The Design Recipe

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1 Design Recipe Steps

This PDF outlines the steps to writing the design recipe; each step is accompanied by part of an example for writing the design recipe. The example function is in Racket, and it determines whether or not a database is empty.

1. Provide data definitions for all non-atomic data types. (If multiple procedures in a single file use the same non-atomic types, provide these data definitions once at the top of the file, not once-per-procedure).

    ;; Data Definition
    ;; Example data:
    ;; string: "Carmen", "Audrey", "dog"
    ;;
    ;; A database is a list of strings

2. Provide examples of the data the procedure will process and produce.

    ;; Data Definition
    ;; Example data:
    ;; string: "Carmen", "Audrey", "dog"
    ;;
    ;; A database is a list of strings
    ;;
    ;; Examples:
    (define db1 empty)
    (define db2 (cons "cat" (cons "dog" empty)))

    ;; bool: true, false
3. Specify the procedures **type signature**, which describes the type of data the procedure consumes, and the type it produces. Your types should be meaningful Racket types, like "string", 'int', 'real', and '<type>' list. A more specific type with no semantic meaning in Racket—something like "nonnegative integer"—should be specified in the I/O contract rather than the type signature. A procedure consuming nonnegative integers would just have the input type "int" and the more detailed description of the nonnegative constraint in the I/O contract.

```racket
;; Data Definition
;; Example data:
;; string: "Carmen", "Audrey", "dog"
;; A database is a list of strings
;; Examples:
(define db1 empty)
(define db2 (cons "cat" (cons "dog" empty)))
;; bool: true, false
;; isDatabaseEmpty: database -> bool
```

4. Following the type signature, describe the procedure's **call structure**, i.e., give names to the procedure and its arguments. (This involves writing the start of a Racket program rather than writing a comment.)

```racket
;; Data Definition
;; Example data:
;; string: "Carmen", "Audrey", "dog"
;; A database is a list of strings
;; Examples:
(define db1 empty)
(define db2 (cons "cat" (cons "dog" empty)))
;; bool: true, false
;; isDatabaseEmpty: database -> bool
(define (isDatabaseEmpty db)
  ...)
```
5. Write a **specification** for the procedure. That is, in words, not code, state the relationship between the procedures input and output (make sure to use the argument names you created in the call structure). This goes in a comment above the call structure. Writing the spec may include restricting the domain in the description of some variable, for instance declaring an input as nonnegative.

```scheme
;; Data Definition
;; Example data:
;; string: "Carmen", "Audrey", "dog"
;;
;; A database is a list of strings
;;
;; Examples:
;; (define db1 empty)
;; (define db2 (cons "cat" (cons "dog" empty)))

;; bool: true, false
;;
;; isDatabaseEmpty: database -> bool
;;
;; input: db, a database
;; output: a boolean that is true if db is empty, and false if it is not

(define (isDatabaseEmpty db)
  ...
)
```

6. Provide **test cases** that exemplify the procedure’s operation. These tests must follow its call structure and satisfy its specification.

```scheme
;; Data Definition
;; Example data:
;; string: "Carmen", "Audrey", "dog"
;;
;; A database is a list of strings
;;
;; Examples:
;; (define db1 empty)
;; (define db2 (cons "cat" (cons "dog" empty)))

;; bool: true, false
;;
;; isDatabaseEmpty: database -> bool
;;
;; input: db, a database
;; output: a boolean that is true if db is empty, and false if it is not

(define (isDatabaseEmpty db)
  ...
)

;; Test cases
(check-expect (isDatabaseEmpty empty) true)
(check-expect (isDatabaseEmpty (cons "hedwig" empty)) false)
```
7. Write the template for the procedure based on the data definition and the type signature. This is where you would decide whether to use an if-statement or a cond-expression.

```scheme
;; Data Definition
;; Example data:
;; string: "Carmen", "Audrey", "dog"
;;
;; A database is a list of strings
;;
;; Examples:
(define db1 empty)
(define db2 (cons "cat" (cons "dog" empty)))

;; bool: true, false
;;
;; isDatabaseEmpty: database -> bool
;;
;; input: db, a database
;; output: a boolean that is true if db is empty, and false if it is not

(define (isDatabaseEmpty db)
  (cond
   [(empty? db) ...]
   [(cons? db) ...]))

;; Test cases
(check-expect (isDatabaseEmpty empty) true)
(check-expect (isDatabaseEmpty (cons "hedwig" empty)) false)
```
8. **Code** the procedure. Specifically, fill in the template *clause by clause*. For each of the possible input types, decide which fields in the input structures are relevant to the problem at hand, and figure out how to operate on them to generate the desired output.

```scheme
;; Data Definition
;; Example data:
;; string: "Carmen", "Audrey", "dog"
;;
;; A database is a list of strings
;;
;; Examples:
(define db1 empty)
(define db2 (cons "cat" (cons "dog" empty)))
;; bool: true, false
;;
;; isDatabaseEmpty: database -> bool
;;
;; input: db, a database
;; output: a boolean that is true if db is empty, and false if it is not

(define (isDatabaseEmpty db)
  (cond
    [(empty? db) true]
    [(cons? db) false]))

;; Test cases
(check-expect (isDatabaseEmpty empty) true)
(check-expect (isDatabaseEmpty (cons "hedwig" empty)) false)
```

9. **Run** your program on your test cases.
2 An OCaml Example

(* Data Definition
 + Example data:
 + string: "Carmen", "Audrey", "dog"
 + A database is a list of strings
 + Examples: *)

[] ;;
["cat"; "dog"] ;;

(* bool: true, false
 + input: db, a database
 + output: a boolean that is true if db is empty, and false if it is not *)

let isDatabaseEmpty (db: string list) : bool =
    match db with
    | [] -> true
    | _  -> false ;;

(* test cases *)
check_expect (isDatabaseEmpty []) true ;;
check_expect (isDatabaseEmpty ["the"; "design"; "recipe"] ) false ;;

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