1993 Paper 6 Question 9

Foundations of Functional Programming

Describe David Turner's algorithm for translating λ-terms to combinators, using $\mathbf{S}$, $\mathbf{K}$, $\mathbf{I}$, $\mathbf{B}$ and $\mathbf{C}$. Demonstrate the algorithm by translating $\lambda x\,y\,f.f\,x\,y$. [4 marks]

Prove that $\lambda^T x.R \equiv \lambda^T y.R[y/x]$ holds for every combinatory term R such that y is not free in R. [6 marks]

Describe the graph reduction of $\mathbf{S}\,\mathbf{I}\,\mathbf{I}\,(\,\mathbf{S}\,\mathbf{I}\,\mathbf{I}\,)$. [4 marks]

Describe the graph reduction of $\mathbf{S}\,\mathbf{mult}\,\mathbf{I}\,(\,\mathbf{fst}\,(\,\mathbf{Y}\,(\,\mathbf{pair}\,3)))$, taking all the constants shown as primitive combinators. [6 marks]