Compound Data So Far

A \texttt{posn} is

\[(\texttt{make-posn } X \ Y)\]

where \texttt{X} is a \texttt{num} and \texttt{Y} is a \texttt{num}

\begin{itemize}
  \item \texttt{(make-posn 1 2)} is a value
  \item \texttt{(posn-x (make-posn 1 2))} \rightarrow 1
  \item \texttt{(posn-y (make-posn 1 2))} \rightarrow 2
\end{itemize}

So much for computation... how about program design?
If the input is compound data, start the body by selecting the parts
If the input is compound data, start the body by selecting the parts

; max-part : posn -> num
; Return the X part of p is it's bigger
; than the Y part, otherwise the Y part
(define (max-part p)
  ...)

(check-expect (max-part (make-posn 10 11)) 11)
(check-expect (max-part (make-posn 7 5)) 7)
Body

If the input is compound data, start the body by selecting the parts

; max-part : posn -> num
; Return the X part of p is it's bigger
; than the Y part, otherwise the Y part
(define (max-part p)
    ... (posn-x p) ... (posn-y p) ...)

(check-expect (max-part (make-posn 10 11)) 11)
(check-expect (max-part (make-posn 7 5)) 7)
If the input is compound data, start the body by selecting the parts

; max-part : posn -> num
; Return the X part of p is it's bigger
; than the Y part, otherwise the Y part
(define (max-part p)
  (cond
   [(> (posn-x p) (posn-y p)) (posn-x p)]
   [else (posn-y p)])
(check-expect (max-part (make-posn 10 11)) 11)
(check-expect (max-part (make-posn 7 5)) 7)
If the input is compound data, start the body by selecting the parts

\[\text{max-part : posn -> num}\]

; Return the X part of p is it's bigger
; than the Y part, otherwise the Y part
\[
\text{(define (max-part p)}
  \text{(cond}
  \quad [ (> \text{(posn-x p)} \text{(posn-y p)}) \text{(posn-x p)}]}
  \quad [\text{else (posn-y p)}]])
\]

\[
\text{(check-expect (max-part (make-posn 10 11)) 11)}
\]
\[
\text{(check-expect (max-part (make-posn 7 5)) 7)}
\]

Since this guideline applies before the usual body work, let’s split it into an explicit step
Design Recipe II

Data
• Understand the input data

Contract, Purpose, and Header
• Describe (but don’t write) the function

Examples
• Show what will happen when the function is done

Template
• Set up the body based on the input data (and only the input)

Body
• The most creative step: implement the function body

Test
• Run the examples
If the input is compound data, start the body by selecting the parts

; max-part : posn -> num
; ...
(define (max-part p)
  ... (posn-x p) ... (posn-y p) ...)

Check: number of parts in template =
number of parts data definition named in contract

A posn is

(make-posn X Y)

where X is a num and Y is a num
If the input is compound data, start the body by selecting the parts

**Handin artifact:** a comment (required starting with HW 2)

```scheme
; max-part : posn -> num
; Return the X part of p is it's bigger
; than the Y part, otherwise the Y part
; (define (max-part p)
; ... (posn-x p) ... (posn-y p) ...)
(define (max-part p)
  ... (posn-x p) ... (posn-y p) ...)
(check-expect (max-part (make-posn 10 11)) 11)
(check-expect (max-part (make-posn 7 5)) 7)
```
Other Kinds of Data

Suppose we want to represent snakes:

- name
- weight
- favorite food

What kind of data is appropriate?

Not **num**, **bool**, **sym**, **image**, or **posn**...
Data Definitions and define-struct

Here’s what we’d like:

A snake is

(make-snake sym num sym)

... but make-snake is not built into DrRacket

We can tell DrRacket about snake:

(define-struct snake (name weight food))

Creates the following:

• make-snake
• snake-name
• snake-weight
• snake-food
Data Definitions and define-struct

Here’s what we’d like:

A snake is

\[(\text{make-snake } \text{sym } \text{num } \text{sym})\]

... but \text{make-snake} is not built into DrRacket

We can tell DrRacket about \text{snake}:

\[(\text{define-struct } \text{snake} \ (\text{name } \text{weight } \text{food}))\]

Creates the following:

\[(\text{snake-name } (\text{make-snake } X Y Z)) \rightarrow X\]
\[(\text{snake-weight } (\text{make-snake } X Y Z)) \rightarrow Y\]
\[(\text{snake-food } (\text{make-snake } X Y Z)) \rightarrow Z\]
(define-struct snake (name weight food))

(make-snake 'Slinky 10 'rats)

(make-snake 'Slimey 8 'pudding)

(define-struct posn (x y))

(make-posn 3 4)

(make-posn 8 -2)
Data

Deciding to define \texttt{snake} is in the first step of the design recipe

\textbf{Handin artifact:} a comment and/or \texttt{define-struct}

\begin{verbatim}
; A snake is
; (make-snake sym num sym)

(define-struct snake (name weight food))
\end{verbatim}

Now that we’ve defined \texttt{snake}, we can use it in contracts
Programming with Snakes

Implement `snake-skinny?`, which takes a snake and returns `true` if the snake weights less than 10 pounds, `false` otherwise.

Implement `feed-snake`, which takes a snake and returns a snake with the same name and favorite food, but five pounds heavier.
Programming with Armadillos

Pick a representation for armadillos ("dillo" for short), where a dillo has a weight and may or may not be alive.

Implement \texttt{run-over-with-car}, which takes a dillo and returns a dead dillo of equal weight.

Implement \texttt{feed-dillo}, where a dillo eats 2 pounds of food at a time.

... unless it's dead