

STAR Exam

14-04-2026

- Write your answers for risk assessment exercises on **separate sheets** than for software testing!
- This exam consists of **8** exercises, each consisting of several questions. Clearly indicate which question you answer.
- The maximum score is 80 points.
- You are allowed to use a **simple calculator** (i.e. one that is not capable of storing extra notes).
- You are allowed to use a **hand-written** cheat sheet of **1 page A4** (double-sided).

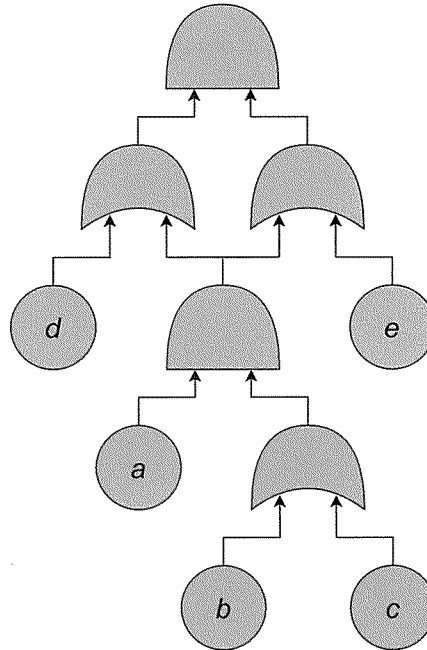
Risk Assessment

Note: write your answers for risk assessment exercises on separate sheets than for software testing!

Exercise 1 (Risk management)

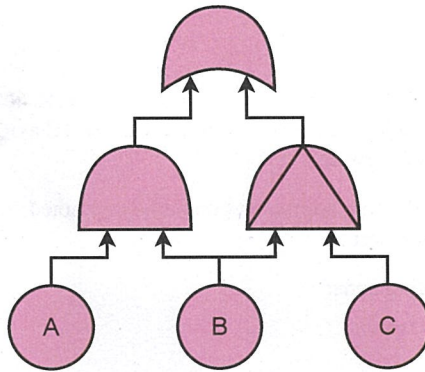
- (2 point) What are the four main strategies for handling risk? One of these has two sub-strategies, what are these?
- (4 points) Name one disadvantage for defining risk as *probability times impact*.
- (4 points) Suppose that your objective is to pass your STAR exam. Give three risks associated with this objective, and for each risk a strategy to handle that risk. State under which of the main risk handling strategies your strategy falls, and sketch the risks and their strategies on the risk matrix.

Exercise 2 (Static fault trees) Consider the fault tree below.



- (2 point) List all of its minimal cut sets.
- (2 point) Suppose $p_a = p_b = p_c = p_d = p_e = 0.1$. Approximate the failure probability using the cut set method; explain your answer.
- (4 points) Give the binary decision diagram of this fault tree, with variable ordering $a < b < c < d < e$.
- (3 points) Use the binary decision diagram to calculate the failure probability of the fault tree; explain your answer.

Exercise 3 (Dynamic fault trees) Consider the dynamic fault tree below. Its basic events a, b, c have failure rates $\lambda_a, \lambda_b, \lambda_c$, respectively.



- (a) (6pt) Represent this DFT as a Markov chain with at most 6 states, and give its transition matrix.
- (b) (3pt) There is one gate in this DFT whose failure probability does not go to 1 as time goes to ∞ . Which gate is it, and why?

Software Testing

Note: write your answers for software testing exercises on separate sheets than for risk assessment!

Exercise 4 (Testing in SE)

- (a) (2 points) Remember the levels of granularity in testing: unit tests, integration tests, system tests, and user acceptance tests. For which level do you think tests in Behaviour-Driven Development can be used the *best*? Motivate your answer.
- (b) (2 points) Do you think the following approaches could be combined: regression testing and model-based testing? Motivate your answer.
- (c) (7 points) Consider the following code:

```

1 | int compute(int x, int y) {
2 |     if(x > y) {
3 |         return 1;
4 |     } else {
5 |         for(int i := 0; i < 2; i++) {
6 |             if(x == i) {
7 |                 return x;
8 |             }
9 |         }
10 |        return y;
11 |    }
12 | }

```

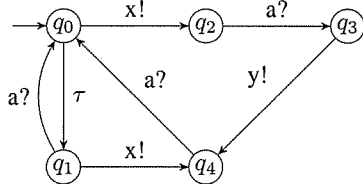
- (i) Draw the flow diagram of the code.
- (ii) What is the branch coverage of the following two test cases?

```

1 | assertEquals(1, compute(2,1));
2 | assertEquals(1, compute(1,2));

```

Exercise 5 (LTS) Consider the following LTS:

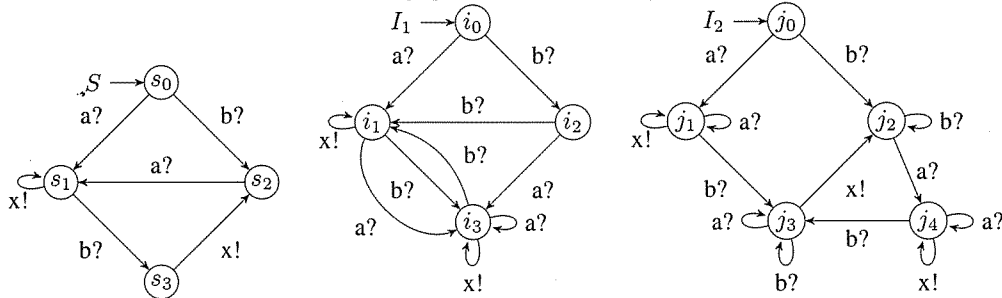


- (a) (2 points) Draw the angelic completion of the LTS.
- (b) (4 points) Compute the following:
- q_2 after $a?y!$
 - q_1 after $a?x!$
 - q_0 after δ
 - out (q_0 after $x!a?$)
- (c) (4 points) Draw a test case of depth 2 for the LTS.

Exercise 6 (Modeling) (8 points)

Create an STS (i.e. its graphical representation) that models an automatic water sprinkler for the garden. It has a sensor that measures the moisture of the soil, and a sensor that measures the intensity of the sun. If the moisture is below 50, and the sun is not shining, then it sprays water into the garden for 10 minutes. If moisture is below 50 and the sun is shining, then the sprinkler waits until either the sun stops shining, or the moisture gets below 30, before it sprays for 10 minutes. The waiting of the sprinkler is displayed with a red light, while moisture above 50 is displayed with a green light. You may assume that while the sprinkler is spraying, the sensors are not taking any measurements, and no lights are shown.

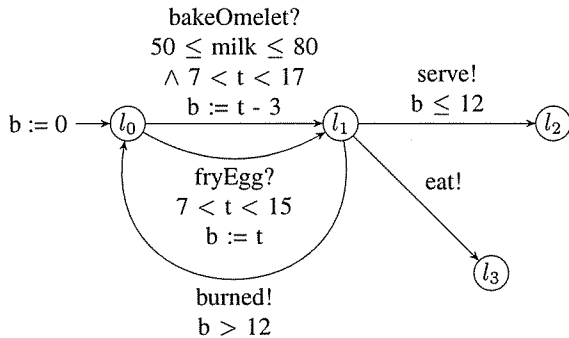
Exercise 7 (ioco) Consider the following specification S and implementations I_1 and I_2 :



Answer the following questions for **both** implementations I_1 and I_2 :

- (a) (2 points) Is the implementation ioco w.r.t. S ?
- (b) (8 points) Motivate your answer, i.e.:
 - (i) If ioco does not hold, give a test case that detects the non-conformance. Also give the parallel composition of the test case and the implementation. Clearly indicate which LTS is your test case and which your parallel composition.
 - (ii) If ioco does hold, then construct the ioco simulation LTS to prove this.

Exercise 8 (STS) Consider the following graphical representation of an STS that models the process of baking and serving an egg. If the baking time is too long, it is burned (and baking can be tried again). Otherwise the egg is served. Alternatively, the egg can be eaten (by the chef), regardless of whether it is burned or not.



- (a) (3 points) Write down the formal definition of the switches with gates `bakeOmelet?`, and `eat!`.
- (b) (6 points) Write down the symbolic execution graph of the STS, up to level 3, i.e. take all valid sequences of three switches from the initial state of the graph.
- (c) (2 points) Provide a test trace of length 2 for the case where an omelet is burned.