

# CHALMERS

## EXAMINATION / TENTAMEN

Course code/kurskod	Course name/kursnamn		
Anonymous code Anonym kod		Examination date Tentamensdatum	Number of pages Antal blad
DIT636	software quality & testing	5/6/2024	13
DIT636-0024-CUY			4

\* I confirm that I've no mobile or other similar electronic equipment available during the examination.  
 Jag intygar att jag inte har mobiltelefon eller annan liknande elektronisk utrustning tillgänglig under  
 exminationen.

Solved task Behandlade uppgifter	Points per task Poäng på uppgiften	Observe: Areas with bold contour are to completed by the teacher. Anmärkning: Rutor inom bred kontur ifylls av lärare.
No/nr		
1	✓ 6	
2	✓ 9	
3	✓ 6	
4	✓ 10	
5	✓ 2	
6	✓ 9	
7	✓ 14	
8	✓ 9	
9	✓ 14	
10		
11		
12		
13		
14		
15		
16		
17		
Bonus poäng		
Total examination points Summa poäng på tentamen	79	

- 1-b for true/false  $\Rightarrow$  Decision coverage C
- 2-b Fed-ex for data testing ~~between~~
- 3-a
- 4-b False because of the need for manual/human testing
- 5-d a, c ⑥
- 6-a
- 7-b, c

performance, to quickly generate questions ~~at~~ each time and respond ~~at~~ ~~base~~ with suggestions based on the most recent stock market state/prices.

scalability, to scale up/down ~~at~~ automatically when needed at pick times and adjust the resources.

Performance is important because the type of questions and answers can affect the user experience ~~and this~~ (together with ~~the~~ performance of getting recent stock market updates)

Scalability is important to keep the system performant and handle questions, results, update and recommendations <sup>market</sup> of stocks at peak hours.

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		Question no. Uppgift nr <b>2-1</b>	

## 2- Quality scenarios

### Performance scenarios

#### \* Description/overview

user adds a new reply successfully.

\* system states system is operating normally under normal load of thousand concurrent users.

\* system environments all notification services external are operating normal.

#### \* External stimulus

user adds a new reply on "movies" board

\* system response system sends the reply info to server.

system shows a "your reply added with success" message

and shows the reply on user's screen. The reply-added is received by the server and added to database. Then a notification is send to all users subscribing to the topic.

\* Response measure system responds to add a new reply within 45 sec, 95% of the time and sends a notification to subscribed users within 1 minute, 99% of the time.

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			Question no. Uppgift nr 2-2

## Scalability Scenarios

⑨

- \* Description/overview concurrent

A ~~sudden~~ pick in  $N_{users}$  after a topic becoming viral.

- \* system state & system operating normally under normal load of

3 thousands of concurrent users.

- \* System environment & all notification services are operating external normally.

\* External stimulus A ~~sudden~~ pick in a topic after it becomes viral on the platform increases the number of  $N_{users}$  to concurrent 6 thousands.

- \* Required system response the system ~~will~~ scales the resources ~~by~~ by adding extra hardware to handle the change. All notifications to users put in a queue to be sent to users.

- \* Response measure

Add previous performance  
To compare

The system must respond to 95% requests within 60 sec / one minute. ~~and 95% and second~~

The system must send notification to subscribed users within ~~95%~~ wanted 95% of the time.  
90-120 seconds

- \* By external notification system, I mean something like IOS notification or external system to notify users by e-mail or text message.

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① Concepts:

In unit testing, we test each piece/smaller component/class of the system to ensure they work as expected.

In Integration testing, we test ~~the component~~ how these pieces work/integrate together.

Both are automated.

→

② ③ First system is tested internally with automated and/or manual tests. Then the system is tested by alpha/Betha testing that shows/exposes the system with customers/users.

④ The faults from first stage are more functionalities whereas the second one would be more related to customer/user's usecase/perspective **Not clear**

Q

## 4- System testing

choice: email Address  
representative values:

Valid, unique (Normal)

email already exists [Error] ~~False outcome, not error~~

Invalid email - does not contain @ [Error]

Invalid email - does not end with ".3-4 letters" pattern [Error]

email missing in request [Error]

choice: user ID

Valid, normal user id

user ID is missing in request [Error]

user ID is invalid, contains banned words

choice: password

valid, normal password

password is too short, invalid [Error]

password is same as user ID [Single]

password is same as email address [Single]

password is missing [Error]

choice: Date of Birth

valid, Normal

age less than 13, invalid [Error] ~~False outcome next page~~

Date of birth ~~can't~~ ~~be~~ in future [Error]

Invalid date, date of birth is not a date [Error]

~~date of birth is missing in request~~ (type)  
~~Invalid date, date of birth is~~ [Error]

\*~~extra~~  
\*~~extra~~ extra checks for password not being same as id,  
email for more security  
and length

(19)

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## Exploratory testing.

- ① submodel tour, this tour focus on GUI and tests through all the features ~~and~~ in GUI  
How?
- ② ~~theory~~  
① Test each feature, for example testing if the reply submit form works and is clear, if the notifications work and how the GUI looks

Three concrete examples

②

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{@Test}

registerUser() { Normal () }

WebForum

webforum = new

WebForum();

try {

var result = webforum.registerUser("test@gmail.com",  
"testUserId", "passwordtest123", "1998-08-12")

catch {

assertTrue(result)

fail("register Normal user failed, this should not happen")

}

assertTrue(result)

}

Age < 13

{@Test}

registerUser - <sup>too young</sup> { Badage () }

WebForum

web = new WebForum();

try {

var result = web.registerUser("test@gmail.com", "testId"  
"password", "2002-08-12")

catch {

fail("this should not happen, register user  
failed")

}

assertFalse(result)

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[@ Test]

registerUser - throws\_email\_invalid () {

WebForum web = new WebForum();

Throwable exception = () => {

~~var result~~ web.registerUser("hello", "thisisname", "password", "2000-08-18")

} } "email\_invalid"

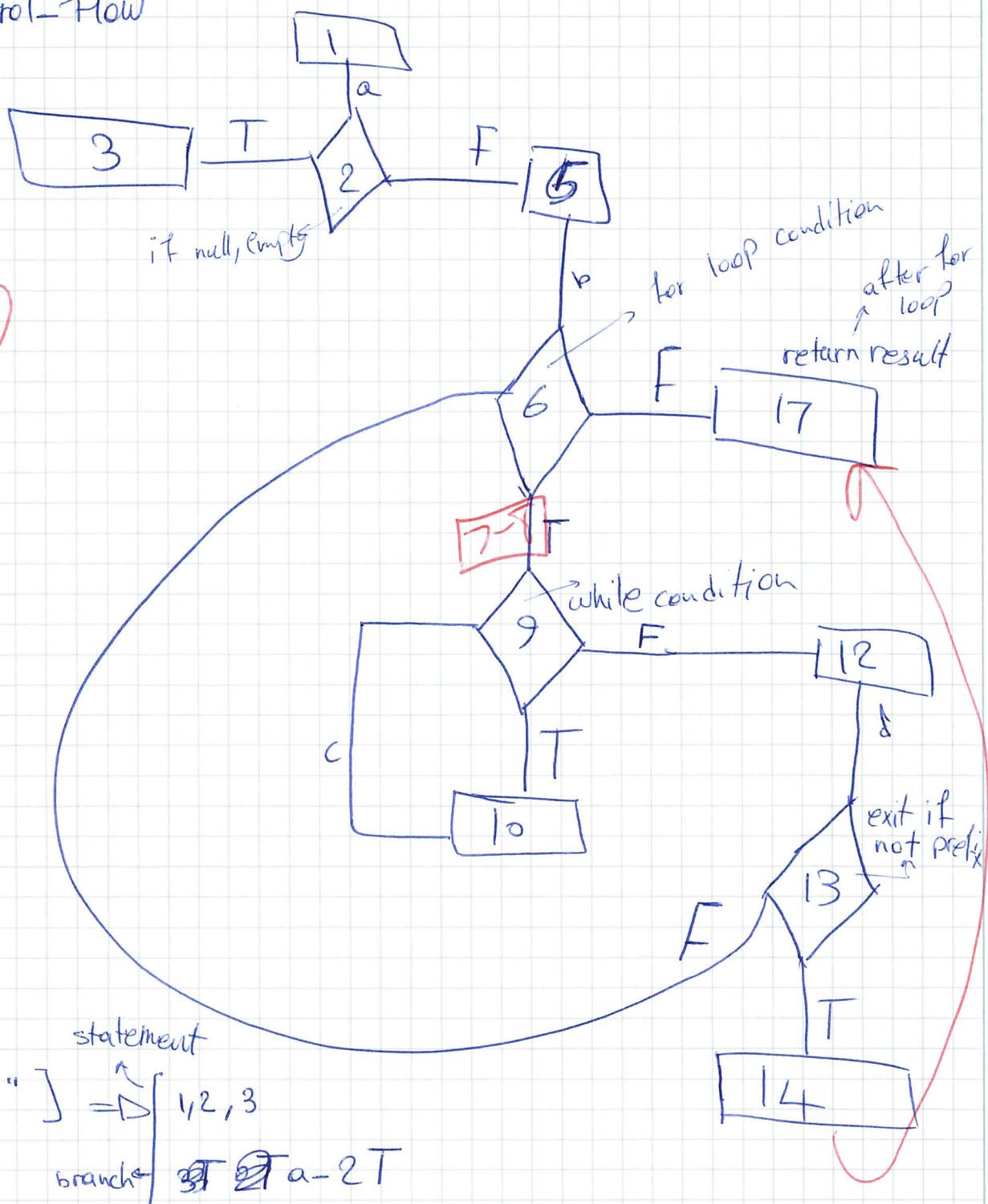
assertEqual(result.exception.getMessage())

g

⑨

## Structural testing 3

## Control-Flow



$$\left[ "Pan", "Pam" \right] \Rightarrow \begin{cases} 1, 2, 5, 6, \textcircled{7}, 8, 9, 10, 12, 13, 17 \\ \textcircled{a} T \textcircled{b} F \textcircled{c} a-2 T \end{cases}$$

$$\left[ "Pan", "Fan" \right] \Rightarrow \begin{cases} 1, 2, 5, 6, 7, 8, 9, 10, 12, 13, 14 \\ \textcircled{a} T \textcircled{b} F \textcircled{c} a-2 T \end{cases}$$

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## Data flow testing 8

① arr<sub>3</sub> sorting redefines the array by moving around elements.

$(1,2), (2,4), (2,5) (2,6) (2,2,8)$

$(2,10), (2,11) (2,13) \text{ } \textcircled{23}$

## Product 8

$(3,6) (6,8) (6,6) (3,8)$

$(3,11) (11,13) (11,11)$

②

i %

$(5,5) (5,6)$

$(10,10) (10,11)$

Need single-item array

②

$\left[ \begin{smallmatrix} 0 & 2 & 1 \\ 1 & 4 & 7 & 8 \end{smallmatrix} \right] \Rightarrow \left\{ \begin{array}{l} \text{arr}_3 (1,2), (2,4), (2,5), (2,6), (2,8) \\ \text{product}_3 (3,6)(6,8) \\ i \% (5,5)(5,6) \end{array} \right.$

$\left[ \begin{smallmatrix} 3 & -1 & 4 \end{smallmatrix} \right] \Rightarrow \left\{ \begin{array}{l} \text{arr}_3 (1,2), (2,10), (2,11), (2,13) \\ \text{product}_3 (3,11)(11,13) \\ i \% (10,10)(10,11) \end{array} \right.$

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Käta Mutation testing:

Relational operator (ror)

- ① 3 ( $\leq$ ) , 5 (num  $\leq$  2) , 8 (i \* i  $\leq$  num) , 9 (num / i == 0)
- 13 (isPrime == true)

- ② line 5, from num  $\leq$  2 to num  $\leq$  2.

③ Any test checking for sum result of ~~2, 3~~ with 2 in the span can reveal this. For example, start=2 and end=4 should result in sum of (2, 3) which is 5 but it will return result of (3)=3 ~~not included~~

Arithmetic operator (aor):

- ① 3 (num++) , 8 (i \* i) ~~num~~ , 8 (i++) , 9 (num / i), 14 (sum  $\pm$  sum)

- ② line 14, from sum += num to sum -= num

③ Any test that checks the result of sum can reveal this since it is not adding to the sum value. For example start=1 and end=5, it should return sum of ~~(2, 3, 5)~~ which is ~~10~~ but it returns (-10) because of the change it will not add to sum.

Constant for constant:

- ① 2 (sum=0) , 4 (isPrime = true) , 6 (isPrime = false) , 8 (i = 2)

10 (isPrime = false) - ~~5, 9, 13~~

- ② line 2, from sum=0 to sum=1

14

③ Any test that checks for result being calculated correctly can be used for this since the sum value is starting from a constant.

for example, for start=1 and end ~~4~~, it should return sum of

~~(2, 3, 5)~~ which is ~~10~~ but it returns ~~10~~ because sum value starts at 1.

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mutation testing:

Relational operator replacement (ror) (only line numbers)

3 ( $<=$ )

line 3 ( $++$ ) to ( $--$ )

Arithmetic operator replacement (oor) & (short-cuts)