Collabora Productivity

Improving Calc parallel calculations

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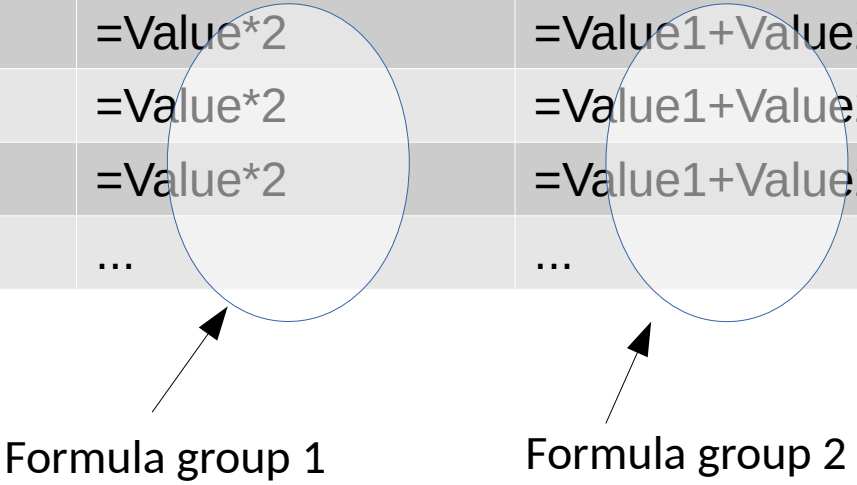
Introduction

Typical spreadsheet

Name	Value1	Value2	Value3
Item1	10	=Value*2	=Value1+Value2
Item2	15	=Value*2	=Value1+Value2
Item3	20	=Value*2	=Value1+Value2
...	...	...	...

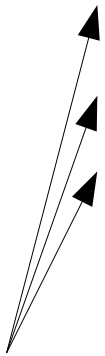
Typical spreadsheet (#2)

Name	Value1	Value2	Value3
Item1	10	=Value*2	=Value1+Value2
Item2	15	=Value*2	=Value1+Value2
Item3	20	=Value*2	=Value1+Value2
...	...	...	...



Typical spreadsheet (#3)

Name	Value1	Value2	Value3
Item1	10	=Value*2	=Value1+Value2
Item2	15	=Value*2	=Value1+Value2
Item3	20	=Value*2	=Value1+Value2
...	...	...	...



Independent rows

Parallel calculation

Rows are often “the same” but independent

Modern CPUs do not improve single core performance that much

But they have more cores

-> It makes sense to compute in parallel

- Reasonably simple
- Should scale well

Implementation

ScFormulaCell

- Each spreadsheet cell

ScFormulaCellGroup

- Grouped cells sharing the same code

Make each thread calculate different cells in the same group

Lockless (mostly)

Threads operate on separate data → no need to lock

Shared instances → per-thread instances

Lock only if needed or if not performance critical

For more details,
talk by Tor from 2017

Problems

Static data

static OUString myCachedValue;

- Use thread_local
- Simply remove the optimization
- Add locking, if worth it (local mutex)
- ScInterpreterContext
- …

Storing state in classes

class ... { ... int currentIndex; ... };

- Protect class use with a mutex
- Move state to its own class (e.g. iterators)
- Move state to a function parameter

This includes also various caching.

On-demand initialization

If(singleton == nullptr) singleton = new Singleton;

- use C++11 thread-safe statics (required now by LO build)
  - static Singleton* singleton = new Singleton;
    - Leaks memory
  - Singleton* getSingleton() { static Singleton s; return &s; }
  - Either case cannot be cleaned up
- comphelper::doubleCheckedInit(singleton, []() { return new Singleton; })

Unsafe code

A lot of library code is not thread-safe (even our code)

- Fix the code (if possible)
- Add locking to the code (if worth it)
- Protect code use from Calc with a mutex

SolarMutex

SolarMutex is still held by main thread while threaded calculation is in progress

- If not done, other threads might interfere (UNO calls, clipboard thread)

→ Calculation threads may not access code requiring SolarMutex

Maybe needs a solution for some cases ???

- Transfer SolarMutex ownership?
- Ask main thread to perform an operation?

Threaded calc assert

assert(!IsThreadedGroupCalcInProgress());

- Code is not meant to be run in threads
- Use the proper function (if exists)
- Make sure code in threads does not modify spreadsheet

ScMutationGuard assert

Code in calculation threads should not modify the document

- (Except for calculating cell results)
- Check your code
- Move code outside of calculation threads

(More) Solutions

Unsupported opcode/type

INDIRECT() (ocIndirect) – may possibly make cells dependent

ocExternal – external functionality (UNO calls)

- Hard to check all code
- May easily deadlock (SolarMutex)

DDE() (ocDDE) – LinkManager class uses extensive caching without locking

External references – ScExternalRefManager uses extensive caching without locking

Unsupported opcode/type (#2)

Simply blacklist all formulas containing problematic opcodes/types

ScTokenArray::CheckForThreading()

ScInterpreterContext

Per-thread data structure, pointer to it passed around

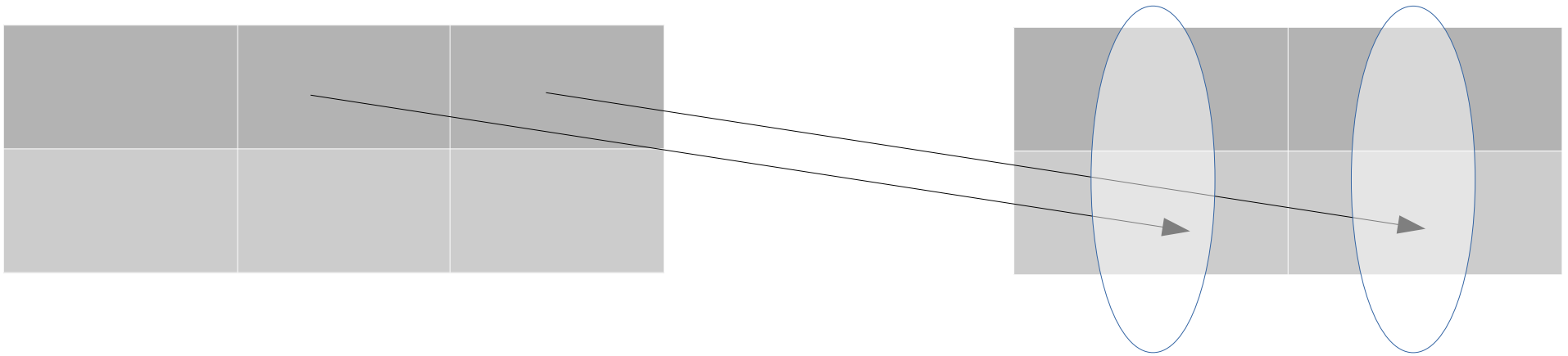
Per-thread class instances

- ScDocument::GetFormatTable() → context→mpFormatter

ScInterpreterContext (#2)

Caches (VLOOKUP)

- Finding result of VLOOKUP may be expensive
- Same lookup used several columns in the same row
- Values must survive between thread invocations
- SetupFrom/MergeBackIntoNonThreadedContext()



ScInterpreterContext (#3)

Moving operation to the main thread

- ScDocument::setNumberFormat() is not thread-safe
- Calls to it can be postponed
- Save relevant data in ScInterpreterContext
- Actual call(s) performed by main thread after calculation threads finish

Add asserts

assert(!IsThreadedGroupCalcInProgress());

- Add wherever need (especially if unsure)

Helgrind (Valgrind)

Detecting thread problems from the Valgrind tools suite

- VALGRIND=helgrind start_lo.sh
- Slow
- Can still save time when finding difficult problems

Testing

Ensure threaded calculation is used

Threads vs OpenCL vs normal (non-threaded)

- Modify settings in UI
- Temporarily hardcode in CalcConfig class functions

Test even with small formula groups

- Group calculation is normally used only for larger groups
- mnOpenCLMinimumFormulaGroupSize
- Should be improved to make possible running tests for everything with the wanted calculation method

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Thank you.

By Luboš Luňák

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