

Axiomatic semantics

CS 152 (Spring 2020)

Harvard University

Thursday, April 9, 2020

Announcements

- ▶ HW2: Grades available in Gradescope
- ▶ HW3: grading in progress...
- ▶ HW4: due Apr 14
- ▶ HW5: will be released Apr 14, due May 1, and combine previous HW5 and HW6.
- ▶ Survey: Thanks for filling it out! Course staff will discuss today.
 - ▶ <https://forms.gle/FM7mb9n4Gbze14Js6>
 - ▶ Feedback is always welcome!!!! Email or post on Piazza...

Today, we will learn about

- ▶ Axiomatic Semantics
 - ▶ Pre- and Post-Conditions
 - ▶ Partial and Total Correctness
 - ▶ Validity of Assertions and Partial Correctness
 - ▶ Hoare Logic

Pre- and Post-Conditions

Partial Correctness and Total Correctness

Example

Invalid Example

Language of Assertions

Validity of Assertions

Validity of Assertions

$\sigma \models_I \mathbf{true}$	(always)
$\sigma \models_I a_1 a_2$	if $\mathcal{A}_{\text{Interp}}[[a_1]](\sigma, I) \mathcal{A}_{\text{Interp}}[[a_2]](\sigma, I)$
$\sigma \models_I a_1 = a_2$	if $\mathcal{A}_{\text{Interp}}[[a_1]](\sigma, I) = \mathcal{A}_{\text{Interp}}[[a_2]](\sigma, I)$
$\sigma \models_I P_1 \wedge P_2$	if $\sigma \models_I P_1$ and $\sigma \models_I P_2$
$\sigma \models_I P_1 \vee P_2$	if $\sigma \models_I P_1$ or $\sigma \models_I P_2$
$\sigma \models_I P_1 \Rightarrow P_2$	if $\sigma \not\models_I P_1$ or $\sigma \models_I P_2$
$\sigma \models_I \neg P$	if $\sigma \not\models_I P$
$\sigma \models_I \forall i. P$	if $\forall k \in \text{Int}. \sigma \models_{I[i \rightarrow k]} P$
$\sigma \models_I \exists i. P$	if $\exists k \in \text{Int}. \sigma \models_{I[i \rightarrow k]} P$

$$\mathcal{A}_{\text{Interp}}[[n]](\sigma, I) = n$$

$$\mathcal{A}_{\text{Interp}}[[x]](\sigma, I) = \sigma(x)$$

$$\mathcal{A}_{\text{Interp}}[[i]](\sigma, I) = I(i)$$

$$\mathcal{A}_{\text{Interp}}[[a_1 + a_2]](\sigma, I) = \mathcal{A}_{\text{Interp}}[[a_1]](\sigma, I) + \mathcal{A}_{\text{Interp}}[[a_2]](\sigma, I)$$

Validity of Partial Correctness

Hoare logic

Hoare logic, ctd.

Soundness and Completeness of Hoare Logic