

Ada Compiler

A compiler for a Ada subset that generates MIPS assembly code.

Overview

The compiler accepts a single Ada procedure and is composed of a lexer + parser + AST builder + type checker + Intermediate Code Generator + Mips assembly generator. It accepts as input one Ada program and outputs: 1. AST representation 2. Whether it passed the type checking (if not it does not execute points 3. and 4.) 3. Three-address intermediate code 4. MIPS assembly code in another file

Language Features

Procedure Declaration

```
procedure Name is
    <declarations>
begin
    <statements>
end Name;
```

Variable Declarations

- **Integer:** X : Integer; or X : Integer := 42;
- **String:** X : String := "ola"; or X : String := Get_Line; or X : String (1 .. 255)
- Declarations must appear before begin

Statements

Assignment

```
X := expr;
```

While Loop

```
while condition loop
    statements;
end loop;
```

If-Then-Else

```
if condition then
    statements;
else
    statements;
end if;
```

Single If

```
if condition then
    statements;
end if;
```

If-Elsif-Else

```
if condition then
    statements;
elsif condition then
    statements;
else
    statements;
end if;
```

Input

```
Get_Line(Var,Length);
```

Reads a line from standard input.

```
Get(var)
```

Reads an integer from standard input.

Output

```
Put_Line(str);
```

Prints a string or the contents of a string variable, and a new line at the end.

```
Put(expr)
```

Prints the result of expr.

Expressions

Arithmetic Expressions

- **Integer literals:** 42, -123
- **Variables**
- **Binary operators:** +, -, *, /

- **Parentheses:** (expr)

Boolean Expressions

- **Literals:** True, False
- **Logical operators:** and, or, not
- **Comparisons:** =, /=, <, <=, >, >=
- **Parentheses:** (bexpr)

Strings

- **Literals:** hello
- **Identifiers**

Build - Compilation

Requirements: Flex, Bison, GCC

```
make
```

Usage

- ./prog tests/main? .adb (where ? is [1-13])

Example of execution

```
make
./prog tests/main6.adb

--- Abstract Syntax Tree ---
mk_compound(
  mk_compound(
    mk_compound(
      mk_declaraction(
        I,
        Integer,
        mk_int(1)
      ),
      mk_declaraction(
        R,
        Integer,
        mk_int(1)
      )
    ),
    mk_declaraction(
      N,
```

```

        Integer,
        NULL
    )
),
mk_compound(
    mk_compound(
        mk_get(N),
        mk_while(
            mk_bbinop(
                E_LESS,
                mk_ident(I),
                mk_ident(N)
            ),
            mk_compound(
                mk_assign(
                    R,
                    mk_op(
                        MULT,
                        mk_ident(R),
                        mk_ident(I)
                    )
                ),
                mk_assign(
                    I,
                    mk_op(
                        PLUS,
                        mk_ident(I),
                        mk_int(1)
                    )
                )
            )
        )
    ),
    mk_put(
        mk_ident(R)
    )
)
)
--- Type Checking ---
Type checking passed

--- Intermediate Code ---
t0 := 1
t1 := 1
Read_Int t2
LABEL label0
t3 := t0
t4 := t2

```

```

COND t3 <= t4 THEN label1 ELSE label2
LABEL label1
t3 := t1
t4 := t0
t1 := t3 * t4
t3 := t0
t4 := 1
t0 := t3 + t4
JUMP label0
LABEL label2
t3 := t1
Print_Int t3

--- MIPS Assembly Code ---
(Writing to tests/main6.s)
Successfully generated tests/main6.s

===== Compilation Complete =====

```

File tests/main6.s would look like this:

```

.data

.text
.globl main
main:
    li $t0, 1
    li $t1, 1
    li $v0, 5
    syscall
    move $t2, $v0
label0:
    move $t3, $t0
    move $t4, $t2
    bgt $t3, $t4, label2
label1:
    move $t3, $t1
    move $t4, $t0
    mul $t1, $t3, $t4
    move $t3, $t0
    li $t4, 1
    add $t0, $t3, $t4
    j label0
label2:
    move $t3, $t1
    move $a0, $t3
    li $v0, 1
    syscall

```

File Structure

```
.  
├── lexer.l                      # Flex lexer  
├── parser.y                     # Bison parser  
├── ast.h / ast.c                # AST  
├── code.h / code.c              # Intermediate code generator  
├── genMIPS.h / genMIPS.c        # MIPS code generator  
├── hashTable.h / hashTable.c    # Symbol table (hash map)  
├── typeChecker.h / typeChecker.c # Type checking  
├── main.c                        # Main driver  
├── Makefile                      # Build script  
├── README.md  
└── tests/                         # Test Ada programs and  
    respetives assembly files
```

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