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# SOLID Design Principles In Common Lisp

Learn how to apply SOLID design principles with Common Lisp and the powerful CLOS system.



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If you find any problem, want to suggest an improvement or commit changes to this book, please visit this Github repository <https://github.com/common-lisp-reserve/solid-design-principles-in-common-lisp>

## Disclaimer

These principles are not rules. Apply them where you think it does make sense. Don't "over-engineer".

We are going to focus on Single Responsibility, Open/Closed, Liskov Substitution and Dependency Inversion principles where they makes the most sense to apply with Common Lisp as a dynamic typed language.

## What is SOLID?

- Single Responsibility Principle
- Open/Closed Principle
- Liskov Substitution Principle
- Interface Segregation Principle (we are not going to cover this)
- Dependency Inversion Principle

## S: Single Responsibility

A class should have one, and only one, reason to change.

### Bad

```
(defclass truck ()
  ((brand
    :initarg :brand
    :reader get-brand)))

(defmethod send-detail ((self truck) customer-id)
  "send truck's brand detail to customer..")

(defclass truck ()
  ((brand
    :initarg :brand
    :accessor brand)))

(defmethod get-brand ((self truck))
  (brand self))

(defmethod set-brand ((self truck) new-brand)
  (setf (brand self) new-brand))
```

### Good

```
(defclass detail-sender ()
  ((customer-id
    :initarg :customer-id
    :accessor customer-id)))

(defmethod get-customer-id ((self detail-sender))
  (customer-id self))

(defmethod set-customer-id ((self detail-sender) new-customer-id)
  (setf (customer-id self) new-customer-id))

(defmethod send-detail ((self detail-sender))
  (send (customer-id self)))
```

## O: Open/Closed

**Objects or entities should be open for extension, but closed for modification.**

What this means is that we should write code that doesn't have to be changed every time the requirements changes. For instance, a class should be easily extendable without modifying the class itself.

Take a look at the open/closed principle violation example below.

### Bad

```
(defclass circle ()
  ((radius
    :initarg :radius
    :reader get-radius)))

(defclass area-calculator ()
  ((shapes
    :initarg :shapes
    :reader get-shapes)))

(defmethod total-area ((self area-calculator))
  (reduce #'(+
    (mapcar #'(lambda (x)
      (* pi
        (get-radius x)
        (get-radius x)))
      (get-shapes self)))))

(defparameter *circle-one*
  (make-instance 'area-calculator
    :shapes
    (list (make-instance 'circle :radius 5)
          (make-instance 'circle :radius 6)
          (make-instance 'circle :radius 2))))

(total-area *circle-one*) ;; 204.20352248333654d0
```

If we do want `total-area` method to calculate a sum of Rectangle areas instead of Circle, we won't be able to do that due to its specific area calculation formula ( $a = \pi * r^2$ ) without modifying `total-area` method.

So how can we go over this limit?

Below code shows a better example.

### Good

```

(defclass shape ()
  nil)

(defclass circle (shape)
  ((radius
    :initarg :radius
    :reader get-radius)))

(defmethod area ((self shape))
  (* pi (get-radius self) (get-radius self)))

(defclass area-calculator ()
  ((shapes
    :initarg :shapes
    :reader get-shapes)))

(defmethod total-area ((self area-calculator))
  (reduce #' +
    (mapcar #'area
      (get-shapes self))))

(defparameter *circle-one*
  (make-instance 'area-calculator
    :shapes
    (list (make-instance 'circle :radius 5)
          (make-instance 'circle :radius 6)
          (make-instance 'circle :radius 2))))

(total-area *circle-one*) ;; 204.20352248333654d0

```

As you've noticed, we moved the function to calculate circle area into its Circle class. This way, if we want to calculate a Rectangle shape area (or triangle, etc), we only have to create a new class with its own method to handle Rectangle area calculation.

For example, a new Rectangle class and area method which calculates a simple Rectangle shape area ( $a = w * h$ )

```

(defclass rectangle (shape)
  ((width
    :initarg :width
    :reader get-width)

    (height
    :initarg :height
    :reader get-height)))

(defmethod area ((self rectangle))
  (* (get-width self)
    (get-height self)))

```

## Full Better Example

```
(defclass shape ()
  nil)

(defclass circle (shape)
  ((radius
    :initarg :radius
    :reader get-radius)))

(defmethod area ((self shape))
  (* pi (get-radius self) (get-radius self)))

(defclass rectangle (shape)
  ((width
    :initarg :width
    :reader get-width)

   (height
    :initarg :height
    :reader get-height)))

(defmethod area ((self rectangle))
  (* (get-width self)
     (get-height self)))

(defclass area-calculator ()
  ((shapes
    :initarg :shapes
    :reader get-shapes)))

(defmethod total-area ((self area-calculator))
  (reduce #' +
    (mapcar #'area
      (get-shapes self))))

(defparameter *circle-one*
  (make-instance 'area-calculator
    :shapes
    (list (make-instance 'circle :radius 5)
          (make-instance 'circle :radius 3)
          (make-instance 'circle :radius 12))))

(defparameter *rectangle-one*
  (make-instance 'area-calculator
    :shapes
    (list (make-instance 'rectangle :height 5 :width 10)
          (make-instance 'rectangle :height 9 :width 20)
          (make-instance 'rectangle :height 23 :width 44))))
```



```
(total-area *circle-one*) ;; 559.2034923389832d0  
(total-area *rectangle-one*) ;; 1242
```

## L: Liskov Substitution

Let  $\Phi(x)$  be a property provable about objects  $x$  of type  $T$ . Then  $\Phi(y)$  should be true for objects  $y$  of type  $S$  where  $S$  is a subtype of  $T$ .

.

## D: Dependency Inversion

- High level modules should not depend upon low level modules. Both should depend upon abstractions.
- Abstractions should not depend upon details. Details should depend upon abstractions.

### Bad

```
(defclass printer ()
  ((data-type
    :initarg :data-type
    :reader get-data-type)))

(defmethod print-epub ((self printer))
  (let ((e (make-instance 'epub-formatter)))
    (process e (get-data-type self))))

(defmethod print-mobi ((self printer))
  (let ((m (make-instance 'mobi-formatter)))
    (process m (get-data-type self))))

(defclass epub-formatter ()
  nil)

(defmethod process ((self epub-formatter) data-type)
  (format t "~a-%data-type: ~a~%"
    "epub formatter's process logic goes here"
    data-type))

(defclass mobi-formatter ()
  nil)

(defmethod process ((self mobi-formatter) data-type)
  (format t "~a-%data-type: ~a~%"
    "mobi formatter's process logic goes here"
    data-type))

(defparameter epub-book (make-instance 'printer :data-type "epubs"))
(defparameter mobi-book (make-instance 'printer :data-type "mobis"))

(print-epub epub-book)
;; epub formatter's process logic goes here
;; data-type: epubs

(print-mobi mobi-book)
;; mobi formatter's process logic goes here
```

```
;; data-type: mobis
```

## Good

```
(defclass printer ()
  ((data-type
    :initarg :data-type
    :reader get-data-type)))

(defmethod prints ((self printer) formatter)
  (let ((f (make-instance formatter)))
    (process f (get-data-type self))))

(defclass epub-formatter ()
  nil)

(defmethod process ((self epub-formatter) data-type)
  (format t "~a-%data-type: ~a~%"
    "epub formatter's process logic goes here"
    data-type))

(defclass mobi-formatter ()
  nil)

(defmethod process ((self mobi-formatter) data-type)
  (format t "~a-%data-type: ~a~%"
    "mobi formatter's process logic goes here"
    data-type))

(defparameter epub-book (make-instance 'printer :data-type "epubs"))
(defparameter mobi-book (make-instance 'printer :data-type "mobis"))

(prints epub-book 'epub-formatter)
;; epub formatter's process logic goes here
;; data-type: epubs

(prints mobi-book 'mobi-formatter)
;; mobi formatter's process logic goes here
;; data-type: mobis
```