Mario Garcia

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CS 411

Dr. Dominick Atanasio

Project 2: Toybox Compiler

For this second project, our mission was to integrate the yacc parser into Toybox, the compiler for the toy programming language designed by Dr. Dominick Atanasio. It’s fate was quite difficult, yet manageable. Given the complexity of the grammar, we managed to make a useful compiler, albeit a few (namely 2) conflicts along with it. Both of these conflicts involve shift/reduce warnings, to which involve our StmtDeclares state recurse. Given Left recursion of Type is still abundant in our yacc CFG, this was bound to cause a minor conflict. Although we have encountered this problem, we have decided to leave the grammar as is, since it has caused no hard in our tests. Yet, the conflicts we did fix involved rather serious implications if left alone. One such conflict we managed to solve was the Lvalue statement left recursion, to which was in need of right recursion, as well as the if-else ambiguity that was sticking out like a sore thumb. Solving these states by removing left recursion helped solve nearly all our conflicts, and leaving merely 2 conflicts that were of no concern.

For testing, we used a relatively simple file, config.in, to check if simple function calling and class declarations we’re parsed correctly:

/\*\*

This is a sample test.

I am a cat. I like cats and other cool things.

\*/

int fact(int x) {

// recursive factorial function

if (x > 1) return x \* fact(x - 1);

else return 1;

}

void main() {

/\* Winter Quarter 2015

CS 411 Project #`

A Lexical analyzer \*/

int x;

int total;

println("factorial of 10 is ", fact(10), " from the recursive function");

total = 1; x = 1;

for (; x <= 10; ) { total = total \* x; x = x + 1; }

println("iterative result of 10! is ", total);

}

class cs411 {

int Funny;

double funny;

boolean flag;

string s;

int [] a;

int Init() {

int flag = true;

int Funny = 0X89aB;

// this is a lex error, no rule saying intconstant is with e.

//int funny = 123456E+7;

int s = "hello world";

while (x = (funny/10)<0) println(s, "have fun !");

a = newarray(20, int);

return 1;

}

}

EOF

Notice how there is also an if statement test case for us, as well as a for, and while loop. The results of this parser was the following:

alxis@alxis-VirtualBox:~/Documents/Github/ToyBox/build$ ./toybox <../config.in

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

[reduce 21]

Shifting token => 42

Shifting token => 45

Shifting token => 11

Shifting token => 41

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 30

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 49]

Shifting token => 42

Shifting token => 18

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 25

Shifting token => 51

Shifting token => 41

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 24

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 42]

[reduce 64]

Shifting token => 42

[reduce 62]

[reduce 40]

[reduce 43]

Shifting token => 38

[reduce 76]

[reduce 34]

Shifting token => 7

Shifting token => 18

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

[reduce 71]

[reduce 30]

Shifting token => 46

[reduce 27]

[reduce 25]

Shifting token => 21

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

[reduce 28]

[reduce 28]

Shifting token => 16

Shifting token => 41

Shifting token => 49

[reduce 68]

[reduce 38]

Shifting token => 42

Shifting token => 38

[reduce 78]

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 37]

Shifting token => 38

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 37]

Shifting token => 38

Shifting token => 10

Shifting token => 41

Shifting token => 38

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 29

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 48]

Shifting token => 38

Shifting token => 42

[reduce 73]

Shifting token => 45

[reduce 59]

[reduce 59]

[reduce 39]

[reduce 37]

Shifting token => 25

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 43]

Shifting token => 38

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 37]

Shifting token => 23

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 41]

Shifting token => 38

[reduce 29]

[reduce 29]

Shifting token => 46

[reduce 27]

Shifting token => 16

Shifting token => 41

Shifting token => 49

[reduce 68]

[reduce 38]

Shifting token => 39

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 79]

Shifting token => 42

Shifting token => 38

[reduce 78]

[reduce 35]

[reduce 36]

[reduce 32]

[reduce 29]

[reduce 29]

[reduce 35]

Shifting token => 46

[reduce 27]

[reduce 26]

Shifting token => 5

Shifting token => 51

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 3

[reduce 10]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 19

[reduce 11]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 43

Shifting token => 44

[reduce 12]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 37

Shifting token => 50

[reduce 69]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 37

Shifting token => 47

[reduce 66]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 37

Shifting token => 49

[reduce 68]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

[reduce 28]

[reduce 28]

[reduce 28]

Shifting token => 22

Shifting token => 41

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 41

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 26

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 44]

Shifting token => 42

[reduce 56

[reduce 37]

Shifting token => 28

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 47]

Shifting token => 42

Shifting token => 16

Shifting token => 41

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 39

Shifting token => 49

[reduce 68]

[reduce 38]

[reduce 79]

Shifting token => 42

Shifting token => 38

[reduce 78]

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 15

Shifting token => 41

Shifting token => 47

Shifting token => 39

Shifting token => 13

[reduce 9]

Shifting token => 42

[reduce 58]

[reduce 37]

Shifting token => 38

Shifting token => 18

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

[reduce 29]

[reduce 35]

[reduce 72]

[reduce 31]

Shifting token => 46

[reduce 27]

[reduce 25]

[reduce 24]

[reduce 23]

[reduce 23]

[reduce 23]

[reduce 23]

[reduce 23]

Shifting token => 46

[reduce 14]

[reduce 2]

[reduce 4]

[reduce 4]

[reduce 0]

Shifting token => 0

END

Of course the amount of shifting and reducing is rather tremendous, the last statement (Shifting token => 0) indicates that we have reached our final state, and that we can accept this file as part of the syntax.

We again test our paser with a slightly more complicated file, main.toy:

/\*

Sample test

Dr. Dominick Atanasio

Authors: Mario Garcia, Michael Wallace

Testing Toy's Front end capabilities.

\*/

//

// Animal interface that describes cool animals mang....

//

//

interface Animal {

int LevelUp();

double GetHeight();

string ConsumeFood(double x, double y, string z);

void Say();

}

/\*

Neutral interface

\*/

interface Neutral {

string GetItems();

}

interface Controllable {

int MoveX();

int MoveY();

int Inject(double x);

}

class Cat implements Animal {

int x;

int y;

boolean z;

}

class Kitten extends Cat implements Neutral, Controllable {

string name;

double age;

Animal[] allies;

double health;

int ConsumeFood(double x, double y, string z) {

allies = newarray(100, Animal);

// Crazy loop test.

for (i = 0; i < x; i = i + 1) {

age = age + 1;

for (j = 0; j < x; j = j + 1) {

while (1) {

x = x || 2;

}

}

}

// Ambiguous if-else stmts

if (age < 0) {

x.age = 12;

if (name == "null") return 0; else return 1;

} else {

return 1;

}

return 11;

}

void DoNothing(boolean nothing) {

}

}

void main() {

Kitten kitten;

boolean ididit = true;

kitten.ConsumeFood(12.0, 12, "I like cats alot");

println("I am the almighty", kitten);

}

Notice a few things in this file, we declare three interfaces, have one class implement an interface, and have another class extend another, along with implmenting two interfaces as well. Not only this, but our classes contain data, as well as functions with parameters. Within our functions, there exists embedded loops, as well as an ambiguous if-else statement. The result of the program is as follows:

alxis@alxis-VirtualBox:~/Documents/Github/ToyBox/build$ ./toybox <../main.toy

Shifting token => 14

Shifting token => 51

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

Shifting token => 6

[reduce 8]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

Shifting token => 19

[reduce 11]

Shifting token => 51

Shifting token => 41

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 39

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 39

Shifting token => 19

[reduce 11]

Shifting token => 51

[reduce 6]

[reduce 21]

[reduce 22]

[reduce 22]

Shifting token => 42

Shifting token => 38

Shifting token => 21

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

[reduce 20]

[reduce 19]

[reduce 19]

[reduce 19]

Shifting token => 46

[reduce 18]

Shifting token => 14

Shifting token => 51

Shifting token => 45

Shifting token => 19

[reduce 11]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

[reduce 19]

Shifting token => 46

[reduce 18]

Shifting token => 14

Shifting token => 51

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

[reduce 21]

Shifting token => 42

Shifting token => 38

[reduce 19]

[reduce 19]

[reduce 19]

Shifting token => 46

[reduce 18]

Shifting token => 5

Shifting token => 51

Shifting token => 12

Shifting token => 51

[reduce 16]

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 3

[reduce 10]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

[reduce 23]

[reduce 23]

[reduce 23]

Shifting token => 46

[reduce 14]

Shifting token => 5

Shifting token => 51

Shifting token => 8

Shifting token => 51

[reduce 15]

Shifting token => 12

Shifting token => 51

Shifting token => 39

Shifting token => 51

[reduce 17]

[reduce 16]

Shifting token => 45

Shifting token => 19

[reduce 11]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 51

[reduce 13]

Shifting token => 43

Shifting token => 44

[reduce 12]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 39

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 39

Shifting token => 19

[reduce 11]

Shifting token => 51

[reduce 6]

[reduce 21]

[reduce 22]

[reduce 22]

Shifting token => 42

Shifting token => 45

[reduce 59]

Shifting token => 41

Shifting token => 47

Shifting token => 39

Shifting token => 51

[reduce 13]

Shifting token => 42

[reduce 58]

[reduce 37]

Shifting token => 38

Shifting token => 10

Shifting token => 41

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 37]

[reduce 74]

Shifting token => 38

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 28

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 47]

Shifting token => 38

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 37]

Shifting token => 23

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 41]

[reduce 74]

Shifting token => 42

[reduce 73]

Shifting token => 45

[reduce 59]

[reduce 59]

[reduce 39]

[reduce 37]

Shifting token => 23

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 41]

Shifting token => 38

Shifting token => 10

Shifting token => 41

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 37]

[reduce 74]

Shifting token => 38

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 28

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 47]

Shifting token => 38

Shifting token => 51

[reduce 59]

Shifting token => 37

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 37]

Shifting token => 23

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 41]

[reduce 74]

Shifting token => 42

[reduce 73]

Shifting token => 45

Shifting token => 22

Shifting token => 41

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 42

Shifting token => 45

[reduce 59]

[reduce 59]

[reduce 39]

[reduce 37]

Shifting token => 35

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 54]

Shifting token => 38

[reduce 29]

Shifting token => 46

[reduce 27]

[reduce 36]

[reduce 72]

[reduce 31]

Shifting token => 46

[reduce 27]

[reduce 36]

[reduce 32]

[reduce 29]

Shifting token => 46

[reduce 27]

Shifting token => 11

Shifting token => 41

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 28

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 47]

Shifting token => 42

Shifting token => 45

Shifting token => 51

[reduce 61]

[reduce 59]

Shifting token => 37

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 37]

Shifting token => 38

Shifting token => 11

Shifting token => 41

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 32

Shifting token => 49

[reduce 68]

[reduce 38]

[reduce 51]

Shifting token => 42

Shifting token => 18

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

Shifting token => 7

Shifting token => 18

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

[reduce 71]

[reduce 30]

[reduce 29]

Shifting token => 46

[reduce 27]

[reduce 36]

Shifting token => 7

Shifting token => 45

Shifting token => 18

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

Shifting token => 46

[reduce 27]

Shifting token => 18

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

[reduce 36]

[reduce 71]

[reduce 30]

[reduce 36]

[reduce 32]

[reduce 29]

Shifting token => 46

[reduce 27]

[reduce 25]

Shifting token => 21

Shifting token => 51

Shifting token => 41

Shifting token => 3

[reduce 10]

Shifting token => 51

[reduce 6]

[reduce 21]

Shifting token => 42

Shifting token => 45

Shifting token => 46

[reduce 27]

[reduce 26]

[reduce 24]

[reduce 24]

[reduce 23]

[reduce 23]

[reduce 23]

[reduce 23]

Shifting token => 46

[reduce 14]

Shifting token => 21

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 45

[reduce 13]

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 3

[reduce 10]

Shifting token => 51

Shifting token => 37

Shifting token => 50

[reduce 69]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

[reduce 28]

[reduce 28]

Shifting token => 51

Shifting token => 41

Shifting token => 48

[reduce 67]

[reduce 38]

Shifting token => 39

Shifting token => 47

[reduce 66]

[reduce 38]

Shifting token => 39

Shifting token => 49

[reduce 68]

[reduce 38]

[reduce 65]

[reduce 65]

[reduce 64]

Shifting token => 42

[reduce 63]

[reduce 40]

Shifting token => 38

Shifting token => 16

Shifting token => 41

Shifting token => 49

[reduce 68]

[reduce 38]

Shifting token => 39

Shifting token => 51

[reduce 59]

[reduce 39]

[reduce 79]

Shifting token => 42

Shifting token => 38

[reduce 78]

[reduce 35]

[reduce 29]

Shifting token => 46

[reduce 27]

[reduce 26]

[reduce 4]

[reduce 2]

[reduce 2]

[reduce 3]

[reduce 3]

[reduce 3]

[reduce 0]

Shifting token => 0

A fairly large file parse, and possibly a very large syntax tree for code generation, yet it managed to successfully accept the file without hesitation, reducing correctly, along with shifting as instructed, especially with the is-else statement.

Let’s take a look at this file, which contains a simple, syntactically incorrect grammar:

/\*

Syntax error intentional file.

Authors: Mario Garcia, Michael Wallace

\*/

class Human {

int x;

int y;

double z;

int DoHumanThings(double x) {

return x;

}

}

class BaseballPlayer extends Human {

string PlayBall() {

while (true) {

x = x + 1;

}

return "Let's play buol!!";

}

}; // not C++, therefore syntax error

int main() {

return 1;

}

Although quite simple, we notice a very slight altercation of the language by adding so much as a ‘;’ after the implementation of BaseballPlayer. This results in a syntax error that yacc will spit out. Eventually, we simply say that this file is not syntactically correct:

Shifting token => 5

Shifting token => 51

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 13

[reduce 9]

Shifting token => 51

Shifting token => 41

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

[reduce 21]

Shifting token => 42

Shifting token => 45

Shifting token => 18

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 38

[reduce 76]

[reduce 34]

Shifting token => 46

[reduce 27]

[reduce 25]

[reduce 24]

[reduce 23]

[reduce 23]

[reduce 23]

Shifting token => 46

[reduce 14]

Shifting token => 5

Shifting token => 51

Shifting token => 8

Shifting token => 51

[reduce 15]

Shifting token => 45

Shifting token => 19

[reduce 11]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 45

Shifting token => 22

Shifting token => 41

Shifting token => 50

[reduce 69]

[reduce 38]

Shifting token => 42

Shifting token => 45

[reduce 59]

[reduce 59]

[reduce 39]

[reduce 37]

Shifting token => 23

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 41]

Shifting token => 38

[reduce 29]

Shifting token => 46

[reduce 27]

Shifting token => 18

Shifting token => 49

[reduce 68]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

[reduce 36]

[reduce 72]

[reduce 31]

Shifting token => 46

[reduce 27]

[reduce 25]

[reduce 24]

Shifting token => 46

[reduce 14]

[reduce 2]

[reduce 2]

[reduce 0]

syntax error

Overall, our program will parse nicely if we decide to eliminate the ‘;’ character from the file.

The next file introduces a bit of another structure, using if-else ambiguity:

/\*

Example of the ToyBox Lexical analyzer.

\*/

interface Animal {

string SaySomething();

void TakeAWalk();

}

class Cat implements Animal {

int age;

double speed;

string name;

string SaySomething() {

return "Meow";

}

void TakeAWalk() {

// Do nothing, cause this function is useless with

// the data we have.

}

}

void main() {

double test = 0.12; // this shouldn't work

double tes2 = 0.121; // this should

double id = 11.0e11; // dunno

string joker = "I like cats";

Cat cat;

println(cat.SaySomething(12));

if (test < 11) {

cat.speed = 0.16;

} else else {

return 1.0;

}

return 0;

}

The output of this file does indeed result in a syntax error, as we find that the if-else statement is not consistent.

Shifting token => 14

Shifting token => 51

Shifting token => 45

Shifting token => 19

[reduce 11]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

Shifting token => 21

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 38

[reduce 20]

[reduce 19]

Shifting token => 46

[reduce 18]

Shifting token => 5

Shifting token => 51

Shifting token => 12

Shifting token => 51

[reduce 16]

Shifting token => 45

Shifting token => 13

[reduce 9]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 6

[reduce 8]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 19

[reduce 11]

Shifting token => 51

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 19

[reduce 11]

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 45

Shifting token => 18

Shifting token => 49

[reduce 68]

[reduce 38]

Shifting token => 38

[reduce 76]

[reduce 34]

Shifting token => 46

[reduce 27]

[reduce 25]

Shifting token => 21

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 45

Shifting token => 46

[reduce 27]

[reduce 26]

[reduce 24]

[reduce 24]

[reduce 23]

[reduce 23]

[reduce 23]

Shifting token => 46

[reduce 14]

Shifting token => 21

Shifting token => 51

Shifting token => 41

Shifting token => 42

Shifting token => 45

Shifting token => 6

[reduce 8]

Shifting token => 51

Shifting token => 37

Shifting token => 48

[reduce 67]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 6

[reduce 8]

Shifting token => 51

Shifting token => 37

Shifting token => 48

[reduce 67]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 6

[reduce 8]

Shifting token => 51

Shifting token => 37

Shifting token => 48

[reduce 67]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

Shifting token => 19

[reduce 11]

Shifting token => 51

Shifting token => 37

Shifting token => 49

[reduce 68]

[reduce 7]

[reduce 6]

Shifting token => 38

[reduce 5]

[reduce 13]

[reduce 6]

Shifting token => 38

[reduce 5]

[reduce 28]

[reduce 28]

[reduce 28]

[reduce 28]

[reduce 28]

Shifting token => 16

Shifting token => 41

Shifting token => 51

Shifting token => 40

Shifting token => 51

Shifting token => 41

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 64]

Shifting token => 42

[reduce 63]

[reduce 40]

Shifting token => 42

Shifting token => 38

[reduce 78]

Shifting token => 11

Shifting token => 41

Shifting token => 51

[reduce 59]

[reduce 39]

Shifting token => 28

Shifting token => 47

[reduce 66]

[reduce 38]

[reduce 47]

Shifting token => 42

Shifting token => 45

Shifting token => 51

[reduce 61]

[reduce 59]

Shifting token => 37

Shifting token => 48

[reduce 67]

[reduce 38]

[reduce 37]

Shifting token => 38

[reduce 29]

Shifting token => 46

[reduce 27]

[reduce 36]

Shifting token => 7

[reduce 71]

[reduce 30]

[reduce 35]

syntax error