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Authors: Michael Wong  
Project: Programming Language C++, SG19 Machine Learning  
Reply to: Michael Wong <michael@codeplay.com>

## SG19: Machine Learning Meeting Minutes 2022/02/10-2022/10/13

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### Minutes for 2022/02/10 SG19 Conference Call

On Wed, Feb 9, 2022 at 10:40 PM Michael Wong <fraggamuffin\_at\_[hidden]> wrote:

> Hi all, SG19 Machine Learning 2 hours.

>

> Hi,

>

> Michael Wong is inviting you to a scheduled Zoom meeting.

>

> Topic: SG19 monthly

> Time: 02:00 PM Eastern Time (US and Canada) 1900 UTC Stats

> Every month on the Second Thu,

>

>

- > Join from PC, Mac, Linux, iOS or Android:
- >
- > <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTILNkx0Zz09>
- > Password: 035530
- >
- > Or iPhone one-tap :
- > US: +13017158592,,93084591725# or +13126266799,,93084591725#
- > Or Telephone:
- > Dial(for higher quality, dial a number based on your current location):
- > US: +1 301 715 8592 or +1 312 626 6799 or +1 346 248 7799 or +1
- > 408 638 0968 or +1 646 876 9923 or +1 669 900 6833 or +1 253 215 8782
- > or 877 853 5247 (Toll Free)
- > Meeting ID: 930 8459 1725
- > Password: 035530
- > International numbers available: <https://iso.zoom.us/u/agewu4X97>
- >
- > Or Skype for Business (Lync):
- > <https://iso.zoom.us/skype/93084591725>
- >
- > Agenda:
- >
- > 1. Opening and introductions
- >
- > The ISO Code of conduct:
- > <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>
- >
- > IEC Code of Conduct:
- >
- > <https://www.iec.ch/basecamp/iec-code-conduct-technical-work>
- >
- > ISO patent policy.
- >
- >
- > [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)
- >
- > The WG21 Practices and Procedures and Code of Conduct:
- >

> <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>

>

> 1.1 Roll call of participants

>

> Michael Wong, Richard Dosselmann, Andrew Lumsdaine, Benjamin, Jens Maurer, Joe Sachs, Kevin Deweese, Luke D'alessandro, Marco Foco, Ozan Irsoy, Phil Ratzloff, Rene Rivera, Scott Mcmillan

> 1.2 Adopt agenda

>

> 1.3 Approve minutes from previous meeting, and approve publishing  
> previously approved minutes to ISOCPP.org

>

> 1.4 Action items from previous meetings

>

> 2. Main issues (125 min)

>

> 2.1 General logistics

>

> Meeting plan, focus on one paper per meeting but does not preclude other paper  
> updates:

>

> Jan 13, 2022 02:00 PM ET/1900 UTC: Review

> Feb 10, 2022 02:00 PM ET/1900 UTC: Stats

> Mar 10, 2022 02:00 PM ET/1900 UTC: Graph

> Apr 14, 2022 02:00 pm ET/1800 UTC: Reinforcement Learning and Differential  
> Calculus

>

>

> ISO meeting status

>

> future C++ Std meetings

>

> 2.2 Paper reviews

>

> 2.2.1: ML topics

>

> 2.2.1.1 Graph Proposal Phil Ratzloff et al

>

> Latest paper:

>

> Here's a link to the paper (different than the previous paper reviewed).

> There are some additional updates I'm planning on making before the  
> meeting.

>

>

> <https://docs.google.com/document/d/1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>

>

>

> Phil presenting:

longer tuples, C++23 zip is needed

Ranges out, views in

with an edge, many algo just need a target key and no source key.

Concepts: Other functions

Data structures: direct\_adjacency vector-> csr\_graph

Additional Work: graph range, algorithms, physical edge list, concepts for  
views

this is more modern

write algo based on infrastructure the package provides using djikstra's  
shortest path; another category is to write temporary on each edge

>

> P1709R3:

>

> [https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\\_dyYdRy4dM/edit?usp=sharing](https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5_dyYdRy4dM/edit?usp=sharing)

>

>

- > [https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug\\_vkkE/edit?usp=sharing](https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug_vkkE/edit?usp=sharing)
- >
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>
- >
- > <
- >
- > <https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpsc-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>
- > \*>\*
- >
- > Array copy semantics:
- > array copy-semantics paper P1997 "Relaxing Restrictions on Arrays",
- > <https://wg21.link/p1997>
- >
- > Stats feedback:
- >
- > P2376R0
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>>
- > Comments
- > on Simple Statistical Functions (p1708r4): Contracts, Exceptions and
- > Special cases Johan Lundberg
- >
- > 2.2.1.2 Reinforcement Learning Larry Lewis Jorge Silva
- >
- > Reinforcement Learning proposal:
- >
- > 2.2.1.3 Differential Calculus:
- >
- >
- > <https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpsc-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>
- >
- > 2.2.1.4: Stats paper
- >
- > Current github
- >
- > <https://github.com/cplusplus/papers/issues/475>

>  
 > <https://github.com/cplusplus/papers/issues/979>  
 >  
 > Stats review Richard Dosselman et al  
 >  
 > <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf>  
 >  
 > Feedback from Johan Lundberg and Oleksandr Korval  
 >  
 > <https://isocpp.org/files/papers/D2376R0.pdf>  
 >  
 > P1708R3: Math proposal for Machine Learning: 3rd review  
 >  
 > PXXXX: combinatorics: 1st Review  
 >  
 > \*> [std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2](http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2)  
 > <<http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>> \*  
 > \*> above is the stats paper that was reviewed in Prague\*  
 > \*> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>  
 > <<http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>> \*  
 > \*> \*  
 > \*> Review Jolanta Polish feedback.\*  
 > \*> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>  
 > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>> \*  
 >  
 >

Richard shows some new additions to stats  
 basic freestanding all the same drop the constraints of the concept  
 concern about your type may work in MS STL , but not GCC, or clang, it  
 would be up to implementation STL; it is how complex number works:  
 specified to work for float and double, long double and happens to work  
 inline: then wording will follow std complex

#### 4.2 accumulator

used to derive from a common parent leading to RTTI  
 but now no more virtual function, more parallelizable  
 copy/move/assignment constructors can be removed as language provides those  
 but add statement to say it is copyable,etc

advise not use auto return type for trivial return type like result, please document rationale as well,  
moving away from abbreviations acc=accumulate/accumulator  
maybe stats namespace under std

change typename to class

follow algorithm section of standard

Nan needs to be used for infinity

SG6 is scheduling every 2 weeks Thursday 3-4:30 pm starting Feb 17

2.2.3 any other proposal for reviews?

- >
- > 2.3 Other Papers and proposals
- >
- > P1416R1: SG19 - Linear Algebra for Data Science and Machine Learning
- >
- > <https://docs.google.com/document/d/1IKUNiUhBgRURW-UkspK7fAAylhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>
- >
- > P1415: Machine Learning Layered list
- >
- > [https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol\\_Wj8fyi4Z4hogfj5tLV\\_Sj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol_Wj8fyi4Z4hogfj5tLV_Sj64/edit#heading=h.tj9hitg7dbtr)
- >
- > 2.2.2 SG14 Linear Algebra progress:
- > Different layers of proposal
- >
- > [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)

- >
- > 2.5 Future F2F meetings:
- >
- > 2.6 future C++ Standard meetings:
- > <https://isocpp.org/std/meetings-and-participation/upcoming-meetings>
- >
- > None
- >
- > 3. Any other business
- >
- > New reflector
- >
- > <http://lists.isocpp.org/mailman/listinfo/sg19>
- >
- > Old Reflector
- > <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19>
- > <<https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14>>
- >
- > Code and proposal Staging area
- >
- > 4. Review
- >
- > 4.1 Review and approve resolutions and issues [e.g., changes to SG's  
> working draft]
- >
- > 4.2 Review action items (5 min)
- >
- > 5. Closing process
- >
- > 5.1 Establish next agenda
- >
- >
- > 5.2 Future meeting
- >
- >
- > Jan 13, 2022 02:00 PM ET/1900 UTC: Review
- > Feb 10, 2022 02:00 PM ET/1900 UTC: Stats
- > Mar 10, 2022 02:00 PM ET/1900 UTC: Graph



- > Apr 14, 2022 02:00 pm ET/1800 UTC: Reinforcement Learning and Differential
- > Calculus

## Minutes for 2022/03/10 SG19 Conference Call

On Tue, Mar 8, 2022 at 11:16 PM Michael Wong <fraggamuffin\_at\_[hidden]> wrote:

- > Hi all, SG19 Machine Learning 2 hours.
- > Hi,
- >
- > Michael Wong is inviting you to a scheduled Zoom meeting.
- >
- > Topic: SG19 monthly
- > Time: 02:00 PM Eastern Time (US and Canada) 1900 UTC Stats
- > Every month on the Second Thu,
- >
- >
- > Join from PC, Mac, Linux, iOS or Android:
- >
- > <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTILNkx0Zz09>
- > Password: 035530
- >
- > Or iPhone one-tap :
- > US: +13017158592,,93084591725# or +13126266799,,93084591725#
- > Or Telephone:
- > Dial(for higher quality, dial a number based on your current location):
- > US: +1 301 715 8592 or +1 312 626 6799 or +1 346 248 7799 or +1
- > 408 638 0968 or +1 646 876 9923 or +1 669 900 6833 or +1 253 215 8782
- > or 877 853 5247 (Toll Free)
- > Meeting ID: 930 8459 1725
- > Password: 035530
- > International numbers available: <https://iso.zoom.us/u/agewu4X97>
- >
- > Or Skype for Business (Lync):
- > <https://iso.zoom.us/skype/93084591725>

- >
- > Agenda:
- >
- > 1. Opening and introductions
- >
- > The ISO Code of conduct:
- > <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>
- >
- > IEC Code of Conduct:
- >
- > <https://www.iec.ch/basecamp/iec-code-conduct-technical-work>
- >
- > ISO patent policy.
- >
- >
- > [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)
- >
- > The WG21 Practices and Procedures and Code of Conduct:
- >
- > <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>
- >
- > 1.1 Roll call of participants
- >
- > 1.2 Adopt agenda
- >
- yes
- review from SG6 on stats
- >
- >
- > 1.3 Approve minutes from previous meeting, and approve publishing
- > previously approved minutes to ISOCPP.org
- >
- > 1.4 Action items from previous meetings
- >
- > 2. Main issues (125 min)
- >
- > 2.1 General logistics

- >
- > Meeting plan, focus on one paper per meeting but does not preclude other
- > paper
- > updates:
- >
- >
- > Mar 10, 2022 02:00 PM ET/1900 UTC: Graph
- > Apr 14, 2022 02:00 pm ET/1800 UTC: Reinforcement Learning and
- > Differential Calculus
- > May 12, 2022 02:00 PM ET/1800 UTC: Stats
- > June 9, 2022 02:00 PM ET/1800 UTC: Graph
- > Jul 14, 2022 02:00 PM ET/1800 UTC: RL and DC
- > Aug 11, 2022 02:00 PM ET/1800 UTC: Stats
- > Sep 13, 2022 02:00 PM ET/1800 UTC: Graph
- > Oct 12, 2022 02:00 PM ET/1800 UTC: RL/DC
- >
- > ISO meeting status
- >
- > future C++ Std meetings
- >
  
- >
- > 2.2 Paper reviews
- >
- > 2.2.1: ML topics
- >
- > 2.2.1.1 Graph Proposal Phil Ratsloff et al
- >
- > Latest paper:
- >
- > Here's a link to the paper (different than the previous paper reviewed).
- > There are some additional updates I'm planning on making before the
- > meeting.
- >
- >
- > <https://docs.google.com/document/d/1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>
- >

>

> storing of the key, was not but now we are

creating useful template aliases, like a copyable vertex

invariant of target key will always exists

vertex\_view<VKey, V, VV>{key, vertex, ...}

Incidence graph view

views::vertexlist and views::...

csr\_graph<EV, VV, GV, VKey, Alloc>

what about a constexpr graph? based on a constexpr vector but you can't

have vector because you can't run a destructor

what about a std::array? a graph is a range of range so is possible

key vs id; id comes from boost graph

use tag\_invoke to do customization point objects, use in paper? tentatively

yes

2 graph data structures are doneish

>

> P1709R3:

>

> [https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\\_dyYdRy4dM/edit?usp=sharing](https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5_dyYdRy4dM/edit?usp=sharing)

>

>

> [https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzq1Ug\\_vkkE/edit?usp=sharing](https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzq1Ug_vkkE/edit?usp=sharing)

>

> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>

>

> <

>

> <https://docs.google.com/document/d/175wIm8o4BNGti0WLq8U6uZORegKVjmnphc-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>

> \*>\*

>

> Array copy semantics:

> array copy-semantics paper P1997 "Relaxing Restrictions on Arrays",

- > <https://wg21.link/p1997>
- >
- > Stats feedback:
- >
- > P2376R0
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>>
- > Comments
- > on Simple Statistical Functions (p1708r4): Contracts, Exceptions and
- > Special cases Johan Lundberg
- >

Sg6 review of stats

renaming various object functions, mean ,std dev, have weighted variants->  
weighted\_\*\*\*, uniform naming conventions  
unspecified value, NaN, -Inf addressed issues with these  
drop a few unnecessary functions

need for projection argument? can be replaced by transform, so the  
projection was removed

- >
- >
- > 2.2.1.2 Reinforcement Learning Larry Lewis Jorge Silva
- >
- > Reinforcement Learning proposal:
- >
- > 2.2.1.3 Differential Calculus:
- >
- >
- > <https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpsc-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>
- >
- > 2.2.1.4: Stats paper
- >
- > Current github
- >
- > <https://github.com/cplusplus/papers/issues/475>
- >
- > <https://github.com/cplusplus/papers/issues/979>

- >
- > Stats review Richard Dosselman et al
- >
- > <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf>
- >
- > Feedback from Johan Lundberg and Oleksandr Korval
- >
- > <https://isocpp.org/files/papers/D2376R0.pdf>
- >
- > P1708R3: Math proposal for Machine Learning: 3rd review
- >
- > PXXXX: combinatorics: 1st Review
- >
- > \*> [std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2](http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2)
- > <<http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>>\*
- > \*> above is the stats paper that was reviewed in Prague\*
- > \*> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>
- > <<http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>>\*
- > \*>\*
- > \*> Review Jolanta Polish feedback.\*
- > \*> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>\*
- >
- > 2.2.3 any other proposal for reviews?
- >
- > 2.3 Other Papers and proposals
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- > P1416R1: SG19 - Linear Algebra for Data Science and Machine Learning
- >
- > <https://docs.google.com/document/d/1IKUNiUhBgRURW-UkspK7fAAylhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>
- >
- > P1415: Machine Learning Layered list
- >
- > [https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol\\_Wj8fyi4Z4hogfj5tLV\\_Sj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol_Wj8fyi4Z4hogfj5tLV_Sj64/edit#heading=h.tj9hitg7dbtr)
- >
- > 2.2.2 SG14 Linear Algebra progress:

- > Different layers of proposal
- >
- > [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)
- >
- > 2.5 Future F2F meetings:
- >
- > 2.6 future C++ Standard meetings:
- > <https://isocpp.org/std/meetings-and-participation/upcoming-meetings>
- >
- > None
- >
- > 3. Any other business
- >
- > New reflector
- >
- > <http://lists.isocpp.org/mailman/listinfo.cgi/sg19>
- >
- > Old Reflector
- > <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19>
- > <https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14>>
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- > Sep 13, 2022 02:00 PM ET/1800 UTC: Graph
- > Oct 12, 2022 02:00 PM ET/1800 UTC: RL/DC



## Minutes for 2022/04/12 SG19 Conference Call

On Wed, Feb 10, 2021 at 12:53 PM Michael Wong <fraggamuffin\_at\_[hidden]> wrote:

Thanks Jens for hosting, Dunia for the notes

These are some of the feedback/action items I got today and the slides are attached:

- The proposal presented here is similar in the level of abstraction to the simd proposal in <https://en.cppreference.com/w/cpp/experimental/simd/simd> and <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2018/p0214r9.pdf> in the sense that it proposes to partition the application data into small chunks that fit into physical registers and focuses on performance and low level programming.
- The example code shows only efficient mapping on AMX in the CPU context. How would this efficiently map to Nvidia GPUs tensorcores?
- A query API is needed to query the different efficiently supported sizes and types on the hardware. These sizes and types are implementation-defined. If an implementation finds a value in emulating sizes or types that are not natively supported by the matrix hardware, the implementation is free to emulate them but these will be communicated to the user via this query API.
- Do we really need the dynamic variant of the sizes? AMX supports it but is this a sufficient reason to add it to the spec? Having only constant sizes (included with the type) would simplify the API and the query interface.
- Besides `matrix_load`, `matrix_store` and `matrix_mad`, what are the operations (mainly element wise operations and others) to be added for completeness? There are three options that we can consider one or a combination of them:
  - have indexing and looping over the scalars as the general approach to implement any kind of operation
  - Since the matrix hardware, at least the main ones here, does not support these operations natively, provide an operation to convert (flatten) the matrix into a vector to be able to apply all these vector operations without introducing extra functions.
  - Select a set of operations that are supported in modern hardware (like a convolution function) and add these specific ones as additional functions that operate on the matrix type.

- This proposal consists of a low level matrix and should be separated from the existing matrix-related proposals like mdspan, mdarray, BLAS and matrix engines. The end users in the latter proposals don't need to think about partitioning the data or what the hardware efficiently supports.
- The vocabulary used in the motivation and use cases of this proposal should move away from the generic ML terminology into more specific terms like linear algebra functions.

Thanks,  
Dounia

On Thu, Apr 14, 2022 at 2:20 PM Michael Wong via SG19 <sg19\_at\_[hidden]> wrote:

> Thank you Jens for hosting.

>

> On Thu, Apr 14, 2022 at 3:19 PM Michael Wong <fraggamuffin\_at\_[hidden]>

> wrote:

>

>> Sorry guys my internet died.

>>

>> On Thu, Apr 14, 2022 at 2:18 PM Jens Maurer via SG19 <

>> sg19\_at\_[hidden]> wrote:

>>

>>>

>>> I can offer

>>>

>>> Join Zoom Meeting

>>> <https://iso.zoom.us/j/97800734479?pwd=OFFMazlWNDVPeXFxSHVWaGdqY2Fldz09>

>>>

>>> Meeting ID: 978 0073 4479

>>> Passcode: 636614

>>>

>>>

>>> as an alternative meeting point until Mike arrives.

>>>

>>> Jens

>>>

>>>

>>>

>>>

>>>

>>>

>>>

>>> On 14/04/2022 20.10, Jens Maurer via SG19 wrote:  
>>> >  
>>> > I'm getting "Please wait for the host to start this meeting."  
>>> >  
>>> > Jens  
>>> >  
>>> >  
>>> > On 13/04/2022 04.10, Michael Wong via SG19 wrote:  
>>> >> Hi all, SG19 Machine Learning meeting will focus on  
>>> Matrix/RL/calculus.  
>>> >>  
>>> >> Michael Wong is inviting you to a scheduled Zoom meeting.  
>>> >>  
>>> >> Topic: SG19 monthly  
>>> >> Time: 02:00 PM Eastern Time (US and Canada) 1800 UTC Stats  
>>> >> Every month on the Second Thu,  
>>> >>  
>>> >>  
>>> >> Join from PC, Mac, Linux, iOS or Android:  
>>> >>  
>>> >>  
>>> <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTlNkx0Zz09> <  
>>> <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTlNkx0Zz09>>  
>>> >> Password: 035530  
>>> >>  
>>> >> Or iPhone one-tap :  
>>> >> US: +13017158592,,93084591725# or +13126266799,,93084591725#  
>>> >> Or Telephone:  
>>> >> Dial(for higher quality, dial a number based on your current  
>>> location):  
>>> >> US: +1 301 715 8592 or +1 312 626 6799 or +1 346 248 7799 or  
>>> +1  
>>> >> 408 638 0968 or +1 646 876 9923 or +1 669 900 6833 or +1 253 215 8782  
>>> >> or 877 853 5247 (Toll Free)  
>>> >> Meeting ID: 930 8459 1725  
>>> >> Password: 035530  
>>> >> International numbers available: <https://iso.zoom.us/u/agewu4X97>  
>>> <<https://iso.zoom.us/u/agewu4X97>>  
>>> >>  
>>> >> Or Skype for Business (Lync):  
>>> >> <https://iso.zoom.us/skype/93084591725> <  
>>> <https://iso.zoom.us/skype/93084591725>>  
>>> >>  
>>> >> Agenda:

>>> >>

>>> >> 1. Opening and introductions

>>> >>

>>> >> The ISO Code of conduct:

>>> >>

>>> <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>

>>> <

>>> <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>

>>> >

>>> >>

>>> >> IEC Code of Conduct:

>>> >>

>>> >> <https://www.iec.ch/basecamp/iec-code-conduct-technical-work> <

>>> <https://www.iec.ch/basecamp/iec-code-conduct-technical-work>>

>>> >>

>>> >> ISO patent policy.

>>> >>

>>> >>

>>> [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)

>>> <

>>> [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)

>>> >

>>> >>

>>> >> The WG21 Practices and Procedures and Code of Conduct:

>>> >>

>>> <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>

>>> <

>>> <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>

>>> >

>>> >>

>>> >> 1.1 Roll call of participants

>>> >>

>>> >> 1.2 Adopt agenda

>>> >>

>>> >> 1.3 Approve minutes from previous meeting, and approve publishing

>>> >> previously approved minutes to ISOCPP.org

>>> >>

>>> >> 1.4 Action items from previous meetings

>>> >>

>>> >> 2. Main issues (125 min)

>>> >>

>>> >> 2.1 General logistics

>>> >>

>>> >> Meeting plan, focus on one paper per meeting but does not preclude  
>>> other paper updates:

>>> >>

>>> >>

>>> >> Apr 14, 2022 02:00 pm ET/1800 UTC: Matrix/Reinforcement Learning  
>>> and

>>> >> Differential Calculus

>>> >> May 12, 2022 02:00 PM ET/1800 UTC: Stats

>>> >> June 9, 2022 02:00 PM ET/1800 UTC: Graph

>>> >> Jul 14, 2022 02:00 PM ET/1800 UTC: RL and DC

>>> >> Aug 11, 2022 02:00 PM ET/1800 UTC: Stats

>>> >> Sep 13, 2022 02:00 PM ET/1800 UTC: Graph

>>> >> Oct 12, 2022 02:00 PM ET/1800 UTC: RL/DC

>>> >>

>>> >> ISO meeting status

>>> >>

>>> >> future C++ Std meetings

>>> >>

>>> >> 2.2 Paper reviews

>>> >>

>>> >> 2.2.1: ML topics

>>> >>

>>> >> 2.2.1.1 Graph Proposal Phil Ratsloff et al

>>> >>

>>> >> Latest paper:

>>> >>

>>> >> Here's a link to the paper (different than the previous paper  
>>> reviewed).

>>> >> There are some additional updates I'm planning on making before the  
>>> meeting.

>>> >>

>>> >>

>>> <https://docs.google.com/document/d/1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>

>>> <

>>> <https://docs.google.com/document/d/1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>

>>> >

>>> >>

>>> >>

>>> >>

>>> >>

>>> >> P1709R3:

```

>>> >>
>>> https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\_dyYdRy4dM/edit?usp=sharing
>>> <
>>> https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\_dyYdRy4dM/edit?usp=sharing
>>> >
>>> >>
>>> >>
>>> https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug\_vkkE/edit?usp=sharing
>>> <
>>> https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug\_vkkE/edit?usp=sharing
>>> >
>>> >>
>>> >> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>
>>> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>
>>> >>
>>> >> <
>>> >>
>>> https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel
>>> <
>>> https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel
>>> >
>>> >> *>*>
>>> >>
>>> >> Array copy semantics:
>>> >> array copy-semantics paper P1997 "Relaxing Restrictions on Arrays",
>>> >> https://wg21.link/p1997 <https://wg21.link/p1997>
>>> >>
>>> >> Stats feedback:
>>> >>
>>> >> P2376R0
>>> >> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>
>>> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>>
>>> >> Comments
>>> >> on Simple Statistical Functions (p1708r4): Contracts, Exceptions and
>>> >> Special cases Johan Lundberg
>>> >>
>>> >> 2.2.1.2 Reinforcement Learning Larry Lewis Jorge Silva
>>> >>

```

>>> >> Reinforcement Learning proposal:  
>>> >>  
>>> >> 2.2.1.3 Differential Calculus:  
>>> >>  
>>> >>  
>>> [https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-\\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel](https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel)  
>>> <  
>>> [https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-\\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel](https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel)  
>>> >  
>>> >>  
>>> >> 2.2.1.4 <<http://2.2.1.4>>: Stats paper  
>>> >>  
>>> >> Current github  
>>> >>  
>>> >> <https://github.com/cplusplus/papers/issues/475> <  
>>> <https://github.com/cplusplus/papers/issues/475>>  
>>> >>  
>>> >> <https://github.com/cplusplus/papers/issues/979> <  
>>> <https://github.com/cplusplus/papers/issues/979>>  
>>> >>  
>>> >> Stats review Richard Dosselman et al  
>>> >>  
>>> >> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf> <  
>>> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf>>  
>>> >>  
>>> >> Feedback from Johan Lundberg and Oleksandr Korval  
>>> >>  
>>> >> <https://isocpp.org/files/papers/D2376R0.pdf> <  
>>> <https://isocpp.org/files/papers/D2376R0.pdf>>  
>>> >>  
>>> >> P1708R3: Math proposal for Machine Learning: 3rd review  
>>> >>  
>>> >> PXXXX: combinatorics: 1st Review  
>>> >>  
>>> >> \*> [std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2](http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2) <  
>>> <http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>>  
>>> >> <<http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2> <  
>>> <http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>>>\*>  
>>> >> \*> above is the stats paper that was reviewed in Prague\*  
>>> >> \*> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19> <  
>>> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>>  
>>> >> <<http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19> <

>>> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>>>\*

>>> >> \*>\*

>>> >> \*> Review Jolanta Polish feedback.\*

>>> >> \*>

>>> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html> <

>>> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>

>>> >> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>

>>> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>>\*

>>> >>

>>> >>

>>> >> 2.2.1.4 <<http://2.2.1.4>>: Matrix paper

>>> >>

>>> >> 2.2.3 any other proposal for reviews?

>>> >>

>>> >> 2.3 Other Papers and proposals

>>> >>

>>> >> P1416R1: SG19 - Linear Algebra for Data Science and Machine Learning

>>> >>

>>> <https://docs.google.com/document/d/1IKUNiUhBgRURW-UkspK7fAAyIhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>

>>> <

>>> <https://docs.google.com/document/d/1IKUNiUhBgRURW-UkspK7fAAyIhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>

>>> >

>>> >>

>>> >> P1415: Machine Learning Layered list

>>> >>

>>> [https://docs.google.com/document/d/1eINFdIXWoetbj01OKol\\_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFdIXWoetbj01OKol_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr)

>>> <

>>> [https://docs.google.com/document/d/1eINFdIXWoetbj01OKol\\_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFdIXWoetbj01OKol_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr)

>>> >

>>> >>

>>> >> 2.2.2 SG14 Linear Algebra progress:

>>> >> Different layers of proposal

>>> >>

>>> [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)

>>> <

>>> [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)

>>> >

>>> >>

>>> >> 2.5 Future F2F meetings:

>>> >>



>>> >> 2.6 future C++ Standard meetings:  
>>> >> <https://isocpp.org/std/meetings-and-participation/upcoming-meetings> <  
>>> <https://isocpp.org/std/meetings-and-participation/upcoming-meetings>>  
>>> >>  
>>> >> None  
>>> >>  
>>> >> 3. Any other business  
>>> >>  
>>> >> New reflector  
>>> >>  
>>> >> <http://lists.isocpp.org/mailman/listinfo.cgi/sg19> <  
>>> <http://lists.isocpp.org/mailman/listinfo.cgi/sg19>>  
>>> >>  
>>> >> Old Reflector  
>>> >> <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19> <  
>>> <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19>>  
>>> >> <  
>>> <https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14> <  
>>> <https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14>>>  
>>> >>  
>>> >> Code and proposal Staging area  
>>> >>  
>>> >> 4. Review  
>>> >>  
>>> >> 4.1 Review and approve resolutions and issues [e.g., changes to SG's  
>>> >> working draft]  
>>> >>  
>>> >> 4.2 Review action items (5 min)  
>>> >>  
>>> >> 5. Closing process  
>>> >>  
>>> >> 5.1 Establish next agenda  
>>> >>  
>>> >>  
>>> >> 5.2 Future meeting  
>>> >>  
>>> >>  
>>> >>  
>>> >> Apr 14, 2022 02:00 pm ET/1800 UTC: Matrix/Reinforcement Learning  
>>> >> and  
>>> >> Differential Calculus  
>>> >> May 12, 2022 02:00 PM ET/1800 UTC: Stats  
>>> >> June 9, 2022 02:00 PM ET/1800 UTC: Graph  
>>> >> Jul 14, 2022 02:00 PM ET/1800 UTC: RL and DC

>>> >> Aug 11, 2022 02:00 PM ET/1800 UTC: Stats  
>>> >> Sep 13, 2022 02:00 PM ET/1800 UTC: Graph  
>>> >> Oct 12, 2022 02:00 PM ET/1800 UTC: RL/DC  
>>> >>  
>>> >  
>>>  
>>> --  
>>> SG19 mailing list  
>>> SG19\_at\_[hidden]  
>>> <https://lists.isocpp.org/mailman/listinfo.cgi/sg19>  
>>>  
>> --  
> SG19 mailing list  
> SG19\_at\_[hidden]  
> <https://lists.isocpp.org/mailman/listinfo.cgi/sg19>



## Minutes for 2022/05/12 SG19 Conference Call

### Minutes

On Wed, May 11, 2022 at 9:55 PM Michael Wong <fraggamuffin\_at\_[hidden]> wrote:

- > Hi all, SG19 Machine Learning meeting will focus on stats.
- > Michael Wong is inviting you to a scheduled Zoom meeting.
- >
- > Topic: SG19 monthly
- > Time: 02:00 PM Eastern Time (US and Canada)
- > Every month on the Second Thu,
- >
- >
- > Join from PC, Mac, Linux, iOS or Android:
- >
- > <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTILNkx0Zz09>
- > Password: 035530
- >
- > Or iPhone one-tap :
- > US: +13017158592,,93084591725# or +13126266799,,93084591725#
- > Or Telephone:
- > Dial(for higher quality, dial a number based on your current location):
- > US: +1 301 715 8592 or +1 312 626 6799 or +1 346 248 7799 or +1
- > 408 638 0968 or +1 646 876 9923 or +1 669 900 6833 or +1 253 215 8782
- > or 877 853 5247 (Toll Free)
- > Meeting ID: 930 8459 1725
- > Password: 035530
- > International numbers available: <https://iso.zoom.us/u/agewu4X97>
- >
- > Or Skype for Business (Lync):
- > <https://iso.zoom.us/skype/93084591725>
- >
- > Agenda:
- >
- > 1. Opening and introductions
- >
- > The ISO Code of conduct:
- > <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>
- >
- > IEC Code of Conduct:
- >

- > <https://www.iec.ch/basecamp/iec-code-conduct-technical-work>
- >
- > ISO patent policy.
- >
- >
- > [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)
- >
- > The WG21 Practices and Procedures and Code of Conduct:
- >
- > <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>
- >
- > 1.1 Roll call of participants
- >
- Michael Wong, Richard Dosselman, Ozan Irsoy, Phil Ratzloff, Luke D'Alessandro, Kevin Dewessee, Chris Ryan, Andrew Lumsdaine, Rene Rivera, Ka Ming Chan Jens Maurer
  
- >
- > 1.2 Adopt agenda
- >
- > 1.3 Approve minutes from previous meeting, and approve publishing previously approved minutes to ISOCPP.org
- >
- > 1.4 Action items from previous meetings
- >
- > 2. Main issues (125 min)
- >
- > 2.1 General logistics
- >
- > Meeting plan, focus on one paper per meeting but does not preclude other paper updates:
- >
- >
- > May 12, 2022 02:00 PM ET: Stats
- > June 9, 2022 02:00 PM ET: Graph
- > Jul 14, 2022 02:00 PM ET: Matrix, RL and DC
- > Aug 11, 2022 02:00 PM ET: Stats

- > Sep 13, 2022 02:00 PM ET: Graph
- > Oct 12, 2022 02:00 PM ET: Matrix RL/DC
- >
- > ISO meeting status
- >
- > future C++ Std meetings
- >

- 2022-11-07 to 12: Kona, HI, USA

<<https://isocpp.org/files/papers/N4912.pdf>>: Standard C++ Foundation

- >
- > 2.2 Paper reviews
- >
- > 2.2.1: ML topics
- >
- > 2.2.1.1 Graph Proposal Phil Ratsloff et al
- >
- > Latest paper:
- >
- > Here's a link to the paper (different than the previous paper reviewed).
- > There are some additional updates I'm planning on making before the
- > meeting.
- >
- >
- > <https://docs.google.com/document/d/1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>
- >
- >
- >
- >
- > P1709R3:
- >
- > [https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\\_dyYdRy4dM/edit?usp=sharing](https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5_dyYdRy4dM/edit?usp=sharing)
- >
- >

- > [https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug\\_vkkE/edit?usp=sharing](https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug_vkkE/edit?usp=sharing)
- >
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>
- >
- > <
- >
- > <https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>
- > \*>\*
- >
- > Array copy semantics:
- > array copy-semantics paper P1997 "Relaxing Restrictions on Arrays",
- > <https://wg21.link/p1997>
- >
- > Stats feedback:
- >
- > P2376R0
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>>
- > Comments
- > on Simple Statistical Functions (p1708r4): Contracts, Exceptions and
- > Special cases Johan Lundberg
- >

Stats SG6:

met with them a month ago

can we fuse the mean\_accumulators into one; construct with no parameter and pass a parameter to it to merge weighed and unweighted version together but weighted version of variance\_accumulator does not have the freedom of  $1/(n-1)$  so will need a different constructor; so decided with SG6 that it is better to have separate weighted and unweighted variance\_accumulator merge the weighted and unweighted kurtosis together? this seems More involved.

clear to move on to LEWG

median quantile and mode are different; lets have a look

median and mode could be multiple values

so need sorted range

good feel median and quantile fn will work, SG6 concerned

don't know how many modes there will be  
mode can be messy to deal with  
user want to bin data into little groups  
looking at Boost histogram library  
quantile in sorted order, want .25 (25th element percentage wise) . if even array it would be 2 in the middle, then avg? or return both?  
user provides sorted range, say which quantile you want, must also give us size  
median would be quantile at 0.5,  
convenience function to get multiple quantiles, so pass a range of them,  
and do one linear scan of them  
does range already have elements in there? there is a concept sized\_range means it has a customization point for size  
what is Q? 60% quantile, unconstrained so float or double?  
why pair in return value why optional? if element is between 2 then return 2 not just one  
std::pair should be smallest struct  
look at ranges algorithm  
if you dont support ranges that dont meet that concept, then N is appropriate so sized\_range could exclude some data type because you might not want to do a scan so may be indicate that through naming  
always have to test the optional for the size, so if you just have 2 is simpler? is that confusing? if you have 5 twice  
i cant always ignore that optional  
can you return a range instead of pair

disagree with alternative fn overload

1 accumulator that brings 4 ; now has memory allocation concerns but it is an output iterator  
or 4 separate accumulator that brings back 1  
use case: compute several things over same range, and scan a large range only once  
if a random access range, then just jump to where data is ;  
want optimization over random access case  
unfriendly interface do we expect a lot of data to be read only once  
select algo on unsorted data is  $O(N)$  instead of  $O(n \log n)$   
dont remove accumulators yet but the sweet spot may be small

naming with sorted range, not on the return; try various naming schemes:  
quantiles\_of\_sorted  
how about a tag? usually only for constructors

quantile fn need a constraint must be convertible from value type of range



template parameters have R as first and sometimes last, can we be consistent? so they will go back

- >
- > 2.2.1.2 Reinforcement Learning Larry Lewis Jorge Silva
- >
- > Reinforcement Learning proposal:
- >
- > 2.2.1.3 Differential Calculus:
- >
- >
- > <https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpsc-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>
- >
- > 2.2.1.4: Stats paper
- >
- > Current github
- >
- > <https://github.com/cplusplus/papers/issues/475>
- >
- > <https://github.com/cplusplus/papers/issues/979>
- >
- > Stats review Richard Dosselman et al
- >
- > <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf>
- >
- > Feedback from Johan Lundberg and Oleksandr Korval
- >
- > <https://isocpp.org/files/papers/D2376R0.pdf>
- >
- > P1708R3: Math proposal for Machine Learning: 3rd review
- >
- > PXXXX: combinatorics: 1st Review

- >
- > \*> [std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2](http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2)
- > <<http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>>\*
- > \*> above is the stats paper that was reviewed in Prague\*
- > \*> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>
- > <<http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>>\*
- > \*>\*
- > \*> Review Jolanta Polish feedback.\*
- > \*> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>\*
- >
- >
- > 2.2.1.4: Matrix paper
- >
- > 2.2.3 any other proposal for reviews?
- >
- > 2.3 Other Papers and proposals
- >
- > P1416R1: SG19 - Linear Algebra for Data Science and Machine Learning
- >
- > <https://docs.google.com/document/d/1IKUNiUhBgRURW-UkspK7fAAyIhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>
- >
- > P1415: Machine Learning Layered list
- >
- > [https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol\\_Wj8fyi4Z4hogfj5tLV\\_Sj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol_Wj8fyi4Z4hogfj5tLV_Sj64/edit#heading=h.tj9hitg7dbtr)
- >
- > 2.2.2 SG14 Linear Algebra progress:
- > Different layers of proposal
- >
- > [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)
- >
- > 2.5 Future F2F meetings:
- >
- > 2.6 future C++ Standard meetings:
- > <https://isocpp.org/std/meetings-and-participation/upcoming-meetings>

- >
- > None
- >
- > 3. Any other business
- >
- > New reflector
- >
- > <http://lists.isocpp.org/mailman/listinfo.cgi/sg19>
- >
- > Old Reflector
- > <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19>
- > <<https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14>>
- >
- > Code and proposal Staging area
- >
- > 4. Review
- >
- > 4.1 Review and approve resolutions and issues [e.g., changes to SG's  
> working draft]
- >
- > 4.2 Review action items (5 min)
- >
- > 5. Closing process
- >
- > 5.1 Establish next agenda
- >
- >
- > 5.2 Future meeting
- >
- >
- >
- >
- > May 12, 2022 02:00 PM ET: Stats
- > June 9, 2022 02:00 PM ET: Graph
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- > Aug 11, 2022 02:00 PM ET: Stats
- > Sep 13, 2022 02:00 PM ET: Graph
- > Oct 12, 2022 02:00 PM ET: Matrix RL/DC\_

## Minutes for 2022/06/10 SG19 Conference Call

On Wed, Jun 8, 2022 at 3:15 PM Michael Wong <fraggamuffin\_at\_[hidden]> wrote:

> Hi all, SG19 Machine Learning meeting will focus on graphs. Michael Wong  
> is inviting you to a scheduled Zoom meeting.

>

> Topic: SG19 monthly

> Time: 02:00 PM Eastern Time (US and Canada)

> Every month on the Second Thu,

>

>

> Join from PC, Mac, Linux, iOS or Android:

>

> <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTlLNkx0Zz09>

> Password: 035530

>

> Or iPhone one-tap :

> US: +13017158592,,93084591725# or +13126266799,,93084591725#

> Or Telephone:

> Dial(for higher quality, dial a number based on your current location):

> US: +1 301 715 8592 or +1 312 626 6799 or +1 346 248 7799 or +1

> 408 638 0968 or +1 646 876 9923 or +1 669 900 6833 or +1 253 215 8782

> or 877 853 5247 (Toll Free)

> Meeting ID: 930 8459 1725

> Password: 035530

> International numbers available: <https://iso.zoom.us/u/agewu4X97>

>

> Or Skype for Business (Lync):

> <https://iso.zoom.us/skype/93084591725>

>

> Agenda:

>

> 1. Opening and introductions

>

> The ISO Code of conduct:

> <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>

>

> IEC Code of Conduct:

>

> <https://www.iec.ch/basecamp/iec-code-conduct-technical-work>

>

> ISO patent policy.

- >
- >
- > [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)
- >
- > The WG21 Practices and Procedures and Code of Conduct:
- >
- > <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>
- >
- > 1.1 Roll call of participants
- >
  
- > Chris Ryan, Jens Maurer, Kevin Dewesee, Ozan Irsoy, Phil Ratzloff, Rene
- > Rivera, Richard Dosselment, Scott McMillan, Michael Wong, ka ming chan,
- > Will wray
- >
- > 1.2 Adopt agenda
- >
- > 1.3 Approve minutes from previous meeting, and approve publishing
- > previously approved minutes to ISOCPP.org
- >
- > 1.4 Action items from previous meetings
- >
- > 2. Main issues (125 min)
- >
- > 2.1 General logistics
- >
- > Meeting plan, focus on one paper per meeting but does not preclude other
- > paper updates:
- >
- >
- >
- > June 9, 2022 02:00 PM ET: Graph
- > Jul 14, 2022 02:00 PM ET: Matrix, RL and DC
- > Aug 11, 2022 02:00 PM ET: Stats
- > Sep 13, 2022 02:00 PM ET: Graph
- > Oct 12, 2022 02:00 PM ET: Matrix RL/DC
- >
- > ISO meeting status
- >
- > future C++ Std meetings
- >
- > <https://cppcon.org/cfs2022/> The submissions deadline is June 24th, with
- > decisions sent by July 31st.

- >
- >
- > 2.2 Paper reviews
- >
- > 2.2.1: ML topics
- >
- > 2.2.1.1 Graph Proposal Phil Ratsloff et al
- >
- > Latest paper:
- >
- > Here's a link to the paper (different than the previous paper reviewed).
- > There are some additional updates I'm planning on making before the
- > meeting.
- >
- >
- > <https://docs.google.com/document/d/1OpH-xxRri7tJtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>
- >
- >
- > edgeless view

2nd set of functions are for edges on a specific vertex  
 not supporting due to pairing down so it is returning incoming edges as well  
 neighbors now instead of adjacency and get source\_id and target\_id  
 undirected incidence graph  
 concept bounds polymorphism on an algo, or like an abstract base class: the  
 undirected incidence and directed incidence graph, the algo used should be  
 well defined - when algo gets target\_id, in an undirected graph, it goes to  
 a specific value which is well-defined, but the physical storage can be  
 element 0 source, and 1 is the target for directed graph, but undirected  
 element 0 or 1 could be source or target

undirected graph needs a source-incidence graph (both a source and target  
 id on an edge), directed vs undirected through emulation?

do we need to store source id?

undirected edge value

undirected graph needs a source and target since we need to know where we  
 came from

different names for directed vs undirected or should be unordered on the  
 edge

terminology should reflect the math

better term? unordered edge/ vertices, as long as uid and vid comes out in  
 the result

what's returned by edge list? edgeless G, E  
can now port NW graph algorithms as interface is very similar

SG14 at cppcon?

- >
- > P1709R3:
- >
- > [https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\\_dyYdRy4dM/edit?usp=sharing](https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5_dyYdRy4dM/edit?usp=sharing)
- g
- >
- >
- > [https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug\\_vkkE/edit?usp=sharing](https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug_vkkE/edit?usp=sharing)
- >
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>
- >
- > <
- >
- > [https://docs.google.com/document/d/175wIm8o4BNGti0WLq8U6uZORegKVjmnpcf-\\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel](https://docs.google.com/document/d/175wIm8o4BNGti0WLq8U6uZORegKVjmnpcf-_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel)
- > \*>\*
- >
- > Array copy semantics:
- > array copy-semantics paper P1997 "Relaxing Restrictions on Arrays",
- > <https://wg21.link/p1997>
- >
- > Stats feedback:
- >
- > P2376R0
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>>
- > Comments
- > on Simple Statistical Functions (p1708r4): Contracts, Exceptions and
- > Special cases Johan Lundberg
- >

More simple stats: added missing stats: median and mode because they are more involved  
weighted percentile, may not have weighted variant of this  
looked at python which has bivariate values  
might try to extend what we have to support these multivariate stats to be on par with python  
prediction needs regression  
return a start and end iterator

JM: template argument of subrange can be omitted as it is defaulted  
what if looking for n modes in n range: allow user to specify how many modes  
JM: why do those 2 ranges need to be same type: value type needs to be  
friends; yes will make separate  
might also need constraints on relationship of value type and allow  
arithmetic  
dof is passed 1 and it will subtract just like python

look at newer ranges algo do

accumulate might need a zipview if precondition has the same length

instead of univariate, bivariate we can condense that down to one

range end iterator is always exclusive : it points to one past the last  
thing and not second element  
mode is sorted

>

> 2.2.1.2 Reinforcement Learning Larry Lewis Jorge Silva

>

> Reinforcement Learning proposal:

>

> 2.2.1.3 Differential Calculus:

>

>

> [https://docs.google.com/document/d/175wIm8o4BNGti0WLq8U6uZORegKVjmnqfc-\\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel](https://docs.google.com/document/d/175wIm8o4BNGti0WLq8U6uZORegKVjmnqfc-_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel)

>

> 2.2.1.4: Stats paper

>

> Current github

>

> <https://github.com/cplusplus/papers/issues/475>

>

> <https://github.com/cplusplus/papers/issues/979>

>

> Stats review Richard Dosselman et al

>

> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf>

>

> Feedback from Johan Lundberg and Oleksandr Korval



>  
> <https://isocpp.org/files/papers/D2376R0.pdf>  
>  
> P1708R3: Math proposal for Machine Learning: 3rd review  
>  
> PXXXX: combinatorics: 1st Review  
>  
> \*> [std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2](http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2)  
> <<http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>> \*  
> \*> above is the stats paper that was reviewed in Prague\*  
> \*> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>  
> <<http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>> \*  
> \*> \*  
> \*> Review Jolanta Polish feedback.\*  
> \*> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>  
> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>> \*  
>  
>  
> 2.2.1.4: Matrix paper  
>  
> 2.2.3 any other proposal for reviews?  
>  
> 2.3 Other Papers and proposals  
>  
> P1416R1: SG19 - Linear Algebra for Data Science and Machine Learning  
>  
> <https://docs.google.com/document/d/1KUNiUhBgRURW-UkspK7fAAyIhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>  
>  
> P1415: Machine Learning Layered list  
>  
> [https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol\\_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr)  
>  
> 2.2.2 SG14 Linear Algebra progress:  
> Different layers of proposal  
>  
> [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)  
>  
> 2.5 Future F2F meetings:  
>  
> 2.6 future C++ Standard meetings:  
> <https://isocpp.org/std/meetings-and-participation/upcoming-meetings>  
>  
> None

- >
- > 3. Any other business
- >
- > New reflector
- >
- > <http://lists.isocpp.org/mailman/listinfo.cgi/sg19>
- >
- > Old Reflector
- > <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19>
- > <<https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14>>
- >
- > Code and proposal Staging area
- >
- > 4. Review
- >
- > 4.1 Review and approve resolutions and issues [e.g., changes to SG's  
> working draft]
- >
- > 4.2 Review action items (5 min)
- >
- > 5. Closing process
- >
- > 5.1 Establish next agenda
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- >
- > 5.2 Future meeting
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- > May 12, 2022 02:00 PM ET: Stats
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- > Sep 13, 2022 02:00 PM ET: Graph
- > Oct 12, 2022 02:00 PM ET: Matrix RL/DC\_

## Minutes for 2022/08/11 SG19 Conference Call

On Thu, Aug 11, 2022 at 10:54 AM Phil Ratzloff <Phil.Ratzloff\_at\_[hidden]> wrote:

> I've attached the current rough draft for P1709r3, in case people want to  
> review it before the meeting.

>

> Anything after page 14 needs major rework and should be taken with a grain  
> of salt.

>

>

>

>

>

> \*From:\* SG19 <sg19-bounces\_at\_[hidden]> \*On Behalf Of \*Michael Wong  
> via SG19

> \*Sent:\* Wednesday, August 10, 2022 9:13 PM

> \*To:\* sg19\_at\_[hidden]

> \*Cc:\* Michael Wong <fraggamuffin\_at\_[hidden]>

> \*Subject:\* [SG19] Aug 11 SG19 Monthly call

>

>

>

> \*EXTERNAL\*

>

> Hi all, SG19 Machine Learning meeting will focus on graphs. Michael Wong  
> is inviting you to a scheduled Zoom meeting. Although the normal schedule  
> is on Diff Calculus, RL, and Matrix, we will have P1709 Graph as an update  
> if none of these materialize.

>

> Topic: SG19 monthly

> Time: 02:00 PM Eastern Time (US and Canada)

> Every month on the Second Thu,

>

>

> Join from PC, Mac, Linux, iOS or Android:

>

> <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTILNkx0Zz09>

>

<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fiso.zoom.us%2Fj%2F93084591725%3Fp>

wd%3DK3QxZjJlcnljaE13ZWU5cTILNkx0Zz09&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412446431%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=ELZeZjWtFqdQeg9ESSO7ZYGgbEtlHAN7YqhsdR1oL34%3D&reserved=0>

> Password: 035530

>

> Or iPhone one-tap :

> US: +13017158592,,93084591725# or +13126266799,,93084591725#

> Or Telephone:

> Dial(for higher quality, dial a number based on your current location):

> US: +1 301 715 8592 or +1 312 626 6799 or +1 346 248 7799 or +1

> 408 638 0968 or +1 646 876 9923 or +1 669 900 6833 or +1 253 215 8782

> or 877 853 5247 (Toll Free)

> Meeting ID: 930 8459 1725

> Password: 035530

> International numbers available: <https://iso.zoom.us/u/agewu4X97>

>

<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fiso.zoom.us%2Fu%2Fagewu4X97&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412446431%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=ZhICYSY2UxSfgLzRR6jomkT6EwmJ4HLGibchRECLMc4%3D&reserved=0>>

>

> Or Skype for Business (Lync):

> <https://iso.zoom.us/skype/93084591725>

>

<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fiso.zoom.us%2Fskype%2F93084591725&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412446431%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=TbzD5c7KW2prP6tl35c%2B0eVW06%2F%2BEILrMII2V7KqrSI%3D&reserved=0>>

>

> Agenda:

>

> 1. Opening and introductions

>

> The ISO Code of conduct:

> <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>

>

<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.iso.org%2Ffiles%2Flive%2Fsites%2Fisoorg%2Ffiles%2Fstore%2Fen%2FPUB100397.pdf&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412446431%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=hoFv2oPuYgF2pd4YiZ8cnisVofiANG0SVj2MRjub6c8%3D&reserved=0>>

>

> IEC Code of Conduct:

>

> <https://www.iec.ch/basecamp/iec-code-conduct-technical-work>

> <<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.iec.ch%2Fbasecamp%2Fiec-code-conduct-technical-work&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=ismNylmSvrNLc5Kt61hCVJpmuQG4iyN67bAIUNULhAA%3D&reserved=0>>

>

> ISO patent policy.

>

>

> [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)

>

<[https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fisotc.iso.org%2Flivelink%2Flivelink%2Ffetch%2F2000%2F2122%2F3770791%2FCommon\\_Policy.htm%3Fnodeid%3D6344764%26vernum%3D-2&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=VR9aN%2BSzYXwTNKMr92TAH76nNiPV0LLU7pJ3C58nM40%3D&reserved=0](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fisotc.iso.org%2Flivelink%2Flivelink%2Ffetch%2F2000%2F2122%2F3770791%2FCommon_Policy.htm%3Fnodeid%3D6344764%26vernum%3D-2&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=VR9aN%2BSzYXwTNKMr92TAH76nNiPV0LLU7pJ3C58nM40%3D&reserved=0)>

>

> The WG21 Practices and Procedures and Code of Conduct:

>

> <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>

> <<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fisocpp.org%2Fstd%2Fstanding-documents%2Fsd-4-wg21-practices-and-procedures&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=0outuRfULmg7gDRT5atocTUEU6YhKH8RUvB64kCtksU%3D&reserved=0>>

>

> 1.1 Roll call of participants

>

Phil Ratzloff, Richard Dosselman, Ozan Irsoy, Michael Wong, Kevin Deweese, Chris Ryan, Andrew Lumsdaine, Luke D'Alessandro, Ka Wing Chan,

>

> 1.2 Adopt agenda

>

> 1.3 Approve minutes from previous meeting, and approve publishing

> previously approved minutes to ISOCPP.org

>

> 1.4 Action items from previous meetings

- >
- > 2. Main issues (125 min)
- >
- > 2.1 General logistics
- >
- >
- CPPCON 222 Sept 14 SG14 hybrid meeting
- laptop mikes, headsets, need floating mikes, floor mikes, speakers
  
- > Meeting plan, focus on one paper per meeting but does not preclude other
- > paper updates:
- >
- >
- >
- > May 12, 2022 02:00 PM ET: Stats
- > June 9, 2022 02:00 PM ET: Graph
- > Jul 14, 2022 02:00 PM ET: Cancelled
- > Aug 11, 2022 02:00 PM ET: Matrix, RL and DC, Graph
- > Sep 13, 2022 02:00 PM ET: Stats
- > Oct 12, 2022 02:00 PM ET: Graph
- >
- > ISO meeting status
- >
- > future C++ Std meetings
- >
- > 2.2 Paper reviews
- >
- > 2.2.1: ML topics
- >
- > 2.2.1.1 Graph Proposal Phil Ratzloff et al
- >
- > Latest paper:
- >
- > Here's a link to the paper (different than the previous paper reviewed).
- > There are some additional updates I'm planning on making before the
- > meeting.
- >
- >
- > <https://docs.google.com/document/d/1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>
- >
- <<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ%2Fedit%3Fusp%3Dsharing&data=05%7C01%7CPhil.Ratzloff%40sas.co>

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> D1709R3:

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> [https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\\_dyYdRy4dM/edit?usp=sharing](https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5_dyYdRy4dM/edit?usp=sharing)

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<[https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\\_dyYdRy4dM%2Fedit%3Fusp%3Dsharing&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=r9nj3Nf4dNWxdKqjh%2FmrvMPHNvAHAVIjeBmfKZYepdw%3D&reserved=0](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5_dyYdRy4dM%2Fedit%3Fusp%3Dsharing&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=r9nj3Nf4dNWxdKqjh%2FmrvMPHNvAHAVIjeBmfKZYepdw%3D&reserved=0)>

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> [https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug\\_vkkE/edit?usp=sharing](https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug_vkkE/edit?usp=sharing)

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<[https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug\\_vkkE%2Fedit%3Fusp%3Dsharing&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=wTA7B4Jh6qFV0KZPmkbeBji2y8CC8uCuIJD5uSG9weQ%3D&reserved=0](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzg1Ug_vkkE%2Fedit%3Fusp%3Dsharing&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=wTA7B4Jh6qFV0KZPmkbeBji2y8CC8uCuIJD5uSG9weQ%3D&reserved=0)>

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> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>  
> <<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.open-std.org%2Fjtc1%2Fsc22%2Fwg21%2Fdocs%2Fpapers%2F2020%2Fp2119r0.html&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6I1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=46XtqYQsaQ4UsroiTgE9qv25%2Fhn2su%2Bjyk0dSHwNkKw%3D&reserved=0>>

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>  
> Phil presenting.

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> <https://docs.google.com/document/d/175wIm8o4BNGti0WLq8U6uZORegKVjmnpcfc->

\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel

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<[https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F175wlm8o4BNGti0WLq8U6uZORegKVjmnpc-](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F175wlm8o4BNGti0WLq8U6uZORegKVjmnpc-_E8PoGS0%2Fedit%3Fts%3D5fff27cd%23heading%3Dh.9ogkehmdmtel&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Iik1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=5agnOyVe%2FV62WIOEI1zDHIPC8pQuadzHlgo6XJHkM2g%3D&reserved=0)

\_E8PoGS0%2Fedit%3Fts%3D5fff27cd%23heading%3Dh.9ogkehmdmtel&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Iik1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=5agnOyVe%2FV62WIOEI1zDHIPC8pQuadzHlgo6XJHkM2g%3D&reserved=0>

> \*>\*

>  
> change to a D paper, consider presenting this at SG14 cppcon  
other than top2, make everyone contributors

concerns about tag\_invoke being not accepted, maybe prepare alternative  
aim for next 2 sg19 meetings to be Graph to get this out of SG14 this year,  
to enter LEWG queue (after presentation to SG14, and may be SG6)

> Array copy semantics:

> array copy-semantics paper P1997 "Relaxing Restrictions on Arrays",

> <https://wg21.link/p1997>

>  
<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwg21.link%2Fp1997&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Iik1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=yeHm3syEA8PmsC1kB48HipJ1TanliDZt3HS%2BxabPYnE%3D&reserved=0>>

>  
> Stats feedback:

>  
> P2376R0

> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>

> <<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.open-std.org%2Fjtc1%2Fsc22%2Fwg21%2Fdocs%2Fpapers%2F2021%2Fp2376r0.pdf&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Iik1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=WZsJiTB0ls3LWmE40yK6MAVWdaMMBIOsRM06qrPeygY%3D&reserved=0>>

> >

> Comments

> on Simple Statistical Functions (p1708r4): Contracts, Exceptions and

> Special cases Johan Lundberg

>

> 2.2.1.2 Reinforcement Learning Larry Lewis Jorge Silva



>  
> Reinforcement Learning proposal:  
>  
> 2.2.1.3 Differential Calculus:  
>  
>  
> [https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-\\_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel](https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-_E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel)  
>  
<[https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-\\_E8PoGS0%2Fedit%3Fts%3D5fff27cd%23heading%3Dh.9ogkehmdmtel&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6IklhaWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=5agnOyVe%2FV62WIOE1zDHIPC8pQuadzHlgo6XJHkM2g%3D&reserved=0](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-_E8PoGS0%2Fedit%3Fts%3D5fff27cd%23heading%3Dh.9ogkehmdmtel&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6IklhaWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=5agnOyVe%2FV62WIOE1zDHIPC8pQuadzHlgo6XJHkM2g%3D&reserved=0)>  
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> 2.2.1.4  
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<<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2F2.2.1.4%2F&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6IklhaWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=nUeEiTgCCSWihMzRWe%2FRncYjTCCVA2kgssgNfOIP1mE%3D&reserved=0>>  
> Stats paper  
>  
> Current github  
>  
> <https://github.com/cplusplus/papers/issues/475>  
>  
<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fgithub.com%2Fcplusplus%2Fpapers%2Fissues%2F475&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412602692%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6IklhaWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=IOmJz4QWaVcQ5aJMUIz0CU4zHsiKLZjakUM54Ke86QQ%3D&reserved=0>>  
>  
> <https://github.com/cplusplus/papers/issues/979>  
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<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fgithub.com%2Fcplusplus%2Fpapers%2Fissues%2F979&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412758904%7CUnknown%7CTWFpbGZsb3d8eyJWljiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6IklhaWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=cU8sRzbUpTnAVyzefz%2FWGNfEK6RyX52fr3KwkNxdFS0%3D&reserved=0>>  
>  
> Stats review Richard Dosselman et al

>  
> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf>  
> <<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.open-std.org%2Fjtc1%2Fsc22%2Fwg21%2Fdocs%2Fpapers%2F2021%2Fp1708r4.pdf&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412758904%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTil6lk1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=annm2V9tTuQx5JekT6UpvHDtr253imKTQf3%2FDRXGebw%3D&reserved=0>>  
>  
> Feedback from Johan Lundberg and Oleksandr Korval  
>  
> <https://isocpp.org/files/papers/D2376R0.pdf>  
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<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fisocpp.org%2Ffiles%2Fpapers%2FD2376R0.pdf&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412758904%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTil6lk1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=8vmwUmAmHyFyExKB YurdSXQ5zNL5YITfik5oX3eso8%3D&reserved=0>>  
>  
> P1708R3: Math proposal for Machine Learning: 3rd review  
>  
> PXXXX: combinatorics: 1st Review  
>  
> \*> [std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2](http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2)  
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> <<http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>  
>  
<<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fstd.org%2Fjtc1%2Fsc22%2Fwg21%2Fdocs%2Fpapers%2F2020%2Fp1708r2&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412758904%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTil6lk1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=CusrwN9W%2FNoMAh7bUMMqSBozYGjhEQiMbe4xSlpS%2Bm0%3D&reserved=0>>  
> > \*  
> \*> above is the stats paper that was reviewed in Prague\*  
> \*> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>  
>  
<<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwiki.edg.com%2Fbin%2Fview%2FWg21prague%2FP1708R2SG19&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412758904%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTil6lk1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=2iGss>>

f0crH%2Flum7NFYw7cKHlft%2FtqJZRwtdT52m0MMg%3D&reserved=0>  
> <<http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>  
>  
<<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwiki.edg.com%2Fbin%2Fview%2FWg21prague%2FP1708R2SG19&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ikl1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=iu0KJ0zkoGp1qTloO00nzkWblg4d1RXIkCRw5nwOi60%3D&reserved=0>  
> > \*  
> \* > \*  
> \* > Review Jolanta Polish feedback.\*  
> \* > <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>  
> <<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.open-std.org%2Fjtc1%2Fsc22%2Fwg21%2Fdocs%2Fpapers%2F2020%2Fp2119r0.html&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ikl1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=nW1aGe9QqjDSGq0tK3C6HBTPKnxFWNq7KK8ANIXVWCg%3D&reserved=0>  
> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>  
> <<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.open-std.org%2Fjtc1%2Fsc22%2Fwg21%2Fdocs%2Fpapers%2F2020%2Fp2119r0.html&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ikl1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=nW1aGe9QqjDSGq0tK3C6HBTPKnxFWNq7KK8ANIXVWCg%3D&reserved=0>  
> > \*  
>  
>  
> 2.2.1.4  
>  
<<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2F2.2.1.4%2F&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoiMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ikl1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=e9cbwaZl1KSnVfCmWPI8yduBtfFjrUrWfEC1k9GrHt0%3D&reserved=0>:  
> Matrix paper  
>  
> 2.2.3 any other proposal for reviews?  
>  
> 2.3 Other Papers and proposals  
>  
> P1416R1: SG19 - Linear Algebra for Data Science and Machine Learning  
>  
> <https://docs.google.com/document/d/1IKUNiUhBgRURW-UkspK7fAAyIhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>

>  
<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1IKUNiUhBgRURW-UkspK7fAAyIhfXuMxjk7xKikK4Yp8%2Fedit%23heading%3Dh.tj9hitg7dbtr&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=vwZLb9aVwvP6YDqd0sFNV4qF1VGb13ipOYqFT70P4pA%3D&reserved=0>>  
>  
> P1415: Machine Learning Layered list  
>  
> [https://docs.google.com/document/d/1eINFDiXWoetbxjO1OKol\\_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFDiXWoetbxjO1OKol_Wj8fyi4Z4hogfj5tLVSj64/edit#heading=h.tj9hitg7dbtr)  
>  
<[https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1eINFDiXWoetbxjO1OKol\\_Wj8fyi4Z4hogfj5tLVSj64%2Fedit%23heading%3Dh.tj9hitg7dbtr&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=VauEkF3Ymc%2BVipNuaaFjzSjYx8dOjMWOHfht6W6C8jw%3D&reserved=0](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1eINFDiXWoetbxjO1OKol_Wj8fyi4Z4hogfj5tLVSj64%2Fedit%23heading%3Dh.tj9hitg7dbtr&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=VauEkF3Ymc%2BVipNuaaFjzSjYx8dOjMWOHfht6W6C8jw%3D&reserved=0)>  
>  
> 2.2.2 SG14 Linear Algebra progress:  
> Different layers of proposal  
>  
> [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)  
>  
<[https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ%2Fedit&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=dawisuYuSWb1tFNc5%2BTgjd4OMZqxZjvKvJyycXCFQI%3D&reserved=0](https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fdocs.google.com%2Fdocument%2Fd%2F1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ%2Fedit&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=dawisuYuSWb1tFNc5%2BTgjd4OMZqxZjvKvJyycXCFQI%3D&reserved=0)>  
>  
> 2.5 Future F2F meetings:  
>  
> 2.6 future C++ Standard meetings:  
> <https://isocpp.org/std/meetings-and-participation/upcoming-meetings>  
> <<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fisocpp.org%2Fstd%2Fmeetings-and-participation%2Fupcoming-meetings&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljoimC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=x7f9zUImrSEH9k%2B6Jb%2BVx6qxjUifx3IYN%2B9W23AdkA4%3D&reserved=0>>  
>  
> None  
>

> 3. Any other business

>

> New reflector

>

> <http://lists.isocpp.org/mailman/listinfo.cgi/sg19>

>

<<https://nam02.safelinks.protection.outlook.com/?url=http%3A%2F%2Flists.isocpp.org%2Fmailman%2Flistinfo.cgi%2Fsg19&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773412915165%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Iik1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=weDAuCMO98Vq%2F0gRFFPiFsg2GW7vvcjqaFv90n0DELc%3D&reserved=0>>

>

> Old Reflector

> <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19>

>

<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fgroups.google.com%2Fa%2Fisocpp.org%2Fforum%2F%23!newtopic%2Fsg19&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773413071390%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Iik1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=D%2F8hZ2QbG36MUv6b%2BmWfFOFighe4FV%2FoT2HCE3M728%3D&reserved=0>>

> <<https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14>

>

<<https://nam02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fgroups.google.com%2Fa%2Fisocpp.org%2Fforum%2F%3Ffromgroups%3D%23!forum%2Fsg14&data=05%7C01%7CPhil.Ratzloff%40sas.com%7C31f7c9e651a34ad7a73d08da7b36a783%7Cb1c14d5c362545b3a4309552373a0c2f%7C0%7C0%7C637957773413071390%7CUnknown%7CTWFpbGZsb3d8eyJWljojMC4wLjAwMDAiLCJQIjoiV2luMzliLCJBTiI6Iik1haWwiLCJXVCi6Mn0%3D%7C3000%7C%7C%7C&sdata=GyCQFm8RptIgyr27%2FgnFDfFRAS34AAv0c6BHfLw5%2F70%3D&reserved=0>>

>>

>

> Code and proposal Staging area

>

> 4. Review

>

> 4.1 Review and approve resolutions and issues [e.g., changes to SG's

> working draft]

>

> 4.2 Review action items (5 min)

>

> 5. Closing process

>

> 5.1 Establish next agenda

>

>

> 5.2 Future meeting

>

- >
- >
- >
- > May 12, 2022 02:00 PM ET: Stats
- > June 9, 2022 02:00 PM ET: Graph
- > Jul 14, 2022 02:00 PM ET: Cancelled
- > Aug 11, 2022 02:00 PM ET: Matrix, RL and DC
- > Sep 13, 2022 02:00 PM ET: Stats
- > Oct 12, 2022 02:00 PM ET: Graph

## Minutes for 2022/10/13 SG19 Conference Call

On Wed, Oct 12, 2022 at 10:20 PM Michael Wong <fraggamuffin\_at\_[hidden]> wrote:

- > Hi all, SG19 Machine Learning meeting will focus on graphs, as agreed as
- > we want to drive graph to completion until year end.
- >
- > Michael Wong is inviting
- > you to a scheduled Zoom meeting. A
- >
- > Topic: SG19 monthly
- > Time: 02:00 PM Eastern Time (US and Canada)
- > Every month on the Second Thu,
- >
- >
- > Join from PC, Mac, Linux, iOS or Android:
- >
- > <https://iso.zoom.us/j/93084591725?pwd=K3QxZjJlcnljaE13ZWU5cTILNkx0Zz09>
- > Password: 035530
- >
- > Or iPhone one-tap :
- > US: +13017158592,,93084591725# or +13126266799,,93084591725#
- > Or Telephone:
- > Dial(for higher quality, dial a number based on your current location):
- > US: +1 301 715 8592 or +1 312 626 6799 or +1 346 248 7799 or +1
- > 408 638 0968 or +1 646 876 9923 or +1 669 900 6833 or +1 253 215 8782
- > or 877 853 5247 (Toll Free)
- > Meeting ID: 930 8459 1725
- > Password: 035530
- > International numbers available: <https://iso.zoom.us/u/agewu4X97>
- >
- > Or Skype for Business (Lync):
- > <https://iso.zoom.us/skype/93084591725>
- >
- > Agenda:
- >
- > 1. Opening and introductions

- >
- > The ISO Code of conduct:
- > <https://www.iso.org/files/live/sites/isoorg/files/store/en/PUB100397.pdf>
- >
- > IEC Code of Conduct:
- >
- > <https://www.iec.ch/basecamp/iec-code-conduct-technical-work>
- >
- > ISO patent policy.
- >
- >
- > [https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common\\_Policy.htm?nodeid=6344764&vernum=-2](https://isotc.iso.org/livelink/livelink/fetch/2000/2122/3770791/Common_Policy.htm?nodeid=6344764&vernum=-2)
- >
- > The WG21 Practices and Procedures and Code of Conduct:
- >
- > <https://isocpp.org/std/standing-documents/sd-4-wg21-practices-and-procedures>
- >
- > 1.1 Roll call of participants
- >
- Phil Ratzloff, Joe Sachs, Kevin Deweese, Muhammad Osama, ozan Irsoy, Scott McMillan, Richard Dosselmann
- >
- >
- > 1.2 Adopt agenda
- >
- > 1.3 Approve minutes from previous meeting, and approve publishing
- > previously approved minutes to ISOCPP.org
- >
- > 1.4 Action items from previous meetings
- >
- > 2. Main issues (125 min)
- >
- > 2.1 General logistics
- >
- > Meeting plan, focus on one paper per meeting but does not preclude other paper
- > updates:
- >



- > CPPCON minutes:
- > <https://wiki.edg.com/bin/view/Wg21virtual2022-07/SG14>
- >
- >
- > Nov 10, 2022 02:00 PM ET: Cancelled due to Kona F2F
- > Dec 8, 2022 02:00 PM ET: Graph
- > Jan 12, 2023 02:00 PM ET: Stats
- > Feb 9, 2023 02:00 PM ET: Matrix, RL and DC
- > Mar 9, 2023 02:00 PM ET: Graph
- >
- >
- > ISO meeting status
- >
- > future C++ Std meetings
- >
- > 2.2 Paper reviews
- >
- > 2.2.1: ML topics
- >
- > 2.2.1.1 Graph Proposal Phil Ratzloff et al
- >
- > Latest paper:
- >
- > Here's a link to the paper (different than the previous paper reviewed).
- > There are some additional updates I'm planning on making before the
- > meeting.
- >
- > P1709R4 will be the aiming for Dec 2022 publication.

CPPCON review had some naming change suggestions

OK to put requirements on random access range, and integral vertex algo and not adjacency list

Joe:  $O(V \log(V))$ , could dominate  $V$

Add examples in complex cases, With Bellman Ford ,just say same as previous example but with negative weights

Vertex\_view name is a bike shed, leave it to LEWG, vertex\_view\_modifier?

Take cancel out

P1709r3c

- >
- > <https://docs.google.com/document/d/1OpH-xxRri7tJTtJJIZTYmSHkkrZJkdBwm9zJ7LqolfQ/edit?usp=sharing>
- >
- >
- >
- >
- > P1709R3 status update only
- >
- > [https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5\\_dyYdRy4dM/edit?usp=sharing](https://docs.google.com/document/d/1kLHhbSTX7j0tPeTYECQFSNx3R35Mu3xO5_dyYdRy4dM/edit?usp=sharing)
- >
- > P1709R1
  
- >
- > [https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzq1Ug\\_vkkE/edit?usp=sharing](https://docs.google.com/document/d/1QkfDzGyfNQKs86y053M0YHOLP6frzhTJqzq1Ug_vkkE/edit?usp=sharing)
- >
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>
- >
- > <
- >
- > <https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpcf-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>
- > \*>\*
- >
- > Array copy semantics:
- > array copy-semantics paper P1997 "Relaxing Restrictions on Arrays",
- > <https://wg21.link/p1997>
- >
- > Stats feedback: P1708
- >

> <https://www.open-std.org/jtc1/sc22/wg21/docs/papers/2022/p1708r6.pdf>

March 15. 2022

D1708R7: passed Sg6, waiting for LEWG.

More Simple Statistics

2 names differ by one letter -> bike shedding should be left to LEWG

how do we return the result if we have even length range: decided return of subrange iterator that points to the medians

Is this ready to exit SG19 to SG6

6/1/0/0/0

Approved to go to SG6.

P2376R0

> <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p2376r0.pdf>>

> Comments

> on Simple Statistical Functions (p1708r4): Contracts, Exceptions and

> Special cases Johan Lundberg

>

> 2.2.1.2 Reinforcement Learning Larry Lewis Jorge Silva

>

> Reinforcement Learning proposal:

>

> 2.2.1.3 Differential Calculus:

>

>

> <https://docs.google.com/document/d/175wlm8o4BNGti0WLq8U6uZORegKVjmnpsc-E8PoGS0/edit?ts=5fff27cd#heading=h.9ogkehmdmtel>

>

> 2.2.1.4: Stats paper

>

> Current github

>

> <https://github.com/cplusplus/papers/issues/475>

>

> <https://github.com/cplusplus/papers/issues/979>

>

> Stats review Richard Dosselman et al

>

- > <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2021/p1708r4.pdf>
- >
- > Feedback from Johan Lundberg and Oleksandr Korval
- >
- > <https://isocpp.org/files/papers/D2376R0.pdf>
- >
- > P1708R3: Math proposal for Machine Learning: 3rd review
- >
- > PXXXX: combinatorics: 1st Review
- >
- > \*> std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2
- > <<http://std.org/jtc1/sc22/wg21/docs/papers/2020/p1708r2>>\*
- > \*> above is the stats paper that was reviewed in Prague\*
- > \*> <http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>
- > <<http://wiki.edg.com/bin/view/Wg21prague/P1708R2SG19>>\*
- > \*>\*
- > \*> Review Jolanta Polish feedback.\*
- > \*> <http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>
- > <<http://www.open-std.org/jtc1/sc22/wg21/docs/papers/2020/p2119r0.html>>\*
- >
- >
- > 2.2.1.4: Matrix paper
- >
- > 2.2.3 any other proposal for reviews?
- >
- > 2.3 Other Papers and proposals
- >
- > P1416R1: SG19 - Linear Algebra for Data Science and Machine Learning
- >
- > <https://docs.google.com/document/d/1IKUNiUhBgRURW-UkspK7fAAylhfXuMxjk7xKikK4Yp8/edit#heading=h.tj9hitg7dbtr>
- >
- > P1415: Machine Learning Layered list
- >
- > [https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol\\_Wj8fyi4Z4hogfj5tLV\\_Sj64/edit#heading=h.tj9hitg7dbtr](https://docs.google.com/document/d/1eINFdIXWoetbxjO1OKol_Wj8fyi4Z4hogfj5tLV_Sj64/edit#heading=h.tj9hitg7dbtr)
- >
- > 2.2.2 SG14 Linear Algebra progress:

- > Different layers of proposal
- >
- > [https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM\\_1Nb6oYAXIK\\_d0ljdUAtSQ/edit](https://docs.google.com/document/d/1poXfr7mUPovJC9ZQ5SDVM_1Nb6oYAXIK_d0ljdUAtSQ/edit)
- >
- > 2.5 Future F2F meetings:
- >
- > 2.6 future C++ Standard meetings:
- > <https://isocpp.org/std/meetings-and-participation/upcoming-meetings>
- >
- > None
- >
- > 3. Any other business
- >
- > New reflector
- >
- > <http://lists.isocpp.org/mailman/listinfo.cgi/sg19>
- >
- > Old Reflector
- > <https://groups.google.com/a/isocpp.org/forum/#!newtopic/sg19>
- > <https://groups.google.com/a/isocpp.org/forum/?fromgroups=#!forum/sg14>>
- >
- > Code and proposal Staging area
- >
- > 4. Review
- >
- > 4.1 Review and approve resolutions and issues [e.g., changes to SG's working draft]
- >
- > 4.2 Review action items (5 min)
- >
- > 5. Closing process
- >
- > 5.1 Establish next agenda
- >
- >
- > 5.2 Future meeting
- >

>

>

>

> May 12, 2022 02:00 PM ET: Stats

> June 9, 2022 02:00 PM ET: Graph

> Jul 14, 2022 02:00 PM ET: Cancelled

> Aug 11, 2022 02:00 PM ET: Matrix, RL and DC

> Sep 13, 2022 02:00 PM ET: Stats

> Oct 12, 2022 02:00 PM ET: Graph