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Written Examination	
Lecture:	Systems and Software Engineering
Lecturer:	Prof. Dr.-Ing. K. D. Müller-Glaser
Affiliation:	Institute of Information Processing Technology (ITIV)
Term:	Summer Term 2012
Date:	06.09.2012

Notes

- The exam consists of 19 pages (including this cover page and two additional blank pages). Please check if you got all sheets.
- You are allowed to bring one page of notes (both sides). Your notes must be your own, and they must be hand-written.
- This test is to be done individually, and you are not allowed to exchange or share your notes with others during the test. As well as communication with other persons is forbidden by any means.
- The examination duration is 120 minutes.
- Please check your name and student ID on the title page.
- If you need more space, use the blank pages in the back or ask for sheets.

  Add the respective problem number on every additional page.

  Do not write on the back of pages or on your own sheets.
- Do not use pencils for writing or drawing! Statements written with pencils are not considered in the marking!
- If your solution path involves several steps, they must be apparent from your answer.
- If you are finished, put all sheets which should be marked into the envelope.

Question	1	2	3	4	5	6	7	8	∑
Topic	General Questions	Nassi-Shneiderman	House of Quality	Reliability	EBNF	Petri Nets	State charts	UML diagrams	
Total Points	12	6	16	6	8	14	13	16	91
Result									
Signature									

1 General Questions

1.a Lifecycle models

/3

Draw a graphical representation of the V-Model and mark the area of the three lifecycle models discussed in the lecture.

1.b Lifecycle model

/2

Name the 5 phases of the Lifecycle Process Model–Flow in the right order:

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1.c Black box

/2

Explain the black box concept with a few sentences?

1.d Scheduling

/5

Name four common scheduling strategies and explain them shortly.

2 Nassi-Shneiderman diagram

```
void calcFibonacciSeq(numTerms) {
    int numberOfTerms = numTerms;
    int loopCounter = 0;
    int fib1        = 0;
    int fib2        = 1;
    int tempTerm;

    do {
        if (loopCounter == 0) printf("fib1");
        else if (loopCounter == 1) printf("fib2");
        else {
            tempTerm = fib1 + fib2;
            fib1 = fib2;
            fib2 = tempTerm;
            printf("fib2");
       }
    loopCounter++;
    }
    while (loopCounter <= numberOfTerms);
}
```

Figure 1: Fibonacci pseudo code

2.a Nassi-Shneiderman diagram

/6

Construct and draw a Nassi-Shneiderman diagram from the pseudo code of the function *calcFibonacciSeq* stated in Figure 1.

3 House of Quality

3.a General question

/1

In which phase of the Hunger model is the quality function deployment placed?

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3.b Product planning

/9

The following describes the Cookie production of a Chocolate Chip Cookie Manufacturer. The given data maps customer requirements to parts and materials to be purchased in order to meet or exceed the customer expectations.

The following shows the list of customer demands which resulted from intensive qualitative customer research. The scale for the importance rating is 1…10, where 1 is least important and 10 is very important

Customer requirement	**Rating**
Generous Portions	5
Tastes Good	9
Low Price	8
Appetizing Appearance	7

As characteristics of the product the design team agreed in the following:

Color, Weight, Size (diameter), Thickness, Tastiness and Cost per Cookie

Fill out the areas in the House of quality in Figure 2. Therefore insert the customer requirements and the product characteristics. Evaluate the correlation between the characteristics of the product. Fill in the dependencies and the prioritization. The comparison with a competitor is not needed.

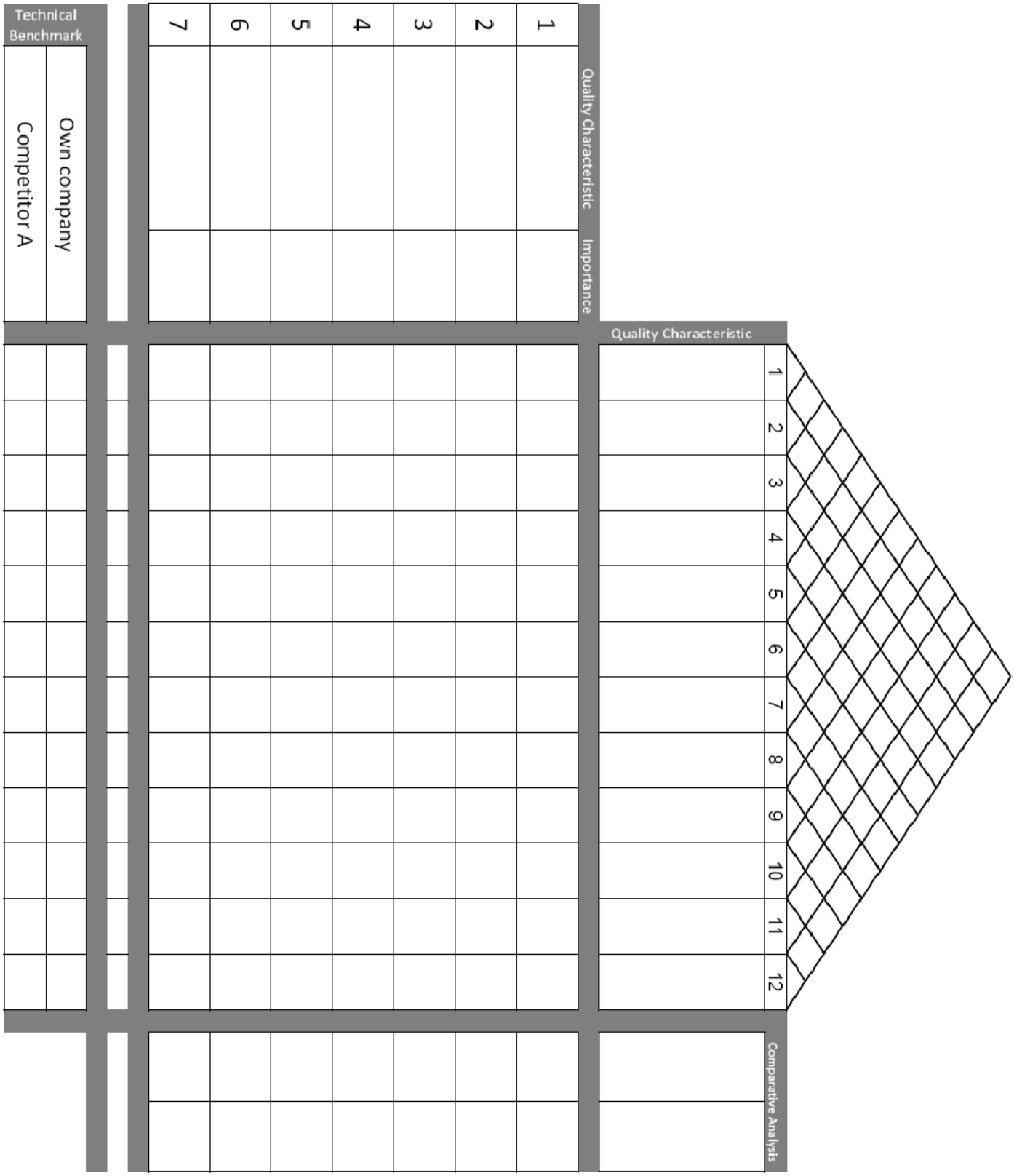

Figure 2: House of Quality

/6

3.c Parts deployment

Assume the following realizations to be the most important for the cookie production. Baking Time, Baking Temperature, Order of Ingredients, Age of Cookie (Length of Time Since Baked), Age of Ingredients, Quality of Ingredients, Cost of Ingredients, Cost of Packaging, Use of "Softening" Shortening, Use of "Crispening" Shortening (shortening – Backfett), Use of Flavorful Ingredients and Ratio of Chocolate Chips to Flour.

Insert the characteristics and realization suggestions in the second House of Quality in Figure 3 and make a quality function analysis.

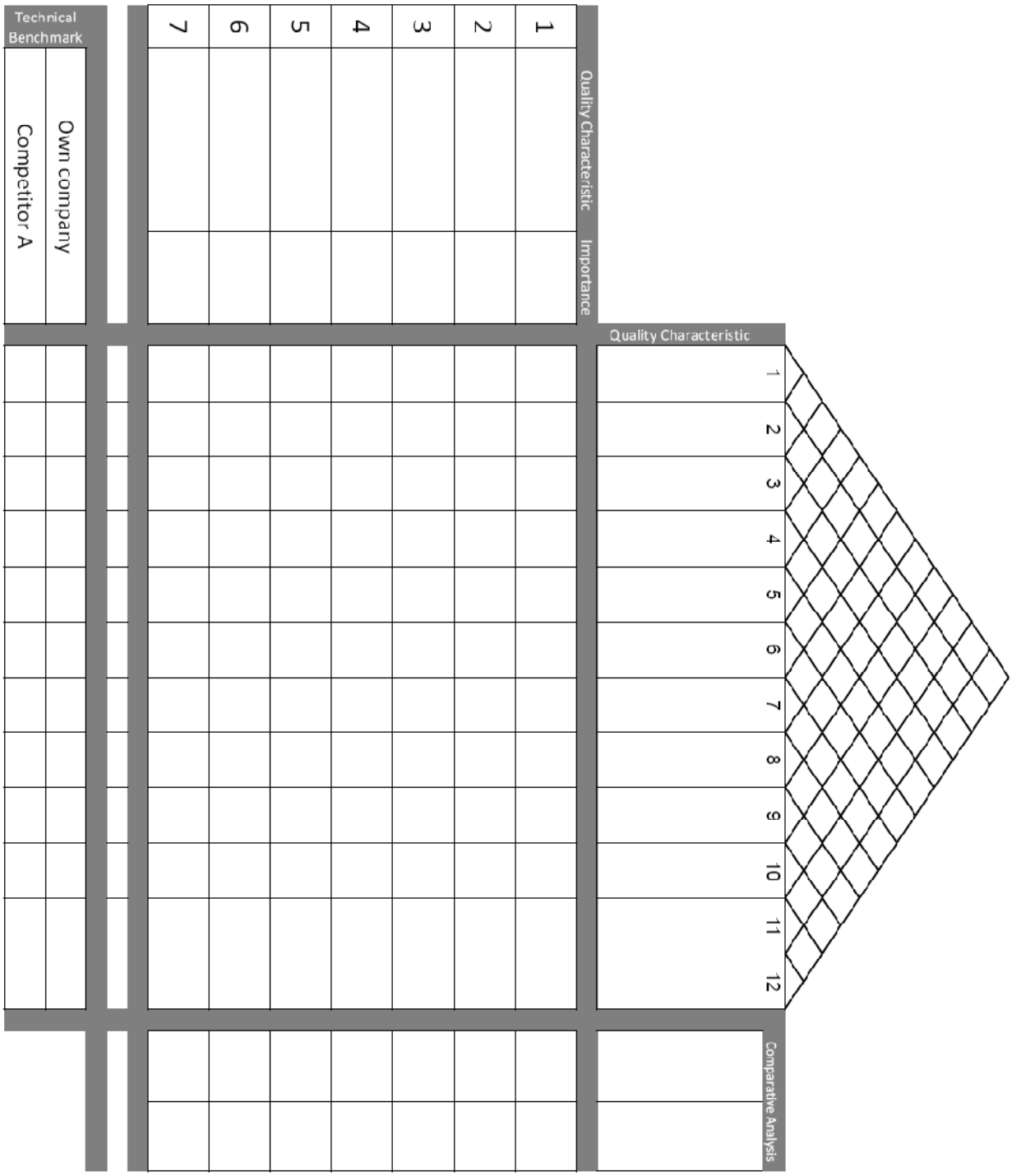

Figure 3: House of Quality

4 Reliability

4.a Reliability block diagram

/3

A car has four identical wheels. If any wheel fails, the vehicle cannot be driven anymore. The reliability of all wheels is stochastically independent. Assume that the failure rate of an individual wheel as $\lambda(t) = 2*10^{-6}$

Draw the reliability block diagram of the car with respect to wheels.

4.b Reliability block diagram

/3

Calculate the system reliability of the car described in 4.a in respect to the wheels.

5 EBNF

5.a

/6

Describe with help of the EBNF notation (as introduced in the lecture) the allowed entry of a simple calculator.

Set up the rules for numbers and basic arithmetic operations (+, -, /, *).

The numbers should allow the following formats:

-123456 1.23456 +165856 1.2e-2456

1e+23456 1e23456 1e-23456 8.54e1456

5.b

/2

Name two terms which you can be build with the notation you declared in section 5.a. The terms must include all rules you have defined above.

6 Petri Nets

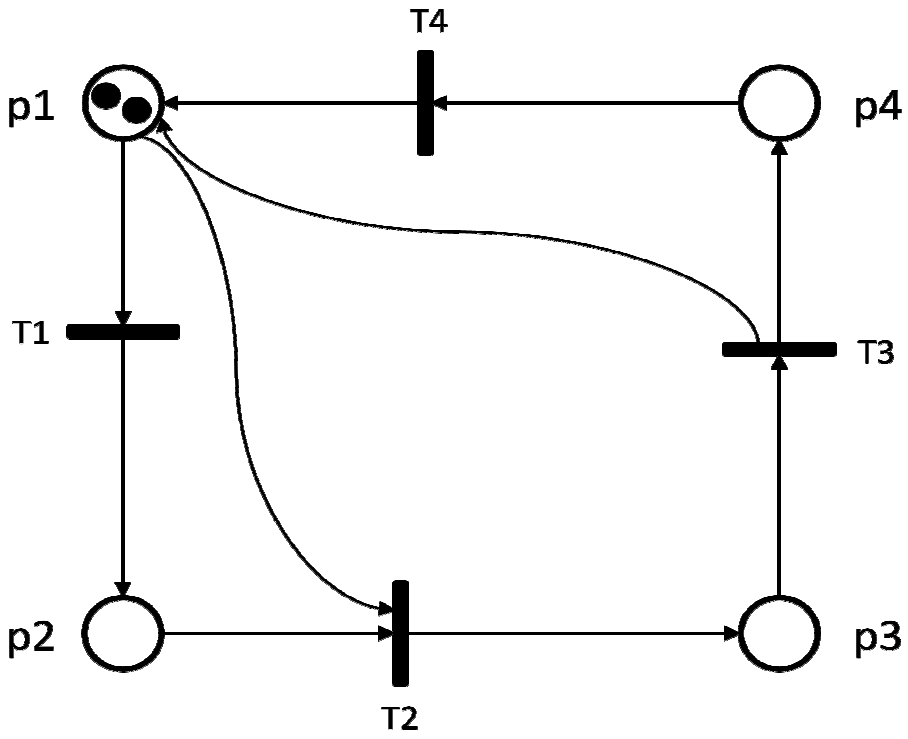

Figure 4: Petri net

6.a Transition graph

/4

Draw the transition graph of the Petri net given in Figure 4.

/2

6.b Reversibility

Is the Petri net given in Figure 4 reversible? Give a short explanation.

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/2

6.c Safeness

Is the Petri net given in Figure 4 k-safe? Give a short explanation.

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/4

6.d Modification

Modify the Petri net given in Figure 4 that it is no longer possible to have more than one token in place 2 (p2). Only add additional places, token and transitions. To prove your concept, draw the transition graph of the modified Petri net.

7 State Charts

Perform an execution time analysis of the state chart given in Figure 5 assuming a synchronous operation mode (clocked control).

7.a Basic states

/1

What number of basic states do you need if you want to transfer the state chart given in Figure 5 into a chart with flatten state chart hierarchy, instead of a state chart with hierarchy and concurrency?

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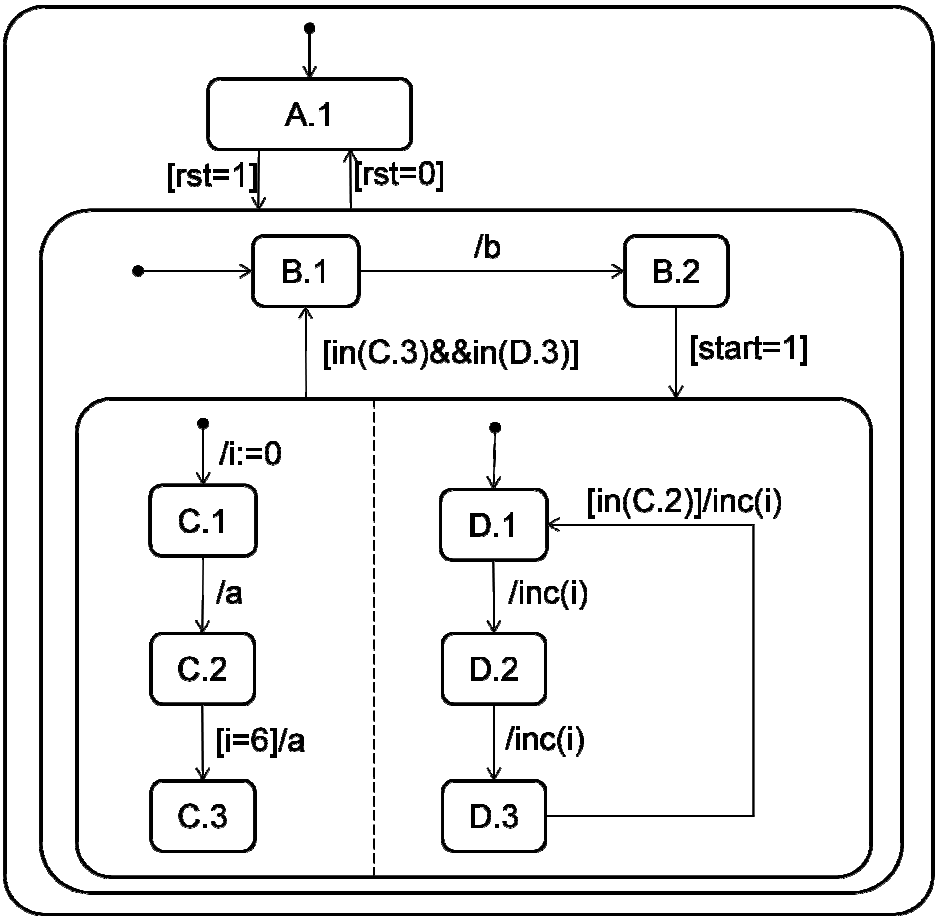

Figure 5: State chart

7.b

/4

Inscribe the occurrence of the actions *a* and *b* of the given state chart of Figure 5 in the time-line in Figure 6.

7.c

/8

Complete Table 1 (simulation step 0 - 50) filling in the sequence of active basic states and the value of variable *i*. Only changes must be considered.

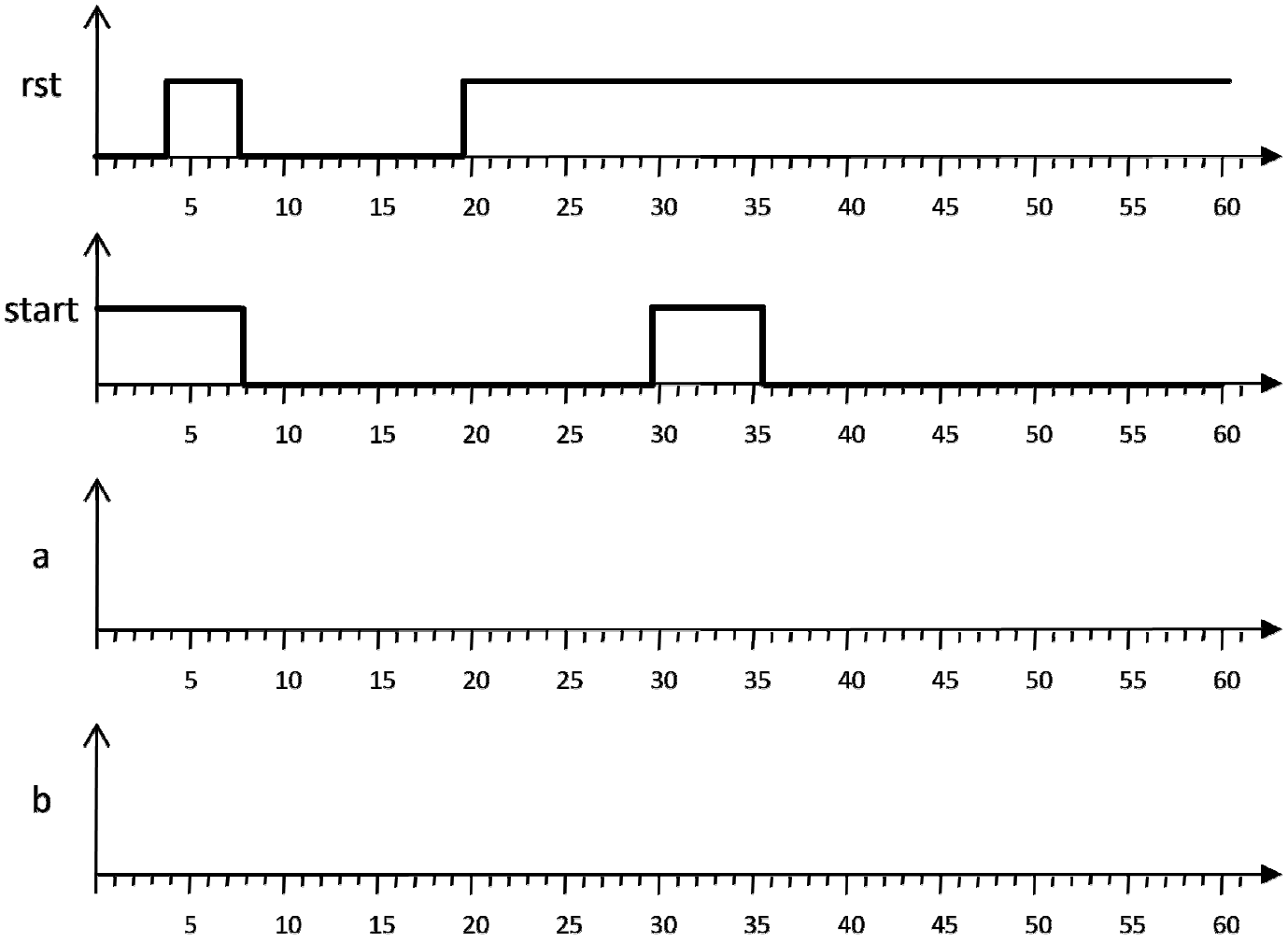

Figure 6: Timing diagram

Simulation step	Active basic states	Value of variable i
0		

Table 1: State Chart Analysis

8 UML diagrams

8.a Class diagram

/10

Consider the world of companies: Companies employ employees (who can only work for one company), and consist of one or more departments. Each company has a single president, who is an employee. Employees are part of a department and each department runs one or more projects. Employees can work in 1 to 3 projects, while a project can have 2 to 50 assigned employees. You may assume that companies have a name and address, while employees have an emp# (unique employee number) and a salary.

Draw a class diagram for the description above. Make sure to show attributes, association types and multiplicities, where appropriate. No need to show any operations.

8.b Collaboration diagram

/6

Draw the corresponding UML Collaboration diagram of the Sequence diagram (Figure 7) that shows as much of the available information as possible.

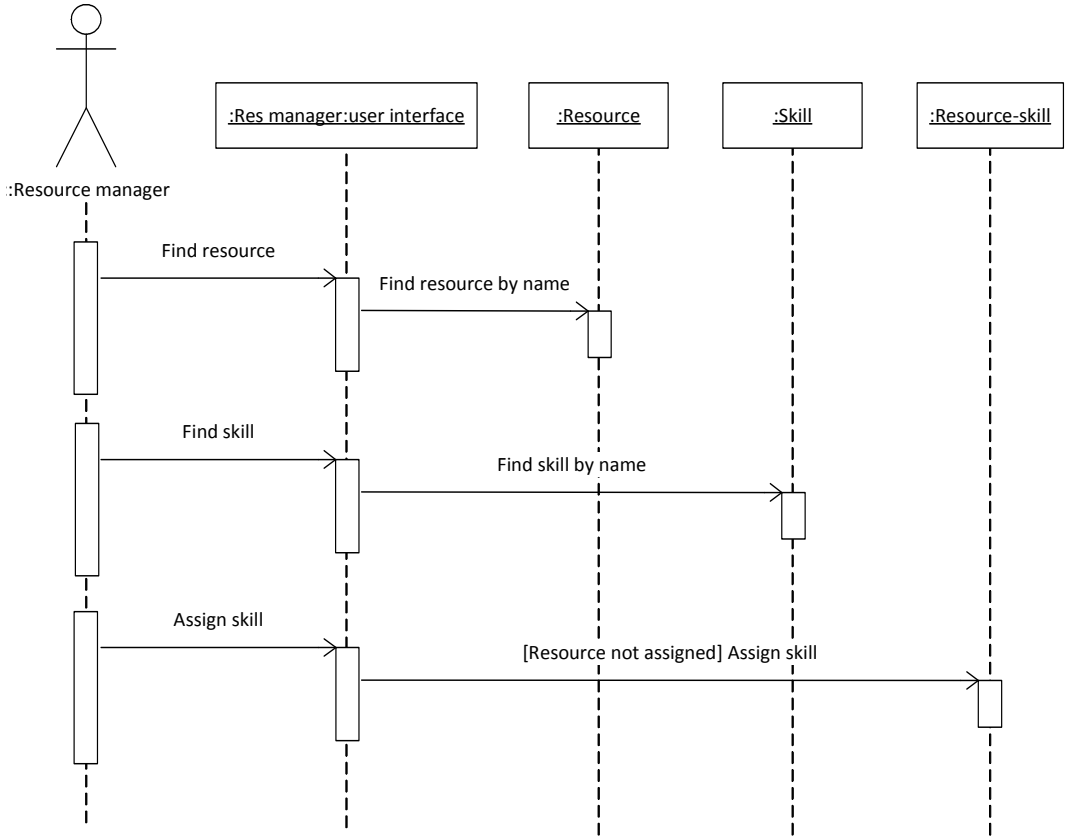

Figure 7: Sequence diagram

Additional working sheet

Additional working sheet