA, email=ercanuca@gmail.com}

username=ercanuca, password=1234}, adminCode=1111,

library_staffs=[]}

----------Created staff!----------

View Staff

LibraryStaff{

Register{Users{

userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}

username=kenankurt, password=1234}

[]

library_books=[]

}

----------Add staff by admin----------

After added Staff View Admin

Admin{

Register{Users{

userID=11, name=Ercan, surname=UCA, email=ercanuca@gmail.com}

username=ercanuca, password=1234}, adminCode=1111,

library_staffs=[

LibraryStaff{

Register{Users{

userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}

username=kenankurt, password=1234}
[]
library_books=[]
}]}

----------Created 2 Books!----------
----------Add Books by staff----------
After added 2 books View books by staff

LibraryStaff{
Register{Users{
userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}
username=kenankurt, password=1234}
[]
library_books=[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]
}

----------Created Library User!----------
----------Registed Library User by Staff!----------

LibraryStaff{
Register{Users{
userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}
username=kenankurt, password=1234}
[LibraryUsers{Register{Users{
userID=0, name=Elif, surname=Serap, email=elifserap.1@gmail.com}
username=eliff, password=222} numberofbooks=[]}]
library_books=[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]
}

----------Created Library User2!----------
View Library User 2
LibraryUsers{Register{Users{
userID=1, name=Yagmur, surname=Can, email=yagmurcan2@gmail.com}
username=yagmurcan, password=321} numberofbooks=[]}

----------Registed Library User2!----------

----------Created Library User3!----------
View Library User 3
LibraryUsers{Register{Users{

userID=2, name=Bekir, surname=Kurt, email=bekirkurt@hotmail.com}
username=bekirkurt, password=bekir11} numberofbooks=[]}

----------Register User3!----------

----------Registered Successfull!----------

----------Log In Library User3 Successfull!----------

----------Library user barrow 2 book User3!----------
****

[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]**********

View Library User 3 After barrow 2 books
LibraryUsers{Register{Users{
userID=2, name=Bekir, surname=Kurt, email=bekirkurt@hotmail.com}
username=bekirkurt, password=bekir11} numberofbooks=[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]}

----------Library user return book one by User3!----------
View Library User 3 After return a book
LibraryUsers{Register{Users{
userID=2, name=Bekir, surname=Kurt, email=bekirkurt@hotmail.com}
username=bekirkurt, password=bekir11} numberofbooks=[
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]}
----------Log Out Library User3 Successfull!----------
----------END OF SYSTEM----------

Took approximately 43 milisecond

----------Created admin!----------
View Admin
Admin{
Register{Users{
userID=11, name=Ercan, surname=UCA, email=ercanuca@gmail.com}
username=ercanuca, password=1234}, adminCode=1111,
library_staffs=[]}

----------Created staff!----------

View Staff

LibraryStaff{
Register{Users{
userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}
username=kenankurt, password=1234}
[]
library_books=[]
}

----------Add staff by admin----------
After added Staff View Admin
Admin{
Register{Users{
userID=11, name=Ercan, surname=UCA, email=ercanuca@gmail.com}
username=ercanuca, password=1234}, adminCode=1111,
library_staffs=[
LibraryStaff{
Register{Users{
userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}
username=kenankurt, password=1234}
[]
library_books=[]
}]}

----------Created 2 Books!----------
----------Add Books by staff----------
After added 2 books View books by staff

LibraryStaff{
Register{Users{
userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}
username=kenankurt, password=1234}
[]
library_books=[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]
}

----------Created Library User!----------
----------Registed Library User by Staff!----------

LibraryStaff{
Register{Users{
userID=0, name=Kenan, surname=Kurt, email=kenankara12@hotmail.com}
username=kenankurt, password=1234}
[LibraryUsers{Register{Users{
userID=0, name=Elif, surname=Serap, email=elifserap.1@gmail.com}

username=eliff, password=222} numberofbooks=[]}]
library_books=[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]
}

----------Created Library User2!----------
View Library User 2
LibraryUsers{Register{Users{
userID=1, name=Yagmur, surname=Can, email=yagmurcan2@gmail.com}
username=yagmurcan, password=321} numberofbooks=[]}

----------Registed Library User2!----------

----------Created Library User3!----------
View Library User 3
LibraryUsers{Register{Users{
userID=2, name=Bekir, surname=Kurt, email=bekirkurt@hotmail.com}
username=bekirkurt, password=bekir11} numberofbooks=[]}

----------Register User3!----------

----------Registered Successfull!----------

----------Log In Library User3 Successfull!----------

----------Library user barrow 2 book User3!----------
****

[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]**********

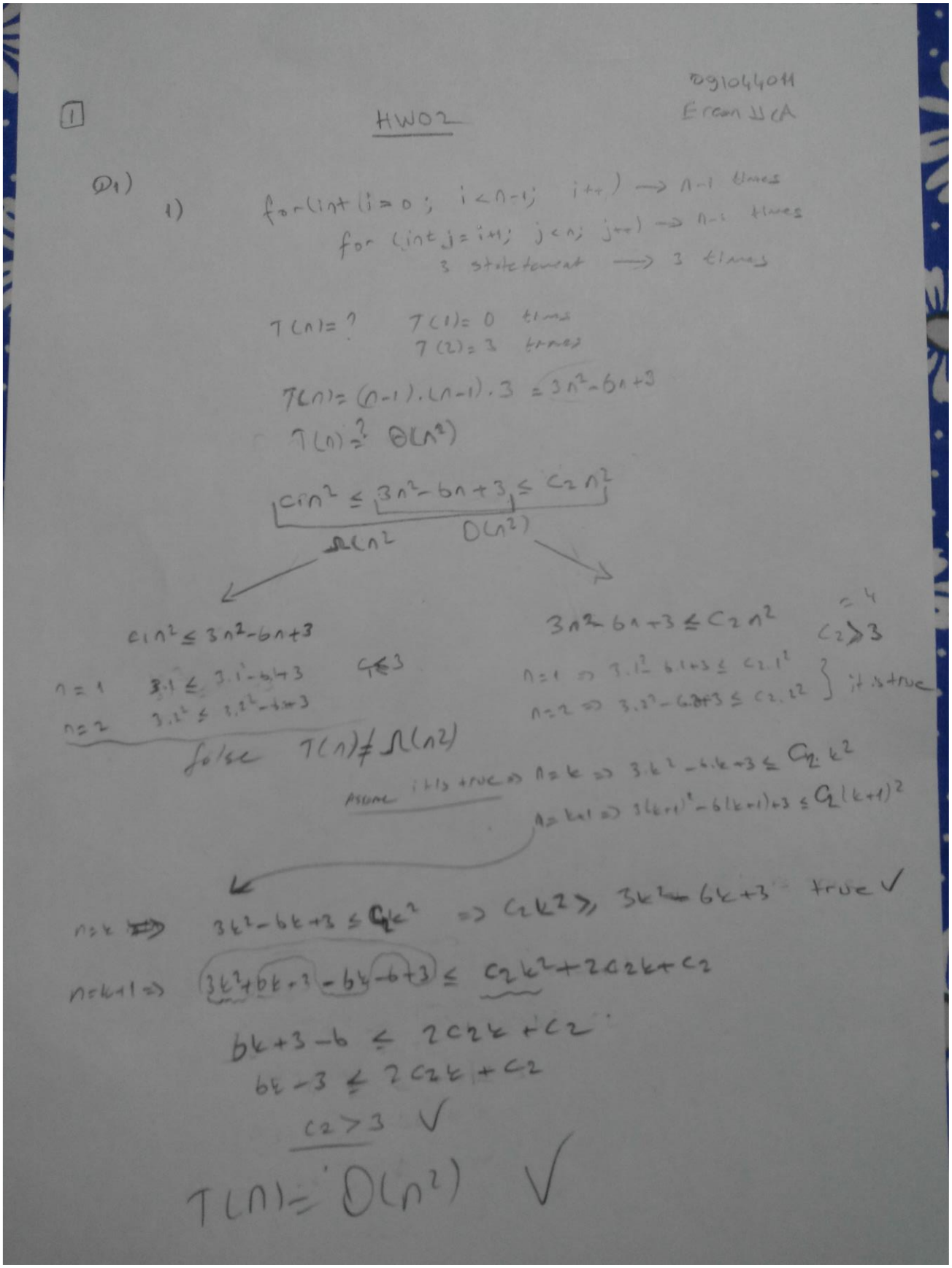
View Library User 3 After barrow 2 books
LibraryUsers{Register{Users{
userID=2, name=Bekir, surname=Kurt, email=bekirkurt@hotmail.com}
username=bekirkurt, password=bekir11} numberofbooks=[
Books{book_name=System Programlama, book_author=Author1, book_type=C and C++, bookID=4583}
,
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]}

----------Library user return book one by User3!----------
View Library User 3 After return a book

LibraryUsers{Register{Users{
userID=2, name=Bekir, surname=Kurt, email=bekirkurt@hotmail.com}
username=bekirkurt, password=bekir11} numberofbooks=[
Books{book_name=C++, book_author=Author2, book_type=C++, bookID=1234}
]}
----------Log Out Library User3 Successfull!----------
----------END OF SYSTEM----------

Took approximately 29 milisecond

9)(1-2-3-4-5 questions answers)



$\boxed{2}$

Q1)

2)
```
public static int lenght(String str){
    if(str==null || str.equals(""))
        return 0;
    return 1+ lenght(str.substring(1));
}
```

$T(n) = ?$ $T(0) = 0$, $T(1) = 1$

$T(n) = 1 + T(n-1) \Rightarrow$ $\cancel{T(1)} = 1 + T(0)$

$\cancel{T(2)} = 1 + \cancel{T(1)}$

$\vdots$

$+ \; T(k) = k + T(\cancel{k-1})$

$T(k) = \frac{k(k+1)}{2}$

$= \frac{k^2+k}{2}$

$T(n) = \frac{n^2+n}{2}$

$T(n) \overset{?}{=} \Theta(n^2)$

$\boxed{T(n) = O(n^2)}$

$c_1 n^2 \le \frac{n^2+n}{2} \le c_2 n^2$

Ω $\qquad$ O

$c_1 n^2 \le \frac{n^2+n}{2}$ $\quad c_1 \le 2$

$n=1$ $\quad c_1 1^2 \le \frac{1^2+1}{2}$ ✓

$n=2$ $\quad c_1 2^2 \le \frac{2^2+2}{2}$ ✓

$\vdots$

$n=k \Rightarrow c_1 k^2 \le \frac{k^2+k}{2}$ assume true ✓

$n=k+1 \Rightarrow c_1(k^2+2k+1) \le \frac{k^2+3k+2}{2}$

$c_1 k^2 + 2c_1 k + c_1 \le \frac{k^2+k}{2} + \frac{2k+2}{2}$

$2c_1 k + c_1 \le k+1$ ✗

$c_1 \le 2$ doğru değil

$c_2 > 2$

$\frac{n^2+n}{2} \le c_2 n^2$

$n=1$ $\quad \frac{1^2+1}{2} \le c_2 . 1^2$ ✓

$n=2$ $\quad \frac{2^2+2}{2} \le c_2 . 2^2$ ✓

assume true $\quad n=k$ $\quad \frac{k^2+k}{2} \le c_2 k^2$

$n=k+1 \Rightarrow \frac{k^2+3k+2}{2} \le c_2 k^2 + 2c_2 k + c_2$

$\frac{k^2+k}{2} + \frac{2k+2}{2} \le c_2 k^2 + 2c_2 k + c_2$

✓ $k+1 \le 2c_2 k + c_2$ $\quad c_2 > 2$

doğru

3

Q2)

```
n ← length(A)
for j ← i to n-1
    do smallest ← j
        for i ← j+1 to n
            do if A[i] < A[smallest]
                then smallest ← i

        exchange A[j] ↔ A[smallest]
```

1) ilk elemanın indexi tutularak en küçük eleman seçiliyor. Sonra arrayin sonuna kadar gidip en küçük indexli seçiliyor ve en başa atılıyor.
Sonra arrayimiz 1 sayı azaltılarak sonraki en küçük seçilip en başa atılıyor.
Selection sort algoritmasıdır yani.

2)

```
int i, j, n;
for (j = 0; j < n-1; j++)
{
    int iMin = j;
    for (i = j+1; i < n; i++)
    {
        if (a[i] < a[iMin])
            iMin = i;
    }
    if (iMin != j)
        swap(a[j], a[iMin]);
}
```

2n

4

Enküçük indexi bulmak için tüm statementların çalışması gerek.

$T(n) = n(2n+5) \Rightarrow 2n^2+5n$

$c_1 n^2 \le 2n^2+5n \le c_2 n^2$ $\quad$ $\underline{T(n) = \Theta(n^2)}$ ✓

$c_1 \le 2$ ✓ $\quad$ $c > 2$ ✓

4

Q2

2) devomi

$$\underbrace{c_1 n^2 \le \underbrace{2n^2+5n}_{\Omega(n^2)} \le c_2 n^2}_{O(n^2)}$$

$c_1 \le 2$

$n=1 \Rightarrow c_1 \cdot 1^2 \le 2 \cdot 1^2 + 5 \cdot 1$ ✓

$n=2 \Rightarrow c_1 \cdot 2^2 \le 2 \cdot 2^2 + 5 \cdot 2$ ✓ } True

!

$n=k \Rightarrow c_1 k^2 \le 2 \cdot k^2 + 5k$ ⇐ assume it's true.

$n=k+1 \Rightarrow c_1 k^2 + 2c_1 k + c_1 \le 2(k^2+2k+1) + 5k+5$

$c_1 k^2 + 2c_1 k + c_1 \le 2k^2 + 4k + 7 + 5k$

$c_1 \le 2$ $\quad 2c_1 k + c_1 \le 4k+7$

ise

$2 \cdot 2k + 2 \le 4k+7$

$T(n) = \Omega(n^2)$ dr $2 \le 7$ ✓

$c > 2$

$2n^2+5n \le c_2 n^2$

$n=1 \Rightarrow 2 \cdot 1^2 + 5 \cdot 1 \le c_1 \cdot 1^2$

$n=2 \Rightarrow 2 \cdot 2^2 + 5 \cdot 2 \le c_1 \cdot 2^2$

$n=k \Rightarrow 2 \cdot k^2 + 5k \le c_1 k^2$

$n=k+1 \Rightarrow 2k^2 + 4k + 7 + 5k \le c_1 k^2 + 2kc_1 + c_1$

$4k+7 \le 2c_1 k + c_1$

$c_1 > 2$ için

$4 \cdot k + 7 \le 6k + 3$

$7 \le 2k+3$ ✓

$T(n) = O(n^2)$ true

$T(n) = \Theta(n^2)$

5

b) 3) $\Theta(g(n))$ hem $O(g(n))$ hem de $\Omega(g(n))$ demektir.

$g(n) = 3n^2+2n+5$ olsun.

$g(n) = \Theta(n^2)$?

$c_1 n^2 \leq 3n^2+2n+5 \leq c_2 n^2$

$\Omega(n^2)$ Best case — $O(n^2)$ worst-case

$c_1 n^2 \leq 3n^2+2n+5$

$n=1 \Rightarrow c_1 \cdot 1^2 \leq 3\cdot 1^2+2\cdot 1+5$, $c_1 \leq 3$ is true

$n=2 \Rightarrow c_1 \cdot 2^2 \leq 3\cdot 2^2+2\cdot 2+5$, $c_1 \leq 3$, true

Assume $n=k$, it's true

$n=k \Rightarrow c_1 \cdot k^2 \leq 3k^2+2k+5$, $c_1 \leq 3$ ✓

$n=k+1 \Rightarrow c_1(k+1)^2 \leq 3(k+1)^2+2(k+1)+5$

$\Rightarrow 2c_1 k + c_1 \leq 6k+5$, $c_1 \leq 3$

$2\cdot 3\cdot k + 3 \leq 6k+5$

$3 \leq 5$ ✓

$\Omega(g(n))$ ✓

$3n^2+2n+5 \leq c_2 n^2$

$n=1 \Rightarrow 3\cdot 1^2+2\cdot 1+5 \leq c_2 \cdot 1^2$, $c_2 \geq 1$ ✓

$n=2 \Rightarrow 3\cdot 2^2+2\cdot 2+5 \leq c_2 \cdot 2^2$, $c_2 \geq 3$ ✓

Assume it's true

$n=k \Rightarrow 3k^2+2k+5 \leq c_2 k^2$, $c_2 \geq 3$

$n=k+1 \Rightarrow 3k^2+2k+5+6k+5 \leq c_2 k^2+2c_2 k+c_2$

$6k+5 \leq 2c_2 k + c_2$, $c_2 \geq 3$

$6k+5 \leq 8k+4$

$1 \leq k$ ✓

$O(g(n))$ ✓

$\Theta(g(n))$ proved it.

6

Q4) ① function insertionSortRec (array A, int n)

```
1 ← if (n > 1)
T(n-1) ← insertionSortRec(A, n-1)
1 ← x = A[n]
1 ← j = n-1
n-1 ← while j ≥ 0 and A[j] > x
2n-2 { 1 ← A[j+1] ← A[j]
       1 ← j ← j-1
       end while
1 ← A[j+1] = x
end if
end function
```

②

$T(n) = T(n-1) + 2n$

$\cancel{T(1)} = T(0) + 2.1$

$\cancel{T(2)} = \cancel{T(1)} + 2.2$

$\cancel{T(3)} = \cancel{T(2)} + 2.3$

$\vdots$

$+ \; T(k) = \cancel{T(k-1)} + 2.k$

$T(k) = T(0) + 2\frac{(k.(k+1))}{2}$

$T(k) = \underbrace{T(0)}_{0} + k^2 + k$

$T(n) = n^2 + n$

$T(n) = O(n^2)$ worst case

$n^2 + n \le c.n^2 \quad c \ge 1$

$n = 1 \Rightarrow 1^2 + 1 \le c.1^2$ ✓

$n = 2 \Rightarrow 2^2 + 2 \le c.2^2$ ✓

$\vdots$

$n = k \Rightarrow k^2 + k \le c.k^2 \Rightarrow$ assume true

$n = k+1 \Rightarrow k^2 + 2k + k + 1 \le ck^2 + 2ck + c$

$\Rightarrow 2k + 1 \le 2ck + c$

$c = 2$

$2k + 1 \le 4k + 2$

$-1 \le 2k$ true

$T(n) = O(n^2)$

③ 3, 4, 1, 2 ⇒ 3, 4

$\boxed{3}$ 4, 1, 2 ⇒ 4, 1

$\boxed{3, 1}$ 4, 2 ⇒ 4, 2

3, 1, 2 $\boxed{4}$ ⇒ 3, 1

1, 3, 2 $\boxed{4}$ ⇒ 3, 2

1, 2, $\boxed{3, 4}$ ⇒ 1, 2

1, $\boxed{2, 3, 4}$ ⇒ 1

$\boxed{1 \mid 2 \mid 3 \mid 4}$

$\boxed{n = 4}$ iken ters sirali iqim worst case

$O(n^2)$ dur. kaysama ve swaps.

7

Q4)

$f(n) = O(g(n))$, $f(n) = \Omega(g(n))$ or $f(n) = \Theta(g(n))$

① $f(n) = n^{0.1}$, $g(n) = (\log n)^{10}$

Θ bakıyoruz

$c_1 (\log n)^{10} \leq n^{0.1} \leq c_2 (\log n)^{10}$

Ω ↙ , O ↘

$\log(c_1 (\log n)^{10}) \leq \log(n^{0.1})$

$\log c_1 + 10 \log(\log n) \leq \frac{\log n}{10}$

$n=2 \Rightarrow \log c_1 \leq 0.1$, $c_1 \leq 2$ X

$n=4 \Rightarrow \log c_1 + 10 \leq 0.2$ $c_1 \leq 2$ X

$f(n) \neq \Omega(g(n))$

$\log(n^{0.1}) \leq \log(c_2 (\log n)^{10})$

$\frac{\log n}{10} \leq \log c_2 + 10 \log(\log n)$ $c_2 > 2$

$\frac{\log n}{10} \leq \log c_2 + 10 \log(\log n)$

$n=2 \Rightarrow 0.1 \leq \log c_2$ ✓

$n=4 \Rightarrow 0.2 \leq \log c_2 + 10$ ✓

true $\Rightarrow n=k \Rightarrow \frac{\log k}{10} \leq \log c_2 + 10 \log(\log k)$

$n=k+1 \Rightarrow \frac{\log(k+1)}{10} \leq \log c_2 + 10 \log(\log k$

$\frac{\log k}{10} + \frac{\log 1}{10} \leq \log c_2 + 10 \log(\log k + \underbrace{\log 1}_{0})$

$0 \leq \log c_2$ its true $\underline{f(n) = O(g(n))}$ ✓

$\underline{c_2 > 2}$ ✓

② $f(n) = n!$, $g(n) = 2^n$

$c_1 2^n \leq n! \leq c_2 2^n$

$c \leq 1$ ↙ , → $n! \leq c_2 2^n$

$n=1$ $c_1 \cdot 2^1 \leq 1!$ false

$n=2$ $c_1 \cdot 2^2 \leq 3!$ false

$f(n) \neq \Omega(2^n)$

$n=1$ $1! \leq c_2 \cdot 2^1$, $c_2 \geq 1$ ✓

$n=2$ $2! \leq c_2 \cdot 2^2$, $c_2 \geq 1$ ✓

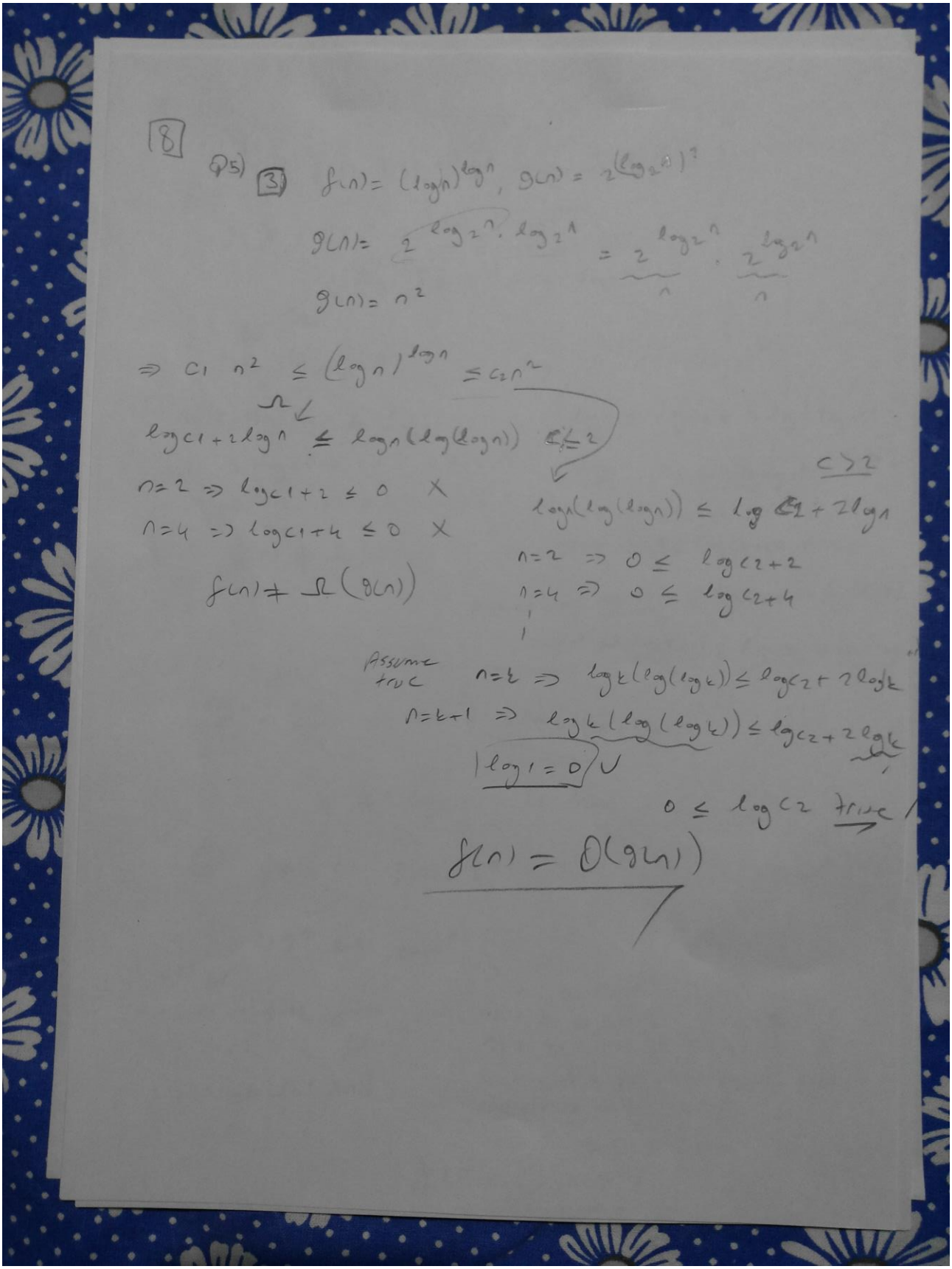
$n=k \Rightarrow k! \leq c_2 \cdot 2^k$ assume true.

$n=k+1 \Rightarrow (k+1)(k+1) \leq c_2 \cdot 2 \cdot 2^k$

$k+1 \leq 2 c_2$ $c_2 \geq 1$

$n \geq n_0$ ✓

$\underline{f(n) = O(g(n))}$ ✓



8) Github Link

Hw02 link: https://github.com/erccanuca/cse222_hw02_2017