

1994 Paper 6 Question 10

Foundations of Functional Programming

Describe the operation of a graph reducer and its treatment of the combinators **K**, **S**, **Y**, **if** (for conditional expressions) and **mult** (integer multiplication). [6 marks]

Describe the operation of the SECD machine, including its treatment of recursive functions. [5 marks]

Exhibit an infinite family Φ_n of distinct fixed-point combinators. Justify your answer by showing that $\Phi_n \rightarrow F(\Phi_n F)$ for all non-negative integers n and λ -terms F . You must also show that $\Phi_m \neq \Phi_n$ for $m \neq n$, quoting standard results about the λ -calculus if necessary. [9 marks]