

Assignment - 8

17CS30022

a) $e[\text{append}]$ Command \rightarrow Record \rightarrow Profile \rightarrow (String * Profile)

$$e[\text{append}] = \lambda r. \lambda p ("append", \text{append}(r, p))$$

$$\text{append}(r, p) = \lambda r. \lambda p (\text{fst } p, (\text{cnd } p) \text{ cons } r)$$

b) $s[\text{insert } p \text{ or insert } s \text{ or moveback or delete or quit}]$

$$\Rightarrow (l', r') = c[\text{insert } r](\text{profile})$$

$$\text{in } (l', r') \text{ cons } \text{fst}(s[\text{insert } s \text{ or moveback or delete or quit}](p'))$$

$$\text{snd}(s[\text{insert } s \text{ or moveback or delete or quit}](p'))$$

$$\Rightarrow (l', r') = ("insert r", \text{insert}(r, (\text{nil}, \text{nil})))$$

$$(l', r') = ("insert r", (\text{nil}, r))$$

$$\text{in } (l', r') \text{ cons } \text{fst}(s[\text{insert } s \text{ or moveback or delete or quit}](p'))$$

$$\text{snd}(s[\text{insert } s \text{ or moveback or delete or quit}](p'))$$

$$s[\text{insert } s \text{ or moveback or delete or quit}](\text{nil}, \text{nil}) \quad \text{--- (I)}$$

$$\Rightarrow (l_1', r_1') = c[\text{append } s](\text{nil}, r)$$

$$\text{in } (l_1', r_1') \text{ cons } \text{fst}(s[\text{moveback or delete or quit}](p_1'))$$

$$\text{snd}(s[\text{moveback or delete or quit}](p_1'))$$

$$\Rightarrow (k_2'', p_2'') = (\text{isempty}(c(r, s)) \rightarrow ("error...", p))$$

$$\square \text{ at first record } (r, s) \rightarrow ("moveback", p)$$

$$[] (" ", \text{backward}(r, s))$$

$$\text{in } ("moveback" \text{ concat } k_2'', p_2'')$$

$$\Rightarrow \text{let } (k_2'', p_2'') = (" ", (\text{nil}, rs))$$

$$\text{in } ("moveback", \text{concat}(\text{nil}, rs))$$

$$= ("moveback", (\text{nil}, rs))$$

$s[\text{delete or quit}] p_1'$
 $= \text{let } (l_3', p_3') : s[\text{delete}] (nil, rs)$
 $\text{in } (l_3' \text{ cons } \text{fst}(s[\text{quit}] p_3'),$
 $\text{snd}(s[\text{quit}] p_3'))$

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III

$\Rightarrow s[\text{delete}] (nil, rs)$

$\Rightarrow \text{let } (l_3', p_3') : \text{is_empty}(nil, rs) \rightarrow ("error...")$

$\text{in } ("delete" \text{ concat } k_3', p_3')$
 $[] (" ", \text{delete}(nil, rs))$

$\Rightarrow \text{let } (k_3', p_3') = (" ", (nil, rs))$

$\text{in } ("delete" \text{ concat } k_3', p_3')$

$= ("delete", (nil, s))$

$s[\text{delete or quit}] p_3'$

$= \text{let } (l_3', p_3') : s[\text{delete}] (nil, rs)$

$\text{in } (l_3' \text{ cons } \text{fst}(s[\text{quit}] p_3')$

$\text{snd}(s[\text{quit}] p_3'))$

IV

$s[\text{quit}] (nil, rs) = ("quit" \text{ cons } nil, (nil, rs))$

Substituting in IV

$s[\text{delete or quit}] p_2'$

$= ("delete" \text{ cons } "quit" \text{ cons } nil, (nil, rs))$

in III

$s[\text{rollback or delete or quit}] p_1'$

$= ("rollback" \text{ delete } "quit", (nil, rs))$

in II
 $s[[insert\ s\ cr\ moveback\ cr\ delete\ cr\ quit]](nil, rs)$
 = $((("insert\ s\ moveback\ delete\ quit", (nil, s)))$

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in I
 $s[[insert\ r\ cr\ insert\ s\ cr\ moveback\ cr\ delete\ cr\ quit]](nil, rs)$
 = $((("insert\ r\ insert\ s\ moveback\ delete\ quit", (nil, rs)))$

2a) $f = \lambda x. x \text{ eq zero} \rightarrow g(\text{zero})[] + (g(x \text{ minus } 2) + 2)$
 $g = \lambda y. y \text{ equals } 0 \rightarrow \text{zero}[] y \text{ times } (y \text{ minus } 2)$

$F = \lambda(f, g). (\lambda x. x \text{ equals } \text{zero} \rightarrow g(\text{zero})[] + (g(x \text{ minus } 2) \text{ plus } 2))$

using ϕ for $(\lambda n. 1n(\lambda n. 1))$

$\text{graph}(f^0(\phi)) = \{(\{\}, \{\})\}$

$\text{graph}(f^1(\phi)) = \{(\{\}, \{\text{zero}, \text{zero}\})\}$

$\text{graph}(F^2(\phi)) = F(F(\phi))$ $F'(\phi) = \lambda x. x \text{ equals } \text{zero} \rightarrow$
 $1[] \perp,$
 $\lambda y. y \text{ equals } \text{zero} \rightarrow \text{zero}[] \perp$

$F^2(\phi) = \lambda x. x \text{ equals } \text{zero} \rightarrow \text{zero}[] \perp$
 $\lambda y. y \text{ equals } \text{zero} \rightarrow \text{zero}[] \perp$

$\text{graph}(F^2(\phi)) = \{(\{\text{zero}, \text{zero}\}, \{\text{zero}, \text{zero}\})\}$

$\text{graph}(F^3(\phi)) = \{(\{\text{zero}, \text{zero}\}, \{\text{zero}, \text{zero}, \text{one}, \text{one}\})\}$

b) $C \Rightarrow f, x_2 \rightarrow \text{less than two} \rightarrow \text{one}[] \neq (x \text{ minus } 1) \text{ plus}$
 $f(x \text{ minus } 2)$

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$$\phi = \lambda \perp$$

$$\text{graph}(C^0(\phi)) = \{\}$$

$$\text{graph}(C^1(\phi)) = \{(zero, one), (one, one)\}$$

$$\text{graph}(C^2(\phi)) = \{(zero, one), (one, one)\}$$

$$\text{graph}(C^3(\phi)) = \{(zero, one), (one, one), (two, two)\}$$

$$\text{graph}(C^4(\phi)) = \text{graph}(C^3(\phi)) \cup \{(three, three)\}$$

\vdots

$$\text{graph}(C^8(\phi)) = \{(zero, one), (one, one), (two, two), (three, three), (four, four)\}$$

$$\text{graph}(C^{22}(\phi)) = \{(zero, one), (one, one), (two, two), (three, three), (four, four), (five, five)\}$$

3. Construct G_1, G_2, G_3, G_4 s.t.

$$G_1 = \text{mapping of set of even numbers} \\ = \{(two, zero), (two, zero), (four, zero), \dots\}$$

$$G_2 = \text{mapping of set of odd no. div by 3} \\ = \{(three, one), (nine, one), \dots\}$$

$$G_3 = \text{mapping of nos. of form } 6k+1, k \geq 0, \\ = \{(one, zero), (seven, zero), (thirteen, zero), \dots\}$$

$G_4 = \text{mapping for number of form}$
 $\{k+5, k \geq 0\}$

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$$= \{(fine, zero), (down, zero), \dots\}$$

$$h^1 = \lambda n. (n \text{ mod two}) \text{ equal zero} \rightarrow one[] \perp$$

$$h^2 = \lambda n. (n \text{ mod two}) \text{ equal zero} \rightarrow zero[]$$

$(n \text{ mod three}) \text{ equal zero} \rightarrow$

$$\text{graph}(h^1) = G_1, \text{ graph}(h^2) = G_1 \cup G_2$$

Unfolding h ,

$$h_0 = \{\}$$

$$h_1 = h_2 = h_3 = G_1 \cup G_2$$

$$h_4 = h_5 = h_6 = G_1 \cup G_2 \cup G_3$$

$$h_7 = h_6 \cup G_4$$

$$\therefore \text{domain}(G_1 \cup G_2 \cup G_3 \cup G_4) = \mathbb{N}at$$

$$\Rightarrow h_i = h_7 \quad \forall i \geq 7, i \in \mathbb{Z}$$