

Optional: Homework # 14

due Friday, May 8, 5:00 PM

This is an optional homework is provided by request. You are under no obligation to do it. Getting a grade on this homework cannot reduce your final grade

Warning: the grade is *not* added to your final score, but rather will take the place of a lower Homework score (if any). It is much more beneficial to get 100% on Homework #13 than to get 50% on each of this Homework and Homework #13.

1 Denotational Semantics

Implement the denotational semantics from lecture in ML:

$$\begin{aligned}
 \mathcal{E}[[n]]s &= n & \mathcal{E}[[e_1 + e_2]]s &= \text{inl } (n_1 + n_2) \text{ where } \mathcal{E}[[e_i]]s = \text{inl } n_i & \mathcal{E}[[x]]s &= sx \\
 \mathcal{E}[[\text{let } x = e_1 \text{ in } e_2]]s &= \mathcal{E}[[e_2]](s[x \mapsto \mathcal{E}[[e_1]]s]) \\
 \mathcal{E}[[\text{fn } x \Rightarrow e]]s &= \text{inr } f \text{ where } fv = \mathcal{E}[[e]](s[x \mapsto v]) \\
 \mathcal{E}[[e_1 e_2]]s &= f(\mathcal{E}[[e_2]]s) \text{ where } \mathcal{E}[[e_1]]s = \text{inr } f
 \end{aligned}$$

You should use the following algebraic data types for expressions and values:

```
datatype expr = LIT of int
              | PLUS of expr * expr
              | VAR of string
              | LET of string * expr * expr
              | FN of string * expr
              | APPLY of expr * expr
              ;
```

```
datatype value = INT of int
               | FUN of value -> value
               ;
```

```
type store = string -> value;
```

You should name the denotational function \mathcal{E} `semant` and it should have type:

```
semant : expr -> store -> value
```

Put your solution in `homework14.sml`.

2 Axiomatic Semantics

Give the weakest precondition at the beginning of this code that enables us to prove that $y \geq 0$ at the end of the following code:

```
y = x;  
if (y < 0) y = 0 - y; else skip
```

(`skip` is the statement that does nothing.) Show your work! Simplify the final logical expression.

Put your answer in a PLAIN ASCII TEXT file named `homework14.txt`.

3 Submitting Your Work

You submit your program work by putting it in the `homework14` directory in your AFS class volume.

The `homework14` directory should include the following:

- `homework14.sml`
- `homework14.txt`