

# CS335A: Milestone 4

Submission By: Aarchie[200004]

Harshit Kumar Tiwari[200432]

Udit Prasad[201055]

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## 1 Steps to run the program

Open the ‘milestone1/src’ folder and type ‘make’. It will show the different options which can be tried with makefile.

1. **help** to Show methods for each of the Makefile recipes
2. **build** to generate files for the executable. It will run the following commands-

```
flex lexer.l
bison -d -t parser.y
g++ lex.yy.c parser.tab.c
```

3. **run** to run the executable using input like-

```
make run input=file-path
```

‘or else run with terminal input. This would run-

```
./myASTgenerator input-file-path
```

Also, assembly file can be named optionally as using-

```
run input=file-path.java output=output-file-path.s
```

Meanwhile, dot and graph formed will also be stored in output-folder by default.

4. **threeAC** to show Three Address Code

```
make ThreeAC
```

5. **runasm** to compile the generated .s file

```
make runasm
```

6. **clean** to clean up the generated files

```
make clean
```

use this command before re-running test cases to clear all the output symbol Tables + three AC code + assembly files all in output folder.

## 2 Tools Used

**flex:** Used for Generating tokens from the input.

**bison:** Used for defining Syntax Grammar for the JAVA language.

**Dot language:** Used to generate the tree from the Grammatical syntax.

**graphviz:** Used to visualize the generated AST.

**Makefile:** Used to automate the working of the program for a specific input with different arguments such as -verbose,help,input,output

**c++ programming language** Used for the logical coding portion of the program.

## 3 Symbol Tables

- We have defined our Global Symbol table named as **global\_sym\_table** in the file **parser.y**.
- In the folder **output/symTables/**, all the Symbol Tables of corresponding scopes are printed in csv file with its name as -
  - for class : className.csv
  - for methods: className\_methodName.csv
  - for constructors: cons\_className

## 4 Three Address Code

### 4.1 Instructions:

- Assignment: It is simple assignment instruction. Ex-  $t_0 = t_1 + t_2$
- Unconditional jump: Jump to given label. Ex- goto L1
- Conditional jump: If condition is true then jump to given label . Ex- if cond goto L1
- Print: print the given variable Ex- print t0
- Param: To push the given parameter into the stack Ex- param t1
  - It is used in case of object instance creation using constructor where we will push the object reference.
  - It is used in case of method invocation when we pass some parameters.
  - It is used while creating array instance, where we will push the size of array to create memory.
- Popparam: To pop last pushed element from the stack. Ex-  $t_1 = \text{popparam}$  . It is also used in similar fashion as previous one.
- call: To call the given function with n number of parameters. Ex-  $t_5 := \text{call func } n$
- getFromSymTable: It gets the offset of the variable from the given scope. Ex - `getFromSymTable(scope,var)`.
- pushArr: It is used to store the array elements in row-major order format.  
Ex- if we want to allocate the array 1,5,2,7, we will first allocate memory for the same and then push each of the elements.  
 $t_{10} := 16 - 4 \text{ elements} * \text{sizeof(int)}$   
param t10  
allocmem 1 – allocate memory

```
t11 := popparam
pushArr t11 1 0
pushArr t11 5 4
pushArr t11 2 8
pushArr t11 7 12
```

## 4.2 Instructions added in Milestone-4

- `getAddress`: It fetches the address stored at given offset from basepointer . It is used in case of getting array address.

`getAddress t_4` means get the address stored at `%rbp - t_4`

Some other changes which we have done in 3AC are as follows:

- Initialization of fields is moved into the Constructor

## 4.3 Features Supported

The IR-Generator supports for the following JAVA language features-

- Primitive data types (e.g., int, boolean)
- Multidimensional arrays supporting C-style declarations
- Basic operators:
  - Arithmetic operators
  - Preincrement, predecrement, postincrement, and postdecrement
  - Relational operators
  - Bitwise operators
  - Logical operators
  - Assignment operators
  - Ternary operator
- Control flow via if-else, for, and while
- Methods and method calls
- Support for recursion
- the library function `println()` for printing integer
- Support for classes and objects. For class definitions, supported public and private access modifiers

## 4.4 Bonus Features

- Array initializing using Array initializer.

## 4.5 Assumptions

- Constructors need to be explicitly declared before creating an instance.
- Field declaration does not have array initialization.

# 5 Contribution

Name	Roll	Email	Contribution
Aarchie	200004	aarchi20@iitk.ac.in	35%
Udit Prasad	201055	uditp20@iitk.ac.in	35%
Harshit Kumar Tiwari	200432	harshitkt20@iitk.ac.in	30%