

A FULL FORMAL DETAILS OF EVALUATION CONTEXT REDUCTION RULES

(instructions) $e ::= \dots \mid \mathbf{label} \text{ nat } e^* e^* \mid \dots$

(a) the label construct

$$\frac{L^0 = v_{ctx}^* [<hole>] e_{ctx}^*}{L^0[e^*] = v_{ctx}^* e^* e_{ctx}^*} \quad \frac{L^{k+1} = v_{ctx}^* (\mathbf{label} \text{ nat } e_{cont}^* L^k) e_{ctx}^*}{L^{k+1}[e^*] = v_{ctx}^* (\mathbf{label} \text{ nat } e_{cont}^* (L^k[e^*])) e_{ctx}^*}$$

$$\frac{S; F; e^* \hookrightarrow S'; F'; e'^*}{S; F; L^k[e^*] \hookrightarrow S'; F'; L^k[e'^*]} \quad \frac{}{S; F; \mathbf{label} \text{ nat } e_{cont}^* (L^k[v^n \mathbf{br} k]) \hookrightarrow S; F; v^n e_{cont}^*}$$

(b) label evaluation context rules (1)

$$\frac{}{S; F; \mathbf{label} \text{ nat } e_{cont}^* \mathbf{trap} \hookrightarrow S; F; \mathbf{trap}} \quad \frac{L^0[\mathbf{trap}] \neq \mathbf{trap}}{S; F; L^0[\mathbf{trap}] \hookrightarrow S; F; \mathbf{trap}}$$

$$\frac{}{S; F; \mathbf{label} \text{ nat } e_{cont}^* v^* \hookrightarrow S; F; v^*}$$

(c) label evaluation context rules (2)

$$\frac{ft = t^m \rightarrow t^n}{S; F; v^m \mathbf{block} ft e^* \hookrightarrow S; F; \mathbf{label} \text{ nat } [] (v^m e^*)}$$

$$\frac{ft = t^m \rightarrow t^n}{S; F; v^m \mathbf{loop} ft e^* \hookrightarrow S; F; \mathbf{label} \text{ nat } m [(\mathbf{loop} ft e^*)] (v^m e^*)}$$

(d) block and loop

(instructions) $e ::= \dots \mid \mathbf{frame} \text{ nat } F e^* \mid \dots$

$$\frac{S; F'; e^* \hookrightarrow S'; F''; e'^*}{S; F; \mathbf{frame} \text{ nat } F' e^* \hookrightarrow S'; F; \mathbf{frame} \text{ nat } F'' e'^*}$$

$$\frac{\text{create } F_{call} \dots \text{full details elided}}{S; F; \mathbf{call} i \hookrightarrow^* S; F; \mathbf{frame} F_{call} \dots} \quad \frac{}{S; F; \mathbf{frame} \text{ nat } F' (L^k[v^n \mathbf{return}]) \hookrightarrow S; F; v^n}$$

$$\frac{}{S; F; \mathbf{frame} \text{ nat } F' v^* \hookrightarrow S; F'; v^*} \quad \frac{}{S; F; \mathbf{frame} \text{ nat } F' \mathbf{trap} \hookrightarrow S; F'; \mathbf{trap}}$$

(e) function call and return

Fig. 16. Wasm's label and frame context reduction rules, used to define the behaviour of Wasm's control flow.

B FULL RECURSIVE FIBONACCI BENCHMARK RESULTS

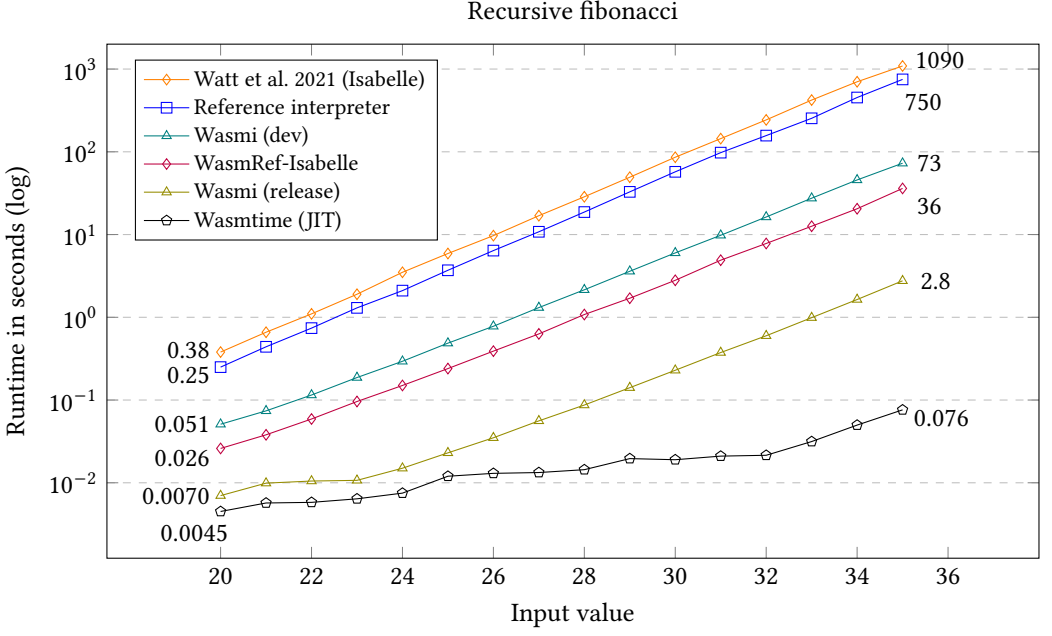


Fig. 17. Recursive fibonacci benchmark. Note the log scale for runtime.