

Tiger to RISC V Compiler

Sourabh Aggarwal

Mentor: Dr. Piyush P. Kurur

September 2019

Department of Computer Science And Engineering
IIT Palakkad

```
function try (c : int) =  
(  
  if c = N  
  then printboard ()  
  else  
    for r := 0 to N - 1 do  
      if row[r] = 0 & diag1[r + c] = 0 & diag2[r + 7 - c] = 0  
      then  
        (  
          row[r] := 1; diag1[r + c] := 1; diag2[r + 7 - c] := 1;  
          col[c] := r;  
          try(c + 1);  
          row[r] := 0; diag1[r + c] := 0; diag2[r + 7 - c] := 0  
        )  
    )  
)
```

```
# str1 < str2 ?
```

```
stringLess:
```

```
    stringLessLoop:
```

```
        lb a2 (a0)
```

```
        lb a3 (a1)
```

```
        blt a2, a3  stringLessA
```

```
        bgt a2, a3  stringLessB
```

```
        # If we have reached this point that means both are equal  
and if one of them is zero that means other is aswell 0,  
so in case strings are equal, I must return 0.
```

```
        beqz a2, stringLessB
```

```
        addi a0, a0, 1
```

```
        addi a1, a1, 1
```

```
        j stringLessLoop
```

```
stringLessA:
```

```
    li a0, 1
```

```
    jr ra
```

```
stringLessB: li a0, 0 jr ra
```

Modifying And Extending Upon Previous Compiler

- Wrote compiler to compile Tiger to MIPS last semester (didn't expect to get it working).

Modifying And Extending Upon Previous Compiler

- Wrote compiler to compile Tiger to MIPS last semester (didn't expect to get it working).
- BUT evidently there were issues.

- The number of arguments that can be given to a function is exactly the number of available argument registers. This is to be fixed to support any number of function arguments.

- The number of arguments that can be given to a function is exactly the number of available argument registers. This is to be fixed to support any number of function arguments.
- Register allocation currently works only on saved registers and temporaries, this can be augmented to use free argument registers as well. (Subjective move)

- The number of arguments that can be given to a function is exactly the number of available argument registers. This is to be fixed to support any number of function arguments.
- Register allocation currently works only on saved registers and temporaries, this can be augmented to use free argument registers as well. (Subjective move)
- Basic blocks have to be optimized with optimizations like constant propagation, constant folding, etc.

- The number of arguments that can be given to a function is exactly the number of available argument registers. This is to be fixed to support any number of function arguments.
- Register allocation currently works only on saved registers and temporaries, this can be augmented to use free argument registers as well. (Subjective move)
- Basic blocks have to be optimized with optimizations like constant propagation, constant folding, etc.
- String comparison has to be made as simple as "`str1 > str2`", etc., instead of calling the string comparison functions to determine it.

- The number of arguments that can be given to a function is exactly the number of available argument registers. This is to be fixed to support any number of function arguments.
- Register allocation currently works only on saved registers and temporaries, this can be augmented to use free argument registers as well. (Subjective move)
- Basic blocks have to be optimized with optimizations like constant propagation, constant folding, etc.
- String comparison has to be made as simple as "`str1 > str2`", etc., instead of calling the string comparison functions to determine it.
- To implement Garbage collection.

- To implement ability to include pre-written code (header) files.

- To implement ability to include pre-written code (header) files.
- To implement additional arithmetic operations like left/right shift.

- To implement ability to include pre-written code (header) files.
- To implement additional arithmetic operations like left/right shift.
- Register allocation algorithm has to be implemented with better heuristics.

- To implement ability to include pre-written code (header) files.
- To implement additional arithmetic operations like left/right shift.
- Register allocation algorithm has to be implemented with better heuristics.
- Error messages has to improved in semantic phase.

- To implement ability to include pre-written code (header) files.
- To implement additional arithmetic operations like left/right shift.
- Register allocation algorithm has to be implemented with better heuristics.
- Error messages has to improved in semantic phase.
- Add support for compile time (initial) arguments.

- To implement ability to include pre-written code (header) files.
- To implement additional arithmetic operations like left/right shift.
- Register allocation algorithm has to be implemented with better heuristics.
- Error messages has to improved in semantic phase.
- Add support for compile time (initial) arguments.
- And much more is possible, as like in a commercial product.

Goal for this Semester

This semester, I am mainly focusing on:-

Goal for this Semester

This semester, I am mainly focusing on:-

- Understanding RISC V.

Goal for this Semester

This semester, I am mainly focusing on:-

- Understanding RISC V.
- Recollecting all that was done last semester (3 month gap 😞).

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.

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.

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.

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.

Example:-

```
| LET decs IN exps END (
  A.LetExp({decs = decs, body = A.SeqExp(exps), pos = LETleft})
)
```

Included many files, viz.

- parse.sml
- errmsg.sml
- tiger.lex
- table.sml, table.sig
- symbol.sml
- tiger.grm, absyn.sml

Compiler Course: Phase II - Building Intermediate Representation Tree

```
datatype stm = SEQ of stm * stm
            | LABEL of label
            | JUMP of exp * label list
            | CJUMP of relop * exp * exp * label * label
            | MOVE of exp * exp
            | EXP of exp
and exp = BINOP of binop * exp * exp
        | MEM of exp
        | TEMP of Temp.temp
        | ESEQ of stm * exp
        | NAME of label
        | CONST of int
        | CALL of exp * exp list
```

Compiler Course: Phase II - Building Intermediate Representation Tree

Included many files, viz.

- types.sml
- env.sml, env.sig
- temp.sml, temp.sig
- findescape.sml
- tree.sml
- risc.sml
- translate.sml
- semant.sml

- Understood RISC V and rewrote "runtime" in RISC V.

- Understood RISC V and rewrote "runtime" in RISC V.
- Worked out till Phase II of Compiler.

Thanks!