Formatting Fortran in the ROSE Compiler

Skylar Neuendorff
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Rice University Class of 2021
Introduction
The ROSE Compiler

- The ROSE Compiler is a source-to-source translator
- Has resources for tools that can translate, analyze, and parse through C, C++, and Fortran files.
The ROSE Compiler

- Problem: The Fortran translator/compiler in ROSE loses a lot of the original formatting of the file.
- Goal: Work towards building a Fortran-Aware backend that preserves formatting.
Building ROSE
Obstacles

- Biggest obstacle: ROSE lacks clear, up-to-date documentation of the versions of its dependencies that it is compatible with (e.g. Boost, GNU)
- Often, errors caused by incompatible dependencies are vague and unclear, so it took a lot of time to resolve them.
- Inability to find libraries even though they existed on the machine.
- Also had to work out the correct paths that had to be added to the Library Path, which again, are poorly documented in ROSE.
Successful Build For ROSE

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### Build Instructions

- cd rose
- PREFIX=`pwd`
- module unload netcdf
- module unload ncarcompilers
- module load gnu/9.1.0
- export CXX=$(which $CXX)
- BOOST_ROOT="/glade/u/home/skylarfn/rose/boost_1_72_0/1.72.0/install"
- cd boost_1_72_0/
  ./bootstrap.sh --prefix="$(BOOST_ROOT)"
  --with-libraries=chrono,date_time,filesystem,iostreams,program_options,random,regex,serialization_system,thread,wave
  ./b2 -std=c++11 -sNO_BZIP2=1 install
- allows it to find the crt1.o and crti.o files
- LIBRARY_PATH=/usr/lib64/:$LIBRARY_PATH
- LD_LIBRARY_PATH=/usr/lib64/:$LD_LIBRARY_PATH
- export LIBRARY_PATH
- export LD_LIBRARY_PATH
- export LD_LIBRARY_PATH="/usr/lib64/jvm/java-1.8.0-openjdk-1.8.0/lib:$LD_LIBRARY_PATH"
- export LD_LIBRARY_PATH="/usr/lib64/jvm/java-1.8.0-openjdk-1.8.0/jre/lib/amd64/server:$LD_LIBRARY_PATH"
- export LD_LIBRARY_PATH="$(BOOST_ROOT)/lib:$LD_LIBRARY_PATH"
- ./build
- Mkdir ../build
- Cd ../build
- ../rose-release/configure --prefix="$(PREFIX)/install"
  --enable-languages=c,c++,fortran
  --with-boost="$(BOOST_ROOT)"
  module load gnu/10.1.0
- Make core -j10
- Make install-core -j10
- Make check-core -j10
- export ROSE_SRC=$(PREFIX)/rose-release
- export ROSE_INSTALL=$(PREFIX)/install # example
- /data/rose/install
- export PATH=${ROSE_INSTALL}/bin:${PATH}
- export LD_LIBRARY_PATH=${ROSE_INSTALL}/lib:${LD_LIBRARY_PATH}
Analyzing the Fortran Compiler
Points of Interest

- Examine what Fortran loses when it is parsed through the compiler
- Through this we can find out what Fortran needs in order to make a good copy of the original file.
Compiling Fortran Files

The compiler loses the following elements of the original files:

- Line indentation/spaces within lines
- Line breaks within single line of code
- Smaller comment blocks that occur within chunks of code
- Additionally, some functions are replaced by mathematical symbols (i.e. the LT function is replaced by the < symbol)
- Adds double-colon syntax “::” to all variable declarations

**EXAMPLE:**

Original test2008_53.f90

```fortran
! This is an error since the function is assigned an implicit type and the declaration of the return type using the older syntax does not reset the type of the function.
function foo2()
    integer foo2
    foo2 = 1
end function
```

Rose compiled test2008_53.f90

```fortran
FUNCTION foo2()
    INTEGER :: foo2
    foo2 = 1
END FUNCTION
```

```fortran
! This is an error since the function is assigned an implicit type and the declaration of the return type using the older syntax does not reset the type of the function.
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```fortran
FUNCTION foo2()
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Why is this happening?

- When unparsing, ROSE has the option to use a UnparseFormatHelp object, which can contain info on how to insert spacing/indentation to maintain formatting, but otherwise it defaults to a standardized format (not usually consistent with the original file formatting)

- Currently, when unparsing fortran files, the UnparseFormatHelp object is null, so there is no info being passed along to help with formatting
Rewrites

- While I didn’t have time to handle all the formatting inconsistencies, I am rewriting unparse_format.C so that it preserves indentation.
- Each line has an Sg_File_Info object associated to it.
- Sg_File_Info contains the number of characters on a line, and the associated line number.
- unparse_format.C doesn’t have a copy of the original line of code.
- Rewrite: pass the original line of code to unparse_format.C to compare with the parsed version.
- Match formatting by comparison.
Conclusion/What’s Next?
What Comes After

- Next Steps: solve the remaining formatting errors in the Fortran Compiler. The most pressing issue is probably the occasional loss of comments, since these are often integral to understand the meaning of the code.
- My work provides a baseline for formatting and parsing through Fortran files and creating a usable Fortran-aware backend. Additionally, this work can be applied to other Fortran-based tools, like Fortran to C translation.
Thank You!

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