Exercise 1 (9/20 Points)

Consider the LSCs in Figure 1.

(i) Provide the mathematical representation of \( L \). (2)

(ii) Give one example each for

- universal chart,
- hot location,
- cold condition,
- simultaneous region,
- co-region,
- hot inclusive local invariant,
- activation mode, and
- pre-chart

in Figure 1 (use the terms of task (i), to be more precise).

If there is no example in Figure 1, make up an (as small as possible) own LSC. For your own example, the mathematical representation is not necessary. (2)

(iii) What does \( L \) (formally) mean? (2)

(iv) Provide a non-trivial UML model which is not consistent with \( L \).
(As usual: convince your tutor of the claimed non-consistency). (3)
Exercise 2 (4/20 Points + 5 Bonus)

Consider the LSCs in Figure 4. They could be result of the following development process:

- LSC $L_1$ was captured in an interview with the customer. At least this scenario shall be possible at least once in the system.

- In later interviews with the customer, it was understood that the desired behaviour is actually a response. A $D$-object shall respond to requests of a corresponding $C$-object. This was formalised by adding a pre-chart to $L_2$.

(i) **Bonus:** Make up a nice story. Who is the customer? What are $C$ and $D$ modelling (maybe some controllers (controlling what kind of hardware?), maybe some software system)? Which communications are the messages modelling?

   Provide a corresponding renaming of $C, D, E, F, G, H$ to more intuitive names. \(5\)

(ii) Provide a UML model which is consistent with $L_1$.

   Is your model also consistent with $L_2$? \(2\)

(iii) Please change your state machine $\mathcal{SM}_C$ such that it sends *two* $E$ events in a row to the $D$ object. Is your model still consistent with $L_2$?

   If not, can you provide a fix? Note that the requirement may be wrong! So you may also propose a change to the requirement (and discuss it with the customer). \(2\)
Exercise 3 (3/20 Points)

- In the semantics of the lecture, LSCs $L_a$, $L_b$, and $L_c$ have the same meaning. If we view $L_a$, $L_b$, and $L_c$ as Sequence Diagrams recorded with Rhapsody, they have three different meanings. Explain. (2)

- How would you change the semantics definition of the lecture to represent the “Rhapsody recorded SD” interpretation? (1)

Exercise 4 (4/20 Points)

(i) What requirement is stated by LSC 4(a) alone? (1)

(ii) What requirement is stated by LSC 4(a) and 4(b) together? (1)

(iii) What requirement is stated by LSC 4(a), 4(b), 4(c), and 4(d) together? (1)

(iv) Assume $M$ is a UML model which satisfies the requirement stated by LSC 4(a), 4(b), 4(c), and 4(d) together. Does $M$ need to ever send $A$? And $B$? And $C$? And $A$, $B$, and $C$? That is, does $M$ need to have a computation path with $Std$-sets comprising $A$ ($B$; $C$; all three, $A$, $B$, and $C$)? (1)