



## Försättsblad till tentamen/Cover sheet for Examination

41

Kursnamn/ Course: **Verifiering och validering**

Kurskod/Course code: **PA2516**

Datum/Date: **2015-03-17**

(Ifyller av studenten, v.g. texta/To be filled in by the Student, block capitals)

Studentens namn/Student's Name

**KATHYAYANI PADIRA**

Personnummer/Personal civic number

**9401155446**

Inlämnade blad/Submitted papers

**9**

Inlämn. tid/Submission time

**19:17**

Lösta uppgifter/Questions attempted: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

### ANVISNINGAR/INSTRUCTIONS

Inlämning får ske tidigast efter 60 minuter. Skriv namn och personnummer på samtliga inlämningspapper. Eventuella beräkningar ska finnas med i tentamen. Även "blank" tentamen ska lämnas in. Resultatet av skrivningen meddelas via e-post senast 15 arbetsdagar efter tentamensdatum. Undantagsvis kan avvikelse förekomma.

Submission is allowed after 60 minutes. Write your name and personal civic nr. on each page. Any assessments should be included in the examination. Also "blank" examinations must be submitted. The results of the exam will be given by e-mail within 15 working days after the examination date. Exceptionally, deviation may occur.

Ansvarig lärare/Responsible teacher: **Kai Petersen**

Meddelande från ansvarig lärare/Information from responsible teacher:

(Ifyller av tentamenvakt/to be filled in by the invigilator)

Legitimation uppvisad, sign:

(Ifyller av ansvarig lärare/to be filled in by the responsible teacher)

Poäng/points:

Betyg/grade:

ECTS:

Sign:

(Ifyller av studenten vid utkvittering av rättad tentamen/To be filled in by the student when signing on the corrected examination)

Härmed utkvitterar jag denna tentamensskrivning. Jag är medveten om att jag därmed förbrukar min rätt att opponera mig mot gjord rättning, poäng och betygssättning./ Hereby, I signed this examination writing. I am aware that I thus consume my right to opposing made corrections, credits and grades.

Datum/Date:

Underskrift/Signature:



3x/ul

**EXAM: PA2516/PA2405 - 2015-03-17**

**2** **=** **Q1. Blackbox versus Whitebox Testing (3 points)** Explain what the role of the requirements specification is in blackbox testing and in whitebox testing.

**4** **=** **Q2. Verification and Validation (4 points)** Shortly explain what the difference between verification and validation is (2 points). Provide an example for each (2 points).

**11** **=** **Q3. Black-Box Testing (12 points)** Given is a ticketing system. Children under age 6 are allowed to travel for free, people under 18 as well as senior people older than 64 pay SEK10, while adults need to pay SEK20. Hence, the customer has to input their age into the system. In order to pay the ticket allows payment with "Debit card" or "Credit card", other forms of payment are not possible.

- (a) Identify the equivalence classes (valid as well as invalid ones).
- (b) Conduct a boundary value analysis.
- (c) Provide the minimum number of test cases needed to achieve "*Each Choice Coverage (ECC)*".
- (d) Create a decision table also (simplify as much as possible).

**4** **=** **Q4. Quality attributes (6 points)** Three different systems are to be developed, namely an automatic stock trading system, a taxing system for the tax authorities to handle the taxing of citizens, and a fantasy computer role-playing game that players can play together on the web. You have been product manager on both products, having to decide which quality attributes for these products are most important. The attributes being considered in the prioritization are: a) efficiency, b) reliability, c) usability, d) safety, and e) security. For each of the product, state which one of the quality attributes a) to e) is the most important for each product, and least important for each product, and *why*.

**6** **=** **Q5. Static code analysis (6 points)** Shortly explain three features of automated static code analysis tools (i.e. the capabilities they have in terms of analyzing the source code), and provide one example per feature.

**10** **=** **Q6. Whitebox-testing (10 points)** Given is the following source code for the Selection Sort algorithm, a[0] to a[n-1] is the array to sort.

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

(a) Draw the control flow graph based on the source code, and provide the path through the graph to achieve statement and decision coverage. (b) Annotate the flow graph with data-flow information. Then determine the paths needed to achieve all-uses coverage.





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## ① Black box v/s White box testing :-

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In blackbox testing, the test case selection is based on the requirement specification. In white box testing, test case selection is based on the structure/code of the system.

! 2

The effectiveness of the testing (i.e how good are the chosen test cases in testing) is based on the requirement specification.

Lärarens  
anteckning:  
Teachers note:

black box testing

white box testing

Requirement specification is a reference for test case selection.

Requirement specification is a reference to evaluate the effectiveness of the test.

!

② Validation:- does the product meet the stated needs; does the product meet the required level of reliability needed by the customer. (ex:- for safety critical systems, customers require higher level of reliability, (ex:- car breaking system)). Validation is to check if the right product is built.

1+1

Verification - specification v/s product. Verification checks if the product is built right. Based on the test data, it verifies if the system achieves the specified reliability level. (for ex:- In car breaking system, verify that the system actually achieves the specified reliability)

4+1

3) variable

Valid equivalence class

Invalid equivalence class

(a)

Age(x)

1.1  $0 < x < 6$  ✓ 0.51.2  $6 \leq x < 18$  0.5Poäng:  
Point:

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variable	Valid equivalence class	Invalid equivalence class	Uppgift nr: Task nr:
	$1 \leq x < 100$	$x < 0$	0.5
	$1 + 18 \leq x \leq 64$	$x > 100$	
Payment method (y)	2.1 $y \in \{\text{debit card}\}$ 0.5 2.2 $y \in \{\text{credit card}\}$	2.ay $\notin \{\text{debit card, credit card}\}$ 0.5	3/3.5 =

### (b) boundary value analysis

- 1.1  $(-1, 0, 1), (5, 6, 7)$
- 1.2 lower bound -  $(5, 6, 7)$   
upper bound -  $(17, 18, 19)$
- 1.3  $(63, 64, 65), (99, 100, 101)$
- 1.4 lower bound -  $(17, 18, 19)$   
upper bound -  $(63, 64, 65)$

Assumption -  
people live  
only upto 100 years  
and no one  
is younger  
than 8 years

### (c) Each choice coverage

variable	T1	T2	T3	T4	T5	T6	T7
age	2	8	67	50	10	-3	107
payment method	debit card	credit card	debit card	credit card	other payment	credit card	debit card
equivalence class	1.1	1.2	1.3	1.4	2.1	1.9	1.6
subset used	2.1	2.2	2.1	2.2	2.1	1.9	1.6

2/2.5  
=

### (d) formula :- $2^n$ condition (no. of conditions)

conditions - 4  
(age)  
 $2^4 = 16$

actions -

Poäng:  
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Uppgift nr:  
Task nr:

R <sub>1</sub>	R <sub>3</sub>	R <sub>5</sub>	R <sub>7</sub>	R <sub>8</sub>	R <sub>9</sub>	R <sub>11</sub>	R <sub>12</sub>	R <sub>13</sub>	R <sub>14</sub>	R <sub>15</sub>	R <sub>16</sub>
T	T	T	T	T	F	F	F	F	F	F	F
T	T	F	F	F	T	T	T	F	F	F	F
T	F	T	F	F	T	F	F	T	T	F	F
-	-	-	T	F	-	T	F	T	F	T	F

✓ Redundant

Lärarens  
anteckning:  
Teachers note:

R <sub>1</sub>	R <sub>3</sub>	R <sub>5</sub>	R <sub>7</sub>	R <sub>8</sub>	R <sub>9</sub>	R <sub>11</sub>	R <sub>12</sub>	R <sub>13</sub>	R <sub>14</sub>	R <sub>15</sub>	R <sub>16</sub>
age > 65	T	T	T	F	F	F	F	F	F	F	F
6 ≤ age ≤ 13	T	F	F	T	T	T	T	F	F	F	F
age > 64	-	T	F	F	T	F	F	T	T	F	F
≥ 6 ≤ age < 64	-	-	T	E	-	T	F	T	F	T	F
Free			X								
10SEK						X		X			
20SEK									X		
Not possible	X	X	X		X	X		X		X	

) Final decision table after removing redundancies

Poäng:  
Point:

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④ → Automatic stock trading system:-

4/6

Most important attributes :- Reliability, security, efficiency can be argued upon.

✓ Reliability (during stock trading system should not crash (recoverability should be there)), security (no manipulation or incorrect breach of system (secure)), efficiency (dynamic & online stock trading)

4/0

Least important :- Usability (not as important for stock trading system).

→ Taxing systems:-

✓

Most important :- security (tax system must be highly secure as the information is confidential and sensitive) availability (recoverable in case of a crash)

 1+0  
2

Least important :- usability (systems is for tax authorities who have knowledge in handling taxes).

→ Role play game (online):-

Most important :- usability (can players understand and play the game), reliability (game should not crash, has to be fault tolerant), efficiency (proper time & resource utilization)

 4/1  
2

Least important :- safety (It is not a safety critical system like car breaking system).

 Poäng:  
 Point:

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Course:(5) Static code analysis:-

→ Code metrics :- Measurement of the code to compare (ex:- cyclomatic complexity:- On basis of the measurement of the linearly independent path in the source code)  $E - N + 2 = \text{cyclomatic complexity}$   
edges / nodes

Uppgift nr:  
Task nr:1+1  
=Lärarens  
anteckning:  
Teachers note:

→ Coding conventions :- Practices & standards to be followed. (ex:- for Java code - File organisation, indentation, white spaces, naming conventions, statements, declaration etc).

H1  
=

→ Parallelization (concurrency):- The bug patterns that are observed due to concurrency mistakes in programming. (ex:- dead locks, livelocks, data races (race conditions) etc).

1+1  
=

→ Structure :- Problems in the control flow of the system (ex:- dead code).

(6) int i = j, int iMin;

for (j = 0; j < n - 1; j++) {

iMin = j;

for (i = j + 1; i < n; i++) {

if (a[i] < a[iMin]) { iMin = i; }

if (iMin != j) swap(a[i], a[iMin]);

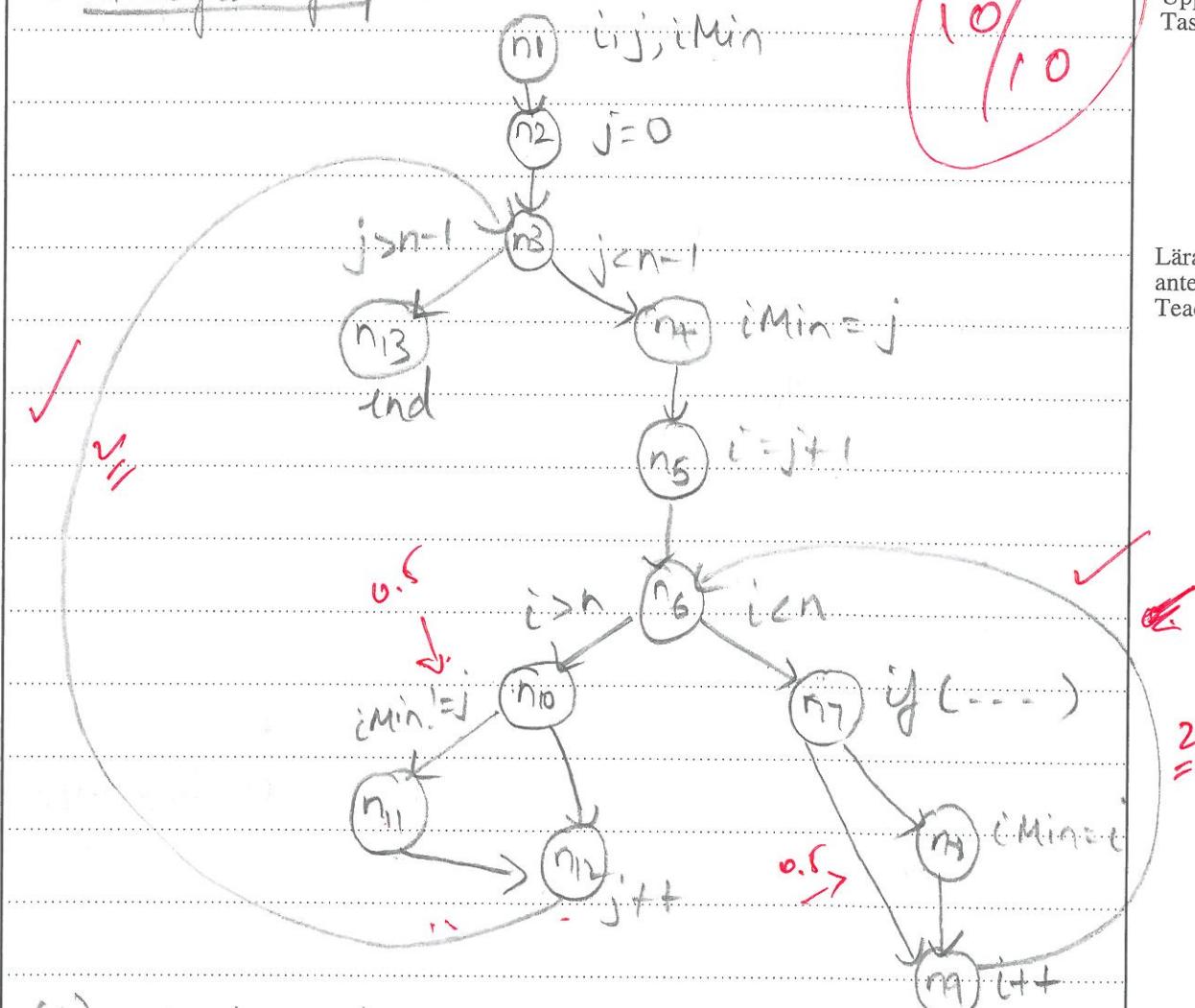
3 3

Poäng:  
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Control flow graph:-



(a) statement coverage:-

path : 1, 2, 3, 4, 5, 6, 7, 8, 9, 6, 10, 11, 12, 3, 13

0.8

decision coverage:-

path1 : 1, 2, 3, 4, 5, 6, 7, 8, 9, 6, 10, 11, 12, 3, 13

0.8

path2 : 1, 2, 3, 4, 5, 6, 7, 9, 6, 10, 12, 3, 13

0.5

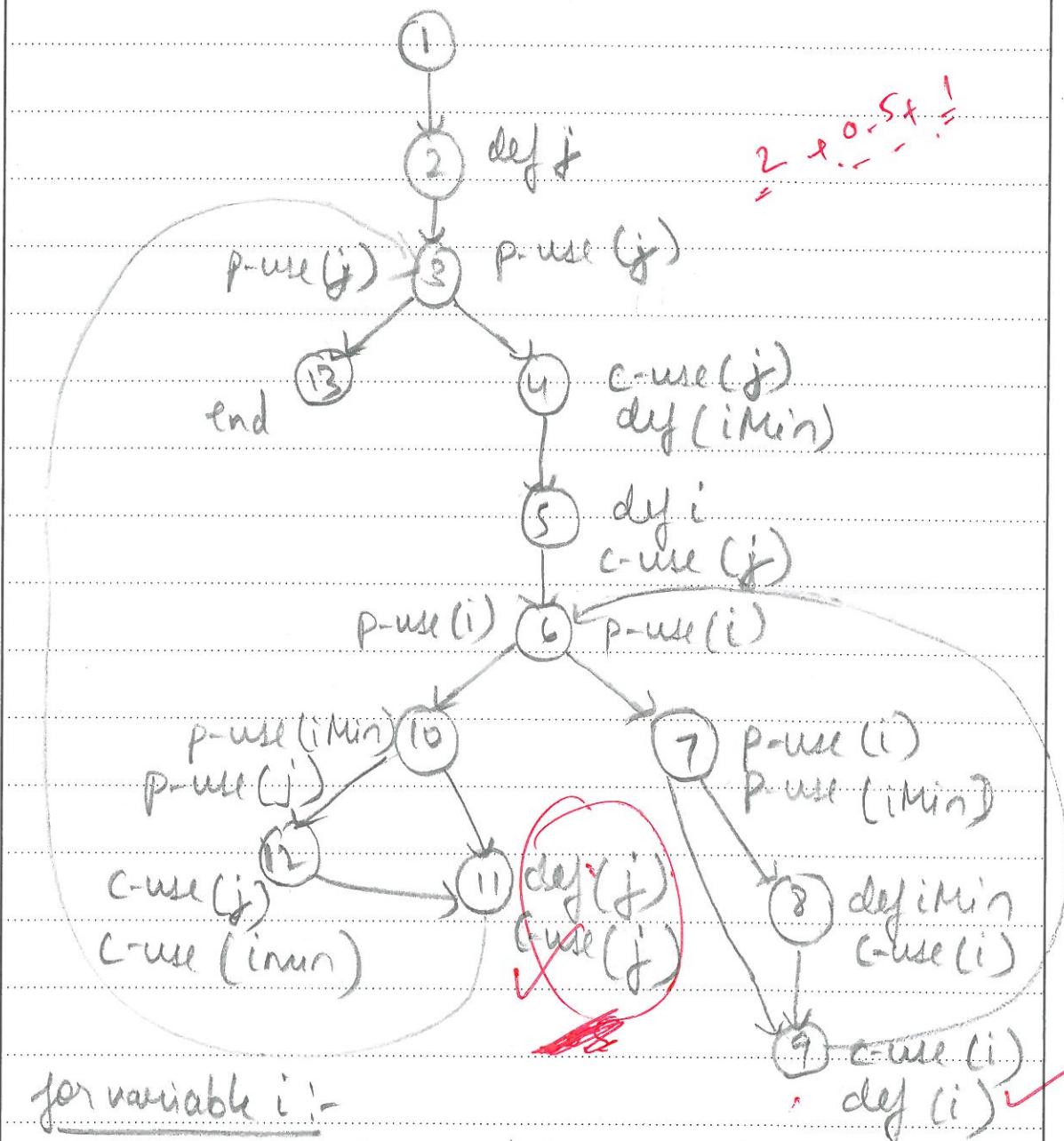
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Annotated graph (Data flow diagram):-

 Uppgift nr:  
Task nr:

 Lärarens  
anteckning:  
Teachers note:

for variable i :-

 set DPU( $i, 5$ ) =  $(5, 6, 7) P_1, P_1^* (5, 6, 10)$ 

 set DCU( $i, 5$ ) =  $(5, 6, 7, 8) C_1$ 
for variable j :-

 set DPU( $j, 2$ ) =  $(2, 3, 4, 5, 6, 10, 12) P_2$   
 $(2, 3, 4, 5, 6, 10, 11) P_2^*$   
 $(2, 3, 13) P_2^{**}$ 

 Poäng:  
Point:

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set DCU(j,2) - (2,3,4,5,6,10,12) C<sub>2</sub>Uppgift nr:  
Task nr:

for variable (iMin)

set DPU(iMin,4) - (4,5,6,7,8) P<sub>3</sub>(4,5,6,7,9) P<sub>3</sub>\*(4,5,6,10,12) P<sub>2</sub>\*\*(4,5,6,10,11) P<sub>2</sub>\*\*\*Lärarens  
anteckning:  
Teachers note:set DCU(iMin,+) - (4,5,6,10,12) C<sub>3</sub>

Path for All uses coverage:-

There are 7 paths for the graph (assumption: loop  
executed only once)case 1 : 1,2,3,13 (P<sub>2</sub>\*\*)case 2 : 1,2,3,4,5,6,7,8,9,6,10,12,11,3,13  
(P<sub>3</sub>, P<sub>1</sub>, C<sub>1</sub>)case 3 : 1,2,3,4,5,6,7,9,6,10,12,11,3,13  
(P<sub>3</sub>\*, P<sub>1</sub>)case 4 : 1,2,3,4,5,6,7,8,9,6,10,11,3,13  
(P<sub>1</sub>, C<sub>1</sub>)case 5 : 1,2,3,4,5,6,7,9,6,10,11,3,13  
(P<sub>1</sub>)case 6 : 1,2,3,4,5,6,10,12,11,3,13  
(P<sub>3</sub>\*\*, P<sub>2</sub>, P<sub>1</sub>, C<sub>3</sub>, C<sub>2</sub>)case 7 : 1,2,3,4,5,6,10,11,3,13  
(P<sub>3</sub>\*\*\*, P<sub>2</sub>\*)Poäng:  
Point:

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