LARA Tutorial

1. Static Analysis

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ANTAREX 10^{18}

SPeCS
Special-Purpose Computing Systems, languages and tools

Objectives

- First steps on LARA
- Introduction to main constructs
- Retrieve static code information
- Generate reports

Some Information

MANET:

- LARA + Cetus*
- ANSI C
- http://specs.fe.up.pt/tools/manet/

- The presented examples
  - Dijkstra from MiBench
  - Disparity from San Diego Vision Benchmark Suite

*Cetus compiler: http://cetus.ecn.purdue.edu/

1.1 Target Language Report

- Goal: Report information regarding the target language
  - Join point: points of interest in the code
  - Attribute: information concerning a join point
  - Action: target code transformation

- Strategy
  - Use *Weaver* object
  - Show available join points and root
  - Iterate join points
    - List attributes, selects and actions

Weaver object members:

```
String   root
String[] joinpoints
String[] selectsOf( jpName )
String[] actionsOf( jpName )
String[] attributesOf( jpName )
```

1.2 Caller and Callee

- Goal: Report calls to, and from a target function

- Strategy
  - Select pairs functions and then calls
  - Filter call by target name
    - When our target function is called
  - Filter function by target name
    - When our target function is a caller

Example output from pretty report:

```
Functions that call enqueue
  dijkstra x2
Functions that are called by enqueue
  malloc x1
  fprintf x1
  exit x1
```

1.3 Static Call Graph

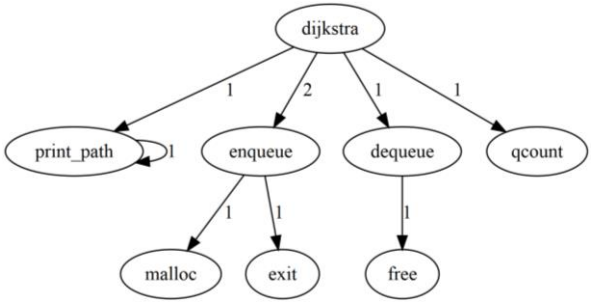
- Goal: Print a static call graph in dot format

- Strategy
  - Select pairs <function, call>
  - Count occurences of each pair
  - Iterate LaraObject and print

Example dot and resulting graph:

```
digraph static_call_graph {

            print_path->print_path [label="1"];
            enqueue->malloc [label="1"];
            enqueue->exit [label="1"];
            dequeue->free [label="1"];
            dijkstra->enqueue [label="2"];
            dijkstra->qcount [label="1"];
            dijkstra->dequeue [label="1"];
            dijkstra->print_path [label="1"];
}
```



1.4 Find Calls to Library Functions

- Goal: Report calls to functions from Math.h or stdio.h

- Strategy
  - Select function calls
    - Filter by name
  - Store function name and location
  - Print Report
  - Also: find and report system calls in loops

Example output:

```
[mibench_dijkstra.c]
  printf
    lines: 43 112 139 140 142
  fflush
    lines: 44
  fprintf
    lines: 55 151 152
  fopen
    lines: 156
  fscanf
    lines: 162
```

1.5 Static Code Report

- Goal: Generate an extended report about program structure

- Strategy
  - Collect
    - general information (files, functions, calls)
    - loop information
    - function information
  - Store in JavaScript objects
  - Pretty print

Example output:

```
-== [ Loop Information ] ==-

==============================
Type       Total    Innermost
------------------------------
For        5        4
While      2        1
Do-While   0        0
------------------------------
Total      7        5
==============================

Largest Loop Nest: 2 @ c_file.c : dijkstra : 124
```

Takeaway Points

- Easy to select points of interest in the code
- Attributes provide a wealth of information
- We can generate metrics, reports, understand an application, find potential problems, ...
- Can use JavaScript to complement the strategies