

CSE 3302/5307 Programming Language Concepts

Homework 11 - Fall 2023

Due Date: Nov.11, 2023, 11:59p.m. Central Time

Problem 1 - 30%

Remember in hw5, we extent tuples to records. Now we extend subtypes to records. Please give some subtyping rules for record type, then draw a derivation showing that $\{x : Nat, y : Nat, z : Nat\}$ is a subtype of $\{y : Nat\}$.

Problem 2 - 50%

Prove Lemma [Inversion of the subtype relation]:

1. If $S \leq T_1 \rightarrow T_2$, then S has the form $S_1 \rightarrow S_2$, with $T_1 \leq S_1$ and $S_2 \leq T_2$.
2. If $S \leq \{l_i : T_i^{i \in l \dots n}\}$, then S has the form $\{k_j : S_j^{j \in l \dots m}\}$, with at least the labels $\{l_i^{i \in l \dots n}\}$ (i.e., $\{l_i^{i \in l \dots n}\} \subseteq \{k_j^{j \in l \dots m}\}$) and with $S_j \leq T_i$ for each common label $l_i = k_j$.

Problem 3 - 20%

In Christopher Strachey's seminal paper[1], he gave the classification of polymorphism of only two kinds: parametric polymorphism and ad hoc polymorphism. After learning about let-polymorphism and subtype-polymorphism in the last couple of lectures, please do a little literature review, and explain what let- and subtype-polymorphism belong to, parametric polymorphism, or ad hoc polymorphism. Why?

References

- [1] Christopher Strachey. Fundamental concepts in programming languages. *Higher-order and symbolic computation*, 13:11–49, 2000.