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2.19 Extra Credit

Answers in black

2.19

Change cc so that it will access its second argument differently

```
(define (cc amount coin-values)
  (cond ((= amount 0) 1)
        ((or (< amount 0) (no-more? coin-values)) 0)
        (else
         (+ (cc amount
                (except-first-denomination coin-values))
            (cc (- amount
                   (first-denomination coin-values))
                coin-values)))))
; input this as coin-values
(define us-coins (list 50 25 10 5 1))
(define uk-coins (list 100 50 20 10 5 2 1 0.5))
```

Write first-denomination, except-first-denomination & no-more?

First-denomination

```
; finds the first value in the list of coin-values
(define (first-denomination coin-values)
  (car coin-values))
```

Except-first-denomination

```
; finds the values in the list of coin-values except the first
(define (except-first-denomination coin-values)
  (cdr coin-values))
```

No-more?

```
; if there are no more values in the list inputted, return #t
(define (no-more? coin-values)
  (if (empty? coin-values) #t #f))
```

Does the order of the list coin-values affect the answer produced by cc? Why or why not?

- **No, because eventually the program will count all the combinations of coins. It does not matter which denomination it starts with first.**

Notes on how cc works

- The number of ways to generate the change of amount a using n kinds of coins is equal to
  - The number of ways to give amount a using all but the first kind of coin, plus
  - The number of ways give amount a - d using all n kinds of coins, where d is the denomination of the first kind of coin
- Example: amount = 6, coin-values are 5, 1
  - First group is not using 5
    - Using 1, we have one possible combo to make 6
  - Second group is 6 - 5, using coin-values 5 and 1
    - We have 1 way to create an amount of 1
  - 1 + 1 → 2
- Second example: amount = 7, coin-values are 10, 5, 1
  - First group is not using 10
    - Using 5 and 1 there are 2 ways
  - Second group is 7 - 10 which is -3 → less than zero so add zero
  - 2 + 0 → 2