# Lessons Learned Implementing StreamBase

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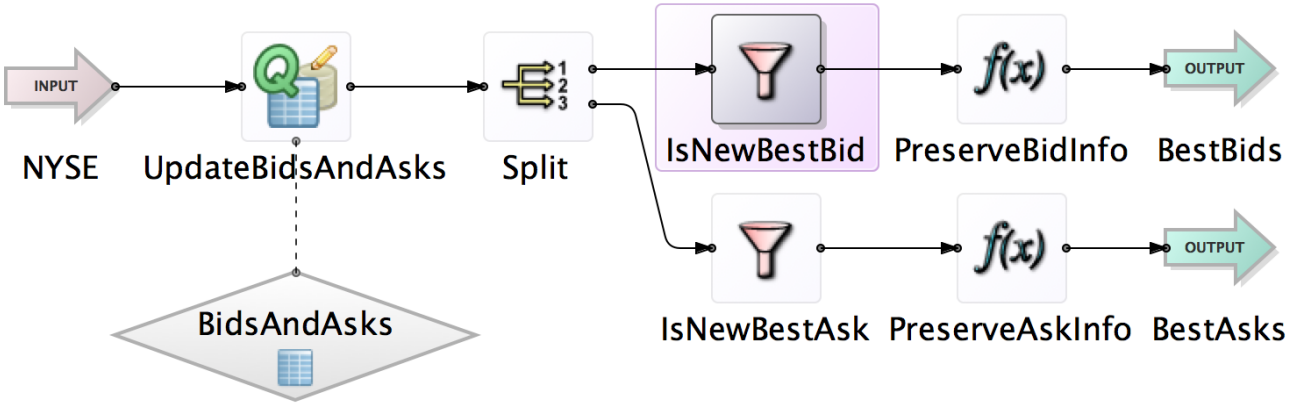
StreamBase Systems

JVM Languages 2012

# Agenda

- What is StreamBase?
- Lessons Learned
  - Spaghetti code is bad; Spaghetti code generation is worse
  - Choose between Generated Code vs Runtime Library
  - Parallel APIs for generating code and for runtime code
  - Type Specialization makes code fast
  - Separate Compilation requires planning
  - Classloaders hurt the unwary
- Case Studies
  - Inherited control flow enables Disruptors
  - Pluggable table implementations and Client API Access
  - JDBC
- Conclusions and Future Work

# StreamBase EventFlow




Editor | Definitions | Parameters | Dynamic Variables | **Annotations** | Metadata

StreamBase Properties (IsNewBestBid – Filter operator) | Typecheck Errors | Problems | StreamBase Extension Points | Console

Specify at least one predicate by adding and completing rows in the table below.

General | Predicate Settings | Concurrency

Create output port for non-matching tuples

**Predicates:**

| Output Port | Predicate |
|---|---|
| 1 | best_bid == bid_price |

Streams | Functions | Expression QuickRef

Input | Output

- input1 (6 fields)
  - time_int int
  - symbol string
  - bid_price double
  - ask_price double
  - best_bid double
  - best_ask double

# Problem Domain for Event Processing

- Interoperate with many external systems
  - Java, C++ Libraries
  - External Systems (Reuters, 29West)
- Large Heaps (40-120 GB)
- Low Latency (20-2000 microseconds)
- Predictable performance and efficiency
- Easily Shardable
- Rapid Development
- 6+ years of experience:
  - extendability
  - debugability
  - optimizability
  - refactorability
  - understandability

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## Generated Code vs Runtime Library

"passive voice" "active voice"

- Eliminate virtual dispatch
- Allows type specialization
- Monomorphic call sites
- Extra level of indirection
- Data can get big
- Code can get big too

- Easier to debug
- Easier to read
- Easier to test
- Faster to code
- Faster start-up
- Polymorphic call sites
- Less indirection

# General Approach

- Abstract classes provide code flow within operators
- Generate type specializations
  - Heroic downcast
  - Cache according to type signature
- Generate mathematical expressions
- Generate application level control flow

```
abstract void fillPrimaryKeyFromDataClass(DiskPackage dp, DC dc);
abstract void fillDataClassFromValue(DC dc, DiskPackage sdp);
abstract DC createDataClass();

public DC getPrimaryImpl(DC pkey) {
  TableTransaction txn = null;  Cursor cursor = null;
  try {
    txn = beginTransaction(); cursor = openCursor(txn);

    DiskPackage pack = new DiskPackage();
    fillPrimaryKeyFromDataClass(pack, pkey);
    cursor.getSearchKey(pack);

    if (pack.hasValue()) {
      DC dc = createDataClass();
      fillDataClassFromValue(dc, pack);
      return dc;
    } else {
      return null;
    }
  } catch (DatabaseException de) {
    throw createEvalException(de);
  } finally {
    finishTransaction(txn, cursor);
  }
}
```

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# Active voice

```
/**
 * A collection of bit flipping operations, with useful names.
 */
public final class BitOps {
    //...
    public static int roundToWord(int i) {
        return (i + 3) & ~3;
    }
    //...
}
```

# Passive voice

```
/**
 * Generated equivalents for the operations in BitOps
 */
public final class BitOpsGen {
    //...
    public static CG.Expr roundToWord(CG.Expr i) {
        return new CG.Op.BitAnd(CG.Op.ADD(i, CG.literal(3)),
                                CG.literal(~3));
    }
    //...
}
```

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# Type Specialization

- Monomorphic call sites
- Unrolled loops
- Avoids garbage
- Lengthens compile time
- Can lead to massive methods

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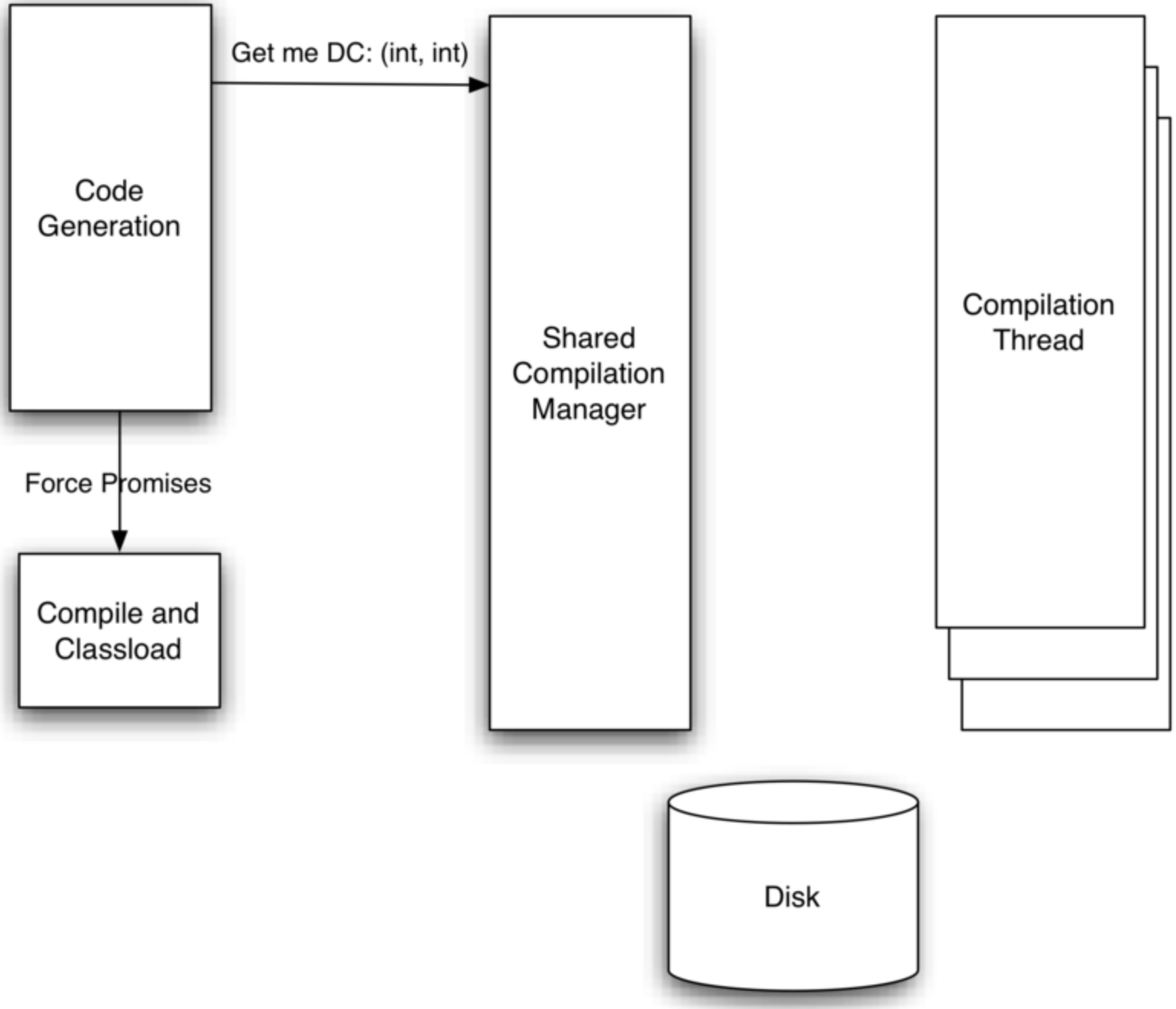
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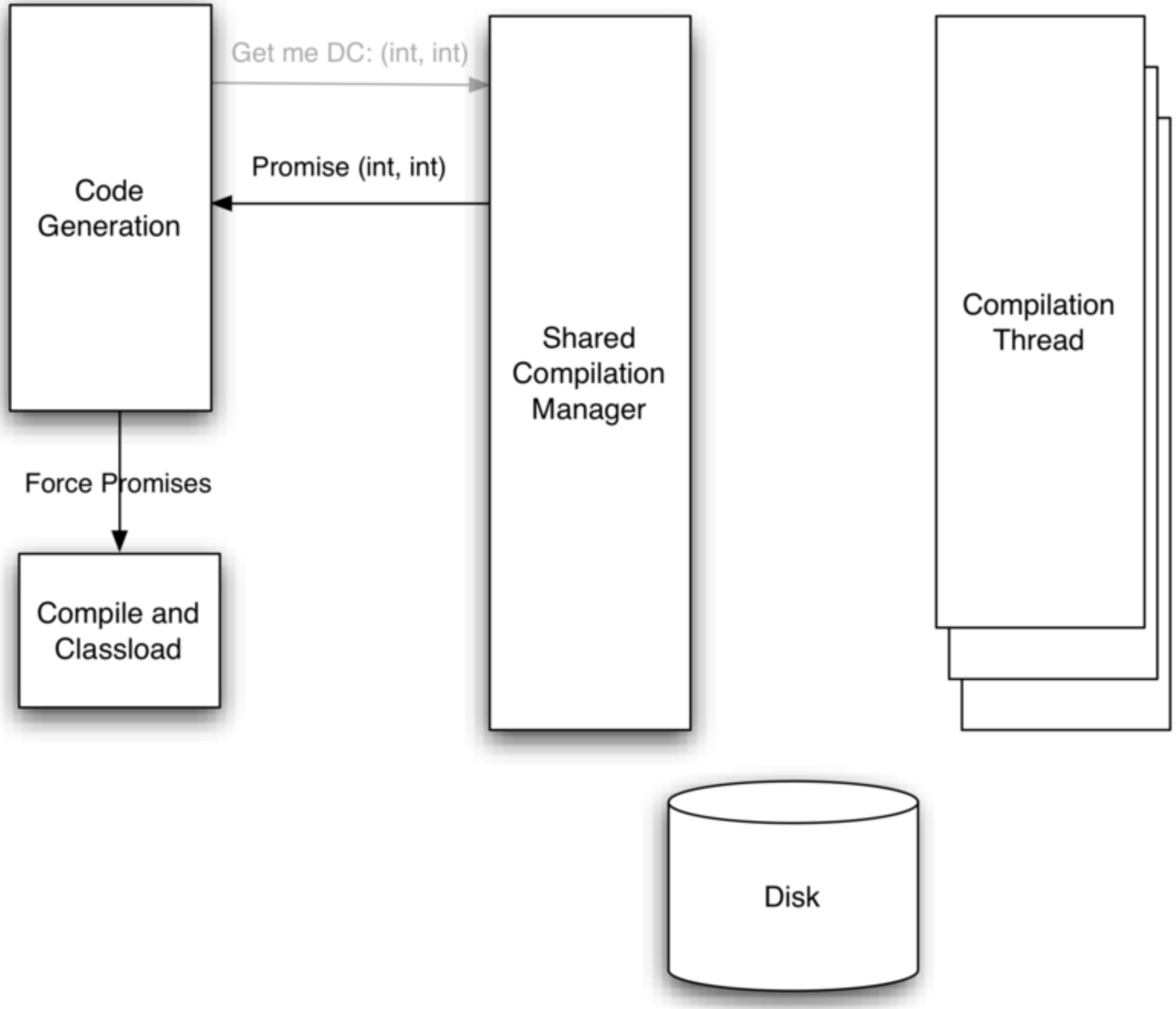
Get me DC: (int, int)
Shared Compilation Manager
Compilation Thread
Force Promises
Compile and Classload
Disk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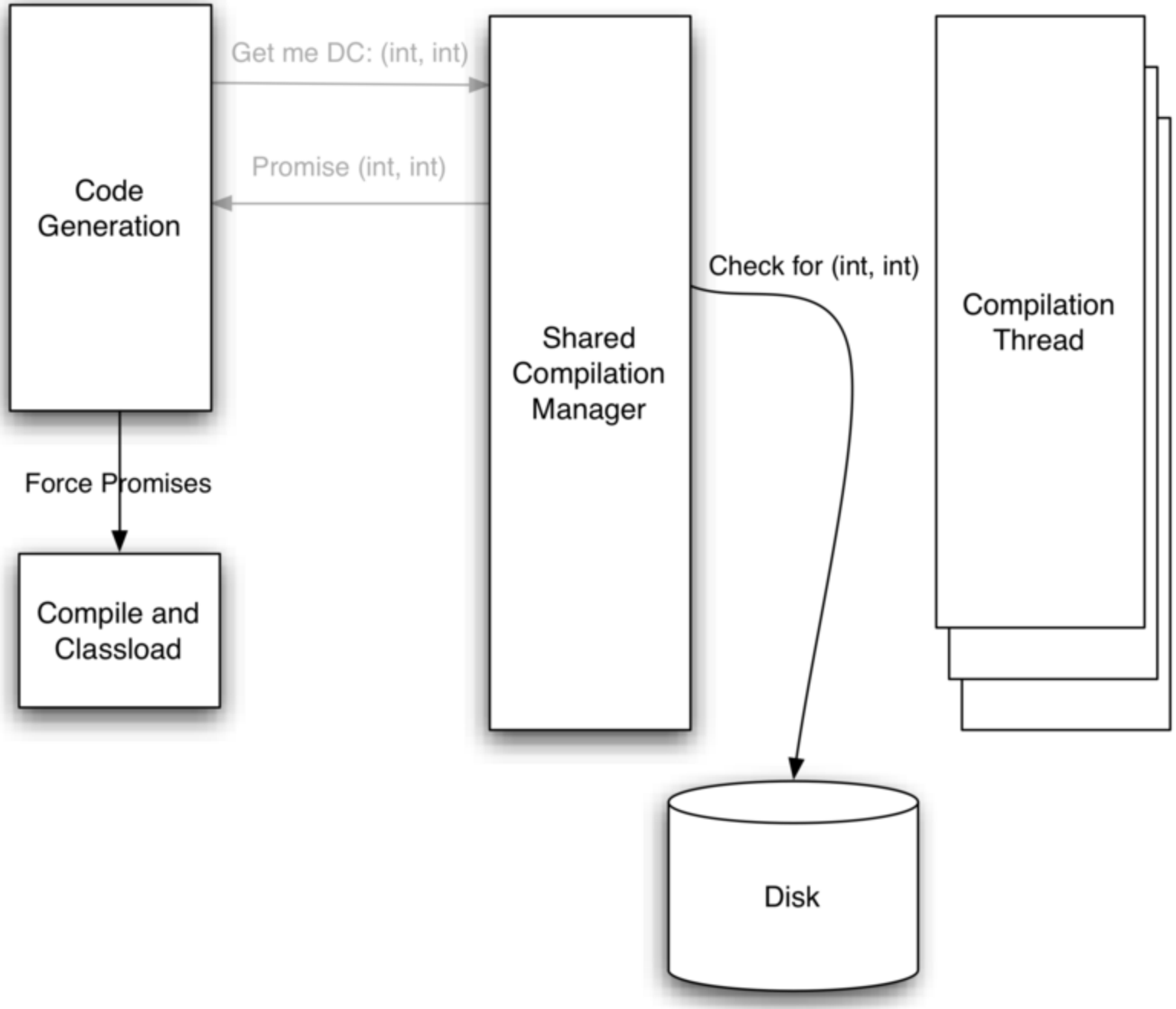
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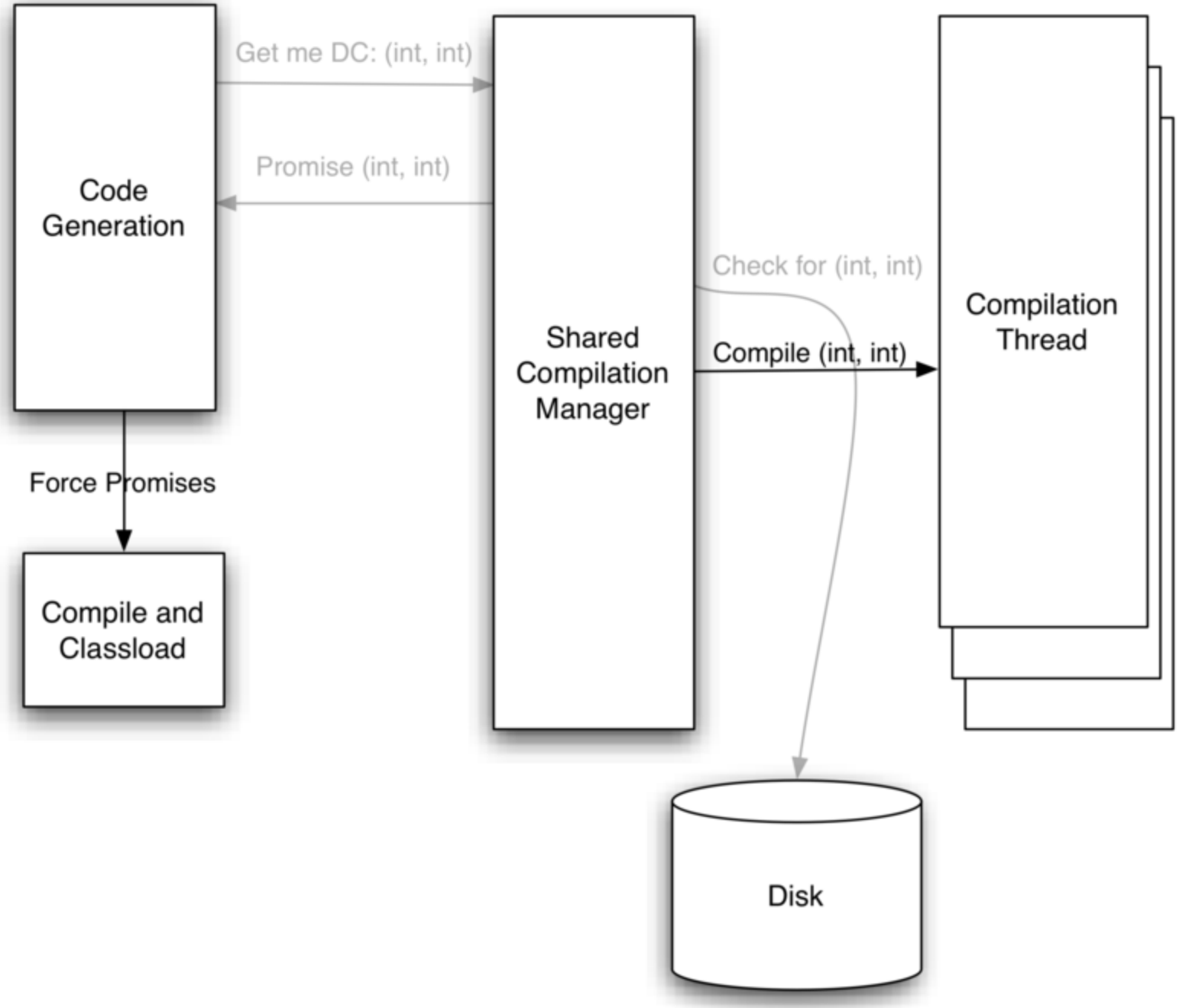
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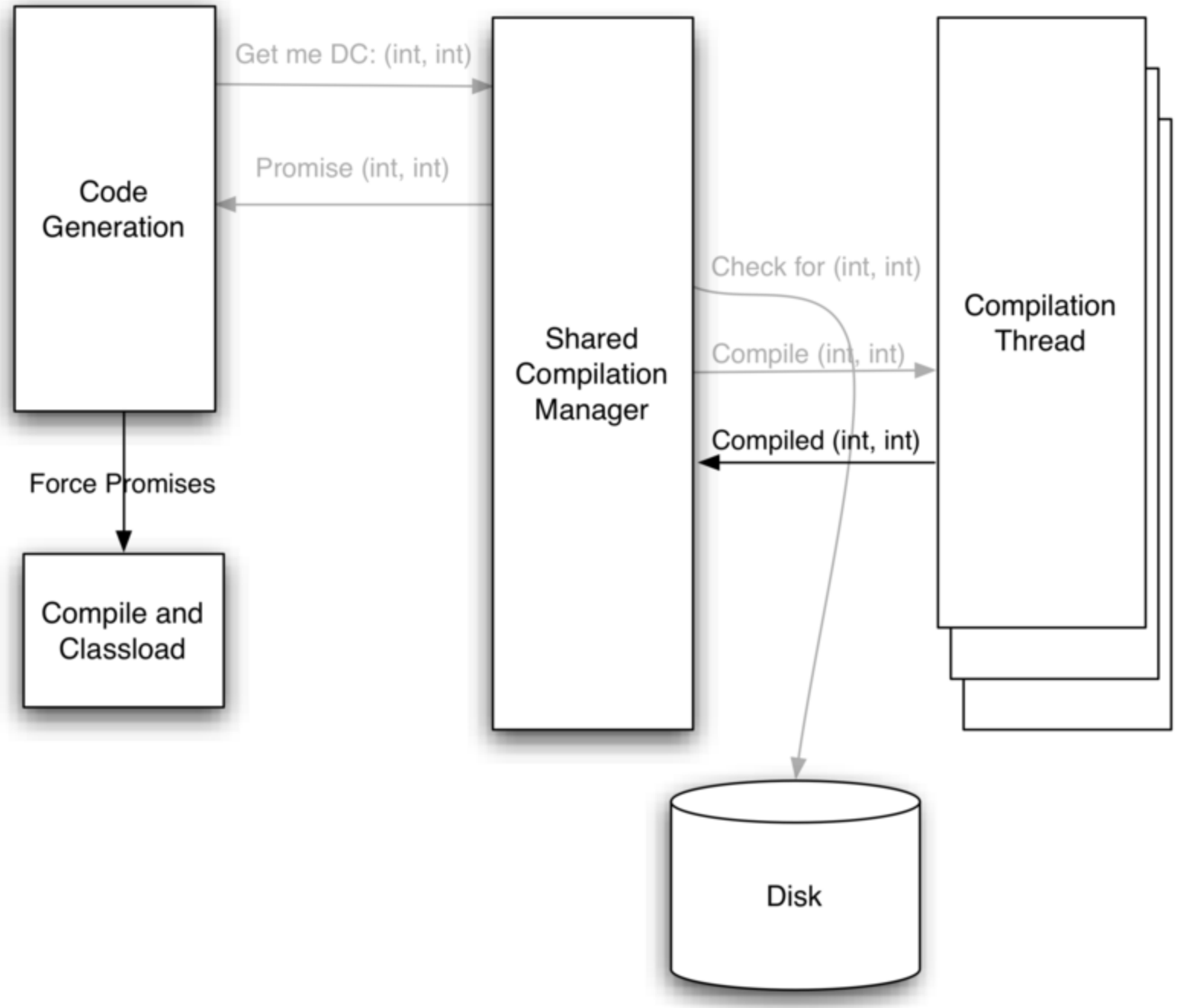
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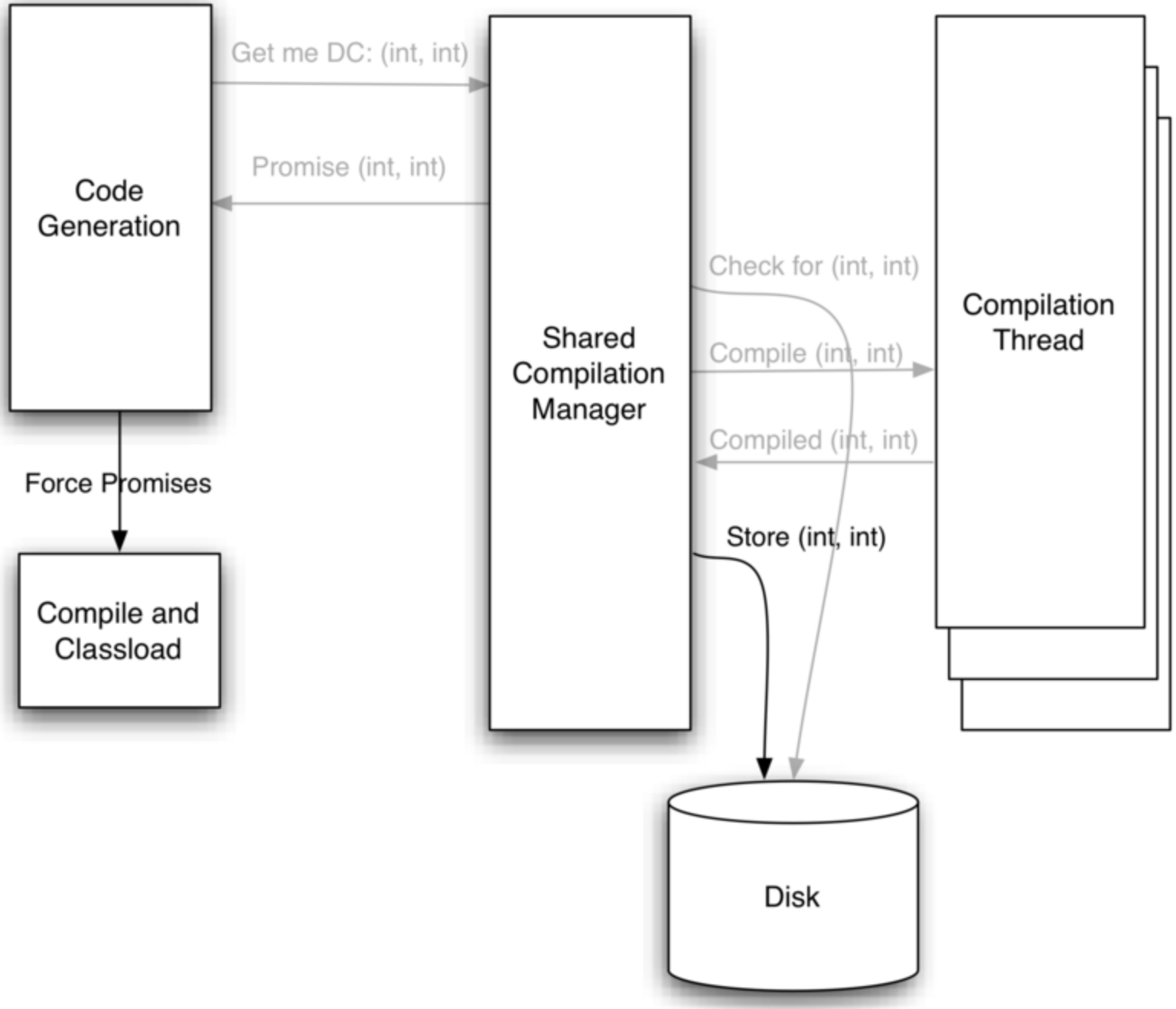
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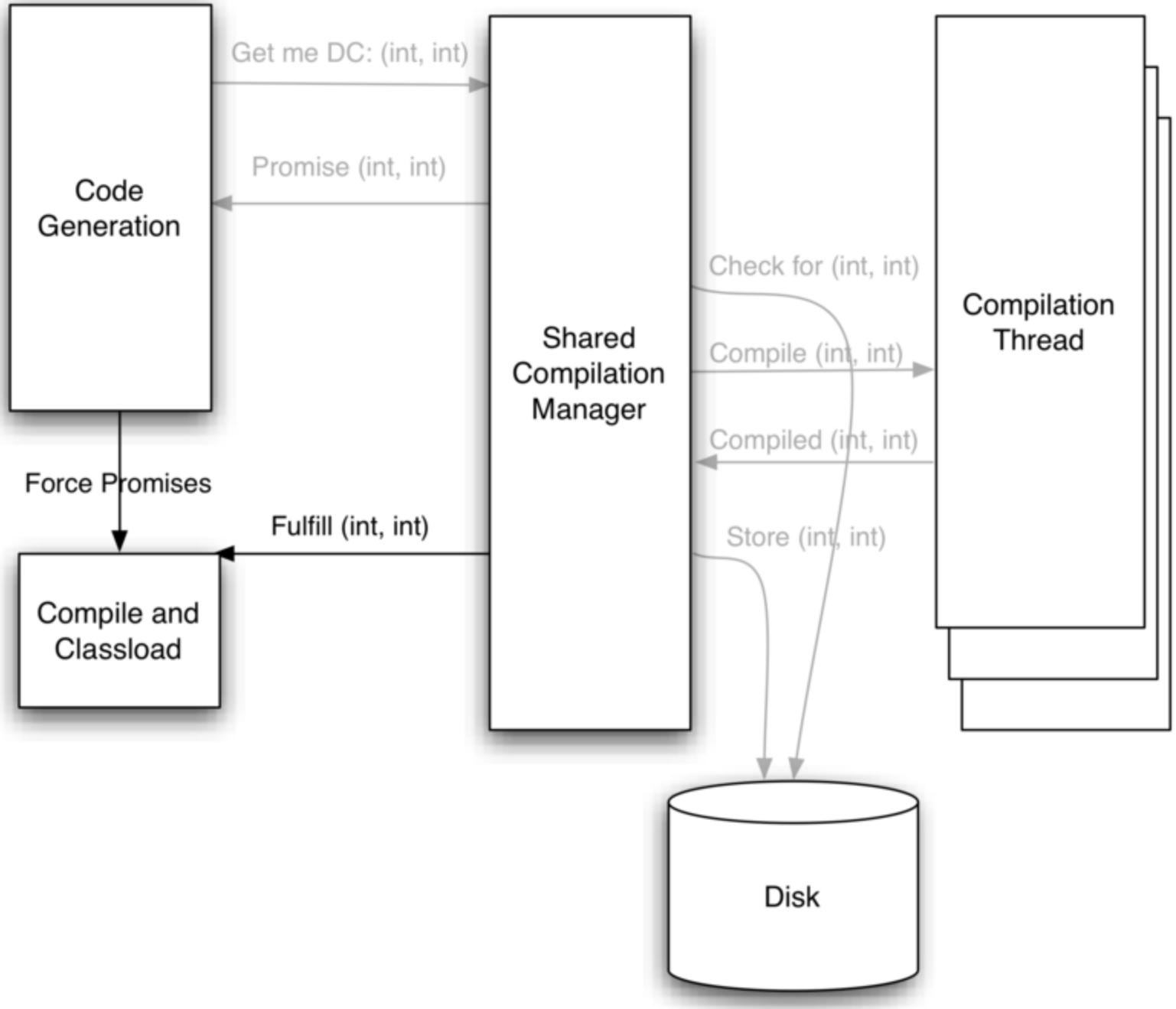
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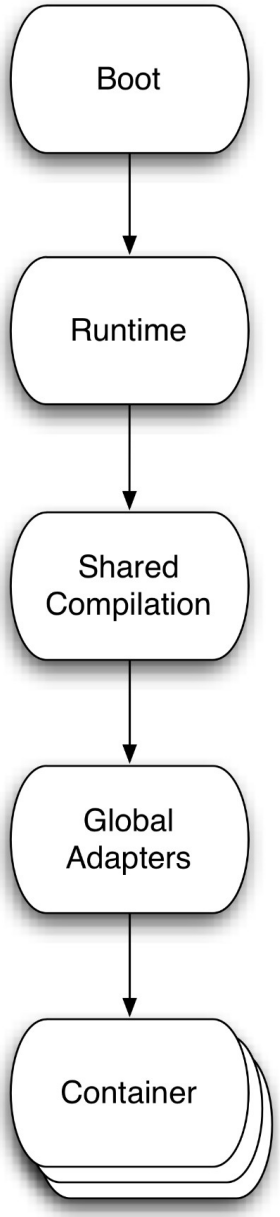
# Classloaders

- Sharing
- Lifecycle
- MS Windows



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## Shameless Plugs

- StreamBase
  - You could build one of these yourself, or use ours
  - Download, Buy, OEM
  - We're hiring
- DEBS – Distributed Event Based Systems
  - Academic (ACM) Conference: Arlington TX in July 2013
- EPTS – Event Processing Technology Society
  - http://ep-ts.org, industry consortium
- IDDS – International Development Design Summit
  - http://iddsummit.org/


# Questions?

Download StreamBase and More Information

http://www.streambase.com