Satsy

Input-Output Code Search Engine

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Problem Statement

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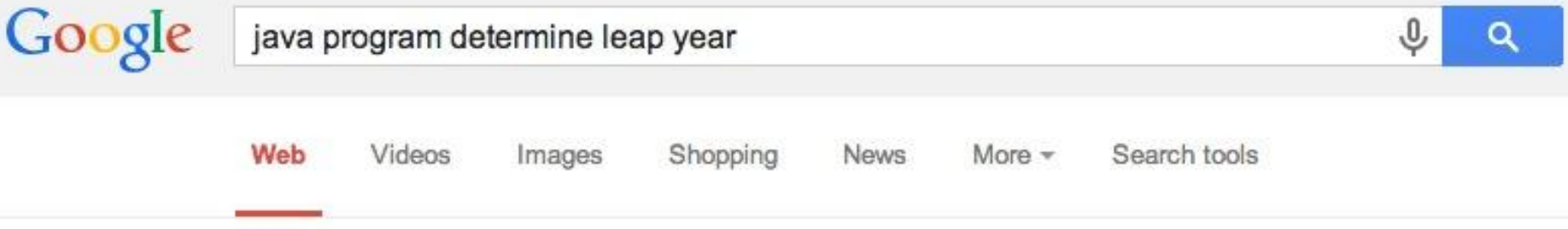
- Lots of open-source code is available for use.
- Instead of rewriting code that already exists, can we search to find the existing code that does what we want?
- Assume we can describe functionality as an Input-Output pair.

Satsy Example

Google Example



Prototype Market Study

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Google		Satsy
48.4	Results Returned	20.5
1.5	Satisfactory Results [1]	8.5

Concept Sketch

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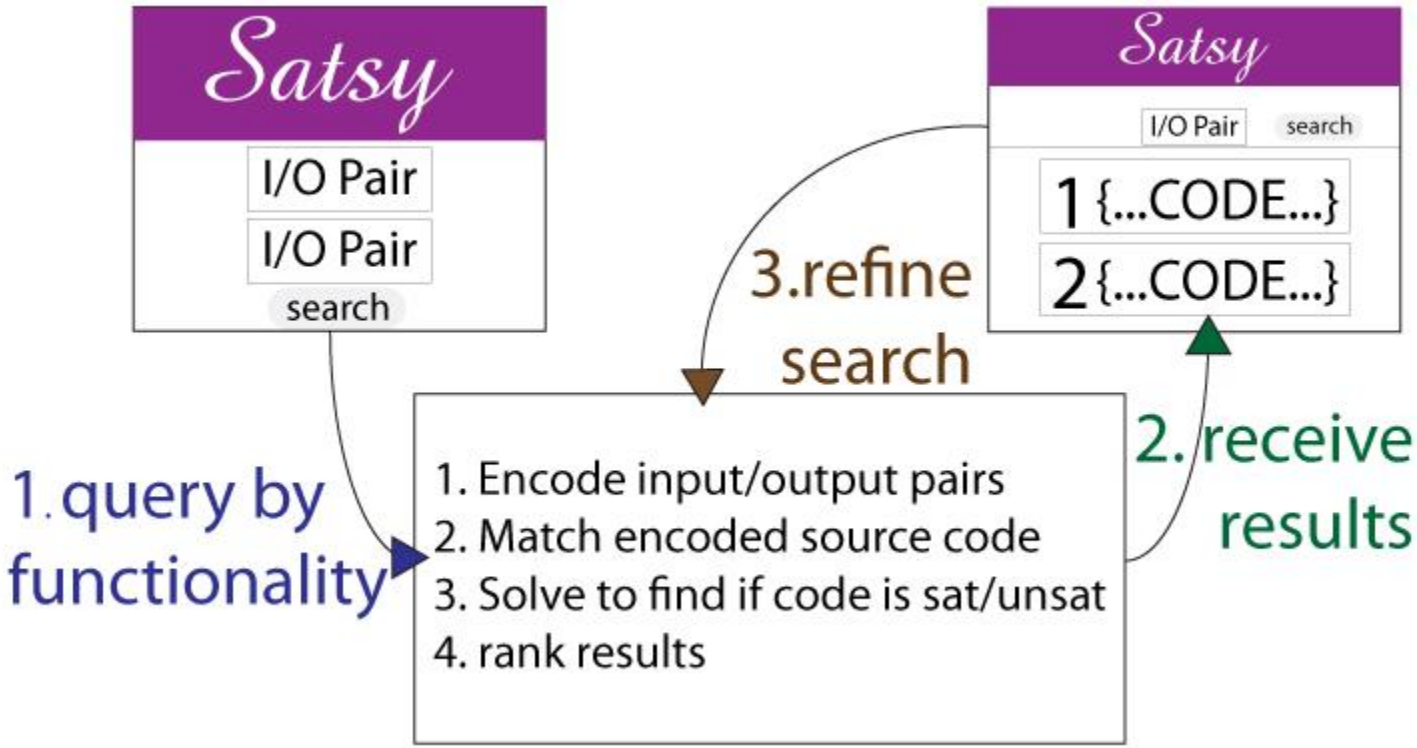

Live Demonstration

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Challenge 1: Technologies

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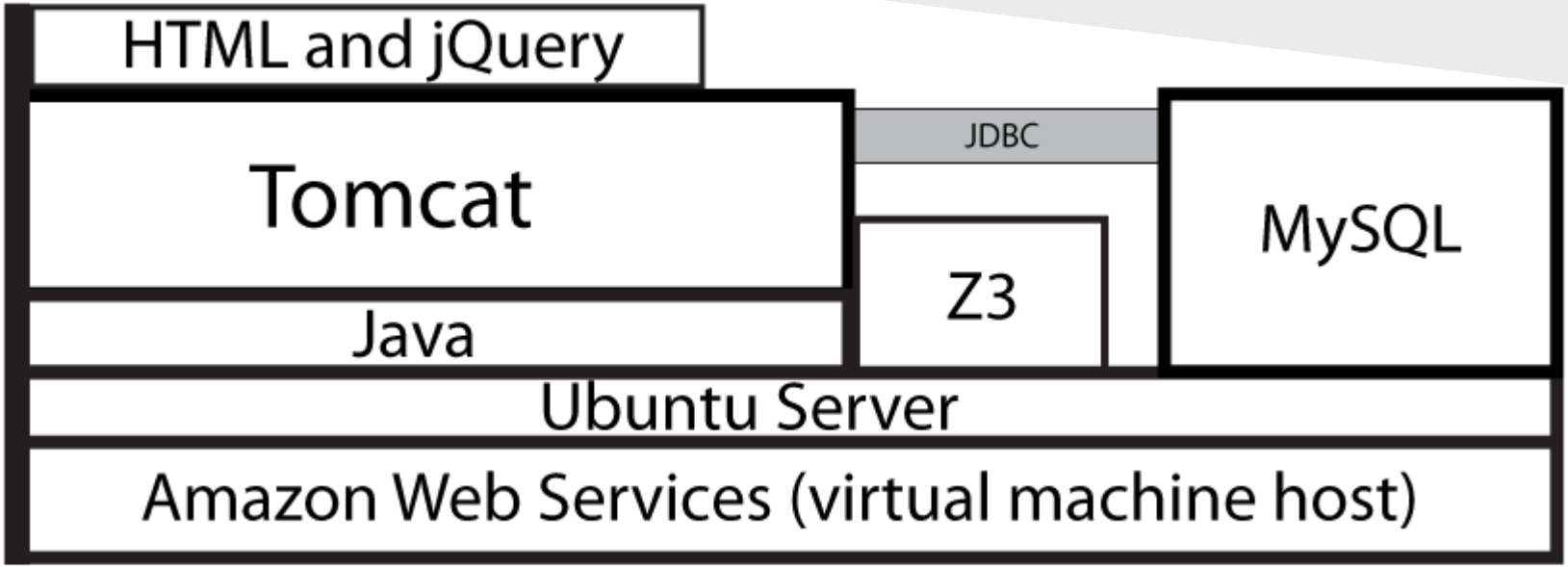

- Amazon Web Services setup
- Running Z3 from Java application
- JDBC connection pool
- Running Java code from HTTP requests
- Asynchronous requests and responses
- Deploying Java web application

Challenge 2: AWS

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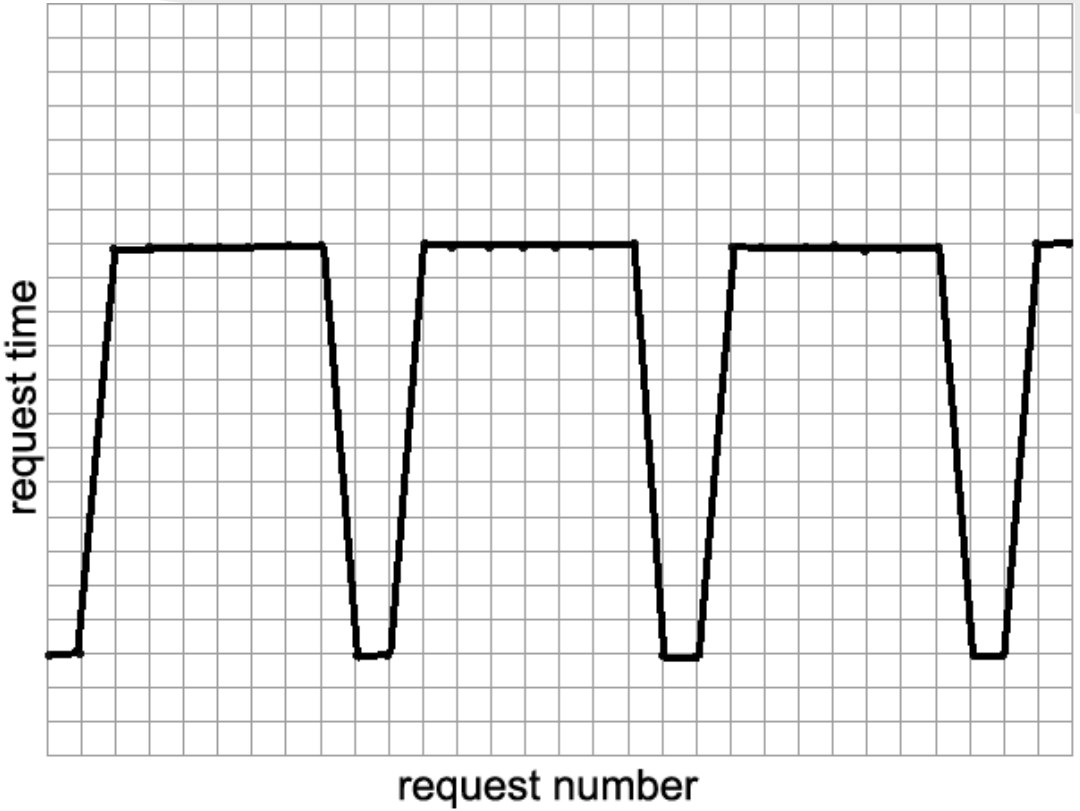
- Why do some search queries seem to stall while others are much more responsive?
- Investigation reveals the AWS EC2 free-tier imposes CPU throttling.



Challenge 3: CPU Bound

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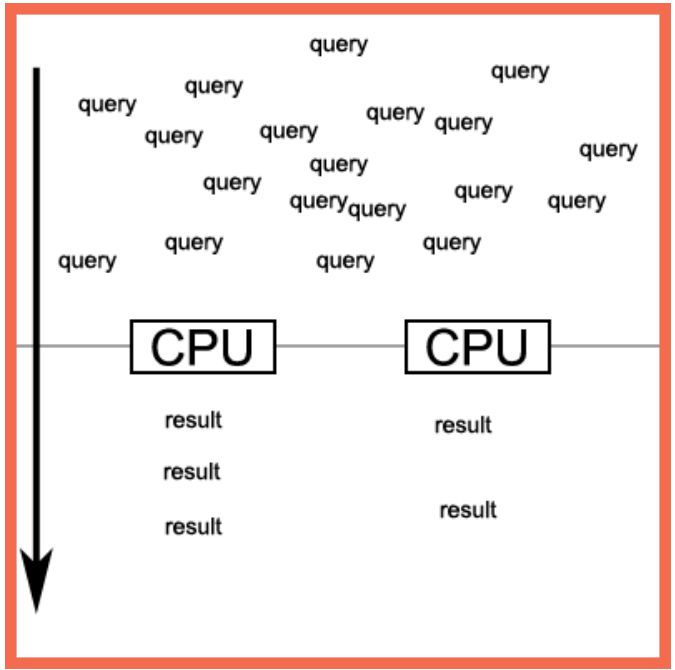
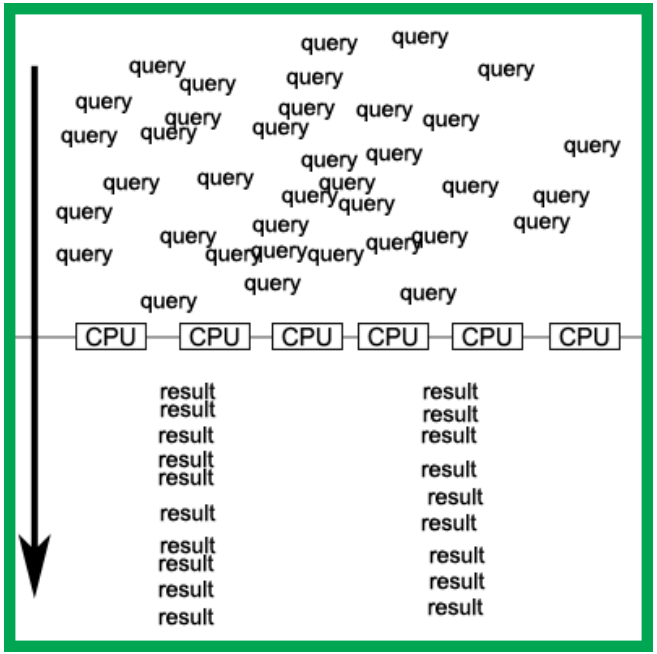
- One Solver takes at least 60 Milliseconds of CPU time
- Searching 1000 database entries takes at least 1 minute





Original Design

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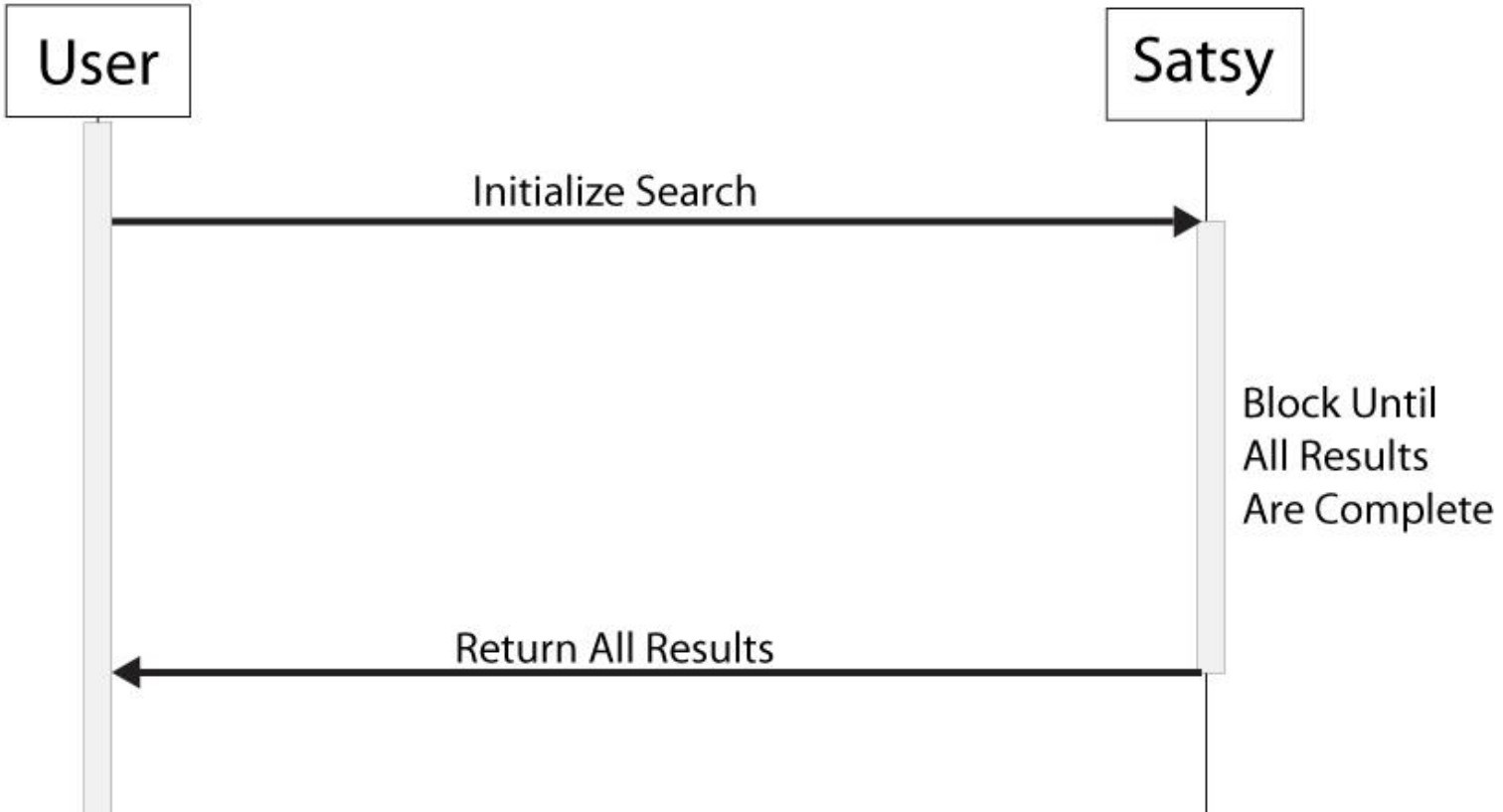

Improved Design

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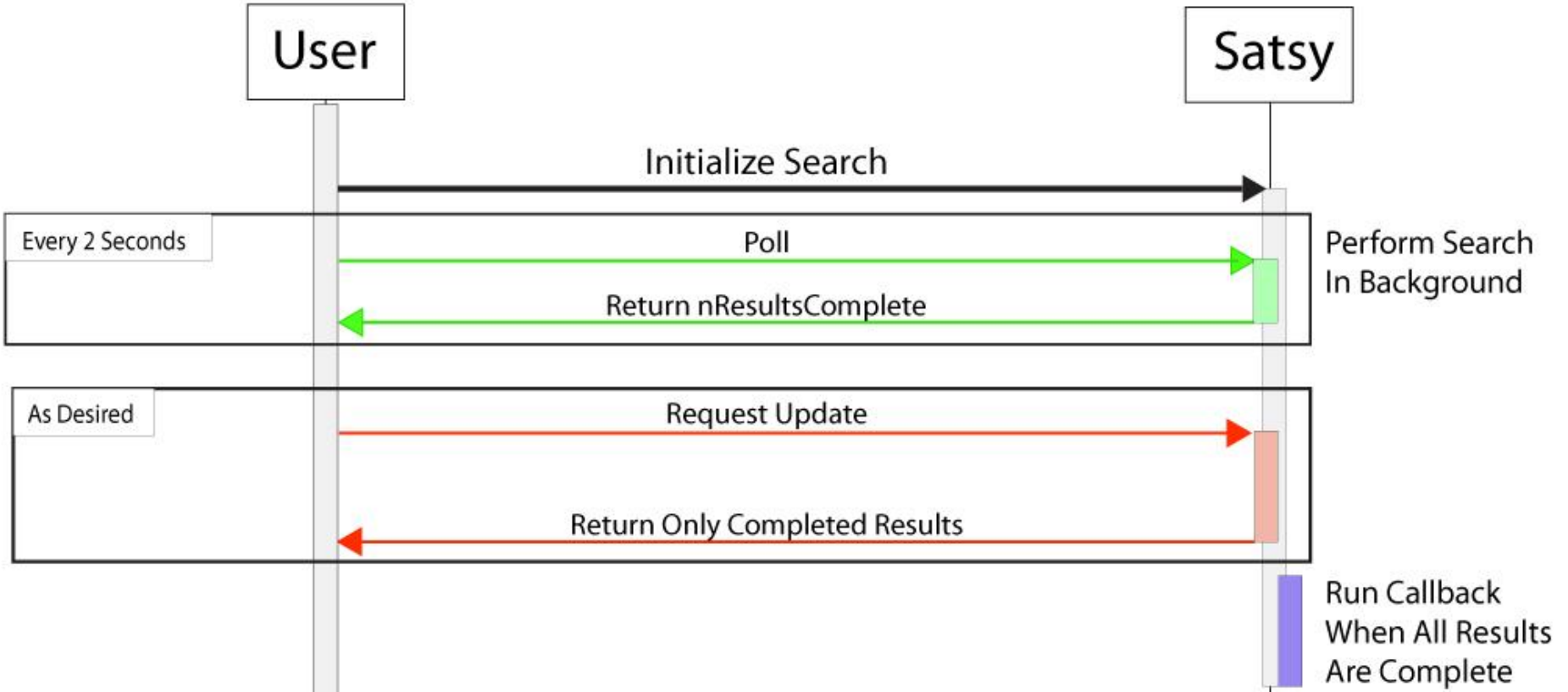

Initialize Search

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1. end old search
2. prepare new ResultMap and Executor
3. create collection of Solvers
4. launch all the Solvers using the new Executor

Solver Algorithm

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1. check for search timeout
2. create SMT file
3. execute z3 and read result
4. increment result matrix
5. notify SearchCallback

Result Matrix

	IO Pair 1	IO Pair 2
INITIAL	0	0
UNKNOWN	0	0
SAT	0	0
UNSAT	0	0
TIMEOUT	0	0
ERROR	0	0

Database Structure

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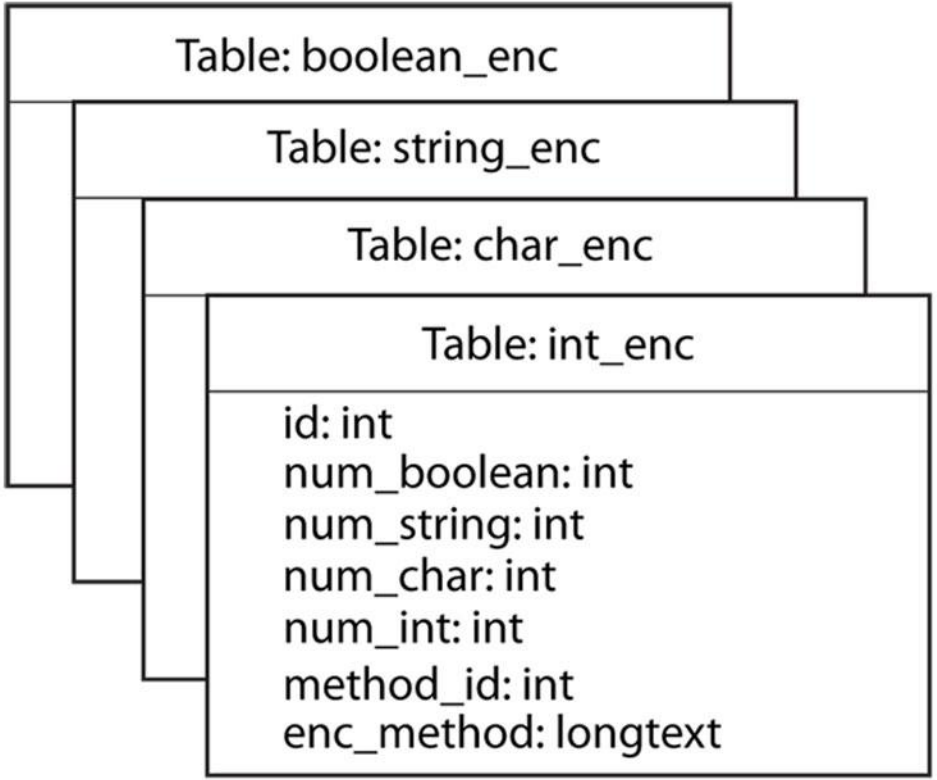

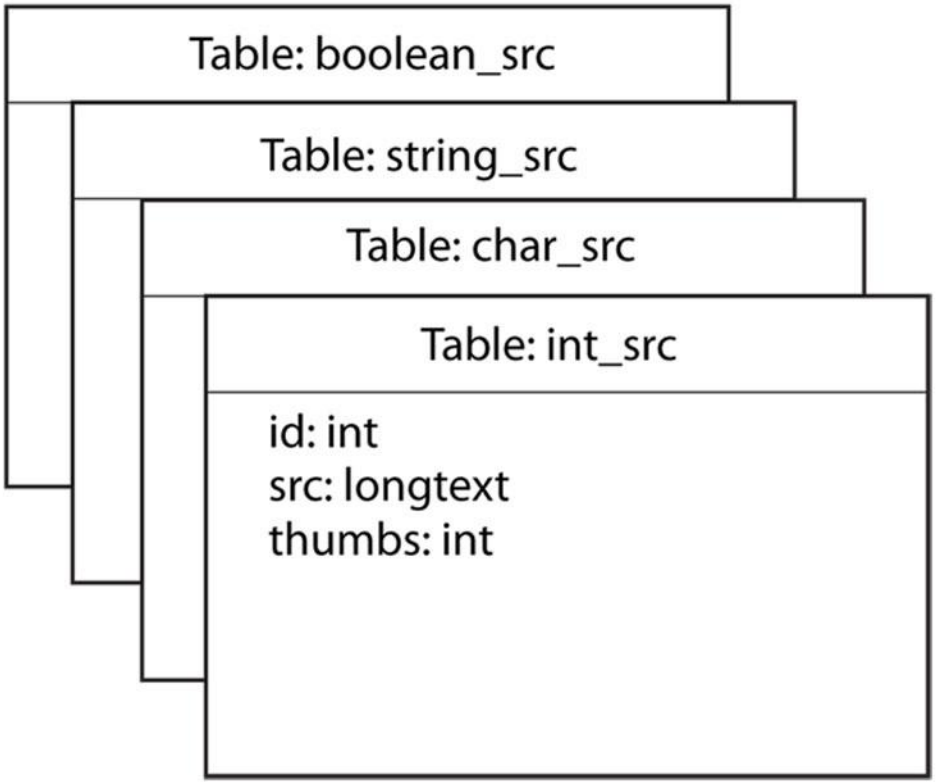

Paths Encoded as SMT

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id	src
566	

```
public static boolean isLeapYear(int year){
  if (year % 4 == 0) {
    if (year % 1000 == 0 && year % 400 != 0){
      return false;
    }
    return true;
  }
  return false;
}
```

source code for the method isLeapYear

id	nb	nc	ni	ns	m_id	enc_method
679	0	0	1	0	566	
680	0	0	1	0	566	

```
...
(assert (= additive6106 (mod year int6105)))
(assert (= boolean6115 true))
(assert (= relationalEq6113 true))
(assert (= int6100 4))
(assert (= int6102 0))
(assert (= int6107 0))
(assert (= relationalEq6108 (= additive6106 int6107)))
(assert (= relationalEq6108 true))
(assert (= int6112 0))
(assert (= int6110 400))
(assert (= additive6111 (mod year int6110)))
(assert (= relationalEq6103 true))
(assert (= int6105 1000))
(assert (= relationalEq6113 (= additive6111 int6112)))
...
```

SMT code for an execution path through isLeapYear

Ranking

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- Generic superclass that can be extended to create new algorithms.
- Current algorithms are sorted by number of paths satisfied, percentage of paths satisfied and if all paths are satisfied.

Front End Design

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- Single Page Web App
- Asynchronous Communication
- Template-based presentation

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```
public static boolean isgraph(int ch){
  return ('!' <= ch && ch <= '~');
}
```

Show 22 More Results

Testing 1: User Simulations

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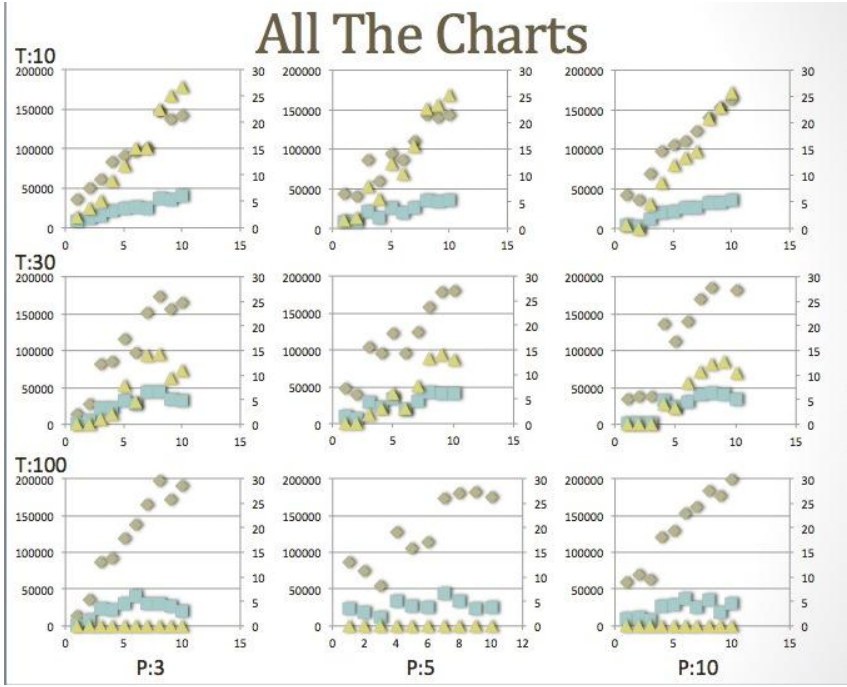
- Strong Engineering Effort put into comprehensive tests
- Relied on Blocking/All-or-nothing nature
- Architectural change -> Out the window



Testing 3: Revised Testing

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- GUI: Manual “Mock” Flags
- Backend: Unit Tests
- Exceptional Cases: Database Integrity

Testing 2: SearchCallback

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- Shift to Asynchronous/Incremental DeliveryArchitecture
- Less control over timing, more “events”
- On completion call SearchCallback

Questions

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