



Assignment 10 Semantics, WS 2011-2012

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Read in Software Foundations: Types and Stlc

Exercise 10.1 Study the Coq development of Hoare logic that is available through the *resources* page. Do all exercises given in this development.

Exercise 10.2 Wednesday's lecture introduced the programming language PCF. The Coq file for this assignment defines the syntax of PCF (types *ty*, *var*, and *tm*). Do the following.

- a) Write a term $t : tm$ representing a function that adds two numbers.
- b) Define an inductive predicate $free : var \rightarrow tm \rightarrow Prop$ such that $free\ x\ t$ is provable iff x is free in t .
- c) Define a function $freeb : var \rightarrow tm \rightarrow bool$ that checks whether a variable is free in a term.
- d) Define a function $subst : tm \rightarrow var \rightarrow tm \rightarrow tm$ such that $subst\ t\ x\ s$ yields the term that is obtained from t by replacing every free occurrence of x with s . Capture of free variables in s through local variables in t is fine.
- e) Define predicates $nvalue : tm \rightarrow Prop$ and $value : tm \rightarrow Prop$ saying which terms are numeric values and values.
- f) Define the small-step semantics of PCF with an inductive predicate $step : tm \rightarrow tm \rightarrow Prop$.
- g) Define the big-step semantics of PCF with an inductive predicate $sem : tm \rightarrow tm \rightarrow Prop$.
- h) Prove *forall* $t\ t'$, $sem\ t\ t' \rightarrow value\ t'$.