Structures and All That

September 24, 2019

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We can get you prepared for the 31st century
With advanced programming and quad rendering
And Java plus plus plus scripting language
We offer advanced job placement assitance"
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- Whereas with "or" we would check which kind of data we would have and then use a computation specific to that data, with products we can directly project out data.
- Let's say that in Java that you have some person class with a first and last name represented as strings.
- It is easy to define a method that returns the person's full name by concatenating the first and last name.

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- We can represent a grid with one number in the same sense that we can simulate a 10x10 2D array with a 100 element array.

Structs Make Things Easier

Personally, I like doing things the easy way.

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def first_name(tup):
  return tup[0]
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- So Python gives classes (or named tuples) as a way to more easily define such structured data.

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- We will return to discussing lists in more detail later, since they are *extremely* important.
- But for now, remember that we wanted to avoid the inconveniences given by using other existing data types to represent some piece of compound data!

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(check-expect (distance-to-0 (point 0 5)) 5)
(check-expect (distance-to-0 (point 7 0)) 7)
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(define (distance-to-0 ap)
  (sqrt
    (+ (sqr (posn-x ap))
       (sqr (posn-y ap)))))
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  2. One selector per field, which extracts the value of the field from a structure instance; and
  3. One structure predicate, which, like ordinary predicates, distinguishes instances from all other kinds of values.

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2. The selectors per field are `(point-x point-val)` and `(point-y point-val)`. The general form of a selector for a specific field is `(struct-name-field-name val)`
3. A predicate for checking types is automatically created, for example: `(point? point-val)` and in general a predicate `struct?` is created.

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- You guys should be able to think of many more examples.

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- Let's first consider defining a 2D vector struct as follows: `(struct vector [delta-x delta-y])`
- Now, we can represent a ball as a point (which only has positive components) and a vector (which can have negative components): `(struct 2D-ball position vec)`

Other Representations

Our 2D Ball struct has nested occurrences of other structs. This is a natural thing, and even recursive descriptions of data are natural, i.e. linked lists and binary trees. But we can also consider using a *flat representation* for our 2D Ball, which doesn't nest structs.

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- Let's talk about defining data definitions for structs. We must specify the form of the struct and the types of its field and provide an interpretation of what each of the fields represents. Here's how we do this for our point struct:

Other Representations

Our 2D Ball struct has nested occurrences of other structs. This is a natural thing, and even recursive descriptions of data are natural, i.e. linked lists and binary trees. But we can also consider using a *flat representation* for our 2D Ball, which doesn't nest structs.

- `(struct 2D-ball [x y delta-x delta-y]`
- Although valid, I think it's better to keep representations natural and just nest things, barring performance concerns.
- Let's talk about defining data definitions for structs. We must specify the form of the struct and the types of its field and provide an interpretation of what each of the fields represents. Here's how we do this for our point struct:

```
(define-struct point [x y])
; A Point is a structure:
;   (point Number Number)
; interpretation a point x pixels from left, y from top
```

-