

# ADMB Project Infrastructure and the Next Steps

Open Source

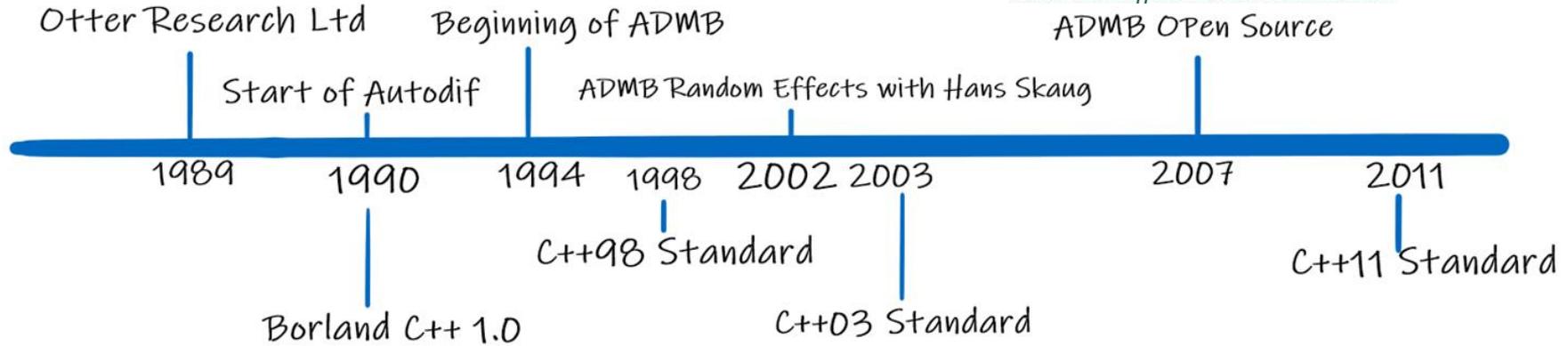
CAPAM Workshop 2019  
Wellington, New Zealand



# Timeline



Automatic Differentiation Model Builder  
ADMB OPEN Source





# ADMB Project

# Objective

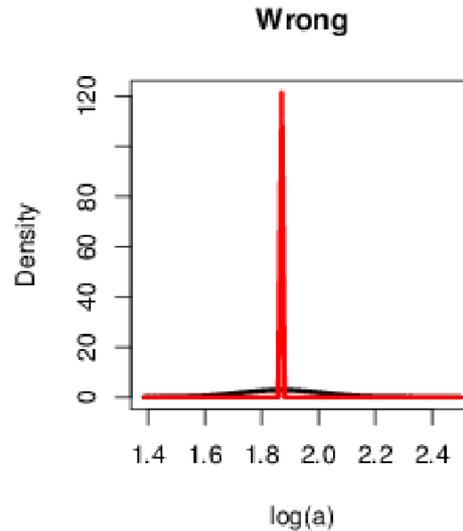
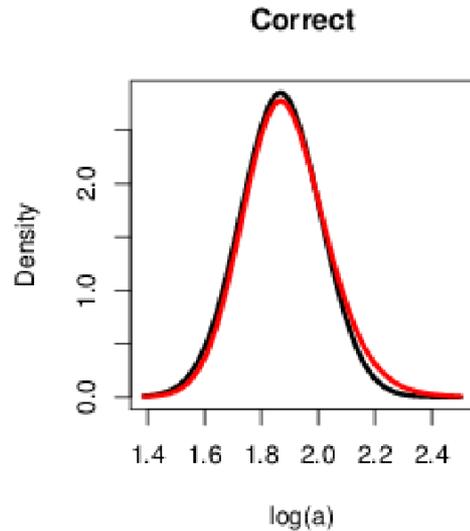
*Continue maintenance and development of ADMB as an open source project.*

- Maintain code to be current with C++ standards.
- Maintain code and build files for current compilers.
- Maintain documentation and information.
- Develop features when requested or needed.
- Fix issues with the code.
- Ensure that users can build, install and the ADMB software.

# Version Control

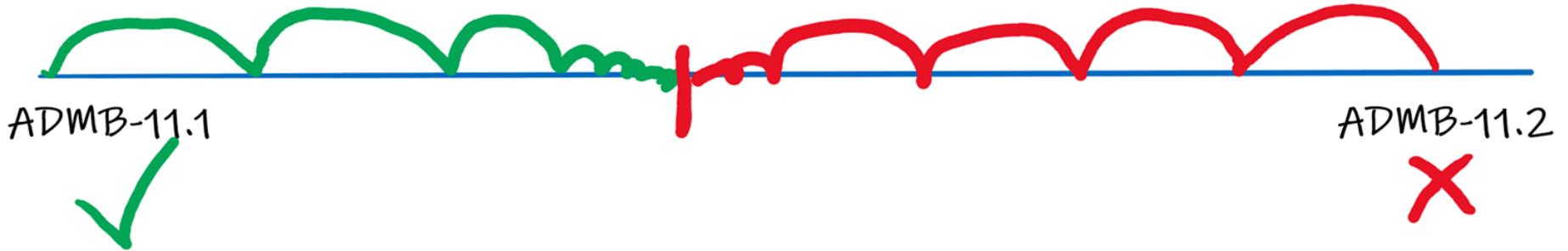
# Likelihood Profile

During Developer Workshop 2017 in Copenhagen, Denmark, Anders reported incorrect results with the likelihood profile.



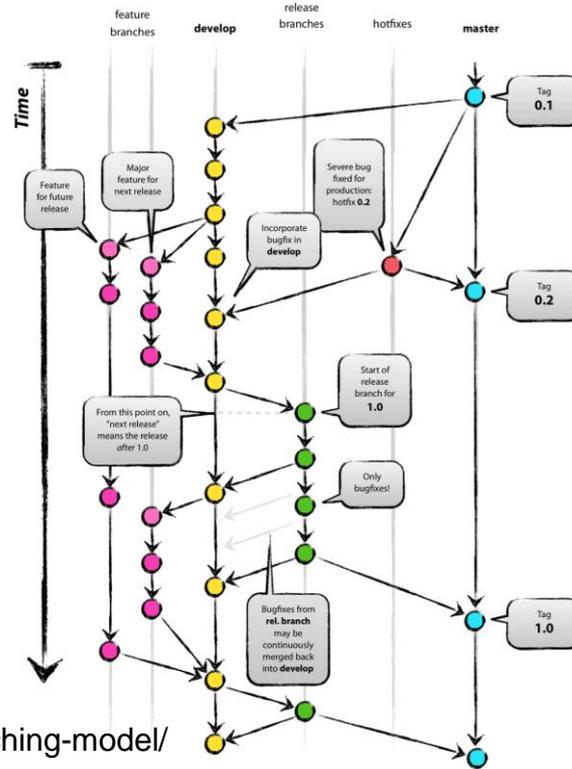
# Finding the Error

```
$ git log --oneline ADMB-11.1...ADMB-11.2 = 1759 commits
```



```
/home/johnnoel/movemod# rm -rf *
```

# Git Branching

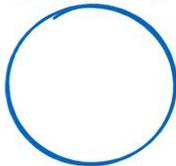


<https://nvie.com/posts/a-successful-git-branching-model/>

Infrastructure

GitHub

Version Control

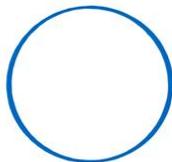


ADMB Project Website



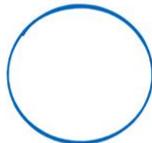
NCEAS

Mailing Lists



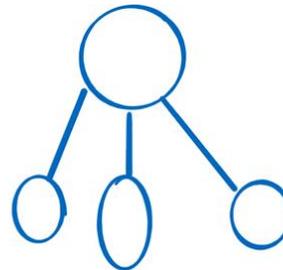
users@admb-project.org  
developers@admb-project.org

Archived Mail



Microsoft Azure

Automated Builds



Travis-CI

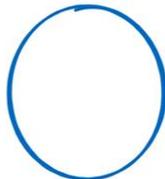


Bluehost

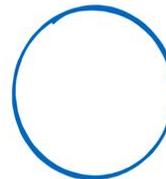
Foundation Website



<http://api.admb-project.org/>



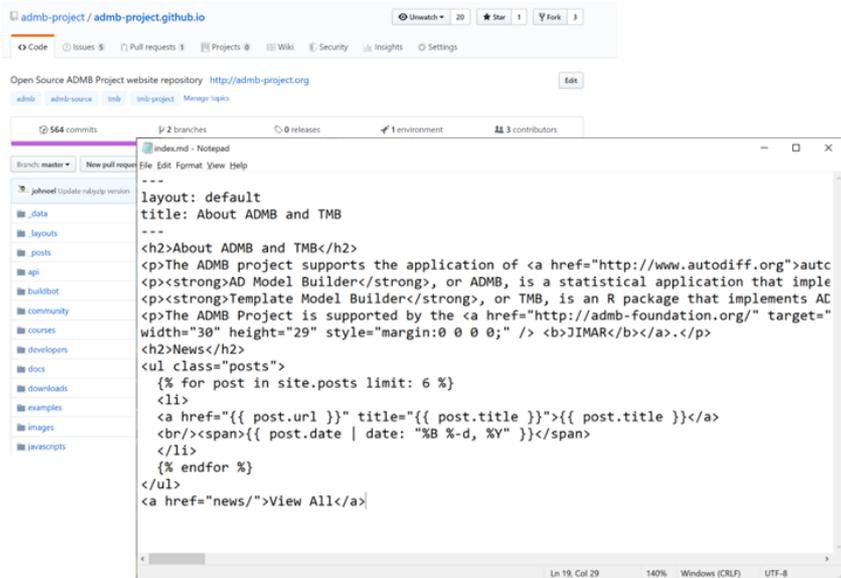
<http://buildbot.admb-project.org/>



# GitHub Pages

- Version Control
- Pages are written in text Markdown and Html
- Supports using custom domains
- Has logic coding!

# Website



```
admb-project / admb-project.github.io
Unwatch 20 Star 1 Fork 3
Code Issues Pull requests Projects Wiki Security Insights Settings
Open Source ADMB Project website repository http://admb-project.org
admb admb-source tmb tmb-project Manage topics
564 commits 2 branches 0 releases 1 environment 3 contributors
index.md - Notepad
Branch: master | New pull request
File Edit Format View Help
johneel Update rubyzip version
data
layouts
posts
api
buildbot
community
courses
developers
docs
downloads
examples
images
javascripts
layout: default
title: About ADMB and TMB
---
<h2>About ADMB and TMB</h2>
<p>The ADMB project supports the application of <a href="http://www.autodiff.org">autc
<p><strong>AD Model Builder</strong>, or ADMB, is a statistical application that imple
<p><strong>Template Model Builder</strong>, or TMB, is an R package that implements AC
<p>The ADMB Project is supported by the <a href="http://admb-foundation.org/" target="
width="30" height="29" style="margin:0 0 0 0;" /> <b>JIMAR</b></a>.</p>
<h2>News</h2>
<ul class="posts">
  {% for post in site.posts limit: 6 %}
    <li>
      <a href="{{ post.url }}" title="{{ post.title }}">{{ post.title }}</a>
      <br/><span>{{ post.date | date: "%B %-d, %Y" }}</span>
    </li>
  {% endfor %}
</ul>
<a href="news/">View All</a>
```



Jekyll Engine

<http://www.admb-project.org/>



## Downloads

[ADMB](#)  
[TMB](#)

## Documentation

[Manuals](#)  
[Examples](#)  
[Tips](#)  
[FAQs](#)  
[Reference](#)  
[Developers](#)

## ADMB Project

[Community](#)  
[Bibliography](#)  
[Tools](#)  
[Outreach](#)

## Events

## About ADMB and TMB

The ADMB project supports the application of *automatic differentiation (AD)* for solutions to non-linear statistical modeling and optimization problems.

**AD Model Builder**, or ADMB, is a statistical application that implements AD using C++ classes and a native template language. ADMB can be [downloaded](#) and source code is available on [GitHub](#). For further information, see this site and the ADMB paper: *Fournier, D.A., Skaug, H.J., Ancheta, J., Ianelli, J., Magnusson, A., Maunder, M.N., Nielsen, A., and Sibert, J. 2012. AD Model Builder: using automatic differentiation for statistical inference of highly parameterized complex nonlinear models. Optim. Methods Softw. 27:233-249.*

**Template Model Builder**, or TMB, is an R package that implements AD using C++ templates. TMB can be downloaded from CRAN and is developed on [GitHub](#). For further information, see the [Wiki](#) and the TMB paper: *Kristensen, K., Nielsen, A., Berg, C.W., Skaug, H.J., and Bell, B.M. 2016. TMB: Automatic Differentiation and Laplace Approximation. J. Stat. Softw. 70(5):1-21.*

The ADMB Project is supported by the [ADMB Foundation](#), [DTU Technical University of Denmark](#), [NCEAS National Center for Ecological Analysis and Synthesis](#), and a grant from [NOAA Fisheries](#) to [JIMAR](#).

## News

# Developing Framework

# Directory Structure

ADMB/

tests/

scripts/

src/

examples/

contrib/

# Testing

- Run Output tests

```
admb-master$ make verify
```

Outputs benchmarks-opt.txt and benchmarks-saf.txt

- Unit tests

Example

What is the expected value?

```
init_b = 1.0 / 2.0
```

# Unit Tests

- Used for testing expected output(s) for individual functions
- Good for Test Driven Development
- Google Test
  - <https://github.com/google/googletest>

```
TEST_F(test_async_gradient_structure, copy_amb_lambda_async2)
{
    gradient_structure gs;
    gradient_structure* p1 = gradient_structure::get();
    ASSERT_TRUE(p1 == &gs);
    double* dptr1 = p1->get_ARRAY_MEMBLOCK_BASE();
    ASSERT_TRUE(dptr1 != NULL);

    std::function<void(void)> f = [gs, dptr1]()
    {
        gradient_structure copy(gs);
        gradient_structure* p2 = gradient_structure::get();
        ASSERT_TRUE(p2 == &copy);
        ASSERT_TRUE(p2->get_ARRAY_MEMBLOCK_BASE() != NULL);
        double* dptr2 = p2->get_ARRAY_MEMBLOCK_BASE();
        ASSERT_TRUE(dptr2 != NULL);

        ASSERT_TRUE(&gs != p2);
        ASSERT_TRUE(dptr1 != dptr2);
        ASSERT_TRUE(gs.get_ARRAY_MEMBLOCK_BASE() != dptr2);
    };

    std::vector<std::future<void>> futures;
    for(int i = 0; i < 10; ++i)
    {
        futures.push_back(std::async(f));
    }
    for(auto& element: futures)
    {
        element.get();
    }
}
```

MINGW64:/c:/Users/johnoe

```
[ OK ] test_valarray.double_and_int (0 ms)
[ RUN ] test_valarray.my_valarray_sum
[ OK ] test_valarray.my_valarray_sum (34 ms)
[-----] 7 tests from test_valarray (173 ms total)

[-----] 4 tests from test_vector
[ RUN ] test_vector.default_constructor
[ OK ] test_vector.default_constructor (35 ms)
[ RUN ] test_vector.sumdoubles
[ OK ] test_vector.sumdoubles (0 ms)
[ RUN ] test_vector.sum
[ OK ] test_vector.sum (35 ms)
[ RUN ] test_vector.my_vector_sum
[ OK ] test_vector.my_vector_sum (33 ms)
[-----] 4 tests from test_vector (103 ms total)

[-----] 1 test from test_xpools
[ RUN ] test_xpools.sizes
[ OK ] test_xpools.sizes (0 ms)
[-----] 1 test from test_xpools (0 ms total)

[-----] 1 test from test_issues
[ RUN ] test_issues.issue50
[ OK ] test_issues.issue50 (34 ms)
[-----] 1 test from test_issues (35 ms total)

[-----] Global test environment tear-down
[=====] 896 tests from 97 test suites ran. (14662 ms total)
[ PASSED ] 896 tests.
[johnoe1@bredhat7 gtests]$
```

# ADMB Toolbox

# Toolbox

- Debuggers
  - GNU gdb
  - MacOS lldb
- Profilers
  - Valgrind
- Static Analysis Tools
  - Coverity
  - Clang++ --analyze option
- Source Code Documentation Tool
  - Doxygen
- Code Coverage
  - Codecov

# Static Analysis C++

SYNOPSIS® My Dashboard FAQ OSS Success Stories Projects Using Scan About Community

← Back to dashboard

admb-project/admb

Overview Project Settings Analysis Settings

coverity passed

## Analysis Metrics

Version: 6ffe0e32

Feb 17, 2019

Last Analyzed

427,628

Lines of Code Analyzed

## Defect changes since previous build date

0

Newly detected

0

Eliminated

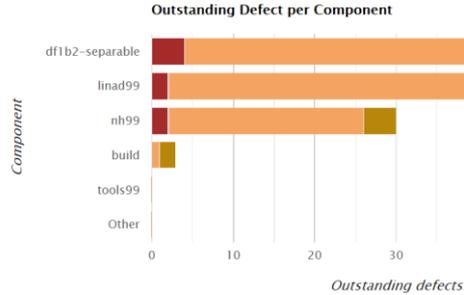
## Defects by status for current build

325

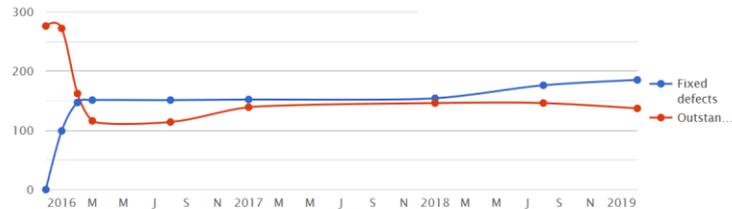
Total defects

137

Outstanding



## Outstanding vs Fixed defects over period of time



CID	Type	Impact	First Detected	Component	Category	File	Function
181962	Division or modulo by fl	Medium	01/12/18	linad99	Incorrect expression	/src/linad99/dmat24.cpp	mean
181961	Division or modulo by fl	Medium	01/12/18	linad99	Incorrect expression	/src/linad99/d3arr3.cpp	mean
181954	Untrusted value as arg.	Medium	01/12/18	df1b2-separable	Insecure data handling	/src/df1b2-separable/df1b2f13.cpp	read_buffer
181953	Untrusted value as arg.	Medium	01/12/18	df1b2-separable	Insecure data handling	/src/df1b2-separable/df1b2f14.cpp	read_buffer
181952	Untrusted loop bound	Medium	01/12/18	linad99	Insecure data handling	/src/linad99/conjprod.cpp	derch
181950	Division or modulo by fl	Medium	01/12/18	df1b2-separable	Incorrect expression	/src/df1b2-separable/df1b2fmpf.cpp	calculate_imp
181949	Untrusted value as arg.	Medium	01/12/18	df1b2-separable	Insecure data handling	/src/df1b2-separable/df1b2f13.cpp	rewind

```

1 /**
2 Author: David Fournier
3 Copyright (c) 2008-2012 Regents of the University of California
4 */
5 #include "fvar.hpp"
6
7 /**
8 Return computed mean of d3_array array.
9 */
10 double mean(const d3_array& array)
11 {
12     1. zero_return: Function call size_count(array) returns 0. [show details]
13     2. assignment: Assigning: size = size_count(array). The value of size is now 0.
14     3. Condition size == 0, taking true branch.
15     if (size == 0)
16     {
17         cerr << "Error: Unable to compute mean of empty d3_array.\n";
18         ad_exit(1);
19     }
20     return sum(array) / size;
21 }

```

CID 181961 (#1-2 of 2): Division or modulo by float zero (DIVIDE\_BY\_ZERO)  
 4. divide\_by\_zero: In expression sum(array) / size, division by expression size which may be zero has undefined behavior.

# Doxygen

```
MINGW64/c/Users/johnel
/**
 * Author: David Fournier
 * Copyright (c) 2008-2012 Regents of the University of California
 */

/** \file
Code for computing square of various constant objects.
*/
#include "fvar.hpp"

/**Return square of value; constant object.
\ingroup misc
\param value to be squared.
\return \f$value^2\f$
*/
double square(const double value)
{
    return value * value;
}

/**
Return dvector results of squaring elements in a values;
constant vector object.

\ingroup misc
\param values of constant object to be squared.
\return vector of the same length as #values containing \f$values_i^2\f$
*/
dvector square(const dvector& values)
{
    dvector results;
    results.allocate(values);
    for (int i = values.indexmin(); i <= values.indexmax(); ++i)
    {
        results(i) = square(values(i));
    }
    return results;
}

/**
Return dvector results of squaring elements in a values;
constant vector object.
"d3arr4.cpp" 85L, 2043C
1,1 Top
```

## ADMB Documentation 12.1-git-8b6aea8a

<a href="#">Main Page</a>	<a href="#">Function Reference</a>	<a href="#">Classes</a>	<a href="#">Source Code</a>	<a href="#">Related Pages</a>
src > linad99 >				

### d3arr4.cpp File Reference

(Git Commit: 7946793dabdb2)

Author: David Fournier Copyright (c) 2008-2012 Regents of the University of California. [More...](#)

```
#include "fvar.hpp"
```

[Go to the source code of this file.](#)

### Functions

**double** [square](#) (const double &value)

Return square of value; constant object. [More...](#)

**dvector** [square](#) (const dvector &values)

Return dvector results of squaring elements in a values; constant vector object. [More...](#)

**ivector** [square](#) (const ivector &values)

Return dvector results of squaring elements in a values; constant vector object. [More...](#)

**dmatrix** [square](#) (const dmatrix &a)

Square of a elements in a matrix; constant matrix object. [More...](#)

**d3\_array** [square](#) (const d3\_array &a)

Square of elements in a 3-dimensional array; constant 3-dimensional array. [More...](#)

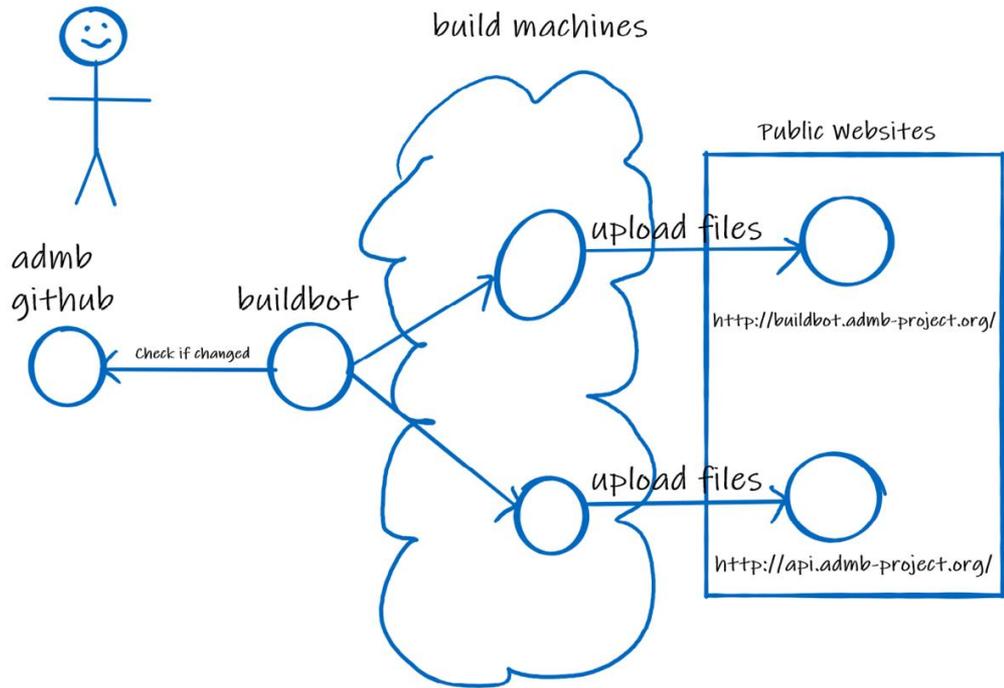
Automation

# Automation Services

- Travis-CI
- Microsoft Azure
- Buildbot

## Benefits

- No time limit restrictions
- Able use a lot more combinations of compilers and operating systems
- Able to do more like building installers and release distributions





# Buildbot

The screenshot displays the Buildbot web interface. On the left is a navigation sidebar with options like Home, Grid View, Waterfall View, Console View, Builds, Builders, Pending Buildrequests, Last Changes, Build Masters, Schedulers, Workers, and Settings. The main area shows a build summary for 'buildADMb\_redhat7/4' which finished a day ago. The build steps listed are worker\_preparation, git, shell, and shell\_1. A detailed view of the 'stdio' step is shown, containing a terminal log of a successful compilation and execution of a program named 'ad2csv'.

```
2774 Compiled contrib.obj.
2775
2776 make[1]: Leaving directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build/contrib/src'
2777
2778 rm -rf src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a
2779 cp -f src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a
2780 ar -rs src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a ../build/objects/dist-x86_64-linux-g++4/contrib-iafp-.obj
2781 rm -f src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a
2782 cp -f src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a
2783 "src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a" -> "src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a"
2784 ar -rs src/./../build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a ../build/objects/dist-x86_64-linux-g++4/contrib-egfp-.obj
2785 make[1]: Leaving directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build/contrib'
2786
2787 make contrib-ad2csv
2788 make[1]: Entering directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build/contrib'
2789 mkdir -p src/./../build/dist/include/contrib
2790 make -directory-recursive COPYFILES UPDATES OPTIMIZE CONTRIB_BINS-./../build/dist/bin/
2791 make[1]: Entering directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build/contrib/ad2csv'
2792 ./././admb ad2csv.cpp main.cpp
2793 g++ -std=c++0x -DUSE_MATH_DEFINES -DUSE_ADMB_CONTRIBS -I./../home/johnol/bb-worker/worker/buildADMb_redhat7/build/build/dist/include -I../home/johnol/bb-worker/worker/buildADMb_redhat7/build/build/dist/include/contrib -oad2csv ad2csv.o main.o
2794 *** Compile ad2csv.cpp
2795 g++ -std=c++0x -DUSE_MATH_DEFINES -DUSE_ADMB_CONTRIBS -I./../home/johnol/bb-worker/worker/buildADMb_redhat7/build/build/dist/include -I../home/johnol/bb-worker/worker/buildADMb_redhat7/build/build/dist/include/contrib -oad2csv ad2csv.o main.o
2796
2797 *** Compile: main.cpp
2798 g++ -std=c++0x -DUSE_MATH_DEFINES -DUSE_ADMB_CONTRIBS -I./../home/johnol/bb-worker/worker/buildADMb_redhat7/build/build/dist/include -I../home/johnol/bb-worker/worker/buildADMb_redhat7/build/build/dist/include/contrib -oad2csv ad2csv.o main.o
2799
2800 *** Linking: ad2csv.o main.o
2801 g++ -std=c++0x -oad2csv.o main.o /home/johnol/bb-worker/worker/buildADMb_redhat7/build/build/dist/lib/libadmb-contrib-x86_64-linux-g++4.a
2802
2803 Successfully built executable.
2804
2805 make[1]: Leaving directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build/contrib/ad2csv'
2806 make[1]: Leaving directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build/contrib'
2807 make[1]: Leaving directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build/contrib'
2808 make[2]: Leaving directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build'
2809 make[1]: Leaving directory '/home/johnol/bb-worker/worker/buildADMb_redhat7/build'
2810 ADMb build dist completed.
2811 Check README.txt for usage and installation information.
2812 program finished with exit code 0
2813 @cleanTime=216.80148
```

# Travis-CI

Travis CI [Dashboard](#) [Changelog](#) [Documentation](#) [Help](#)

Search all repositories

My Repositories +

- ✗ [admb-project/admb](#) # 1998
  - Duration: 13 hrs 6 min 9 sec
  - Finished: a day ago
- ✗ [johnoe/admb](#) # 45
  - Duration: 15 min 39 sec
  - Finished: 2 years ago

admb-project / admb build failing

Current Branches Build History Pull Requests > Build #1996 More options

✗ **master** Opps... ↔ #1996 failed Restart build

- ↔ Commit a6b8f82
- ↔ Compare bb19ee1..a6b8f82
- ↔ Branch master
- 👤 johnoe
- 🕒 Ran for 2 hrs 55 min 33 sec
- 🕒 Total time 12 hrs 57 min 47 sec
- 📅 2 days ago

Build jobs View config

- ✗ # 1996.1 A... </> Compiler: gcc C++ CXXFLAGS="-coverage-O0" LD 🕒 8 min
- ✓ # 1996.2 A... </> Compiler: gcc C++ SAFE\_ONLY=yes DEBUG=yes PI 🕒 24 min 18 sec

gh admb-project admb [Docs](#) [Support](#)

Build distribution.

👤 Johnoe a month ago ✗ CI Failed 57.93% -0.17%

↔ d34ef80 ↗ master 📄 460ccb5

📄 Diff **Files** 📄 Build 📄 Graphs

Files	📄	🟢	🟡	🔴	Coverage
df1b2-separable	17...	8,268	0	8,867	48.25%
linad99	21...	12...	0	9,174	58.06%
nh99	10...	3,562	0	6,726	34.62%
sparse	2,194	0	0	2,194	0.00%
tools99	938	852	0	86	90.83%
<b>Folder Totals</b> (5 files)	52...	25...	0	27...	48.41%
<b>Project Totals</b> (695 files)	64...	37...	0	27...	57.93%

Next Steps

# What to do?

- Find a place for the buildbot
- Continue Coding
- Document Data Flow
- Plan next workshop

# Future of Generic Mapping Tools (GMT)

- Using GitHub
- Using Travis and Azure for Automation
- Major Issue is increasing the number of project developers
- Developing Succession Plan
- Funding maintenance

# Auto Differentiation Workshop 2020

## Location

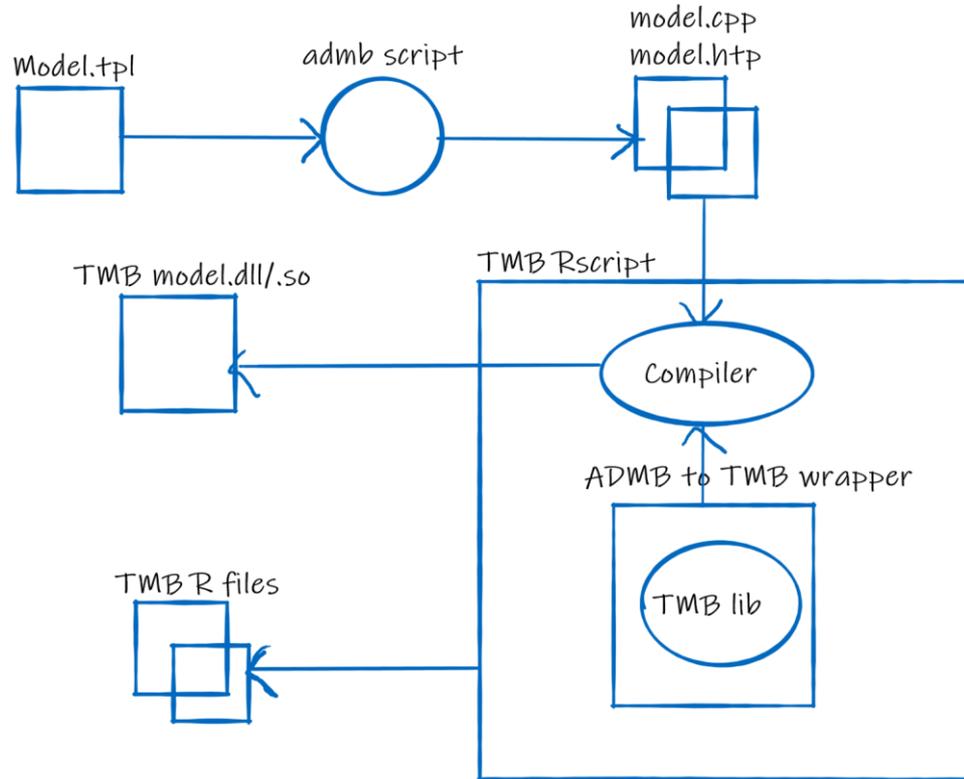
*Copenhagen, Denmark*

*Fall of 2020*

## Tasks

- Reducing number of temporaries with `std::move`
- Discuss a framework for AD development
- Develop a migration tool for ADMB to TMB
- Prepare ADMB and TMB for C++20 Standard

# ADMB to TMB tool



Thank You