CPSC-354 Report

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Abstract

Short summary of purpose and content.

Contents

1 Introduction

This is the report for CPSC 354 Programming Languages. It will contain homework for each week, as well as project work and analysis.

2 Homework

This section will contain your solutions to homework.

2.1 Week 1

HW 1 - Greatest Common Divisor

```python
def gcd(n, m):
    while n != m:
        if n > m:
            n = n-m
        else:
            m = m-n
```

```
    return n
```

The code above implements Euclid's algorithm to find the greatest common divisor in python. Below is an explanation given sample input gcd(9,33).

While n != m, the code will compare whether or not n is greater than m. If n > m, n will become n – m. Otherwise if n < m, m will become m – n. When n == m, the greatest common divisor has been found.

Keeping this logic in mind, let n = 9, m = 33.

```
gcd(9,33) =
gcd(9,24) =
gcd(9,15) =
gcd(9,6) =
gcd(3,6) =
gcd(3,3) =
3
```

Since n == m and the value of both is 3, the greatest common divisor is 3 for this example.

2.2   Week 2

HW 2 - Recursion in Functional Programming

```
select_evens :: [a] -> [a]
select_evens [] = []
select_evens (x:(y:xs)) = y:select_evens(xs)

select_odds :: [a] -> [a]
select_odds [] = []
select_odds (x:(y:xs)) = x:select_odds(xs)

member :: (Eq a) => a -> [a] -> Bool
member a [] = False
member a (x:xs)
    | a == x = True
    | otherwise = a 'member' xs

append :: (Ord a) => [a] -> [a] -> [a]
append [] [] = []
append [] ys = ys
append (x:xs) (ys) = x:append(xs) (ys)

revert :: [a] -> [a]
revert [] = []
revert (x:xs) = append (revert xs) [x]

less_equal :: (Ord a) => [a] -> [a] -> Bool
less_equal [] [] = True
less_equal (x:xs) (y:ys)
    | x > y   = False
    | otherwise = xs 'less_equal' ys
```

The code above implements select_evens, select_odds, member, append, revert, less_equal as recursive functions in Haskell. Below are explanations showing computations for given inputs.

Select Evens example:

Select Evens ["a","b","c","d"]

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

Select Odds example:

Select Odds ["a","b","c","d"]

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

Member example:

Member 2 [5,2,6]

```
member 2 [5,2,6] =
    2 != 5 : (member 2 [2,6]) =
    2 != 5 : (2 == 2) =
    True
```

Append example:

Append [1,2,3] [4,5]

```
append [1,2,3] [4,5] =
    1 : (append [2,3] [4,5]) =
    1 : (2 : (append [3] [4,5])) =
    1 : (2 : (3 : (append [] [4,5]))) =
    1 : (2 : (3 : [4,5])) =
    [1,2,3,4,5]
```

Revert example:

Revert [1,2,3]

```
revert [1,2,3] =
    append(revert [2,3], [1]) =
    append(revert [2,3], [1]) : append(revert [3], [2]) =
    append(revert [2,3], [1]) : append(revert [3], [2]) : append(revert [], [3]) =
    [3,2,1]
```

Less Equal example:

Less Equal [1,2,3] [2,3,4]

```
less_equal [1,2,3] [2,3,4] =
    1 !> 2 : (less_equal [2,3] [3,4]) =
    1 !> 2 : (2 !> 3 : (less_equal [3] [4])) =
```

```
    1 !> 2 : (2 !> 3 : (3 !> 4 : (less_equal [] []))) =
    True
```

2.3 Week 3

HW 3 - Towers of Hanoi

```
hanoi 5 0 2
  hanoi 4 0 1
    hanoi 3 0 2
      hanoi 2 0 1
        hanoi 1 0 2 = move 0 2
        move 0 1
        hanoi 1 2 1 = move 2 1
      move 0 2
      hanoi 2 1 2
        hanoi 1 1 0 = move 1 0
        move 1 2
        hanoi 1 0 2 = move 0 2
    move 0 1
    hanoi 3 2 1
      hanoi 2 2 0
        hanoi 1 2 1 = move 2 1
        move 2 0
        hanoi 1 1 0 = move 1 0
      move 2 1
      hanoi 2 0 1
        hanoi 1 0 2 = move 0 2
        move 0 1
        hanoi 1 2 1 = move 2 1
  move 0 2
  hanoi 4 1 2
    hanoi 3 1 0
      hanoi 2 1 2
        hanoi 1 1 0 = move 1 0
        move 1 2
        hanoi 1 0 2 = move 0 2
      move 1 0
      hanoi 2 2 0
        hanoi 1 2 1 = move 2 1
        move 2 0
        hanoi 1 1 0 = move 1 0
    move 1 2
    hanoi 3 0 2
      hanoi 2 0 1
        hanoi 1 0 2 = move 0 2
        move 0 1
        hanoi 1 2 1 = move 2 1
      move 0 2
      hanoi 2 1 2
        hanoi 1 1 0 = move 1 0
        move 1 2
        hanoi 1 0 2 = move 0 2
```

In order to solve the puzzle, the moves are as follows:

```
move 0 2
move 0 1
move 2 1
move 0 2
move 1 0
move 1 2
move 0 2
move 0 1
move 2 1
move 2 0
move 1 0
move 2 1
move 0 2
move 0 1
move 2 1
move 0 2
move 1 0
move 1 2
move 0 2
move 1 0
move 2 1
move 2 0
move 1 0
move 1 2
move 0 2
move 0 1
move 2 1
move 0 2
move 1 0
move 1 2
move 0 2
```

The word "hanoi" appears in the computation 31 times.

This computation can be expressed as a formula that works for moving any number of disks n as:

```
hanoi 1 x y = move x y

hanoi (n+1) x y =
   hanoi n x (other x y)
   move x y
   hanoi n (other x y) y
```


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.

[P] Punctuation, StackExchange, 2022.

[S] Spacing, StackExchange, 2022.