

Midterm Practice Test

The practice test is not graded. The following instructions are only intended as guidance for the midterm.

- The test lasts 50 min.
- The maximum score on the test is 10 points.

Question 1 (2 points)

Define the notions of

- normal form
- confluence
- termination
- invariant

Question 2 (6 points)

Consider the schemas of rules

$ba \rightarrow ab$
 $ab \rightarrow ba$

$aaa \rightarrow$
 $aa \rightarrow b$
 $ab \rightarrow$
 $bb \rightarrow a$

- Write down an English sentence describing the meaning of the first 2 rules schemas. (0.5 points)
- Write down an invariant for the first 2 rules. No justification required. (0.5 points)
- Compute normal forms of (1 point)
 - a
 - aa
 - aaa
 - bb
 - bbbb
 - bbb
- Can you find a nice way of stating which words are in the equivalence class of the empty word? Is the empty word a normal form? Is it the unique normal form of its equivalence class? Justify your answer. (0.5 points)
- Describe the equivalence classes of ``a`` and of ``b``. No justification required. (0.5 point)
- Describe all the equivalence classes of the ARS using the invariant of the previous question. (1 point)
- Explain why the ARS does not terminate. Change the rules so that the ARS becomes terminating

without changing its equivalence classes. Justify your answer. (1 point)

– Which measure function proves termination of your modified system? Justify your answer. (1 point)

Question 3 (1 point)

– Put all parentheses ``(`` and ``)`` into the following lambda expressions to indicate the correct parsing.

$\lambda f. \lambda x. f(fx)) \lambda x. x$

$(\lambda f. \lambda x. ffx) \lambda x. \lambda y. xy$

Question 4 (1 point)

Reduce the following to normal form:

$(\lambda f. \lambda x. f(fx)) \lambda x. x$