Science & Technology Facilities Council

Comparative Debugging Using TotalView Scripting

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Scenario

A software developers day …

Starting point:

A code which “works”

Current point:

A modified code which produces “different” results

End point:

A modified code which produces the “same” results

Comparative debugging

We wish to be able to debug differences between two executions

These may be ...

- Same program, different number of tasks and threads
- Same program, different data
- Different programs, updated functionality e.g. new code vs. a reference version
- Same functionality, different languages e.g. C vs. Fortran

Comparative debugging – a manual process

What do we do currently?

- Fill the code / both the codes with write statements
- Run both versions writing debugging data to files, often large amounts of data
- Compare the files using diff, script, …
- Try to understand the source of the differences
- Modify one or both codes
- Repeat, many, many times!

Comparative debugging – towards automation

Can we automate the process through a GUI-based debugger?

Well initially a proof-of-concept using TotalView scripting

Comparative debugging – the cdtv script

We have developed and tested the cdtv script.

High level flow of cdtv

- Load programs
- Set breakpoints
- Run programs to first breakpoint
- While processes still running
  - Check for difference
  - Exit if found
  - Advance to next breakpoint
- Exit

Comparative debugging – example output

```
CDTV Loop Counter:  8
Checking iteration: 8
Checking main_data_array...
==================================
 Difference Detected!!!
 t = 8
 ==================================
 Working Code:       simple_finite_diff_code
 Location:    t2.1, main_data_array[4][4]
 Value:              0.00417282
 ==================================
 Broken Code: bugy-simple_finite_diff_code
 Location:    t1.1, main_data_array[4][4]
 Value:              0.00554456
```

Comparative debugging – progress so far

We have developed and tested the cdtv script.

For time-stepping codes can speed-up by

- Not testing every time step
- When a difference is found, backtrack using reverse debugging

Tested so far with:

- Fortran and C
- MPI and OpenMP

Conclusions

We have a strong need for better GUI-based capabilities for comparative debugging

We have demonstrated a simple way for using TotalView scripting to track down a results difference between two versions of a code

We have demonstrated this in Fortran and C, MPI and OpenMP

A report is in (final) preparation, please email me for a copy: mike.ashworth@stfc.ac.uk