

Static Analysis Handin #1

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1 Question 1

Vi har her brugt typereglerne til at finde alle constraints.

$$\begin{aligned} [[\text{map}]] &= ([[l]], [[f]], [[z]]) \rightarrow [[r]] \\ [[l == \text{null}]] &= \text{int} \\ [[l]] &= [[\text{null}]] \\ [[\text{null}]] &= \&\alpha \\ [[r]] &= [[z]] \\ [[l]] &= \& [[*l]] \\ [[f]] &= [[\text{map}(*l, f, z)]] \rightarrow [[(f)(\text{map}(*l, f, z))]] \\ [[r]] &= [[\text{map}(*l, f, z)]] \\ [[\text{foo}]] &= [[i] \rightarrow [[i + 1]] \\ [[i + 1]] &= \text{int} \\ [[i]] &= [[1]] \\ [[1]] &= \text{int} \end{aligned}$$

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[[main]] = () → [[map(h, foo, 0)]]
[[t]] = [[null]]
[[null]] = &β
[[n]] = [[42]]
[[42]] = int
[[n > 0]] = int
[[n]] = [[0]]
[[0]] = int
[[n]] = [[n - 1]]
[[n - 1]] = int
[[n]] = [[1]]
[[1]] = int
[[h]] = [[malloc]]
[[malloc]] = &γ
[[h]] = & [[t]]
[[t]] = [[h]]
[[map]] = ([[h]], [[foo]], [[0]]) → [[map(h, foo, 0)]]

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Solution: Disse to constraints kan ikke begge være opfyldt. Enten er programmet ikke typeassignable eller også har vi lavet en fejl.

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[[h]] = & [[t]]
[[t]] = [[h]]

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Hvis vi ser bort fra denne konflikt fåes denne løsning:

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[[foo]] = int → int
[[f]] = int → int
[[h]] = &α
[[t]] = &α
[[l]] = &α
[[map]] = (&α, int → int, int) → int
[[main]] = () → int
[[malloc]] = &α
[[null]] = &α

```

2 Question 2

Vi har lavet følgende constraints:

$$\begin{aligned} \{\} &: [[\{\}]] \\ \{E_1, E_2, \dots, E_k\} &: \tau [[E_1]] \wedge [[E_i = E_j]] \quad \forall i, j \in [0, k] \\ \text{add}(E_1, E_2) &: [[E_1]] = \tau\alpha \wedge [[E_2]] = \alpha \wedge [[\text{add}(E_1, E_2)]] = [[E_1]] \\ \text{for } id \text{ in } E &: [[E]] = \tau\alpha \wedge [[id]] = \alpha \end{aligned}$$

Vi har her løst type constraints'ne til programmet i opgaven.

$$\begin{aligned} [[x]] &= [[\{1, 2, 3\}]] = \tau [[1]] \\ [[1]] &= [[2]] = [[3]] = \text{int} \\ [[y]] &= [[\{\{\}, x, \{4\}\}]] = \tau [[\{\}]] = \tau\alpha \\ [[\{\}]] &= [[x]] = [[\{4\}]] = \tau\beta \\ [[y]] &= \tau\gamma \\ [[z]] &= \gamma \\ [[z]] &= \tau\delta \\ [[i]] &= \delta \\ [[x]] &= [[\text{add}(x, i)]] \\ [[\text{add}(x, i)]] &= [[x]] \\ [[x]] &= \tau\epsilon \\ [[i]] &= \epsilon \end{aligned}$$

Dette giver anledning til løsningen:

$$\begin{aligned} [[x]] &= \tau \text{int} \\ [[\beta]] &= \text{int} \\ [[\{4\}]] &= [[\{\}]] = \tau \text{int} \\ [[\alpha]] &= \tau \text{int} \\ [[y]] &= \tau \tau \text{int} \\ [[z]] &= \tau \text{int} \\ [[i]] &= \text{int} \end{aligned}$$