CPSC-354 Report

Jackson Goldberg
Chapman University

October 9, 2022

Abstract

My Report.

Contents

1 Introduction

Hi there. My name is Jackson Goldberg. I am a senior here at chapman University and I am taking programming languages. I like playing chess. Enjoy reading my report.

2 Homework

2.1 Week 1

I have added my program into this github repo. It is a simple python program that loops infinatly until a and b are equal. I ran it with python 3 and manually input 9 and 33 yeilding the answer 3.

2.2 Week 2

This week we were tasked with creating simple recursive programs in huskall. These are my solutions for all of the assigned functions. These functions can also be found in a huskell file titled "Main.hs".

```
-- Takes a list of char and returns a list of char. This works by assinging the element at odd
    positional values of a list into an empty list using the zip function which is what it
    returns.
select_evens :: [[a]] -> [[a]]
select_evens xs = [x | (x,i) <- zip xs [0..], odd i]

-- Example:
select_evens ["a","b","c","d","e"] =
           [] : (select_evens["b","c","d","e]) =
        ["b"] : (select_evens ["c","d","e"]) =
        ["b"] : (select_evens ["d","e"]) =
        ["b","d"] : (select_evens ["e"])
        ["b","d"] : (select_evens []) =
        ["b","d"]
```

I referenced this.

```
-- Same logic as above just assignes based on even possition.
select_odds :: [[a]] -> [[a]]
select_odds xs = [x | (x,i) <- zip xs [0..], even i]

-- Example:
select_odds ["a","b","c","d","e"] =
        ["a"] : (select_odds["b","c","d","e]) =
        ["a"] : (select_odds ["c","d","e"]) =
    ["a","c"] : (select_odds ["d","e"]) =
    ["a","c"] : (select_odds ["e"])
["a","c", "e"] : (select_odds []) =
["a","c", "e"]
```

```
-- Uses the filter to function to create a list of all matching elements to the ones provided.
   If the length is greater then 0 the its a member.
member :: Int -> [Int] -> IO Bool
member x li= do
  let xs = filter(== x) li
  if length xs == 0
      then
          return (False)
      else do
          return(True)

-- Example:
member 2 [5,2,6] =
1 = filter(== 2) li
if length xs == 0
      else do
        return(True)
True
```

```
-- Uses ++ to concatinate lists.
append :: [Int] -> [Int] -> [Int]
append l1 l2 = l1 ++ l2

--Example:
append [1,2] [3,4,5] =
  [1,2] ++ [3,4,5] =
[1,2,3,4,5]
```

```
-- Recursively assigns element to back of new list, creating a reverse list.
revert :: [Int] -> [Int]
revert [] = []
revert (x:xs) = revert xs ++ [x]

--Example:
revert [1,2,3] =
   [3]: revert[1,2] =
 [3,2]: revert[1] =
 [3,2,1]
```

```
-- Compares two strings using <=.
less_equal :: [Int] -> [Int] -> IO Bool
less_equal l1 l2 = do
    if last l1 <= last l2
        then
            return (True)
        else do
             return (False)
--Example:
less_equal [1,2,3] [2,3,2] =
3 > 2
False
```

2.3 Week 3

This week we were tasked with finishing the hanoi file supplied to us. The full file can be found in Hanoi.txt. Hanoi is used 31 times in the file. You can express this as formula because it doesn't matter the starting blocks since the process will always be the exact same. you will always need to reduce to the highest block so the number is nonconsiquental. There are many cool visuals of this online which show what is looks like using a graphical interpritation. There is a simple break down for however many N you have.

2.4 Week 4

This week we worked with context free grammers and parse trees. Part one can be found here, part 2 can be found here.

2.5 Week 5

This week we are doing a lot of lambda calc stuff with abstract syntax trees.

Using the parser to generate linearized abstract syntax trees:

```
Input:
```

```
\ x . x a

[Abstract Syntax]

Prog (EApp (EAbs (Id "x") (EVar (Id "x"))) (EVar (Id "a")))

 Output:
a
```

```
Input:
\ x . x a

[Abstract Syntax]

Prog (EAbs (Id "x") (EApp (EVar (Id "x")) (EVar (Id "a"))))

 Output:
\ x . x a
```

```
Input:
\ x . \ y . x a b

[Abstract Syntax]

Prog (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "x")))) (EVar (Id "a"))) (EVar (Id
    "b")))

 Output:
a
```

```
Input:
\ x . \ y . y a b

[Abstract Syntax]

Prog (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "y")))) (EVar (Id "a"))) (EVar (Id
    "b")))

 Output:
b
```

```
Input:
\ x . \ y . x a b c

[Abstract Syntax]

Prog (EApp (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "x")))) (EVar (Id "a"))) (EVar
    (Id "b"))) (EVar (Id "c")))

 Output:
a c
```

```
Input:
\ x . \ y . y a b c

[Abstract Syntax]

Prog (EApp (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "y")))) (EVar (Id "a"))) (EVar
    (Id "b"))) (EVar (Id "c")))

 Output:
b c
```

```
Input:
\ x . \ y . x a (b c)

[Abstract Syntax]

Prog (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "x")))) (EVar (Id "a"))) (EApp (EVar
    (Id "b")) (EVar (Id "c"))))

 Output:
a
```

```
Input:
\ x . \ y . y a (b c)

[Abstract Syntax]

Prog (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "y")))) (EVar (Id "a"))) (EApp (EVar
    (Id "b")) (EVar (Id "c"))))

 Output:
b c
```

```
Input:
\ x . \ y . x (a b) c

[Abstract Syntax]

Prog (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "x")))) (EApp (EVar (Id "a")) (EVar (Id
    "b")))) (EVar (Id "c")))

 Output:
a b
```

```
Input:
\ x . \ y . y (a b) c

[Abstract Syntax]

Prog (EApp (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "y")))) (EApp (EVar (Id "a")) (EVar (Id
    "b")))) (EVar (Id "c")))
```

```
 Output:
c
```

```
Input:
\ x . \ y . x (a b c)

[Abstract Syntax]

Prog (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "x")))) (EApp (EApp (EVar (Id "a")) (EVar (Id
    "b"))) (EVar (Id "c"))))

 Output:
\ yx0 . a b c
```

```
Input:
\ x . \ y . y (a b c)

[Abstract Syntax]

Prog (EApp (EAbs (Id "x") (EAbs (Id "y") (EVar (Id "y")))) (EApp (EApp (EVar (Id "a")) (EVar (Id
    "b"))) (EVar (Id "c"))))

 Output:
\ yy0 . yy0
```

Evaluate using pen-and-paper the following expressions:

```
(\x.M) N
N = argument
M = function operation

(\x.x) a = a
\x.x a = \x.x a   cannot be reduced further because there are no parentheses
(\x.\y.x) a b = (\x.(\y.x) a) b
                = (\x.x) a
                = a
(\x.\y.y) a b = (\x.(\y.y) a) b
                = (\y.y) b
                = b
(\x.\y.x) a b c = ((\x.(\y.x) a) b) c
                  = ((\y.a) b) c
                  = (\y.a) b c
                  = a c
(\x.\y.y) a b c = ((\x.(\y.y) a) b) c
                  = ((\y.y) b) c
                  = b c
(\x.\y.x) a (b c) = ((\x.(\y.x)) a) (b c)
                    = (\y.a) (b c)
                    = a
(\x.\y.y) a (b c) = ((\x.(\y.y)) a) (b c)
                    = (\y.y) (b c)
                    = b c
(\x.\y.x) (a b) c = ((\x.(\y.x)) (a b)) c
```

```
                      = (\y. a b) c
                      = a b
(\x.\y.y) (a b) c = ((\x.(\y.y)) (a b)) c
                      = (\y.y) c
                      = c
(\x.\y.x) (a b c) = (\x.(\y.x)) (a b c)
                      = (\y. a b c)
(\x.\y.y) (a b c) = (\x.(\y.y)) (a b c)
                      = (\y.y)
```

All of the hand writen notes can be found Here.

2.6 Week 6

This week for homework we did lambda calc beta reduction on exponentiation. The file containing my solution can be founnd in week6.hs Here (Has .hs for sake of parentheses convienience).

3 Project

Introductory remarks ...

The following structure should be suitable for most practical projects.

3.1 Specification

3.2 Prototype

3.3 Documentation

3.4 Critical Appraisal

...

4 Conclusions

(approx 400 words)

In the conclusion, I want a critical reflection on the content of the course. Step back from the technical details. How does the course fit into the wider world of programming languages and software engineering?

References

[PL] Programming Languages 2022, Chapman University, 2022.