

DYALOC

User Meeting 2016



DYALOC

Glasgow 2016

Programme for Dyalog '16



Sunday 9 October – Thursday 13 October 2016





Welcome to the Dyalog User Meeting 2016 in Glasgow

All the presentation/workshop materials will be available on the Dyalog '16 webpage at <http://www.dyalog.com/user-meetings/dyalog16.htm>.

As usual, we will be recording and publishing as many presentations as we can (as a presenter you will always have the opportunity to review the recording and approve publication). We would like to ask for your help in ensuring that question and answer sessions are also recorded; you can help by not asking questions unless you are in possession of a microphone. If your question cannot wait until the Q&A session that concludes each presentation, or if the presenter specifically states that questions are welcome throughout, please move to the microphone at the front of the Auditorium (and then wait until asked before proceeding). Naturally, everyone from Dyalog Ltd will be happy to answer questions relating to their topics at any time during the user meeting.

For practical information, see the back cover

If you have any questions not related to APL, please ask Karen.



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A Message from Dyalog's CEO

A very warm welcome to our annual user meeting and to Scotland!

2016 is a special year for APL where we can celebrate the first 50 years of having APL available to solve interesting and complex problems. Together with the British APL Association, BAA, we have set aside all of Wednesday and the morning of Thursday for a trip down memory lane followed by a look to the future. The programme includes presenters who have been involved with APL since its discovery, presenters who have wielded it with great success over the years and also complete newcomers who have just been introduced to APL.

At Dyalog we really look forward to this celebration of APL and we have tasked ourselves and those of our users who are going to present their recent work with a somewhat tighter schedule than usual to fit into the remaining time.

Thanks to Stormwind and Optima Systems we have a special Viking Challenge this year. You are invited to try out the Stormwind simulator on a 3D platform provided by Simotion.

We wish you a good user meeting and hope you will enjoy yourself and that most importantly you will leave Scotland with a renewed network and that one good idea, insight or contact that will mean a difference to you and your organisation in the future!

Gitte Christensen

Team Dyalog at Dyalog '16

This year, Dyalog Ltd is represented by 19 members of the current team. Meet Team Dyalog at <http://www.dyalog.com/meet-team-dyalog.htm>.

The Dyalog forums (<http://forums.dyalog.com/>) are regularly visited by Dyalog Ltd staff as well as other stalwarts of the Dyalog community and are a great place to ask questions and share your expertise.



Your Feedback

We want to ensure that our user meetings meet (if not exceed!) your expectations, and your feedback is critical to this. The new approach we took to collecting feedback last year greatly increased the amount we received, so we'll be repeating it this year. This means that:

- Each workshop will have its own feedback form, given out at that workshop.
- Feedback forms on the presentations will be distributed each morning and will only cover the presentations given that day.
- Feedback on the venue, facilities, social aspects, etc. can be given at any time at the Dyalog desk in the foyer of the Central Plaza.

Please do take the time to let us know your thoughts on Dyalog '16 – what you like, what you find most interesting, suggestions for improvements, whether changes we've made this year as a result of last year's feedback have been successful, etc. – so that we can take these into account when planning future user meetings.

Thank you

Follow us on:

- Facebook (<https://www.facebook.com/DyalogAPL>)
- LinkedIn (<https://www.linkedin.com/company/dyalog-ltd->)
- Twitter (<https://twitter.com/DyalogAPL>)

Useful Dyalog e-mail addresses:

- usermeeting@dyalog.com
any user meeting-related issues, both technical and non-technical
- sales@dyalog.com
any non-technical questions related to Dyalog, for example, pricing information or licence purchase (not user meeting-specific)
- support@dyalog.com
any technical questions concerning Dyalog (not user meeting-specific)



Birds of a Feather Discussion Groups

A Birds-of-a-Feather session is an open, face-to-face conversation with fellow user meeting attendees. It is not a presentation or lecture (there is no projector and there are no slides) or a problem-fixing session but rather a discussion, and provides the opportunity to find and engage with others who share your interest in a subject area.

Each Birds-of-a-Feather session has a host who gets the discussion started and keeps it moving around the group. The host is not the person with all the answers (or all the questions). Asking questions, offering answers, exploring possibilities and sharing opinions is everyone's job!

We're offering three of these discussion groups on Sunday evening. Those interested in participating should meet their host in the Lounge bar at 21:00.

The discussion topics on offer are:

- Functional Programming
hosts: John Scholes, Nick Nikolov, Jay Foad
- Native File Functions
hosts: Richard Smith, Andy Shiers
- Web Applications
hosts: Brian Becker, Michael Bass



Stormwind Simulator

Some people may already know about Tomas Gustafsson's incredible *Stormwind*, a virtual reality boating simulator for navigation training in the complex archipelago between Finland and Sweden that is written using Dyalog APL. Tomas has adapted Stormwind for Dyalog '16 and brings us *Stormwind: The Game*! Following Tomas' presentation on Monday morning, the simulator and motion platform (in the Central Plaza) will be available for use; make the most of this time to get your sea legs sorted because on Tuesday evening the competition starts...

Sign-up sheets for the competition are by the simulator.

The competition will run at the following times:

- Tuesday 18:30-19:30
- Tuesday 21:00-23:00

If this is not sufficient time for all competitors to complete a run, then the following times will also be used for the competition:

- Wednesday 10:00-10:30
- Wednesday 12:15-13:15

Please read the documents by the simulator before using it and do not use it if the operator is not present.

Stormwind software developed by: <http://stormwind.fi/>

Simulator provided by: <http://www.simotion.ie/>

and brought to Dyalog '16 by: <http://www.optima-systems.co.uk/>



50 Years of APL



Dyalog '16 includes a celebration of APL's Golden Anniversary, hosted in conjunction with the British APL Association. The celebration is not aimed at just Dyalog APL (which is only 33 years old); presentations are also being given by users of other APL flavours. As well as a look at how APL has changed over its first 50 years, we'll also be seeing how relevant APL is in today's world and what its role might be in the future.

In addition to the presentations, there is a display of materials from Dyalog's museum in the Central Plaza; please do have a look at what's there.

Dyalog has a webpage of papers, videos, and information on APL's Golden Anniversary – see <http://www.dyalog.com/50-years-of-apl.htm>. If you have a photograph/paper that we can publish, a reference that ought to be included or a good story from the first 50 years, then please email us at apl50@dyalog.com.

Follow the Golden Anniversary on Twitter and contribute using the hashtag #50yearsofapl



Schedule: Sunday 9 October

08:30 – 09:30	Registration (Dyalog desk in foyer of the <i>Central Plaza</i>)
09:30 – 13:00 (11:00 – 11:30 tea and coffee available)	<p>Workshops</p> <p>(SA1) CookBook: Part I <i>Clyde Room</i> Stephen Taylor and Kai Jaeger</p> <p>(SA2) Threading and Synchronisation <i>Agamemnon Room</i> Morten Kromberg and Adám Brudzewsky</p> <p>(SA3) Web Application Development: Part I <i>Arcoona Room</i> Brian Becker and Michael Baas</p> <p>(SA4) Compiler and Performance Features <i>Inspiration Room</i> Jay Foad and Roger Hui</p>
13:00 – 14:00	LUNCH Waterhouse Room
14:00 – 17:30 (15:30 – 16:00 tea and coffee available)	<p>Workshops</p> <p>(SP1) CookBook: Part II <i>Clyde Room</i> Stephen Taylor and Kai Jaeger</p> <p>(SP2) Artificial Neural Networks in APL <i>Agamemnon Room</i> Romilly Cocking</p>



	<p>(SP3) Taming Statistics with TamStat <i>Inspiration Room</i> Stephen Mansour</p> <p>(SP4) A Tour (de Force) of APL in 16 Expressions <i>Arcoona Room</i> Roger Hui</p>
17:30 – 19:30	Free time
19:30 – 21:00	<p>DINNER Waterhouse Room</p>
21:00 –	<p>INFORMAL GATHERING Lounge Bar (cash bar)</p> <p>Includes Birds Of A Feather Discussion Groups Meet your chosen topic's host in the bar (see page 4)</p>

For workshop abstracts, see pages 17-21.

NOTES:



Schedule: Monday 10 October

All presentations take place in the *Auditorium*.

08:30 – 09:00	Registration (Dyalog desk in foyer of the <i>Central Plaza</i>)
09:00 – 09:30	(D01) Welcome to Dyalog '16 Gitte Christensen, Managing Director (CEO)
09:30 – 10:00	(D02) Technical Road Map: The User Experience Morten Kromberg, User Experience Director (CXO)
10:00 – 10:30	(D03) Technical Road Map: Under The Covers Jay Foad, Technical Manager (CTO)
10:30 – 11:00	TEA/COFFEE – Central Plaza
11:00 – 11:30	(U01a) How I Won the Programming Contest (General Computing Category) Joshua David (The University of Scranton)
11:30 – 12:00	(U02) Weighty Arrays Romilly Cocking (<i>independent</i>)
12:00 – 12:45	(U03) The Calm Before the Stormwind Tomas Gustafsson (Stormwind OY)
12:45 – 13:45	LUNCH Central Plaza
13:45 – 14:15	(D04) Tools Group Update Brian Becker, Dan Baronet, Adám Brudzewsky
14:15 – 14:45	(D05) vecdb Morten Kromberg
14:45 – 15:30	(D06) New Primitive Functions and Operators John Scholes & Roger Hui
15:30 – 16:00	TEA/COFFEE – Central Plaza
16:00 – 16:45	(U04) The Journey of an APL2 Bigot to Dyalog World Veli-Matti Jantunen (Statistics Finland)



16:45 – 17:15	(U05) Moving Data Binding to the Web Michael Hughes (MJH Software Services Ltd.)
17:15 – 18:00	(D07) The Airfix™ Model: Programming from a Kit of Parts John Daintree
18:00 – 19:30	Free time
19:30 – 21:00	DINNER Waterhouse Room
21:00 –	Whisky and chocolate tasting Waterhouse Room

For Dyalog presentation abstracts see pages 22-24.

For user presentation abstracts see pages 25-29.

NOTES:



Schedule: Tuesday 11 October

All presentations take place in the *Auditorium*.

09:00 – 09:30	(U06) Co-dfns Report: GPU Performance, Workflow, and Usability Aaron Hsu (Indiana University)
09:30 – 10:00	(U07) Compiling a Subset of APL into Performance Efficient GPU Programs Martin Elsmann (University of Copenhagen)
10:00 – 10:30	(D08) Performance: The Neverending Story Jay Foad & Roger Hui
10:30 – 11:00	TEA/COFFEE – Central Plaza
11:00 – 11:45	(U08) A Compendium of SIMD Boolean Array Algorithms in APL Robert Bernecky (Snake Island Research)
11:45 – 12:15	(U01b) How I Won the Programming Contest (Bioinformatics Category) Marinus Oosters (Universiteit Utrecht)
12:15 – 13:15	LUNCH Waterhouse Room
13:15 – 13:45	(U09) Cooking with Dyalog Kai Jaeger (APL Consultant) & Stephen Taylor (Equiniti Claybrook)
13:45 – 14:15	(U10) Markdown for the APLer Kai Jaeger (APL Consultant)
14:15 – 15:00	(U11) The Wisdom of Those who Came Before Us, or, The Price of Freedom Stefano Lanzavecchia (APL Italiana)
15:00 – 15:30	TEA/COFFEE – Central Plaza
15:30 – 16:00	(U12) New Features in TamStat Stephen Mansour (The University of Scranton)



16:00 – 16:30	(U13) Hobbyist APLing in the 21st Century Alex Weiner (<i>independent</i>)
16:30 – 17:00	(D09) Web Stack of the Future Morten Kromberg & Bjørn Christensen
17:00 – 17:15	Short break
17:15 – 17:45	(D10) Open Front Ends Morten Kromberg & Nick Nikolov
17:45 – 18:30	(D11) Uncle Andy's Fireside Chat v3.0 Andy Shiers
18:30 – 19:30	Stormwind: The Game! Central Plaza
19:30 – 21:00	DINNER Waterhouse Room
21:00 – 23:00	Stormwind: The Game! Central Plaza

For Dyalog presentation abstracts see pages 22-24.
For user presentation abstracts see pages 25-29.

NOTES:



Schedule: Wednesday 12 October



Today at Dyalog '16, Dyalog (in conjunction with the British APL Association) celebrate APL's golden anniversary. The celebration is not only aimed at Dyalog APL (which is only 33 years old) but at all flavours of APL and array languages.

All presentations take place in the *Auditorium*.

08:30 – 09:15	(L01) The Way We Were Roy Sykes (Sykes Systems)
09:15 – 10:00	(L02) 50 Years of APL Datatypes: From Booleans to Hypercomplex Numbers Bob Smith (Sudley Place Software)
10:00 – 10:30	TEA/COFFEE – Central Plaza
10:30 – 11:00	(L03) Zoo Story: How the I.P. Sharp APL Development Group Got its Name Robert Bernecky (Snake Island Research)
11:00 – 11:45	(L04) Dyalog Implementation – The Early Years Stephen Taylor (Equiniti Claybrook) with Geoff Streeter & John Scholes (Dyalog Ltd.)
11:45 – 12:15	(L05) Same Difference Simon Garland (Kx Systems Inc.)
12:15 – 13:15	LUNCH Central Plaza
13:15 – 13:45	(U01c) How I Won the Programming Contest (Finance Category) Zack Batik (University of Cape Town)
13:45 – 14:00	(U01) Programming Contest Awards Ceremony Brian Becker & Niels Hallenberg (SimCorp)
14:00 – 14:30	(L06) The use of APL in SimCorp Dimension Niels Hallenberg (SimCorp)
14:30 – 14:45	Short break



14:45 – 15:45	(L07) Composition Based Modelling and Dyalog APL Stephen B. Jaffe (ExxonMobil – <i>retired</i>)
15:45 – 16:15	TEA/COFFEE – Central Plaza
16:15 – 16:45	(L08) Lessons from 40 Years of APL (Not Old Enough for 50 Years!) Jay Whipple III (TheCommonGame.com)
16:45 – 17:15	(L09) Trees with Loops – where APL made a difference in Rowntree Adrian Smith (APL-385)
17:15 – 18:00	(L10) The Joy of (Especially Dyalog) APL and Some Gripes Charles Brenner (DNA-View)
18:00 – 19:00	Free time
19:00 – 20:00	PRE-PRANDIAL DRINKS Lounge Bar
20:00 –	50 YEARS OF APL CELEBRATION BANQUET Arcoona Room

For user presentation abstracts see pages 25-29.

For 50 Years of APL presentation abstracts see pages 30-35.

NOTES:



Schedule: Thursday 13 October



This morning at Dyalog '16, Dyalog (in conjunction with the British APL Association) celebrate APL's golden anniversary. The celebration is not only aimed at Dyalog APL (which is only 33 years old) but at all flavours of APL and array languages.

All presentations take place in the *Auditorium*.

09:15 – 10:00	(L11) 50 Years of APL Gitte Christensen (Dyalog Ltd.)
10:00 – 10:45	(L12) 60 Years of IT Progress Romilly Cocking (<i>independent</i>)
10:45 – 11:15	TEA/COFFEE – Central Plaza
11:15 – 11:45	(L13) Getting the Word Out in Colour Paul Grosvenor (Optima Systems)
11:45 – 12:30	(L14) The Cartoon Introduction to APL Roberto Minervini, Liceo Classico S. M. Legnani (Italy) with Federico D'Ettorre, Mattia Passarelli, Teresa Renda & Federica Zoanni – illustrated by Giuseppe Mastropierro
12:30 – 13:00	Open Forum and Closing Session Team Dyalog
13:00 – 14:00	LUNCH Waterhouse Room
14:00 – 17:30	Workshops
includes breaks (15:30 – 16:00 tea and coffee available)	(TP1) Version 15.0 in Depth <i>Inspiration Room</i> Dan Baronet and Adám Brudzewsky (TP2) Compiling ANN & other APL Code <i>Agamemnon Room</i> Aaron Hsu



	<p>(TP3) Web Application Development: Part II <i>Innovation Centre</i> Brian Becker and Michael Baas</p> <p>(TP4) Data Visualisation <i>Arcoona Room</i> Gitte Christensen, John Daintree and Nicolas Delcros</p>
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For 50 Years of APL presentation abstracts see pages 30-35.
For workshop abstracts, see pages 17-21.

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Abstracts: Workshops

These workshops have significant time set aside for participants to experiment with the subject matter.

Some of the workshops require materials that should be installed on your laptop before attending. These pre-requisites are listed by workshop at dyalog.com/user-meetings/dyalog16/workshops/prerequisites.htm. Please ensure that you meet these pre-requisites before attending a workshop if at all possible.

SA1: Cookbook: Part I

Sunday 09:30 – 13:00

Stephen Taylor and Kai Jaeger

The Dyalog Cookbook sets out how to build in Dyalog an application that can be shared or sold commercially.

This workshop reviews the opening chapters, identifying issues and exploring solutions. The focus will be on understanding the problems to be solved in packaging an application for distribution, and the solutions on offer.

Topics include:

- How to structure the workspace
- Exporting a stand-alone executable
- Logging events
- Handling errors
- Writing, using, and maintaining tests
- Providing online help
- Writing an installer
- Managing source code

This workshop continues in session **SP1**, which focuses on getting hands-on experience with the tools and scripts of the book. If you are already familiar with the topics of the book and want only to acquaint yourself with its tools, then workshop **SP1** can be attended without attending workshop **SA1**.



SA2: Threading and Synchronisation

Sunday 09:30 – 13:00

Morten Kromberg and Adám Brudzewsky

In the immortal words of Pete Donnelly, "Programming with threads requires care". If all goes well, you will leave this workshop with a good idea of how to use threads safely and efficiently to make your application more responsive and increase performance. The workshop will cover the use of tokens for thread synchronisation and show how threading can be used to take full advantage of futures and isolates.

SA3: Web Application Development: Part I

Sunday 09:30 – 13:00

Brian Becker and Michael Baas

After a long gestation period, version 3.0 of MiServer has reached a level of usability where we think it is ready for the big time. This pair of workshops, split across Sunday and Thursday, will walk through implementation principles and details of one of the first commercial applications built on the new platform. In addition to demonstrating the implementation details of a sophisticated user interface with web-based reporting and graphics, you will learn how to implement a scalable and secure multi-user application with self-enrolment of new users using open source tools that are available to all Dyalog users.

This workshop spans two sessions; the second session is **TP3**.

SA4: Compiler and Performance Features

Sunday 09:30 – 13:00

Jay Foad and Roger Hui

Recent versions of Dyalog APL include a number of performance enhancements, both to core interpreter algorithms and the optimised byte code execution engine controlled by `400⍲`. In this workshop, Roger and Jay will show how to take advantage of the new features; they will also cover some of the most important new language features that can be used to improve the performance of your application.



SP1: Cookbook: Part II

Sunday 14:00 – 17:30

Stephen Taylor and Kai Jaeger

This workshop spans two sessions; the first session was **SA1**. It is recommended that attendees of this session who are not already acquainted with the topics of the Dyalog Cookbook also attend the first session.

The Dyalog Cookbook sets out how to build in Dyalog an application that can be shared or sold commercially. This workshop focuses on getting hands-on experience with the tools and scripts of the book.

SP2: Artificial Neural Networks in APL

Sunday 14:00 – 17:30

Romilly Cocking

Artificial Neural Networks (ANNs) help to power Google, Facebook and Amazon. ANN building blocks carry out simple operations on numeric arrays, so APL is a natural language for ANN implementation. In this workshop you will learn how you can build your own Neural Networks to do tasks like image recognition and text analysis.

SP3: Taming Statistics with TamStat

Sunday 14:00 – 17:30

Stephen Mansour

TamStat is a software package, written in Dyalog APL, that allows the user to perform statistical analysis by taking advantage of arrays, functions, operators and namespaces.

In this tutorial we will discuss the four basic types of functions used in statistics: measurements, distributions, relational and logical functions. We will then introduce several operators which can be used with these functions to perform statistical analysis:

- Discrete and continuous probability distributions using the `probability`, `criticalValue` and `theoretical` operators
- Inferential statistics using the `confInt`, `sampleSize` and `hypothesis` operators
- Simulation using the `randomVariable` operator



In addition, we will discuss the following advanced topics on request: tests for goodness of fit, tests of independence, regression and ANOVA.

SP4: A Tour (de Force) of APL in 16 Expressions

Sunday 14:00 – 17:30

Roger Hui

APL will be 50 years old in November 2016 (50 years from 1966-11-27 15.53.58, to be exact), and it remains unsurpassed in manifesting Kenneth E. Iverson's five important characteristics of notation:

- ease of expression
- suggestivity
- subordination of detail
- economy
- amenability to proof

These characteristics are demonstrated by working through 16 APL expressions. The material is approachable for beginners and yet thought-provoking for experts.

One of the 16 expressions is a fast computation of the partition function without use of the Hardy-Ramanujan (1918) results.

TP1: Version 15.0 in Depth

Thursday 14:00 – 17:30

Dan Baronet and Adám Brudzewsky

Version 15.0 of Dyalog APL is full of new features aimed at making you more productive, including new system functions for file and folder management (which work identically on all platforms), support for source code in Unicode text files, and numerous performance features such as "hashed" arrays for repeated fast lookups. Version 15.0 comes with RIDE 3.0, a portable development tool for all Dyalog platforms. In this workshop, Dan and Adám will examine all these new features in detail.



TP2: Compiling ANN & other APL Code

Thursday 14:00 – 17:30

Aaron Hsu

This workshop will use code from the ANN workshop (**SP2**) and additional examples to take you through accelerating your Dyalog applications using the Co-dfns compiler. All steps are covered, from initial investigation to final optimisation. Guidance on the use of the compiler will be provided and you will be shown how to get the most from it in your applications.

(You do not need to have attended session **SP2** to attend this workshop.)

TP3: Web Application Development: Part II

Thursday 14:00 – 17:30

Brian Becker (Tools Group Manager) and Michael Baas

This workshop spans two sessions; the first session was **SA3**. It is recommended that attendees of this session also attend the first session.

After a long gestation period, version 3.0 of MiServer has reached a level of usability where we think it is ready for the big time. This pair of workshops, split across Sunday and Thursday, will walk through implementation principles and details of one of the first commercial applications built on the new platform. In addition to demonstrating the implementation details of a sophisticated user interface with web-based reporting and graphics, you will learn how to implement a scalable and secure multi-user application with self-enrolment of new users using open source tools that are available to all Dyalog users.

TP4: Data Visualisation

Thursday 14:00 – 17:30

Gitte Christensen, John Daintree and Nicolas Delcros

Dyalog APL and its interfaces give you access to a wide variety of visualisation tools. You can use the built-in Chart Wizard based on SharpPlot, write APL code to embed charts in publishable documents using SharpLeaf, call R or Excel to create charts, use WPF data binding to display data using tools implemented on the Microsoft.NET framework, or use MiServer to drive JavaScript based visualisation packages. In this workshop, we will show you how to use all of these techniques – and perhaps one or two more!



Abstracts: Dyalog Presentations

D01: Welcome to Dyalog '16

Gitte Christensen, Managing Director (CEO)

Dyalog Ltd's CEO opens the user meeting.

D02: Technical Road Map: The User Experience

Morten Kromberg, User Experience Director (CXO)

Morten presents his vision of the future, including: challenges facing customers, new platforms and ways of deploying applications, and the future of user interfaces.

D03: Technical Road Map: Under The Covers

Jay Foad, Technical Manager (CTO)

Jay discusses technical achievements in the latest version of Dyalog APL, new projects targetting the next release, and priorities for the engineering team for the next few years.

D04: Tools Group Update

Brian Becker, Dan Baronet & Adám Brudzewsky

The APL Tools Group has been busy developing tools that make it easier for Dyalog users to build and deploy their applications. In this presentation, members of the Tools Group will present the latest developments, including MiServer 3.0 and tools to provide and consume RESTful web services. Brian, Dan and Adám will discuss the availability of APL tools on GitHub and how you can contribute to the tools libraries and will then take a look at the tools work planned for the coming months. During the question and answer segment at the end of the presentation, you are encouraged to share your thoughts on the tools you need.



D05: vecdb

Morten Kromberg

vecdb is a simple "columnar database": each column in the database is stored in a single memory-mapped file. It is written in (and for) Dyalog APL as a tool on which to base new applications that need to generate and query very large amounts of data and do a large number of high performance reads, but do not need a full set of RDBMS features.

D06: New Primitive Functions and Operators

John Scholes & Roger Hui

New operators:

- at – another attempt at a merge/fusion operator
- tile – AKA tessellation, moving window, stencil code

New functions:

- where – $\underline{\iota}\omega$ are indices where Boolean array ω are 1
- interval index – sorted α partitions the domain into intervals; $\alpha\underline{\iota}\omega$ are the indices of the interval for each cell of ω .

D07: The Airfix™ Model: Programming from a Kit of Parts

John Daintree

It is very satisfying when one is able to reuse existing fragments of code. John has taken fragments of varying size from the Dyalog "kit of parts" and combined them into something new and exciting...

D08: Performance: The Neverending Story

Jay Foad & Roger Hui

Roger and Jay will recap the most important performance work that went into Dyalog version 15.0, and then lift the veil on work that is targeting Dyalog version 16.0. This is a condensed version of the **SA4** workshop on Compiler and Performance Features.

**D09: Web Stack of the Future**

Morten Kromberg & Bjørn Christensen

Bjørn and Morten introduce version 3 of the Web API known as Conga. In addition to improved performance and scalability driven by clients with thousands of simultaneous users, very significant new functionality is on the way. Keywords: UDP, direct HTTP support, Web Sockets.

D10: Open Front Ends

Morten Kromberg & Nick Nikolov

Morten and Nick review the state of the RIDE project and examine the consequences of its new status as an open source project.

D11: Uncle Andy's Fireside Chat v3.0

Andy Shiers

Andy will yet again dip his toes into the pool of lesser-known and less well advertised features of Dyalog...and he might even mention one or two that are coming along in 16.0. Unlike last year, he hopes this year to start and end with dry feet!



Abstracts: User Presentations

U01: How I Won the APL Problem Solving Competition

Brian Becker & Niels Hallenberg, SimCorp (Denmark)

Joshua David, University of Scranton (U.S.A.)

Marinus Oosters, Universiteit Utrecht (The Netherlands)

Zack Batik, University of Cape Town (South Africa)

There are three grand prize winners in the eighth annual International APL Programming Contest, one in each category. All three are here to describe their experiences with APL/Dyalog and tell us how they managed to win.

- **U01**: Award Ceremony – Brian Becker & Niels Hallenberg
- **U01a**: General Computing category – Joshua David
- **U01b**: Bioinformatics category – Marinus Oosters
- **U01c**: Finance category – Zack Batik

U02: Weighty Arrays

Romilly Cocking, independent (U.K.)

There are a growing number of Open Source platforms for building Artificial Neural Networks (ANNs), but few really support the exploratory programming style that APLers love so well.

In this brief overview Romilly takes a look at the core algorithms used in ANNs and explains why he believes that Dyalog APL is an ideal environment for exploration.

U03: The Calm Before the Stormwind

Tomas Gustafsson, Stormwind OY (Finland)

Tomas demonstrates the multi-player version of the boating simulator Stormwind. This version is intended to behave like an MMO game, bringing together a multitude of participants from diverse geographical locations into a common virtual world. The solution involves a root server, game servers and peer-to-peer communication. Currently, an integration of Windows sockets and APL is used to manage the data transmission. He will explain the architecture and cover some practical issues, starting with synchronizing computer time and internet time servers, before introducing the Hexapod motion platform. Can you take on the challenge and the angry elements?!



U04: The Journey of an APL2 Bigot to Dyalog World

Veli-Matti Jantunen, Statistics Finland (Finland)

In the beginning there was a young gullible student at a technical university, and a course with an inviting topic "A Programming Language". That was over 35 years ago.

Instead of a bright future in the nuclear industry, the chain reaction ignited by the explosion in Chernobyl brought another secure looking career – mainframes and banking. Then something unexpected happened...the Soviet Union collapsed, Finland's team started winning (some) ice hockey tournaments and mainframe APL2 changed to workstation Dyalog APL. The bank vanished, though.

Veli-Matti relates his story, that of an APL2 person slowly adapting to Dyalog APL, and highlights the features that he has found to be crucial, interesting or just annoying during and since his transition.

U05: Moving Data Binding to the Web

Michael Hughes, MJH Software Services Ltd. (U.K.)

With the advent of a XAML/C# compiler to HTML5/CSS/JavaScript, it is now possible to build client/app side GUIs using pure XAML and automatically link them to groups of namespaces in APL using a user command. All the APLer needs to think about is some XAML; behind the scenes, pure APL data using Web Sockets gives it a responsive feel.

In this presentation Michael outlines the philosophy and shows a prototype of a simple working example.

U06: Co-dfns Report: GPU Performance, Workflow, and Usability

Aaron Hsu, Indiana University (U.S.A.)

The Co-dfns compiler is now showing improved performance on GPUs for a variety of test applications. Aaron reports on the performance improvements available through using the compiler and demonstrates the workflow for migrating applications to utilize the compiler. He also provides information on the current features supported in the compiler and how to track future releases.



U07: Compiling a Subset of APL into Performance Efficient GPU Programs

Martin Elsmann, University of Copenhagen (Denmark)

Martin presents a compiler infrastructure for compiling a subset of APL, written in the style of co-dfns, into performance efficient GPU programs. He demonstrates that, for a number of benchmarks, the generated GPU programs runs in the order of 100x faster than compiled generated C code running on similarly-priced CPU hardware. He will reflect on the programmer's experience with programming in the supported, statically typeable, subset of APL and the fact that the compiler infrastructure does not necessarily embrace the use of idioms before inviting APL programmers to reproduce the obtained results; he will also invite experienced APL programmers to improve on the implementation of the Dyalog versions of the benchmarks and to provide feedback about which additional APL features should be considered indispensable.

The compiler infrastructure compiles APL programs into programs written in a typed array intermediate language (called TAIL), which are then recompiled into programs written in the functional array programming language, Futhark. The Futhark compiler performs a number of GPU-critical optimisations before outputting GPU-optimised OpenCL code, which will be shown to integrate well with host-executed implementations of high-level languages, such as Python or even an APL interpreter.

U08: A Compendium of SIMD Boolean Array Algorithms in APL

Robert Bernecky, Snake Island Research (Canada)

Computation on large Boolean arrays is becoming more prevalent, due to applications such as cryptography, data compression and imaging. The advent of GPUs and bit-oriented vector extensions for microprocessors presents opportunities for significant performance improvements in such Boolean-dominated applications.

Since APL is one of the few computer languages that supports dense (one bit per element) Boolean arrays as first-class objects, it has naturally attracted interest in optimizations for improving the performance of Boolean array operations.



Robert presents some of the SIMD Boolean-related optimizations that have appeared in APL implementations, and suggests ways in which those optimizations might be exploited using contemporary hardware.

U09: Cooking with Dyalog

Kai Jaegar, APL Consultant (U.K.) & Stephen Taylor, Equiniti Claybrook (U.K.)

Given the new tools that have appeared in recent years, how these days do you set about building an application from scratch? Do workspaces even come into it? Kai and Stephen attempt to answer these questions in a new book, *The Dyalog Cookbook*, an open-source project on GitHub, using their combined experience as developers and the tools in the APLTree library. The book is particularly written for domain-expert developers looking to turn useful software into a shippable maintained product.

U10: Markdown for the APLer

Kai Jaegar, APL Consultant (U.K.)

In recent years Markdown has become ubiquitous: Stackflow, Git, Sourceforge, Trello...all the big boys are using it as a writing format, often unnoticed. This is a short introduction to Markdown itself, whether there is a standard, what its pitfalls are and why it is so great.

MarkAPL is a class written in Dyalog that converts Markdown into HTML5. Examples include automated documentation generation (ADOC), how to use MarkAPL in MiServer and how a Markdown file can be converted into an HTML document with a Dyalog user command.

U11: The Wisdom of Those who Came Before Us, or, The Price of Freedom

Stefano Lanzavecchia, APL Italiana (Italy)

They say that a picture is worth a thousand words. Certainly, most human beings find an interactive chart more intuitive than a table with a thousand numeric rows. Sofia, our portfolio management system for institutional investors, is capable of producing large quantities of numbers. A short while ago we decided that the time was ripe for it to start drawing pictures to better show the beauty of those numbers. Instead of trying to compete with dedicated reporting tools, we thought we would play to our strengths if we concentrated on a handful of tailored charts. We identified a few areas



where the introduction of charts would improve significantly the user experience and set off on their implementation. The first step was the choice of the tools and so we went fishing and caught in our net D3.js, a very versatile open source JavaScript library for manipulating web documents based on data. All that remained was to learn how to use it and how to seamlessly integrate it in a traditional Windows-based APL application. Stefano will show how that was done.

U12: New Features in TamStat

Stephen Mansour, The University of Scranton (U.S.A.)

Over the past academic school year, Stephen has used TamStat in his Statistics and Management Science classes at the University of Scranton. He will discuss some of the issues that came up during the past year and demonstrate some of the new features that were developed as a result of student input. These include expression builders for probability distributions, hypothesis testing and regression.

U13: Hobbyist APLing in the 21st Century

Alex Weiner, independent (U.S.A.)

Alex discusses the current (2016) APL scene and shares the things he encountered as a beginner while developing an application first in J and then in APL. He answers the following questions, all of which he asked when learning APL:

- What interpreters are available?
- What do you mean no control structures?
- How do you set up the keyboard?
- Do arrays start at zero or one? (spoiler alert: it doesn't matter!)
- You found out what base-value does?! And it has a practical use?
- APL...and images?



Abstracts: 50 Years of APL Presentations

L01: The Way We Were

Roy Sykes, Sykes Systems (U.S.A.)

APL and Its Milieu in the 1970s: How APL developed as a computer language in its formative years, and the environment in which it thrived.

L02: 50 Years of APL Datatypes: From Booleans to Hypercomplex Numbers

Bob Smith, Sudley Place Software (U.S.A.)

A personal view of the growth of APL through its datatypes. Some of the major datatype ideas of the last 50 years include:

- Booleans
- Nested arrays
- Unicode characters
- Arithmetic Progression Arrays (extending APVs)
- Multi-precision Integer/Rational numbers (extending 64-bit Ints)
- Multi-precision Floating Point numbers (extending 64-bit Floats)
- Hypercomplex (complex, quaternion and octonion) numbers which provide a natural extension of the real (one-dimensional) numbers to two-, four-, and eight-dimensions. The coefficients of these numbers are all either 64-bit integers or floats, or multi-precision integer/rational or float (twelve new datatypes altogether).
- Shared variables
- Namespaces
- Object oriented programming

In short, although the major leaps in the last 50 years of APL are often described in terms of language ideas (new functions and operators) and implementation improvements (smaller, faster), I see the most important driving force as new datatypes.



L03: Zoo Story: How the I.P. Sharp APL Development Group Got its Name

Robert Bernecky, Snake Island Research (Canada)

The I.P. Sharp Associates APL timesharing system was already operational when Robert was hired at IPSA in early 1971; he tells the tale of how he became part of the APL Development Group, how the Group became known as The Zoo and relates some of the development work that he and others did there in the early 1970s.

L04: Dyalog Implementation – The Early Years

Stephen Taylor, Equiniti Claybrook (U.K.) with Geoff Streeter, Dyalog Ltd. (U.K.) & John Scholes, Dyalog Ltd. (U.K.)

It's 33 years since Dyalog version 1.0 went on sale and, as any hobbit can tell you, 33 means coming of age and reflecting on how you got to where you are now. In this spirit, Stephen interviews Geoff and John, two of the original team, about some of the challenges that faced the initial implementation of Dyalog and how some of the choices made decades ago are still reflected in the product to this day.

L05: Same Difference

Simon Garland, Kx Systems Inc. (Switzerland)

Kx's languages k and q have been around since the early 90s and have been continually evolving during that time. Although Arthur Whitney's early work was with APL, many choices were made over the years that took these languages further and further away from the APL world, some of them with far-reaching ramifications for the language and implementation that only really became apparent years later. Simon will highlight a few of the differences and their consequences that he finds interesting, and hopefully make you look at some of the things you take for granted in a new light. He's said that he'll try not to be snarky about `⎕IO`!

L06: The use of APL in SimCorp Dimension

Niels Hallenberg, SimCorp (Denmark)

SimCorp Dimension is an integrated front-to-back system for large investment managers around the world. Dimension has been developed over more than 20 years and includes a wealth of advanced features within the front office, middle office and back office operations. Being an integrated



enterprise system is a core value of Dimension. More than 400 people work on developing Dimension on a daily basis. APL has been part of the technology stack from the start. Today, other technologies have been added including C# and OCaml. Niels' presentation will illustrate the use of APL in Dimension and how APL supports product development. He will also look forward to how APL may evolve in the future to support a product like Dimension.

L07: Composition Based Modelling and Dyalog APL

Stephen Jaffe, ExxonMobil – retired (U.S.A.)

Dr Jaffe is a chemical engineer with a distinguished career and the co-inventor of SOL.

Composition Based Modelling represents a significant improvement in the approach to building kinetic models of petroleum systems. The activity is divided into three areas:

- The Model of Composition (High Detail Hydrocarbon Analysis – aka HDHA)
- Describing the chemistry of petroleum mixtures (Structure Oriented Lumping – aka SOL)
- Model Delivery Technology

Composition Based Models have been built for all major petroleum conversion processes including reforming, fluid catalytic cracking, hydrocracking, catalytic hydro-desulphurisation and lubricant manufacture. They are presented to the user through a uniform architecture on a PC platform and are in use worldwide to optimise refinery operation. In the last few years they have seen the greatest value for refinery feed crude selection.

Numerous analytical methods, collectively known as HDHA, enable the composition of petroleum to be represented as a consistent set of over 5,000 molecular species. Physical, chemical and performance properties of petroleum are calculated using composition-based correlations and are used to "property balance" the HDHA analyses.

SOL describes the reactions of hydrocarbon mixtures. Using SOL, individual hydrocarbon molecules are represented as vectors of incremental structural features. These vectors provide a convenient framework to construct



rule-based reaction networks of arbitrary size and complexity. Models using SOL typically follow the conversion of molecular species through more than 100,000 elementary reaction steps.

Dyalog APL is used in every aspect of the project. The petroleum composition is analysed and organised with APL. SOL is entirely APL-based, and the reactor models are in Fortran generated under program control by APL. Finally, the user interface is 100% Dyalog APL.

L08: Lessons from 40 Years of APL (Not Old Enough for 50 Years!)

Jay N. Whipple III, TheCommonGame.com (U.S.A.)

Building real businesses on APL platforms. Keys to success and implications for the future relevance for the next generation of software architects.

L09: Trees with Loops – where APL made a difference in Rowntree

Adrian Smith, APL-385 (U.K.)

An overview of some of the key areas where APL got our research department noticed in the chocolate industry, and a particular look at the (rather hard) problem of turning a recipe into an ingredients list, where the recipe has much re-use of finished (and semi-finished) materials back in earlier stages. A simple demo version of the algorithm will be available to take away (but I still can't give you the recipe for Kit Kat – they'd have to kill all of us!).

L10: The Joy of (Especially Dyalog) APL and Some Gripes

Charles Brenner, DNA-View (U.S.A.)

APL notation is elegant and mathematically appealing to the considerable extent that it's consistent, general, concise, and the rules are few. Especially during the preliminary, the design, stage of my *Mixture Solution* program (an algorithm for an important class of forensic DNA situations) good notation was vital. All the experts (myself included) understood that there is an essential complication to DNA mixture analysis that makes a purely analytical algorithm impractically slow. Consequently all the existing programs necessarily used Monte Carlo sampling methods. But in the course of months trying to think clearly why that had to be so, a series of insights dawned on me and eventually the realization that it is not so. The "essential complication" disappears if you pile your logs in the right order.



Each new idea had to be written down – otherwise the next day you doubt yourself, and conclude you were probably confused. APL proved to be good for taking notes. Concise and explicit notes made it easy to review the steps and be clear that the simplifying discovery was correct. Tool of thought.

Good notation though is only part of a great programming tool. Implementation is equally important, and here Dyalog APL has great strengths but in some ways it's clumsy. One example is the horrifying clunkiness of typing a function name into the session log in order to open it for editing. Of course there are plenty of delights – a simple APL defined operator implements the mathematical operator of conjugation; some bit of code that I expected to be inefficient turns out to be blindingly fast (tricky Roger); a bit of code that required special-casing the empty case in STSC's APL just plain works in Dyalog.

So I'll temper my praise with criticism – fine whining.

L11: 50 Years of APL

Gitte Christensen, Dyalog Ltd. (Denmark)

An introduction to the early years of APL. The different applications of APL are described in the context of changing conditions through the last 50 years. The evolution of APL is outlined and the current state established. In summary, this is a story of computing driven by end-users.

L12: 60 Years of IT Progress

Romilly Cocking, independent (U.K.)

APL veteran Romilly Cocking takes a lighthearted look at how the world of IT has developed since he wrote his first program in 1958.

L13: Getting the Word Out in Colour

Paul Grosvenor, Optima Systems (U.K.)

The APL community has discussed, deliberated, debated, conversed, cogitated, pondered, reflected and considered how we should get our word out to the various communities and raise our profile. In more recent times we have seen the emergence of a number of groups that meet regularly and prove that there are those out there who want more. These groups are now starting to market themselves properly; getting their presence known,



creating a brand, an identity and publishing regularly. As a result, interest and awareness is growing.

The job of selling ourselves will never be complete and there is still much to do, but we get better.

Paul discusses what is happening with some of the groups he is familiar with; what are they doing, when are they doing it and how do they sell themselves...Oh and of course, does any of this make a difference?

Finally, he will introduce a touch of *your* colour for you to discuss, deliberate and cogitate...

L14: The Cartoon Introduction to APL

Roberto Minervini, Liceo Classico S. M. Legnani (Italy) with Federico D'Ettorre, Mattia Passarelli, Teresa Renda & Federica Zoanni – illustrations by Giuseppe Mastropierro

Roberto is a maths teacher and in his view one of the best problem-solving techniques is arriving at a solution to a problem by means of images. Can a mathematical language as concise and abstract as APL help us to give an image to the problems? He discusses this with four of his students and an illustrator.

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Practical Information

To make your stay as pleasant as possible, we would like to draw your attention to some practical details.

Check In and Out

Your room is available from **15:00** on the day of arrival; you will need to check out of the room by **12:00 noon** on the day of departure.

Internet Access

Free WiFi is available in all areas. The WiFi network is *Beardmore Public WiFi* – you will need to accept their terms and conditions to connect. There are PCs with internet access and printers near the reception area that all delegates can use.

Meals and Drinks

The user meeting fee includes all meals and breaks on user meeting days.

- The Lunch buffet includes soft drinks and tea/coffee.
- Dinner includes soft drinks and tea/coffee. Wine is available to buy.
- Wine is included in the Banquet Dinner.
- Guest rooms have tea/coffee making facilities.

There is a bar on the ground floor of the hotel that is open every day from 10:00 to 00:00. Please remember to settle your bar bill when you check out!

Hotel Facilities

All rooms have an en-suite bathroom with bath/shower, tea/coffee making facilities, an HD Smart TV, air conditioning, an iron and ironing board, a desk and a hairdryer. Overnight accommodation includes breakfast.

The hotel has a Health Suite on site with a fully equipped gym, steam room, sauna and swimming pool. It is open from 06:30 to 22:00 (last entry 45 minutes before closing) and is available to hotel guests. Exercise classes are also included – the timetable for these varies.

The hotel has free parking on site for up to 300 cars but this is shared with the hospital next door so can become congested at times. There are regular trains and buses into central Glasgow – please ask at the hotel reception for details.

Smoking Policy

Smoking is not permitted anywhere in the hotel or its grounds. Guests can smoke at the end of the entrance drive, which is a 2-3 minute walk from the hotel main entrance.