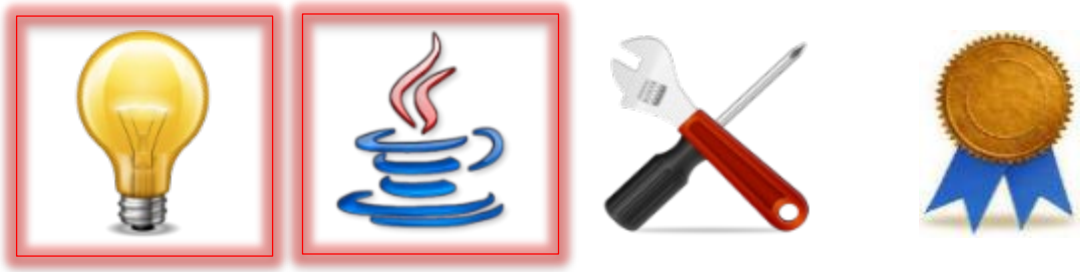
Static Methods vs. Instance Methods



Common Features

- Static and instance methods:
  - May have formal parameters, of any types
  - May return any type, or nothing (**`void`**)
  - May be **`public`** or **`private`**
  - May compute the same things
- Arguments are passed to all calls using the same parameter-passing mechanism

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This is the mechanism described earlier, termed call-by-copying or call-by-value.

Static Methods

- Are declared with the keyword **`static`**
  - Suppose `power` is a ***static method*** declared in the class `NNStaticOps`
  - Its declaration might look like this:

```
public static void power(
    NaturalNumber n, int p)
{...}
```

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Whether it is **`public`** or **`private`** is unrelated to whether it is a static or an instance method.

Static Methods

- Are called *without* a receiver
  - A call to `power` from within the class `NNExtraOps` might look like this:

```
power(m, k);
```

  - A call to `power` from outside the class `NNExtraOps` might look like this; i.e., before a dot, the method name is ***qualified*** with the name of the ***class*** where it is declared:

```
NNExtraOps.power(m, k);
```

Instance Methods

- Are declared *without* the keyword **`static`**
  - Suppose `power` is an ***instance method*** declared in the class `NNExtraOps`
  - Its declaration might look like this:

```
public void power(int p)
{...}
```

Instance Methods

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  - Suppose `power` is an ***instance method*** declared in the class `NNExtraOps`
  - Its declaration might look like this:

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Whether it is **`public`** or **`private`** is unrelated to whether it is a static or an instance method.

Instance Methods

- Are declared *without* the keyword **`static`**
  - Suppose `power` is an ***instance method*** declared in the class `NNExtraOps`
  - Its declaration might look like this:

```
public void power(int p)
{...}
```

Why is there only one formal parameter now? The other formal parameter is **`this`**, which is implicit because it is an instance method.

Instance Methods

- Are called *with* a receiver
  - Suppose `m` is a variable of dynamic/object type `NNExtraOps` (or, it turns out, any type that extends `NNExtraOps`)
  - Then a call might look like this; i.e., before a dot is the name of the ***receiver*** of the call:

```
m.power(k);
```

Check Your Understanding

- It is easy to tell from the method's ***declaration*** whether it is a static or instance method; how?
- If you see the following ***call***, how can you tell whether it is a call to a static method or an instance method?

```
foo.bar(x, y, z);
```

Why Have Two Kinds of Methods?

- There is one main reason to have instance methods: ***polymorphism***
- An instance method that has exactly the same functional behavior as a static method simply ***distinguishes*** one formal parameter by placing it "out front"
  - It is the implicit formal parameter called **`this`**
  - It means there must be a ***receiver*** of a call to that method

# of Methods?

This is why an instance method seems to have one less formal parameter than a static method with exactly the same functional behavior.

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Recall that polymorphism is the mechanism that selects the method body to be executed based on the dynamic/object type of the receiver.

Implications for Contracts

- Unfortunately, although in Java (as of Java 8) you can declare a static method in an interface, you are also *required* to provide an implementation (a method body)!
- This limitation, along with the flexibility added by polymorphism, is a good reason to (generally) prefer instance methods to static methods in Java, all other things being equal

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This is a problem because interfaces are meant to be used for contracts only (client view) and including implementation code breaks the clean separation between client view and implementer view.

Implications for Method Bodies

- The variables in scope in a static method's body are its formal parameters
- The variables in scope in an instance method's body are its explicit formal parameters, plus the implicit formal parameter `this`
- The bodies do not otherwise differ