

; CSC324 – 2020F – Exercise #1  
; Due Sunday September 20th at 9PM.

; Write out by hand (on paper, or via pen interface) the evaluation steps for the (non-definitions)  
; from the second page, and upload an image or pdf of that to our MarkUs instance.

; You don't need to include the “● Steps ●” header nor the “○” or “•” bullet points in front of steps,  
; but do need to include the underlining that shows which sub-expressions(s) are being reduced.

; You don't need to match the line-break choices that step's layout algorithm chooses exactly,  
; but the nested structure and standard indentation conventions along with a few standard style  
; rules determine most of the formatting choices.

; 1. Put at least one space around adjacent (aka sibling) terms.

; For example, the function and argument terms inside the function call ...

```
#;(length (range 10)) ; ... are the siblings ...
#;length ; ... and ...
#;(range 10)
; ... so they need that space between them, and without the space we get a red alert in DrRacket ...
#;(length(range 10))
```

; That standard style rule is meant to :

; • follow the clause separation convention from English and many other Natural Languages  
; • help the reader avoid an incorrect "f(x, y)" association

; 2. Indent terms that are inside parentheses to the right of the opening parenthesis

; (if you spread some of those terms across multiple lines).

; In other words, you should be able to draw a rectangle around the whole parenthesized term  
; with the opening parenthesis as the upper-left corner. If you move the cursor in front of an  
; expression you can see the highlighting draw those rectangles (the DrRacket menu item  
; View > Tightlight has some options to tweak that if you like).

; Here are example layouts illustrating two extremes for laying out the same term ...

```
#;(a b ((c d) e) (f g))
#;(a
  b
  ((c
    d)
  e)
  (f
    g))
```

; 3. Put consecutive open parentheses, and consecutive close parentheses, on the same line.

; This might feel unnatural for a while.

; If you look at #2 again you'll see that it avoided the INCORRECT ...

```
#;(a
  b
  (
  (c
    d)
  e)
  (f
    g)
  )
```

; Note : under the DrRacket menu item Language > CSC104 Settings you can select  
; “step : display anonymous functions compactly” if you would like to see step try show  
; anonymous functions with their and body of anonymous functions on the same line  
; (when reasonable).

; A.

```
(step (map ((fun t) (same? (text-length t) 3))
            (list "ant" "bear" "cod")))
```

; B.

```
(define (T f a-list)
  (map ((fun e) (list e (f e)))
        a-list))
```

```
(step (T triangle (list 20 30 10)))
```

; C.

```
(define (f m n)
  (if (zero? n) m
      else (+ n (f m (dec n)))))
```

```
(define (g m n)
  (if (zero? n) m
      else (g (+ n m) (dec n))))
```

```
(step (hide if-introduction) (f 0 3))
```

```
(step (hide if-introduction) (g 0 3))
```

; D.

```
(define (P a-text images)
  (beside-top (text->image (text-join a-text " : "))
              (combine above-left images)))
```

```
(define (out v)
  (if (list? v) (P (first v) (map out (rest v)))
      else v))
```

```
(step (out △))
```

```
(step (hide if-introduction P) (out (list "A" □ △)))
```

```
(step (hide if-introduction P out)
      (out (list "C" ○ ■ (list "B" (list "A" □ △) ●))))
```

A

1. (map (c fun t) (same? (text-length t) 3)) (list "ant" "bear")  
"cod")))

2. (list ((fun t) (same? (text-length t) 3)) "ant")  
((fun t) (same? (text-length t) 3)) "bear")  
((fun t) (same? (text-length t) 3)) "cod"))

3. (list (same? (text-length "ant") 3)  
(same? (text-length "bear") 3)  
(same? (text-length "cod") 3)))

4. (list (same? 3 3) (same? 4 3) (same? 3 3)))

5. (list #true #false #ture )

B

1 (T triangle (list 20 30 10))

2 (map ((fun e) (list e (triangle e))) (list 20 30 10))

3 (list (((fun e) (list e (triangle e))) 20)

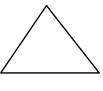
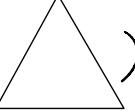
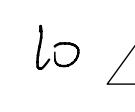
((fun e) (list e (triangle e))) 30)

((fun e) (list e (triangle e))) 10))

4 (list (list 20 (triangle 20))

(list 20 (triangle 30))

(list 20 (triangle 10)))

5 (list (list 20 )) (list 30 ) (list 10 )

C

$$\underline{1 \ f(0,3)}$$

$$2 (+3(f 0 \underline{(dec 3)}))$$

$$3 (+3(f' 0 2))$$

$$4 (+3(+2(f 0 \underline{(dec 2)})))$$

$$5 (+3(+2(f 0 \underline{1})))$$

$$6 (+3(+2(+1(f 0 \underline{(dec 1)}))))$$

$$7 (+3(+2(+1(f 0 \underline{0}))))$$

$$8 (+3(+2(+1 \underline{0})))$$

$$9 (+3(+2 \underline{1}))$$

$$10 (+3 \underline{3})$$

$$11 6$$

$$\underline{1 (g 0 3)}$$

$$2 (g (+3 0) \underline{(dec 3)})$$

$$3 (g \underline{\overline{3 2}})$$

$$4 (g \underline{(+2 3)} \underline{(dec 2)})$$

$$5 (g \underline{\overline{5 1}})$$

$$6 (g \underline{(+1 5)} \underline{(dec 1)})$$

$$7 (g \underline{\overline{6 0}})$$

$$8 6$$

D

- 1  $\text{cont } \Delta$ )
  - 2  $(\text{if } (\underline{\text{list? }} \Delta) (\text{P} (\text{first } \Delta) (\text{map out} (\text{rest } \Delta))) \text{ else } \Delta)$
  - 3  $(\text{if } (\# \text{false}) (\text{P} (\text{first } \Delta) (\text{map out} (\text{rest } \Delta))) \text{ else } \Delta)$
  - 4  $\Delta$
- 
- 1  $\text{cont} (\text{list "A"} \square \Delta))$
  - 2  $(\text{if } (\underline{\text{list? }} (\text{list "A"} \square \Delta)) (\text{P} (\text{first} (\text{list "A"} \square \Delta)) (\text{map out} (\text{rest} (\text{list "A"} \square \Delta)))) \text{ else } (\text{list "A"} \square \Delta)))$
  - 3  $(\text{if } (\# \text{true}) ((\text{P} (\text{first} (\text{list "A"} \square \Delta)) (\text{map out} (\text{rest} (\text{list "A"} \square \Delta)))) \text{ else } (\text{list "A"} \square \Delta)))$
  - 4  $((\text{P} (\text{first} (\text{list "A"} \square \Delta)) (\text{map out} (\text{rest} (\text{list "A"} \square \Delta))))$
  - 5  $((\text{P} (\text{first} (\text{list "A"} \square \Delta)) (\text{map out} (\text{rest} (\text{list "A"} \square \Delta))))$
  - 6  $(\text{P "A"} (\underline{\text{map out}} (\text{list } \square \Delta)))$
  - 7  $(\text{P "A"} (\text{list } (\underline{\text{cont }} \square) (\underline{\text{out }} \Delta)))$
  - 8  $(\text{P "A"} (\text{list } \square \Delta))$
  - 9  $C \text{beside-top } ("A" \rightarrow \text{image} (\text{text-join "A" ":"})) (\underline{\text{combine above left}} (\text{list } \square \Delta)))$
- PA: 

- 1  $(\text{out}(\text{list}^{\circ} \text{C}) \circ \boxed{\text{map}} (\text{list}^{\circ} \text{B} (\text{list}^{\circ} \text{A} \square \Delta) \otimes)))$
- 2  $(P \text{C} \text{first} (\text{list}^{\circ} \text{C}) \circ \boxed{\text{map}} (\text{list}^{\circ} \text{B} (\text{list}^{\circ} \text{A} \square \Delta) \otimes)))$   
 $(\text{map} \text{ out} (\text{rest} (\text{list}^{\circ} \text{C}) \circ \boxed{\text{map}} (\text{list}^{\circ} \text{B} (\text{list}^{\circ} \text{A} \square \Delta) \otimes)))$
- 3  $(P^{\circ} \text{C} (\text{map} \text{ out} (\text{list}^{\circ} \circ \boxed{\text{map}} (\text{list}^{\circ} \text{B} (\text{list}^{\circ} \text{A} \square \Delta) \otimes)))$ )
- 4  $(P^{\circ} \text{C} (\text{list} (\text{out} \circ) \text{cont} \boxed{\text{map}}) \text{cont} (\text{list}^{\circ} \text{B} (\text{list}^{\circ} \text{A} \square \Delta) \otimes)))$
- 5  $(P^{\circ} \text{C} (\text{list}^{\circ} \circ \boxed{\text{map}}^{\text{B:A:}}))$

6 C:

