CSE 341: Programming Languages

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Lecture 3— Let bindings, options, and benefits of no mutation

Let bindings

Motivation: Functions without local variables can be poor style and/or really inefficient.

Syntax: `let b1 b2 ... bn in e end` where each `bi` is a *binding*.

Typing rules: Type-check each `bi` and `e` in context including previous bindings. Type of whole expression is type of `e`.

Evaluation rules: Evaluate each `bi` and `e` in environment including previous bindings. Value of whole expression is result of evaluating `e`.

Elegant design worth repeating:

- Let-expressions can appear anywhere an expression can.
- Let-expressions can have any kind of binding.
  - Local functions can refer to any bindings *in scope*.

More than style

Exercise: hand-evaluate `bad_max` and `good_max` for lists `[1,2]` `[1,2,3]`, and `[3,2,1]`.

Summary and general pattern

Major progress: recursive functions, pairs, lists, let-expressions

Each has a syntax, typing rules, evaluation rules.

Functions, pairs, and lists are very different, but we can describe them in the same way:

- How do you create values? (function definition, pair expressions, empty-list and `::`)
- How do you use values? (function application, `#1` and `#2`, `null`, `hd`, and `tl`)

This (and conditionals) is enough for your homework though:

- `andalso` and `orelse` help
- You need *options* (next slide)
- Soon: much better ways to use pairs and lists (pattern-matching)

Options

"Options are like lists that can have at most one element."

- Create a `t option` with `NONE` or `SOME e` where `e` has type `t`.
- Use a `t option` with `isSome` and `valOf`

Why not just use (more general) lists? An interesting style trade-off:

- Options better express purpose, enforce invariants on callers, maybe faster.
- But cannot use functions for lists already written.

You want to *change* something?

There is no way to *mutate* (assign to) a binding, pair component, or list element.

How could the *lack* of a feature make programming easier?
In this case:

- Amount of sharing is indistinguishable
  - Aliasing irrelevant to correctness!
- Bindings are invariant across function application
  - Mutation breaks compositional reasoning, a (the?) intellectual tool of engineering