Advanced Student Language

A <defn> is one of

```
(define <var> <exp>)
(define (<var> <var> ... <var>) <exp>)
(define-struct <var> (<var> ... <var>))
```

An <exp> is one of

```
<var>
<con>
<prim>
(<exp> <exp> ... <exp>)
(cond [<exp> <exp>] ... [<exp> <exp>])
(cond [<exp> <exp>] ... [else <exp>])
(and <exp> ... <exp>)
(or <exp> ... <exp>)
(local [<defn> ...] <exp>)
(lambda (<var> ... <var>) <exp>)
(set! <var> <exp>)
(begin <exp> ... <exp>)
```

Mini Racket

A **<defn>** is one of

```
(define <var> <exp>)
(define <var> (lambda (<var>) <exp>))
```

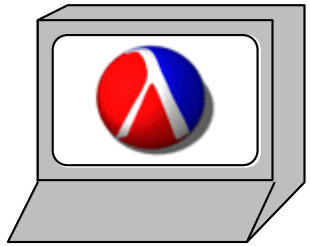
An **<assign>** is

```
(set! <var> <exp>)
```

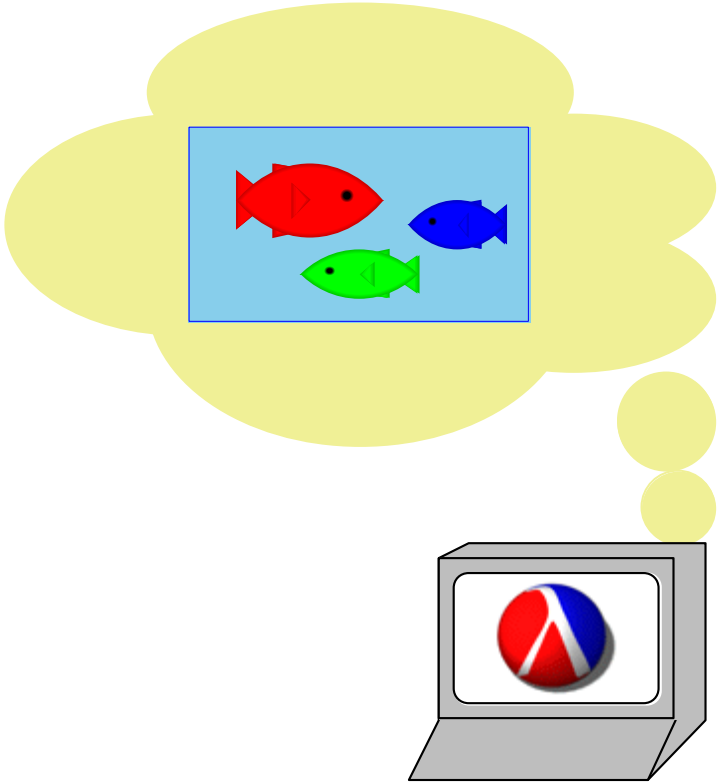
An **<exp>** is one of

```
<var>
<num>
(+ <exp> <exp>)
(- <exp> <exp>)
(* <exp> <exp>)
(<var> <exp>)
```

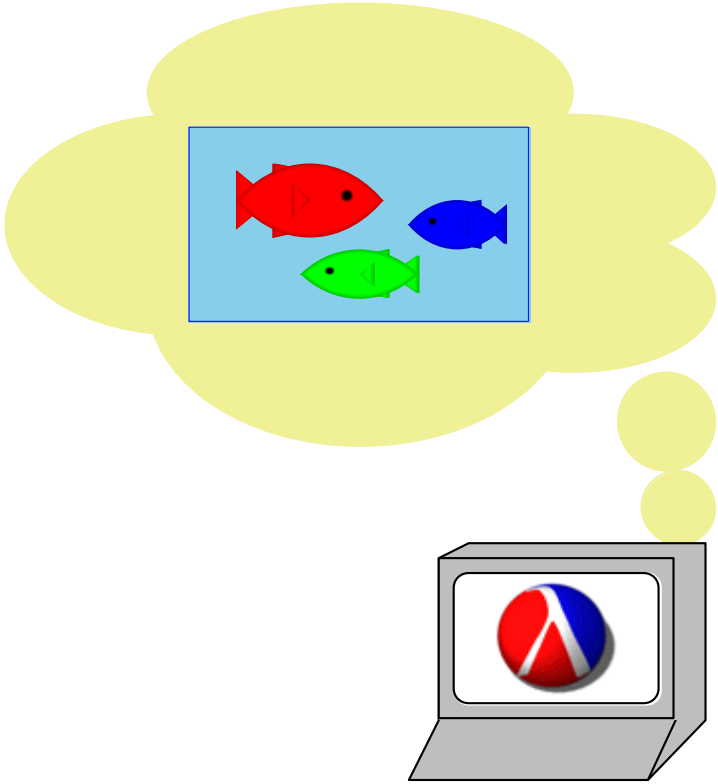
Implementing Aquariums in Advanced Student



Implementing Aquariums in Advanced Student

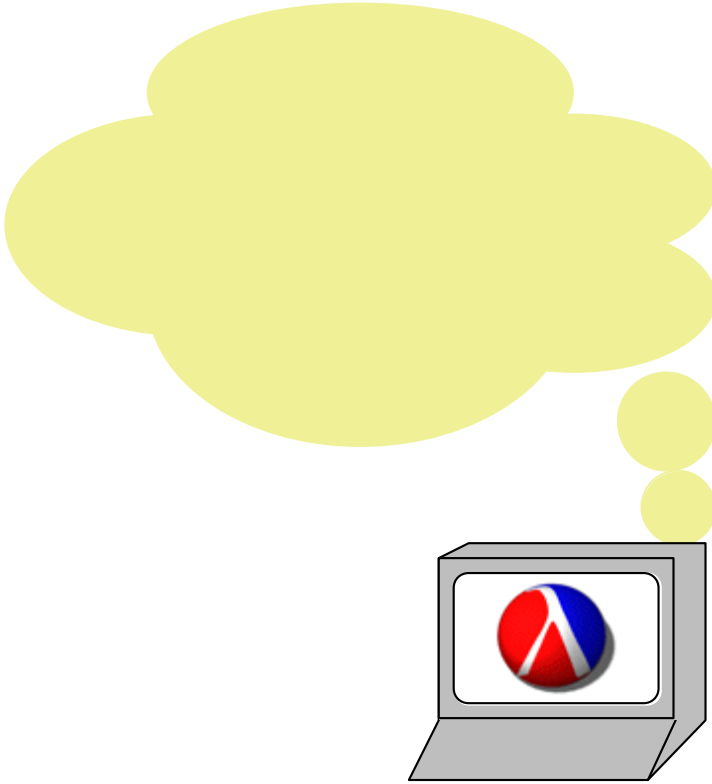


Implementing Aquariums in Advanced Student

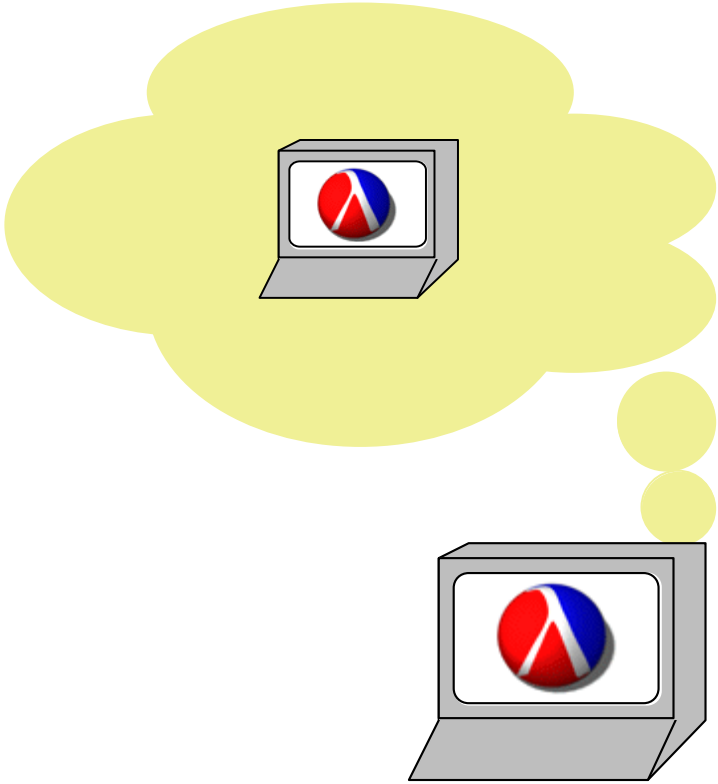


Represent fish, as opposed to stuffing *real* fish into DrRacket

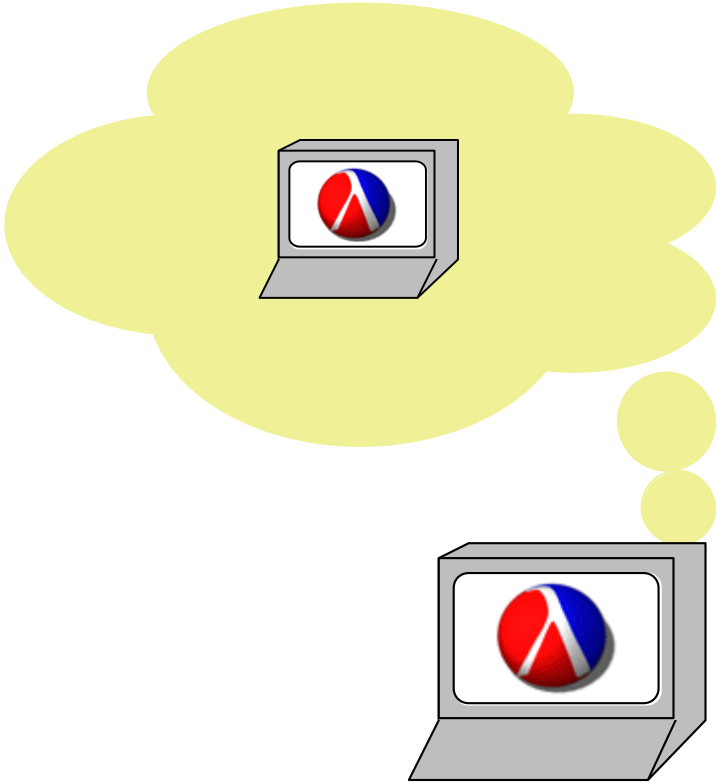
Implementing Mini Racket in Advanced Student



Implementing Mini Racket in Advanced Student



Implementing Mini Racket in Advanced Student



Represent Mini Racket expressions, as opposed to typing *real* expressions into DrRacket

Representing Mini Racket Expressions

An <exp> is one of

```
<var>
<num>
(+ <exp> <exp>)
(- <exp> <exp>)
(* <exp> <exp>)
(<var> <exp>)
```

We can't simply write

```
(+ 1 2)
```

to represent a Mini Racket addition expression

Representing Mini Racket Expressions

An <exp> is one of

```
<var>
<num>
(+ <exp> <exp>)
(- <exp> <exp>)
(* <exp> <exp>)
(<var> <exp>)
```

We can write

```
(make-plus 1 2)
```

Representing Mini Racket Expressions

An **<exp>** is one of

<var>
<num>
(+ <exp> <exp>)
(- <exp> <exp>)
(* <exp> <exp>)
(<var> <exp>)

To represent the **<var> x**:

```
'x
```

Representing Mini Racket Expressions

An `<exp>` is one of

```
<var>
<num>
(+ <exp> <exp>)
(- <exp> <exp>)
(* <exp> <exp>)
(<var> <exp>)
```

To represent the `<num>` `5`:

```
5
```

Representing Mini Racket Expressions

An `<exp>` is one of

```
<var>
<num>
(+ <exp> <exp>)
(- <exp> <exp>)
(* <exp> <exp>)
(<var> <exp>)
```

To represent the application `(f (+ 1 2))`

```
(make-app 'f (make-plus 1 2))
```

Representing Mini Racket Expressions

Data definition:

```
; An expr is either
;   - sym
;   - num
;   - (make-plus expr expr)
;   - (make-minus expr expr)
;   - (make-times expr expr)
;   - (make-app sym expr)
```