CSE 341: Programming Languages

Spring 2005
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].

Extra Credit Exercise: As a function of \( n \), how long will it take to calculate

- \( \text{bad\_max}([1, 2, \ldots, n]) \)?
- \( \text{bad\_max}([n, n-1, \ldots, 1]) \)?
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 \texttt{t option} with \texttt{NONE} or \texttt{SOME e} where \texttt{e} has type \texttt{t}.
- Use a \texttt{t option} with \texttt{isSome} and \texttt{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.