Oberon2 Compiler
CS335: Compiler Project

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April 16, 2011
- Source Language ($S$) $\rightarrow$ Oberon 2
- Target Language ($T$) $\rightarrow$ MIPS Assembly Language
- Implementation Language ($I$) $\rightarrow$ C++
- Library Used $\rightarrow$ STL library
Oberon was developed by Prof. Niklaus Wirth as part of the Oberon operating system.

Oberon was derived from Modula-2 with type extension features and simplified grammar.

Oberon 2 is an extension of Oberon that adds limited object-oriented features. (Type bound Procedures)

Important features

- Array bounds checking
- Static typing with strong type checking
- Modularity
- Garbage Collection
### Organization of Code

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Oberon supports basic types (INTEGER, CHAR, BOOLEAN, REAL etc.) and their extensions with POINTER, ARRAY, RECORD and PROCEDURE.

- We are representing types by a tree structure.
- The root node contains information about the extension or the basic type and the children are the types from which it is derived.
- Graceful error recovery system.
- Type expansion for arithmetic types has been implemented for type checking phase.
- For ex: typeExpansion.m, typeConversion.m, record_type.m
Syntax of Intermediate Language

- LABEL
- JUMP, CJUMP
- CALL, PARAM, RETURN, END
- ARRR (rvalue), ARRL (lvalue)
- RECR (rvalue), RECL (lvalue)
- PRINT
- ADD, SUB, MIN, MUL, DIV, MOD, COPY

We generated a strong front end interface which can be easily extended to provide new back end features.
Array and Records

- **Run time array bound** checking: We maintain the array dimensions during runtime.

- **Multidimensional array**: Represented in the memory as row major form.

- **Complex expression** can be used as array indices.

- Array can passed as **array arguments**: Required declaration of a stack dedicated to saving information of the parent array as the parsing follows the same rule in the grammar to avoid the loss of information.

- **Record**: Offsets for variables are found using nested symbol tables.

- For ex: arrayArg.m, multiArray.m, record.m
Conditional and Control Structure

- IF, ELSE-IF, ELSE
- Maintained the true list and false list accordingly with the back patching algorithm
- While statement, Repeat-Until Statements implemented.
- For ex: ifelse.m, whilearray.m, repeatuntil.m, boolAssign.m

Assigning Boolean Values to variables

- BOOLEAN \( V = \text{Expr} \)
- Generate the code for \( \text{Expr} \) as usual (maintaining Truelist and Falselist)
- Create Two Statements-
  - statement 1: \( V := TRUE \)
  - statement 2: \( V := FALSE \)
- Backpatch Truelist with statement 1 and Falselist with stat2
Type of a procedure is represented as:
\[(\text{return-type})*(\text{arg1-type})*(\text{arg2-type})*\ldots*(\text{argN-type})\]

**Multiple Argument Procedure**: any number of arguments

**Recursive function** call support:

### Activation Record

- **Parameters**: passed by the caller
- **Return Address**: (set by the callee)
- **Frame Pointer**: (set by the callee)
- **Access Link**: (set by the caller)

The frame pointer is set to point towards the Access Link.

For ex: `factorial.m`, `func_call.m`, `procArgument.m`
Static Scoping system implemented.

Support for identical name for procedures and variables in different scopes available.

Takes help for the access links maintained at the time of insertion of activation record.

Access link is set up by the caller for the caller activation record.

Accessing parent variables: Variables is searched recursively in the symbol table of the current and previous environments. After finding the depth, access links are used to generate the stack address.

For ex: scope0.m, scope1.m, scope2.m
We converted intermediate code to **basic blocks** by converting into a **Flow Graph** creating new blocks on a *jump, cjump, call and reachable labels.*

- After a jump statement, searched for the **first reachable label** (from another jump statement). Till that delete the code.

- Do a **BFS** on the basic blocks to find reachability from the starting block (Main). Delete the unreachable blocks.

- Run example: `dead1.m`, `dead2.m`