



Technology Overview

FEBRUARY 2023

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HPCC Systems: End to End Data Lake Management



Completely free
open source data
lake solution



Out of the box
capabilities for
consistency and
ease of use



Less coding
and more using (even
though we love to
code)



We are your
one stop
shop for all
your data
integration,
querying and
analytical
needs



Why does HPCC Systems exist?

- ✓ It was NOT developed with the idea of selling the technology to anybody else!
- ✓ It was all created only to solve some of the data-handling problems that we encountered as we were developing our products.
- ✓ HPCC defined is a *distributed data parallel processing* platform.

HPCC Systems Evolution

2001



Original
version of HPCC
Systems
released

2011



Open source Apache
license and code
release to GitHub

Exceeded market-
leading performance
benchmark achieved

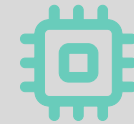
2012 – 16



Continuous
QUALITY-FOCUSED
improvements

Better support and
training with
improved integration
— faster and easier to
use

2017-2022



Improved processing
architecture

IoT enabled

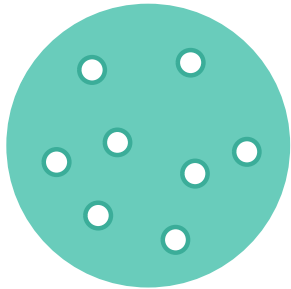
ML Expansion!

Cloud Native!

The Data Centric Approach

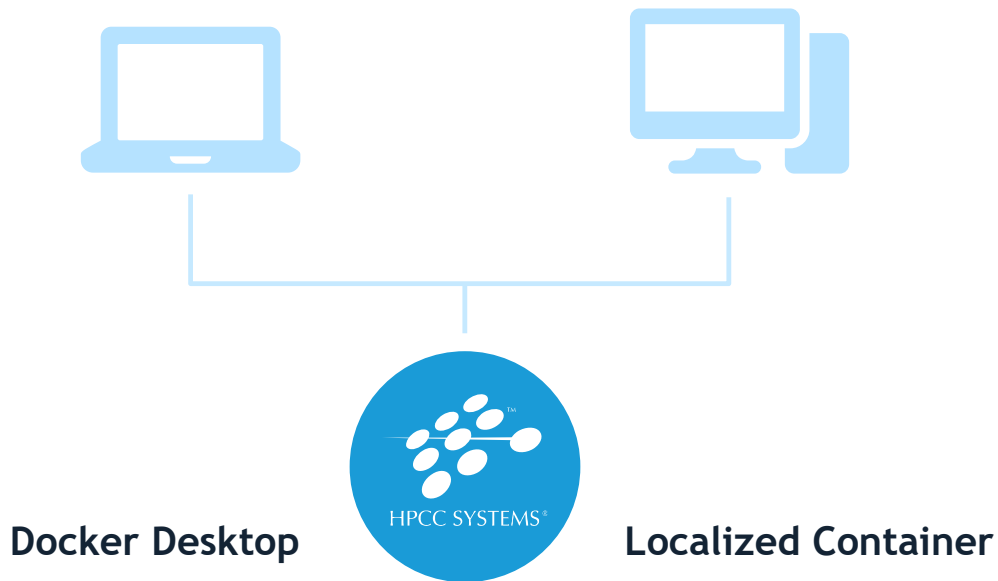
A single source of data is insufficient to overcome inaccuracies

Our platform is built on the premise of absorbing data from **many data sources** and transforming them to **actionable smart data**

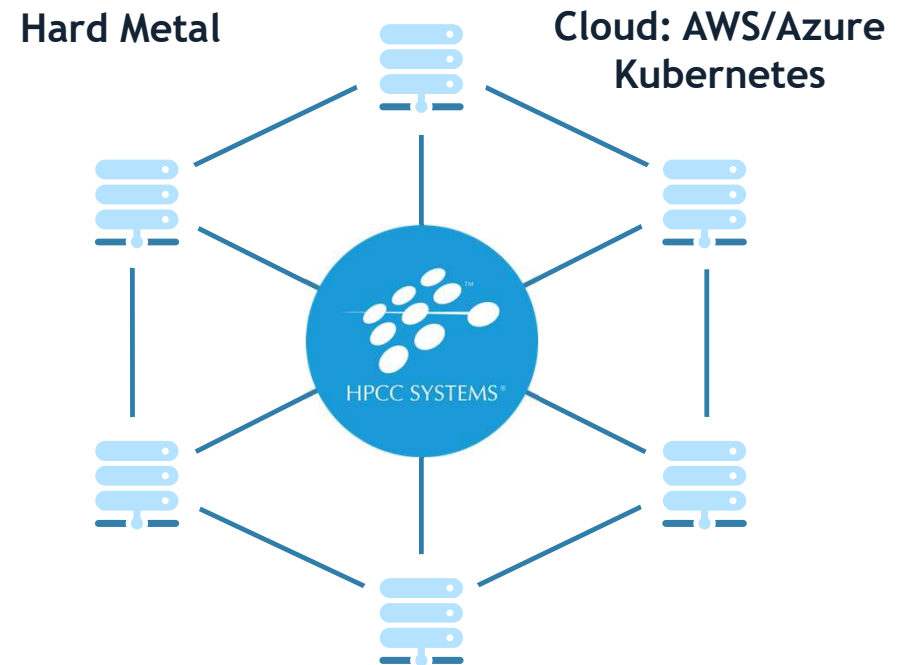


Scale from Small to Big

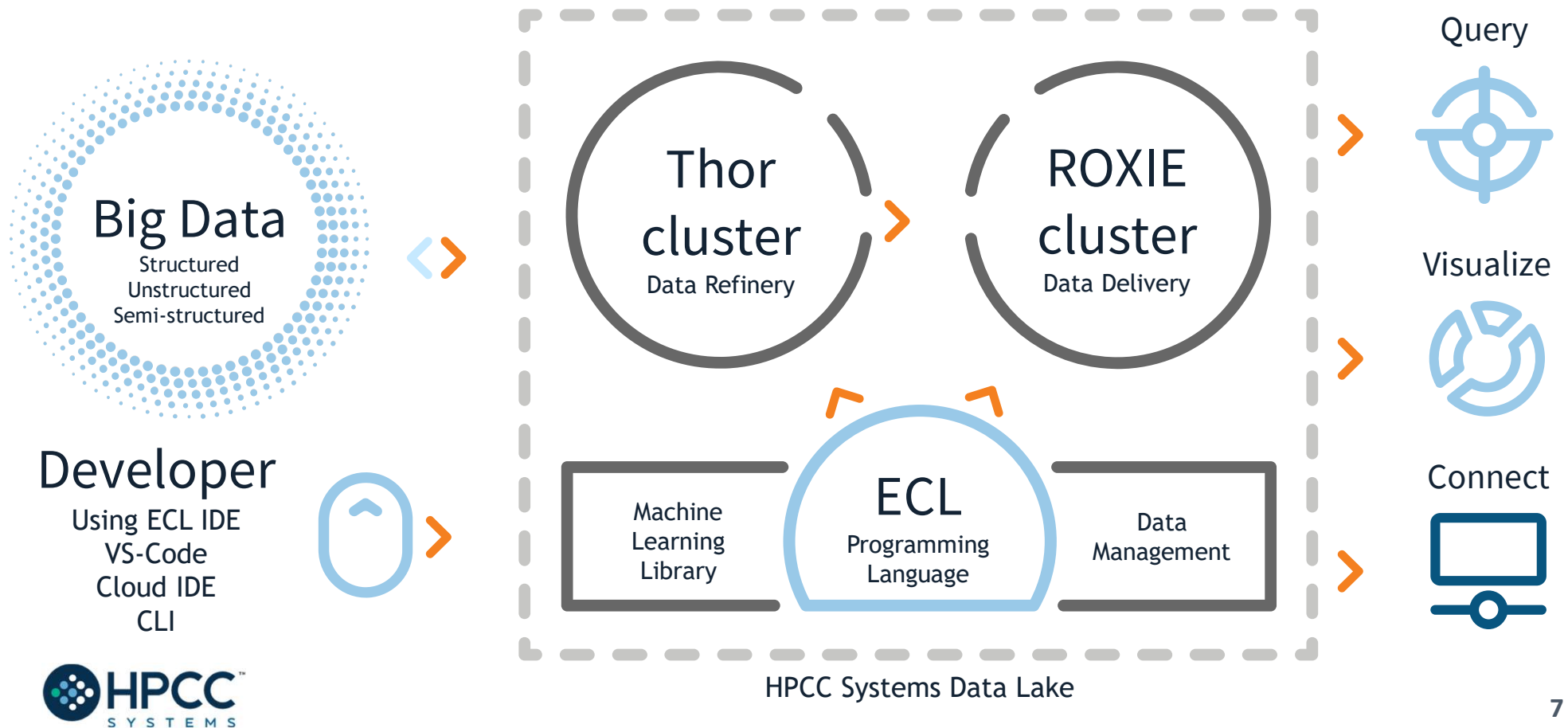
The stack can run on a single laptop or desktop.



In more sophisticated cases, HPCC Systems run *clusters*, hundreds of servers working as a single processing entity, to transform and deliver big data.



The HPCC Systems Components



Technology – The Open Source Stack



Thor: Data Refinery Cluster

Extraction, loading, cleansing, transforming, linking and indexing



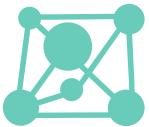
ROXIE: Data Delivery Engine

Rapid data delivery cluster with high-performance online query delivery for big data



Data Management Tools

Data profiling, cleansing, snapshot data updates, consolidation, job scheduling and automation



Machine Learning Library

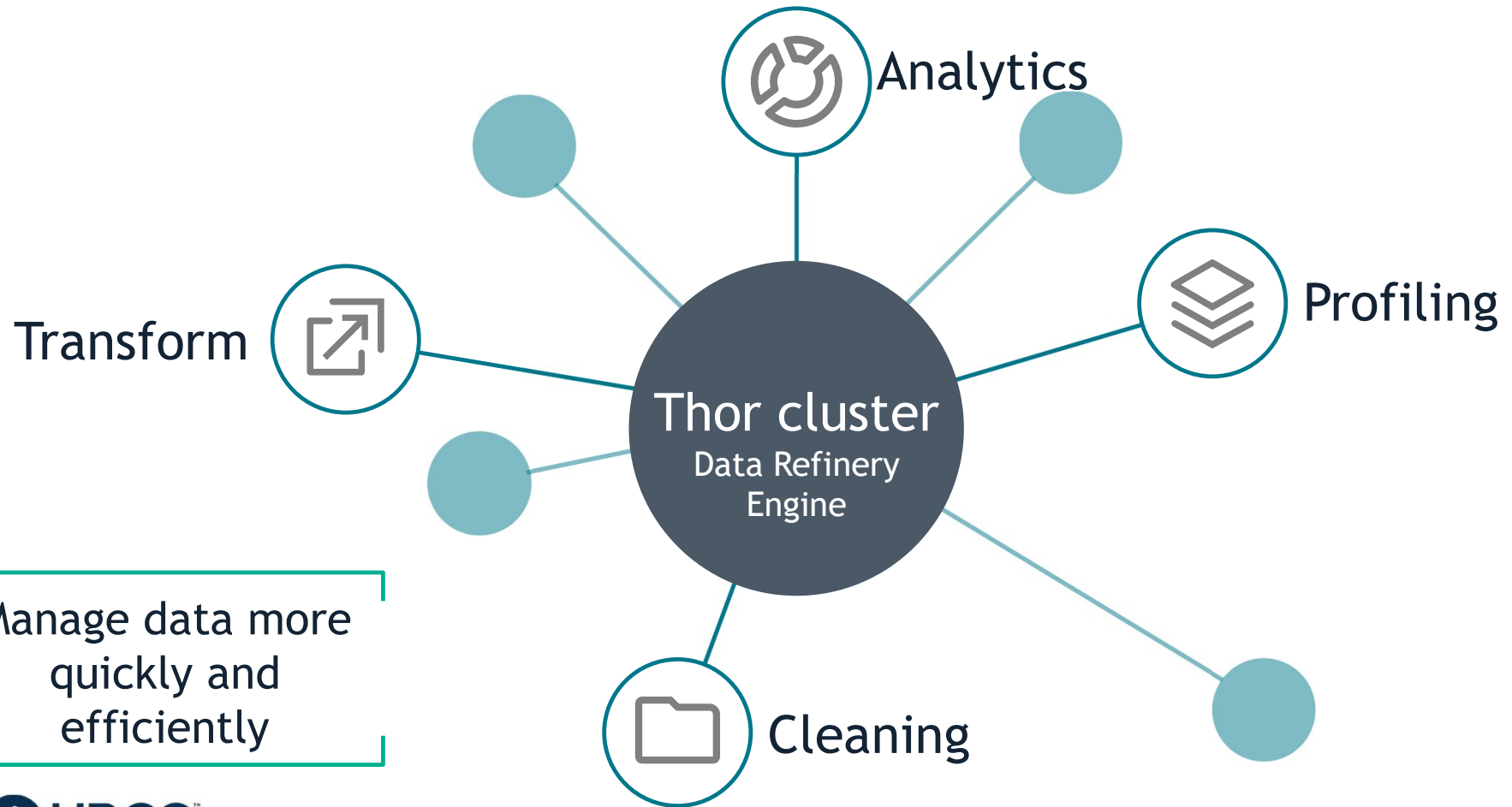
Linear regression, logistic regression, decision trees and random forests



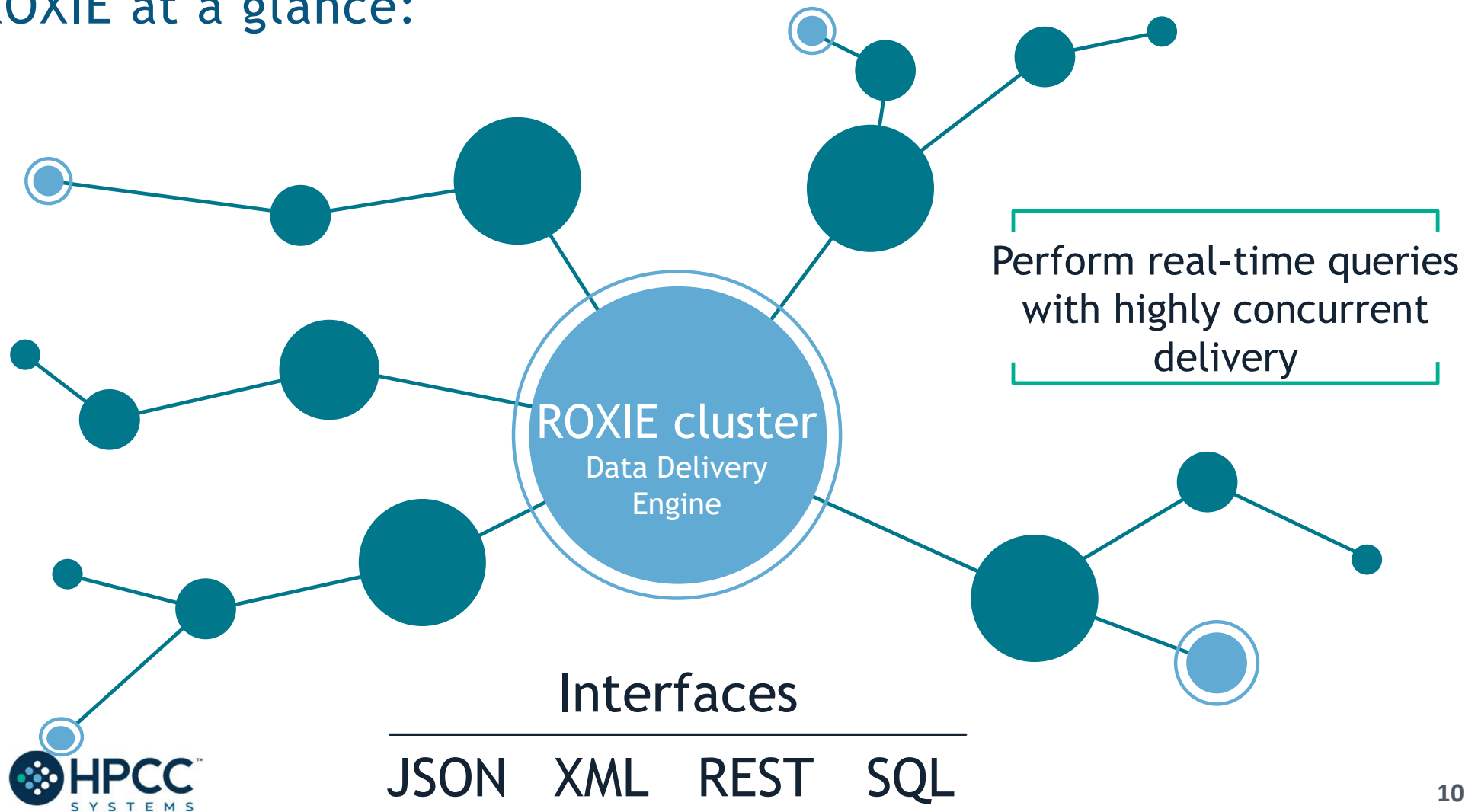
Connectivity & Third-Party Tools

New plugins to help integrate third party tools with the HPCC Systems platform

THOR at a glance:



ROXIE at a glance:



An Introduction to ECL

ECL Enterprise Control Language



```
IMPORT $, STD, ML;
EXPORT Func(UNSIGNED C, UNSIGNED2 Dist, UNSIGNED size, STRING Fld, REAL Parm1=0, REAL Parm2=0, REAL Parm3=0) := MODULE
  SHARED Node := STD.system.Thorlib.Node()+1;
  SHARED PersistPrefix := $.Parms.PersistPrefix;
  SHARED TotalRecs := $.Parms.RecCnt*CLUSTER_SIZE;
  SHARED UIDval := IF(C=1, node, node + ((C-1)*CLUSTER_SIZE));
  SHARED BOOLEAN IsRandFile := $.Parms.Randomness = $.ut.RandomSrc.file;
  SHARED Normal := FUNCTION
    Thisdist := IF(Parm3=0,
      ML.Distribution.Normal(Parm1, Parm2),
      ML.Distribution.Normal(Parm1, Parm2, Parm3));
    RetVals := ML.Distribution.GenData(TotalRecs, Thisdist, 1) : PERSIST(PersistPrefix + 'NormalDistInt' + Fld, EXPIRE(1));
    RETURN RetVals;
  END;
  SHARED Normal2 := FUNCTION
    Thisdist := IF(Parm3=0,
      ML.Distribution.Normal2(Parm1, Parm2),
      ML.Distribution.Normal2(Parm1, Parm2, Parm3));
    RetVals := ML.Distribution.GenData(TotalRecs, Thisdist, 1) : PERSIST(PersistPrefix + 'Normal2DistInt' + Fld, EXPIRE(1));
    RETURN RetVals;
  END;
  SHARED Uniform := FUNCTION
    Thisdist := IF(Parm3=0,
      ML.Distribution.Uniform(Parm1, Parm2),
      ML.Distribution.Uniform(Parm1, Parm2, Parm3));
    RetVals := ML.Distribution.GenData(TotalRecs, Thisdist, 1) : PERSIST(PersistPrefix + 'UniformDistInt' + Fld, EXPIRE(1));
    RETURN RetVals;
  END;
  SHARED StudentT := FUNCTION
    Thisdist := ML.Distribution.StudentT(Parm1, Parm2);
    RetVals := ML.Distribution.GenData(TotalRecs, Thisdist, 1) : PERSIST(PersistPrefix + 'StudentTDistInt' + Fld, EXPIRE(1));
    RETURN RetVals;
  END;
END;
```



- Transparent and implicitly parallel programming language
- Both powerful and flexible

- Optimized for data-intensive operations, declarative, non-procedural and dataflow oriented
- Uses intuitive syntax which is modular, reusable, extensible and highly productive

How to do
it



vs.



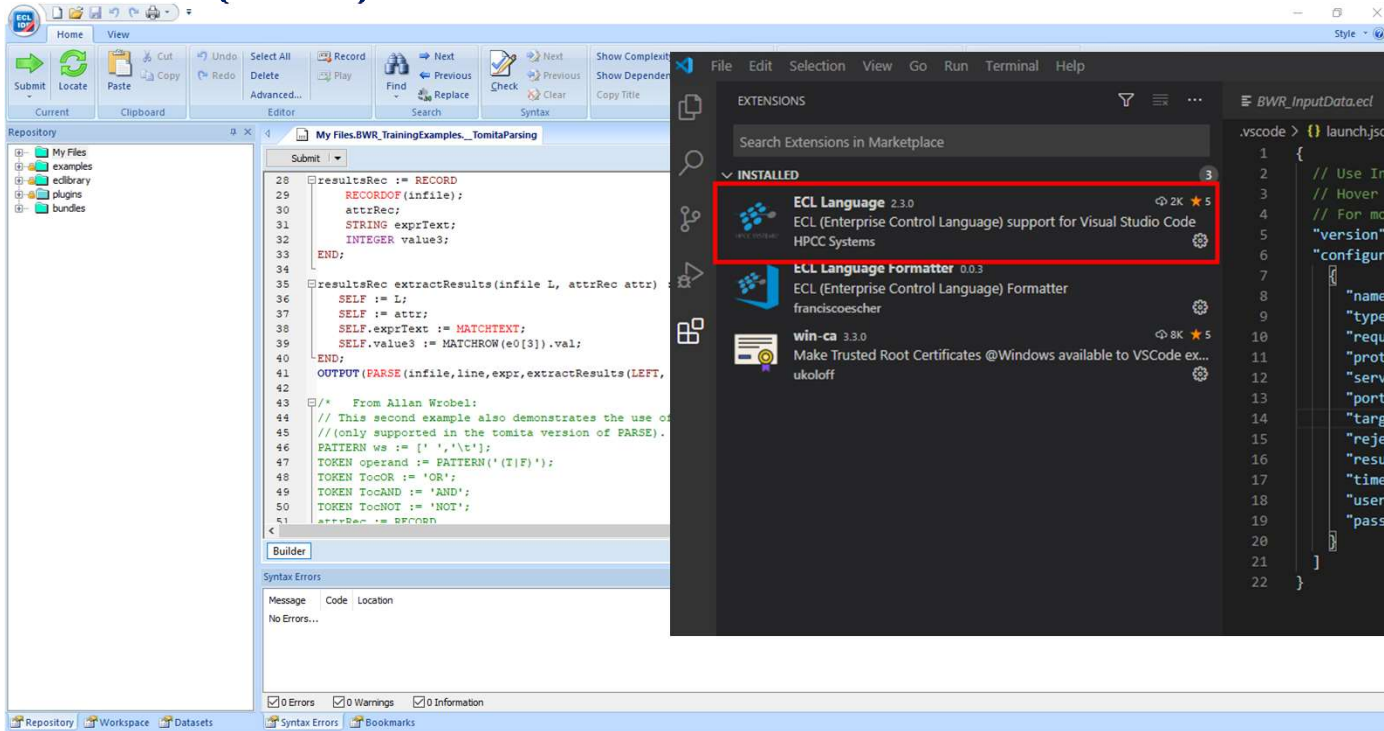
What to
do



Integrated Development Environments

ECL IDE (Win)

Visual Studio Code (Ux/MacOS)



And CLI too! ECL.EXE

ECL IDE Features:



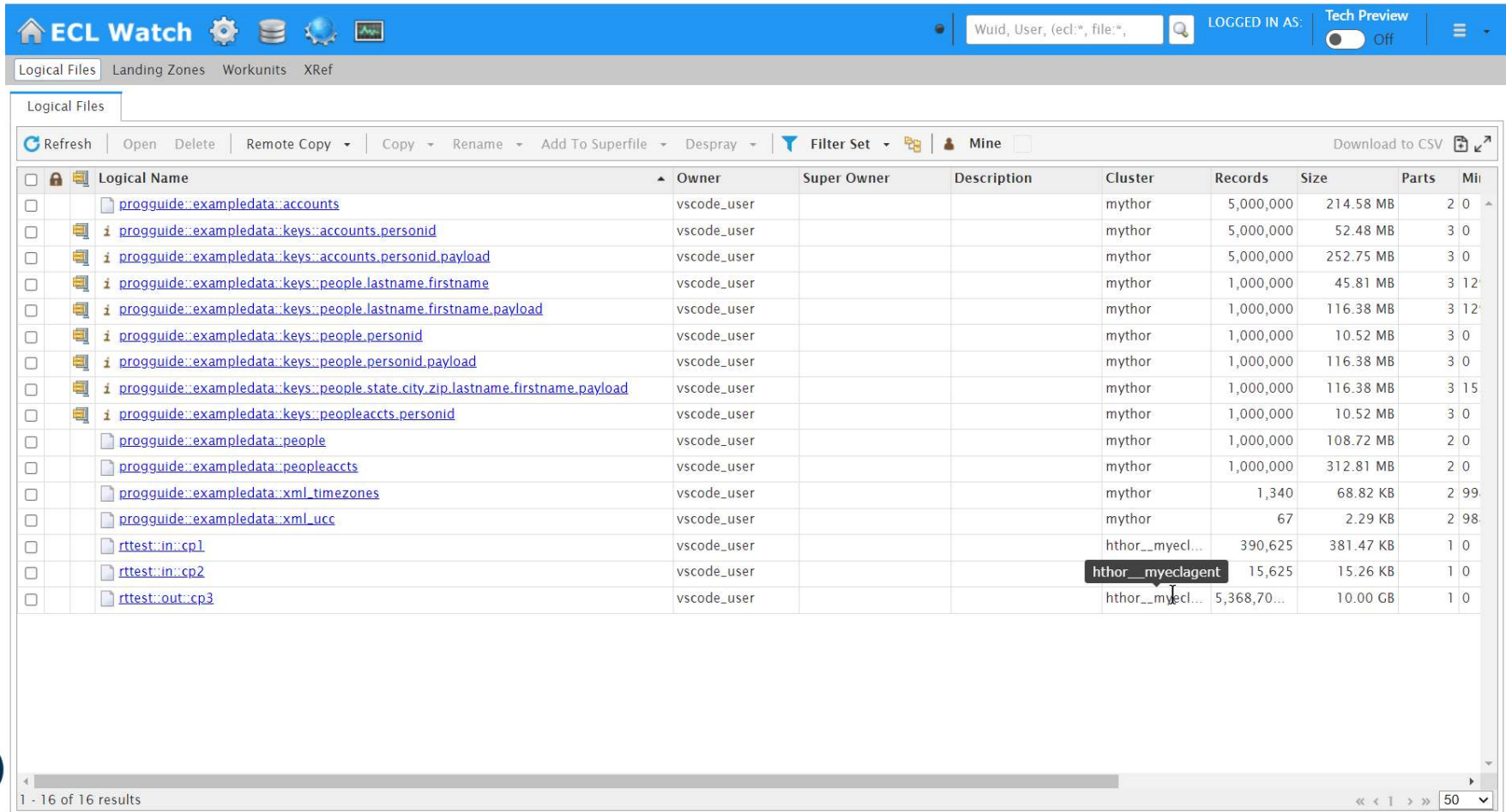
A full-featured GUI for ECL development providing access to the ECL repository and many of the ECL Watch capabilities.

Uses various ESP services via SOAP.

Provides the easiest way to create:

1. Queries into your data.
2. ECL Definitions to build your queries which:
 - Are created by coding an expression that defines how some calculation or record set derivation is to be done.
 - Once defined, can be used in succeeding ECL definitions.

The ECL Watch (pre-version 9)



The screenshot displays the ECL Watch application interface. At the top, there is a blue header bar with the ECL Watch logo, navigation icons, a search bar containing 'Wuid, User, (ecl:*, file:*)', and a 'LOGGED IN AS' section with a 'Tech Preview' toggle set to 'Off'. Below the header is a grey navigation bar with tabs for 'Logical Files', 'Landing Zones', 'Workunits', and 'XRef'. The main content area is titled 'Logical Files' and features a toolbar with buttons for 'Refresh', 'Open', 'Delete', 'Remote Copy', 'Copy', 'Rename', 'Add To Superfile', 'Despray', 'Filter Set', 'Mine', and a 'Download to CSV' link. A table lists various logical files with columns for Logical Name, Owner, Super Owner, Description, Cluster, Records, Size, Parts, and Mii. The table contains 16 rows of data, including files like 'progguide::exampledata::accounts' and 'rttest::in::cp1'. A tooltip is visible over the 'hthor__myeclagent' entry in the 'Cluster' column. At the bottom, a status bar shows '1 - 16 of 16 results' and a pagination control set to '50'.

Logical Name	Owner	Super Owner	Description	Cluster	Records	Size	Parts	Mii
progguide::exampledata::accounts	vscode_user			mythor	5,000,000	214.58 MB	2	0
progguide::exampledata::keys::accounts.personid	vscode_user			mythor	5,000,000	52.48 MB	3	0
progguide::exampledata::keys::accounts.personid.payload	vscode_user			mythor	5,000,000	252.75 MB	3	0
progguide::exampledata::keys::people.lastname.firstname	vscode_user			mythor	1,000,000	45.81 MB	3	12
progguide::exampledata::keys::people.lastname.firstname.payload	vscode_user			mythor	1,000,000	116.38 MB	3	12
progguide::exampledata::keys::people.personid	vscode_user			mythor	1,000,000	10.52 MB	3	0
progguide::exampledata::keys::people.personid.payload	vscode_user			mythor	1,000,000	116.38 MB	3	0
progguide::exampledata::keys::people.state.city.zip.lastname.firstname.payload	vscode_user			mythor	1,000,000	116.38 MB	3	15
progguide::exampledata::keys::peopleaccts.personid	vscode_user			mythor	1,000,000	10.52 MB	3	0
progguide::exampledata::people	vscode_user			mythor	1,000,000	108.72 MB	2	0
progguide::exampledata::peopleaccts	vscode_user			mythor	1,000,000	312.81 MB	2	0
progguide::exampledata::xml.timezones	vscode_user			mythor	1,340	68.82 KB	2	99
progguide::exampledata::xml.ucc	vscode_user			mythor	67	2.29 KB	2	98
rttest::in::cp1	vscode_user			hthor__myecl...	390,625	381.47 KB	1	0
rttest::in::cp2	vscode_user			hthor__myeclagent	15,625	15.26 KB	1	0
rttest::out::cp3	vscode_user			hthor__myecl...	5,368,70...	10.00 GB	1	0

The ECL Watch 9

ECL Watch v9

Wuid, User, (ecl:*, file:*, dfu:*, query:*)...

Tech Preview On

Workunits Playground

Refresh Open Delete Set To Failed Abort Protect Unprotect Filter Mine

WUID	Owner	Job Name ↓	Cluster	Roxie Cluster	State	Total Cluster Time	Execution Cost	File Access Cost
W20220907-165435	siuray01	XTAB_Persons_Gender	thor		completed	5.296	0.00 (USD)	0.00 (USD)
W20220901-153139	Jimi	testme-263372	thor		failed	0.000	0.00 (USD)	0.00 (USD)
W20220906-075140	vscode_user	Step01b	thor		compiled	0.000	0.00 (USD)	0.00 (USD)
W20220906-074606	vscode_user	Step01-215848	thor		failed	0.000	0.00 (USD)	0.00 (USD)
W20220906-074327	vscode_user	Step01	thor		failed	0.000	0.00 (USD)	0.00 (USD)
W20220906-075102	vscode_user	Step01	thor		completed	1:06.111	0.00 (USD)	0.01 (USD)
W20220906-074437	vscode_user	Step01	thor		failed	0.000	0.00 (USD)	0.00 (USD)
W20220906-074723	vscode_user	Step01	thor		failed	0.000	0.00 (USD)	0.00 (USD)
W20220906-074449	vscode_user	Step01	hthor		failed	0.000	0.00 (USD)	0.00 (USD)
W20220912-070601	aaa	PREDICT1	thor		completed	44.480	0.00 (USD)	0.00 (USD)
W20220912-064736	aaa	PREDICT1	thor		completed	21.994	0.00 (USD)	0.00 (USD)
W20220912-132624	aaa	PREDICT1	thor		completed	39.644	0.00 (USD)	0.00 (USD)
W20220906-170731	siuray01	Persons	thor		completed	1.103	0.00 (USD)	0.00 (USD)
W20220902-181153	siuray01	Persons	thor		failed	0.000	0.00 (USD)	0.00 (USD)
W20220902-175740	siuray01	Persons	thor		completed	0.000	0.00 (USD)	0.00 (USD)
W20220902-181411	siuray01	Persons	thor		failed	0.000	0.00 (USD)	0.00 (USD)

1 - 25 of 632 Rows

1 2 3 4 5 25

ECL Watch Features:

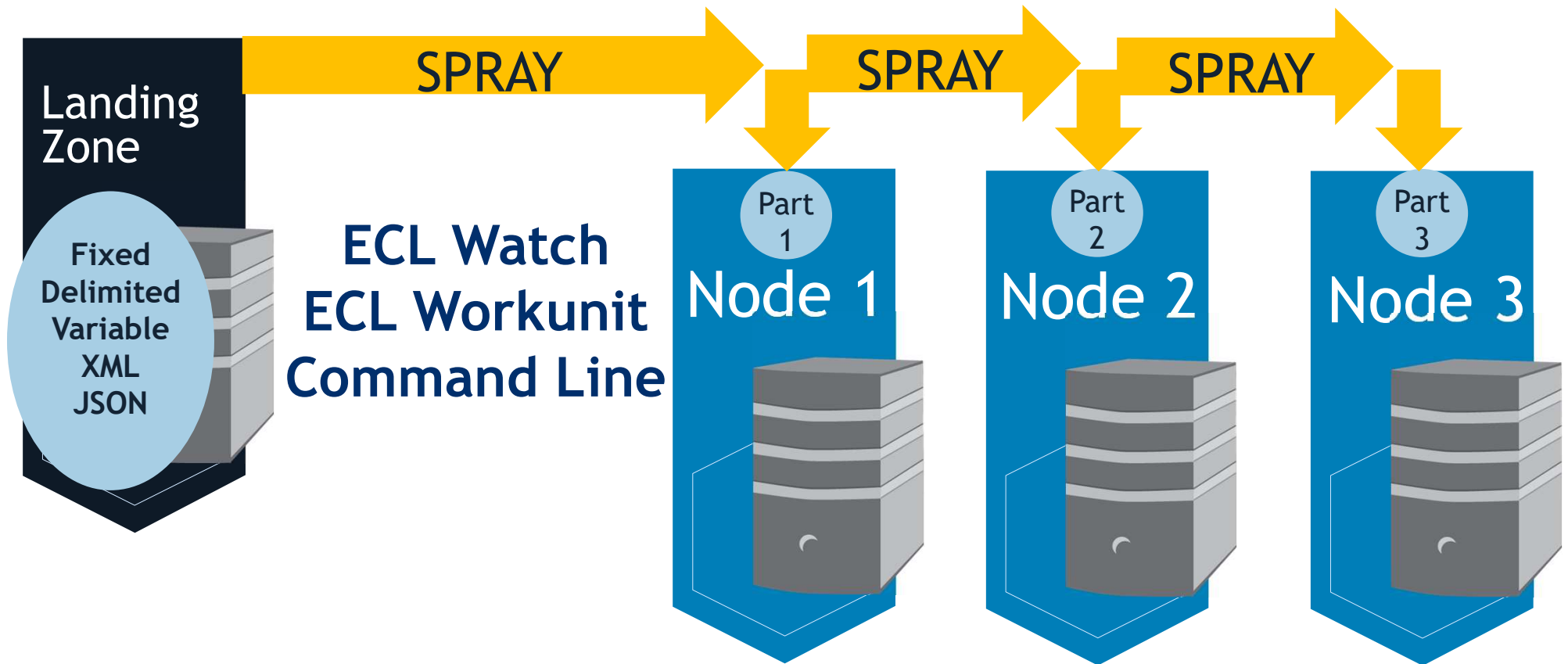
A web-based query execution, monitoring and file management interface. It can be accessed via ECL IDE or a web browser.

ECL Watch allows you to:

1. See information about active workunits.
2. Monitor cluster activity.
3. Browse through previously submitted Workunits.
4. See a visual representation of the data flow within the WU, complete with statistics which are updated as the job progresses.
5. Search through files and see information including:
 - Record counts and layouts.
 - Sample records.
 - The status of all system servers whether they are in clusters or not.
6. View log files.
7. Start and stop processes.



SPRAY Operation





ECL Overview

FEBRUARY 2023

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LexisNexis Risk Solutions

ECL (Enterprise Control Language)

ECL is a language design to query/manipulate massive data and is used for ETL (Extract, Transform, Load) and data visualization.

Extract

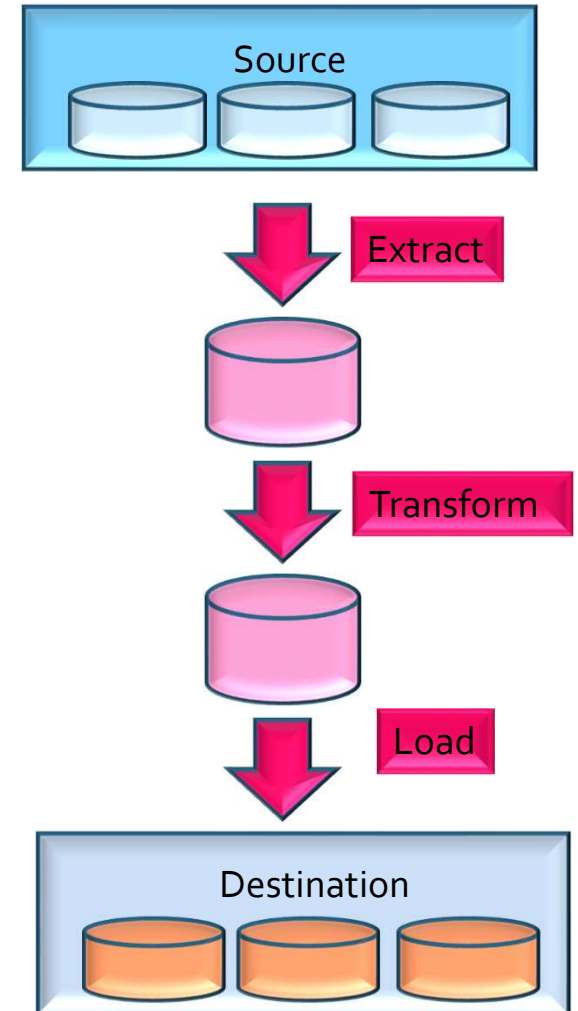
Reading data from different type of datasets

Transform

Formatting/converting data to needed shape

Load

Writing (Delivering) dataset to its target location



Fundamentals of ECL

- ✓ Declarative Language
- ✓ **Not** case-sensitive
- ✓ White space is ignored (Makes your code more readable)
`// This is a single line comment`
`/* A block comment */`
- ✓ Object.Property syntax is used to qualify definition scope and disambiguate field references within datasets:
- ✓ `ModuleName.Definition` //reference a definition from another module/folder
- ✓ `Dataset.Field` //reference a field in a dataset or record set

Fundamentals of ECL (Continued)

- ✓ Definition assignment is `:=`
- ✓ Semicolon terminator: `num := 12;`
- ✓ Equality test is `=` `valOne = valTwo`
- ✓ Not equal: Use `<>` or `!=`
- ✓ Definitions can be defined only once.
- ✓ Only those definitions that contribute to a result are compiled and used.
- ✓ There are no loops. `TRANSFORM` and `PROJECT` is used instead.

Common Data Types

Character

- STRING[n]
- UTF8
- UNICODE[_locale][n]

Numeric

- INTEGER[n]
- UNSIGNED[n]
- REAL[n]
- DECIMAL<n>[_y]
- UDECIMAL<n>[_y]

Other

- BOOLEAN
- SET OF <type>
- RECORD
- DATASET

Usage:

Type Name := default value

Name must start with a letter and can contain letters, numbers and the underscore character

Record Structure

Defines the layout of fields in the dataset, order of the fields should be the same as the dataset.

Dataset

A physical data file. It can be defined in code (inline) or can be read from disk.

Job	Catergory	City	State	Avg_Salary
Manager	IT	Atlanta	GA	87000
Director	Art	Atlanta	GA	100000
CIO	IT	Tampa	FL	112000
Sales	General	Chicago	IL	55000

RECORD Structure Example:

```
EXPORT Layout_Company := RECORD  
  UNSIGNED  sic_code;  
  STRING1   source;  
  STRING120 company_name;  
  STRING10  prim_range;  
  STRING2   predir;  
  STRING28  prim_name;  
  STRING4   addr_suffix;  
  STRING2   postdir;  
  STRING5   unit_desig;  
  STRING8   sec_range;  
  STRING25  city;  
  STRING2   state;  
  STRING5   zip;  
  STRING4   zip4;  
  STRING10  phone;  
END;
```


DATASET

```
name := DATASET( file, recorddef, THOR [options]);  
name := DATASET( file, recorddef, CSV [ ( options ) ] );  
name := DATASET( file, recorddef, XML( path, [options] ) );  
name := DATASET( file, recorddef, JSON( path, [options] ) );
```

- ✓ *name* - The definition name by which the file is subsequently referenced.
- ✓ *file* - A string constant containing the logical filename.
- ✓ *recorddef* - The RECORD structure of the dataset.
- ✓ *options* - options specific to the dataset type.
- ✓ *path* - A string constant containing the full XPATH to the tag that delimits the records in the *file*
- ✓ *command* - third-party program that creates the dataset.

DATASET introduces a new data file into the system with the specified *recorddef* layout.

RECORDOF

RECORDOF(*recordset*)

- *recordset* – The set of data records whose RECORD structure to use. This may be a DATASET or any derived recordset.

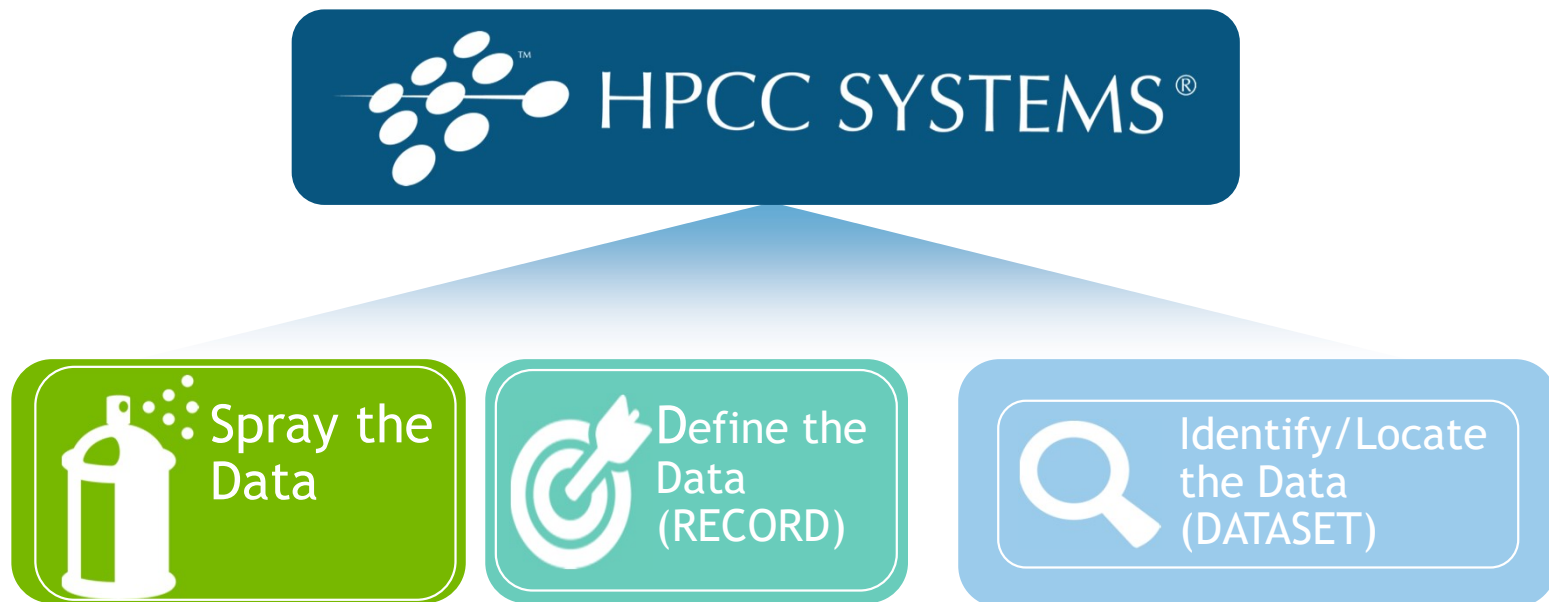
The **RECORDOF** declaration specifies inheriting just the record layout (without default values) of the specified *recordset*.

```
t := TABLE(People,{LastName,FirstName});
```

```
r := RECORD  
RECORDOF(t);  
UNSIGNED1 NewByte;  
END;
```

Three ECL Data Rules

Before you begin to work on any data in the HPCC cluster, you must always do three things:



RECORD and DATASET example

Layout_Company := RECORD

```
UNSIGNED    sic_code;  
STRING120   company_name;  
STRING10    prim_range;  
STRING2     predir;  
STRING28    prim_name;  
STRING4     addr_suffix;  
STRING2     postdir;  
STRING5     unit_desig;  
STRING8     sec_range;  
STRING25    city;  
STRING2     state;  
STRING5     zip;  
STRING4     zip4;  
END;
```

```
EXPORT File_Company_List := DATASET('~CLASS::Company_List', Layout_Company, THOR);
```

Inline Dataset

```
SalaryAvg_Layout := RECORD
  STRING Job;
  STRING Category;
  STRING City;
  STRING2 State;
  INTEGER Avg_Salary;
END;

// Inline Dataset
SalaryAvg_DS := DATASET([
  {'Manager', 'IT', 'Atlanta', 'GA', 87000},
  {'Director', 'Art', 'Atlanta', 'GA', 100000},
  {'CIO', 'IT', 'Tampa', 'FL', 112000},
  {'Sales', 'General', 'Chicago', 'IL', 55000}
], SalaryAvg_Layout //Layout definition
);
```

OUTPUT

Let's display the result.

Job	Catergory	City	State	Avg_Salary
Manager	IT	Atlanta	GA	87000
Director	Art	Atlanta	GA	100000
CIO	IT	Tampa	FL	112000
Sales	General	Chicago	IL	55000

CHOOSEEN

Returns the first n number of records.

```
// A simple output
OUTPUT(SalaryAvg_DS, NAMED('SalaryAvg_DS'));

//CHOOSEEN
OUTPUT(CHOOSEEN(SalaryAvg_DS, 2), NAMED('SalaryAvg_Choosen'));
```

##	job	category	city	state	avg_salary
1	Manager	IT	Atlanta	GA	87000
2	Director	Art	Atlanta	GA	100000
3	CIO	IT	Tampa	FL	112000
4	Sales	General	Chicago	IL	55000

##	job	category	city	state	avg_salary
1	Manager	IT	Atlanta	GA	87000
2	Director	Art	Atlanta	GA	100000

SORT

Ascending or descending sort

Filter

Choosing a smaller part of dataset. A BOOLEAN expression following any recordset or dataset.

Job	Catergory	City	State	Avg_Salary
Manager	IT	Atlanta	GA	87000
Director	Art	Atlanta	GA	100000
CIO	IT	Tampa	FL	112000
Sales	General	Chicago	IL	55000

```
//Filter
OUTPUT(SalaryAvg_DS(City = 'Tampa'), NAMED('Tampa_Filter'));

//Sort
SortJobs := SORT(SalaryAvg_DS, Job);
OUTPUT(SortJobs, NAMED('SortJobs'));
```

##	job	category	city	state	avg_salary
1	CIO	IT	Tampa	FL	112000

##	job	category	city	state	avg_salary
1	CIO	IT	Tampa	FL	112000
2	Director	Art	Atlanta	GA	100000
3	Manager	IT	Atlanta	GA	87000
4	Sales	General	Chicago	IL	55000

More on Filtering

All records within *dataset* will be evaluated

If *boolean_expression* evaluates to TRUE for a particular record, it will be included in the result

Logical Operators

AND

OR

NOT or ~

```
youngeOrLowIncome := allPeople(age < 20 OR  
                                avgHouseIncome <= 10000);
```

Comparison Operators

$$=$$

<> or !=

^

>

 \leq \geq $\langle = \rangle$

Math Functions

```
MathLayout := RECORD
```

```
  INTEGER Num1;
```

```
  INTEGER Num2;
```

```
  INTEGER Num3;
```

```
END;
```

```
DS := DATASET([ {20,45,34},  
                {909,56,45},  
                {30,-1,90}],  
              MathLayout);
```

Num1	Num2	Num3
20	45	34
909	56	45
30	-1	90

```
COUNT(DS);           //Counts the number records in a dataset -- Returns 3  
MAX(DS, Num1);       //Returns the MAX value on a field in a dataset -- Returns 909  
MIN(DS, Num2);       //Returns the MIN value on a field in a dataset -- Returns -1  
AVE(DS, Num1);       //Returns the AVERAGE value on a field in a dataset -- Returns 319.66666666666667  
SUM(DS, Num1 + Num3); //Returns the result of adding numbers together -- Returns 1128  
TRUNCATE(AVE(DS, Num1)); //Returns the integer portion of the real_value. -- Returns 319  
ROUND(3.45);         //Returns the rounded value -- Return 3  
ROUND(3.76);         //Returns the rounded value -- Return 4
```

CORRELATION

NumOne	NumTwo
1	1
2	2
3	3
4	4
5	5
6	6



```
CORRELATION(ds1, NumOne, NumTwo)
```



Returns 1.0

NumObe	NumTwo
1938960000.00	2044820000.00
1779710000.00	854858000.00
2961810000.00	1248480000.00
2774400000.00	1263570000.00
1144160000.00	434290000.00
3387280000.00	1302380000.00
3195380000.00	1711770000.00



```
CORRELATION(ds2, NumOne, NumTwo)
```



Returns 0.4978702535543908

FUNCTION (ECL Definitions with parameters)

```
EXPORT myfunc (STRING val) := FUNCTION
  Result := 'Hello ' + val + ' , welcome to this function';
  RETURN Result;
END;

//Using myfunc
res := myfunc('Jonny');
OUTPUT(res, NAMED('res'));

OUTPUT(myfunc('Sunny'), NAMED('Sunny'));
```

<u>Sunny</u>	Hello Sunny , welcome to this function
<u>res</u>	Hello Jonny , welcome to this function

One Line Function

```
INTEGER checkMax (SET OF INTEGER numList) := MAX(numList);
OUTPUT(checkMax([2,5,8,10,45,11]), NAMED('checkMath'));
```

MODULE

Is a container that allows you to group related definitions. The *parameters* passed to the module are shared by all the related *members* definitions.

Variable Scope

- Local definitions are visible only up to an EXPORT or SHARED
- SHARED definitions are visible within module.
- EXPORT definitions are visible within and outside of a module .

```

MyMod := MODULE

  // Visible only by MyMod
  SHARED x := 88;
  SHARED y := 42;

  // Visible by MyMod and outsiders
  EXPORT See := 'This is how a module works.';
  EXPORT res := Y * 2;
END;

OUTPUT(MyMod.See);

OUTPUT(MyMod.Res, Named('ViewResult'));

```

Result_5

This is how a module works.

ViewResult

84

TRANSFORM

Specifies exactly how each field in the output record set is to receive its value.

- It should include the result type.
- Should contain name
- Contains parameter list
- SELF: refers to fields in result type.

PROJECT

Processes through all the records in the dataset performing the TRANSFORM.

- LEFT: refers to dataset getting passed to PROJECT.
- COUNTER: Optional counter that counts calls to TRANSFORM

Standalone TRANSFORM

```
Person_Layout := RECORD
  STRING FirstName;
  STRING LastName;
END;

NameDS := DATASET([{'Sun', 'Shine'},
                  {'Blue', 'Sun'},
                  {'Silver', 'Rose'}],
                  Person_Layout);

NameOutRec := RECORD
  STRING FirstName;
  STRING LastName;
  STRING CatValues;
  INTEGER RecCount
END;

NameOutRec CatThem(Person_Layout L, INTEGER C) := TRANSFORM
  SELF.CatValues := L.FirstName + ' ' + L.LastName; //Defines value for new field
  SELF.RecCount := C; // Adding Counter
  SELF := L; // Assign everything with same field name from NameDS
END;

CatRecs := PROJECT(NameDS, // Dataset to loop through
                  CatThem //Transform name
                  (LEFT, //Left dataset which is NameDS
                   COUNTER //Simpler Counter
                  ));

OUTPUT(CatRecs, NAMED('CatRecs'));
```

FirstName	LastName
Sun	Shine
Blue	Moon
Silver	Rose

firstname	lastname	catvalues	reccount
Sun	Shine	Sun Shine	1
Blue	Moon	Blue Moon	2
Silver	Rose	Silver Rose	3

NameOutRec: Result Layout

CatThem: Transform Name

Person_Layout: Input Dataset Layout

L : Reference to Person_Layout fields

SELF: Refers to fields in result dataset

C: Will do the Counting

Inline TRANSFORM

```
Person_Layout := RECORD
  INTEGER PersonalID;
  STRING FirstName;
  STRING LastName;
END;

NameDS := DATASET([{100, 'Jo', 'Smith'},
                  {203, 'Dan', 'Carpenter'},
                  {498, 'Sally', 'Fryman'},
                  {302, 'Silver', 'Rose'}],
                  Person_Layout);

NameOutRec := RECORD
  INTEGER RecCount;
  INTEGER PersonalID;
  STRING PersonName;
  STRING FutureAddress;
END;

CatRecs := PROJECT(NameDS,
  TRANSFORM(NameOutRec,
    SELF.PersonName := LEFT.FirstName + ' ' + LEFT.LastName;
    SELF.RecCount := COUNTER;
    SELF := LEFT;
    SELF := [];
  ));

OUTPUT(CatRecs, NAMED('Inline_CatRecs'));
```

PersonalID	FirstName	LastName
100	Jo	Smith
203	Dan	Carpenter
498	Sally	Fryman
302	Silver	Rose

reccount	personalid	personname	futureaddress
1	100	Jo Smith	
2	203	Dan Carpenter	
3	498	Sally Fryman	
4	302	Silver Rose	

CatRecs: Project Name

NameDS: Input Dataset to loop through

NameOutRec: Result layout

SELF: Refers to fields in result dataset

SELF := LEFT: Assign everything with same field name from NameDS

SELF := []: All un-assigned fields will be set to default values

TABLE (recordsets in memory, cross-tab tool)

```
Pickup_Layout := RECORD
  STRING10 pickup_date;
  DECIMAL8_2 fare;
  DECIMAL8_2 distance;
END;
Pickup_DS := DATASET([{'2015-01-01', 25.10, 5},
                      {'2015-01-01', 40.15, 8},
                      {'2015-01-02', 30.10, 6},
                      {'2015-01-02', 25.15, 4}],
                      Pickup_Layout);

crossTabLayout := RECORD
  Pickup_DS.pickup_date;
  avgFare := AVE(GROUP, Pickup_DS.fare);
  totalFare := SUM(GROUP, Pickup_DS.fare);
END;

crossTabDs := TABLE(Pickup_DS, // Input Dataset
                     crossTabLayout,
                     pickup_date);

OUTPUT(crossTabDs, NAMED('crossTabDs'));
```

pickup_date	fare	distance
2015-01-01	25.1	5
2015-01-01	40.15	8
2015-01-02	30.1	6
2015-01-02	25.15	4

pickup_date	avgfare	totalfare
2015-01-01	32.625	65.25
2015-01-02	27.625	55.25

JOIN

The JOIN function produces a result set based on the intersection of two or more datasets or indexes.

INNER: Only those records that exist in both datasets.

LEFT OUTER: At least one record for every record in the left.

RIGHT OUTER: At least one record for every record in the right.

LEFT ONLY: One record for each left record with no match in the left.

RIGHT ONLY: One record for each left record with no match in the right.

FULL ONLY: One record for each left and right record with no match in the opposite.

EmpDS

EmpID	Name	HireYear
1000	Jack	2014
2000	Blue	2016
3000	Mary	2016
5000	Mart	2000
8000	Cat	2002

JobCatDS

EmpID	Department	Title
1000	IT	developer
2000	Biz	Manager
4000	Fin	accountant
8000	IT	analyst

```
InnerJoin := JOIN(EmpDS, JobCatDS,
    LEFT.EmpID = RIGHT.EmpID,
    TRANSFORM(EmpResult_Layout,
        SELF := LEFT,
        SELF := RIGHT));
```

empid	name	title	department
1000	Jack	developer	IT
2000	Blue	Manager	Biz
8000	Cat	analyst	IT

```
LeftOuterJoin := JOIN(EmpDS, JobCatDS,
    LEFT.EmpID = RIGHT.EmpID,
    TRANSFORM(EmpResult_Layout,
        SELF := LEFT,
        SELF := RIGHT),
    LEFT OUTER);
```

empid	name	title	department
3000	Mary		
5000	Mart		

```
FullOuterJoin := JOIN(EmpDS, JobCatDS,
    LEFT.EmpID = RIGHT.EmpID,
    TRANSFORM(EmpResult_Layout,
        SELF := LEFT,
        SELF := RIGHT),
    FULL OUTER);
```

empid	name	title	department
1000	Jack	developer	IT
2000	Blue	Manager	Biz
3000	Mary		
0		accountant	Fin
5000	Mart		
8000	Cat	analyst	IT

VISUALIZATION (built-ins and an ECL Bundle)

Methods include

- Two-Dimensional
- Multi-Dimensional Methods
- Geospatial
- General

A basic visualization typically requires the following steps:

1. Creation of a suitable dataset.
2. Output the dataset with a suitable name, so that visualization can locate the data.
3. Create (and output) the visualization, referencing the named output from step 2

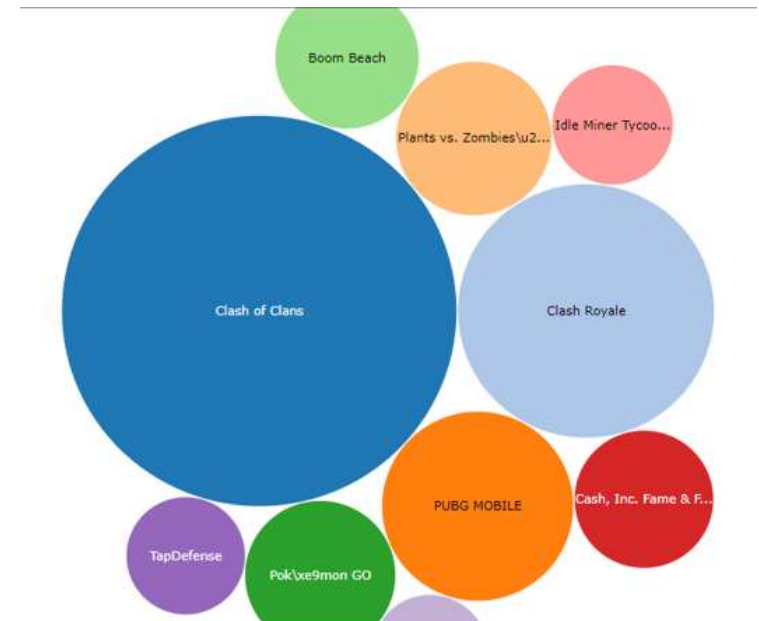
```

top_user_rating_count := TOPN(
    TABLE(clean_mod.games_ds,
        {name,
        user_rating_count}) ,
    10,
    -user_rating_count);

OUTPUT(analysis_mod.top_user_rating_count, NAMED('user_rating_count'));
Visualizer.TwoD.Bubble['user_rating_count',
    /*datasource*/,
    'user_rating_count'];

```

Bubble
 Pie
 Bar
 Scatter
 Line
 WorldCloud
 Area



Useful links!

UGAHacks8 HPCC Systems Wiki Page:

<https://wiki.hpccsystems.com/display/hpcc/University+of+Georgia+UGAHacks8+2023>

Learn ECL Academy

<https://hpccsystems-solutions-lab.github.io>

ECL training containing six short videos

https://www.youtube.com/watch?time_continue=192&v=Lk78BCCtM-0

ECL documentation

http://cdn.hpccsystems.com/releases/CE-Candidate-8.10.12/docs/EN_US/ECLLanguageReference_EN_US-8.10.12-1.pdf

Visualization document

https://cdn.hpccsystems.com/releases/CE-Candidate-8.10.12/docs/EN_US/VisualizingECL_EN_US-8.10.12-1.pdf

Standard Library

https://cdn.hpccsystems.com/releases/CE-Candidate-8.10.12/docs/EN_US/ECLStandardLibraryReference_EN_US-8.10.12-1.pdf

Machine Learning

<https://hpccsystems.com/download/free-modules/machine-learning-library>



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