CSc 520

Principles of Programming Languages

37: Scheme — Symbols and Structures

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Symbols

In addition to numbers, strings, and booleans, Scheme has a primitive data-type \((atom)\) called symbol.

A symbol is a lot like a string. It is written:

\[
\ 'identifier
\]

Here are some examples:

\[
\ 'apple\\n\ 'pear\\n\ 'automobile
\]

\((\text{symbol? } \text{arg})\) checks if an atom is a symbol.

To compare two symbols for equality, use \((\text{eq? } \text{arg1} \text{arg2})\). HTDP says to use \((\text{symbol=? } \text{arg1} \text{arg2})\) but DrScheme doesn’t seem to support this.
Symbols...

> (symbol? "hello")
#f
> (symbol? 'apple)
#t
> (eq? 'a 'a)
#t
> (eq? 'a 'b)
#f
> (display 'apple)
apple
> (string->symbol "apple")
apple
> (symbol->string 'apple)
"apple"
(define (healthy? f)
  (case f
    [(sushi sashimi) 'hell-yeah]
    [(coke) 'I-wish]
    [(licorice) 'no-but-yummy]
    [else 'nope]
  ))

> (healthy? 'sashimi)
hell-yeah
> (healthy? 'coke)
i-wish
> (healthy? 'licorice)
no-but-yummy
> (healthy? 'pepsi)
nope
Structures

Some versions of Scheme have structures. Select Advanced Student in DrScheme.

These are similar to C’s struct, and Java’s class (but without inheritance and methods).

Use define-struct to define a structure:

```
(define-struct struct-name (f1 f2 ...))
```

define-struct will automatically define a constructor:

```
(make-struct-name (f1 f2 ...))
```

and field-selectors:

```
struct-name-f1
struct-name-f2
```
(define-struct person (name sex date-of-birth))

> (define bob (make-person "bob" 'male '1978))
> bob
(make-person "bob" 'male '1978)
> (define alice (make-person "alice" 'female '1979))

> (person-sex bob)
'male
> (person-date-of-birth alice)
'1979
Equivalence

Every language definition has to struggle with equivalence; i.e. what does it mean for two language elements to be the same?

In Java, consider the following example:

```java
void M(String s1, String s2, int i1, int i2) {
    if (i1 == i2) . . . ;
    if (s1 == s2) . . . ;
    if (s1.equals(s2)) . . . ;
}
```

Why can I use `==` to compare ints, but it is usually wrong to use it to compare strings?
Equivalence...

- Scheme has three equivalence predicates `eq?`, `eqv?` and `equal?`.

- `eq?` is the pickiest of the three, then comes `eqv?`, and last `equal?`.

- In other words,
  - If `(equal? a b)` returns `#t`, then so will `(eq? a b)` and `(eqv? a b)`.
  - If `(eqv? a b)` returns `#t`, then so will `(eq? a b)`.

  `(equal? a b)` generally returns `#t` if `a` and `b` are structurally the same, i.e. print the same.
Equivalence...

(eqv? a b) returns #t if:

- a and b are both #t or both #f.
- a and b are both symbols with the same name.
- a and b are both the same number.
- a and b are strings that denote the same locations in the store.

```
> (define S "hello")
> (eqv? S S)
true
> (eqv? "hello" "hello")
false
> (eqv? 'hello 'hello)
true
```
(equal? a b) returns #t if a and b are strings that print the same.
This is known as structural equivalence.

> (equal? "hello" "hello")
true
> (equal? alice bob)
false
> (define alice1 (make-person "alice" 'female '1979))
> (define alice2 (make-person "alice" 'female '1979))
> (equal? alice1 alice2)
true