

**CM20019—COMPUTATION III:
FORMAL LOGIC AND SEMANTICS
EXERCISE SHEET 8, 17.11.2007**

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Problem 1. Write a Prolog program, consisting only of pure Horn clauses (so, with no use of built-in predicates or any extra-logical feature), that computes the predicate $\text{mul}(X, Y, Z)$, which is true if and only if $X \times Y = Z$, on natural numbers in Peano notation. Try to make a program such that the following queries get answers as indicated below:

<pre>?- consult(ex8). % ex8 compiled 0.00 sec, 3,064 bytes Yes ?- mul(s(s(0)),s(s(s(0))),Z). Z = s(s(s(s(s(s(0)))))) ; No ?- mul(s(s(0)),Y,s(s(s(s(s(s(0))))))). Y = s(s(s(0))) ; No ?- mul(X,s(s(s(0))),s(s(s(s(s(s(0))))))). X = s(s(0)) ; No ?- mul(X,Y,s(s(s(s(s(s(0))))))). X = s(s(s(s(s(s(0)))))), Y = s(0) ; X = s(0),</pre>	<pre>Y = s(s(s(s(s(s(0)))))) ; X = s(s(s(0))), Y = s(s(0)) ; X = s(s(0)), Y = s(s(s(0))) ; No ?- mul(X,s(s(s(0))),Z). X = 0, Z = 0 ; X = s(0), Z = s(s(s(0))) ; X = s(s(0)), Z = s(s(s(s(s(s(0)))))) Yes ?- mul(s(s(0)),Y,Z). Y = 0, Z = 0 ;</pre>	<pre>Y = s(0), Z = s(s(0)) ; Y = s(s(0)), Z = s(s(s(s(0)))) Yes ?- mul(X,Y,Z). X = 0, Y = 0, Z = 0 ; X = s(0), Y = 0, Z = 0 ; X = s(s(0)), Y = 0, Z = 0 Yes</pre>
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Notice the use of the semicolon for getting more answers to the same query. It is important that the program is correct and it always terminates. It is not important that it gives answers in the same order as reported above, and that the values for the last query are as above (provided you can get infinitely many different and correct results).

Problem 2. Write a Prolog program, consisting only of pure Horn clauses, that computes the predicate $\text{notprime}(X)$, which is true if and only if X is not a prime number (do this for natural numbers in Peano notation).

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The web page for the course is at [1]. You can find other exercises in Dan Richardson's notes, available from the web page.

References

1. Alessio Guglielmi, *CM20019—Computation III: Formal logic and semantics*, <http://cs.bath.ac.uk/ag/CM20019>, 2007.