



Technology Overview



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Welcome to UGAHacksX!

- ✓ Our challenge will use the **HPCC Systems** platform and **ECL** (Enterprise Control Language). This overview gives a detailed look at both!
- ✓ HPCC defined is a *distributed data parallel processing* platform.
High Performance Computing Cluster
- ✓ Contains a THOR cluster where the majority of your coding will be done, and a ROXIE cluster to deliver your results.
- ✓ A proven platform for LexisNexis for over 20 years, and open source since 2011!

HPCC Systems: End to End Data Lake Management



Completely free
open source data
lake solution



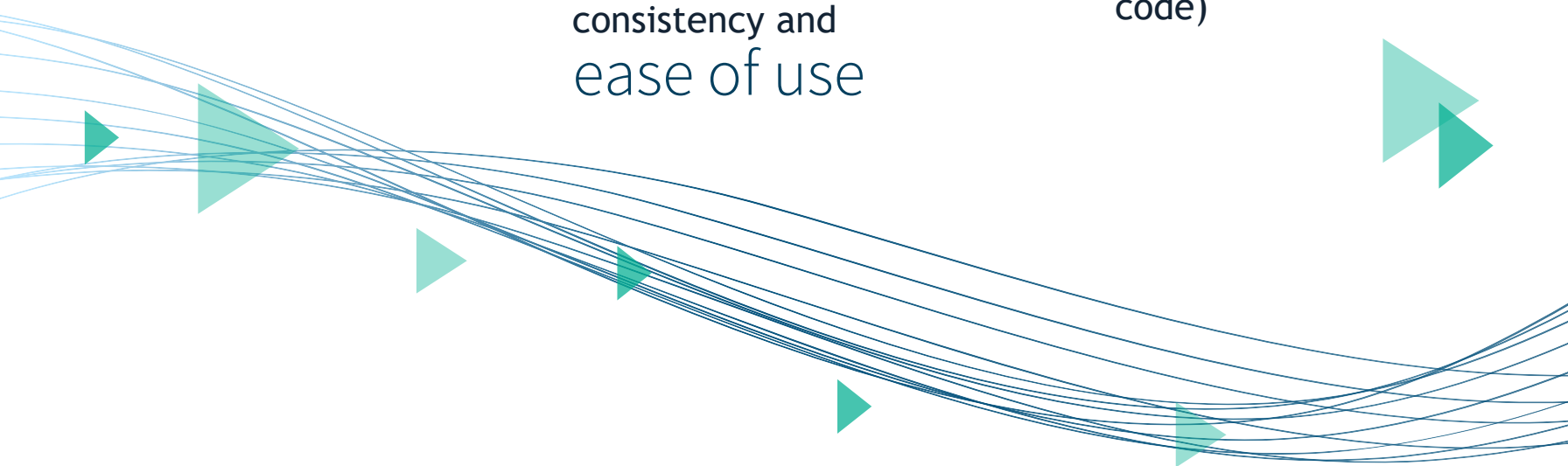
Out of the box
capabilities for
consistency and
ease of use



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



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

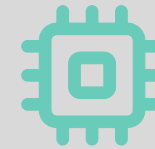
2012 – 16



Continuous
QUALITY-FOCUSED
improvements

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

2017-Present



Improved processing
architecture

IoT enabled

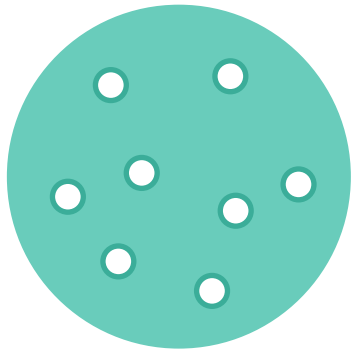
ML Expansion!

Cloud Native!

The Data Centric Approach

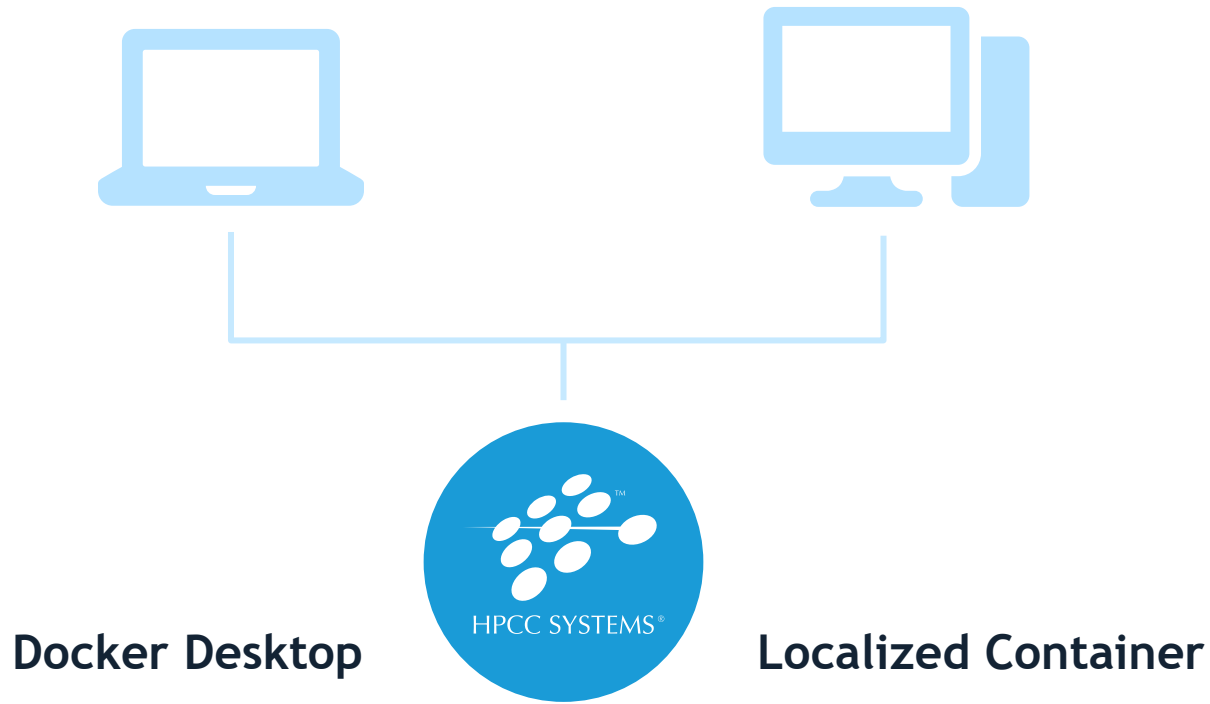
A single source of data is insufficient to overcome inaccuracies

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

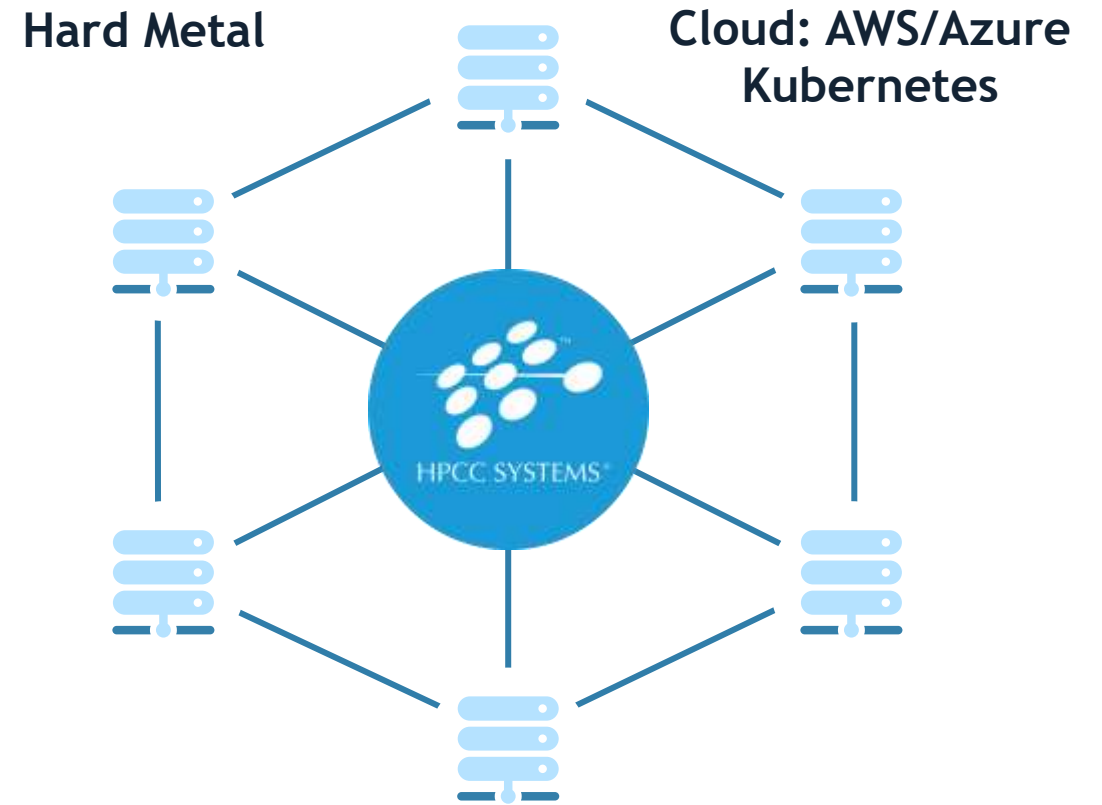


Scale from Small to Big

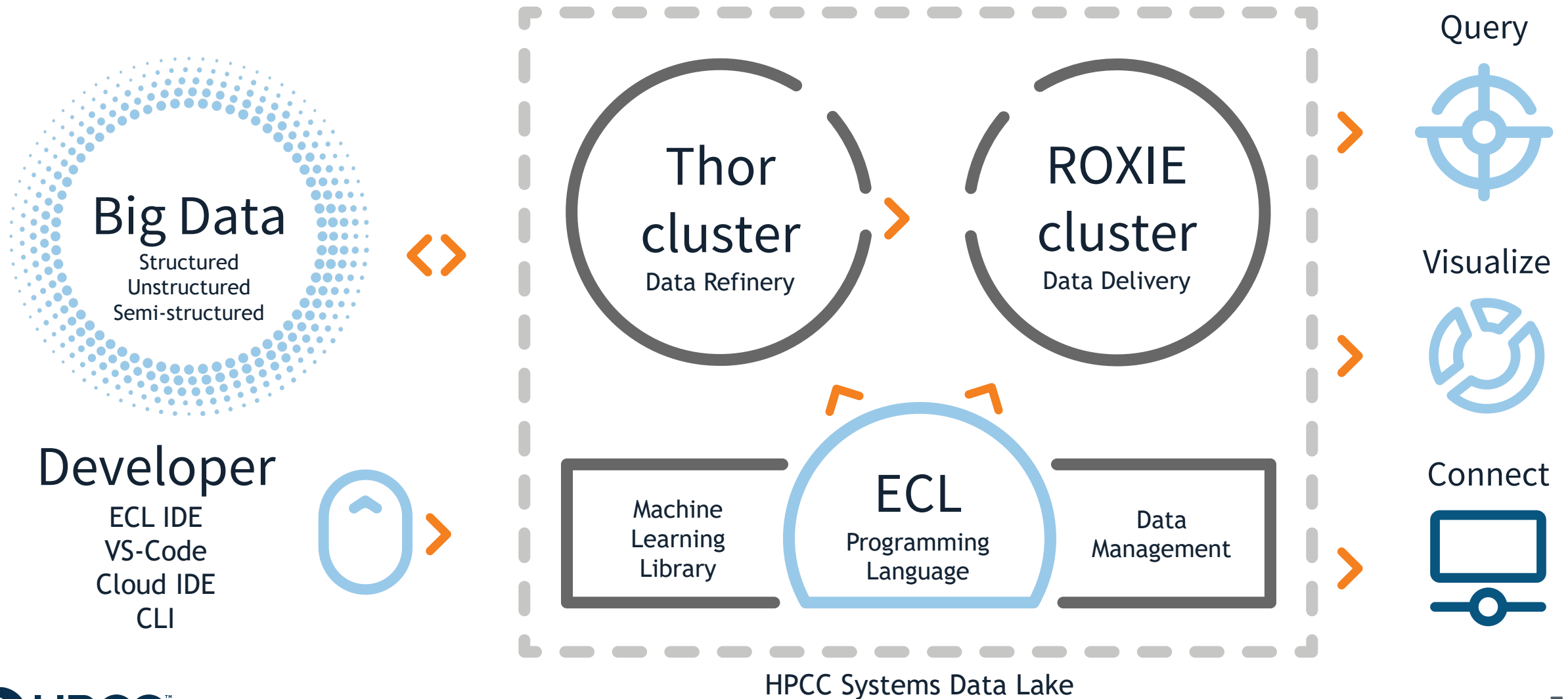
The stack can run on a single laptop or desktop.



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



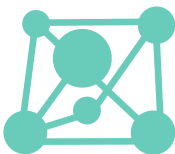
ROXIE: Data Delivery Engine

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

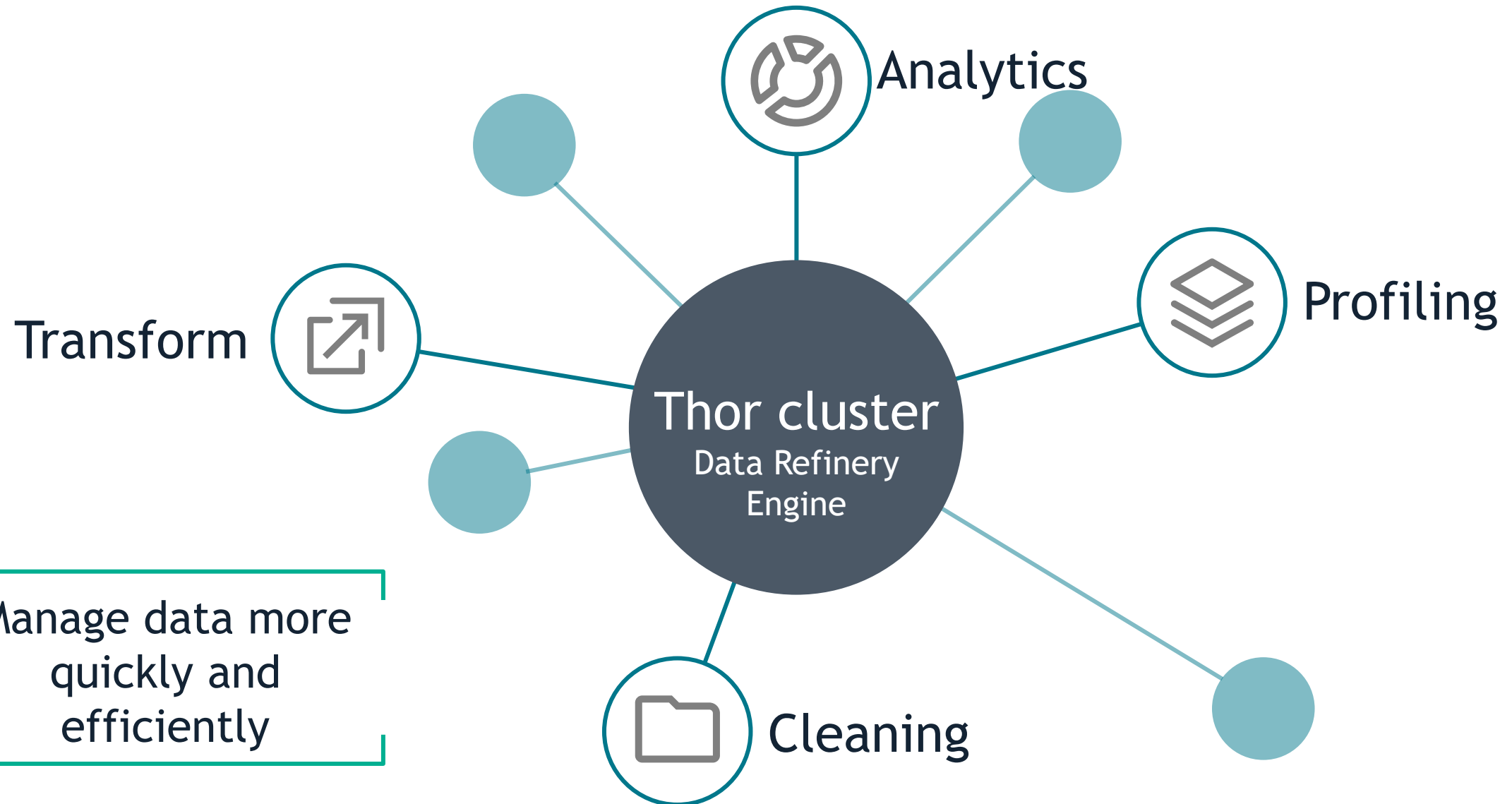
Linear regression, logistic regression, decision trees and random forests



Connectivity & Third-Party Tools

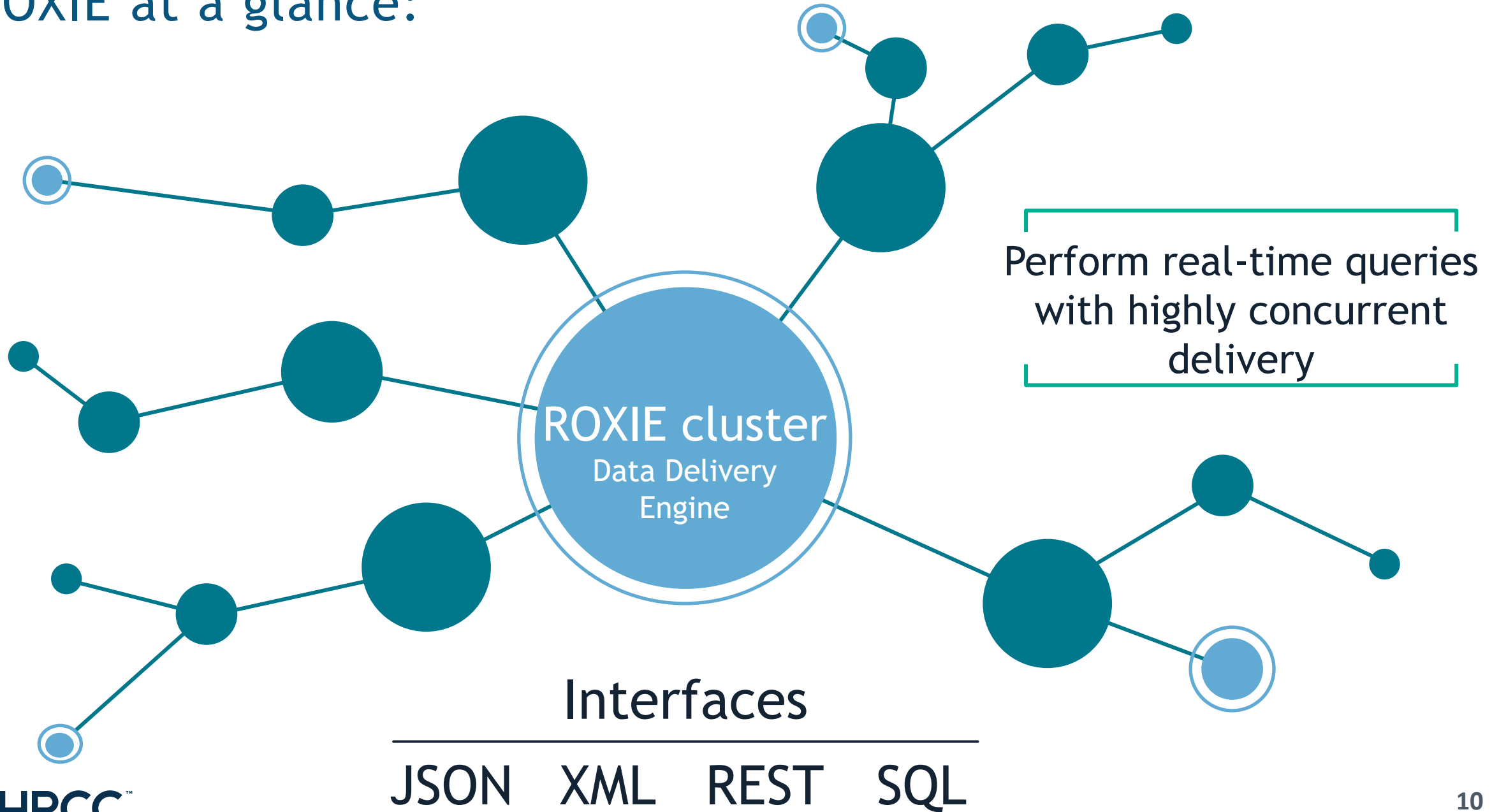
New plugins to help integrate third party tools with the HPCC Systems platform

THOR at a glance:



Manage data more
quickly and
efficiently

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.

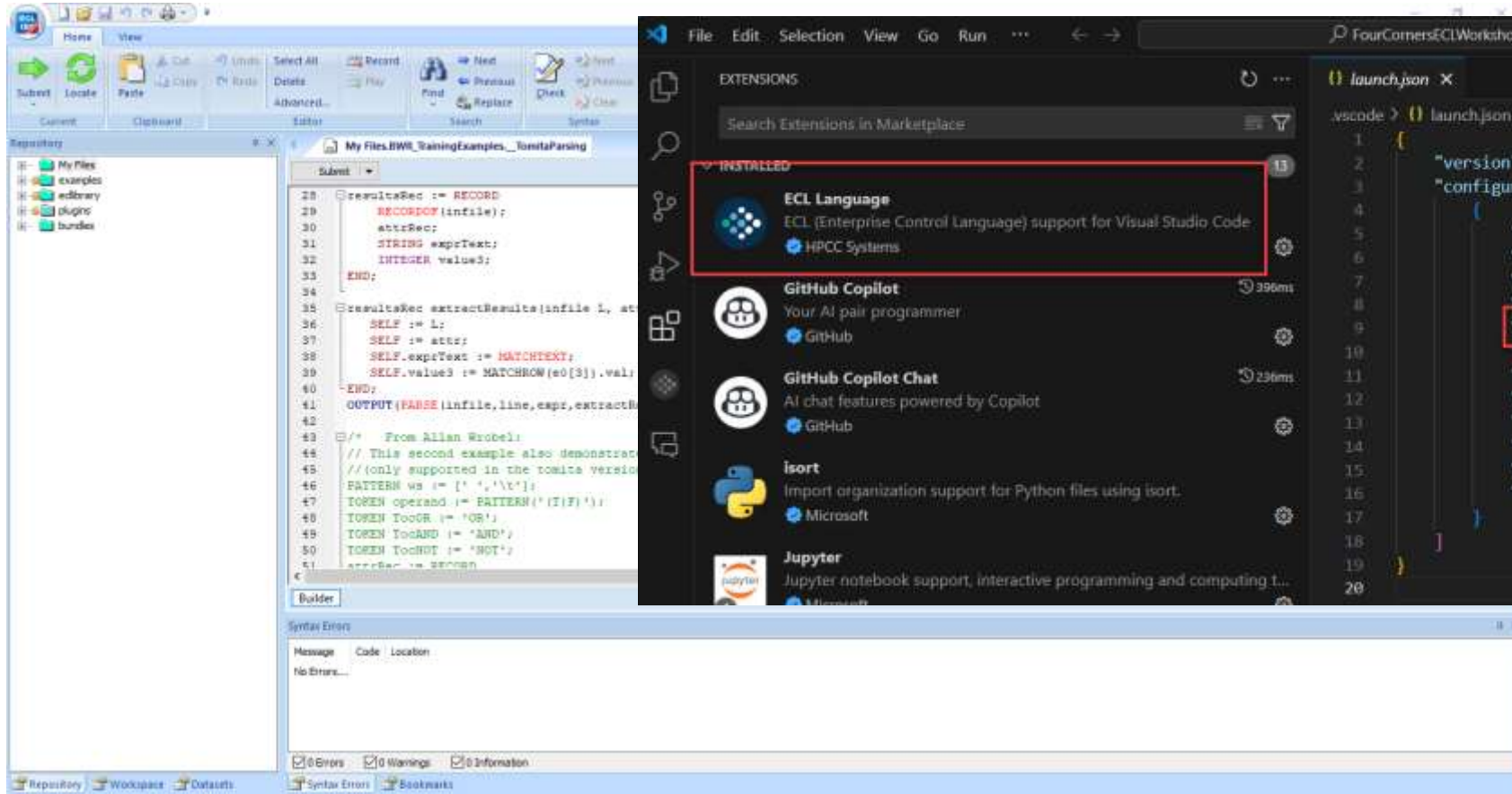


What to do

Integrated Development Environments

ECL IDE (Win)

Visual Studio Code (Ux/MacOS)



And CLI too! ECL.EXE

The Playing Field!

HPCC Cluster ECL Watch:

<http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/>

```
launch.json X
.vscode > {} launch.json > ...
1  {
2    "version": "0.2.0",
3    "configurations": [
4      {
5        "name": "CloudHPCC",
6        "type": "ecl",
7        "request": "launch",
8        "protocol": "http",
9        "serverAddress": "challenge.us-hpccsystems-dev.azure.lnrsg.io",
10       "port": 8010,
11       "targetCluster": "thor",
12       "rejectUnauthorized": false,
13       "resultLimit": 100,
14       "timeoutSecs": 60,
15       "user": "BobF",
16       "password": ""
17     ]
18   }
19 }
20
```

{} launch.json X

Preferences

Configurations: ChallengeCluster

Locate New... Delete

Server Editor Colors Results Compiler Other

Server IP: challenge.us-hpccsystems-dev.azure.lnrsg.io ☐ SSL ☒ Advanced

Topology Server: http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/WsTi

Workunit Server: http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/WsV

Attribute Server:

Account Server: http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/Ws_

SMC Server: http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/WsSI

Spray Server: http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/FileS

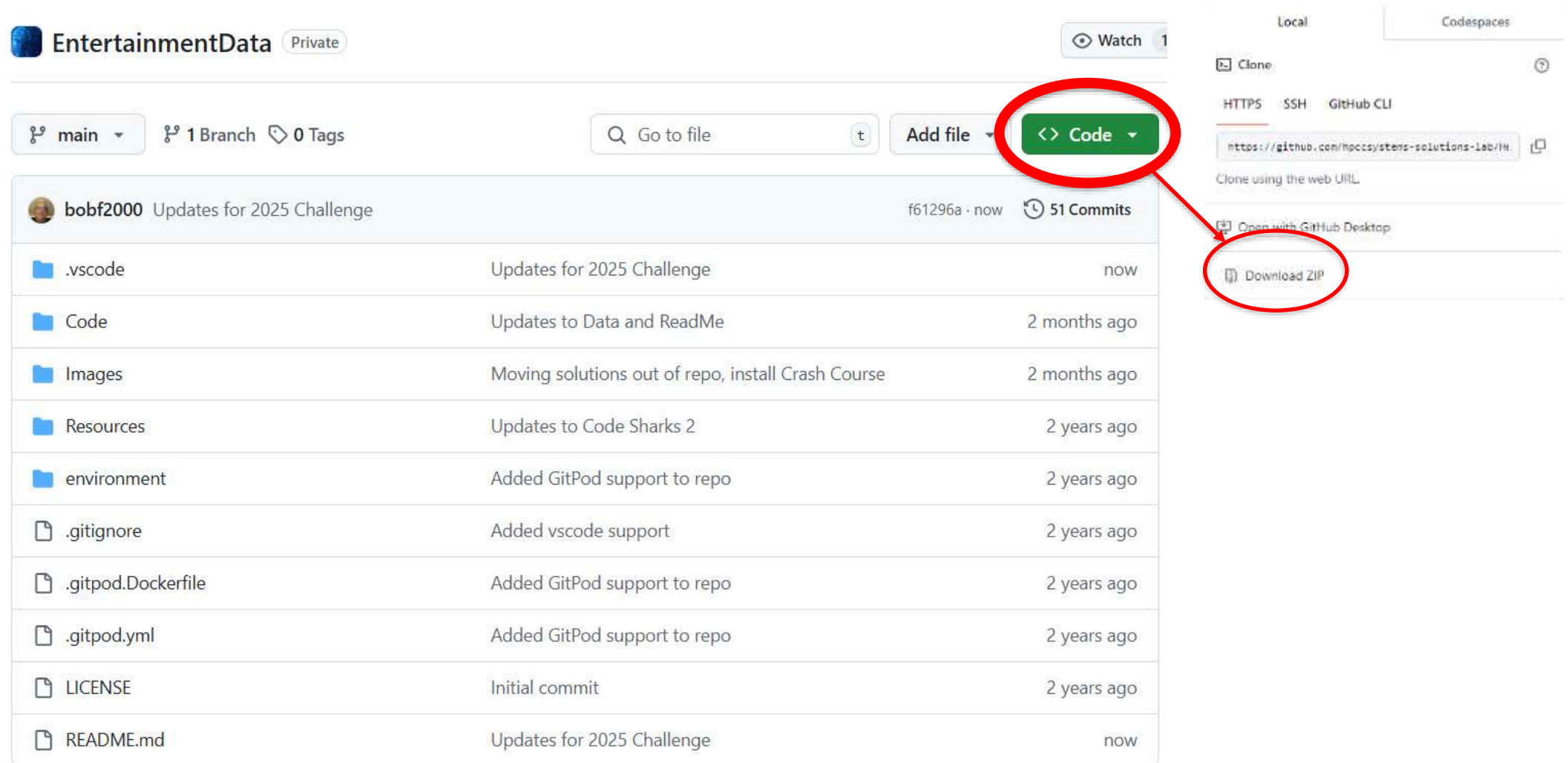
DFU Server: http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/WsD

ECL Watch URL: http://challenge.us-hpccsystems-dev.azure.lnrsg.io:8010/esp/

Ok Cancel Apply

The Repo!

<https://github.com/hpccsystems-solutions-lab/EntertainmentData>



The screenshot shows the GitHub repository page for **EntertainmentData**, which is a private repository. The page includes a 'Watch' button and a 'Code' button. A red circle highlights the 'Code' button, and another red circle highlights the 'Download ZIP' option in the 'Clone' dropdown menu.

The repository is owned by **bobf2000** and has 51 commits. The file list includes:

File/Folder	Commit Message	Time
.vscode	Updates for 2025 Challenge	now
Code	Updates to Data and ReadMe	2 months ago
Images	Moving solutions out of repo, install Crash Course	2 months ago
Resources	Updates to Code Sharks 2	2 years ago
environment	Added GitPod support to repo	2 years ago
.gitignore	Added vscode support	2 years ago
.gitpod.Dockerfile	Added GitPod support to repo	2 years ago
.gitpod.yml	Added GitPod support to repo	2 years ago
LICENSE	Initial commit	2 years ago
README.md	Updates for 2025 Challenge	now

IDE Features:



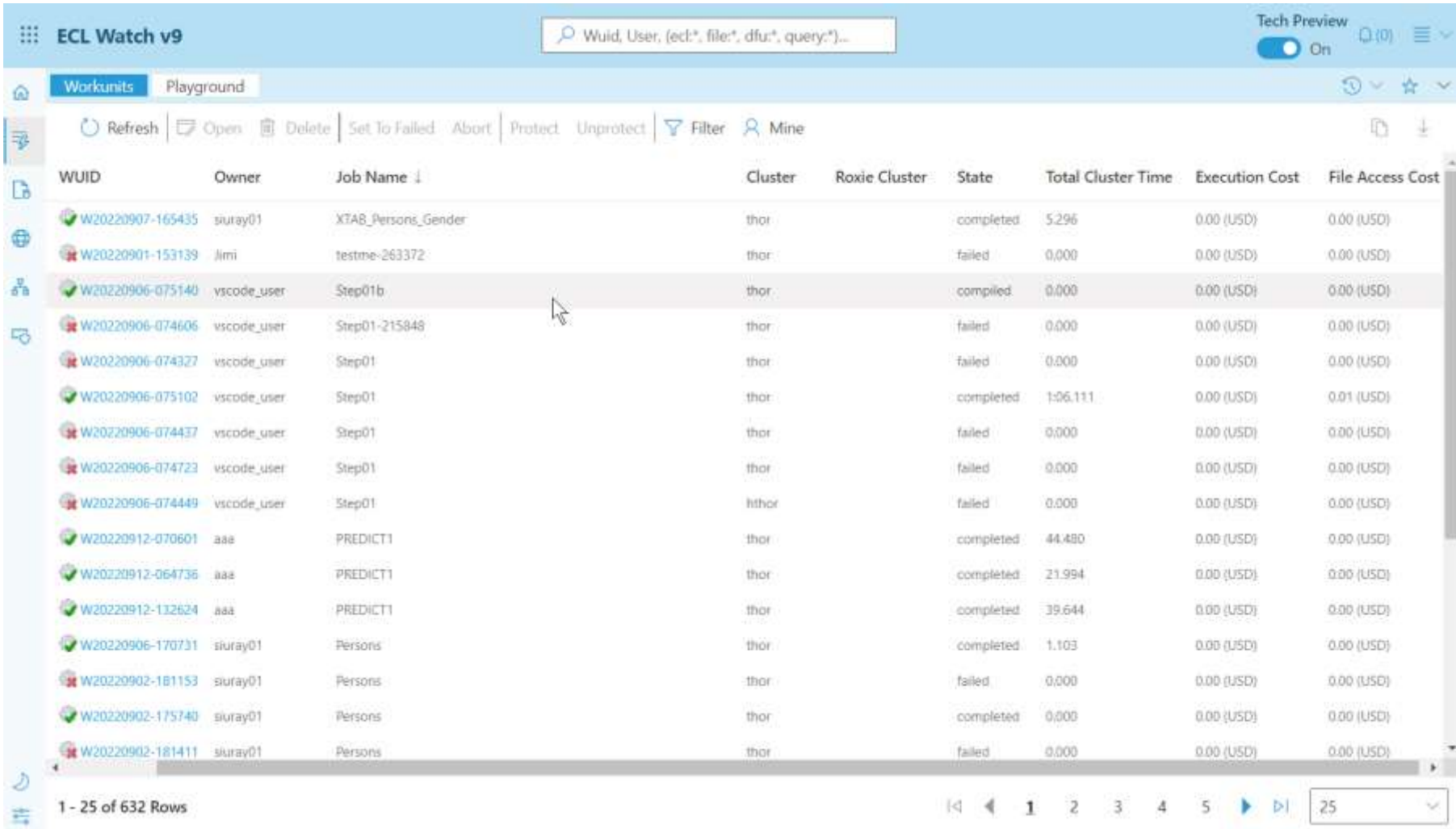
A full-featured GUI for ECL development providing access to the ECL repository and many of the ECL Watch capabilities.

Uses various ESP services via SOAP.

Provides the easiest way to create:

1. Queries into your data, instant results!
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.

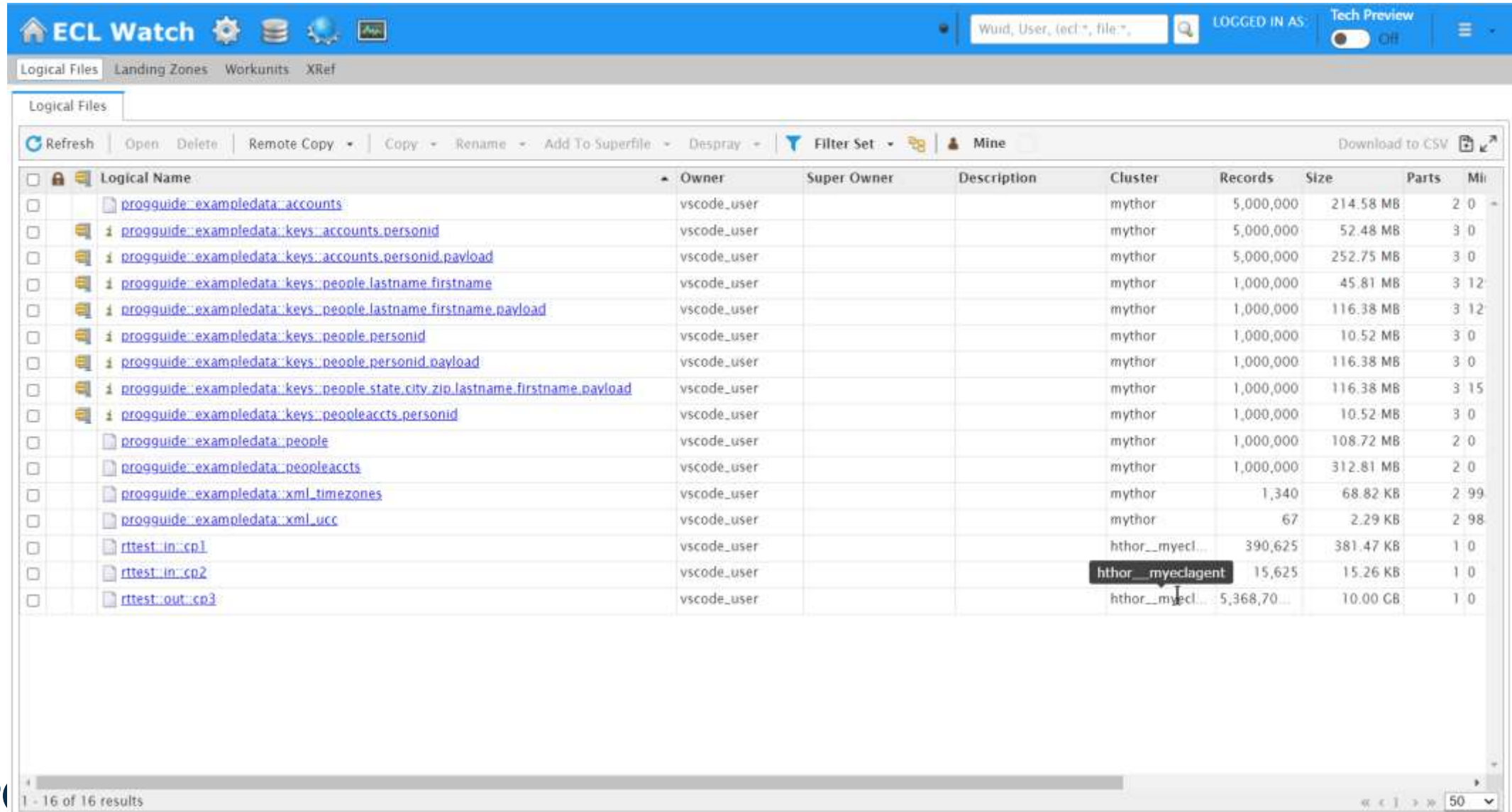
The ECL Watch (Version 9)



The screenshot displays the ECL Watch v9 web interface. At the top, there's a search bar with the placeholder text "Wuid, User, (ect:*, file:*, dfur:*, query:*)...". To the right of the search bar is a "Tech Preview" toggle switch set to "On". Below the search bar, there are tabs for "Workunits" and "Playground". A toolbar contains buttons for "Refresh", "Open", "Delete", "Set To Failed", "Abort", "Protect", "Unprotect", "Filter", and "Mine". The main area is a table with the following columns: WUID, Owner, Job Name, Cluster, Roxie Cluster, State, Total Cluster Time, Execution Cost, and File Access Cost. The table lists 25 rows of workunit data. The status of each workunit is indicated by a green checkmark for "completed" and a red X for "failed". The bottom of the interface shows a pagination bar with "1 - 25 of 632 Rows" and a set of navigation controls including arrows and page numbers 1 through 5, with a dropdown menu currently showing "25".

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	testime-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	lithor		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)

The ECL Watch (pre-version 9)



The screenshot shows the ECL Watch application interface. At the top is a blue header bar with the 'ECL Watch' logo, navigation icons, a search bar containing 'Wuid, User, (ocl *, file:*)', a 'LOGGED IN AS' indicator, a 'Tech Preview' toggle set to 'Off', and a menu icon. Below the header is a grey navigation bar with tabs for 'Logical Files', 'Landing Zones', 'Workunits', and 'XRef'. The 'Logical Files' tab is active, displaying a table of logical files. Above the table is a toolbar with buttons for 'Refresh', 'Open', 'Delete', 'Remote Copy', 'Copy', 'Rename', 'Add To Superfile', 'Desprays', 'Filter Set', 'Mine', and a 'Download to CSV' button. The table has columns for 'Logical Name', 'Owner', 'Super Owner', 'Description', 'Cluster', 'Records', 'Size', 'Parts', and 'Mi'. It lists 16 logical files, including various 'progguide::exampledata::' and 'rttest::' entries. The bottom 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	Mi
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	

ECL Watch Features:

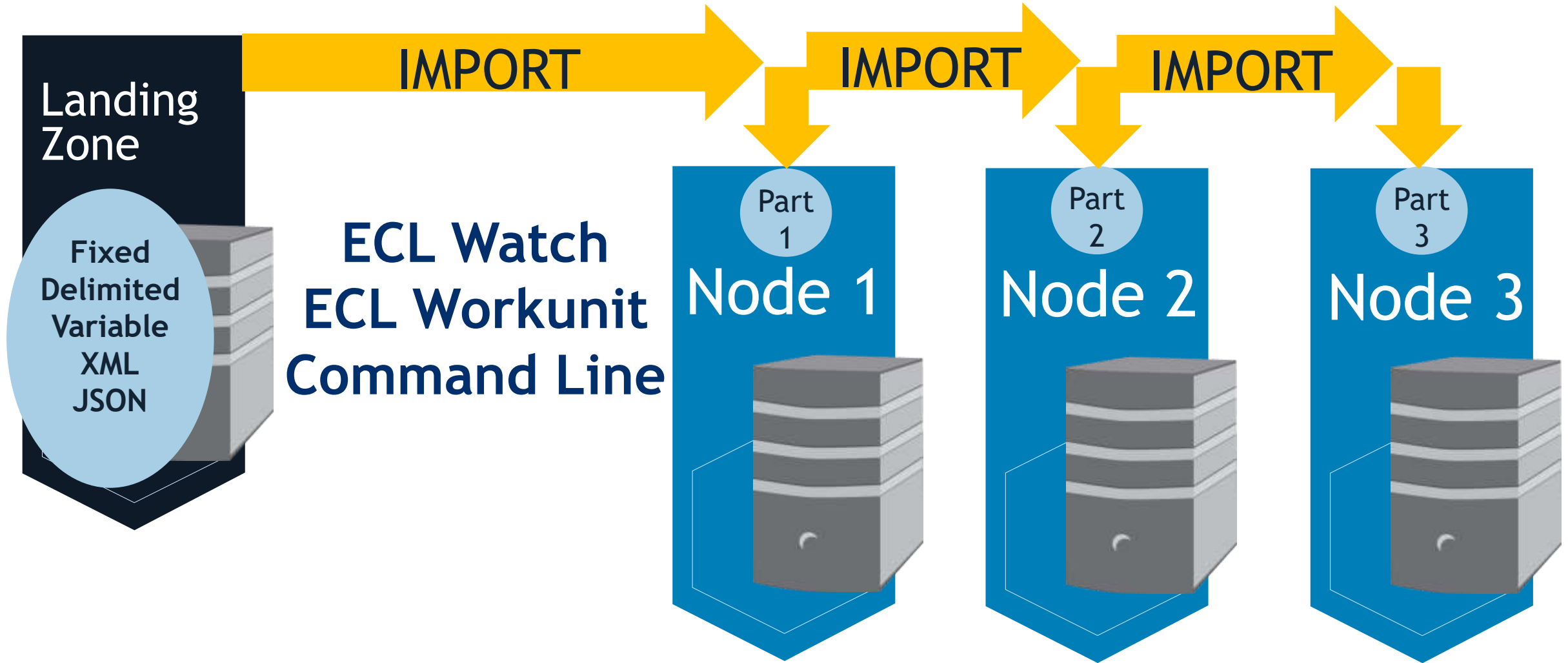
A web-based query execution, monitoring and file management interface. It can be accessed via ECL IDE or a web browser.

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.



Getting the data to the cluster!



Treated as a *single* logical file...



ECL Overview



ECL (Enterprise Control Language)

ECL is a language designed to *query and manipulate* big data and is used for ETL (Extract, Transform, Load) and data visualization.

Extract

Reading and ingesting data from different type of datasets

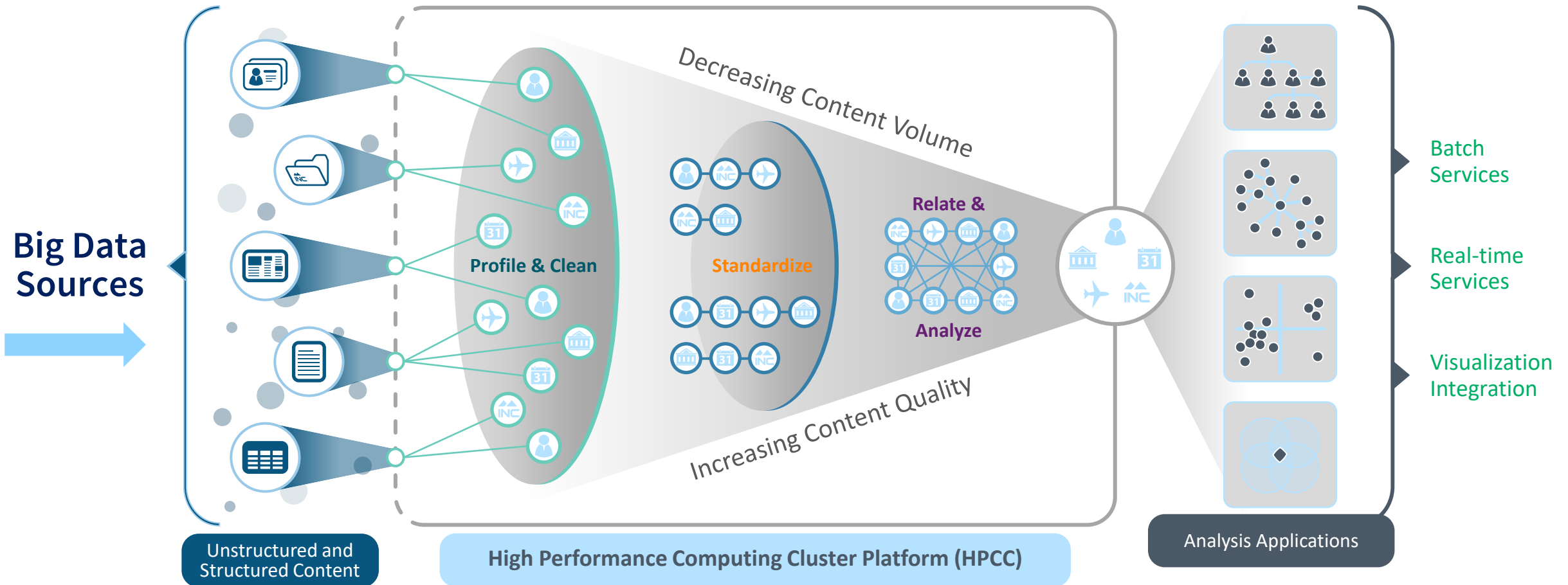
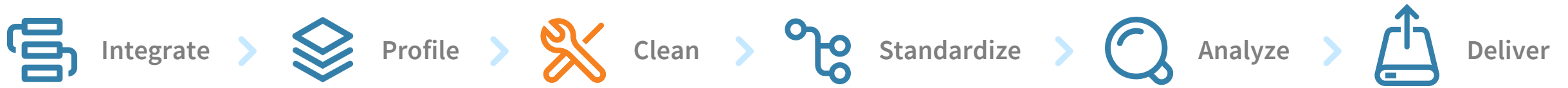
Transform

Formatting/converting data to needed shape and content

Load

Writing (Delivering) dataset to its target location

HPCC Systems (Small to Big Data) ETL



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:
- ✓ *FolderName.Definition* //reference a definition from another module/folder
- ✓ *Dataset.Field* //reference a field in a dataset or record set

Fundamentals of ECL (Continued)

- ✓ Definition operator is **`:=`** "is defined as" (`firstname := 'Bob';`)
- ✓ Semicolon is line terminator: `num := 12;`
- ✓ Equality test: `valOne = valTwo`
- ✓ Not equal: Use `<>` or `!=`
- ✓ Definitions can be defined only once (They are *not* variables).
- ✓ *Only those definitions that contribute to a result are compiled and used.*
- ✓ There are no traditional 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
`UNSIGNED1 MyNumber := 0;`

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});
```

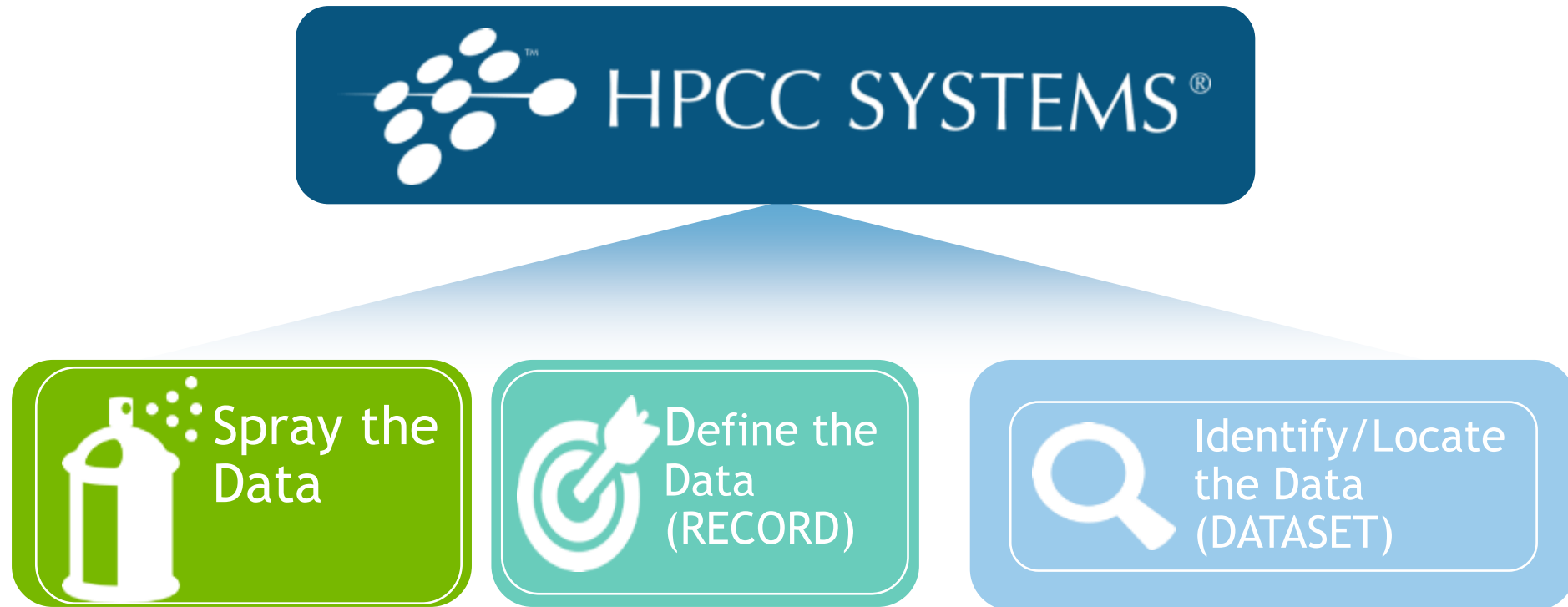
```
newRec := RECORD  
  RECORDOF(t);  
  UNSIGNED1 NewByte;  
END;
```



```
anotherRec := RECORD  
  newRec;  
  STRING20 NewName;  
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

```
3 SalaryAvg_Layout := RECORD
4     STRING Job;
5     STRING Category;
6     STRING City;
7     STRING2 State;
8     INTEGER Avg_Salary;
9 END;
10
11 //Inline Dataset
12 SalaryAvg_DS := DATASET([
13     {'Manager','IT','Atlanta','GA',87000},
14     {'Director','Art','Atlanta','GA',100000},
15     {'CIO','IT','Tampa','FL',112000},
16     {'Sales','General','Chicago','IL',55000}
17 ], SalaryAvg_Layout);
18
19 OUTPUT(SalaryAvg_DS);
```


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

CHOOSSEN

Returns the first n number of records.

##	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

```
19 // A simple output
20 OUTPUT(SalaryAvg_DS,NAMED('SalaryAvg_DS'));
21
22 //CHOOSSEN
23 OUTPUT(CHOOSSEN(SalaryAvg_DS,2),NAMED('SalaryAvg_Choosen'));
```

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

```
25  //Filter
26  OUTPUT(SalaryAvg_DS(City = 'Tampa'),NAMED('Tampa_Filter'));
27
28  //Sort
29  SortJobs := SORT(SalaryAvg_DS, Job);
30  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 ~

Comparison Operators

=

<> or !=

<

>

<=

>=

<=>

Example:

```
youngOrLowIncome = allPeople(age < 20 OR avgHouseIncome <= 20000);
```

Math Functions

```
1  Mathlayout := RECORD
2    INTEGER Num1;
3    INTEGER Num2;
4    INTEGER Num3;
5  END;
6
7  DS := DATASET([
8    {20,45,34},
9    {909,56,45},
10   {30,-1,90}
11  ],MathLayout);
12
13  COUNT(DS);           //Counts the number of records in the dataset -- Returns 3
14  MAX(DS,Num1);        //Returns the maximum value on a field in the dataset -- Returns 909
15  MIN(DS,Num2);        //Returns the minimum value on a field in the dataset -- Returns -1
16  AVE(DS,Num1);        //Returns the average value on a field in the dataset -- Returns 319.6666666666667
17  SUM(DS, Num1 + Num3); //Returns the result of adding numbers together -- Returns 1128
18  TRUNCATE(AVE(DS,Num1)); //Returns the interger portion of the real value. -- 319
19  ROUND(3.45);         //Returns the rounded value -- Return 3
20  ROUND(3.76);         //Returns the rounded value -- Return 4
```

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

CORRELATION

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



`CORRELATION(ds1, NumOne, NumTwo);`



Returns 1.0

NumOne	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)

```
1  myfunc (STRING val) := FUNCTION
2  |   Result := 'Hello ' + val + ' , welcome to this function';
3  |   RETURN Result;
4  END;
5
6  //Using myfunc
7  res := myfunc('Trish');
8  OUTPUT(res, NAMED('FunctionResult'));
9
10 OUTPUT(myfunc('George'), NAMED('GeorgeTest'));
```

FunctionResult: Hello Trish , welcome to this function

GeorgeTest: Hello George , welcome to this function

```
12 //Single line function:
13 MaxVal(SET OF INTEGER numlist) := MAX(numlist);
14 OUTPUT(MaxVal([2,5,8,10,45,11]), NAMED('CheckMax'));
```

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 .


```
1  EXPORT myMod := MODULE
2    //Visible only by MyMod
3    SHARED x := 88;
4    SHARED y := 42;
5
6    //Visible by MyMod and externally
7    EXPORT See := 'This is how a module works';
8    EXPORT Res := Y * 2;
9  END;
```

```
1  IMPORT $;
2  OUTPUT($.MyMod.See, NAMED('Message'));
3  OUTPUT($.MyMod.Res, NAMED('Result'));
```

Message: This is how a module works

Result: 84

Message

This is how a module works

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

FirstName	LastName
Sun	Shine
Blue	Moon
Silver	Rose

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

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

```
1  Person_Layout := RECORD
2      STRING FirstName;
3      STRING LastName;
4  END;
5
6  NameDS := DATASET([
7      {'Sun','Shine'},
8      {'Blue','Moon'},
9      {'Silver','Rose'}
10     ],Person_Layout);
11
12  NameOutRec := RECORD
13      STRING15  FirstName;
14      STRING15  LastName;
15      STRING15  CatValues;
16      UNSIGNED1 RecCount;
17  END;
18
19  NameOutRec CatThem(Person_Layout Le,INTEGER Ct) := TRANSFORM
20      SELF.CatValues := TRIM(Le.FirstName) + ' ' + Le.LastName;
21      SELF.RecCount  := Ct;
22      SELF           := Le;
23  END;
24
25  CatRecs := PROJECT(nameDS, //dataset to loop through
26      CatThem //Transform name
27      (LEFT, //Left dataset which is nameDS
28          COUNTER //Simple Counter
29      ));
30
31  OUTPUT(CatRecs, NAMED('CatRecs'));
```

Inline TRANSFORM

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

```
1  Person_Layout := RECORD
2      INTEGER PersonID;
3      STRING FirstName;
4      STRING LastName;
5  END;
6
7  NameDS := DATASET([
8      {100, 'Jo', 'Smith'},
9      {203, 'Dan', 'Carpenter'},
10     {498, 'Sally', 'Fryman'},
11     {302, 'Silver', 'Rose'}
12 ], Person_Layout);
13
14  NameOutRec := RECORD
15      UNSIGNED1 RecCount;
16      INTEGER PersonID;
17      STRING PersonName;
18      STRING FutureAddress;
19  END;
20
21  CatRecs := PROJECT(NameDS,
22      TRANSFORM(NameOutRec,
23          SELF.PersonName := LEFT.FirstName + ' ' + LEFT.LastName;
24          SELF.RecCount := COUNTER;
25          SELF := LEFT;
26          SELF := [];
27      ));
28
29  OUTPUT(CatRecs, NAMED('Inline_CatRecs'));
```

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

TABLE (recordsets in memory, cross-tab tool)

```
1 Pickup_layout := RECORD
2   STRING10 pickup_date;
3   DECIMAL8_2 fare;
4   DECIMAL8_2 distance;
5 END;
6
7 Pickup_DS := DATASET([
8   | | | | | {'2015-01-01',25.10,5},
9   | | | | | {'2015-01-01',40.15,8},
10  | | | | | {'2015-01-02',30.10,6},
11  | | | | | {'2015-01-02',25.15,4}
12  | | | | | ], Pickup_layout);
13
14 crossTabLayout := RECORD
15   Pickup_DS.pickup_date;
16   avgFare := AVE(GROUP,Pickup_DS.fare);
17   totFare := SUM(GROUP,Pickup_DS.fare);
18 END;
19
20 crossTabDS := TABLE(Pickup_DS, // Input Dataset
21   | | | | | crossTabLayout,
22   | | | | | pickup_date);
23
24 OUTPUT(crossTabDS, NAMED('crossTabs'));
```

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);
```



empid	name	hireyear	department	title
1000	Jack	2014	IT	Developer
2000	Blue	2016	Biz	Manager
8000	Cat	2002	IT	Analyst

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



empid	name	hireyear	department	title
1000	Jack	2014	IT	Developer
2000	Blue	2016	Biz	Manager
3000	Mary	2016		
5000	Marty	2000		
8000	Cat	2002	IT	Analyst

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



empid	name	hireyear	department	title
1000	Jack	2014	IT	Developer
2000	Blue	2016	Biz	Manager
3000	Mary	2016		
4000		0	Fin	Accountant
5000	Marty	2000		
8000	Cat	2002	IT	Analyst

VISUALIZATION (built-ins and an ECL Bundle)

Methods include

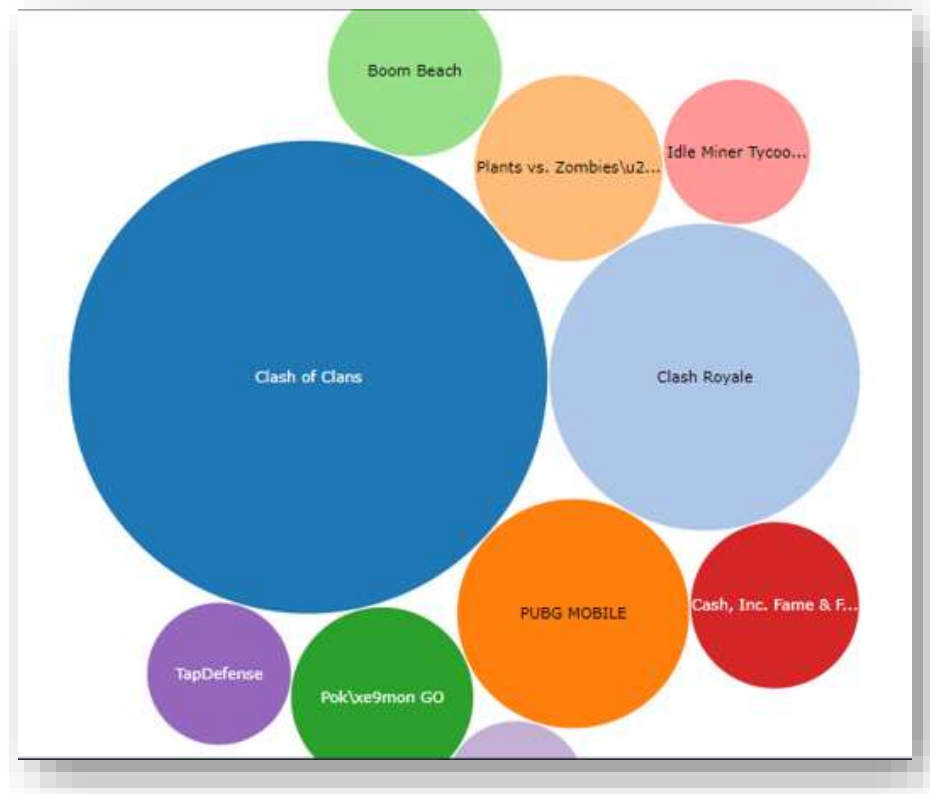
- Two-Dimensional
- Multi-Dimensional Methods
- Geospatial
- Relational
- And more!

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


```
Games_DS := DATASET('~tech::vg-sales', GamesRec, CSV(HEADING(1)));  
top_sales_Count := TOPN(TABLE(Games_DS, {name, Global_Sales}), 10, -Global_Sales);  
OUTPUT(top_sales_Count, NAMED('salescount'));  
Visualizer.TwoD.Bubble('global_count',, 'salescount');
```

Bubble
Pie
Bar
Scatter
Line
WorldCloud
Area



Useful links!

UGAHacksX HPCC Systems Wiki Page:

<https://wiki.hpccsystems.com/display/hpcc/University+of+Georgia+UGAHacksX+2025>

“Learn ECL” Web Tutorial:

<https://solutionslab.hpccsystems.com/learn-ecl/introduction/>

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-9.8.52/docs/EN_US/ECLLanguageReference_EN_US-9.8.52-1.pdf

Visualization document

https://cdn.hpccsystems.com/releases/CE-Candidate-9.8.52/docs/EN_US/VisualizingECL_EN_US-9.8.52.pdf

Standard Library

https://cdn.hpccsystems.com/releases/CE-Candidate-9.8.52/docs/EN_US/ECLStandardLibraryReference_EN_US-9.8.52-1.pdf

Machine Learning

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

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