

CS 536 — Spring 2016

CSX Code Generation Routines

Part IV

CSX Class Body

We first generate the Jasmin class header declarations. A shared field `CLASS` is set to the name of the CSX class. Next, we generate field declarations. We then generate a method definition for `main(String [])`, which is the standard starting point for JVM executions. This method contains non-trivial field initializations and a call to `main()`, the standard CSX starting point. Finally, methods are translated.

```
void visit(classNode n) {
    currentMethod = null; // We're not in any method body (yet)
    CLASS = n.className.idname;
    // generate:
    // .class public CLASS
    // .super java/lang/Object

    // Generate field declarations for the class
    this.visit(n.members.fields);

    // generate:
    // .method public static main([Ljava/lang/String;)V

    // Generate non-trivial field initializations
    this.visit(n.members.fields);

    // generate:
    // invokestatic CLASS/main()V
    // return
    // .limit stack 2
    // .end method

    // Finally translate methods
    this.visit(n.members.methods);
}
```

Methods

We'll assume that if we're currently translating an AST node that's within a method declaration (that is, "under" a `methodDeclNode`) then a shared field `currentMethod` points to that `methodDeclNode`. If we're not within a method declaration then `currentMethod` is null.

Calls are straightforward to translate. We first translate the parameter list, pushing each actual parameter onto the stack. We then "call" the appropriate method. Because Jasmin requires that a method name in a call must contain type codes for the parameters and return value, we will build the appropriate code using the overloaded utility routine `buildTypeCode`. If an integer function `f` is called with a single integer parameter, it has a type code code of "`f(I)I`". Since we look at the types of the parameters actually used in the call, overloaded methods are correctly handled.

```
String typeCode(typeNode type){
    // Return type code
    if (type instanceof intTypeNode)
        return "I";
    else if (type instanceof charTypeNode)
        return "C";
    else if (type instanceof boolTypeNode)
        return "Z";
    else // (type instanceof voidTypeNode)
        return "V";
}

String typeCode(Types type){
    // Return type code
    switch (type){
        case Integer:
            return "I";
        case Character:
            return "C";
        case Boolean:
            return "Z";
        case Void:
            return "V";
    }
}

String buildTypeCode(argDeclNode n) {
    if (n instanceof valArgDeclNode)
        return typeCode(((valArgDeclNode) n).argType);
    else // must be an arrayArgDeclNode
        return
            arrayTypeCode(((arrayArgDeclNode) n).elementType);
}
```

```

String buildTypeCode(argDeclsNode n){
    if (n.moreDecls.isNull())
        return buildTypeCode(n.thisDecl);
    else
        return buildTypeCode(n.thisDecl)+
            buildTypeCode((argDeclsNode) n.moreDecls);
}

String buildTypeCode(exprNode n){
    if (isArray(n.kind))
        return arrayTypeCode(n.type);
    else return typeCode(n.type);
}

String buildTypeCode(argsNode n){
    if (n.moreArgs.isNull())
        return buildTypeCode(n.argVal);
    else return buildTypeCode(n.argVal) +
        buildTypeCode((argsNode) n.moreArgs);
}

String buildTypeCode(String methodName,
                    argsNodeOption args, String returnCode){
    String newTypeCode = methodName;
    if (args.isNull())
        newTypeCode = newTypeCode + "()";
    else newTypeCode = newTypeCode + "(" +
        buildTypeCode((argsNode) args) + ")";
    return newTypeCode + returnCode;
}

void visit(argsNode n) {
    // Evaluate arguments and load them onto stack
    this.visit(n.argVal);
    this.visit(n.moreArgs);
}

void visit(callNode n) {
    // Evaluate args and push them onto the stack
    this.visit(n.args);
    // Generate call to method, using its type code
    String typeCode =
        buildTypeCode(n.methodName.idname, n.args,
            n.methodName.idinfo.methodReturnCode);
    genCall(CLASS+ "/" + typeCode);
}

```

The translation of `fctCallNodes` is essentially identical to that of `callNodes`.

Return statements within a function will evaluate the return value onto the stack and then do an `ireturn`. Return statements within a procedure generate a `return`.

```
void visit(returnNode n) {
    if (n.returnVal.isNull())
        // generate: return
    else { // Evaluate return value
        this.visit(n.returnVal);
        // generate: ireturn
    }
}
```

Within methods, each parameter and local variable will be assigned a “local variable index,” starting at zero. A field `numberOfLocals`, within a method’s `SymbolInfo` node, will track how many locals have been allocated an index.

```
void visit(argDeclsNode n) {
    // Label each method argument with its address info
    this.visit(n.thisDecl);
    this.visit(n.moreDecls);
}

void visit(valArgDeclNode n) {
    // Label method argument with its address info
    n.argName.idinfo.adr = local;
    n.argName.idinfo.varIndex =
        currentMethod.name.idinfo.numberOfLocals++;
}

void visit(arrayArgDeclNode n) {
    // Label method argument with its address info
    n.argName.idinfo.adr = local;
    n.argName.idinfo.varIndex =
        currentMethod.name.idinfo.numberOfLocals++;
}

void visit(methodDeclNode n) {
    currentMethod = n; // We're in a method now!
    n.name.idinfo.numberOfLocals = 0;
    String newTypeCode = n.name.idname;
    if (n.args.isNull())
        newTypeCode = newTypeCode + "()";
    else newTypeCode = newTypeCode + "(" +
        buildTypeCode((argDeclsNode) n.args) + ")";
    newTypeCode = newTypeCode + typeCode(n.returnType);
    n.name.idinfo.methodReturnCode = typeCode(n.returnType);
    // generate:
    // .method public static newTypeCode
    this.visit(n.args); // Assign local variable indices to args
    // Generate code for local decls and method body
    this.visit(n.decls);
    this.visit(n.stmts);
}
```

```

// generate default return at end of method body
if (n.returnType instanceof voidTypeNode)
    // generate: return
else { // Push a default return value of 0
    loadI(0);
    // generate: ireturn
}
// Generate end of method data;
// we'll guesstimate stack depth needed at 25
// (almost certainly way too big!)
// generate: .limit stack 25
// generate: .limit locals n.name.idinfo.numberOfLocals
// generate: .end method
}

```

We need to extend visit methods for varDeclNode, constDeclNode and arrayDeclNode to handle local variables.

```

void visit(varDeclNode n){
    if (currentMethod == null) // A global field decl
        if (n.varName.idinfo.adr == none)
            // First pass; generate field declarations
            declField(n);
        else { // 2nd pass; do field init (if needed)
            if (! n.initValue.isNull())
                if (! isNumericLit(n.initValue)) {
                    // Compute init value & store in field
                    this.visit(n.initValue);
                    storeId(n.varName);
                }
        }
    else { // Process local variable declaration
        // Give this var an index equal to numberOfLocals
        // and remember index in symbol table entry
        n.varName.idinfo.varIndex =
            currentMethod.name.idinfo.numberOfLocals;
        n.varName.idinfo.adr = local;
        // Increment numberOfLocals used in this method
        currentMethod.name.idinfo.numberOfLocals++;
        // Do initialization (if necessary)
        if (! n.initValue.isNull()){
            this.visit(n.initValue);
            storeId(n.varName);
        }
    }
}

```

```

void visit(constDeclNode n) {
    if (currentMethod == null) // A global const decl
        if (n.constName.idinfo.adr == none)
            // First pass; generate field declarations
            declField(n);
        else { // 2nd pass; do field initialization (if needed)
            if (! isNumericLit(n.constValue)) {
                // Compute init value & store in field
                this.visit(n.constValue);
                storeId(n.constName);
            }
        }
    else { // Process local const declaration
        // Give this variable an index equal to numberOfLocals
        // and remember index in symbol table entry
        n.constName.idinfo.varIndex =
            currentMethod.name.idinfo.numberOfLocals;
        n.constName.idinfo.adr = local;
        // Increment numberOfLocals used in this method
        currentMethod.name.idinfo.numberOfLocals++;
        // compute and store const value
        this.visit(n.constValue);
        storeId(n.constName);
    }
}

void visit(arrayDeclNode n) {
    // Create a new array and store resulting reference
    if (currentMethod == null) { // A global array decl
        if (n.arrayName.idinfo.adr == none) {
            // First pass; generate field declarations
            declField(n);
            return;
        }
    } else {
        // Process local array declaration
        // Give this variable an index equal to numberOfLocals
        // and remember index in symbol table entry
        n.arrayName.idinfo.varIndex =
            currentMethod.name.idinfo.numberOfLocals;
        n.arrayName.idinfo.adr = local;
        // Increment numberOfLocals used in this method
        currentMethod.name.idinfo.numberOfLocals++;
    }

    // Now create the array & store a reference to it
    loadI(n.arraySize.intval); // Push size of array
    allocateArray(n.elementType);
    if (n.arrayName.idinfo.adr == global)
        storeGlobalReference(n.arrayName.idinfo.label,
            arrayTypeCode(n.elementType));
    else storeLocalReference(n.arrayName.idinfo.varIndex);
}

```

Finally, we handle blocks. Local declarations are allocated within the frame of the enclosing method.

```
void visit(blockNode n) {  
  // Generate code for block decls and body  
    this.visit(n.decls);  
    this.visit(n.stmts);  
}
```