Midterm 1 Aftermath

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let is just **lambda**!

```
(let ((var_1 val_1)
      (var_2 val_2)
        .
        .
        .
      (var_N val_N))
  body)
```

⇓

```
((lambda (var_1 var_2 ...var_N) body)
  (val_1 val_2 ...val_N))
```

Figure: `let| s are just lambdas`

let* is just nested **let**'s!

```
(let* ((var_1 val_1)        (let ((var_1 val_1))
       (var_2 val_2)          (let ((var_2 val_2))
          .                       .
          .          ⇒            .
          .                       .
       (var_N val_N))            (let ((var_N val_N))
  body)                            body) … ))
```

Figure: `let*| s are just let| s`

Tail Positions

- Tail positions are shown in red:
  - (**if** pred val_1 val_2)
  - (**cond** ($pred_1$ val_1) ... ($pred_{N-1}$ val_{N-1}) (else val_N))
  - (**ord** $pred_1$ $pred_2$ ... $pred_{N-1}$ $pred_N$)
  - (**and** $pred_1$ $pred_2$ ... $pred_{N-1}$ $pred_N$)
- These positions within special forms in tail positions are also tail positions!

  e.g:
  - (**if** pred val_1 (**if** pred val_2 val_3))
  - (**cond** ($pred_1$ val_1) ... ($pred_{N-1}$ (**if** pred $val_1^{'}$ $val_2^{'}$)) (else (**and** $pred_1^{'}$ $pred_2^{'}$ ... $pred_{N-1}^{'}$ $pred_N$)))

Tail positions in special forms

Also Tail Positions!

collateral	sequential	recursive
(**let** ((var$_1$ val$_1$)	(**let*** ((var$_1$ val$_1$)	(**letrec** ((var$_1$ val$_1$)
(var$_2$ val$_2$)	(var$_2$ val$_2$)	(var$_2$ val$_2$)
.	.	.
.	.	.
.	.	.
(var$_N$ val$_N$))	(var$_N$ val$_N$))	(var$_N$ val$_N$))
body)	*body*)	*body*)

Figure: Tail positions in some special forms

Top position

- If *a* is a constant, *a* is the top position
- If `(f arg1 arg2 ... argn)` is a function application, *f* is the top position

Tail recursive functions

Recursive functions such that the recursive call only happens at the tail positions in the top position

Thinking all possible cases

Review last exercise of midterm I