Compilers

Types

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- **What is a type?**
  - The notion varies from language to language

- **Consensus**
  - A set of values
  - A set of operations on those values

- **Classes are one instantiation of the modern notion of type**

Consider the assembly language fragment

add $r1, $r2, $r3

What are the types of $r1, $r2, $r3?

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- Certain operations are legal for values of each type

  – It doesn't make sense to add a function pointer and an integer in C

  – It does make sense to add two integers

  – But both have the same assembly language implementation!

- A language's type system specifies which operations are valid for which types

- The goal of type checking is to ensure that operations are used with the correct types

  - Enforces intended interpretation of values, because nothing else will!

- Three kinds of languages:

  - *Statically typed*: All or almost all checking of types is done as part of compilation (C, Java, Cool)

  - *Dynamically typed*: Almost all checking of types is done as part of program execution (Scheme)

  - *Untyped*: No type checking (machine code)

- Competing views on static vs. dynamic typing

- Static typing proponents say:
  - Static checking catches many programming errors at compile time
  - Avoids overhead of runtime type checks

- Dynamic typing proponents say:
  - Static type systems are restrictive
  - Rapid prototyping difficult within a static type system

- A lot of code is written in statically typed languages with an "escape" mechanism
  - Unsafe casts in C, Java

- People retrofit static typing to dynamically typed languages
  - For optimization, debugging

- It's debatable whether either compromise represents the best or worst of both worlds

- The types in Cool are:
  - Class Names
  - SELF_TYPE

- The user declares types for identifiers

- The compiler infers types for expressions
  - Infers a type for *every* expression

- *Type Checking* is the process of verifying fully typed programs

- *Type Inference* is the process of filling in missing type information

- The two are different, but the terms are often used interchangeably