DYNA26

An APL App End-to-End

Rich Park

APL Evangelist, Dyalog Ltd

DYALOG
Glasgow 2024

https://dyalog.tv

Dyalog '24 APLSeeds '24 Dyalog '23 APL Seeds '23 Dyalog '22 Webinar APL Seeds '22 Dyalog '21 APL Seeds '21

Dyalog '20 Dyalog '19 Dyalog '18 Dyalog '17 Dyalog '16 Dyalog '15 Dyalog '14 Dyalog '13 Dyalog '12 Dyalog '11

APL Berlin 2010 Dyalog '09 Dyalog '08

Introduction

Welcome to Dyalog '24
Stine Kromberg

The Road Ahead
Morten Kromberg

Behind the Scenes

Ullu – A Test Framework for Dyalog APL
Aarush Bhat

Video Library | parallel | Search

Filter by Date Range: 2008 to 2026

Filter by Presenter: For example: Morten Kromberg

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Segmented Scans and Nested Data Parallelism

- Andrzej Filinski

Oct 2012 in Dyalog '12

APL Worker Bees – Another Way to Run APL Tasks in Parallel

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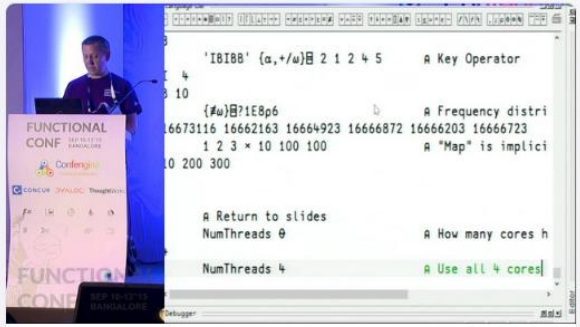
Oct 2023 in Dyalog '23



Parallel Programming in Dyalog using Futures and Isolates

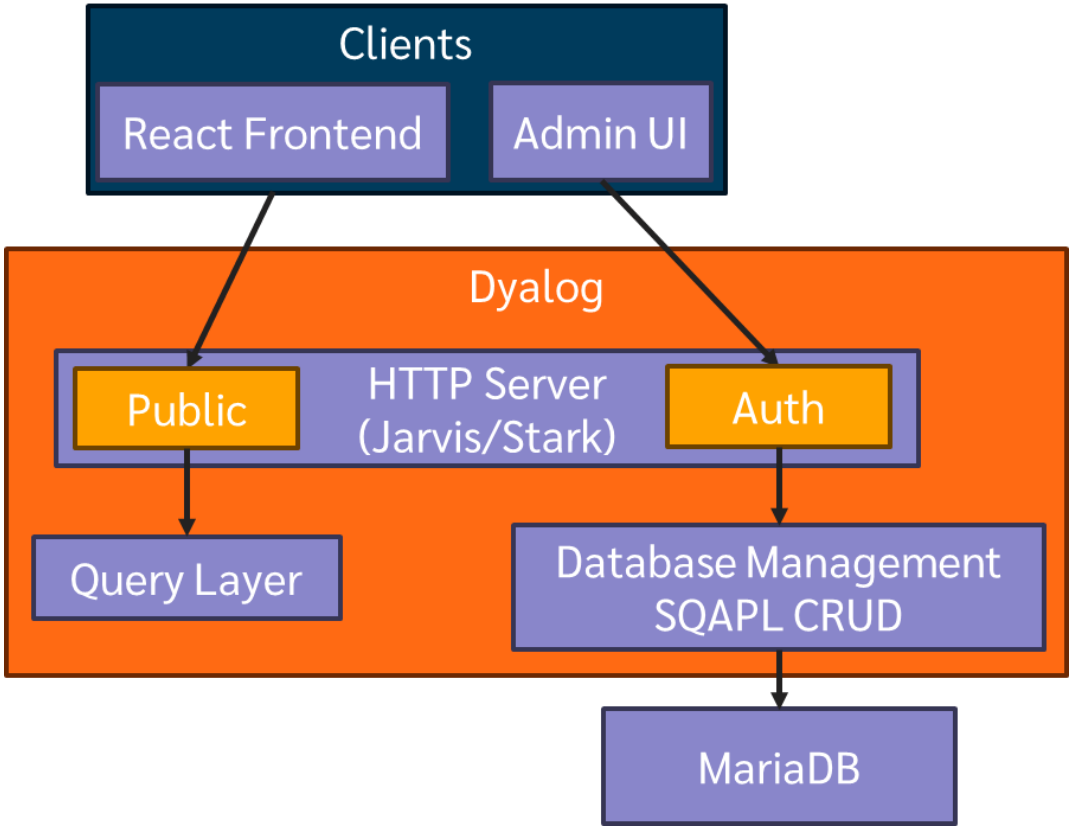
- Morten Kromberg

Sept 2015 in Functional Conf 2015

Coming Up...

- Architecture Overview
- Development Setup
- Component Details
  - Database
  - HTTP Server
  - Search and Recommendation

Dyalog Content Management System (DCMS)



Development & Deployment

- Develop in Docker (write once, work anywhere)
- Mirror Production in Development
- Jenkins Automation for Deployment
- Testing
  - In APL session
  - In local Docker
  - In continuous deployment pipeline
- Reduce "works on my machine" issues

Development & Deployment

Stage View

	Checkout	Build container	Update MariaDB	Install dependencies	Test service	Publish DCMS	Create ENV file	Deploying with Docker Swarm
Average stage times: (full run time: ~2min 55s)	1s	1s	1s	10s	27s	58s	374ms	25s
#239 Apr 20 10:24 — No Changes	931ms	1s	1s	10s	27s	56s	368ms	28s
#238 Apr 09 09:10 — 1 commit	1s	1s	1s	12s	27s	1min 1s	313ms	28s

Tatin & NuGet Packages

apl-dependencies.txt

```
dyalog-HttpCommand-5.9.3
dyalog-Jarvis-1.20.5
dyalog-NuGet-0.2.5
bkaw-Stark-0.1.10 (not yet public)
```

Tatin & NuGet Packages

```
      ]tatin.listpackages
 Registry: https://tatin.dev                    ≠ 70
 Group & Name                      # major versions
 ------------                      ----------------
 abrudz-ColSchemes                                1
 abrudz-sort                                      1
 ·····································
 sjt-translate                                    1
 tiamatica-Mutsu                                  1
 tiamatica-Notela                                 1
```

Tatin & NuGet Packages

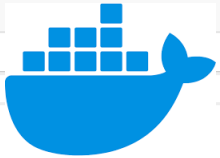
- NuGet: library of .NET tools
- Can use from APL with]USING
- Porter2Stemmer NuGet package

```
      Stem¨(
          'analytic'
          'analytics'
          'analytically'
      )
analyt  analyt  analyt
```

Tatin & NuGet Packages

```
      NuGet.Setup'/app/nuget-packages'
      NuGet.Add 'Porter2Stemmer'
      DCMS.⍞USING←NuGet.Using'/app/nuget-packages'
,/app/nuget-packages/published/Porter2Stemmer.dll
,/app/nuget-packages/published/_nuget-packages.dll
```

```
   Stem¨(
       'analytic'
       'analytics'
       'analytically'
   )
analyt  analyt  analyt
```

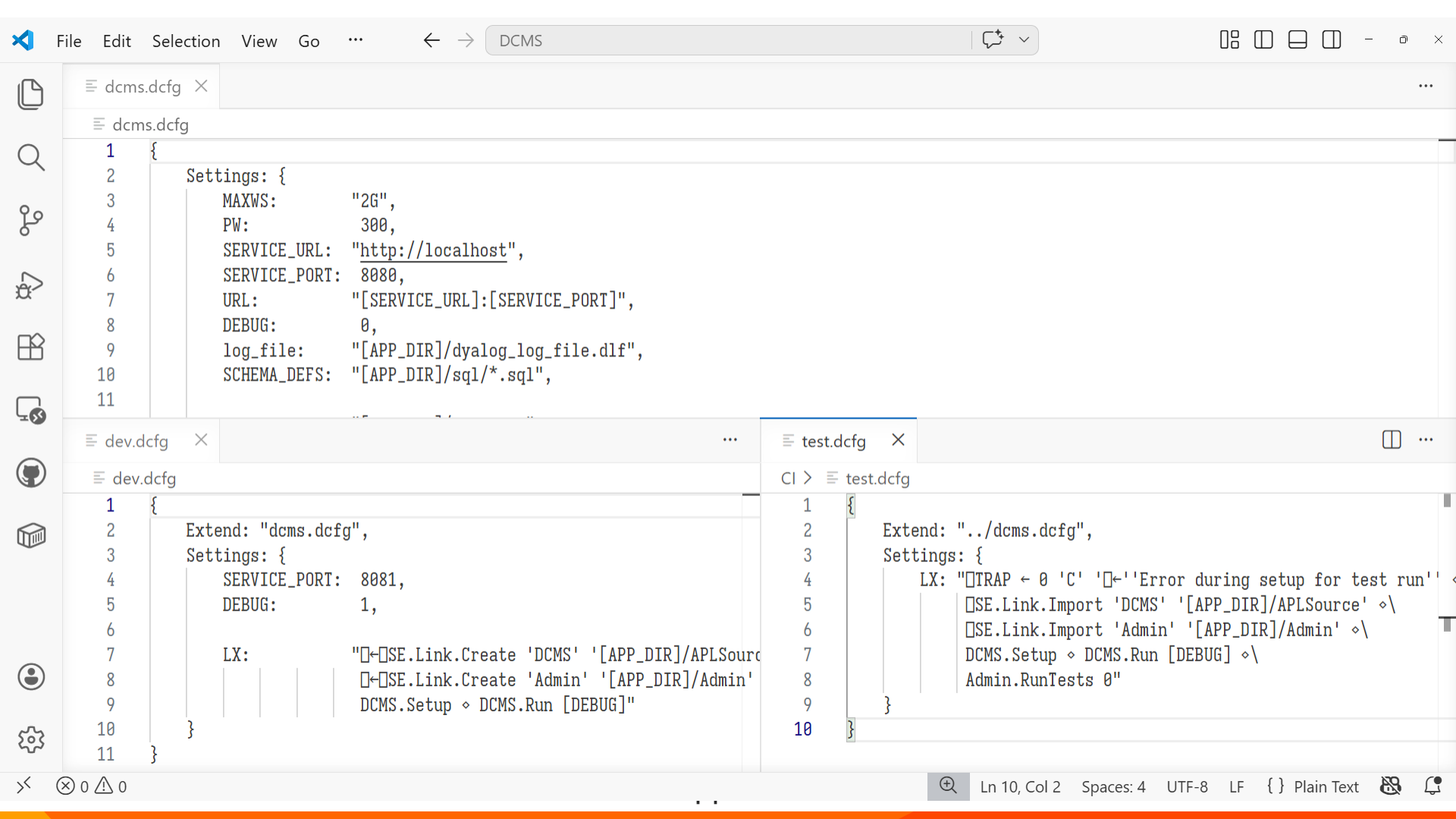


```
#!/usr/bin/dyalogscript DYALOG_INITSESSION=1
⎕←'Installing application dependencies...'

root←2 ⎕NQ # 'GetEnvironment' 'APP_DIR'
pkg←root,'/packages'
nuget←root,'/nuget-packages'

:Trap 0
    ⎕SE.Tatin.ReInstallDependencies pkg
    ⎕SE.Tatin.LoadPackages 'NuGet' ⎕THIS
    NuGet.Publish nuget
    ⎕←'Application dependencies installed in ',pkg,' and ',nuget
    ⎕OFF 0
:Else
    ⎕←'Could not install dependencies.'
    ⎕←1⎕JSON⎕OPT'Compact'0⊢⎕DMX
    ⎕OFF 1
:EndTrap

```


File Edit Selection View Go
DCMS
dcms.dcfg
dcms.dcfg
{
Settings: {
MAXWS: "2G",
PW: 300,
SERVICE_URL: "http://localhost",
SERVICE_PORT: 8080,
URL: "[SERVICE_URL]:[SERVICE_PORT]",
DEBUG: 0,
log_file: "[APP_DIR]/dyalog_log_file.dlf",
SCHEMA_DEFS: "[APP_DIR]/sql/*.sql",
dev.dcfg
dev.dcfg
{
Extend: "dcms.dcfg",
Settings: {
SERVICE_PORT: 8081,
DEBUG: 1,
LX: "⍎⍕SE.Link.Create 'DCMS' '[APP_DIR]/APLSourc
⍎⍕SE.Link.Create 'Admin' '[APP_DIR]/Admin'
DCMS.Setup ⋄ DCMS.Run [DEBUG]"
}
}
test.dcfg
CI > test.dcfg
{
Extend: "../dcms.dcfg",
Settings: {
LX: "⍎⍕TRAP ← 0 'C' '⍎⍕''Error during setup for test run'' ⋄
⍎⍕SE.Link.Import 'DCMS' '[APP_DIR]/APLSource' ⋄\
⍎⍕SE.Link.Import 'Admin' '[APP_DIR]/Admin' ⋄\
DCMS.Setup ⋄ DCMS.Run [DEBUG] ⋄\
Admin.RunTests 0"
}
}
0 0
Ln 10, Col 2
Spaces: 4
UTF-8
LF
{ } Plain Text

demo.dcfg

```
{
 Settings: {
  MAXWS: "2G",
  LX: "⍞←'Hi, I was launched from [CONFIGFILE]!'"
 }
}
```

demo.dcfg

```
{
 Settings: {
  MAXWS: "2G",
  LX: "⎕←'Hi, I was launched from [CONFIGFILE]!'"
 }
}
```

```
> .\dyalog.exe CONFIGFILE=\tmp\demo.dcfg
```

demo

```
{
  Set
    MA
    LX
  }
}
```

```
! '"
```

CLEAR WS - Dyalog APL/W-64 20.0 Unicode

File Edit View Window Session Log Action Options Tools Threads Layout Help

WS Object Tool Edit Session APL385 Unicode

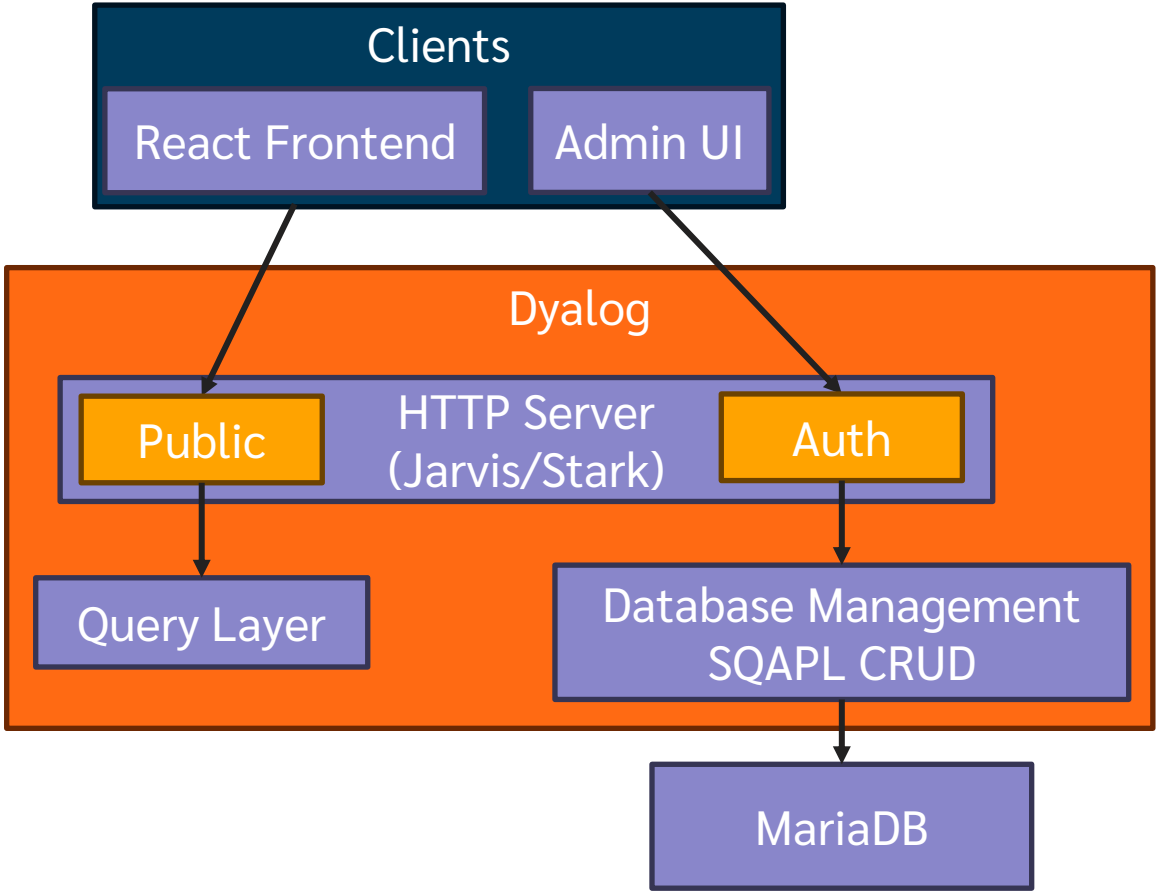
```
Dyalog APL/W-64 20.0 Unicode - Version 20.0.52921
Serial number: UNREGISTERED - not for commercial use
+-------------------------------------------------------------------+
| Dyalog is free for non-commercial use but is not free software.   |
| A basic licence can be used for experiments and proof of          |
| concept until the point in time that it is of value.             |
| For further information visit                                     |
| https://www.dyalog.com/prices-and-licences.htm                    |
+-------------------------------------------------------------------+
Sun Apr 26 07:44:19 2026
'Hi, I was launched from \tmp\demo.dcfg!'
```

Debugger

Ready... Ins NUM

CurObj: &:1 DQ:0 TRAP SI:0 IO:1 ML:1

Editor


Clients
React Frontend
Admin UI
Dyalog
Public
HTTP Server
(Jarvis/Stark)
Auth
Query Layer
Database Management
SQAPL CRUD
MariaDB

MariaDB

Video **Library** parallel Search

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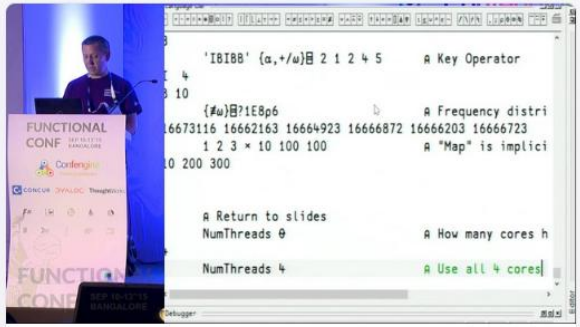

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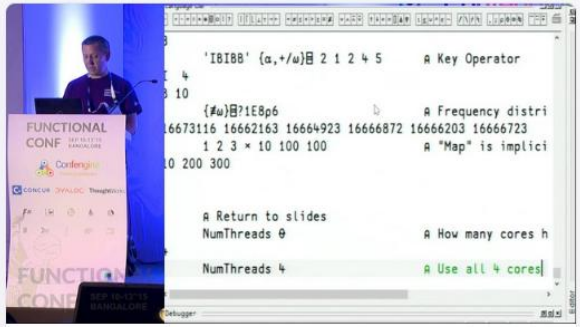

Parallel Programming in Dyalog using Futures and Isolates

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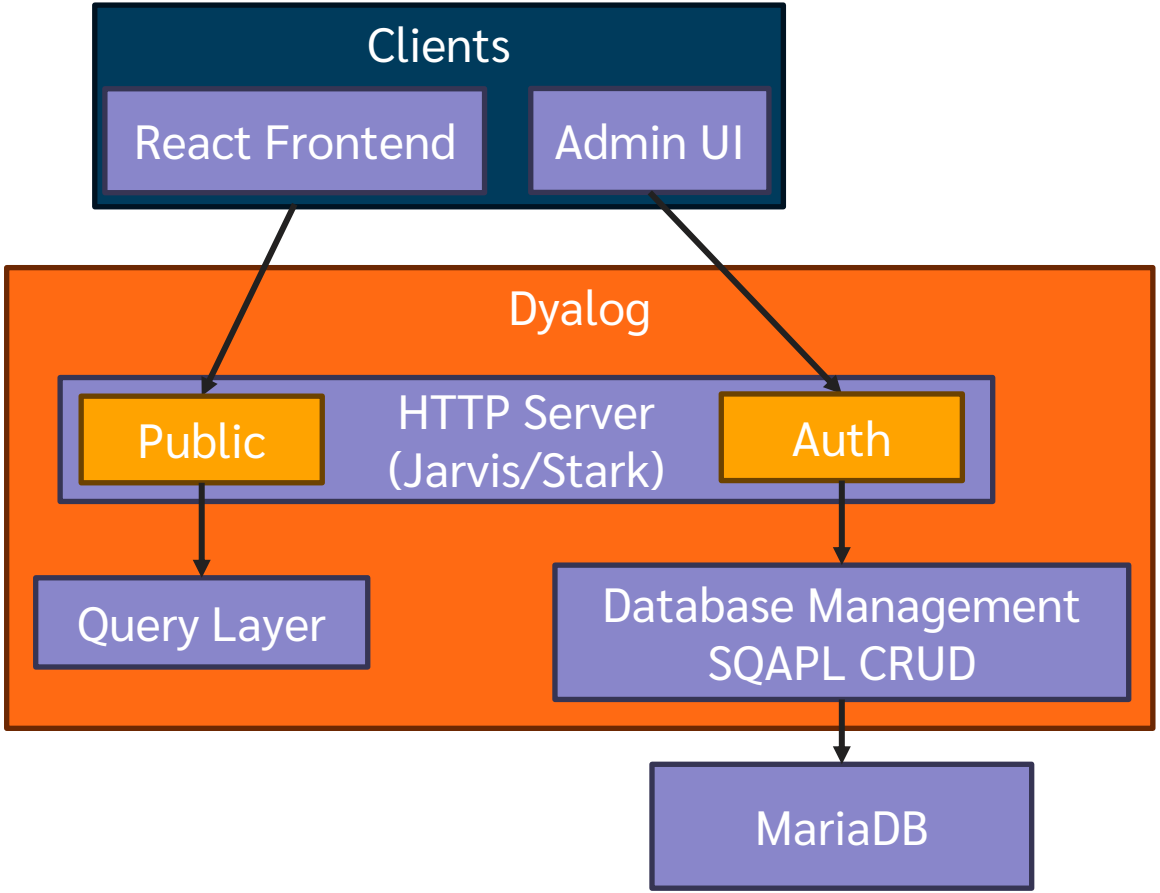
Sept 2015 in Functional Conf 2015

MariaDB

- Data integrity
  - Database normalization
  - Foreign key constraints
- Share data source with other apps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CRUD

API: Create, Read, Update, Delete

SQL: INSERT, SELECT, UPDATE/SET, DELETE

```
sql←'SELECT col1,col2 FROM table :>type1,type2:'
SQA.Prepare cursor
SQA.Exec cursor
data←2⊃SQA.Fetch cursor
```

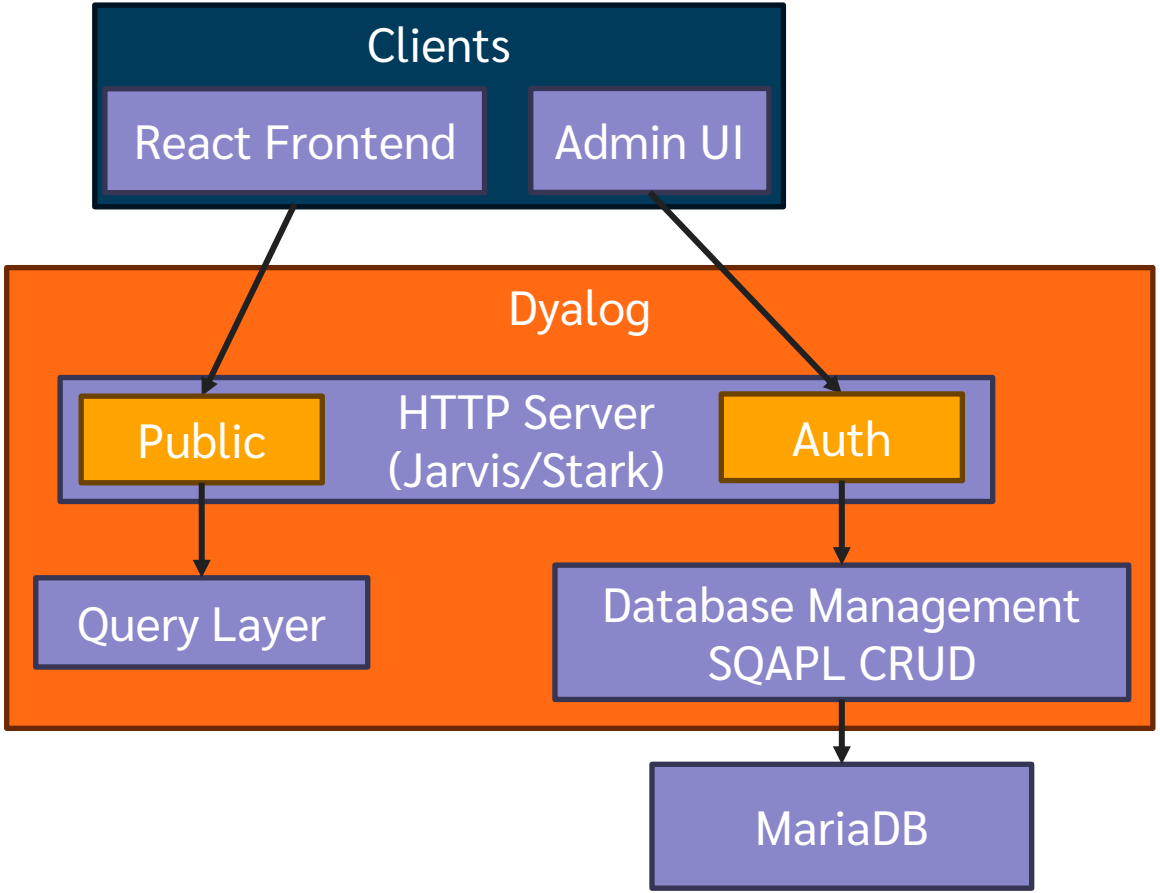
CRUD

API: Create, Read, Update, Delete

SQL: INSERT, SELECT, UPDATE/SET, DELETE

```
SQL.Select(table:table_name ◇ columns:fields)
```

CRUD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HTTP Server

Jarvis REST mode

REST: Principles for resource management

HTTP: POST GET PATCH DELETE

API: Create Read Update Delete

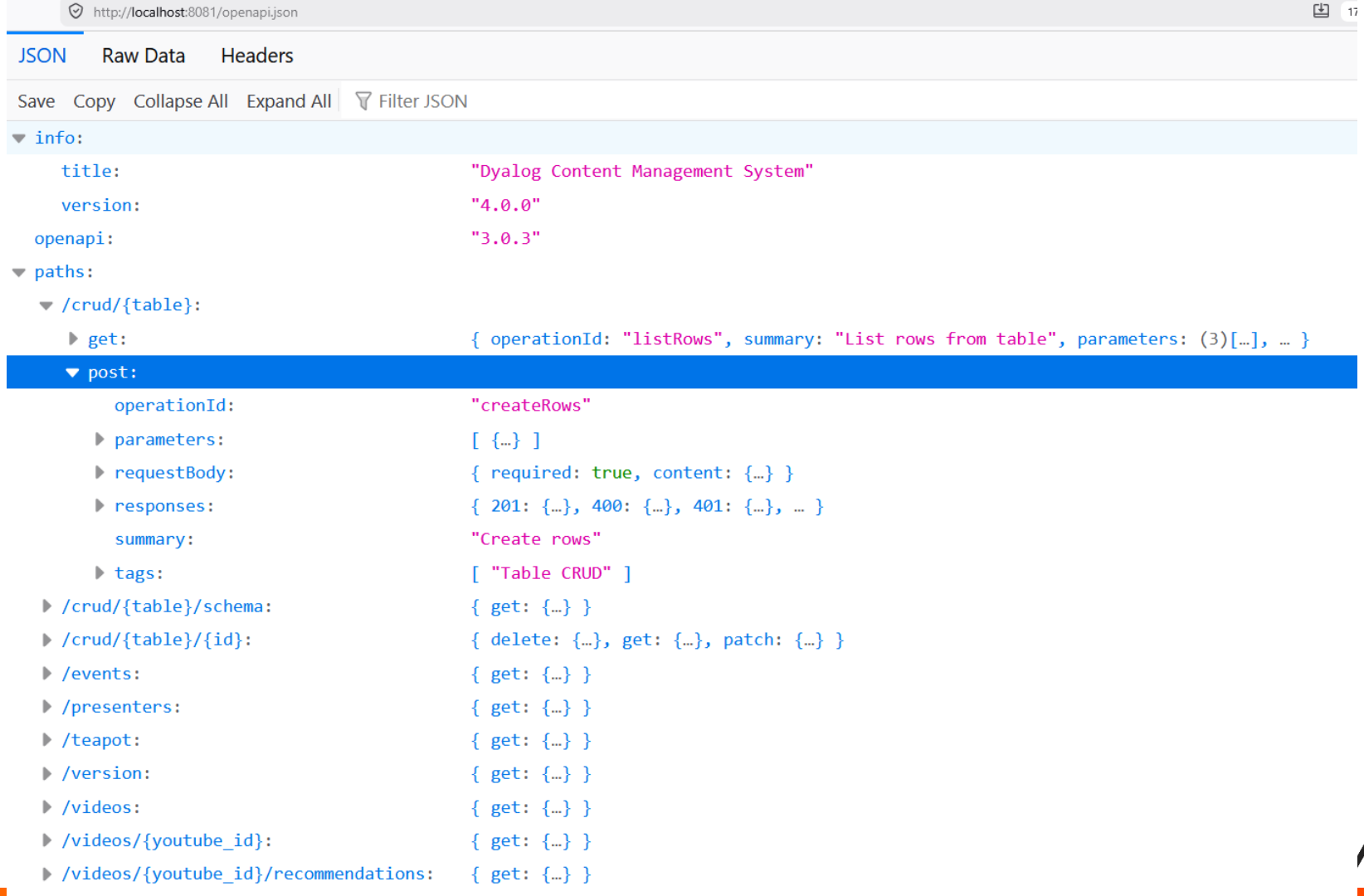
Stark REST router (experimental)

```
'/crud/{table}' router.Get 'CRUD.Read'
```

+ OpenAPI spec generator!

OpenAPI

- Standardized framework for REST API specification
- Well supported tooling and interoperation


http://localhost:8081/openapi.json
JSON
Raw Data
Headers
Save
Copy
Collapse All
Expand All
Filter JSON
info:
title: "Dyalog Content Management System"
version: "4.0.0"
openapi: "3.0.3"
paths:
/crud/{table}:
get: { operationId: "listRows", summary: "List rows from table", parameters: (3)[…], … }
post:
operationId: "createRows"
parameters: [{…}]
requestBody: { required: true, content: {…} }
responses: { 201: {…}, 400: {…}, 401: {…}, … }
summary: "Create rows"
tags: ["Table CRUD"]
/crud/{table}/schema: { get: {…} }
/crud/{table}/{id}: { delete: {…}, get: {…}, patch: {…} }
/events: { get: {…} }
/presenters: { get: {…} }
/teapot: { get: {…} }
/version: { get: {…} }
/videos: { get: {…} }
/videos/{youtube_id}: { get: {…} }
/videos/{youtube_id}/recommendations: { get: {…} }

SQL Tables to JSON Objects

- APL matrix/table from SQL database
- REST service provides JSON
- `]JSON` wrappers!

Wrappers

A wrapper is an enclosed vector of the form:

```
⊂code special
```

The nature of the `special` data structure is identified within the wrapper by a leading numeric code. Code 1 is used to identify JSON values such as `null`, `true` and `false`. Codes 2, 3 and 4 are used to identify different forms of datasets.

This wrapper mechanism has been chosen to identify special treatment because a scalar enclosure cannot be represented in JSON/JavaScript.

A wrapper may be specified directly in the right argument to `⎕JSON` and/or as part of the array structure specified by the right argument, as a sub-array or in a namespace. This allows a special array to be processed appropriately as part of a general data structure that is to be rendered in JSON notation.

Wrappers for special JSON values

Wrappers may be used to export JSON special values such as `null`, `true` and `false` using code 1. This mechanism is supplementary to the use of enclosed character vectors. See

```
Table2JSON←{
      1 ⎕JSON⊂2,⊂⍵
}
```

name	age	is_cool
Tom	42	false
Dick	56	true
Asher	37	true

```
json←Table2JSON matrix
```

```
[{
   age: 42,
   is_cool: false,
   name: "Tom",
},
{
   age: 56,
   is_cool: true,
   name: "Dick",
},
{
   age: 37,
   is_cool: true,
   name: "Asher",
}]
```

```
Table2JSON←{
      1 ⎕JSON⊂2,⊂⍵
}
```

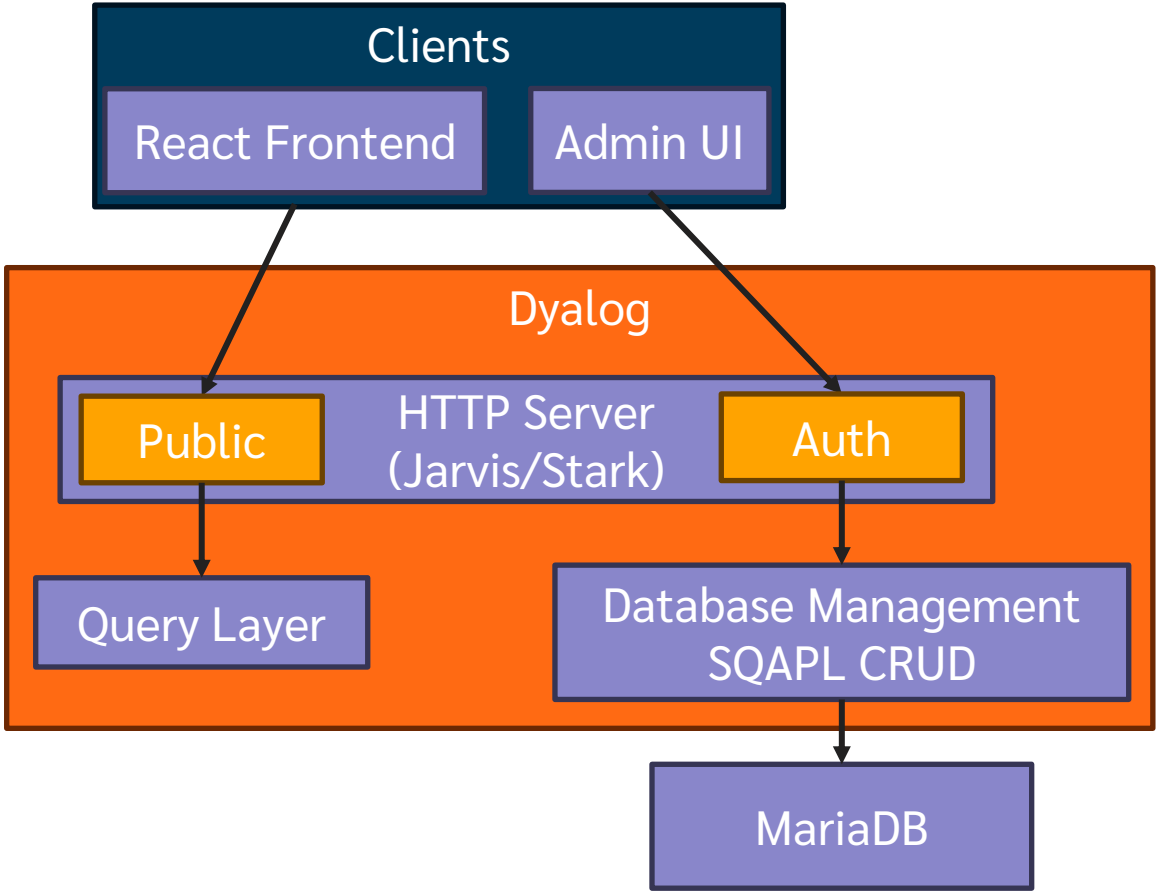
CRUD/Create.aplf

```
our_values←↑req.Payload ⎕VGET column_names

inserted←SQL.Insert(
  table:table_name ⋄ columns:column_names
  values:our_values ⋄ returning:our_cols
)

r←Table2JSON our_cols;inserted
```

CRUD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Query Layer

Search

Filter

Recommendations

Search

Term-frequency inverse-document-frequency

Common words count less towards results

```
tf_idf←tf+.÷df
```

Search

```
term_count←⍉↑(+/⍷∘docs)¨terms
relevant_vids←⍳∨/0<term_count
tf←term_count[relevant_vids;]
df←+⌿tf
tf_idf←tf+.÷df
relevant_vids[⍒tf_idf]
```

Query Layer

Search

Filter

Recommendations

Filter Date Range

```
      ddn←DT2DDN '2026-04-27 09:30:00'
46138.39583

      (from∘≤∧≤∘to)ddn
```

Filter Date Range

```
    DT2DDN←{1 ⎕DT 2⊃⍵'-' ':'⍵⎕VFI⍵⊆⍨⍵}
    FormatDateTime←{⍺⍺(1200⌶)⍵}
    ⎕←ddn←DT2DDN '2026-04-27 09:30:00'
46138.39583

    'YYYY-DD-MM hh:mm:ss' FormatDateTime ddn
2026-27-04 09:30:00
```

Filter Date Range

```
    DT2DDN←{'YYYY-MM-DD hh:mm:ss' 1 ⎕DT⍵}
    FormatDateTime←⎕DT
    ⎕←ddn←DT2DDN '2026-04-27 09:30:00'
46138.39583
```


```
    'YYYY-DD-MM hh:mm:ss' FormatDateTime ddn
2026-27-04 09:30:00
```

Filter Date Range

```
    DT2DDN←{'%ISO%' 1 ⎕DT⍸⍵}
    FormatDateTime←⎕DT
    ⎕←ddn←DT2DDN '2026-04-27T09:30:00'
46138.39583

    '%ISO%' FormatDateTime ddn
2026-27-04T09:30:00
```

Query Layer

Search

Filter

Recommendations

Recommendations

Setting and Getting Variable Values

Adám Brudzewsky

November 2023

in Dyalog '23

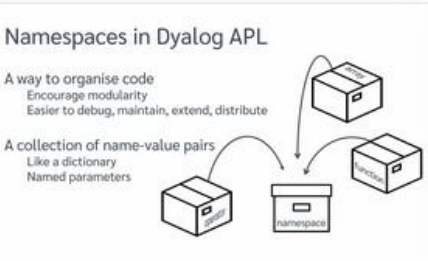
Assignment and using the value of a variable are important elements of programming, but, in more complex systems, the name of a variable is sometimes dynamic, and determined separately. Current solutions to these situations suffer from poor readability and performance. Adám proposes an alternative approach in the form of system functions for getting name-value pairs (⎕NV), getting a name (⎕NG) and setting a name (⎕NS). If you recognise the last one, luckily his proposal is a consistent extension of the current ⎕NS system function.

Suggested Videos:

Setting and Getting Variable Values Mk II

- Adám Brudzewsky

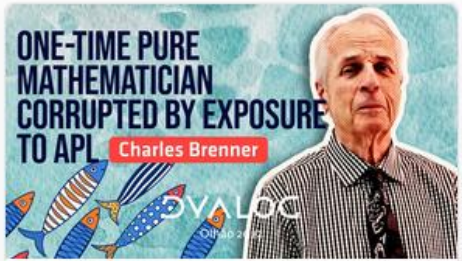
Sept 2024 in Dyalog '24



Namespaces in Dyalog APL

- Rich Park

Jun 2022 in Tutorials



One-Time Pure Mathematician Corrupted by Exposure to APL

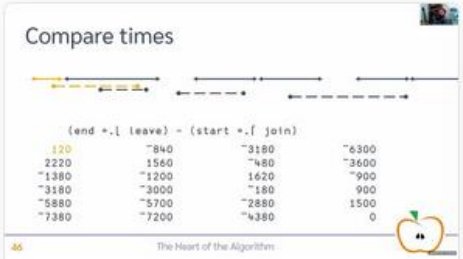
- Charles Brenner

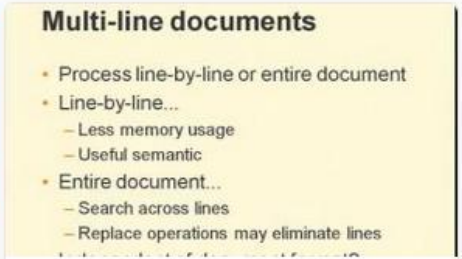
Oct 2022 in Dyalog '22

Creating and managing your own User Commands

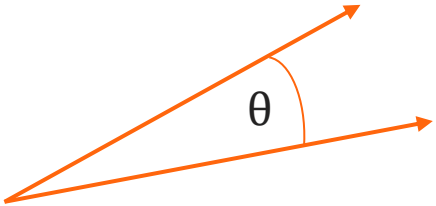
- Adám Brudzewsky

May 2018 in Dyalog Webinar





Cosine Similarity



$$A \cdot B = |A||B| \cos\theta$$

$$\cos\theta = \frac{A \cdot B}{\sqrt{\sum A^2} \times \sqrt{\sum B^2}}$$

```
(c+.×⌽c)÷∘.×⍨0.5*⍨+/c*2
```

Cosine Similarity

Isn't that expensive?

Yes

Isolates

Isolates

Core Documentation

These documents describe the details of the language and program construction; they are not specific to an operating system.

- Dyalog APL Language Reference Guide (summary)
- Dyalog Programming Reference Guide (summary)

- .NET Interface Guide (summary) NOTE: Dyalog Unicode edition only
  - Comparison of .NET/.NET Framework Interfaces
- Compiler User Guide (summary)
- Parallel Language Features (summary)
- Shared Code Files User Guide (summary) NOTE: Dyalog Unicode edition only

https://www.dyalog.com/documentation_200.htm

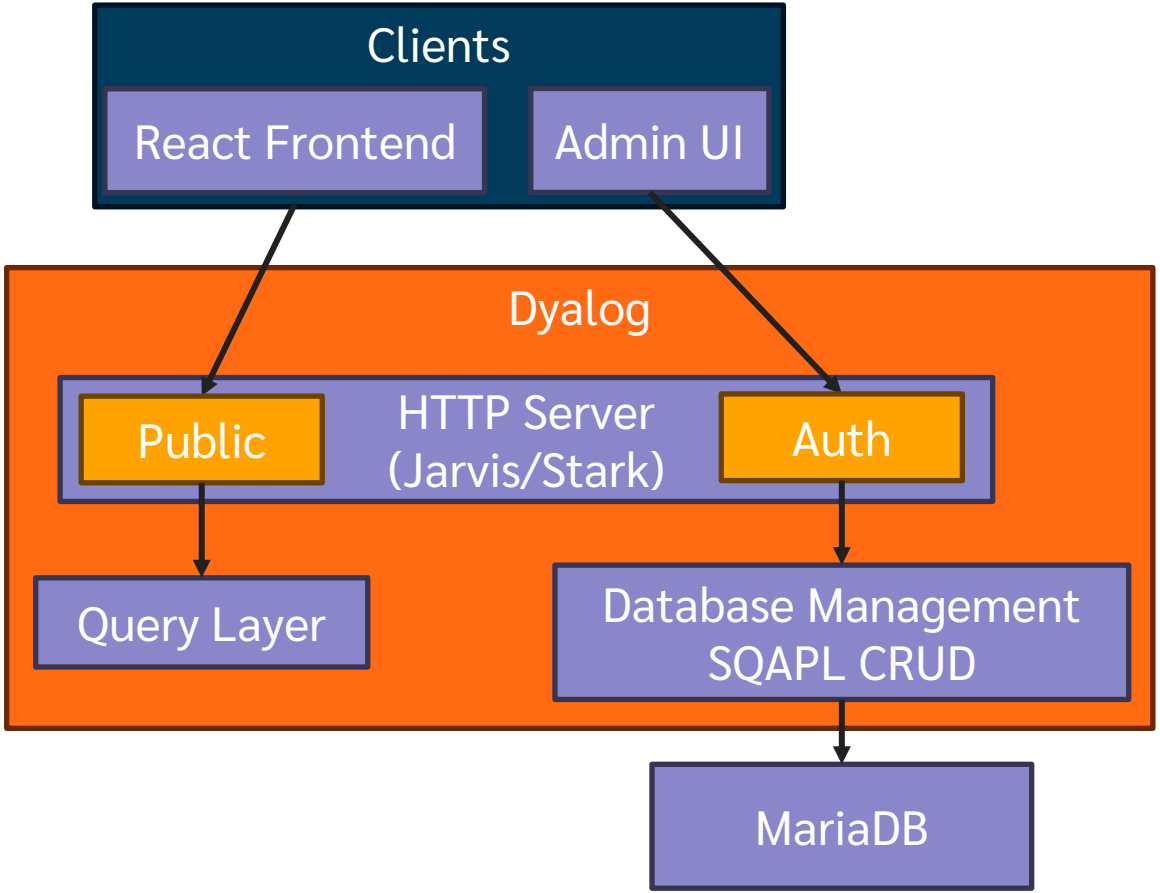
Isolates

```
#.⎕CY'isolate'
II←#.II ⋄ Values←#.isolate.Values


vids←CACHE.videos

data←vids.index_cols⌷⍨⊂vids.fields⍳⊆'title' 'description' 'presenter'

recommendations←videos.ComputeRecommendations II data


:If 0=⎕NC'vids.recommendations'
    vids.recommendations←1⍴⍨⍨s,0⌈¯1+s←≠vids.values
:EndIf
```

Meanwhile...

... in the Recommendations endpoint function

```
Values←#.isolate.Values


⍝ Use existing values unless the ComputeRecommended
⍝ isolate has finished processing
vids.recommendations←⊃vids.recommendations Values'##.recommendations'
```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github.com/Dyalog/DCMS

dyalog.com/tools/tools-and-code-libraries.htm