



Compilers

Typing Methods

$$O \vdash e_0 : T_0$$
$$O \vdash e_1 : T_1$$
$$\dots$$
$$O \vdash e_n : T_n$$

$$O \vdash e_0.f(e_1, \dots, e_n) : ?$$

[Dispatch]

- In Cool, method and object identifiers live in different name spaces
 - A method **foo** and an object **foo** can coexist in the same scope
- In the type rules, this is reflected by a separate mapping **M** for method signatures

$$M(C, f) = (T_1, \dots, T_n, T_{n+1})$$

means in class **C** there is a method **f**

$$f(x_1:T_1, \dots, x_n:T_n): T_{n+1}$$

$$O, M \vdash e_0 : T_0$$

$$O, M \vdash e_1 : T_1$$

$$\dots$$

$$O, M \vdash e_n : T_n$$

$$M(T_0, f) = (T_1', \dots, T_n', T_{n+1})$$

$$T_i \leq T_i' \text{ for } 1 \leq i \leq n$$

$$O, M \vdash e_0.f(e_1, \dots, e_n) : T_{n+1} \quad [\text{Dispatch}]$$

$$\begin{array}{c}
 O, M \vdash e_0 : T_0 \\
 O, M \vdash e_1 : T_1 \\
 \dots \\
 O, M \vdash e_n : T_n \\
 T_0 \leq T \\
 M(T, f) = (T_1', \dots, T_n', T_{n+1}) \\
 T_i \leq T_i' \text{ for } 1 \leq i \leq n \\
 \hline
 O, M \vdash e_0 @ T.f(e_1, \dots, e_n) : T_{n+1}
 \end{array}
 \quad [\text{Static Dispatch}]$$

Given the class definitions and method declaration at right, which of the following are valid types for the variables in the statement below?

`z <- x.setCenter(y)`

- ☐ x: Rect, y: Object, z: Bool
- ☐ x: Circle, y: Point, z: Bool
- ☐ x: Object, y: Object, z: Object
- ☐ x: Shape, y: Point, z: Bool

Typing Methods

Class Object

Class Bool inherits Object

Class Point inherits Object

Class Line inherits Object

Class Shape inherits Object {
 `setCenter(p: Point): Bool` {

...

};

...

};

Class Quad inherits Shape

Class Circle inherits Shape

Class Rect inherits Quad

Class Square inherits Rect

- The method environment must be added to all rules
- In most cases, M is passed down but not actually used
 - Only the dispatch rules use M

$$\frac{O \vdash e_1 : \text{Int} \quad O \vdash e_2 : \text{Int}}{O \vdash e_1 + e_2 : \text{Int}} \quad [\text{Add}]$$

- For some cases involving **SELF_TYPE**, we need to know the class in which an expression appears
- The full type environment for COOL:
 - A mapping **O** giving types to object id's
 - A mapping **M** giving types to methods
 - The current class **C**

The form of a *sentence* in the logic is

$$O, M, C \vdash e : T$$

Example:

$$\frac{O, M, C \vdash e_1 : \text{Int} \quad O, M, C \vdash e_2 : \text{Int}}{O, M, C \vdash e_1 + e_2 : \text{Int}} \text{ [Add]}$$

- The rules in this lecture are COOL-specific
 - Some other languages have very different rules
- General themes
 - Type rules are defined on the structure of expressions
 - Types of variables are modeled by an environment
- Warning: Type rules are very compact!