Information Flow Control with Errors

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Scripted Apps, Risks

- Javascript in
  - Facebook
  - IPhone, Android
  - Windows Metro
- Ruby, Python, ...

- Profile
- Contacts
- Usage data

Security Approach

- Confidentiality
- Usage Control / Information Flow Control
- Security lattice, e.g., $\{L, H\}$
- Runtime monitoring
- Static enforcement
  - Logic
  - Static Analysis
  - *Type Systems*

The Problem

- Javascript very dynamic
- Approaches
  - Linear Types (Kehrt & Aldrich, FOOL'08)
  - Recency Types (Heidegger & Thiemann, FOOL'09)
  - Singleton Types (Zhao, FOOL'10)
- Richards (PLDI'10): practive vs. theory

Our Approach

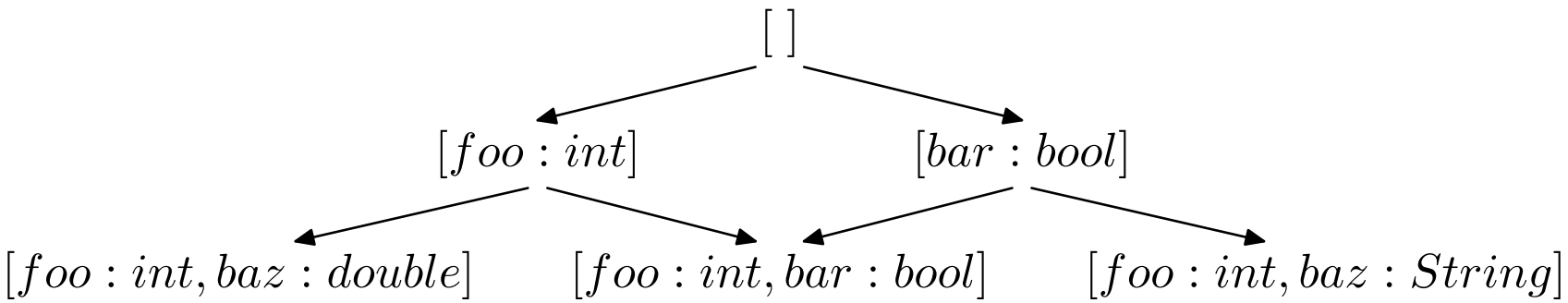
- Drop error-freeness as goal
- Pluggable type system
- Handle errors in security type system
- Ensure that errors do not leak information

OO Calculi

- Based on Abadi & Cardelli
- Includes extension (inspired by Liquori)
- Errors: method not found on invocation

- All syntactical elements labeled
- Reduction includes explicit rules for error states

Traditional Type System Setup



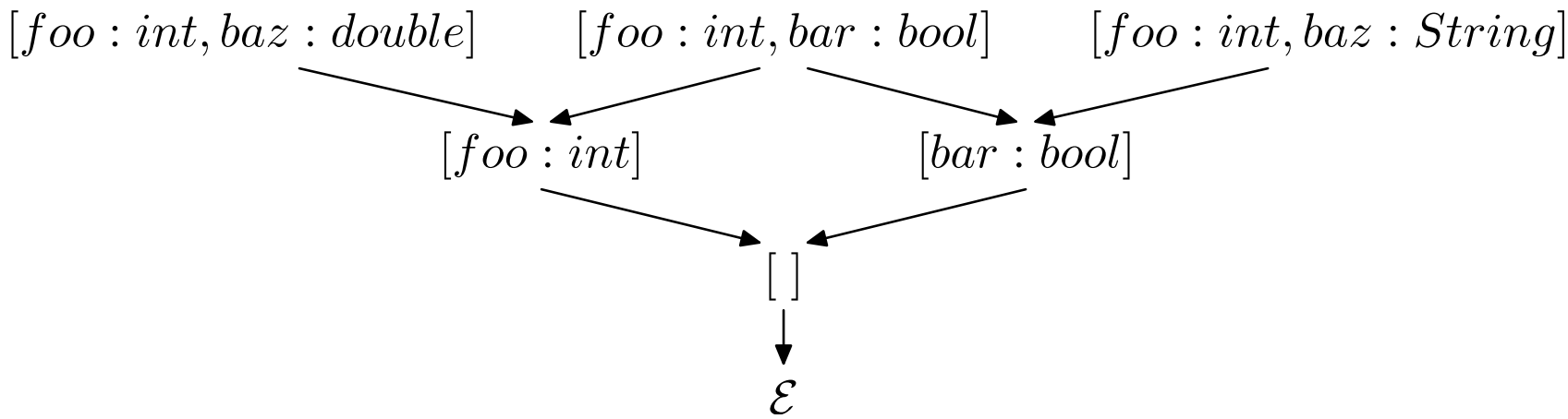
- Subtyping allows to use an object in a more general context

  If we expect a point, we can use a colored point.
  We only "forget" the color functionality.

- Underapproximate set of methods

Our Setup

- Overapproximate types, add error type

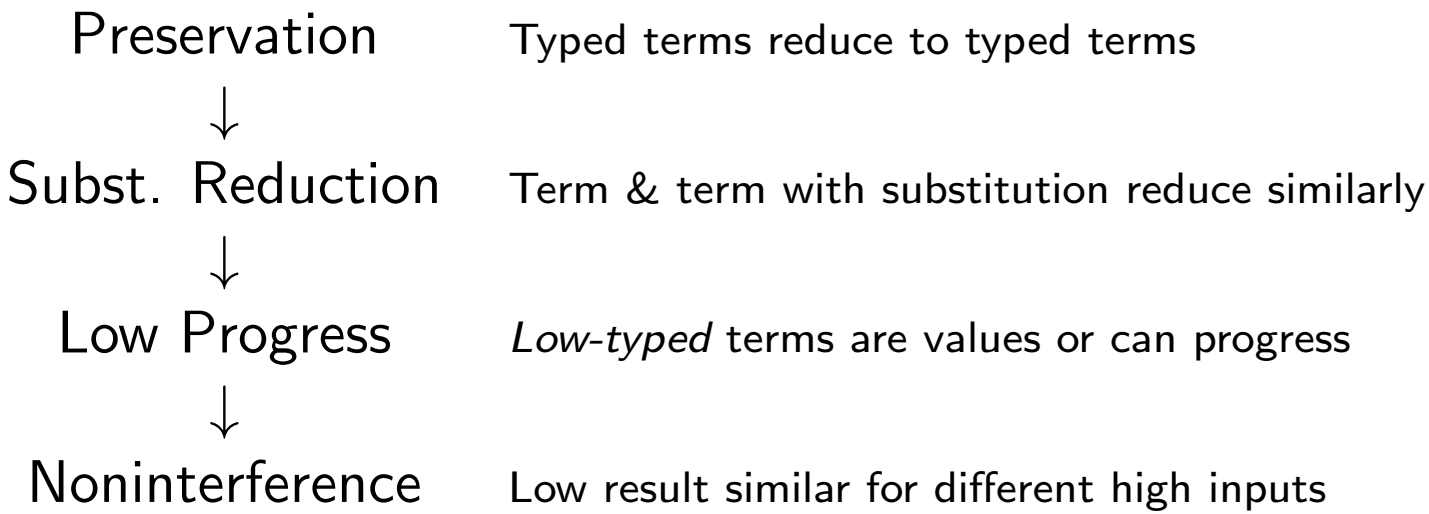


- Only enforces the *consistent* usage of all methods

Consequences

- Code can call unknown methods
- Allows incomplete objects to be typed
- Only one rule for override & extension
- Diamond types are not needed (cf. Liquori)

Security Proof



Indistinguishability by bisimulation

- Indistinguishability by behaviour
  - Two objects equivalent if all low calls have equivalent results
  - Coinductive definition
  - Establish with bisimulation
    - ★ Similar to noninterference proof itself

Type Inference

- Structural inference
- Adapted from Palsberg
  1. Term
  2. Constraint System
  3. Constraint Graph
  4. Type Automaton
     - Subtyping inversed $\rightarrow$ some constraints inversed
- Security typing: incrementally propagate from type environment

Future Work

- Imperative version
- Delegation / explicit prototypes
- Method deletion

Thanks!

Questions?