de Bruijn indices

CSCI 312 Homework 5

February 8, 2023

de Bruijn indices: Write a procedure to transform WAE expressions into equivalent expressions using de Bruijn indices, as in the examples on page 25 of the text. For example,

```
{with {x 5}
    {with {y 3}
        {+ x y}}}
```

transforms into

```
{with 5
    {with 3
        {+ <1> <0>}}}
```

And we convert

```
{with {x 5}
    {with {y {+ x 3}}
        {+ x y}}}
```

into

```
{with 5
    {with {+ <0> 3}
        {+ <1> <0>}}}
```

Data types: Use the text's definition of WAEs:

```
(define-type WAE
  [num (n number?)]
  [add (left WAE?) (right WAE?)]
  [sub (left WAE?) (right WAE?)]
  [with (name symbol?) (named-exp WAE?) (body WAE?)]
  [id (name symbol?)])
```

Also use a datatype defining DBWAEs

```
(define-type DBWAE
  [dbnum ...]
  [dbadd ...]
  [dbsub ...]
  [dbwith ...]
  [dbid ...])
```

where I will let you fill in the appropriate fields for each type.

Examples: The two textbook examples will look like this:

```
(db (with 'x (num 5)
          (with 'y (num 3)
                (add (id 'x) (id 'y)))) )
   =>

(dbwith
 (dbnum 5)
 (dbwith (dbnum 3) (dbadd (dbid 1) (dbid 0))))
```

and

```
(db (with 'x (num 5)
          (with 'y (add (id 'x) (num 3))
                (add (id 'x) (id 'y)))) )
  =>
(dbwith
 (dbnum 5)
 (dbwith
  (dbadd (dbid 0) (dbnum 3))
  (dbadd (dbid 1) (dbid 0))))
```

Optional 1: Include a parser for WAEs and an "unparser" for DBWAEs, so that the input/output can look like this:

```
(debruijn
  `{with {x 5}
      {with {y {+ x 3}}
          {+ x y}}})
  =>
`(with 5
    (with (+ <0> 3)
        (+ <1> <0>)))
```

Optional 2: Include parsers and tranformers that will go the other way, transforming DBWAEs into WAEs.

Turn in: Put all your files into a folder `csci312hw05yourname`, zip it, and submit to canvas.