Announcements/Follow-ups

- P6 posted, due next Wednesday
- Quiz tomorrow on Collections and generics
- Follow-ups:
  - Enums
  - Bidirectional maps
  - getClass debug
- Finish collections:
  - Concurrent modification
  - Iterators
  - Collections Example: temporary storage

Generic types

Analogy with methods:

- *method*(*argument*)
  - Methods can be supplied with arguments that affect their behavior. The argument itself is something with a value:
    - A literal
    - A primitive variable
    - An object
    - An expression
- *generic_type<type_argument>*
  - Generic types are supplied with arguments that affect their behavior. The argument itself is a data-type:
    - A class
    - An enum
    - An interface
    - (not a primitive)

Generic Usage

- Collections: “One-size-fits-all”

```
ArrayList<String> strs = new ArrayList<String>();
ArrayList<Integer> ints = new ArrayList<Integer>();
```

Vs

```
Object[] objs = new Object[0];
```

  - ArrayList class is only defined once
  - No repetitive code for StringList, IntegerList, etc.
  - Type safety:
    - No casting to and from object
    - Compiler-time warnings for bad type-casting

Generic Usage

- The comparable interface:
- http://docs.oracle.com/javase/7/docs/api/java/lang/Comparable.html
- Implemented by
  - String
  - Integer
  - Date
  - File (?)
  - Many more
- Comparable example

Lexicographical ordering

- The mathematical generalization of alphabetical ordering:
  - Compare “Strings” from left to right
  - At the first mismatch, the “lower” letter determines the “lower” “String”
  - For example:
    - “aaab” < “aaac”< “abaa”
    - [0,0,0,1] < [0,0,0,2] < [0,1,0,0]

Generic methods

```
static void method(Object first, Object second)
{
      //Do stuff
      Object temp = first;
      //Do more stuff
}
```

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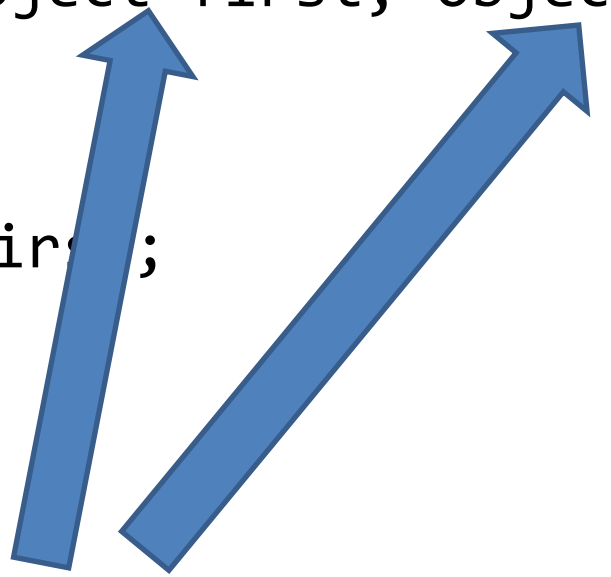

"Arguments" or "Parameters"?

Generic methods

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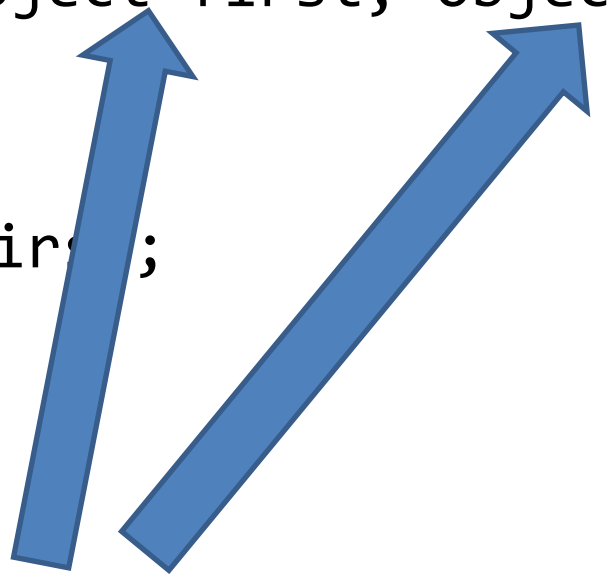

Parameters.

Arguments: when it's called

Parameters: when it's defined

Generic methods

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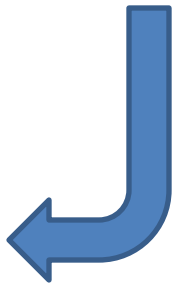
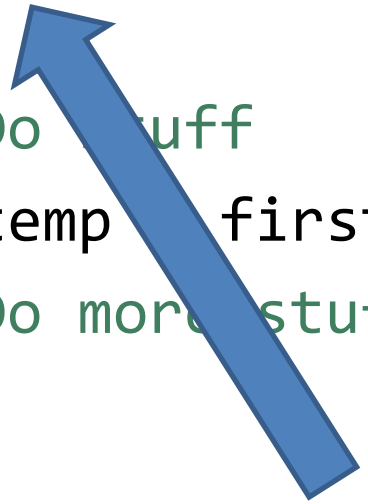
```



Value is copied to every occurrence in the method body

Generic methods

```
static <T> void method(T first, T second)
{
        //Do stuff
        T temp = first;
        //Do more stuff
}
```



"Type Parameter"
Single upper-case letter is customary (NON-descriptive…)

Generic methods

```
static <T> void method(T first, T second)
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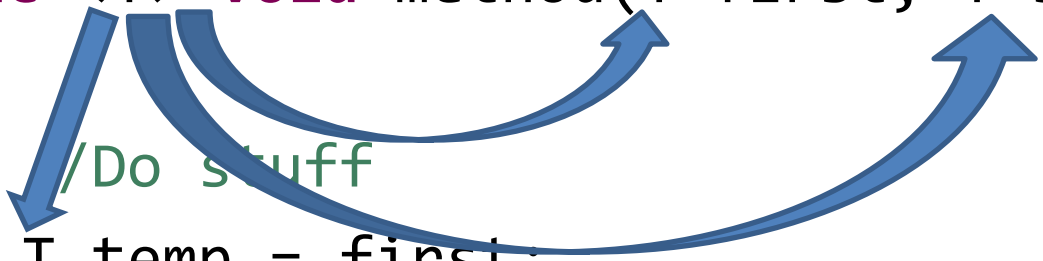
}
```



"Value" is copied to every occurrence in the method body

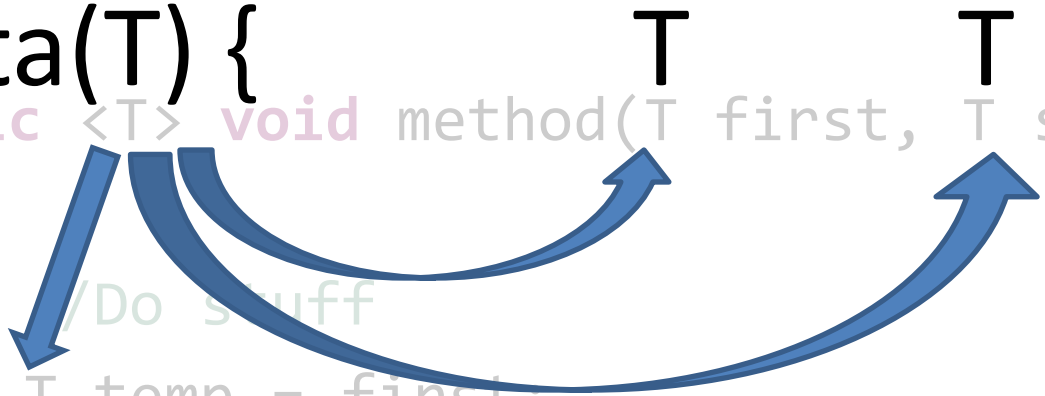
- Not really a "Value", but a data-type.
- "Meta"

Generic methods

Meta(T) {

```
static <T> void method(T first, T second)
{
    //Do stuff
    T temp = first;
    //Do more stuff
}
```

}



- Generic Swap Example

Generic Interfaces

- Comparable: Intended for any class whose objects can be ordered.
- Interface signature:
  - `public interface Comparable<T>`
- Single method signature:
  - `int compareTo(T o) //access modifier?`
- MyInteger vs. MyComparableInteger

Type Erasure

- Really “Type Parameter Erasure”
- Occurs during compilation
- Resulting byte-code consists of ordinary (non-generic) classes, interfaces, and methods.
  - Type-parameters are replaced by Object, or more specific types when possible
  - All necessary type-casts are inserted
  - Effectively, it translates generic swap to non-generic swap automatically
  - Essentially no run-time cost
- BidirectionalMapExample revisited

Collection algorithms

- There is a class called “Collections” with many static methods for manipulating collections
  - Search, sort, shuffle, reverse, rotate, fill, etc.
  - All generic
    - Contrast with Arrays class: all overloaded
- Collections example