

VSCode Configuration and Tips for Flang Development

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Preliminaries

- You can find my slides at
https://cabreraam.github.io/files/presentations/2023_01_05-hcbb_vscode_mlir_presentation.pdf
- You can find my configuration files at
https://github.com/cabreraam/flang_vscode_pres_supplement
- If you have any suggestions, feedback, or errata, please email me at
cabreraam AT ornl DOT gov

Overview

VSCode Configuration

Stepping Through Code

Case Study

Current Topic

VSCode Configuration

VSCode Extensions

Configuration Files

Stepping Through Code

Case Study

Current Topic

VSCode Configuration

 VSCode Extensions

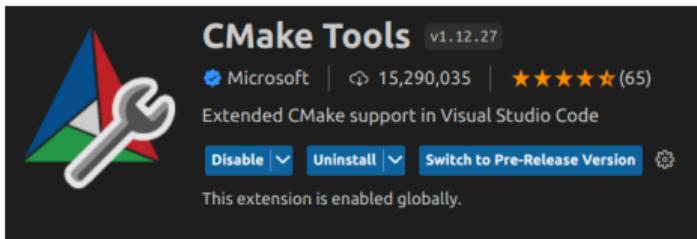
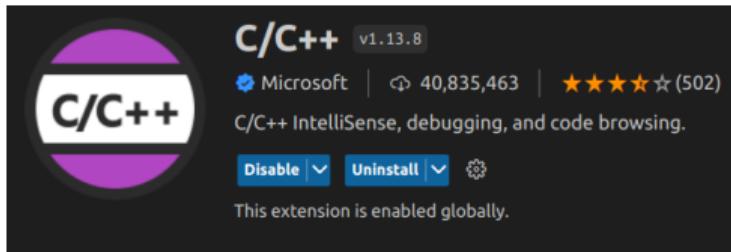
 Configuration Files

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Case Study

Extensions to Download

- C/C++
- CMake Tools



Current Topic

VSCode Configuration

VSCode Extensions

Configuration Files

CMakePresets.json and CMakeUserPresets.json

settings.json

launch.json

tasks.json

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CMakePresets.json and **CMakeUserPresets.json**

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 - Specifically, in the Flang project, the `CMakePresets.json` config can contain the [default build configuration from the Flang README.md](#), and the `CMakeUserPresets.json` can contain your personal system-specific details for building on your machine

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Use these config files over `cmake-kits.json` and `cmake-variants.json`

It's cross-platform; you can share your `CMakePresets.json` and `CMakeUserPresets.json` files with someone who does not use VSCode as their IDE, since the presets files are a 'CMake' feature and not a VSCode feature. Also, [this is now the recommended method from Microsoft developers](#).

CMakePresets.json Example

```
1  {
2      "version": 5,
3      "cmakeMinimumRequired": {
4          "major": 3,
5          "minor": 23,
6          "patch": 0
7      },
8      "include": [],
9      "configurePresets": [
10         {
11             "name": "Flang Default Configure",
12             "displayName": "Flang Default Configure",
13             "description": "Flang Default configure recipe given from Flang docs",
14             "generator": "Ninja",
15             "binaryDir": "${sourceDir}../build_flang_default",
16             "cacheVariables": [
17                 "CMAKE_INSTALL_PREFIX": "${sourceDir}../install_flang_default",
18                 "CMAKE_CXX_STANDARD": "17",
19                 "CMAKE_BUILD_TYPE": "Release",
20                 "CMAKE_EXPORT_COMPILE_COMMANDS": "ON",
21                 "CMAKE_CXX_LINK_FLAGS": "-WL,-rpath,$LD_LIBRARY_PATH",
22                 "FLANG_ENABLE_WERROR": "ON",
23                 "LLVM_ENABLE_ASSERTIONS": "ON",
24                 "LLVM_TARGETS_TO_BUILD": "host",
25                 "LLVM_LIT_ARGS": "-v",
26                 "LLVM_ENABLE_PROJECTS": "clang;mlir;flang;openmp",
27                 "LLVM_ENABLE_RUNTIMES": "compiler-rt"
28             ]
29         }
30     ],
31     "buildPresets": [ ... ],
32     "testPresets": [ ... ],
33 }
34 }
```

CMakeUserPresets.json Example

```
lvm > {} CMakeUserPresets.json > [] testPresets
1  {
2    "version": 5,
3    "cmakeMinimumRequired": {
4      "major": 3,
5      "minor": 23,
6      "patch": 0
7    },
8    "include": [
9    ],
10   "configurePresets": [
11     {
12       "name": "default_local_relwithdebuginfo_with_gcc",
13       "inherits": [
14         "Flang Default Configure"
15       ],
16       "binaryDir": "${sourceDir}/../build_relwithdebuginfo_gcc",
17       "displayName": "local Default relwithdebuginfo Config with gcc",
18       "description": "local Default relwithdebuginfo build using Ninja generator",
19       "environment": [
20       ],
21       "cacheVariables": {
22         "CMAKE_C_COMPILER": "gcc",
23         "CMAKE_CXX_COMPILER": "g++",
24         "CMAKE_BUILD_TYPE": "RelWithDebInfo"
25       }
26     }
27   ],
28   "buildPresets": [
```

```
67   "buildPresets": [
68     {
69       "name": "build_from_user_presets_gcc_relwithdebuginfo",
70       "configurePreset": "default_local_relwithdebuginfo_with_gcc",
71       "displayName": "Build from user presets gcc relwithdebuginfo",
72       "description": "local Default build using Ninja generator",
73       "jobs": 128
74     }
75   ],
76   "testPresets": [
77   ]
78 ]
```

settings.json

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- Specifically in LLVM and Flang, we need to associate .inc files c++ files
- You can't step through auto-generated .inc files unless you make this association
- Example settings.json file:

```
.vscode > {} settings.json > ...
1  {
2    "files.associations": {
3      "*.inc": "cpp",
4      "*.tcc": "cpp",
5      "string": "cpp",
6      "regex": "cpp"
7    },
8    "cmake.sourceDirectory": "${workspaceFolder}/llvm",
9    "cmake.parallelJobs": 16,
10   "git.ignoreLimitWarning": true,
11 }
```

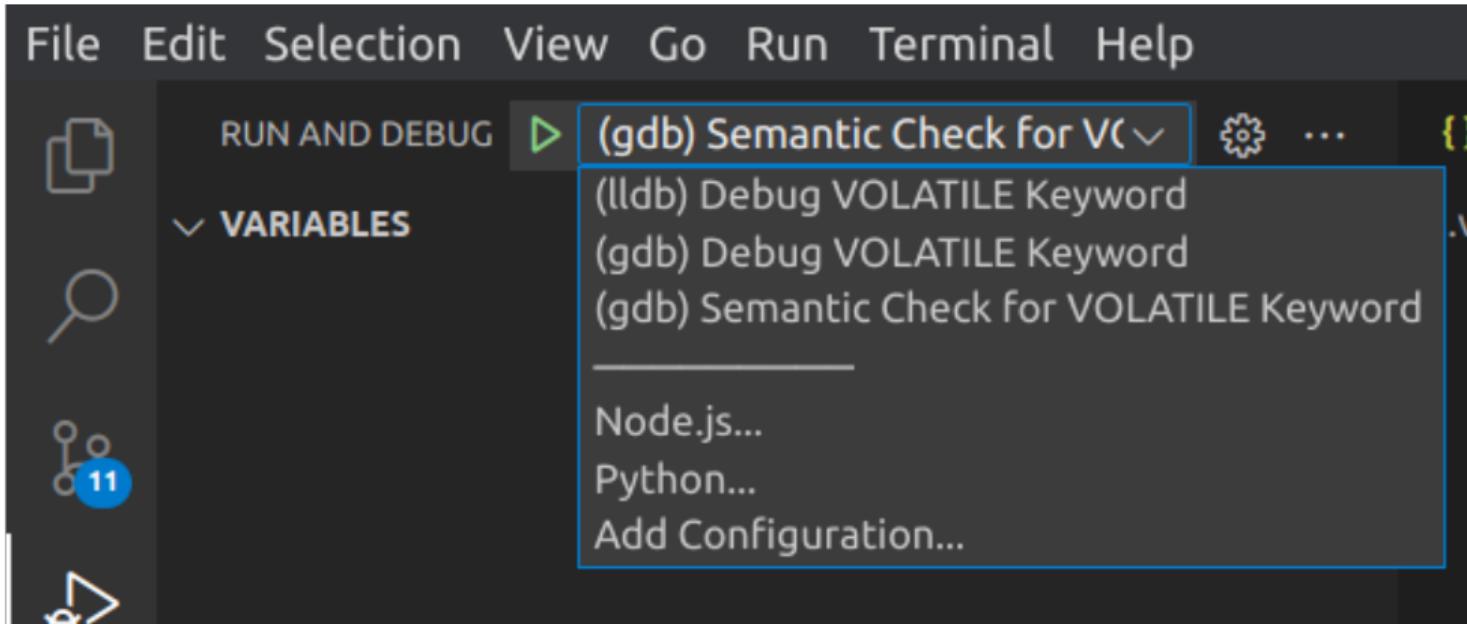
launch.json

A `launch.json` file is used to configure the `debugger` in VSCode

launch.json

A launch.json file is used to configure the **debugger** in VSCode

- This is useful for quickly selecting between debugging tasks



launch.json

Add a screencap of the launch.json file

tasks.json

This config file allows you to create tasks with external tools, e.g., through shell commands, that are easily navigatable and can be executed within the VSCode environment

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This config file allows you to create tasks with external tools, e.g., through shell commands, that are easily navigatable and can be executed within the VSCode environment

- For example, this is helpful for *quickly* compiling a given test to check if LLVMFlang behaved as expected or not

File Edit Selection View Go Run Terminal Help

EXPLORER

OPEN EDITORS

- tasks.json vscode
- LLVM-PROJECT [SSH: SECRETARIAT]**
 - > .github
 - > .vscode
 - () launch.json
 - () settings.json
 - () tasks.json
 - > bolt
 - > build
 - > build_debug
 - > build_debug_gcc
 - > build_fujitsu
 - > build_relwithdebginfo_gcc
 - > clang
 - > clang-tools-extra
 - > cmake

OUTLINE

- version 2.0.0
- [] tasks
 - () 0
 - type shell
 - label build_and_run
 - command #bash build_and_run.sh
 - () 1
 - type shell
 - label Anthony's Semantic Check with test_errors.py
 - command module load gcc/12.1.0 && python /noback/93u/Research/secretariat/llvm-project/flang/test/Semantics/test_errors.py /noback/93u/Research/secretariat/llvm-project/flang/test/Semantics/call38.f90 /noback/93u/Research/secretariat/llvm-project/build_debug_gcc/bin/flang-new -fcl -Werror
 - [] dependsOn []
 - [] dependsOrder sequence
 - () 2
 - type shell
 - label load LLVM 14.0.0
 - command module load llvm/14.0.0
 - () 3
 - type shell
 - label Add llvm.build_debug/bin binary dir to path
 - command export PATH=/noback/93u/Research/secretariat/.../bin:\$PATH
 - () 4
 - label Run Before debugging build_debug
 - [] dependsOn
 - () 0
 - () 1
 - () 5
 - type shell

TIMELINE

tasks.json x

```

1 {
2   "version": "2.0.0",
3   "tasks": [
4     {
5       "type": "shell",
6       "label": "build_and",
7       "command": "#bash b
8     },
9     {
10    "type": "shell",
11    "label": "Anthony's
12    "command": "module
13    "dependsOn": [
14    ],
15    "dependsOrder": "se
16  },
17  {
18  },
19  {
20  },
21  {
22  }
23 },
24 ]
25 },
26

```

Select the task to run

Anthony's Semantic Check with test_errors.py recently used

Anthony's Semantic Check
Compile volatile example with -fc1, build_debug_gcc
echo User
load GCC 12.1.0
Run Before debugging build_debug
Add llvm build_debug/bin binary dir to path
build_and_run
Compile volatile example with -fc1, build_fujitsu
Compile volatile example with -flang-experimental-exec, build_debug_gcc
load LLVM 14.0.0

contributed

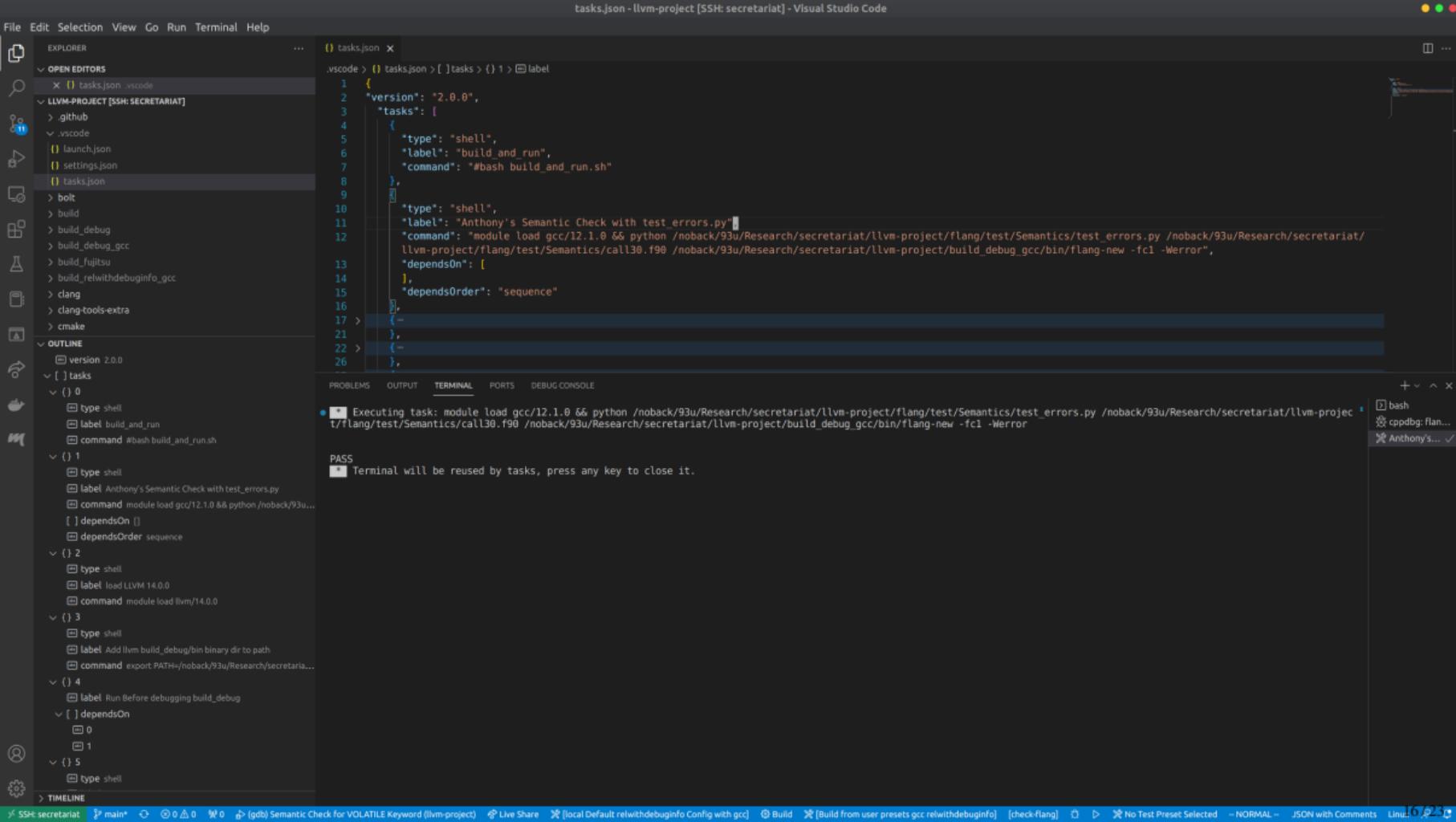
/flang/test/Semantics/test_errors.py /noback/93u/Research/secretariat/.../bin/flang-new -fcl -Werror

bash
cpdpdbg: flang...
Anthony's... ✓

PROBLEMS OUTPUT TERMINAL PORTS DEBUG CONSOLE

Executing task: module load gcc/12.1.0 && python /noback/93u/Research/secretariat/llvm-project/flang/test/Semantics/test_errors.py /noback/93u/Research/secretariat/llvm-project/flang/test/Semantics/call38.f90 /noback/93u/Research/secretariat/llvm-project/build_debug_gcc/bin/flang-new -fcl -Werror

PASS Terminal will be reused by tasks, press any key to close it.



Current Topic

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Using GDB to Step Through Code

Though it's somewhat slow to step through LLVM using a debugger, the tradeoff is that you can *interactively* see what the code is doing. This is particularly useful when you're still learning the codebase (like me!)

Using GDB to Step Through Code

Though it's somewhat slow to step through LLVM using a debugger, the tradeoff is that you can *interactively* see what the code is doing. This is particularly useful when you're still learning the codebase (like me!)

- You can examine the state of all variables
- You can jump through all currently active call stacks
- You can easily see where certain routines/variables are defined

RUN AND DEBUG ▶ (gdb) Semantic Check for VC... ⚙ ...

VARIABLES

```
dummyIsOptional: false
actualIsNull: false
> dummy: [...]
dummyName: [...]
    npos: 18446744073709551615
< _M_dataplus
    > std::allocator<char> (base): std::allocator<char>
        < _M_p: 0x7367640 "dummy argument 'n6='"
            _M_p: 100 'd'
            M_string.length: 28
```

WATCH

CALL STACK Paused on breakpoint

```
Fortran::semantics::CheckExplicitDataArg(const Fortran::operator()(const struct [...] * const __closure, const Fortran::common::log2visit::Log2VisitHelper<0, 0, void, Fortran::common::log2visit::Log2VisitHelper<0, 1, void, Fortran::common::log2visit::Log2VisitHelper<0, 2, void, Fortran::common::log2visit::visit::Fortran::common::visit Fortran::semantics::CheckExplicitInterfaceArg(Fortran::semantics::CheckExplicitInterfaceArg::Context&)
```

BREAKPOINTS

- All C++ Exceptions
- check-call.cpp Flang/lib/Semantics 108
- check-call.cpp Flang/lib/Semantics 117
- check-call.cpp Flang/lib/Semantics 148
- check-call.cpp Flang/lib/Semantics 182
- check-call.cpp Flang/lib/Semantics 229
- check-call.cpp Flang/lib/Semantics 239
- check-call.cpp Flang/lib/Semantics 423
- CompilerInstance.cpp Flang/lib/Frontend 166
- driver.cpp flang/tools/flang-driver 66
- driver.cpp flang/tools/flang-driver 109
- ExecuteCompilerInvocation.cpp Flang/lib/Fronten... 103

C: check-call.cpp 9+ X

```
403     // Problems with polymorphism are caught in the callee's definition.
404     DefinabilityFlags flags{DefinabilityFlag::PolymorphicOkInPure};
405     if (isElemental || dummyIsValue) { // 15.5.2.4(21)
406         flags.set(DefinabilityFlag::VectorSubscriptisOk);
407     }
408     if (actualIsPointer && dummyIsPointer) { // 19.6.8
409         flags.set(DefinabilityFlag::PointerDefinition);
410     }
411     if (auto whyNot = WhyNotDefinable(messages.at(), *scope, flags, actual)) {
412         if (auto msg = messages.Say(
413             "Actual argument associated with %s %s is not definable" _err_en_US,
414             reason, dummyName))) {
415             msg->Attach(std::move(*whyNot));
416         }
417     }
418 }
419
420 // technically legal but worth emitting a warning
421 // llvm-project issue #58973: constant actual argument passed in where dummy
422 // argument is marked volatile
423 if (dummyIsVolatile && !IsVariable(actual)) {
424     messages.Say(
425         "actual argument associated with VOLATILE %s is not a variable" _warn_en_US,
426         dummyName);
427 }
428
429 // Cases when temporaries might be needed but must not be permitted.
430 bool actualIsContiguous(IsSimplyContiguous(actual, context));
431 bool dummyIsAssumedShape(dummy.type.attrs().test(
432     characteristics::TypeAndShape::Attr::AssumedShape));
433 bool dummyIsContiguous(
434     dummy.attrs.test(characteristics::DummyDataObject::Attr::Contiguous));
435 if ((actualIsAsynchronous || actualIsVolatile) &&
436     (dummyIsAsynchronous || dummyIsVolatile) && !dummyIsValue) {
437     if (actualIsCoindexed) { // C1538
438         messages.Say(
439             "Coindexed ASYNCHRONOUS or VOLATILE actual argument may not be associated with %s with ASYNCHRONOUS or VOLATILE
440             attributes unless VALUE" _err_en_US,
441             dummyName);
442     }
443     if (actualRank > 0 && !actualIsContiguous) {
444         if (dummyIsContiguous ||
445             !(dummyIsAssumedShape || dummyIsAssumedRank ||
446                 (actualIsPointer && dummyIsPointer))) { // C1539 & C1540
447             messages.Say(
448                 "ASYNCHRONOUS or VOLATILE actual argument that is not simply contiguous may not be associated with a contiguous
```

SSH: secretariat % main.c ⚙ 12 A 0 W 0 ⚙ (gdb) Semantic Check for VOLATILE Keyword (llvm-project) ⚙ Live Share ⚙ [local Default relwithdebinfo Config with gcc] ⚙ Build ⚙ [Build from user preset: gcc relwithdebinfo] ⚙ [[Targets In Preset]] ⚙ ⚙ ⚙ No test set 197/23

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llvm-project issue 58973

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- Here is an issue that is raising an error when a warning is more appropriate
 - A little more specifically, an attribute of a dummy argument does not correspond to the actual argument being passed
- Besides knowing that I want to step through the code using gdb, I have no idea where to start, so I of course ask the Flang community for help
- After a tip, I find that `flang/lib/Semantics/check-call.cpp` might be where the fix should be applied
- Before going further, I start configuring VSCode + CMake
 - I set up `CMakeUserPresets.json` with the default Flang configuration, and set up `CMakeUserUserPresets.json` with details specific to my system as well as setting the `RelWithDebInfo` build option

llvm-project issue 58973 (cont.)

- I visually scan the `flang/lib/Semantics/check-call.cpp` and start setting breakpoints in places where I think might be useful
- I start implementing what I think the fix should be
- Once I have something I think works, it's time to build LLVM using the CMake extension integrated into our VSCode environment
- At this point, I can start editing the `launch.json` and `tasks.json` config files
 - The commands in `launch.json` and `tasks.json` will essentially be the same except `launch.json` contains config information for the debugger, and the `tasks.json` file will configure shell command that allows for a quick check for whether we see what we expect or not
- Once I'm happy with what I have so far, I start [soliciting reviews on Phabricator](#)
- After an iterative process, the fix was deemed acceptable but contingent on writing some tests in the `flang/test` directory

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