

Types

A Type is a Set of Values

Consider the statement:

Read Chapter 6

```
int n;
```

Here we declare `n` to be a variable of type `int`; what we mean, `n` can take on any value from the set of all integer values.

Also observe that the elements in a type share a common representation: each element is encoded in the same way (float, double, char, etc.)

Also, all elements of a type share the same operations the language supports for them.

Types

Def: A type is a set of values.

Def: A primitive type is a type programmer can use but not define.

Def: A constructed type is a user defined type.

Example: Java, primitive type

```
float q;
```

type float \Rightarrow set of all possible floating point values

} `q` is of type float, only a value that is a member of the set of all floating point values can be assigned to `q`.

Types

Example: ML, primitive type

```
- val p = ...;
```

}
}

untyped variable → can assume a value of any type.

```
- val p:real = ...;
```

}
}

Now p only accepts a value
that is the member of the type
real.

Types

Example: Java, constructed type

```
class Foobar { int i; String s; };
```

```
Foobar c = new Foobar();
```

}
}

Now the variable c only accepts values that are members of type Foobar;
☞ object instantiations of class Foobar.

Types

Example: ML, constructed type

```
- type foobar = int * string;  
- val c:foobar = (1, "two");
```

}
an element of
type foobar.

Types

Example: C, constructed type

```
int a[3];
```

}

the variable a will accept values which are arrays of 3 integers.

e.g.: int a[3] = {1,2,3};
int a[3] = {7,24,9}

Example: ML, constructed type

```
- val L : int list = ...;
```

}

L will accept values which are integer lists – more formally, L will accept values that are members of of type 'int list'.

Subtypes

Def: a subtype is a subset of the elements of a type.

Example: Java

Short is a subtype of int: $\text{short} \subset \text{int}$

Observations:

- (1) converting a value of a subtype to a values of the super-type is called widening type conversion.
- (2) converting a value of a supertype to a value of a subtype is called narrowing type converion.

Example: Java

$\text{float} \subset \text{double}$