Macros

To oversimplify, a macro is just a rule for rewriting programs as a prepass to evaluation: it’s very syntactic.

The “level” at which macros are defined affects their usefulness.

- “Sublexical” e.g.: Replace car with hd turns car into hd.
  - Macro-expander should recognize program tokens.

- “Pre-parsing” e.g., in C/C++:
  
  ```
  #define PI 3.14
  #define add(x, y) x - y
  r = add(5 + a, b) * c;
  ==> r = 5 * a + b * c
  circumference = 2 * PI * r;
  ==> 2 * 3 + .14 * r
  ```

- “Pre-binding” e.g.: Replace car with hd would turn \((\text{let* (\text{hd 0} [\text{car 1}] \text{hd})})\) into \((\text{let* (\text{hd 0} [\text{hd 1}]) \text{hd})}\).
  - Few macro systems let bindings shadow macros; Scheme does

Today

- What are macros and what do they mean?
  - Why do they have a bad reputation?

- Scheme’s macro system and hygiene
  - Free variables in macros
  - Bound variables in macros
  - Why hygiene is usually what you want

- What macros are good and not good for

The bad news

- Macros are very hard to use well.

- Most macro systems are so impoverished they make it harder.

- Actual uses of macros often used to ameliorate shortcomings in the underlying language.

But:

- Macros have some good uses

- Scheme has a very sensible, integrated macro system

- So today’s goal is to see them.
Hygiene

A “hygienic” macro system:
- Gives fresh names to local variables in macros at each use of the macro
- Binds free variables in macros where the macro is defined

Without hygiene, macro programmers:
- Get very creative with local-variable names
- Get creative with helper-function names too
- Try to avoid local variables, which conflicts with predictable effects

Hygiene is a big idea for macros, but sometimes is not what you want.

Note: Letting variables shadow macros is also useful, but a separate issue.

Why macros

Non-reasons:
- Anything where an ordinary binding would work just as well.
- Including manual control of inlining.

Reasons:
- Cosmetics
- “Compiling” a domain-specific language
  - But error messages a tough issue
- Changing evaluation-order rules
  - Function application will not do here
- Introducing binding constructs
  - A function here makes no sense