Views on Edits to Variational Software – Appendix

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1 PROOF OF CORRECTNESS OF $view_{smart}$ (THEOREM 5.8)

LEMMA 1.1. *For a variation diff $D = diff(T_b, T_a) = (V, E, r, \tau, l, \Delta)$ that is the difference of two variation trees $T_i = (V_i, E_i, r_i, \tau_i, l_i)$, $i \in \{b, a\}$, the root, typing, and labels of D and T_t are equal for all times $t \in \{b, a\}$, i.e., $r = r_t$ and $\forall v \in V_t : l(v) = l_t(v)$ and $\tau(v) = \tau_t(v)$.*

PROOF OF LEMMA 1.1. Let $t \in \{b, a\}$. As of $diff(T_b, T_a) = (V, E, r, \tau, l, \Delta)$, we also have $project(diff(T_b, T_a), t) = project((V, E, r, \tau, l, \Delta), t)$. The left side simplifies by Definition 5.2 to T_t. The right side, by definition of *project* (Equation 1), simplifies to (V', E', r, τ, l) with $V' = \{v \in V_t \mid t \in \Delta(v)\}$ and $E' = \{e \in E_t \mid e \in \Delta(e)\}$. Thus, $T_t = (V_t, E_t, r_t, \tau_t, l_t) = (V', E', r, \tau, l)$ from which we conclude that $r = r_t$ and $\forall v \in V_t : l(v) = l_t(v)$ and $\tau(v) = \tau_t(v)$. □

PROOF OF CORRECTNESS OF $view_{smart}$ (THEOREM 5.8). Let $T_i = (V_i, E_i, r_i, \tau_i, l_i)$, $i \in \{b, a\}$ be two variation trees and ρ a relevance. Let $D = diff(T_b, T_a) = (V_D, E_D, r_D, \tau_D, l_D, \Delta_D)$. Our goal is to prove

$$view_{smart}(D, \rho) \equiv diff(view_{tree}(T_b, \rho), view_{tree}(T_a, \rho))$$

which by definition of semantic equivalence $\equiv$ (Definition 5.3) means that for all times $t \in \{b, a\}$, the following has to hold:

$$project(view_{smart}(D, \rho), t) = project(diff(view_{tree}(T_b, \rho), view_{tree}(T_a, \rho)), t)$$

The proof works by case analysis on the time t and showing that both sides of the equation simplify to the same term.

Case $t = b$:

By definition of *project* (Equation 1), the left side of our goal simplifies to

$$project(view_{smart}(D, \rho), b) = (\{v \in V_{smart} \mid b \in \Delta_{smart}(v)\}, \{e \in E_{smart} \mid b \in \Delta_{smart}(e)\}, r_D, \tau_D, l_D)$$

with $(V_{smart}, E_{smart}, r_D, \tau_D, l_D, \Delta_{smart}) = view_{smart}(D, \rho)$. The right side of our goal simplifies to

$$\begin{aligned} & project(diff(view_{tree}(T_b, \rho), view_{tree}(T_a, \rho)), b) && \text{apply Def. 5.2 by substituting } T_b \text{ with } view_{tree}(T_b, \rho) \\ &= view_{tree}(T_b, \rho) && \text{Eq. 4} \\ &= (V_{view_{tree}}, E_{view_{tree}}, r_b, \tau_b, l_b) && \text{Lem. 1.1} \\ &= (V_{view_{tree}}, E_{view_{tree}}, r_D, \tau_D, l_D) \end{aligned}$$

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where $V_{view_{tree}} = viewnodes(T_{b}, \rho)$ and $E_{view_{tree}} = E_{b} \cap (V_{view_{tree}} \times V_{view_{tree}})$. After simplifying both sides, thus our goal is to prove

$$(\{v \in V_{smart} \mid b \in \Delta_{smart}(v)\}, \{e \in E_{smart} \mid b \in \Delta_{smart}(e)\}, r_D, \tau_D, l_D) = (V_{view_{tree}}, E_{view_{tree}}, r_D, \tau_D, l_D).$$

To show that both simplified sides are equal, it thus remains to prove that

(I) $\{v \in V_{smart} \mid b \in \Delta_{smart}(v)\} = V_{view_{tree}}$ and
(II) $\{e \in E_{smart} \mid b \in \Delta_{smart}(e)\} = E_{view_{tree}}$.

(I)

$$\begin{aligned}
& \{v \in V_{smart} \mid b \in \Delta_{smart}(v)\} && \text{Eq. 10} \\
&= \{v \in V_{smart} \mid b \in tor(D, v, \rho)\} && \text{def } V_{smart} \text{ via Eq. 10} \\
&= \{v \in V_D \mid tor(D, v, \rho) \neq \emptyset, b \in tor(D, v, \rho)\} && \text{simplify} \\
&= \{v \in V_D \mid b \in tor(D, v, \rho)\} && \text{Eq.9} \\
&= \{v \in V_D \mid b \in \Delta_D(v), v \in viewnodes(project(D, b), \rho)\} && \text{def } D \\
&= \{v \in V_D \mid b \in \Delta_D(v), v \in viewnodes(T_{b}, \rho)\} && \text{Def. 5.2} \\
&= \{v \in V_{b} \mid v \in viewnodes(T_{b}, \rho)\} && \text{simplify} \\
&= viewnodes(T_{b}, \rho) && \text{def } V_{view_{tree}} \\
&= V_{view_{tree}}
\end{aligned}$$

(II)

$$\begin{aligned}
& \{e \in E_{smart} \mid b \in \Delta_{smart}(e)\} && \text{Eq. 10} \\
&= \{(v, w) \in E_{smart} \mid b \in \Delta_{smart}(v), b \in \Delta_{smart}(w)\} && \text{def } E_{smart} \\
&= \{(v, w) \in (E_{b} \cap (V_{smart} \times V_{smart})) \mid b \in \Delta_{smart}(v), b \in \Delta_{smart}(w)\} \\
&= \{(v, w) \in E_{b} \mid (v, w) \in V_{smart} \times V_{smart}, b \in \Delta_{smart}(v), b \in \Delta_{smart}(w)\} \\
&= \{(v, w) \in E_{b} \mid v \in V_{smart}, w \in V_{smart}, b \in \Delta_{smart}(v), b \in \Delta_{smart}(w)\} \\
&= \{(v, w) \in E_{b} \mid v \in \{v \in V_{smart} \mid b \in \Delta_{smart}(v)\}, w \in \{v \in V_{smart} \mid b \in \Delta_{smart}(v)\}\} && \text{(I)} \\
&= \{(v, w) \in E_{b} \mid v \in V_{view_{tree}}, w \in V_{view_{tree}}\} \\
&= \{(v, w) \in E_{b} \mid (v, w) \in V_{view_{tree}} \times V_{view_{tree}}\} \\
&= E_{b} \cap (V_{view_{tree}} \times V_{view_{tree}}) && \text{def } E_{view_{tree}} \\
&= E_{view_{tree}}
\end{aligned}$$

Case $t = a$:

Analogous to the first case $t = b$.

□