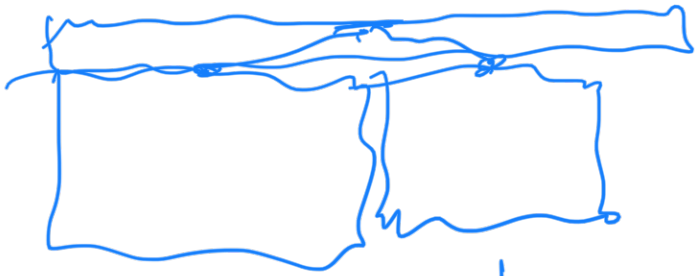


3 ways to use local:

- eliminate identical recursive calls
- encapsulate 2 or more definitions
- improve code clarity by giving names to intermediate values

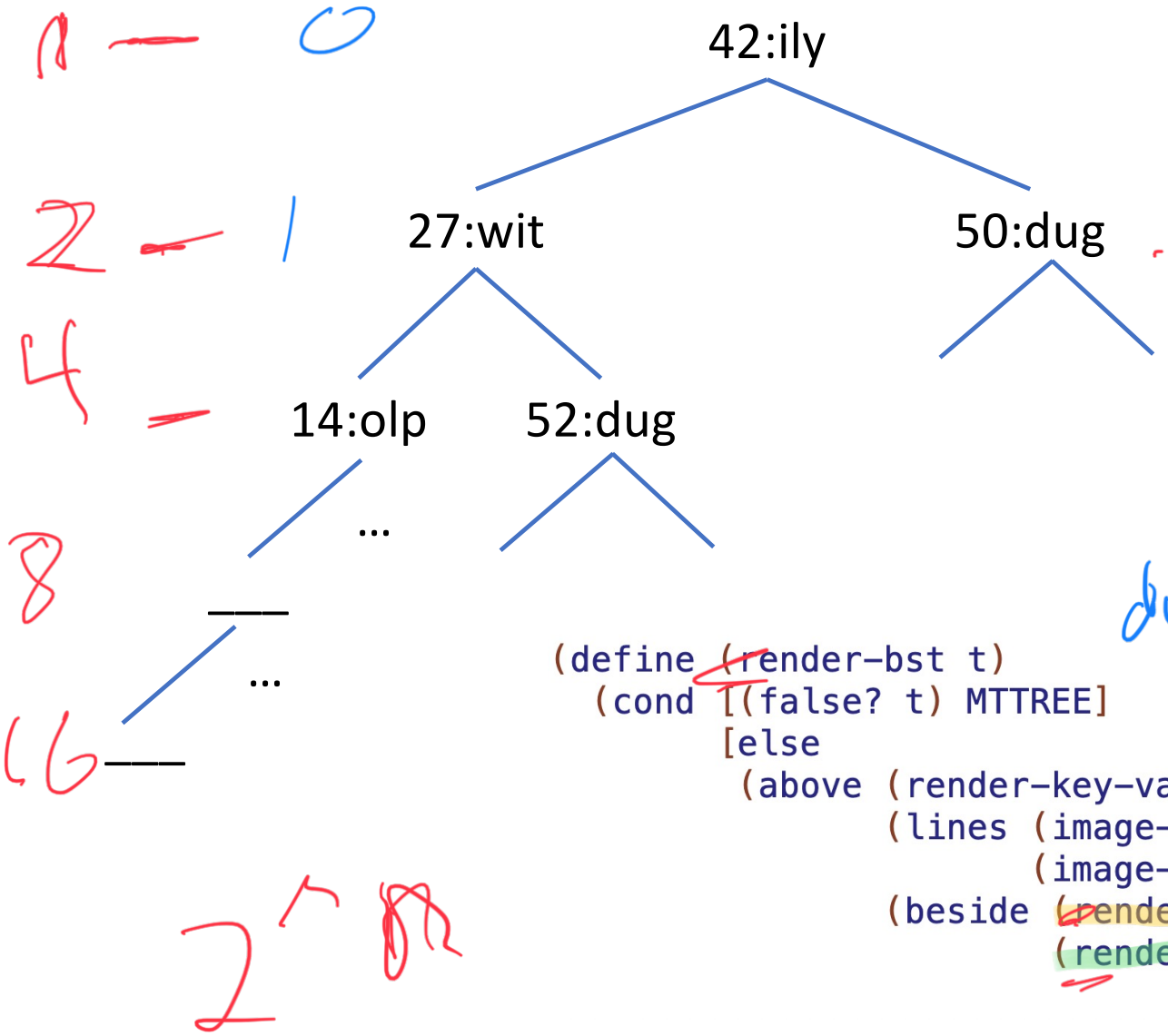
refactoring

- a fundamental technique for improving code
- take a correct running program, refactor to improve structure

3 ways to use local

- achieved through refactoring
- or achieved when initially writing code

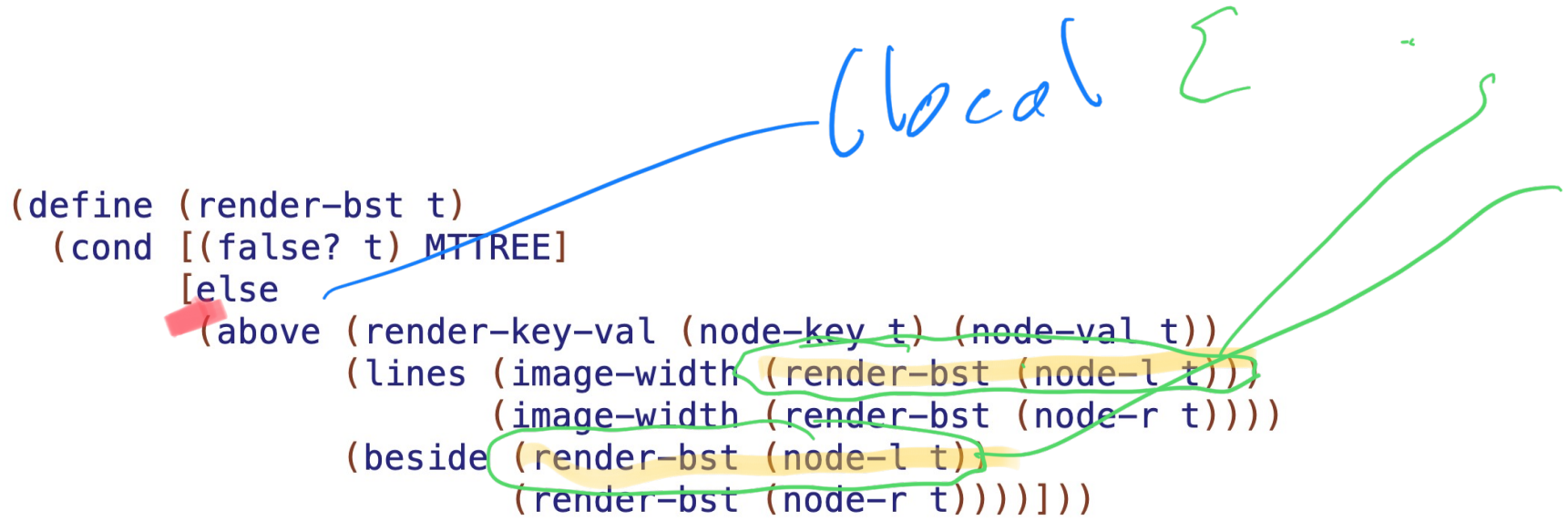
	Eliminate…	Encapsulate 2…	Give names to vals
Via refactoring			
While originally writing code			



how many times is render-bst called at each level?

duplicate recursive calls

```
(define (render-bst t)
  (cond [(false? t) MTTREE]
        [else
         (above (render-key-val (node-key t) (node-val t))
                (lines (image-width (render-bst (node-l t)))
                       (image-width (render-bst (node-r t))))
                (beside (render-bst (node-l t))
                        (render-bst (node-r t))))]))
```



1. identify duplicate recursive calls
2. find nearest enclosing conditional branch
3. add local there
4. move call to local definition
5. and replace original call with local constant name

```
(@htdf all-labels--region all-labels--lor)
(@signature Region -> ListOfString)
(@signature ListOfRegion -> ListOfString)
;; produce labels of all regions in region (including root)
(check-expect (all-labels--lor empty) '())
(check-expect (all-labels--region S1) (list "one"))
(check-expect (all-labels--lor LOR123) (list "one" "two" "three"))
(check-expect (all-labels--region G4)
              (list "one" "two" "three"
                    "four" "five" "six"))

(@template-origin Region)

(define (all-labels--region r)
  (cond [(single? r) (list (single-label r))]
        [else
         (all-labels--lor (group-subs r))]))

(@template-origin ListOfRegion)

(define (all-labels--lor lor)
  (cond [(empty? lor) empty]
        [else
         (append (all-labels--region (first lor))
                 (all-labels--lor (rest lor)))]))
```

```
(@htdf all-labels)
(@signature Region -> ListOfString)
;; produce labels of all regions in region (including root)
(check-expect (all-labels L1) (list "one"))
(check-expect (all-labels I4) (list "one" "two" "three" "four" "five" "six"))

(@template-origin encapsulated Region ListOfRegion)

(define (all-labels r)
  (local [(define (all-labels--region r)
            (cond [(leaf? r) (list (leaf-label r))]
                  [else      (all-labels--lor (inner-subs r))]))


          (define (all-labels--lor lor)
            (cond [(empty? lor) empty]
                  [else
                   (append (all-labels--region (first lor))
                           (all-labels--lor (rest lor)))]))]

    (all-labels--region r)))
```

red defines not visible from top level

```
(@htdf all-with-color--region all-with-color--lor)
(@signature Color Region -> ListOfRegion)
(@signature Color ListOfRegion -> ListOfRegion)
;; produce all regions with given color
(check-expect (all-with-color--lor "red" empty) '())
(check-expect (all-with-color--region "red" S1) (list S1))
(check-expect (all-with-color--region "blue" S1) '())
(check-expect (all-with-color--lor "red" LOR123) (list S1))
(check-expect
 (all-with-color--region "red"
                         (make-group "blue"
                                     (list G4
                                           (make-single "X" 90 "red'
 (list G1 S1 (make-single "X" 90 "red")))

(@template-origin Region)

(define (all-with-color--region c r)
  (cond [(single? r) (if (string=? (single-color r) c) (list r) '()
        [else
         (if (string=? (group-color r) c)
             (cons r (all-with-color--lor c (group-subs r)))
             (all-with-color--lor c (group-subs r)))]))

(@template-origin ListOfRegion)

(define (all-with-color--lor c lor)
  (cond [(empty? lor) empty]
        [else
         (append (all-with-color--region c (first lor))
                 (all-with-color--lor c (rest lor)))]))
```

```
#| Refactor using local to encapsulate. |#

(@htdf all-with-color)
(@signature Color Region -> ListOfRegion)
;; produce all regions with given color
(check-expect (all-with-color "red" S1) (list S1))
(check-expect (all-with-color "blue" S1) empty)
(check-expect (all-with-color "red"
                              (make-group "blue"
                                          (list G4
                                                (make-single "X" 90 "red"))))
              (list G1 S1 (make-single "X" 90 "red")))

(@template-origin Region ListOfRegion encapsulated)

(define (all-with-color c r)
  (local [(define (all-with-color--region c r)
            (cond [(single? r)
                   (if (string=? (single-color r) c) (list r) empty)]
                  [else
                   (if (string=? (group-color r) c)
                       (cons r (all-with-color--lor c (group-subs r)))
                       (all-with-color--lor c (group-subs r)))]))

          (define (all-with-color--lor c lor)
            (cond [(empty? lor) empty]
                  [else
                   (append (all-with-color--region c (first lor))
                           (all-with-color--lor c (rest lor)))]))]

    (all-with-color--region c r)))
```