CST Part IB/II(G)/Diploma *Computation Theory*
List of corrections to the 2013/14 lecture notes

31 March 2014

Page 100: see the attached page.

Proof sketch, cont.

Writing $\vec{x}$ for $x_1, \ldots, x_n$, let $config_M(\vec{x}, t)$ be the code of M's configuration after t steps, starting with initial register values $\mathtt{R}_0 = 0, \mathtt{R}_1 = x_1, \ldots, \mathtt{R}_n = x_n$. It's in **PRIM** because:

$$\begin{cases} config_M(\vec{x}, 0) & = \ulcorner [0, 0, \vec{x}] \urcorner \\ config_M(\vec{x}, t+1) & = next_M(config_M(\vec{x}, t)) \end{cases}$$

Can assume M has a single `HALT` as last instruction, Ith say (and no erroneous halts). Let $halt_M(\vec{x})$ be the number of steps M takes to halt when started with initial register values $\vec{x}$ (undefined if M does not halt). It satisfies

$$halt_M(\vec{x}) \equiv \text{least } t \text{ such that } I - lab(config_M(\vec{x}, t)) = 0$$

and hence is in **PR** (because $lab, config_M, I - (\ ) \in$ **PRIM**).

So $f \in$ **PR**, because $f(\vec{x}) \equiv val_0(config_M(\vec{x}, halt_M(\vec{x})))$.