

Homework 3

CS 541
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1 Consider the denotational semantics specification for literals, expressions, and constant declarations on pp. 24–27 of the notes. Assume expressions are defined as enhanced on p. 27 of the notes.

- Draw the derivation tree for the expression `let val x=5 in 2*x`.
- Compute $\mathcal{CD}[\text{val } x=5]$.
- Compute $\mathcal{E}[2*x]$.
- Compute $\mathcal{E}[\text{let val } x=5 \text{ in } 2*x]$.

2 Consider the following denotational semantics specification:

- Syntax

$$\begin{aligned} L &\longrightarrow N\# && \text{(Literal)} \\ N &\longrightarrow D\# \mid N_1D && \text{(Based-Numeral)} \\ D &\longrightarrow 0 \mid 1 \mid \dots \mid 9 && \text{(Digit)} \end{aligned}$$

- Semantic Elements

$<: \mathbf{N}_\perp \otimes \mathbf{N}_\perp \circ \rightarrow \mathbf{T}$ is defined as usual.

- Semantic Functions

$\mathcal{L}: \text{Literal} \rightarrow \mathbf{N}_\perp$ is defined by

$$\mathcal{L}[N\#] = \text{on}_2 \mathcal{N}[N]$$

$\mathcal{N}: \text{Based-Numeral} \rightarrow \mathbf{N}_\perp \times \mathbf{N}_\perp$ is defined by

$$\mathcal{N}[D\#] = (\mathcal{D}[D], 0)$$

$$\mathcal{N}[N_1D] = \begin{cases} \text{on}_1 \mathcal{N}[N_1], & \text{if } < (\text{smash}(\mathcal{D}[D]), \text{on}_1 \mathcal{N}[N_1]) \\ \text{then sum}(\text{smash}(\text{prod}(\text{smash } \mathcal{N}[N_1]), \mathcal{D}[D])) \\ \text{else } \perp_{\mathbf{N}_\perp} \end{cases}$$

$\mathcal{D}: \text{Digit} \rightarrow \mathbf{N}_\perp$ is defined by

$$\mathcal{D}[0] = 0$$

$$\mathcal{D}[1] = 1$$

\vdots

$$\mathcal{D}[9] = 9$$

- Compute $\mathcal{L}[8\#35\#]$.
- Compute $\mathcal{L}[2\#\#]$.
- Compute $\mathcal{L}[2\#21\#]$.