Advanced Topics in Compilers

Profiling

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Outline

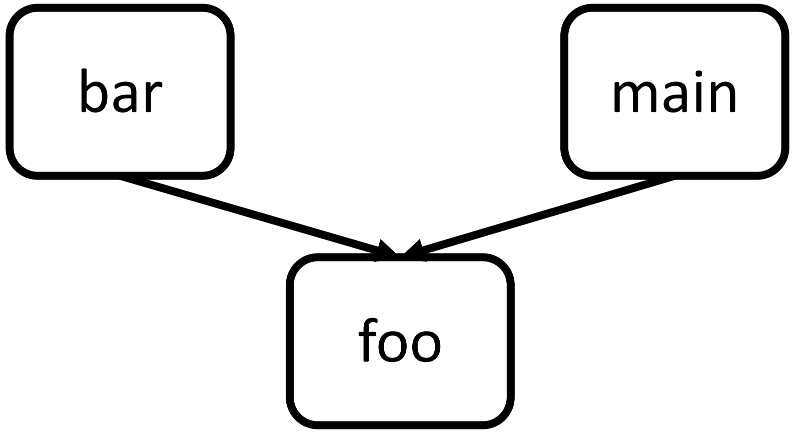
- How to profile with NOELLE

- Accessing profile information

- Loops and profiles

Profiles available

- Number of instructions of a given code region that has been executed
- Cumulative between all invocations of a code region



Normalize the code

Code must be normalized before you use NOELLE

- noelle-norm MYIR.bc –o IR.bc
  or
- noelle-simplification MYIR.bc –o IR.bc

Generate, run, embed

- **Step 0: Generate** a binary that will be run to collect the profile
  noelle-prof-coverage $\underline{\text{IR.bc}}$ standalone_binary –lm –lstdc++

The IR you want to profile

Generate, run, embed

- **Step 0: Generate** a binary that will be run to collect the profile
  noelle-prof-coverage IR.bc standalone_binary –lm –lstdc++

The name of the binary
that will be generated with instrumentation code

Generate, run, embed

- **Step 0: Generate** a binary that will be run to collect the profile
  noelle-prof-coverage IR.bc standalone_binary –lm –lstdc++

Compilation options to use
to translate the input IR into binary
(e.g., libraries to link)

Generate, run, embed

- **Step 0: Generate** a binary that will be run to collect the profile
  noelle-prof-coverage IR.bc standalone_binary –lm –lstdc++

- **Step 1: Run** the program with the inputs you want
  The execution will generate default.profraw
  ./standalone_binary myInput

  ./standalone_binary 10 20 30

  ./standalone_binary input_to_process.txt

Generate, run, embed

- **Step 0: Generate** a binary that will be run to collect the profile

```
noelle-prof-coverage IR.bc standalone_binary –lm –lstdc++
```

- **Step 1: Run** the program with the inputs you want

  The execution will generate default.profraw

```
./standalone_binary myInput
```

- **Step 2: Embed** the profile into the IR

  so that NOELLE can load it in memory automatically

  every time you need it

```
noelle-meta-prof-embed default.profraw IR.bc –o IR_with_profile.bc
```

Accessing the profile from your pass

- Every time you load NOELLE, the profile will be available and accessible via NOELLE's APIs

```
noelle-load –load ~/CAT/lib/CAT.so –CAT IR_with_profile.bc
                              –disable-output
```

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Fetching the profiles

```
/*
 * Fetch NOELLE
 */
auto& noelle = getAnalysis<Noelle>();
```

```
auto hot = noelle.getProfiles();
```

```
if (!hot->isAvailable()){
  return false;
}
errs() << "The profiler is available\n";
```

noelle/core/Hot.hpp

Profiles

- Queries you can do:
  - Has X executed?
    (X = instruction, loop, function, basic block, SCC)
  - The number of times X is executed
  - Number of static instructions that compose X
  - How often a branch is taken

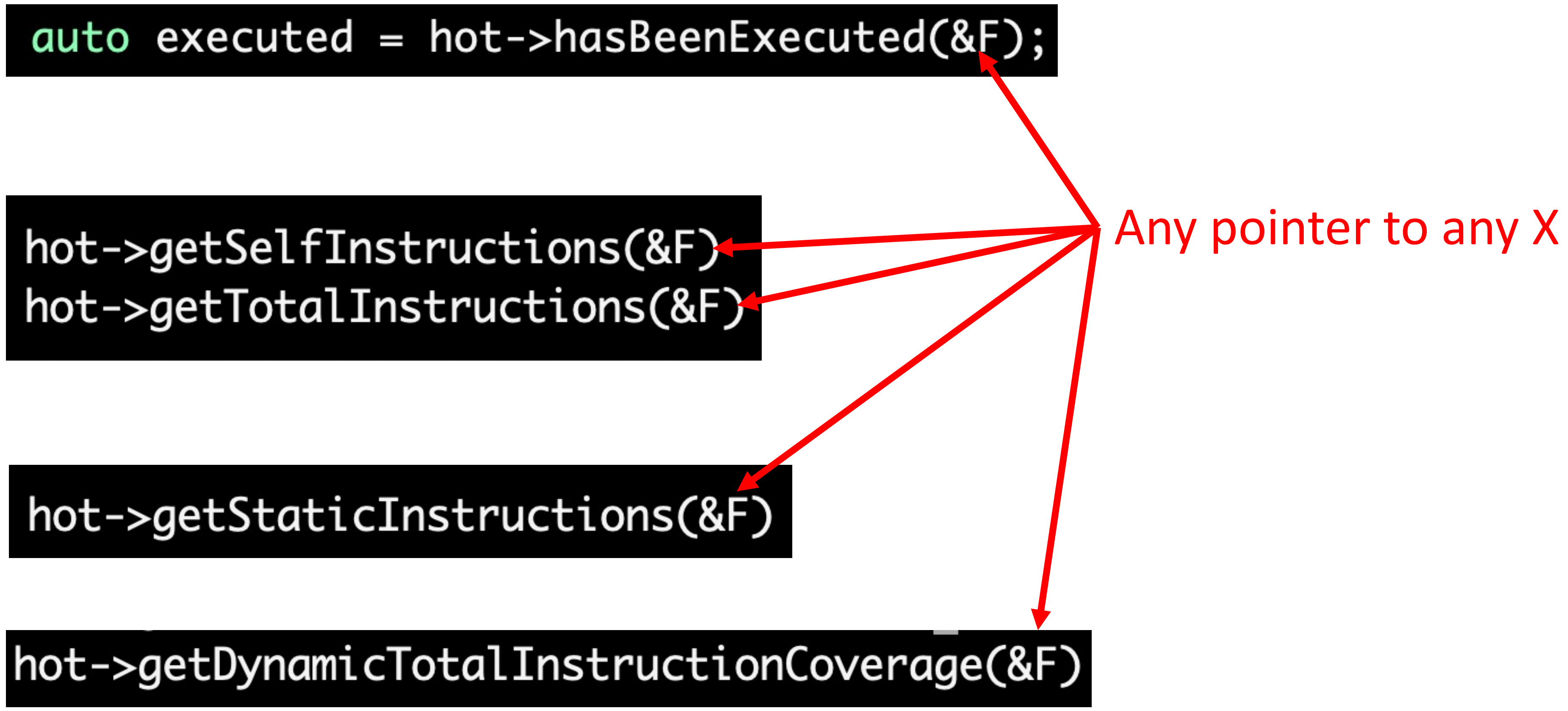
Self, total, static

- Static = number of static instructions that compose X

- Self = number of dynamic instructions executed within X for the
  whole program execution
  without counting instructions executed by callees

- Total = number of dynamic instructions executed within X for the
  whole program execution
  counting instructions executed by callees

APIs for all X



```
auto executed = hot->hasBeenExecuted(&F);
```

```
hot->getSelfInstructions(&F)
hot->getTotalInstructions(&F)
```

```
hot->getStaticInstructions(&F)
```

```
hot->getDynamicTotalInstructionCoverage(&F)
```

APIs for all X but SCC

```
hot->getInvocations(&F)
```

Any pointer to any X

Each X has extra X-specific APIs

```
hot->getAverageLoopIterationsPerInvocation(LS)
```

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APIs

- NOELLE provides API to sort loops by their profile

```
noelle.sortByHotness(*loops);
```

```
auto loop = (*loops)[0];
```

Hottest loop of a program

Always have faith in your ability

Success will come your way eventually

Best of luck!