

CSCC24 – Principles of Programming Languages

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polymorphism

- from Greek: *polus* (“many”, “much”) and *morphe* (“shape”, “form”)
- a programming language feature that allows values of different data types to be handled using a uniform interface
- flavours of polymorphism:
 - **ad-hoc** polymorphism
 - **parametric** polymorphism
 - **subtype** or **inclusion** polymorphism

ad-hoc polymorphism

- function/method overloading
- polymorphic functions can be applied to arguments of different types
- a polymorphic function denotes a number of distinct implementations depending on the type of argument(s)
- operator overloading
- user-defined operator overloading?
- examples in Python, Java, Haskell

ad-hoc polymorphism

- uniform way to invoke the overloaded function
- from point of view of compiler, these are different functions
- compiler chooses which function is executed based on the signature (and assigns a unique name for internal purposes)
- Question: when does the compiler/interpreter decide which function should be executed?

parametric polymorphism

- polymorphic function or polymorphic data type
- allows a function or datatype to be written generically
- handles values of different types in the same way
- maintains full static type-safety
- in object-oriented languages, parametric polymorphism is often called **generics**

parametric polymorphism

- example in Haskell:
 - polymorphic datatype
 - polymorphic function
- example in Java:
 - polymorphic datatype \iff generic class
 - polymorphic function \iff generic method
- in Python?

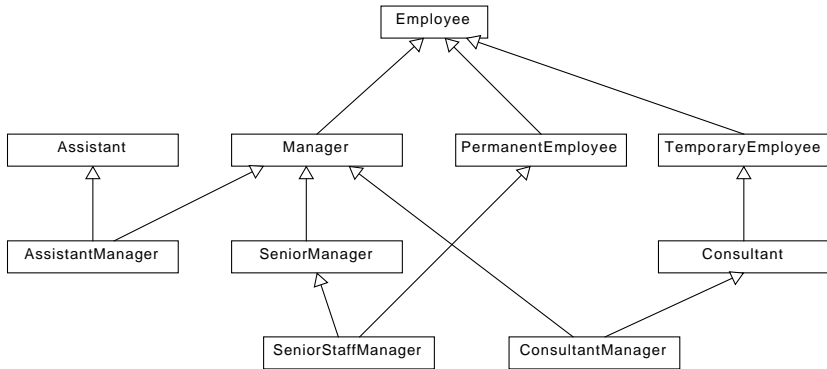
subtype polymorphism

- also called **inclusion** polymorphism
- allows a function to be written to take an object of a certain type T , but also work correctly if passed an object that belongs to a type S that is a subtype of T
- usually written as $S <: T$
- in object oriented languages subtype polymorphism is offered using **subclassing** or **inheritance**
- method overriding
- example in Python, Java
- Question: when does the compiler decide which method to execute?

multiple inheritance

- some programming languages (e.g., Python, C++) support multiple inheritance
- a subclass is allowed to have more than one superclass
- example in Python

multiple inheritance – example



multiple inheritance

- In some languages causes the “diamond problem” .
- MRO = Method Resolution Order
- Python uses depth-first left-to-right search to find the method to execute
 - in a diamond pattern the top class is visited last
- Java does not support multiple inheritance
- Question: how can we accomplish the same thing in Java?