

# The Future of Java

Bob Lee

Google Inc.



# Who is Bob Lee?

- > Google engineer
- > Android core library lead
- > Guice creator
- > JSR-330 lead
- > Google's alternate EC rep
- > St. Louisan
- > Speedo model



# Let's talk about...

- > Project Coin
- > JSR-330: Dependency Injection for Java
- > MapMaker



# Project Coin

Small language **changes**



# Currently accepted proposals

- > Strings in switch
- > Automatic Resource Management (ARM)
- > Improved generic type inference for constructors
- > Simplified varargs method invocation
- > Collection literals and access syntax
- > Better integral literals
- > JSR-292 (Invokedynamic) support

# Currently accepted proposals

- > Strings in switch
- > **Automatic Resource Management (ARM)**
- > Improved generic type inference for constructors
- > **Simplified varargs method invocation**
- > Collection literals and access syntax
- > Better integral literals
- > JSR-292 (Invokedynamic) support

# ARM

- > Automatic Resource Management
- > Helps dispose of resources
- > Proposed by Josh Bloch



# Example: Parsing a file header

```
public class HeaderParser {  
    /** Parses header from the first line of file. */  
    public static Header parse(File file) throws IOException,  
        ParseException {  
        BufferedReader in = new BufferedReader(new FileReader(file));  
        Header header = parse(in.readLine());  
        in.close();  
        return header;  
    }  
  
    private static Header parse(String first) throws ParseException {  
        ...  
    }  
}
```



# Example: Parsing a file header

```
public class HeaderParser {  
    /** Parses header from the first line of file. */  
    public static Header parse(File file) throws IOException,  
        ParseException {  
        BufferedReader in = new BufferedReader(new FileReader(file));  
        Header header = parse(in.readLine());  
        in.close();  
        return header;  
    }  
  
    private static Header parse(String first) throws ParseException {  
        ...  
    }  
}
```

**See the problem?**

# If we don't reach `close()`, we leak.

```
public class HeaderParser {
    /** Parses header from the first line of file. */
    public static Header parse(File file) throws IOException,
        ParseException {
        BufferedReader in = new BufferedReader(new FileReader(file));
        Header header = parse(in.readLine());
        in.close();
        return header;
    }

    private static Header parse(String first) throws ParseException {
        ...
    }
}
```

# finally ensures close( ) is always called.

```
public class HeaderParser {
    /** Parses header from the first line of file. */
    public static Header parse(File file) throws IOException,
        ParseException {
        BufferedReader in = new BufferedReader(new FileReader(file));
        try {
            return parse(in.readLine());
        } finally {
            in.close();
        }
    }

    private static Header parse(String first) throws ParseException {
        ...
    }
}
```

# But what happens when `close()` throws?

```
public class HeaderParser {
    /** Parses header from the first line of file. */
    public static Header parse(File file) throws IOException,
        ParseException {
        BufferedReader in = new BufferedReader(new FileReader(file));
        try {
            return parse(in.readLine());
        } finally {
            in.close();
        }
    }

    private static Header parse(String first) throws ParseException {
        ...
    }
}
```



*We could* ignore the exception from `close()`.

```
public class HeaderParser {
    /** Parses header from the first line of file. */
    public static Header parse(File file) throws IOException,
        ParseException {
        BufferedReader in = new BufferedReader(new FileReader(file));
        try {
            return parse(in.readLine());
        } finally {
            try { in.close(); } catch (IOException e) { /* ignore */ }
        }
    }

    private static Header parse(String first) throws ParseException {
        ...
    }
}
```

# But it's better to throw the right exception.

```
public class HeaderParser {
    /** Parses header from the first line of file. */
    public static Header parse(File file) throws IOException,
        ParseException {
        BufferedReader in = new BufferedReader(new FileReader(file));
        boolean successful = false;
        try {
            Header header = parse(in.readLine());
            successful = true;
            return header;
        } finally {
            try { in.close(); } catch (IOException e) {
                if (successful) throw e;
                else e.printStackTrace(); // let original exception propagate
            }
        }
    }

    private static Header parse(String first) throws ParseException {
        ...
    }
}
```

# Equivalent code, using an ARM block.

```
public class HeaderParser {  
    /** Parses header from the first line of file. */  
    public static Header parse(File file) throws IOException,  
        ParseException {  
        try (BufferedReader in = new BufferedReader(  
            new FileReader(file))) {  
            return parse(in.readLine());  
        }  
    }  
  
    private static Header parse(String first) throws ParseException {  
        ...  
    }  
}
```

# Equivalent code, using an ARM block.

```
public class HeaderParser {  
    /** Parses header from the first line of file. */  
    public static Header parse(File file) throws IOException,  
        ParseException {  
        try (BufferedReader in = new BufferedReader(  
            new FileReader(file))) {  
            return parse(in.readLine());  
        }  
    }  
  
    private static Header parse(String first) throws ParseException {  
        ...  
    }  
}
```

**Note:** Technincally, we could still leak.



# Equivalent code, using an ARM block.

```
public class HeaderParser {
    /** Parses header from the first line of file. */
    public static Header parse(File file) throws IOException,
        ParseException {
        try (Reader fin = new FileReader(file);
            BufferedReader in = new BufferedReader(fin)) {
            return parse(in.readLine());
        }
    }

    private static Header parse(String first) throws ParseException {
        ...
    }
}
```

# Why ARM is important

# Why ARM is important

- > The JDK opens & closes resources in 110 places.

# Why ARM is important

- > The JDK opens & closes resources in 110 places.
- > 74 of those can leak. *2/3rds!*



# Why ARM is important

- > The JDK opens & closes resources in 110 places.
- > 74 of those can leak. *2/3rds!*
- > None suppress exceptions correctly.

# Why ARM is important

- > The JDK opens & closes resources in 110 places.
- > 74 of those can leak. *2/3rds!*
- > None suppress exceptions correctly.
- > ARM reduces error-prone boilerplate.

# Why ARM is important

- > The JDK opens & closes resources in 110 places.
- > 74 of those can leak. *2/3rds!*
- > None suppress exceptions correctly.
- > ARM reduces error-prone boilerplate.
- > Ideally, *all finally* blocks would work this way.

# Simplified varargs method invocation

- > Moves warnings from caller to callee
- > Vastly reduces # of warnings
  - One warning for every caller vs.
  - One warning on **Arrays.asList()** itself
- > Helps catch errors sooner
- > Proposed by Bob Lee



# Today, the compiler warns the caller.

```
/** Collects instances of T. */
abstract class Sink<T> {
    /** Adds instances to this sink. */
    abstract void add(T... a);

    /** Adds t unless it's null. */
    void addUnlessNull(T t) {
        if (t != null)
            // Warning: "uses unchecked or unsafe operations"
            add(t);
    }
}
```

# What's really going on here...

```
/** Collects instances of T. */
abstract class Sink<T> {
    /** Adds instances to this sink. */
    abstract void add(T... a);

    /** Adds t unless it's null. */
    void addUnlessNull(T t) {
        if (t != null)
            // Warning: "unchecked cast"
            add((T[]) new Object[] { t });
    }
}
```

# After the language change...

```
/** Collects instances of T. */
abstract class Sink<T> {
    /** Adds instances to this sink. */
    abstract void add(T... a);

    /** Adds t unless it's null. */
    void addUnlessNull(T t) {
        if (t != null)
            add(t);
    }
}
```

# Before the language change

```
class BrokenSink<T> extends Sink<T> {  
    Object[] array;  
  
    @Override void add(T... a) {  
        array = a;  
    }  
  
    void violateTypeSystem() {  
        array[0] = 5;  
    }  
}
```

# After the language change

```
class BrokenSink<T> extends Sink<T> {  
    Object[] array;  
  
    // Warning: "enables unsafe generic array creation"  
    @Override void add(T... a) {  
        array = a;  
    }  
  
    void violateTypeSystem() {  
        array[0] = 5;  
    }  
}
```



# What does this program print?

```
class StringSink extends Sink<String> {  
    final List<String> list = new ArrayList<String>();  
    @Override void add(String... a) {  
        list.addAll(Arrays.asList(a));  
    }  
    @Override public String toString() {  
        return list.toString();  
    }  
    public static void main(String[] args) {  
        Sink<String> ss = new StringSink();  
        ss.addUnlessNull("cyanide");  
        System.out.println(ss);  
    }  
}
```

- a) StringSink@32c41a
- b) ["cyanide"]
- c) Nothing. It throws an exception.

# If you answered C, you're correct!

```
class StringSink extends Sink<String> {  
    final List<String> list = new ArrayList<String>();  
    @Override void add(String... a) {  
        list.addAll(Arrays.asList(a));  
    }  
    @Override public String toString() {  
        return list.toString();  
    }  
    public static void main(String[] args) {  
        Sink<String> ss = new StringSink();  
        ss.addUnlessNull("cyanide"); // ClassCastException!  
        System.out.println(ss);  
    }  
}
```

a) StringSink@32c41a

b) ["cyanide"]

**c) Nothing. It throws ClassCastException.**

# Let's look at Sink again...

```
/** Collects instances of T. */
abstract class Sink<T> {
    /** Adds instances to this sink. */
    abstract void add(T... a);

    /** Adds t unless it's null. */
    void addUnlessNull(T t) {
        if (t != null)
            // Warning: "unchecked cast"
            add((T[]) new Object[] { t });
    }
}
```

# After the language change

```
class StringSink extends Sink<String> {
    final List<String> list = new ArrayList<String>();
    // Warning: "override generates a more specific varargs
    //           type erasure"
    @Override void add(String... a) {
        list.addAll(Arrays.asList(a));
    }
    @Override public String toString() {
        return list.toString();
    }
    public static void main(String[] args) {
        Sink<String> ss = new StringSink();
        ss.addUnlessNull("cyanide");
        System.out.println(ss);
    }
}
```

# Not so fast. One more loophole...

```
abstract class PlainSink<T> extends Sink<T> {  
    @Override abstract void add(T[] a);  
}
```

# After the language change

```
abstract class PlainSink<T> extends Sink<T> {  
    // Warning: "Overrides non-reifiable varargs type with array"  
    @Override abstract void add(T[] a);  
}
```

# All that work just to get...

```
public class Arrays {  
    // Warning: "enables unsafe generic array creation"  
    public static <T> List<T> asList(T... a) {  
        ...  
    }  
    ...  
}
```



# So we can suppress it once and for all!

```
public class Arrays {  
    @SuppressWarnings("generic-varargs")  
    // Ensures only values of type T can be stored in elements.  
    public static <T> List<T> asList(T... a) {  
        ...  
    }  
    ...  
}
```

# The moral of this story...

- > Arrays and generics don't mix.
- > Varargs should have used **List**.



## **JSR-330: Dependency Injection for Java**