

# Checking Contracts with BDE

Joshua Berne - `jberne4@bloomberg.net`

2020-06-10

## Copyright Notice

©2020 Bloomberg L.P. Permission is granted to copy, distribute, and display this material, and to make derivative works and commercial use of it. The information in this material is provided “AS IS”, without warranty of any kind. Neither Bloomberg nor any employee guarantees the correctness or completeness of such information. Bloomberg, its employees, and its affiliated entities and persons shall not be liable, directly or indirectly, in any way, for any inaccuracies, errors or omissions in such information. Nothing herein should be interpreted as stating the opinions, policies, recommendations, or positions of Bloomberg.

- 1 A Function
- 2 Brand New Library
- 3 Existing Software
- 4 Other Reading

- Let's say you want to write a function.

- Let's say you want to write a function.

```
int foo(int x, int y);
```

- Let's say you want to write a function.
- With a contract.

```
int foo(int x, int y);
```

- Let's say you want to write a function.
- With a contract.

```
int foo(int x, int y);  
  // Do some foo with the specified 'x' and 'y'. Return  
  // how fooable they were.
```

- Let's say you want to write a function.
- With a contract.
- That is a narrow contract.

```
int foo(int x, int y);  
  // Do some foo with the specified 'x' and 'y'. Return  
  // how fooable they were.
```



- Let's say you want to write a function.
- With a contract.
- That is a narrow contract.

```
int foo(int x, int y);  
  // Do some foo with the specified 'x' and 'y'. Return  
  // how fooable they were. The behavior is undefined  
  // unless 'x <= y'.
```

- 1 A Function
- 2 Brand New Library
- 3 Existing Software
- 4 Other Reading

- Assume foo is in a new library.

```
#include <foo.h>

int foo(int x, int y)
{
    return fooability(x) * fooability(y);
}
```

- Assume foo is in a new library.
- We can assert our preconditions.

```
#include <foo.h>
#include <bsls_assert.h>

int foo(int x, int y)
{
    BSLS_ASSERT(x <= y);
    return fooability(x) * fooability(y);
}
```

- Assume `foo` is in a new library.
- We can assert our preconditions.
- We can invoke our function.

- Assume foo is in a new library.
- We can assert our preconditions.
- We can invoke our function.

```
#include <foo.h>
#include <bsl_iostream.h>

int main()
{
    int fooishness = foo(3,5);
    bsl::cout << "My Fooishness is:" << fooishness << bsl::endl;
    return 0;
}
```

- Assume `foo` is in a new library.
- We can assert our preconditions.
- We can invoke our function.
- ... or have a very bad bug.

```
#include <foo.h>

int main()
{
    int fooishness = foo(5,3);
    bsl::cout << "My Fooishness is:" << fooishness << bsl::endl;
    return 0;
}
```

- We can build our code with assertions enabled.

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o badmain.tsk foo.cpp badmain.cpp
```



- We can build our code with assertions enabled.
- Then run it.

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o badmain.tsk foo.cpp badmain.cpp  
$ ./badmain.tsk
```

- We can build our code with assertions enabled.
- Then run it.
- And kaboom.

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o badmain.tsk foo.cpp badmain.cpp
$ ./badmain.tsk
FATAL foo.cpp:6 Assertion failed: x <= y
Aborted (core dumped)
```

## What Can a violation handler do?

- Violations can be configured to do a number of things

## What Can a violation handler do?

- Violations can be configured to do a number of things

```
typedef void (*ViolationHandler)(const AssertViolation&);  
bsls::Assert::setViolationHandler(Assert::ViolationHandler function);
```

## What Can a violation handler do?

- Violations can be configured to do a number of things

```
typedef void (*ViolationHandler)(const AssertViolation&);  
bsls::Assert::setViolationHandler(Assert::ViolationHandler function);
```

- Handlers exist to abort, sleep, log, throw, or write your own.

## What Can a violation handler do?

- Violations can be configured to do a number of things

```
typedef void (*ViolationHandler)(const AssertViolation&);  
bsls::Assert::setViolationHandler(Assert::ViolationHandler function);
```

- Handlers exist to abort, sleep, log, throw, or write your own.
- The default handler aborts. Use that.

What *SHOULD* a violation handler do?

## What *SHOULD* a violation handler do?

- In production code: Abort.



## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort.

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)
- The source of a violation may be close or far.

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)
- The source of a violation may be close or far.
- The risk when continuing is unbounded.

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)
- The source of a violation may be close or far.
- The risk when continuing is unbounded.
  - Best case is a quick failure with bad values

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)
- The source of a violation may be close or far.
- The risk when continuing is unbounded.
  - Best case is a quick failure with bad values
  - Worst case is silent failure and spreading corruption.

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)
- The source of a violation may be close or far.
- The risk when continuing is unbounded.
  - Best case is a quick failure with bad values
  - Worst case is silent failure and spreading corruption.
- Fast failure has well known cost.



## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)
- The source of a violation may be close or far.
- The risk when continuing is unbounded.
  - Best case is a quick failure with bad values
  - Worst case is silent failure and spreading corruption.
- Fast failure has well known cost.
  - Failures will be caught and escalated

## What *SHOULD* a violation handler do?

- In production code: Abort.
- In development code: Abort.
- In unit tests: Abort. or throw when explicitly tested. (see BSLS\_ASSERTTEST)
- The source of a violation may be close or far.
- The risk when continuing is unbounded.
  - Best case is a quick failure with bad values
  - Worst case is silent failure and spreading corruption.
- Fast failure has well known cost.
  - Failures will be caught and escalated
  - Software will not attempt to execute in a corrupt state

# Writing A New Library

## Writing A New Library

- In a new library, use `BSLS_ASSERT`

## Writing A New Library

- In a new library, use `BSLS_ASSERT`
- In a new function, use `BSLS_ASSERT`

## Writing A New Library

- In a new library, use `BSLS_ASSERT`
- In a new function, use `BSLS_ASSERT`
- When deploying a new application, use `BSLS_ASSERT`

## Writing A New Library

- In a new library, use `BSLS_ASSERT`
- In a new function, use `BSLS_ASSERT`
- When deploying a new application, use `BSLS_ASSERT`
- Catch errors fast, run safer systems.

- 1 A Function
- 2 Brand New Library
- 3 Existing Software**
- 4 Other Reading



## Checks In Old Code

## Checks In Old Code

- New checks in old code? use BSLS\_REVIEW

## Checks In Old Code

- New checks in old code? use `BSLS_REVIEW`
- Enabling dormant checks in old code? use `BSLS_REVIEW_LEVEL...`

## Checks In Old Code

- New checks in old code? use `BSLS_REVIEW`
- Enabling dormant checks in old code? use `BSLS_REVIEW_LEVEL...`
- Safely roll out checks before enforcing them.

- Let's say you wrote a function long ago.

- Let's say you wrote a function long ago.

```
int foo(int x, int y);
```

- Let's say you wrote a function long ago.
- With a contract.

```
int foo(int x, int y);
```

- Let's say you wrote a function long ago.
- With a contract.

```
int foo(int x, int y);  
  // Do some foo with the specified 'x' and 'y'. Return  
  // how fooable they were.
```



- Let's say you wrote a function long ago.
- With a contract.
- But it fails badly and subtly if  $x \leq y$ , so you want to narrow the contract.

```
int foo(int x, int y);  
    // Do some foo with the specified 'x' and 'y'. Return  
    // how fooable they were.
```

- Let's say you wrote a function long ago.
- With a contract.
- But it fails badly and subtly if  $x \leq y$ , so you want to narrow the contract.
  - Returns a value out of range

```
int foo(int x, int y);  
    // Do some foo with the specified 'x' and 'y'. Return  
    // how fooable they were.
```

- Let's say you wrote a function long ago.
- With a contract.
- But it fails badly and subtly if  $x \leq y$ , so you want to narrow the contract.
  - Returns a value out of range
  - Writes and doesn't delete a large temporary file on disk

```
int foo(int x, int y);  
    // Do some foo with the specified 'x' and 'y'. Return  
    // how fooable they were.
```

- Let's say you wrote a function long ago.
- With a contract.
- But it fails badly and subtly if  $x \leq y$ , so you want to narrow the contract.
  - Returns a value out of range
  - Writes and doesn't delete a large temporary file on disk
  - Takes seconds to complete instead of microseconds

```
int foo(int x, int y);  
    // Do some foo with the specified 'x' and 'y'.  Return  
    // how fooable they were.
```

- Let's say you wrote a function long ago.
- With a contract.
- But it fails badly and subtly if  $x \leq y$ , so you want to narrow the contract.
  - Returns a value out of range
  - Writes and doesn't delete a large temporary file on disk
  - Takes seconds to complete instead of microseconds
- All problems that could be going unnoticed in production

```
int foo(int x, int y);  
    // Do some foo with the specified 'x' and 'y'. Return  
    // how fooable they were.
```

- Let's say you wrote a function long ago.
- With a contract.
- But it fails badly and subtly if  $x \leq y$ , so you want to narrow the contract.
  - Returns a value out of range
  - Writes and doesn't delete a large temporary file on disk
  - Takes seconds to complete instead of microseconds
- All problems that could be going unnoticed in production
- So you want to narrow the contract

```
int foo(int x, int y);  
    // Do some foo with the specified 'x' and 'y'. Return  
    // how fooable they were. The behavior is undefined  
    // unless 'x <= y'.
```

- Assume foo is old as dirt.

```
#include <foo.h>

int foo(int x, int y)
{
    return fooability(x) * fooability(y);
}
```

- Assume `foo` is old as dirt.
- We can review our new preconditions.

```
#include <foo.h>
#include <bsls_review.h>

int foo(int x, int y)
{
    BSLS_REVIEW(x <= y);
    return fooability(x) * fooability(y);
}
```



- Assume `foo` is old as dirt.
- We can review our new preconditions.
- Eventually, we migrate on to `BSLS_ASSERT`.

```
#include <foo.h>
#include <bsls_assert.h>

int foo(int x, int y)
{
    BSLS_ASSERT(x <= y);
    return fooability(x) * fooability(y);
}
```

- Assume `foo` is old as dirt.
- We can review our new preconditions.
- Eventually, we migrate on to `BSLS_ASSERT`.
- But that can't be released safely.

KABOOM

- We can build our code with assertions enabled

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o questionablemain.tsk  
oldfoo.cpp questionablemain.cpp
```

- We can build our code with assertions enabled
- This will enable reviews of the same type too.

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o questionablemain.tsk  
oldfoo.cpp questionablemain.cpp
```

- We can build our code with assertions enabled
- This will enable reviews of the same type too.
- Then run it.

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o questionablemain.tsk  
  oldfoo.cpp questionablemain.cpp  
$ ./questionablemain.tsk
```

- We can build our code with assertions enabled
- This will enable reviews of the same type too.
- Then run it.
- And oopsie.

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o questionablemain.tsk
  oldfoo.cpp questionablemain.cpp
$ ./questionablemain.tsk
ERROR oldfoo.cpp:6 BSLS_REVIEW failure: (level:R-DBG) 'x <= y'
Please run "/bb/bin/showfunc.tsk ./questionablemain.tsk 8048B28
8048A07 8048A26" to see the stack trace.
My Fooishness is: 171717
```

- We can build our code with assertions enabled
- This will enable reviews of the same type too.
- Then run it.
- And oopsie.
- ...with a stack trace!.

```
$ /bb/bin/showfunc.tsk ./questionablemain.tsk 8048B28 8048A07
8048A26
0x8048b28 _ZN11BloombergLP4bsls6Review9failByLogERKNS0
    _15ReviewViolationE + 88
0x8048a07 _Z3fooi + 81
0x8048a26 main + 26
```

- We can build our code with assertions enabled
- This will enable reviews of the same type too.
- Then run it.
- And oopsie.
- ...with a stack trace!.
- ... or a more readable stack trace!.

```
$ /bb/bin/showfunc.tsk ./questionablemain.tsk 8048B28 8048A07
8048A26 | c++filt
0x8048b28 BloombergLP::bsls::Review::failByLog(
    BloombergLP::bsls::ReviewViolation const&) + 88
0x8048a07 foo(int, int) + 81
0x8048a26 main + 26
```



# Tickets

## Tickets

- Every BSLS\_REVIEW failure logged to `act.log` will be processed by GUTS.

## Tickets

- Every BSLS\_REVIEW failure logged to `act.log` will be processed by GUTS.
- Most will result in a DRQS created for the owner of the code that failed.

## Tickets

- Every BSLS\_REVIEW failure logged to act.log will be processed by GUTS.
- Most will result in a DRQS created for the owner of the code that failed.
- Tickets are throttled, only act.log is monitored, and GUTS routing can be inaccurate.

# Tickets

- Every BSLS\_REVIEW failure logged to act.log will be processed by GUTS.
- Most will result in a DRQS created for the owner of the code that failed.
- Tickets are throttled, only act.log is monitored, and GUTS routing can be inaccurate.
  - Keep your PWHO entries and procmgr ids set up correctly

# Tickets

- Every BSLS\_REVIEW failure logged to act.log will be processed by GUTS.
- Most will result in a DRQS created for the owner of the code that failed.
- Tickets are throttled, only act.log is monitored, and GUTS routing can be inaccurate.
  - Keep your PWHO entries and procmgr ids set up correctly
  - Monitor your own logs too.

# Tickets

- Every BSLS\_REVIEW failure logged to act.log will be processed by GUTS.
- Most will result in a DRQS created for the owner of the code that failed.
- Tickets are throttled, only act.log is monitored, and GUTS routing can be inaccurate.
  - Keep your PWHO entries and procmgr ids set up correctly
  - Monitor your own logs too.

- You might be running with asserts off

```
$ g++ -DBSLS_ASSERT_LEVEL_NONE -o badmain.tsk foo.cpp  
badmain.cpp
```



- You might be running with asserts off
- If you switch to this, things might go boom

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o badmain.tsk foo.cpp  
badmain.cpp
```

- You might be running with asserts off
- If you switch to this, things might go boom
- This will switch asserts to reviews first

```
$ g++ -DBSLS_ASSERT_LEVEL_NONE -DBSLS_REVIEW_LEVEL_REVIEW  
-o badmain.tsk foo.cpp badmain.cpp
```

- You might be running with asserts off
- If you switch to this, things might go boom
- This will switch asserts to reviews first
- Now deploy, monitor, fix bugs

```
$ g++ -DBSLS_ASSERT_LEVEL_NONE -DBSLS_REVIEW_LEVEL_REVIEW  
-o badmain.tsk foo.cpp badmain.cpp
```

- You might be running with asserts off
- If you switch to this, things might go boom
- This will switch asserts to reviews first
- Now deploy, monitor, fix bugs
- Then switch to this.

```
$ g++ -DBSLS_ASSERT_LEVEL_ASSERT -o badmain.tsk foo.cpp  
badmain.cpp
```

- 1 A Function
- 2 Brand New Library
- 3 Existing Software
- 4 Other Reading

# Documentation

- BDE Starting point: `http://bde.bloomberg.com/`

# Documentation

- BDE Starting point: <http://bde.bloomberg.com/>
- BSLS\_ASSERT: [https://bde.bloomberg.com/bde-resources/doxygen/bde\\_api\\_prod/group\\_\\_bsls\\_\\_assert.html](https://bde.bloomberg.com/bde-resources/doxygen/bde_api_prod/group__bsls__assert.html)

# Documentation

- BDE Starting point: <http://bde.bloomberg.com/>
- BSLS\_ASSERT: [https://bde.bloomberg.com/bde-resources/doxygen/bde\\_api\\_prod/group\\_\\_bsls\\_\\_assert.html](https://bde.bloomberg.com/bde-resources/doxygen/bde_api_prod/group__bsls__assert.html)
- BSLS\_REVIEW: [https://bde.bloomberg.com/bde-resources/doxygen/bde\\_api\\_prod/group\\_\\_bsls\\_\\_review.html](https://bde.bloomberg.com/bde-resources/doxygen/bde_api_prod/group__bsls__review.html)



## Source Code

- BDE Starting point: <http://bbgithub.dev.bloomberg.com/bde/bde/>

## Source Code

- BDE Starting point: <http://bbgithub.dev.bloomberg.com/bde/bde/>
- Or Open Source: <https://github.com/bloomberg/bde>

## Source Code

- BDE Starting point: `http://bbgithub.dev.bloomberg.com/bde/bde/`
- Or Open Source: `https://github.com/bloomberg/bde`
- BSLS\_ASSERT: `https://github.com/bloomberg/bde/blob/master/groups/bsl/bsls/bsls\_assert.h`

## Source Code

- BDE Starting point: `http://bbgithub.dev.bloomberg.com/bde/bde/`
- Or Open Source: `https://github.com/bloomberg/bde`
- BSLS\_ASSERT: `https://github.com/bloomberg/bde/blob/master/groups/bsl/bsls/bsls\_assert.h`
- BSLS\_REVIEW: `https://github.com/bloomberg/bde/blob/master/groups/bsl/bsls/bsls\_review.h`

## Things to Learn

- Build Targets: BDE\_BUILD\_TARGET\_OPT, BDE\_BUILD\_TARGET\_DBG, BDE\_BUILD\_TARGET\_SAFE.

## Things to Learn

- Build Targets: `BDE_BUILD_TARGET_OPT`, `BDE_BUILD_TARGET_DBG`, `BDE_BUILD_TARGET_SAFE`.
- Build Levels, other macros: `BSLS_ASSERT_LEVEL_*`, `BSLS_REVIEW_LEVEL_*`, `BSLS_ASSERT_*`, `BSLS_REVIEW_*`.

## Things to Learn

- Build Targets: `BDE_BUILD_TARGET_OPT`, `BDE_BUILD_TARGET_DBG`, `BDE_BUILD_TARGET_SAFE`.
- Build Levels, other macros: `BSLS_ASSERT_LEVEL_*`, `BSLS_REVIEW_LEVEL_*`, `BSLS_ASSERT_*`, `BSLS_REVIEW_*`.
- Testing: `BSLS_ASSERTTEST`