



SINTEF

IN5130 2021

Questions and solutions

Figure 1

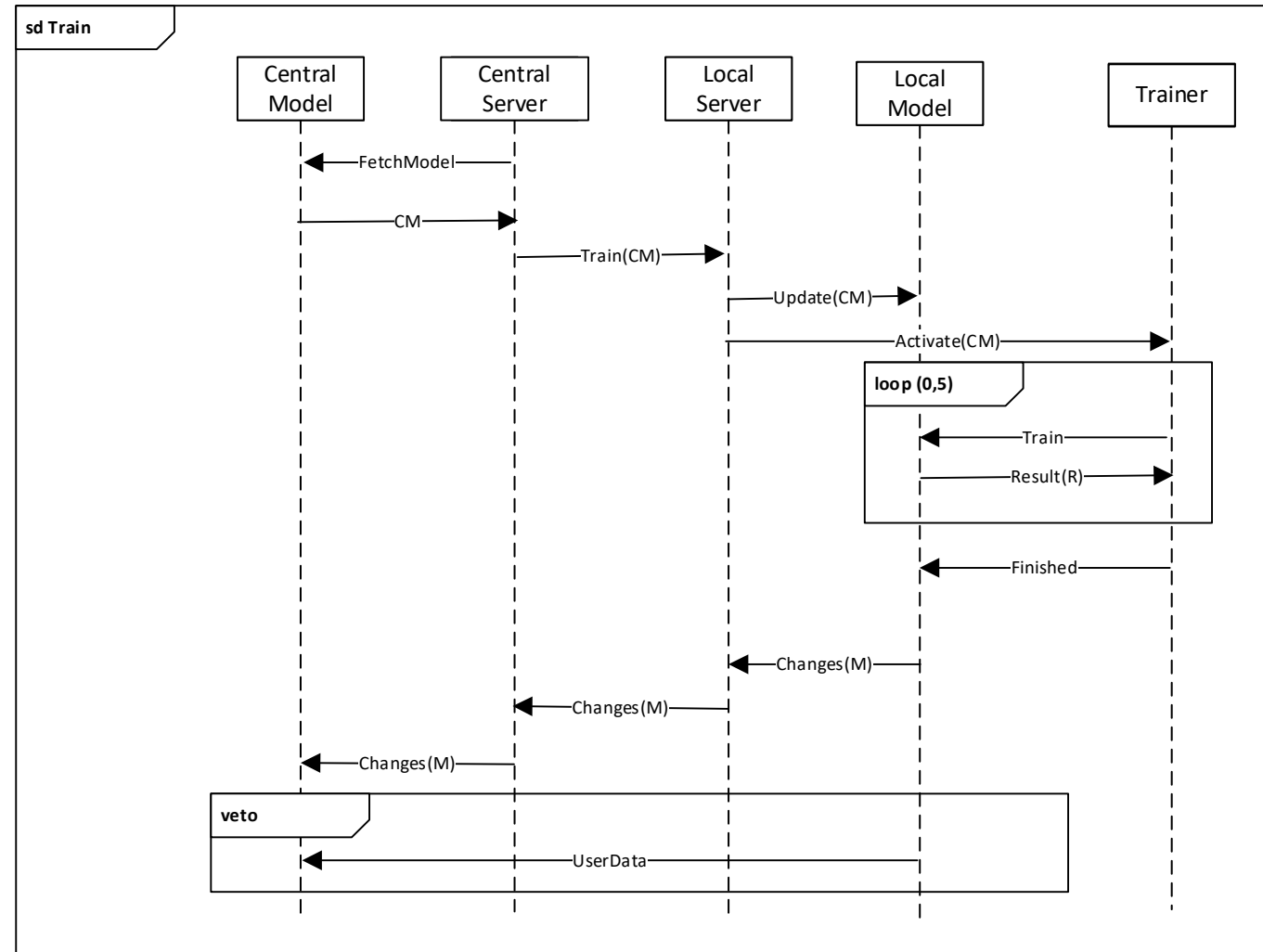


Figure 2

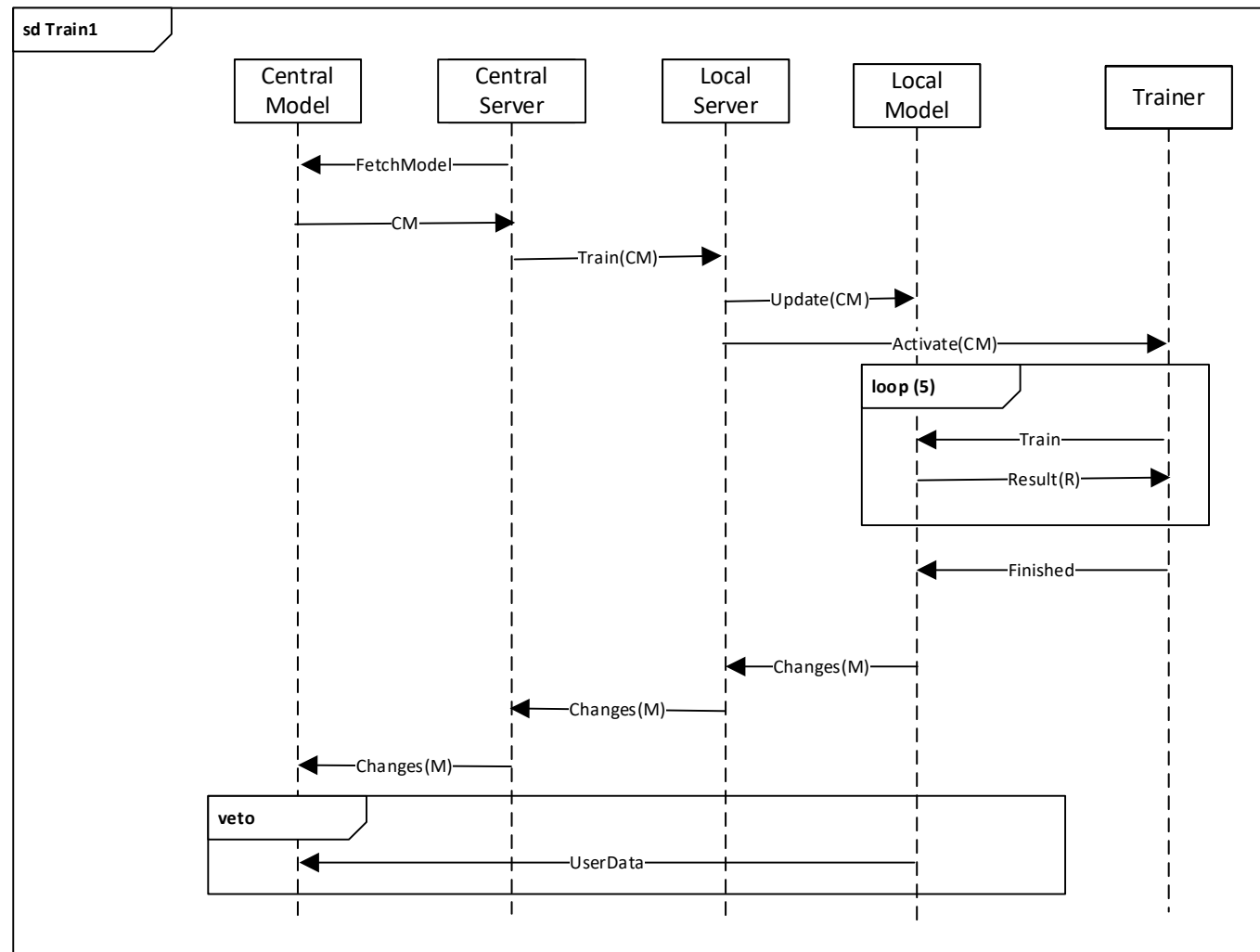
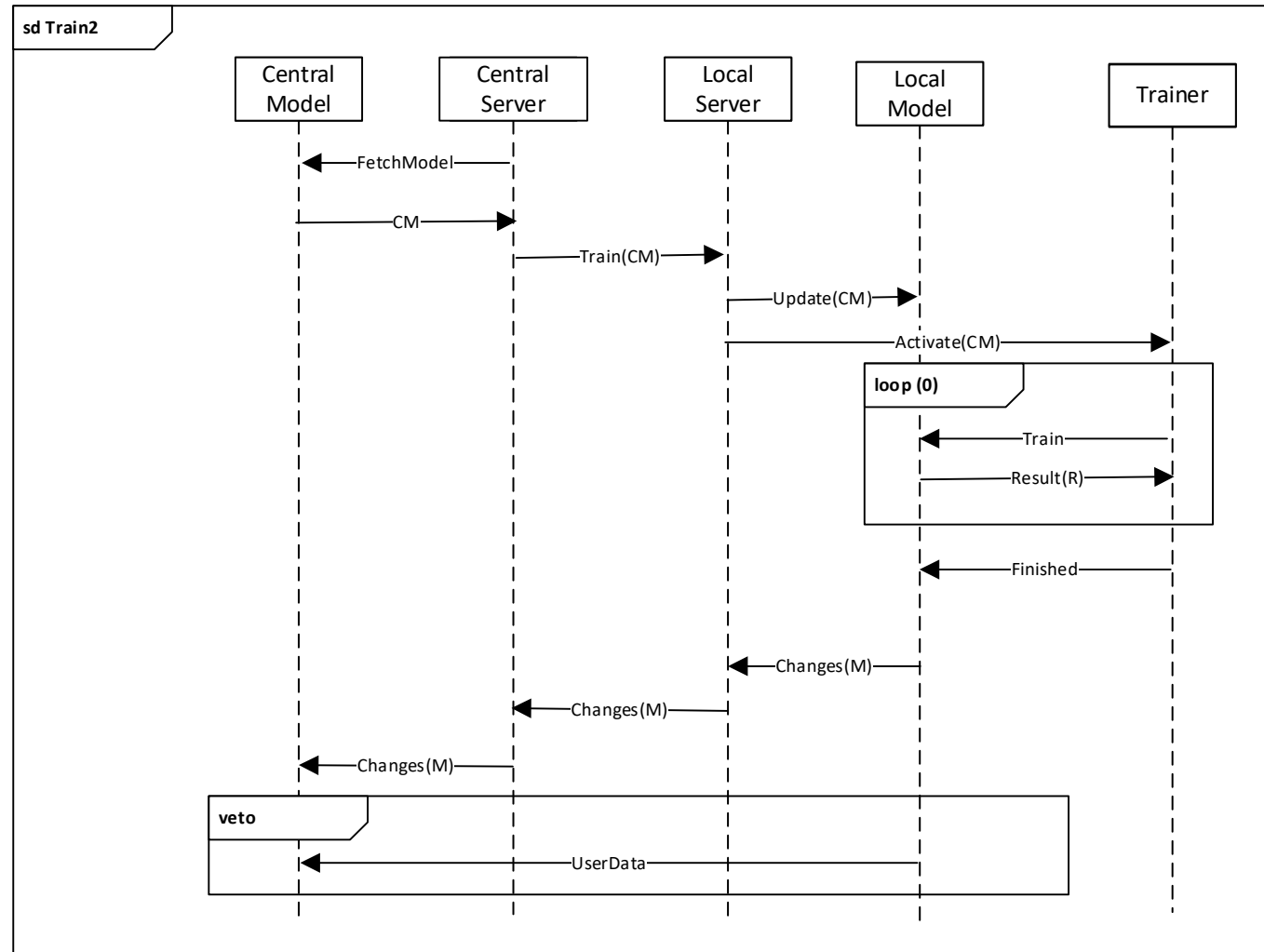


Figure 3





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Question 1 (5-5-6-6=22 points)

- 1a) What is the length of the shortest positive trace described by sd Train? Explain your answer.
- 1b) What is the length of the shortest negative trace described by sd Train? Explain your answer.
- 1c) Assume the loop of sd Train iterates exactly five times as specified in sd Train1. How many positive traces do we get? Explain your answer.
- 1d) Assume the loop of sd Train iterates exactly zero times as specified in sd Train2. How many negative traces do we get? Explain your answer.



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Solution Question 1

- 1a) 18. There are 9 messages if we skip for loop and veto.
- 1b) 20. There are 10 messages if we skip for loop but execute the veto operand.
- 1c) 4. The only source of nondeterminism is ?Update(CM) that may occur anywhere in between <!Update(CM), !Activate(CM), ?Activate(CM), !Train, ?Train>
- 1d) 24. There are two sources of nondeterminism
 - ?Update(CM) that may occur anywhere in between <!Update(CM), !Activate(CM), ?Activate(CM), !Finished, ?Finished>
 - !UserData that may occur anywhere in between <!Changes(M), ?Changes(M), !Changes(M), ?Changes(M), !Changes(M), ?Changes(M), ?UserData>



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Question 2 (6-6-5=17 points)

- 2a) Explain how to change sd Train into a sequence diagram sd Train3 with no veto construct so that sd Train3 and sd Train have identical semantics.
- 2b) Explain how to change sd Train into a sequence diagram sd Train4 with no loop construct so that sd Train4 and sd Train have identical semantics.
- 2c) Explain to what extent any pair of Train, Train1 and Train2 as presented in ~~previous questions~~ **Question 1** can be related by refinement?

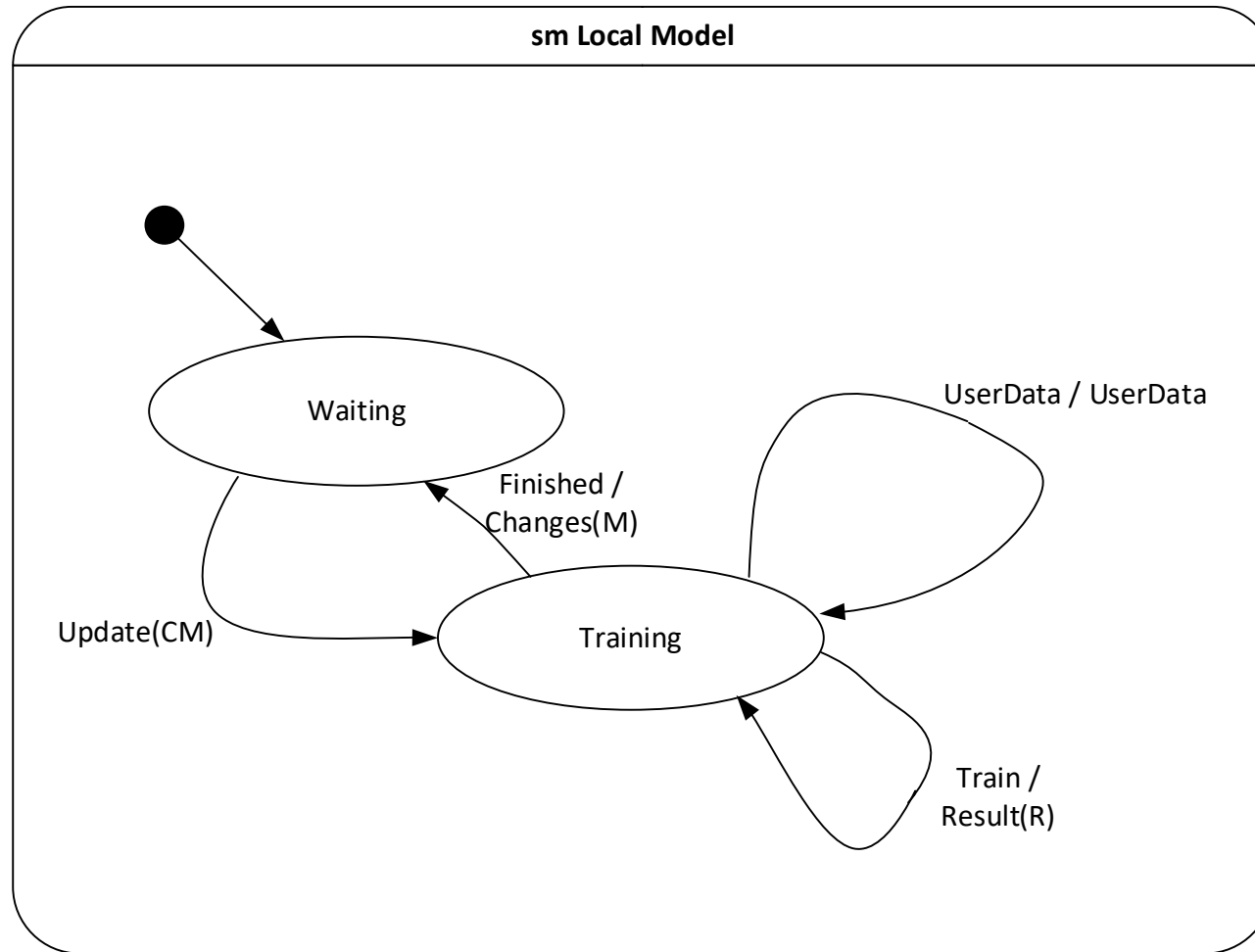


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Solution Question 2

- 2a) Use alt with two operands as the main construct of sd Main3.
 - Put everything above the veto in sd Main into the first operand.
 - Use refuse as the main construct in the second operand.
- 2b) Transform Train into Train4 by replacing the loop construct in Main with an alt construct with five operands.
 - Use the opt construct as the main construct in the first operand. Use the operand of the loop in sd Main as the operand of the opt.
 - In the other four operands of the alt construct repeat the operand of the loop two, three, four and five times respectively.
- 2c) Train1 and Train2 both have traces that are inconclusive in the other. Hence, they do not refine each other. However, any positive/negative trace in Train1/Train2 is positive/negative in Train. Hence, **Train supplements** both Train1 and Train2.

Figure 4





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Question 3 (5-5-6=16 points)

- 3a) Describe one positive trace of sm Local Model.
- 3b) Describe one negative trace of sm Local Model.
- 3c) Is sm Local Model consistent with the lifeline Local Model in sd Train? Explain your answer.



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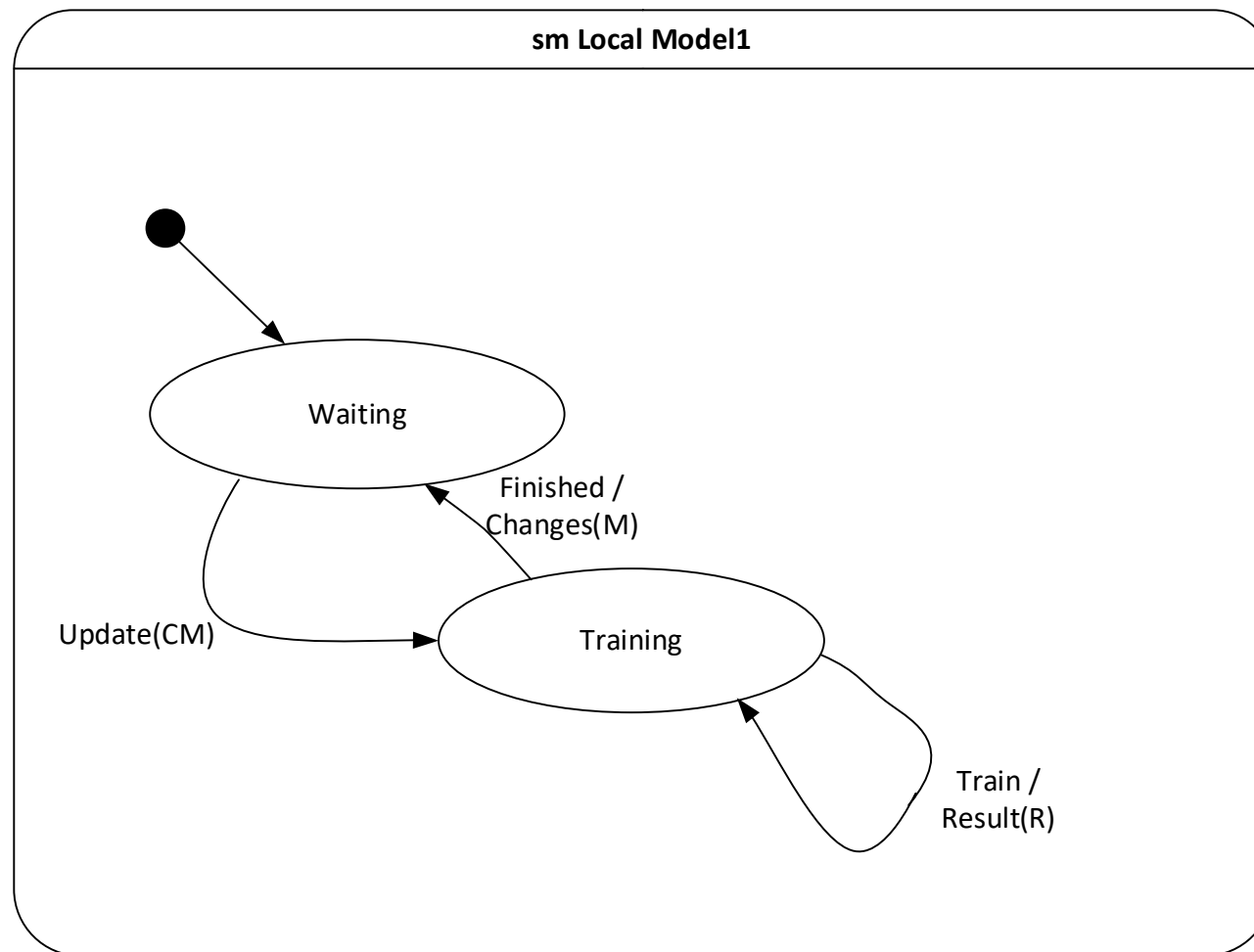
Solution Question 3

- 3a) $\langle \rangle$ if no input is ever received.
- 3b) Any trace of length 2 whose first event is ?Update(CM) and whose second event is an output event is negative.
- 3c) Yes.
 - The state machine may produce infinitely many traces and disallows infinitely many traces.
 - Any positive trace of the lifeline may be produced. Any negative trace of the lifeline is disallowed.



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Figure 5





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Question 4 (6-6=12 points)

- 4a) sm Local Model1 is obtained from sm Local Model by removing one of its transitions. Is Local Model1 a narrowing of Local Model? Explain your answer.
- 4b) Is it possible to draw a state machine sm Local Model2 so that Local Model2 supplements sm Local Model. Explain your answer.



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Solution Question 4

- 4a) No. The trace $\langle ?\text{Update}(\text{CM}), !\text{UserData} \rangle$ is for example positive in Local Model1 but negative in Local Model.
- 4b) No. A state machine has no inconclusive traces.

Figure 6

Value	Definition
Strong	Recommended by consumer organizations and in service evaluations
High	Increasing popularity among consumers; does pretty good in evaluation
Medium	Quite popular, but does distinguish itself compared to competitors
Small	Marketshare is decreasing; some bad publicity
Little	Very bad publicity; identified as an underperformer in social media

Figure 7

Value	Definition
Frequent	<1000:1y, 1 000 000:1y]
High	<20:1, 1000:1y]
Often	<10:1y, 20:1y]
Seldom	<1:1y, 10:1y]
Rare	[0.1:1y, 1:1y]



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Question 5 (6-6-6=18 points)

- 5a) Is the scale presented in Fig. 6 suited as a consequence scale for the asset reputation of company? Explain your answer.
- 5b) Assume we use the average number of occurrences per month to measure frequency. Suggest a matching quantitative scale for the asset Integrity of user data ~~that does not make use of intervals~~. Explain your answer.
- 5c) Evaluate the quality the frequency scale presented in Fig. 7.



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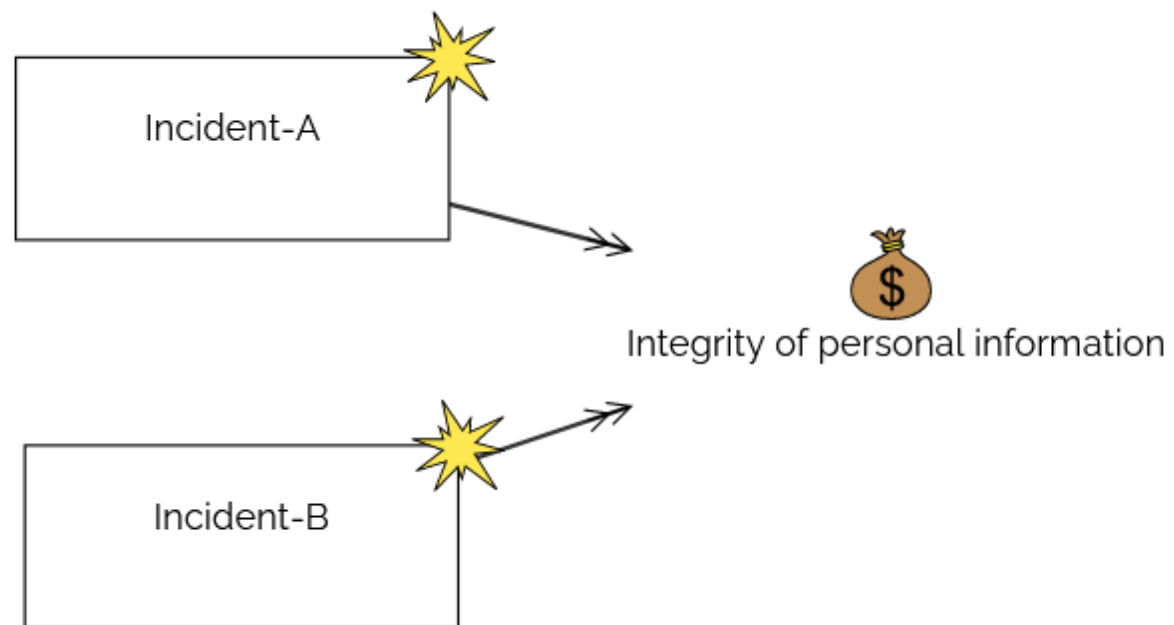
Solution Question 5

- 5a) No. It measure reputation, not the impact of an incident that harms reputation.
- 5b) Average percentage of user data altered.
- 5c) There are several problems.
 - The scale cannot handle 0.01 and values above 1 million.
 - The often interval is surprisingly small.
 - The intuitive ordering of the values based on natural language interpretation could have been better.



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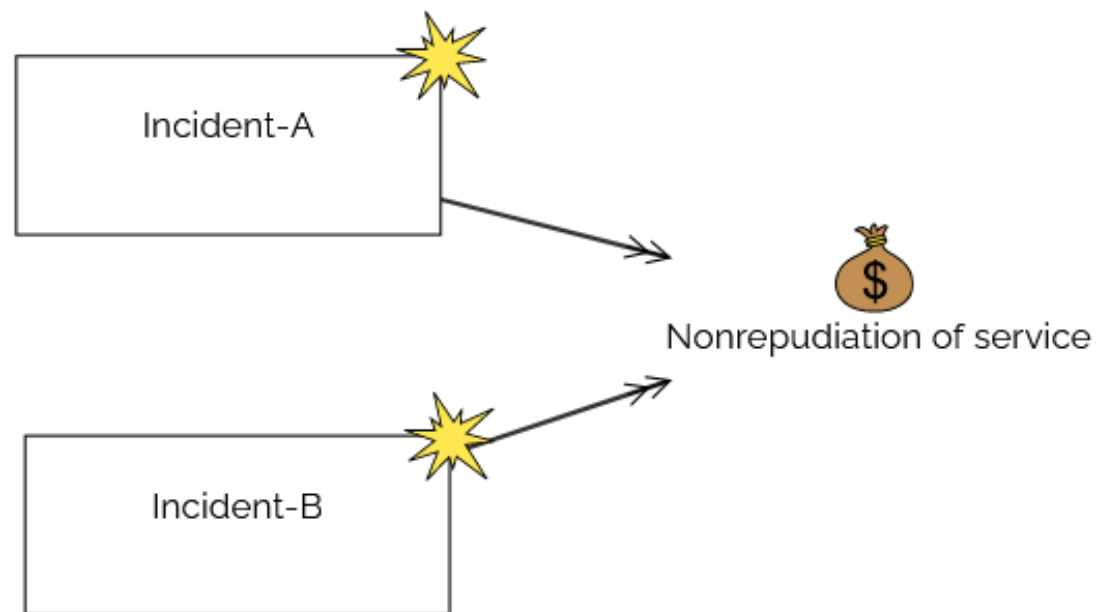
Figure 8





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Figure 9





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Question 6 (5-5-5=15 points)

- 6a) Consider the CORAS threat diagram fragment in Fig. 8. Define two unwanted incidents for the placeholders Incident-A and Incident-B ~~with respect to the asset Nonrepudiation of service~~ that are separate.
- 6b) Consider the CORAS threat diagram fragment in Fig. 9. Define two unwanted incidents for the placeholders Incident-A and Incident-B ~~with respect to the asset Integrity of personal information~~ that are not separate.
- 6c) Explain why the frequency calculation rule for the initiate relation cannot be the same as the frequency calculation rule for the leads-to relation.



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Solution Question 6

- 6a)
 - Modification of history-log caused by non-malicious threat
 - Modification of history-log caused by malicious threat
- 6b)
 - Personal information modified by unauthorized actor
 - Personal information modified with the help of Trojan horse
- 6c) Threats do not have likelihoods. A threat agent exists; only its actions have likelihood. Threat scenarios and unwanted incidents have likelihoods.



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