2002 Paper 5 Question 7

Prolog for Artificial Intelligence

(*a*) Give a simple definition of the Prolog predicate `dfx` that can perform symbolic differentiation with respect to the variable `x` of expressions composed of integers (e.g. `0`, `1`, ...), symbolic constants (e.g. `a`, `b`, ...), symbolic variables (e.g. `x`, `y`, ...) and the operators `+`, `-` and `*`, for addition, subtraction and multiplication. The first argument of `dfx` is the expression to differentiate and the second argument is the result. Your definition need not perform any simplification of the result. [6 marks]

(*b*) Trace the execution of the call: `dfx(x*x-2, R)`. [2 marks]

(*c*) Now modify your definition so that it simplifies the result by the applications of rewriting rules such as: `1*x`⇒`x` and `x-0`⇒`x`. [8 marks]

(*d*) Discuss to what extent, if any, either of your predicates could be used to integrate an expression. [4 marks]