Joseph Camacho-Terrazas
11/17/2020
Lisp Programming

For this assignment, we were to write a Lisp program where given a circuit descriptor as input, we had to write a function that counted logical operators, listed the unique variables, and reduce the CD using tautologies. To count the logical operators, the function takes the CD as well as the user supplied operator argument. It will then compare the operators in the CD to the user input and will increase the count if there is a match. As for the unique function, it takes the CD and splits the list to obtain each variable. It will then list each variable once and will not list them more than once. Finally, for the reduce function, we have the evalcd function which will make calls to the NOT, AND, and OR tautology functions in order to reduce the CD.

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```
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;;Input: A logical argument
;;Output: A reduced CD form, number of specified operators, or a list of all uniq
ue variables
;;Precondition: The user gives a proper CD as input
;;Postcondition: The program will give the correct output based on the specified
function.

;;Evaluates a circuit design

;;Counts the number of specified operators in the argument
;;Format is 'operator '(operator list)
(define (count_operator x operatorlist)
    (cond ((null? operatorlist) 0)
        ((not (list? operatorlist))
        (if (eq? x operatorlist) 1 0))
        (else (+ (count_operator x (car operatorlist)) (count_operator x (cdr ope
ratorlist)))));;End cond
);;End define

;;Lists all the unique variables in the argument
;;Format is '(operator list)
(define (unique operatorlist)
    (cond ((null? operatorlist) '() )
        ((not (list? operatorlist)) '() )
        ((member (car operatorlist) (cdr operatorlist)) (unique (cdr operatorlist
)))
        (else (cons (car operatorlist) (unique (cdr operatorlist)))));;End cond

);;End define

;; NOT CD1
(define(evalcd CD)
    ;; Base Case
    (cond ((null? CD) '())
        ;; True, False, or A1....A1000
        ((not (list? CD)) CD)
        ((eq? (car CD) 'NOT) (evalcd_not CD))
        ((eq? (car CD) 'AND) (evalcd_and CD))
        ((eq? (car CD) 'OR ) (evalcd_or CD)));;End cond
);;End define
```

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```
;;PRE:MUST be a (NOT CD) form (CAR CD) => NOT
;;Reduce the Argument and see if we can reduce it
(define (evalcd_not CD)
    (cond ((eq? (evalcd (cadr CD)) 0) 1)
        ((eq? (evalcd (cadr CD)) 1) 0)
        (else (cons 'NOT (list (evalcd (cadr CD))))));;End cond
);;End define

;;PRE: MUST be (AND CD1 CD2) format
;;POST: Apply simple tautologies to the CD1 and CD2 and maybe reduce
;;AND
(define (evalcd_and CD)
    (cond ((eq? (evalcd (cadr CD)) 0) 0)
        ((eq? (evalcd (caddr CD)) 0) 0)
        ((eq? (evalcd (cadr CD)) 1) (evalcd (caddr CD)))
        ((eq? (evalcd (caddr CD)) 1) (evalcd (cadr CD)))
        (else (cons 'AND
            (list (evalcd (cadr CD))
            (evalcd (caddr CD))))));;End cond
);;End define

;;PRE: MUST be (OR CD1 CD2) format
;;POST: Apply simple tautologies to the CD1 and CD2 and maybe reduce
;;OR
(define (evalcd_or CD)
    (cond ((eq? (evalcd (cadr CD)) 1) 1)
        ((eq? (evalcd (caddr CD)) 1) 1)
        ((eq? (evalcd (cadr CD)) 0) (evalcd (caddr CD)))
        ((eq? (evalcd (caddr CD)) 0) (evalcd (cadr CD)))
        (else (cons 'OR
            (list (evalcd (cadr CD))
            (evalcd (caddr CD))))));;End cond
);;End define
```

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```
> (count_operator 'NOT '(NOT (AND 0 (NOT 1))))
2
> (count_operator 'AND '(NOT (AND 1 (AND A1 A2))))
2
> (count_operator 'OR '(NOT (OR 1 (OR A1 (OR A2 A3)))))
3
```

```
> (unique '(OR 0 (AND A1 A2)))
(OR 0 (AND A1 A2))
> (unique '(NOT (AND 1 (NOT 1))))
(NOT (AND 1 (NOT 1)))
> (unique '(NOT NOT NOT NOT OR))
(NOT OR)
```

```
> (evalcd '(NOT (AND 0 (OR A1 A2))))
1
> (evalcd '(OR 0(AND A1 A2)))
(AND A1 A2)
> (evalcd '(AND 1 (OR A1 (NOT 1))))
A1
```