

Midterm

Midterm – Wednesday 3/8

Chapters 1 thru 9

Closed book/closed notes

Polymorphism

A closer look at types....

Chap 8

polymorphism \equiv comes from Greek meaning 'many forms'

In programming:

Def: A function or operator is polymorphic if it has at least two possible types.

Polymorphism

i) Overloading

Def: An overloaded function name or operator is one that has at least two definitions, all of different types.

Example: In Java the '+' operator is overloaded.

```
String s = "abc" + "def";
```

↙
+: String * String → String

```
int i = 3 + 5;
```

↙
+: int * int → int

Polymorphism

Example: Java allows user defined polymorphism with overloaded function names.

```
bool f (char a, char b) {  
    return a == b;  
}
```

f : char * char → bool

```
bool f (int a, int b) {  
    return a == b;  
}
```

f : int * int → bool

Note: ML does not allow function overloading

Polymorphism

ii) Parameter Coercion

Def: An implicit type conversion is called a coercion.

Coercions usually exploit the type-subtype relationship because a widening type conversion from subtype to supertype is always deemed safe → a compiler can insert these automatically → type coercions.

Example: type coercion in Java

```
double x;  
x = 2;  
    ↙  
    the value 2 is coerced from int to double by the compiler
```

Polymorphism

Parameter coercion is an implicit type conversion on parameters. Parameter coercion makes writing programs easier – one function can be applied to many subtypes.

Example: Java

```
void f (double a) { ... }
```

```
int ⊂ double  
float ⊂ double  
short ⊂ double  
byte ⊂ double  
char ⊂ double } all legal types that can be passed to function 'f'.
```

Note: ML does not perform type coercion (ML has no notion of subtype).

Polymorphism

iii) Parametric Polymorphism

Def: A function exhibits parametric polymorphism if it has a type that contains one or more type variables.

Example: ML

```
- fun f(x,y) = (x = y);  
val f = fn : 'a * 'a -> bool
```

└──────────┘
polytype
(poly = many)

Example: C++

C++ has templates that support parametric polymorphism.

Example: Java

Java does not support polytypes.

Polymorphism

iv) Subtype Polymorphism

Def: A function or operator exhibits subtype polymorphism if one or more of its constructed types have subtypes.

Note: one way to think about this is that this is type coercion on constructed types.

