

# Generic Types

CS 272 Software Development

# Generic Types

- Enables **types** to be specified **as a parameter** when defining classes or methods
- Allows **generalization** of code, while still being able to provide some restrictions on type
- Reduces amount of **casting** that must happen in code

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# Collection Examples

```
1. // ArrayList can be used with different types
2. ArrayList<String> lines = new ArrayList<>();
3. ArrayList<Double> values = new ArrayList<>();
4.
5. // Sometimes, we must specify multiple types
6. HashMap<String, String> map = new HashMap<>();
7. HashMap<String, ArrayList<Integer>> nestedMap
8.     = new HashMap<>();
```

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# Generic Types

- Use a single uppercase letter to name a generic type
- Use **E** for an element (good default)
- Use **K** for a key element
- Use **V** for a value element
- Use **N** for a number element

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# Method Example

```
1. public <E> E chooseRandom(E item1, E item2) {  
2.     if (Math.random() > 0.5) {  
3.         return item1;  
4.     }  
5.     else {  
6.         return item2;  
7.     }  
8. }
```

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# Class Example

```
1. public class Pair<K, V> {
2.     private K key;
3.     private V value;
4.
5.     public Pair(K key, V value) {
6.         this.key = key;
7.         this.value = value;
8.     }
9. }
```

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# Comparable Example

```
1. public <B extends Comparable<B>>
2.     chooseMax(B item1, B item2) {
3.     if (item1.compareTo(item2) > 0) {
4.         return item1;
5.     }
6.     else {
7.         return item2;
8.     }
9. }
```

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# Wildcard Example

```
1. public double sumNumbers(  
2.     Collection<? extends Number> nums) {  
3.     double sum = 0.0;  
4.     for (Number n : nums) {  
5.         sum += n.doubleValue();  
6.     }  
7.     return sum;  
8. }
```

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>





# What You Can Do

- Can declare one or more generic types when defining a method or a class
- Can restrict the generic type using **bounding** and inheritance relationships
- Can restrict the generic type using **wildcards** and upcasting references

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# What You Can't Do

- Cannot use primitive types as a generic type
- Cannot create an instance of a generic type
  - e.g. `E elem = new E(); // error`
- Cannot use generic types for static members
  - e.g. `private static E elem; // error`
- Other strange restrictions; see tutorial

<https://docs.oracle.com/javase/tutorial/java/generics/index.html>



# Questions?

