

**Java generics...and beyond...**

# Objectives

- Introduce generics
- Look at what generics lead to
- Java politics

# What goes around comes around

- composition → inheritance → composition
- functional programming (lisp)
  - object-oriented programming (java)
  - + functional programming (java8)

# Generics

- Java without generics - before Java5
- Storing stuff in a collection - can hold any referenced type

```
List list = new LinkedList();  
list.add("abc");    // fine  
list.add(new Date()); // fine
```

# Java without generics

- What could possibly go wrong?
- Well...reading stuff back from a collection

```
String s = list.get(0); // compiler error
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s = (String) list.get(0); // needs cast
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# Java without generics

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- Well...reading stuff back from a collection

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String s = list.get(0); // compiler error
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s = (String) list.get(0); // needs cast
```

```
Date d = (Date) list.get(1);
```

```
d = (String) list.get(0); // oops again!
```

# Java without generics

- What could possibly go wrong?
- Well...reading stuff back from a collection

```
String s = list.get(0); // compiler error
```

```
s = (String) list.get(0); // needs cast
```

```
Date d = (Date) list.get(1);
```

```
d = (String) list.get(0); // oops!
```

- Collection can store any type
- Need to remember what types of objects were stored
- No way to specify the types that a collection should store



# Java without generics

- What could possibly go wrong? (cont'd)
- Compiler can be fooled by a cast

```
List list = new LinkedList();
```

```
list.add("abc");
```

```
list.add(new Date());
```

```
String s = (String) list.get(0);
```

```
s = (String) list.get(1); // compiles ok
```

```
    // but raises exception at runtime...
```

# Java without generics

- What could possibly go wrong? (cont'd)
- Compiler can be fooled by a cast

```
List list = new LinkedList();  
list.add("abc");  
list.add(new Date());  
String s = (String) list.get(0);  
s = (String) list.get(1); // compiles ok  
                        // but raises exception at runtime...
```

- ...and that's way worse

# Generics

- Java with generics – Java5 and up
- Storing and reading stuff in a collection is straightforward

```
// list of Strings
```

```
List<String> list = new LinkedList<>();
```

```
list.add("abc"); // fine
```

```
String s = list.get(0); // ok
```

# Java with generics

- What's been gained?
- Type safety
  - "In Java, a program is considered type-safe if it compiles without errors and warnings and does not raise any unexpected `ClassCastException`s at runtime."
  - Angelika Langer
- Compiler detects collection type errors

# Java with generics

- What else has been gained?
- See the **generics FAQ**...all ~~427~~ ~~513~~ ~~297~~ 352 pages!!!
  - Generic types and generic methods...
  - Type parameters, wildcard instantiation...
  - Genericity & inheritance...
  - ...

# What people are saying

"I don't know how to ease into this gently. So I'll just spit it out. Generics are a mistake. This is not a problem based on technical disagreements. It's a fundamental language design problem."

Ken Arnold

- Ken Arnold is the author of *The Java Programming Language*, and he can't understand generics...

# What people are saying

"I am completely and totally humbled. Laid low. I realize now that I am simply not smart at all. I made the mistake of thinking that I could understand generics. I simply cannot. I just can't. This is really depressing. It is the first time that I've ever not been able to understand something related to computers, in any domain, anywhere, period."

# What people are saying

"I'm the lead architect here, have a PhD in physics, and have been working daily in Java for 10 years and know it pretty well. The other guy is a very senior enterprise developer (wrote an email system that sends 600 million emails/year with almost no maintenance). If we can't get [generics], it's highly unlikely that the 'average' developer will ever in our lifetimes be able to figure this stuff out."



# Java - what happened?

- Initially a pretty simple "blue-collar" language
  - Followed 80 / 20 rule - had 80% of desired features for 20% of the complexity
  - "When in doubt, leave it out."
- Then "feature-envy" set in prompted by...
  - ..."C# has some feature A and Java doesn't"
  - ..."Ruby, Python, etc. have some feature B and Java doesn't"
  - ..."wouldn't it be cool to add feature C, just because it's cool!"

# Java – what happened?

- Eg, inner classes, enumerations, annotations, generics, builtin databases, closures...
- The latest psychodrama concerned **closures** (lambda functions)

Finally made it into Java 8

- See
  - **Java closures** site
  - Bruce Eckel - *Java: Evolutionary Dead End*

# Java - what choices

- Freeze the language (à la C)
- And risk developers abandoning for "sexier" languages
- Java is steadily **losing popularity**

# Java - what choices

- Add features while maintaining backward compatibility
- And risk the complexity of C++ (backward compatible with C)

# Java - what choices

- Add features that may break compatibility with existing codebase
- Python 3 has taken this courageous but sometimes painful approach
- Implementation can be greatly simplified

# Java - what choices

- Abandon source-code compatibility while maintaining binary compatibility
- Eg, Scala, Groovy, Clojure, Jython...

# Java - what choices

"My argument is that trying to add fundamental new features AND preserve backward compatibility produces bad new features. My previous attitude was to break backwards compatibility in order to add the feature correctly. I now think that the feature shouldn't be added if it requires compromise in order to maintain compatibility."

Bruce Eckel

# Java - what choices

"Java is functional; trying to add every feature will break it. If you really need those features, perhaps using another JVM language that is designed from scratch to support those features (Scala, for example) is a better choice than trying to (badly) force it into Java."

Bruce Eckel



# New and improved Java7/8

- Small language enhancements
  - Strings in `switch`
  - Support for dynamically-typed languages
  - More new I/O APIs
- Major enhancement
  - Lambda expressions (enable closures)
- Etc...

# Java futures

- Today – “How many of you know COBOL?”

# Java futures

- In 10 years - “How many of you know Java?”
- Takeaway lessons
  - Learn the principles, details are subject to change
  - Don't put all your eggs in one basket

And now for something completely  
different...

# Java is free, right?

- What exactly is the difference between:
  - open source
  - free...as in gratuit (or, free as in beer)
  - free...as in libre

# Java is free, right?

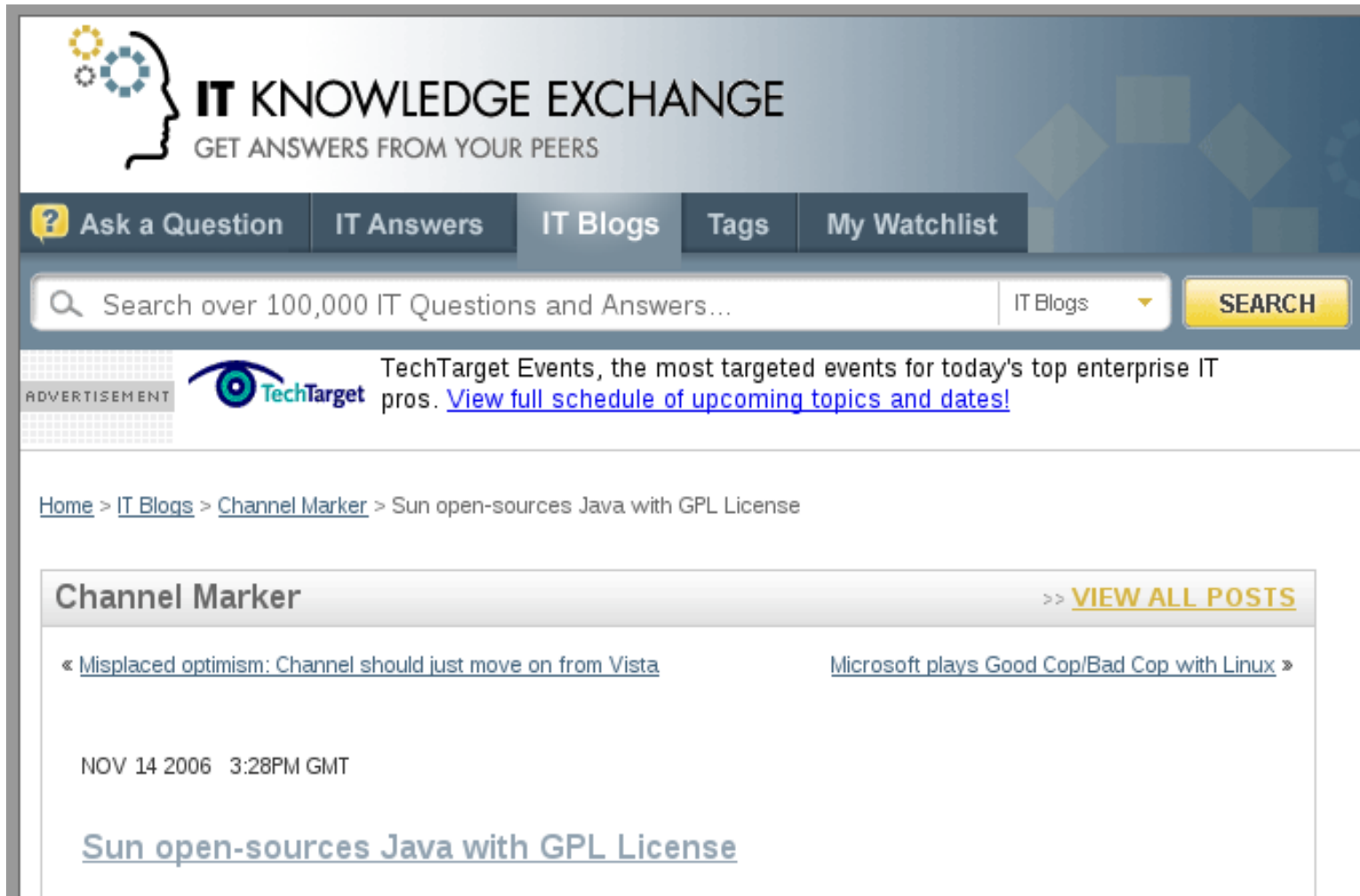
- Richard Stallman had warned for years about the **Java trap**:

“If you develop a Java program on Sun's Java platform, you are liable to use Sun-only features without even noticing. By the time you find this out, you may have been using them for months, and redoing the work could take more months. You might say, “It's too much work to start over.” ...”



# Java is what, exactly?

- Under GPL licence – free as in libre?



The screenshot shows the IT Knowledge Exchange website. The header includes the logo and the text "IT KNOWLEDGE EXCHANGE" and "GET ANSWERS FROM YOUR PEERS". Below the header is a navigation bar with links: "Ask a Question", "IT Answers", "IT Blogs", "Tags", and "My Watchlist". A search bar is present with the text "Search over 100,000 IT Questions and Answers..." and a "SEARCH" button. Below the search bar is an advertisement for TechTarget Events. The main content area shows a breadcrumb trail: "Home > IT Blogs > Channel Marker > Sun open-sources Java with GPL License". Below this is a section titled "Channel Marker" with a link to "VIEW ALL POSTS". The section contains two links: "« Misplaced optimism: Channel should just move on from Vista" and "Microsoft plays Good Cop/Bad Cop with Linux »". Below these links is the date and time "NOV 14 2006 3:28PM GMT". At the bottom of the section is the link "Sun open-sources Java with GPL License". A blue arrow points to this link from the left side of the image.

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# Java is what, exactly?

- Oh oh...

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MERGERS & ACQUISITIONS

**Oracle to Buy Sun for \$7.4 Billion**

April 20, 2009, 7:50 AM



**Update | 8:38 a.m.** *The New York Times's Ashlee Vance has more on the Oracle-Sun deal [here](#).*

**Oracle** on Monday agreed to buy **Sun Microsystems** for \$7.4 billion, weeks after **I.B.M.** walked away from deal talks to buy Sun for \$7 billion.



# Java is what, exactly?

- Oops...



The screenshot shows the front page of The New York Times Business Day. At the top, there are navigation links: HOME PAGE, TODAY'S PAPER, VIDEO, MOST POPULAR, and TIMES TOPICS. Below these is the masthead with "The New York Times" and "Business Day". A secondary navigation bar includes links for WORLD, U.S., N.Y. / REGION, BUSINESS, TECHNOLOGY, SCIENCE, HEALTH, SPORTS, and OPINION. A search bar is located below the navigation. A large advertisement for "ooprint" is visible, featuring a stack of business cards and the text "100 cartes de visite GRATUITES". Below the ad, a blue arrow points to the article "Oracle Sues Google In a Patent Dispute". The article is by THE ASSOCIATED PRESS, published on August 13, 2010. The text of the article states that Oracle filed a lawsuit against Google, claiming that Google's Android system infringes on its patented Java technology. On the right side of the article, there are links for "SIGN IN TO E-MAIL" and "PRINT".

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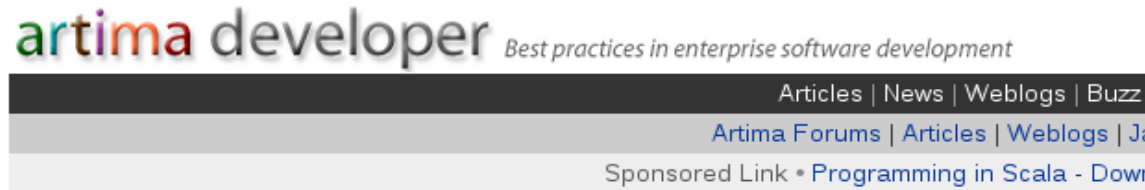
**Oracle Sues Google In a Patent Dispute**

By THE ASSOCIATED PRESS  
Published: August 13, 2010

REDWOOD SHORES, Calif. (AP) -- Oracle said on Thursday that it had filed a patent and copyright-infringement lawsuit against Google, saying that Google's Android system for mobile phones infringes its patented Java technology.

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# Java is what, exactly?



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Flat View: This topic has 38 replies on 3 pages [ 1 2 3 | » ]

[Bruce Eckel](#)

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“Now, if you are choosing a programming language, aren't you more likely to consider something truly unencumbered like Ruby or Python — where something like this just wouldn't happen — than you are Java? Joel West points out a problem that Sun always had — that of semi-openness — which now comes back to bite those that trusted it.”

# Verdict



## Pow! Oracle told by judge to cover for Google's legal expenses

by **Bams Sadewo** on Jun 05, 2012 with 5 Comments

20

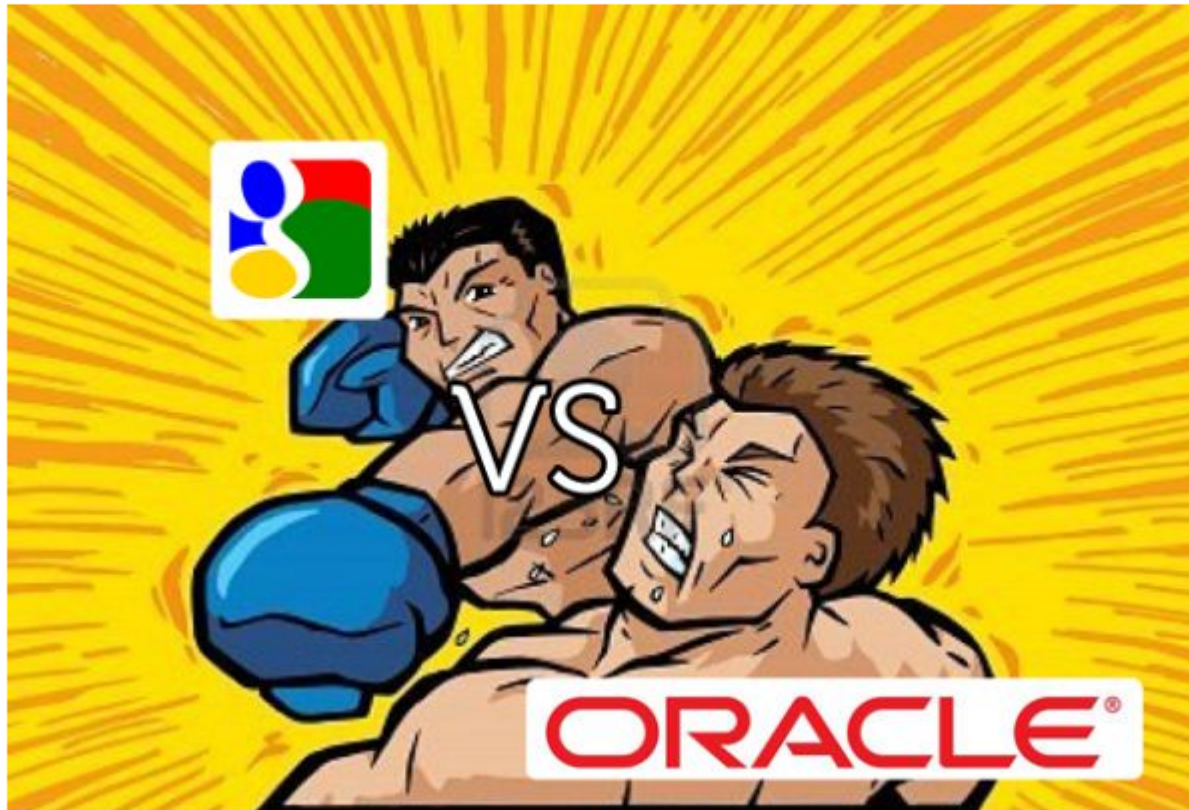
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The smackdown against Oracle in the courtroom continues. It was only last week that victory

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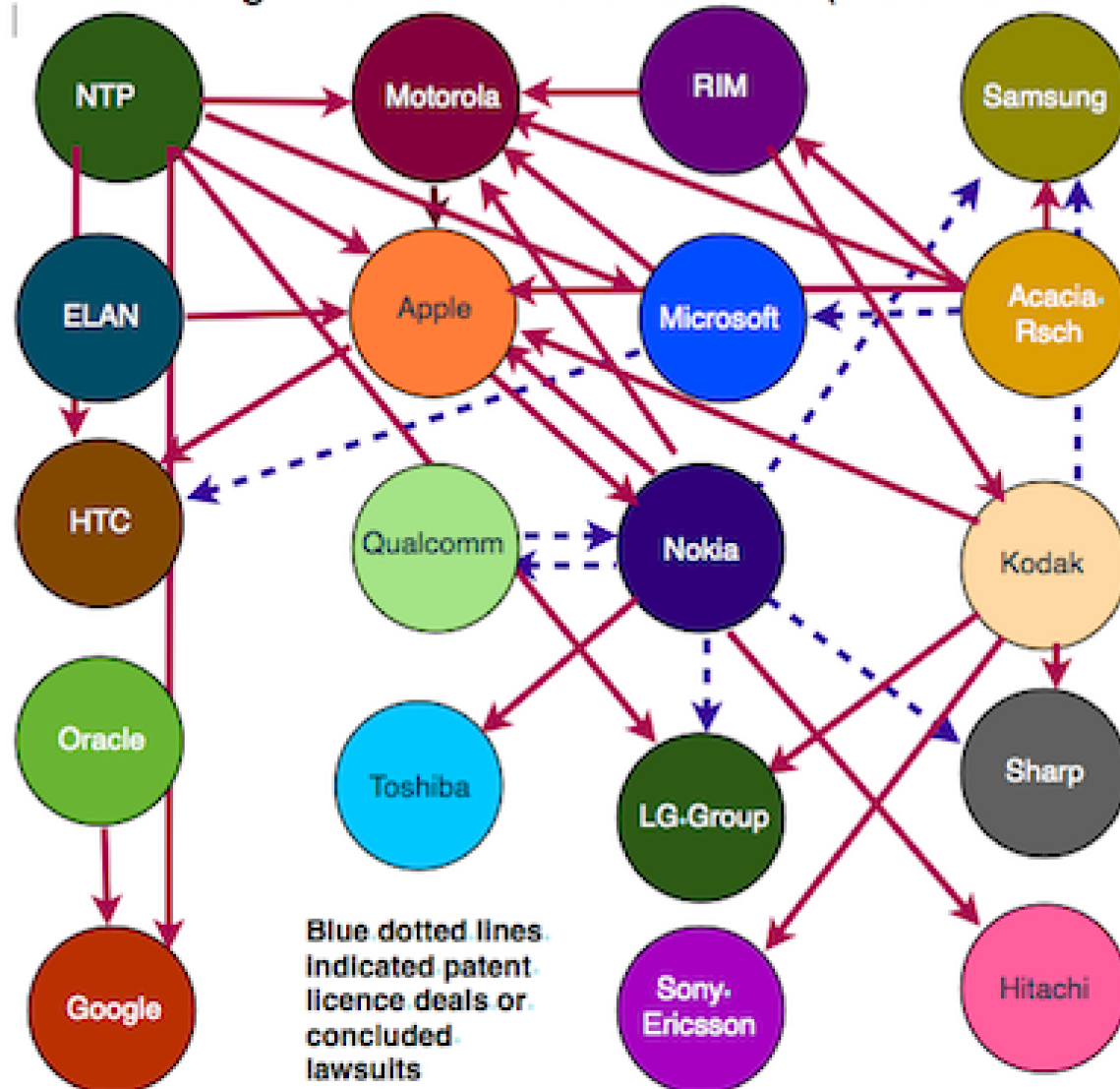
**New Galaxy S3 Jelly Bean firmware leaks – release date for Android 4.1.1 update available [Download]**



**Android Authority Episode 28 – Motorola RAZR HD and Kindle Fire**

# Oracle vs. Google vs...

Who's suing who in the mobile business (8 Oct 2010 11.20)



# Zombies never go away...



## Java APIs Copyrightable, Court Rules in Oracle vs. Google

By Chris Preimesberger | Posted 2014-05-09 [Email](#) [Print](#)



Two years ago its case seemed dead in the water, but Oracle now can pursue its high-profile copyright suit against Google over Android's use of Java.

A major intellectual property lawsuit involving IT giants Oracle and Google is in the process of determining the legal definitions of "creative" and "utilitarian" in software development.

A three-judge U.S. Court of Appeals in Washington, D.C., on May 9 overturned a 2012 circuit court decision, ruling that Oracle is entitled to copyright protection over

application programming interfaces in the Java programming language that are vital components in the open-source Android operating system.

As a result, Oracle now can pursue its high-profile copyright suit against Google over Android's use of Java.



# ...but they can be wounded!



**The Register**  
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**\$10bn Oracle v Google copyright jury verdict:  
Google wins, Java APIs in Android are Fair Use**

Big Red tells us it immediately plans to appeal

26 May 2016 at 20:19, Shaun Nichols and Chris Williams

108 91