The Unnamed Language

Programming language for the UVic CSC 435 Compiler Construction class. The grammar for the language can be found here.

View this repo on Github.

Compiling

The compiler is built with `make`.

- `make grammar` runs Antlr to generate lexer and parser classes
- `make compiler` compiles the compiler
- `make clean` removes compile and build files

To do a full clean and build run,

```
make clean; make
```

Running

The compiler can be run against language files to generate IR code for them. By default, IR will be sent to standard out. Options can be specified to change the default behaviour, such as specifying a file to output the IR to.

The built compiler is located in the `bin/` directory.

```
cd bin/
java Compiler path/to/file.ul
```

Options

- `-o outfile` Specify a file to save the pretty printed output or dot mode output. If no file is given, output is sent to stdout.
- `-ir 1|0` IR generation mode. If `1` then the IR text will be generated to the file and sent to

`outfile`. *(Default 1)*
- `-p 1|0` Pretty print mode. If `1` then file will be pretty printed after type checking. *(Default 0)*
- `-d 1|0` Dot mode. If `1` then the output is in the DOT language. *(Default 0)*

Testing

There are a bunch of .ul language files that can be tested against the compiler. Throughout the course I will update the test script to check whether the latest requirements are met. Use the script `test.sh` to run all tests.

```
# Run the tests
./test.sh
```

The latest provided tests are in `accept/provided` for all `*_valid.ul` files and `reject/provided` for all `*_invalid.ul` files.

`.ul` files in the `tests/output` directory have a corresponding `.txt` file. When the tests are run, the IR is sent through `./codegen` and `jasmin`. The output of the Java `.class` file is compared to the `.txt` file. If they are different then an error is thrown. These tests allow me to ensure the behaviour of the programs the compiler generates is expected.

Differences From Default Spec

My compiler has a few changes from the default specification. These are

- Variables can be declared anywhere in a function and their use is scoped to the current block
- int < float subtype relationship
- Functions with same name but different type signature are allowed

Variable Declarations and Scopes

I have changed by grammar to treat variable declarations as statements. This means that variables can be declared anywhere in the function. Their use is scoped to the current block. My environment creates a new scope when a function or block is entered. For example, the following code was previously not in the language, now it is.

```
void main() {
    print "hello"
    int x;

    if (true) {
        int y;
        x = y + 1;
    }
}
```

If a scope is exited, then the variable becomes out of scope and is not allowed. For example, this would result a "Variable is not declared" error.

```
void main() {
    int x;

    if (true) {
        int y;
    }
    x = y; // not allowed because y is not in scope.
}
```

Subtype Relationship

With the single subtype relationship, this code is allowed

```
void main() {
    int a;
    float b;
    float c;

    a = 1;
    b = 1.1;
    c = a + b;
}
```

Because of this relationship, test wSt3.2.2.ainvalid.ul has been removed from the test set.

Function Declarations

Type signatures are used when comparing function declarations. Two functions can have the same name as long as their signatures are different. For example, this is allowed.

```
void foo() {}
void foo(int x) {}
void main() {}
```

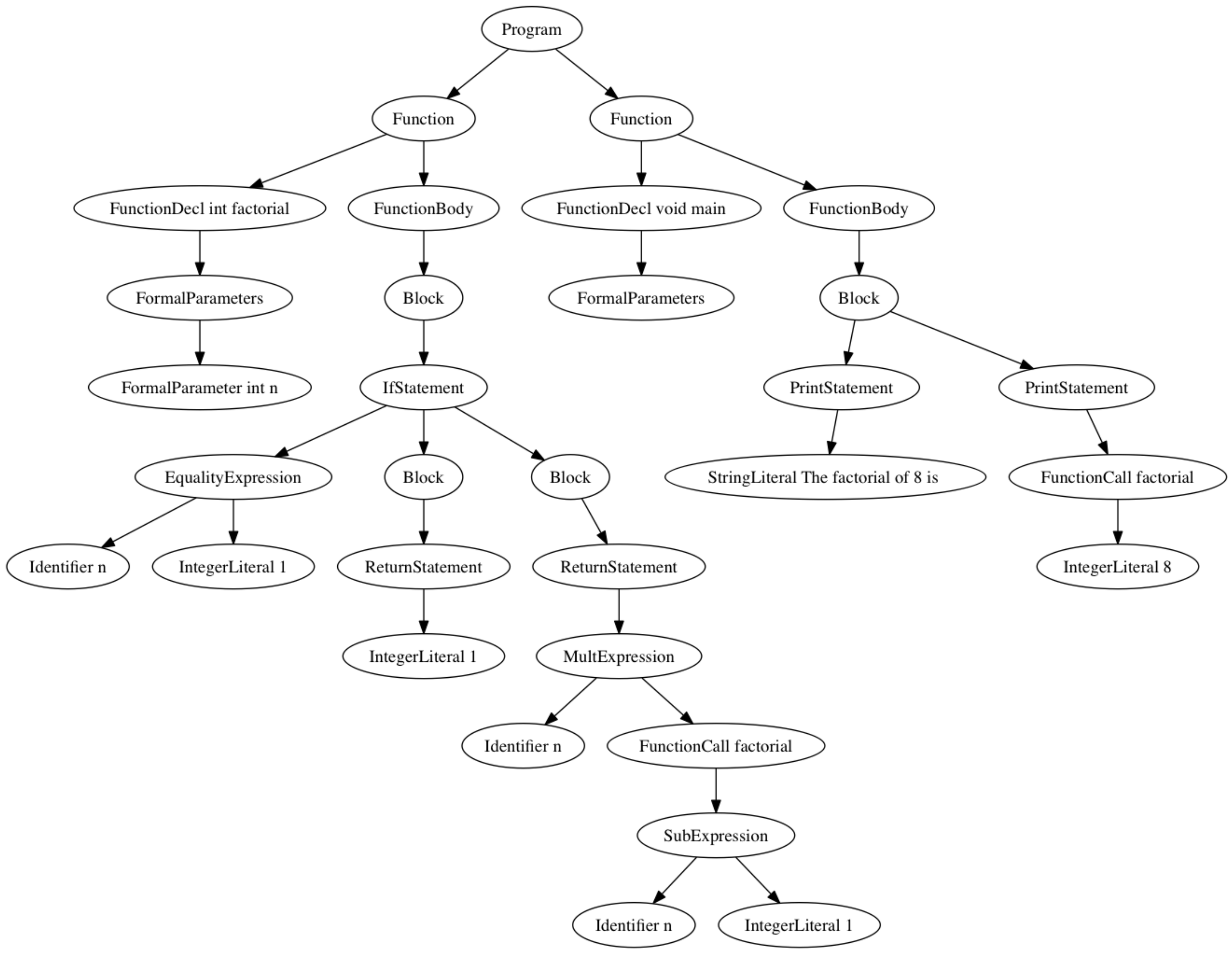
Example

This following code finds the factorial of 8.

```
int factorial (int n) {
  if (n == 1) {
    return 1;
  } else {
    return n*factorial(n-1);
  }
}

void main () {
  print "The factorial of 8 is ";
  println factorial(8);
}
```

The following AST is produced.



The following IR is generanted

```
PROG test
FUNC factorial (I)I
{
    TEMP 0:I;
    TEMP 1:I;
    TEMP 2:Z;
    TEMP 3:I;
    TEMP 4:I;
    TEMP 5:I;
    TEMP 6:I;
    TEMP 7:I;

        T1 := 1;
        T2 := T0 I== T1;
        T2 := Z! T2;
        IF T2 GOTO L0;
        T3 := 1;
        RETURN T3;
        GOTO L1;
    L0:;
        T5 := 1;
        T6 := T0 I- T5;
        T4 := CALL factorial(T6);
        T7 := T0 I* T4;
        RETURN T7;
    L1:;
        RETURN;
}

FUNC main ()V
{
    TEMP 0:U;
    TEMP 1:I;
    TEMP 2:I;

        T0 := "The factorial of 8 is ";
        PRINTU T0;
        T2 := 8;
        T1 := CALL factorial(T2);
        PRINTLNI T1;
        RETURN;
}
```

Dot Graphs

Dot language programs can be produced with the `-d 1` option to the compiler.

For example, if you have this file

```
// hello.ul
void main() {
    println "hello world";
}
```

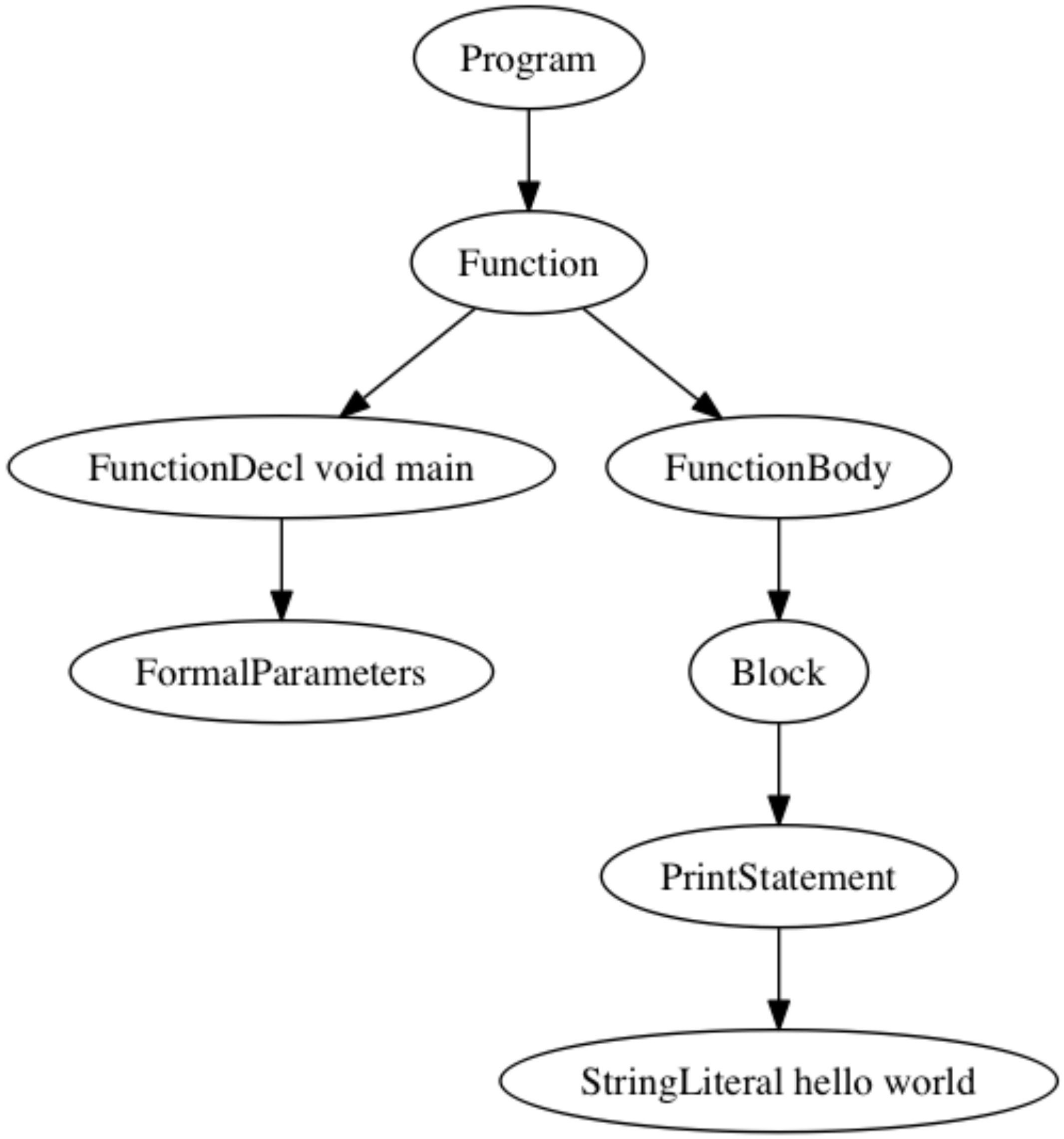
You can compile it with

```
java Compiler -d 1 -ir 0 -o hello.dot hello.ul
```

You can then use the dot program to create a png image file and open it

```
dot -Tpng hello.dot -O && open hello.dot.png
```

The output should be



Licenses

All third party code is referenced in the LICENSES file.

TODO

- [x] Lexer
- [x] Parser and AST generation
- [x] Pretty printing
- [x] Dot output
- [x] Syntax analysis
- [x] Type checking

- [x] Intermediate code generation
- [ ] Machine code generation
- [ ] Assembly and linking