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
  'pear
  'automobile
  ```
- `(symbol? arg)` checks if an atom is a symbol.
- To compare two symbols for equality, use `(eq? arg1 arg2)`. HTDP says to use `(symbol=? arg1 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"
```


Symbols...

```
(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
```


Structures. . .

```
(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:

```
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 `int`s, but it is it 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
```


Equivalence...

- `(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
```