

Tiger to RISC V Compiler

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November 2019

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What Has Been Acheived

1. Successfully translated compiler functionality from MIPS to RISC V.
 - 1.1 During this process, lots of code refactoring is done along with improvement in time complexity of various intermediate computations.
 - 1.2 Files such as [runtime.s](#) and [riscframe.sml](#) were completely rewritten along with various modifications required at other places.



What Has Been Acheived

2. Implemented improvements in lexical phase to detect more errors; errors in lexical phase are reported immediately resulting in program termination unlike in semantic analysis where a guess is made to facilitate printing all errors in the end.

```
Compiler > TestFiles > err2.tig
1  /* Hello World! */
2  let
3
4      var N := "\tHel
5              o\n\t\tWorld!\n"
6
7  in
8      print (N)
9  end
```

PROBLEMS 6 OUTPUT DEBUG CONSOLE TERMINAL

LEXING ERROR: Error is at line no: 4 and column no is: 21. Message: Newline without terminating string

uncaught exception Error
raised at: tiger.lex.sml:137.9-137.23
tiger.lex.sml:2577.45
parse.sml:34.53



What Has Been Acheived

3. Wrote complete documentation of my compiler at tigercompiler.ml. This is done to help me and anyone interested in this project to quickly revise the fundamentals and understand the working of this compiler.

The screenshot shows the Tiger Compiler documentation website. The header is purple with the Tiger Compiler logo and name. The left sidebar contains a navigation menu with links to Introduction, Intro, Understanding Function Calls, Phase III, Introduction, Canonisation (highlighted in blue), Instruction Selection, Liveness Analysis and Interference, Graph, and Register Allocation. The main content area is titled 'Canonisation' and has an 'EDIT' button. Below the title is an 'Abstract' section. The abstract text reads: 'It's useful to be able to evaluate the sub-expressions of an expression in any order. If tree expressions did not contain ESEQ and CALL nodes, then the order of evaluation would not matter.' Below the abstract is a section titled 'Why CALL nodes are an issue?'. The text under this section reads: 'In actual implementation. CALL nodes will return value in the'. On the right side of the page, there is an 'Abstract' section with two links: 'Why CALL nodes are an issue?' and 'Why ESEQ nodes are an issue?'.



What Has Been Acheived

4. Wrote automated testing using [Travis](#). Now I'll be able to see whether my changes don't break the existing functionalities and also it is useful in case someone sends a pull request.

sourabh2311 / btp build passing

Current Branches Build History Pull Requests More options

✓ master Report Update - 14 passed Restart build

Commit 33a9781
Compare 8f27478...33a9781
Branch master
Sourabh Aggarwal

Python: 3.6
AMD64

Job log View config

Remove log Raw log

1 Worker information worker_info 0.88s
6
7 Build system information system_info Top



What Has Been Acheived

5. **Fixed** a major bug; Initially my compiler supported only fixed number of arguments. Now this has been extended to support any number of arguments.

The screenshot shows a code editor with a Rust program and a commit message. The program is a function `last` that takes 12 integer arguments and returns the last one. It is called with 12 arguments in `printI`. The terminal output shows the program exited with code 0. Below the code editor, a commit message is displayed: "Added support for more than one function arguments" by `sourabh2311` on Oct 4. The commit shows 5 changed files with 674 additions and 3 deletions. The diff for `Compiler/accessConv.sml` shows the addition of a signature and two val bindings for `ACCESSCONV`.

```
Compiler > TestFiles > tc2.tlg
1 let
2   function last (a : int, b : int, c : int, d : int, e : int, f : int, g :
      int, h : int, i : int, j : int, k : int, l : int) : int = l
3 in printI(last(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)); print("\n"); exit(0)
4 end
```

PROBLEMS 12 OUTPUT DEBUG CONSOLE TERMINAL 1: Code + - + ^

12
Exited with code: 0
Program terminated by calling exit

Added support for more than one function arguments [Browse files](#)

`master`

`sourabh2311` committed on 4 Oct 1 parent 74cc398 commit 5270be5c637331a29cfb40092c3b5011735652fa

Showing 5 changed files with 674 additions and 3 deletions. [Unified](#) [Split](#)

39 `Compiler/accessConv.sml` ...

```
... @@ -0,0 +1,39 @@
1 + signature ACCESSCONV =
2 + sig
3 +   val frameToTree: RiscFrame.access list -> Tree.access list
4 +   val treeToFrame: Tree.access list -> RiscFrame.access list
5 + end
```



What Has Been Acheived

6. Added 2 more arithmetic operations, viz. left shift and right shift.

```
Compiler > TestFiles > tc9.tig
1  let
2      var N := 8
3      var S := N << 2
4      var D := S >> 2
5  in
6      (printI(S); print(" and "); printI(D); print("\n"); exit(0))
7  end
8

PROBLEMS 19 OUTPUT DEBUG CONSOLE TERMINAL
1: Code + []
32 and 8
Exited with code: 0
Program terminated by calling exit
```



What Has Been Acheived

7. Implemented multiplication by power of 2 optimization inside basic block thus laid foundation for other basic block optimizations like constant propagation, constant folding.

```
Compiler > TestFiles > tc10.tig
1  let
2      var N := 8
3      var M := 4 * N
4      var O := N * 4
5  in
6      (printI(M); print("\n"); printI(O); print("\n"); exit(0))
7  end
8
PROBLEMS 19 OUTPUT DEBUG CONSOLE TERMINAL 1: Code
32
32
Exited with code: 0
```

```
Compiler > TestFiles > ASM tc10.tig.s
28      mv s10, s11
29      li s7, 8
30      slli s1, s7, 2
31      mv s11, s1
32      slli s1, s7, 2
```




What Has Been Acheived

8. Started work on giving a guess of literal in case of small typo.
 - Printing suggestions which are atmost 2 **distance** apart. This will bring the time complexity of standard DP approach of $O(n^2)$ to just $O(n)$.
 - Currently the issue is that to implement this, I would have to do lots of modification of the current code. Although I have **abstracted** out *Not Found* error messages out with the environment, what is just left is to compare the literal with those of nearby length in the environment.
 - The main issue is that in the current design, environment just have integers mapped to environment entry. We got this integer by mapping string to counter, not storing the reverse map. This can be worked around by using **Atom**.



What Has Been Acheived

9. Started work on improving my Register Allocator. Current version is a bit simplified version of the algorithm mentioned in the text and is without coalescing.



- Register Allocator as mentioned.
- Basic blocks has to optimizations as mentioned.
- Error messages improvement in semantic phase as mentioned.
- String comparison has to be made as simple as "`str1 > str2`", etc., instead of calling the string comparison functions to determine it.
- To implement ability to include pre-written code (header) files.
- To implement garbage collection.
- To implement dataflow analyses such as reaching definitions and available expressions and use them to implement some of the optimizations.
- To implement first-class function values in Tiger, so that functions can be passed as arguments and returned as results.
- Add support for compile time (initial) arguments.



Goal for this Semester

This semester, I am mainly focusing on:-

- Understanding RISC V.
- Recollecting all that was done last semester (3 month gap 😞).
- Refactoring, fixing bugs and translating everything to RISC V.
- Writing good documentation of the code for easy recollection.
- Travis script for automated testing.
- And of course, if there is time, I'll work on the previous mentioned issues else they are to be focused on next semester.

Thanks!