

```
Quick quasiquotation review: `(+ ,(* 2 3) 1) evaluates to (+ 6 1)

Add `and , in some blanks so that the second expression evaluates to (+ (* a a) (* b b))

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_( _+ _( _square-expr _a) _( _square-expr _b))
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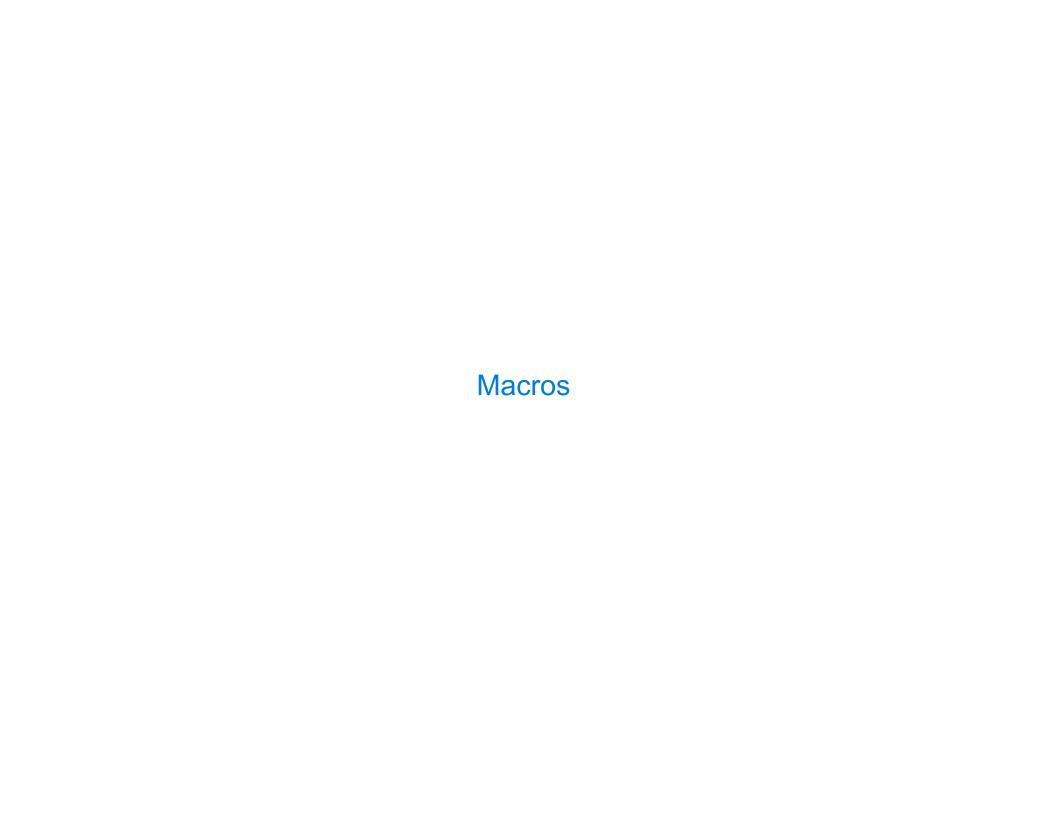
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 `( + ,( square-expr `a) ,( square-expr `b))
                                (Demo)
```



Macros	Perform	Code 7	Transf	formations
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A macro is an operation performed on the source code of a program before evaluation

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(define-macro (twice expr)
  (list 'begin expr expr))
```

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```
(define-macro (twice expr)
  (list 'begin expr expr)) > (twice (print 2))
```

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Evaluation procedure of a macro call expression:

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Evaluation procedure of a macro call expression:

• Evaluate the operator sub-expression, which evaluates to a macro

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Evaluation procedure of a macro call expression:

- Evaluate the operator sub-expression, which evaluates to a macro
- Call the macro procedure on the operand expressions without evaluating them first

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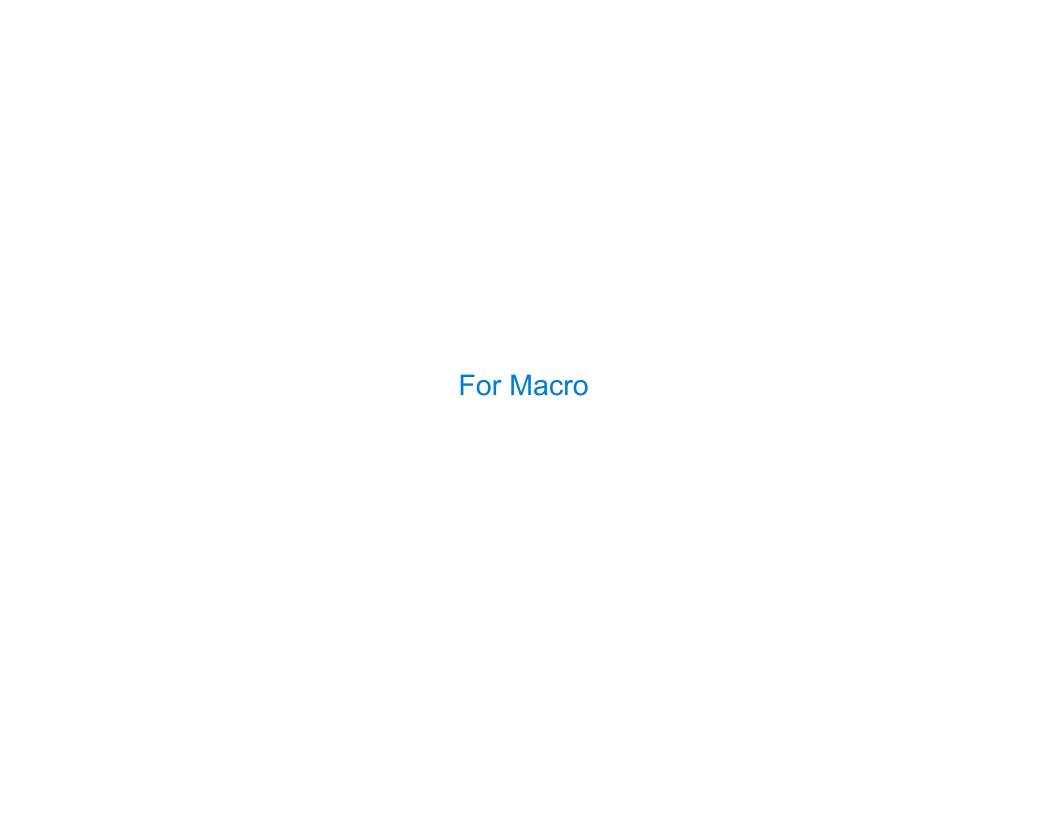
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(Demo)



```
scm> (for x (2 3 4 5) (* x x))
(4 9 16 25)
```

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scm> (map (lambda (x) (* x x)) (2 3 4 5))
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Define a macro that evaluates an expression for each value in a sequence

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Define a macro that evaluates an expression for each value in a sequence

(Demo)



Tracing Recursive Calls							

```
def trace(fn):
    def traced(n):
        print(f'{fn.__name__}({n})')
        return fn(n)
    return traced

@trace
def fact(n):
    if n == 0:
        return 1
    else:
        return n * fact(n - 1)
```

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>>> fact(5)
fact(5)
fact(4)
fact(3)
fact(2)
fact(1)
fact(0)
120
```

```
def trace(fn):
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def fact(n):
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fact(5)
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fact(2)
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```

```
def trace(fn):
                                               (define fact (lambda (n)
    def traced(n):
                                                 (if (zero? n) 1 (* n (fact (- n 1))))))
        print(f'{fn. name }({n})')
        return fn(n)
                                               (define original fact)
    return traced
                                               (define fact (lambda (n)
                                                          (print (list 'fact n))
@trace
                                                          (original n)))
def fact(n):
    if n == 0:
        return 1
    else:
        return n * fact(n - 1)
>>> fact(5)
                                              scm> (fact 5)
fact(5)
                                               (fact 5)
                                              (fact 4)
fact(4)
fact(3)
                                               (fact 3)
fact(2)
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        print(f'{fn. name }({n})')
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    return traced
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fact(0)
                                                                                         (Demo)
120
                                               120
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