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**Carnegie Mellon Develops Java Programming Tools
Employing Human-Centered Design Techniques**

PITTSBURGH—Researchers at Carnegie Mellon University's School of Computer Science have developed two new tools to help computer programmers select from among thousands of options within the application programming interfaces (APIs) that are used to write applications in Java, today's most popular programming language.

The tools — Jadeite (www.cs.cmu.edu/~jadeite) and Apatite (www.cs.cmu.edu/~apatite) — take advantage of human-centered design techniques to significantly reduce the time and guesswork associated with finding the right classes and methods of APIs.

APIs are standardized methods that a Java program uses to ask the computer's operating system or another program to do something, such as opening a file or sending an email. Choosing APIs for accomplishing a given task is at the heart of Java programming, but is not intuitive, said Brad A. Myers, professor of human-computer interaction. With more than 35,000 methods listed in 4,100 classes in the current Javadoc library of APIs — and more being added in every new version — not even the savviest developer can hope to be familiar with them all.

"This is a fundamental problem for all programmers, whether they are novices, professionals or the growing number of end-users who just need to modify a Web page," Myers said. "It's possible to design APIs so that they are easier to use, but that still leaves thousands of existing APIs that are hard to use but essential for Java programming. Jadeite and Apatite help programmers find what they need among those existing APIs."

Jadeite (Java Documentation with Extra Information Tacked-on for Emphasis) improves usability by enhancing the existing Javadoc documentation. For instance, Jadeite displays the names of API classes in font sizes that correspond with how heavily they are used based on Google searches, helping programmers navigate past little-used classes. The commonly used "PrintWriter" is in large, prominent letters, while the lesser used "PrintEvent" is in smaller type.

Jadeite also uses crowd-sourcing to compensate for the fact that an API sometimes doesn't include methods that programmers expect. For instance, the Message and MimeMessage classes don't include a

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method for sending an email message. So Jadeite allows users to put so-called placeholders for these expected classes and methods within the alphabetical listing of APIs. Users can edit the placeholder to guide programmers to the actual location of the desired method, explain why a desired method is not part of the API, or note that a desired functionality is impossible.

Finding the way to create certain types of objects, such as SSL sockets that enable secure Internet communications, may not be obvious to programmers the first time they encounter these objects. In these cases, Jadeite includes examples of the most popular code used by programmers to create these objects, allowing the user to learn from the examples.

User studies showed that programmers could perform common tasks about three times faster with Jadeite than with the standard Javadoc documentation.

Apatite (Associative Perusal of APIs That Identifies Targets Easily) takes a different approach, allowing programmers to browse APIs by association, seeing which packages, classes and methods tend to go with each other. It also uses statistics about the popularity of each item to provide weighted views of the most relevant items, listing them in larger fonts.

Both Jadeite and Apatite remain research tools, Myers said, but are available for public use. Broader use of the tools will enhance the crowd-sourcing aspects of the tools, while giving the researchers important feedback about how the tools can be improved.

Research by Jeffrey Stylos, who was awarded a Ph.D. in computer science this spring, underlies both Jadeite and Apatite. Besides Myers, research programmer Andrew Faulring and undergraduate computer science student Zizhuang Yang contributed to the development of Jadeite and computer science undergraduate Daniel S. Eisenberg led the implementation of Apatite. Eisenberg's work on Apatite earned first place in the Yahoo! Undergraduate Research Awards competition at Carnegie Mellon this spring.

Jadeite and Apatite are part of the Natural Programming Project, www.cs.cmu.edu/~NatProg/, an initiative within Carnegie Mellon's Human-Computer Interaction Institute that is investigating how to make programming easier. Both tools have been funded by grants from the National Science Foundation and software giant SAP AG Inc.

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