JSR-335 Update for JCP EC Meeting, January 2012

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Why closures for Java?

• Help Java programmers easily harness the power of today’s multicore processors

• In Java SE 7, the serial code and the parallel code for a given computation look completely dissimilar – a barrier to parallelism

• The idiom of *internal iteration* is key to reducing this barrier

• Closures enable the development of rich, parallel-friendly libraries by supporting internal iteration

• This is not controversial – all other mainstream languages have already embraced closures (C#, VB, JavaScript, Ruby, Obj-C…)}
Example: A simple query

“In a music library, get the set of ‘favorite’ albums where at least one track is highly rated”

class Album {
    String title;
    List<Track> tracks;
}

class Track {
    String title;
    String artist;
    int rating;
}

class Library {
    Set<Album> albums;

    Set<Album> favoriteAlbums() {
        // TODO
    }
}
Identifying a favorite album

// Set hasFavorite to true if some track in album a is rated >= 4

boolean hasFavorite = false;
for (Track t : a.tracks) {
    if (t.rating >= 4) {
        hasFavorite = true;
        break;
    }
}

Identifying a favorite album

// Set hasFavorite to true if some track in album a is rated >= 4

boolean hasFavorite = false;
for (Track t : a.tracks) {
    if (t.rating >= 4) {
        hasFavorite = true;
        break;
    }
}

External iteration

- Client controls iteration
- *Inherently serial*: iterate from beginning to end
- Lots of boilerplate
- Not thread-safe because business logic is stateful
Identifying a favorite album with lambdas

// Set hasFavorite to true if some track in album a is rated >= 4

boolean hasFavorite = false;
for (Track t : a.tracks) {
    if (t.rating >= 4) {
        hasFavorite = true;
        break;
    }
}

boolean hasFavorite = a.tracks.anyMatch(t -> t.rating >= 4);
Identifying a favorite album with lambdas

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boolean hasFavorite = false;
for (Track t : a.tracks) {
    if (t.rating >= 4) {
        hasFavorite = true;
        break;
    }
}

boolean hasFavorite = a.tracks.anyMatch(t -> t.rating >= 4);

Internal iteration
- Iteration / filtering / accumulation controlled by the library
- Not inherently serial
- Thread-safe because business logic is stateless in the client
Making a set of favorite albums

// Initialize favs as a set of favorite albums drawn from albums

Set<Album> favs = new HashSet<>();
for (Album a : albums) {
    if (a.tracks.anyMatch(t -> (t.rating >= 4)))
        favs.add(a);
}
Making a set of favorite albums

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for (Album a : albums) {
    if (a.tracks.anyMatch(t -> (t.rating >= 4)))
        favs.add(a);
}

Set<Album> favs =
    albums.filter(a -> a.tracks.anyMatch(t -> t.rating >= 4))
    .into(new HashSet<>());
Loops v. Lambdas

Set<Album> favs = new HashSet<>();
for (Album a : albums) {
    boolean hasFavorite = false;
    for (Track t : a.tracks) {
        if (t.rating >= 4) {
            hasFavorite = true;
            break;
        }
    }
    if (hasFavorite) favs.add(a);
}

Set<Album> favs =
    albums.filter(a -> a.tracks.anyMatch(t -> t.rating >= 4))
    .into(new HashSet<>());
Loops v. Lambdas

Explicit but unobstrusive parallelism

Set<Album> favs = new HashSet<>();
for (Album a : albums) {
    boolean hasFavorite = false;
    for (Track t : a.tracks) {
        if (t.rating >= 4) {
            hasFavorite = true;
            break;
        }
    }
    if (hasFavorite) favs.add(a);
}

Set<Album> favs =
    albums.parallel()
    .filter(a -> a.tracks.anyMatch(t -> (t.rating >= 4)))
    .into(new ConcurrentHashMap<>());
The real challenge: Library evolution

• If Java had closures in 1996, APIs would look very different

• Adding closures now, but not evolving core APIs to support them, would be foolish
  • The older APIs get, the more obvious the gaps
  • It is difficult to add entirely new core libraries because the old interfaces (e.g. List) permeate non-core libraries

• Historically, evolving interface-based APIs has been a problem

• Virtual extension methods provide a mechanism for controlled evolution of libraries over time
  • Puts burden of evolution on API designers/implementers, not users
JSR-335 features

• Language features
  • Lambda expressions (closures) with “SAM conversion”
  • Method references
  • Virtual extension methods

• Upgraded libraries to use new language features
  • Bulk data operations on Collections
    e.g. filter, map, reduce…
  • “Point lambdafication” of java.util / java.io / java.net
    e.g. “run this closure for every line of a file”

• Synergy with JSR-292 VM enhancements
JSR-335 status

• EDR #1 completed December 2011
  • Specification covers lambda expressions, SAM conversion, method references
  • Prototype of RI compiler available in OpenJDK Project Lambda

• EDR #2 targeted for April 2012
  • Adds type inference and virtual extension methods

• EDR #3 targeted for Summer 2012
  • Adds bulk data operations
  • Initial design is starting now in JSR 166 EG
  • API specification is ultimately expected to go through SE 8 Umbrella JSR