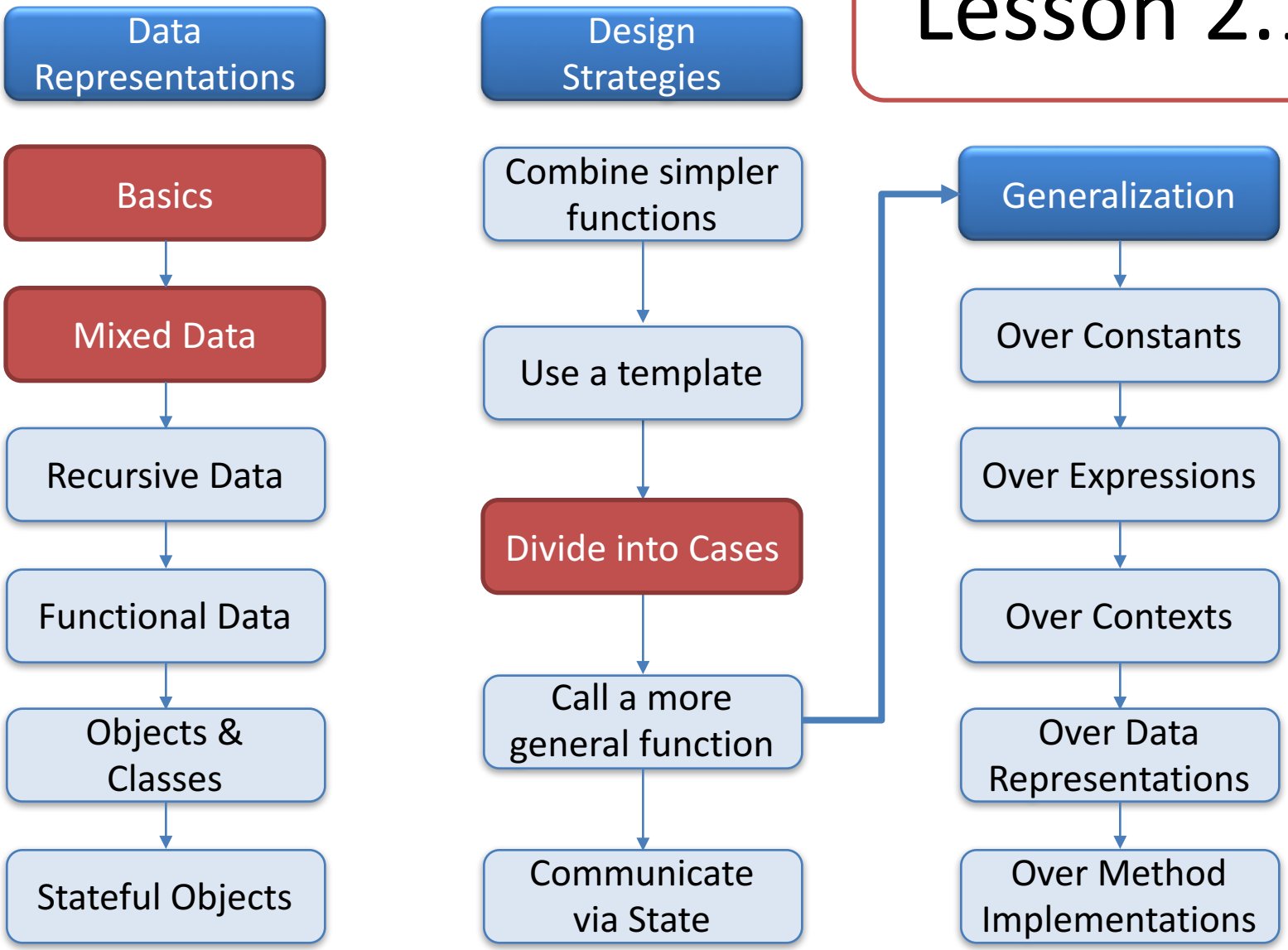
Design Strategies 3: Divide into cases

CS 5010 Program Design Paradigms

Lesson 2.2

Lesson 2.1


Data Representations
Basics
Mixed Data
Recursive Data
Functional Data
Objects & Classes
Stateful Objects
Design Strategies
Combine simpler functions
Use a template
Divide into Cases
Call a more general function
Communicate via State
Generalization
Over Constants
Over Expressions
Over Contexts
Over Data Representations
Over Method Implementations

Divide into cases on <condition>

- Sometimes you need to break up an argument in some way other than by its template.
- We already saw this in Lesson 0.4 in the definition of **abs:**

```
; abs : Real -> Real
; RETURNS: the absolute value of the given real number.
; STRATEGY: divide into cases on sign of x
(define (abs x)
  (if (< x 0)
      (- 0 x)
      x))
```

Example: income tax

- Imagine we are computing income tax in a system where there are three rates:
  - One on incomes less than $10,000
  - One on incomes between $10,000 and $20,000
  - One on incomes of $20,000 and over
- The natural thing to do is to partition the income into three cases, corresponding to these three income ranges.

Write a **cond** or **if** that divides the data into the desired cases

```
;; STRATEGY: Cases on amt
;; f : NonNegReal -> ??
(define (f amt)
  (cond
    [(and (<= 0 amt) (< amt 10000))      ...]
    [(and (<= 10000 amt) (< amt 20000)) ...]
    [(<= 20000 amt) ...]))
```

Write a **cond** or **if** that divides the data into the desired cases

```
;; tax-on : NonNegReal -> NonNegReal
;; GIVEN: A person's income
;; RETURNS: the tax on the income
;; EXAMPLES: ....
;; STRATEGY: Cases on amt
(define (tax-on amt)
  (cond
    [(and (<= 0 amt) (< amt 10000))      ...]
    [(and (<= 10000 amt) (< amt 20000)) ...]
    [(<= 20000 amt) ...]))
```

This is contract is sloppy. Currency amounts should never be **Real**. They should always be integers, and units should be specified. But we don't need to be so careful for this made-up example.

The predicates must be exhaustive. Make them mutually exclusive when you can.

Now fill in the blanks

```
;; tax-on : NonNegReal -> NonNegReal
;; GIVEN: A person's income
;; RETURNS: the tax on the income
;; EXAMPLES: ....
;; STRATEGY: Cases on amt

(define (tax-on amt)
  (cond
    [(and (<= 0 amt) (< amt 10000))
      0]
    [(and (<= 10000 amt) (< amt 20000))
     (* 0.10 (- amt 10000))]
    [(<= 20000 amt)
     (+ 1000 (* 0.20 (- amt 20000)))]))
```

That's all you need to do!

Another example

```
;; ball-after-tick : Ball -> Ball
;; GIVEN: The state of a ball b
;; RETURNS: the state of given ball at the next tick
;; STRATEGY: cases on whether ball would hit the wall on
;; the next tick

(define (ball-after-tick b)
  (if (ball-would-hit-wall? b)
      (ball-after-bounce b)
      (ball-after-straight-travel b)))
```

Where does cases fit in our menu of design strategies?

- If you are inspecting a piece of enumeration or mixed data, you almost always want to use the template for that data type.
- Cases is just for when dividing up the data by the template doesn't work.

Next Steps

- If you have questions or comments about this lesson, post them on the discussion board.
- Go on to the next lesson