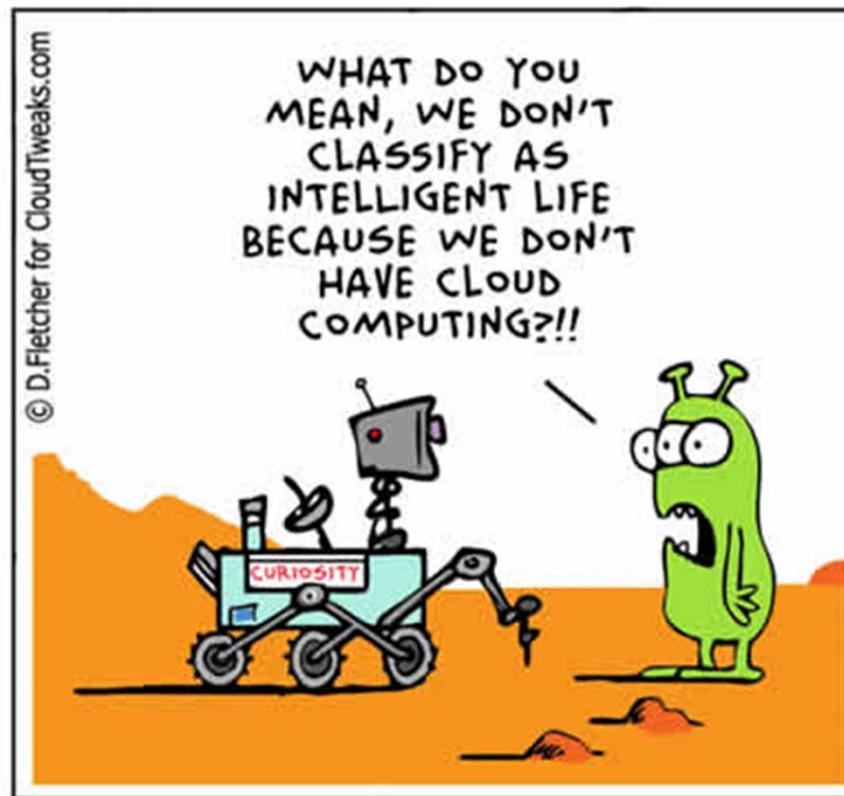


L05: IBM Bluemix Cloud Services



Outline

- Objective
- Organization of Global Cloud Datacenters
- Bluemix Services and High-level Architecture
- Examples
 - PaaS: Developing a Web Application
 - SaaS: Analytics using in-cloud Db2 Database Service, R Script and Visualization
 - SaaS: IBM Watson Analytics & Example
- Watch video – How-to's & Demos: A Tour of Bluemix 2017 & How Watson Works
- Summary

Objective

- develop simple PaaS and SaaS applications using IBM Bluemix
- use of in-cloud database systems to provide data for web applications
- perform data analytics with IBM Bluemix tools (Database, SQL, R)
- use of cognitive tools with IBM Watson

IBM Global Cloud Datacenters



IBM Cloud Public Regions

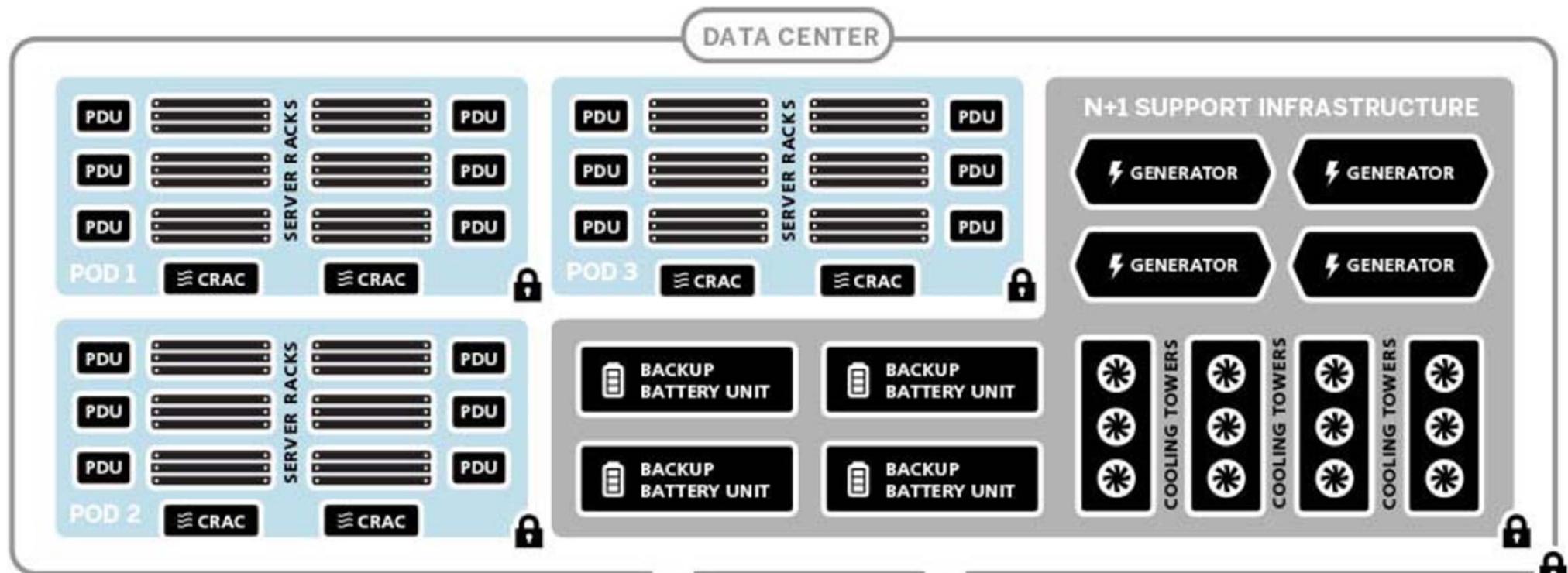
- Data Center & Network PoP
- ◇ Region
- Network PoP
- Federal Data Center



Region Name	Geographic Location	Region Prefix of API endpoint	UI Console
US South	Dallas, US	ng	api.ng.bluemix.net console.ng.bluemix.net
United Kingdom	London, England	eu-gb	api.eu-gb.bluemix.net console.eu-gb.bluemix.net
Sydney	Sydney, Australia	au-syd	api.au-syd.bluemix.net console.au-syd.bluemix.net
Frankfurt region	Frankfurt, Germany	eu-de	api.eu-de.bluemix.net console.eu-de.bluemix.net



Inside IBM Cloud Data Centers



PHYSICAL SECURITY LAYER

COMPUTER ROOM AIR CONDITIONER

POWER DISTRIBUTION UNIT

REDUNDANT
UTILITY POWER

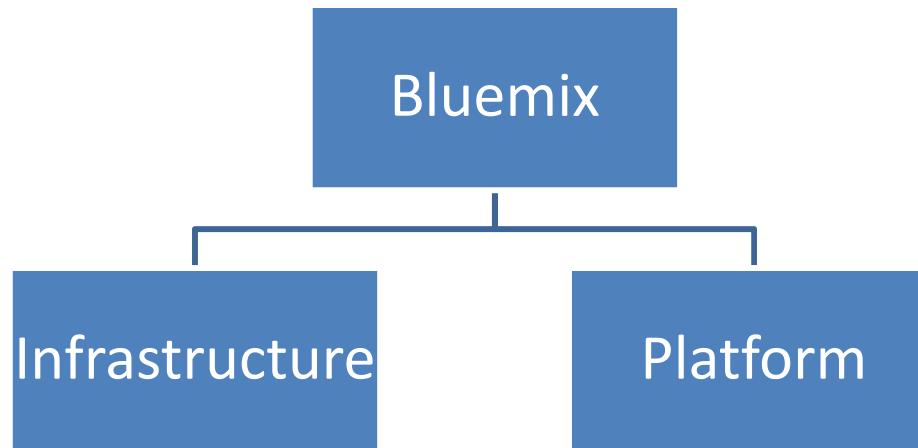
- n+1 UPS Battery Backup Units
- n+1 Backup Power Generators
- n+1 Cooling Infrastructure
- Pre-Action Dry Pipe Fire Suppression
- Multi-Level Access Control

What is IBM Bluemix?

“an implementation of IBM’s Open Cloud Architecture, leveraging Cloud Foundry (**PaaS**) to enable developers to rapidly build, deploy, and manage their cloud applications, while tapping a growing ecosystem of available services and runtime frameworks”

<https://console.bluemix.net/>

IBM Bluemix Services



- | | | |
|---------------|-------------------------|------------------------|
| 1. Compute | 1. Boilerplates | 8. Finance |
| 2. Storage | 2. APIs | 9. Functions |
| 3. Network | 3. Application Services | 10. Integrate |
| 4. Security | 4. Blockchain | 11. Internet of Things |
| 5. Containers | 5. Cloud Foundry Apps | 12. Mobile |
| 6. VMware | 6. Data & Analytics | 13. Security |
| | 7. DevOps | 14. Watson |

Bluemix Catalog

Screenshot of the IBM Cloud Catalog interface showing the Infrastructure section.

The left sidebar shows categories like Infrastructure, Compute, Storage, Network, Security, Containers, VMware, Platform, Application Services, Blockchain, Cloud Foundry Apps, Data & Analytics, DevOps, Finance, Functions, Integrate, Internet of Things, Mobile, Network, Security, and Watson.

The main content area is titled "Infrastructure". It includes sections for "Compute", "Storage", and "Network".

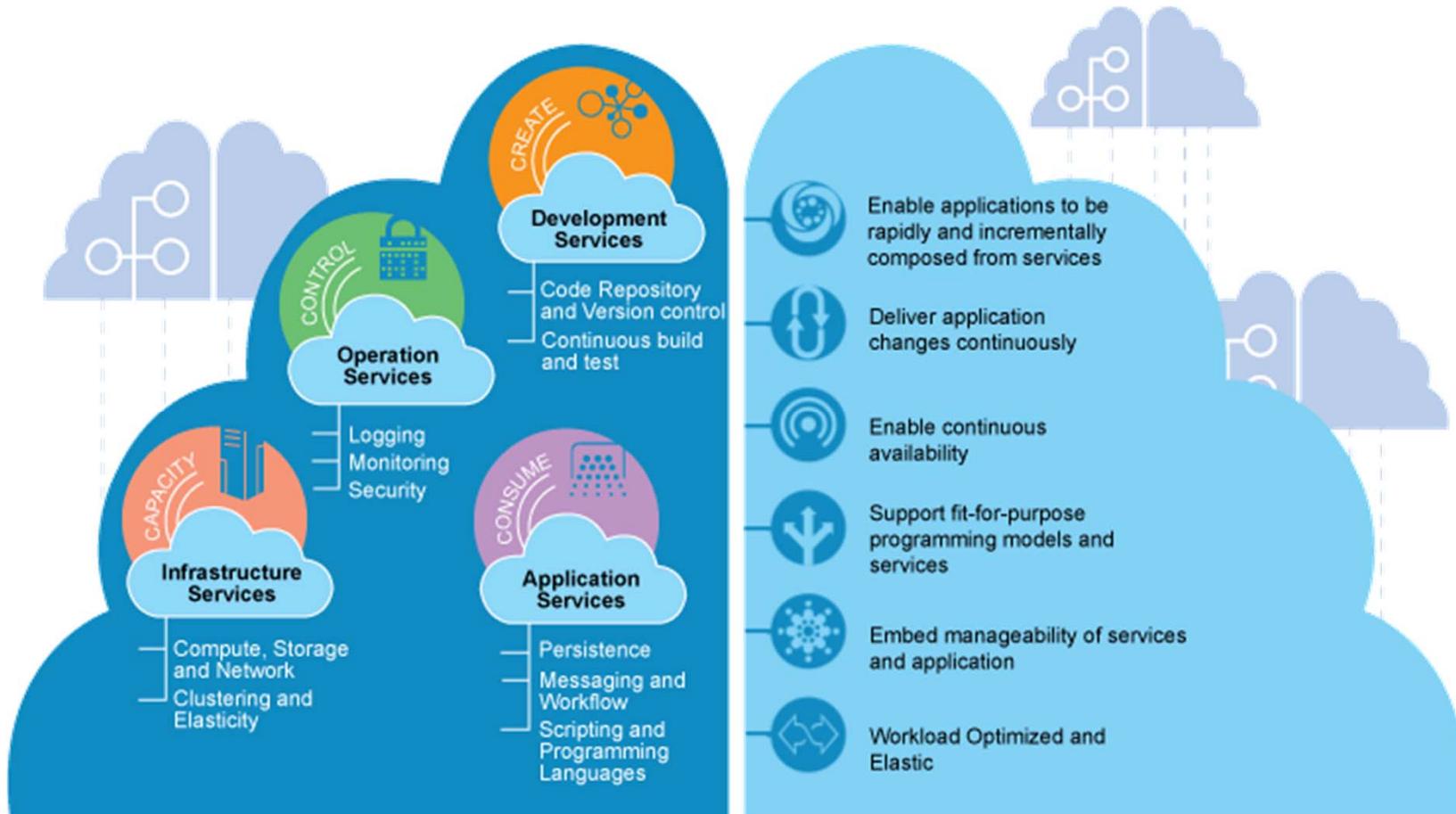
Compute: Includes "Bare Metal Server" and "Virtual Server".

Storage: Includes "Block Storage", "File Storage", and "Object Storage".

Network: Includes "Content Delivery Network", "Direct Link Dedicated", "Direct Link Dedicated Hosting", "Direct Link Exchange", "Domain Name Service", and "IPSec VPN".

A search bar and a "Filter" button are at the top right. The URL in the address bar is <https://console.bluemix.net/catalog/?taxonomyNavigation=apps>.

Bluemix Platform Features



source: <http://www.ibm.com/developerworks/cloud/library/cl-bluemix-dbarnes/>

Target Cloud Consumers

- Application Developers
 - Supports multiple languages
 - Auto-managed: version control, flexible capacity
- Businesses
 - Ease of deployment -> faster time-to-market
 - Lesser need for technical know-how
- Users
 - Needs are addressed fast
 - Feature updates made sooner
 - No need for special “going live mode” to update/release feature

Companies using Bluemix



New



Finance

IBM Bluemix accelerates digital banking innovation through the Citi Mobile Challenge.



Technology

Bitcraze builds Crazyflie drone with IBM Bluemix.

More

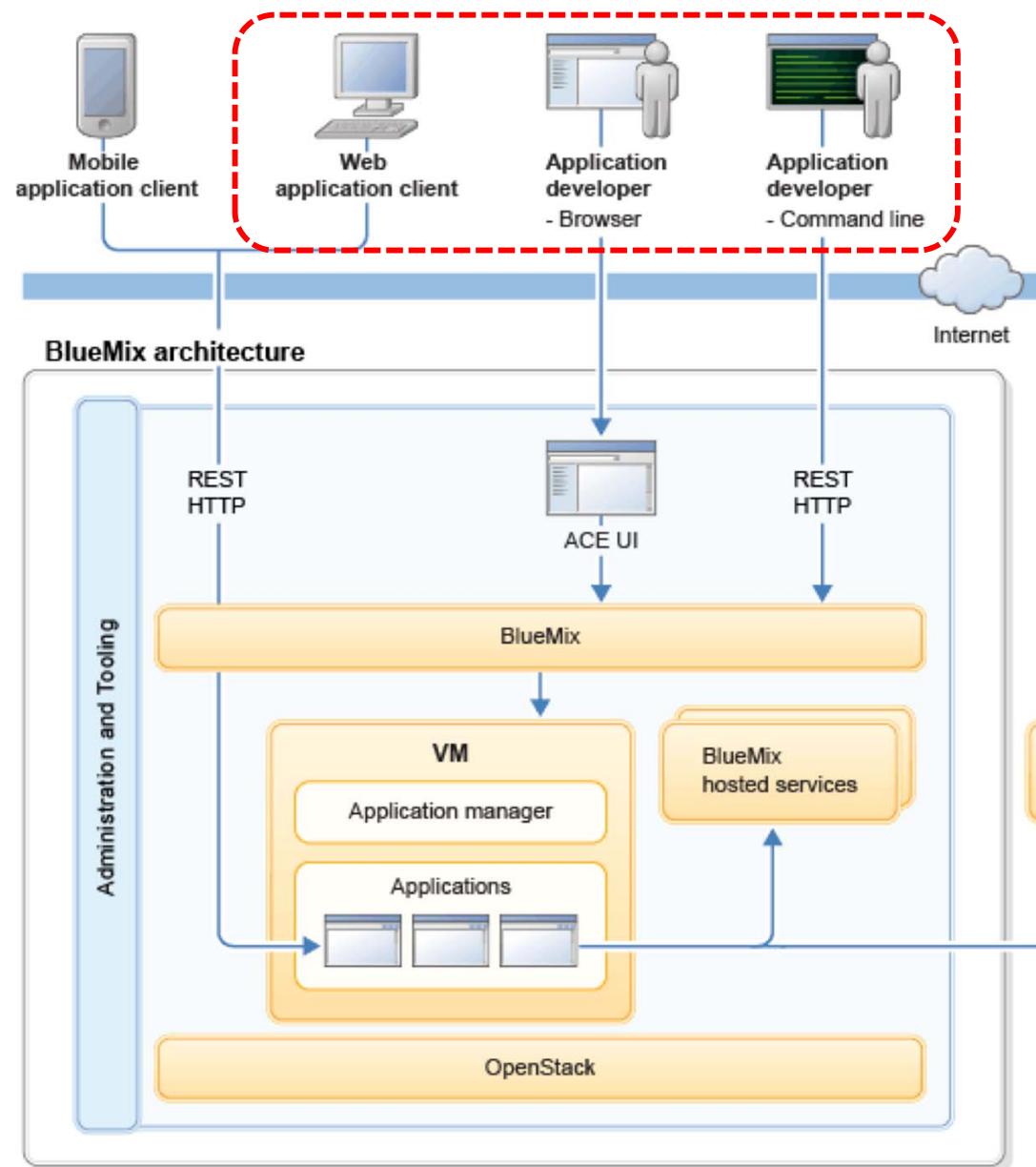
Creating a unique digital experience to capture the moments that matter



Retail

IBM Bluemix delivers scalable, cost-effective DevOps capabilities for BYTE restaurant feedback startup.

Bluemix High-level Architecture



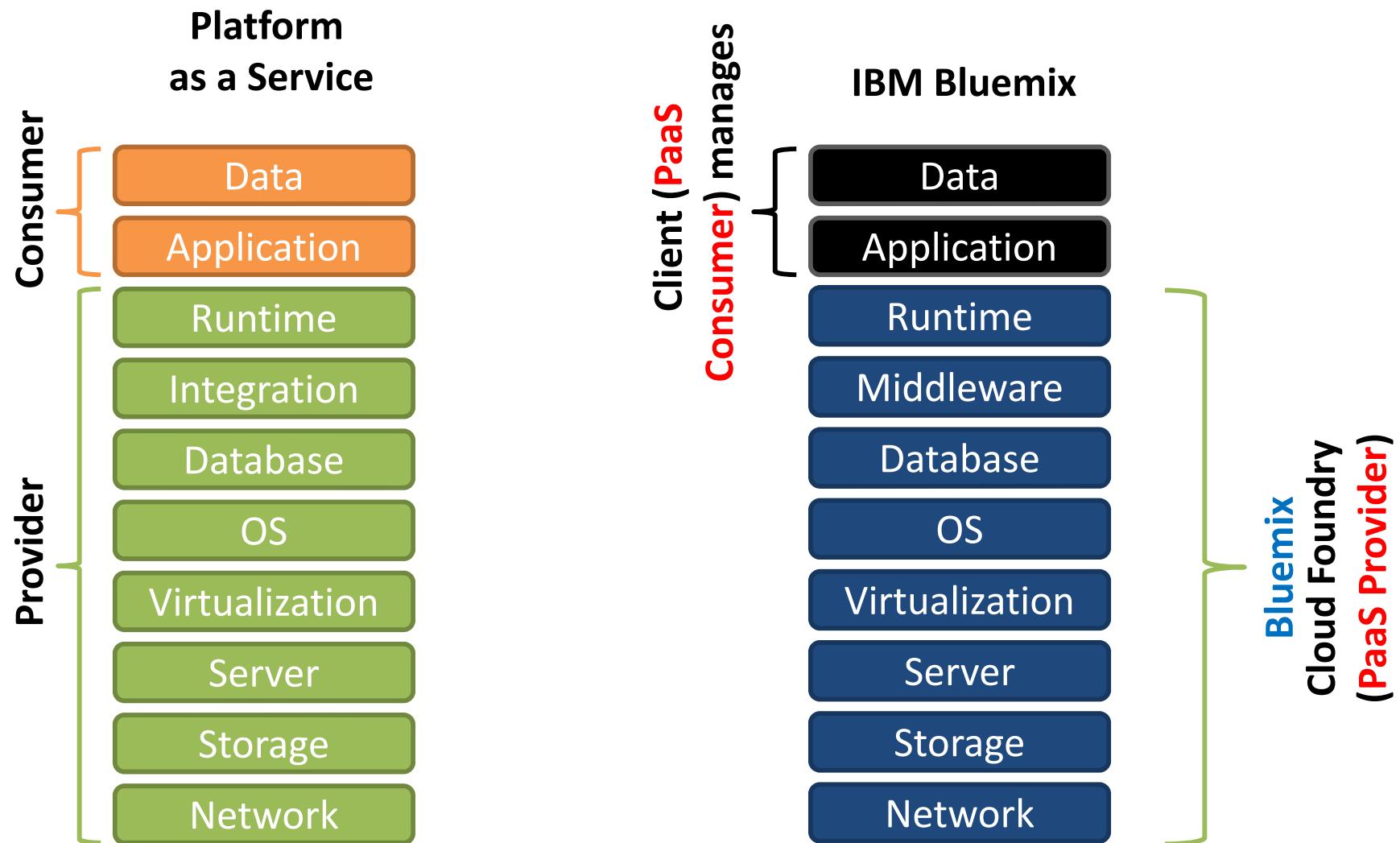
Application developer interacts with systems through:

1. Command line interface
2. Browser interface

Bluemix Cloud Foundry

- Users focus on application code, i.e., don't have to worry about the OS and infrastructure layers
- Cloud Foundry is an open source PaaS
 - Corporate users: SAS, Cisco, Rakuten, Baidu, SAP Verizon, ..
 - Leverages on the broad community
 - Push, extend and manage applications using
 - a command line tool (cf)
 - eclipse plugin
 - DevOps ...
 - Addresses PaaS lack of cross-compatibility among different cloud providers

IBM Cloud Services - PaaS



EXAMPLE 1

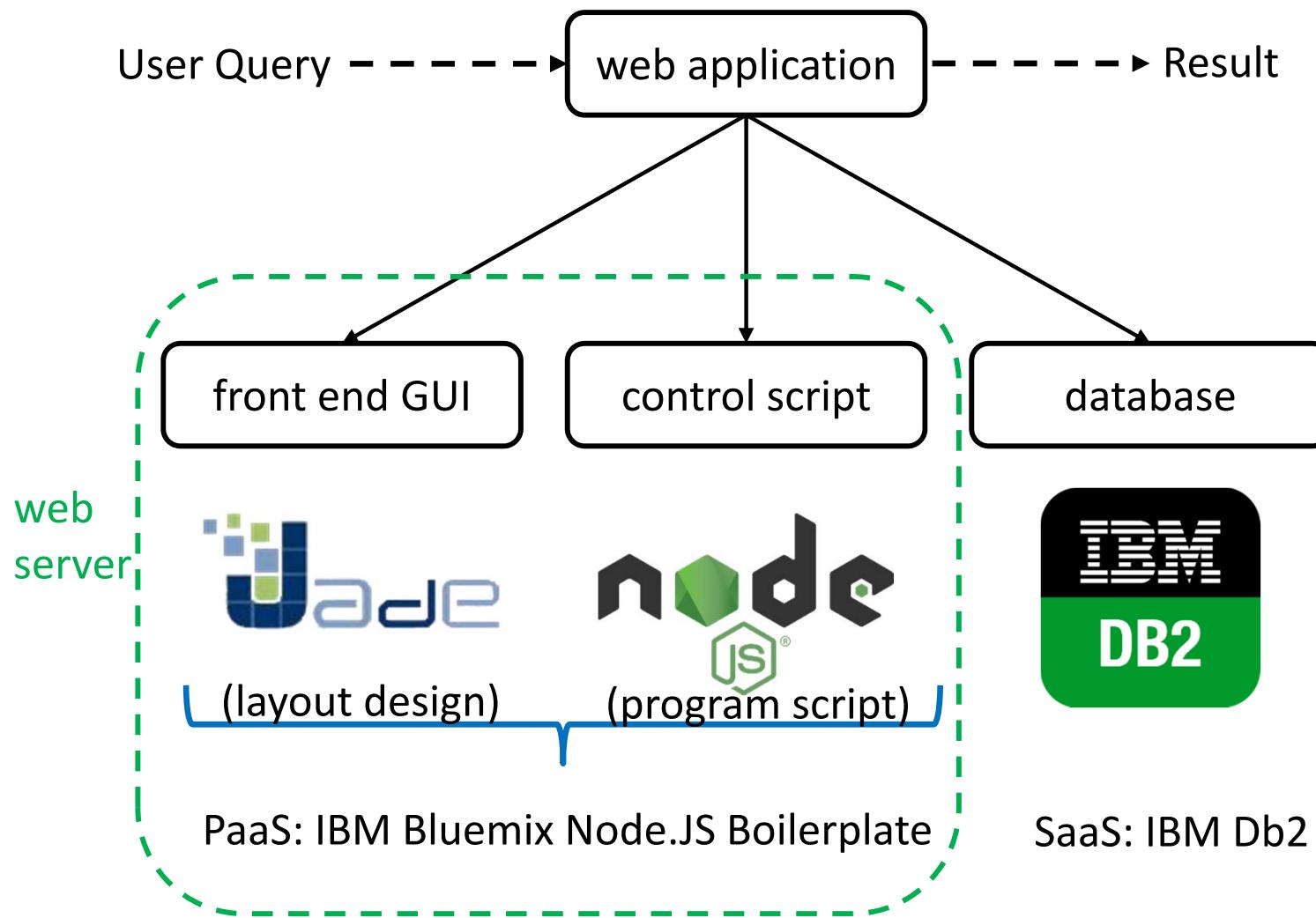
PaaS: Developing a Web Application

- Overview
- Architecture
- Main Steps: Db2 and Node.JS Boilerplate
- GUI Layout with Jade
- Javascript: Application Logic, Database Query

Developing a Web Application

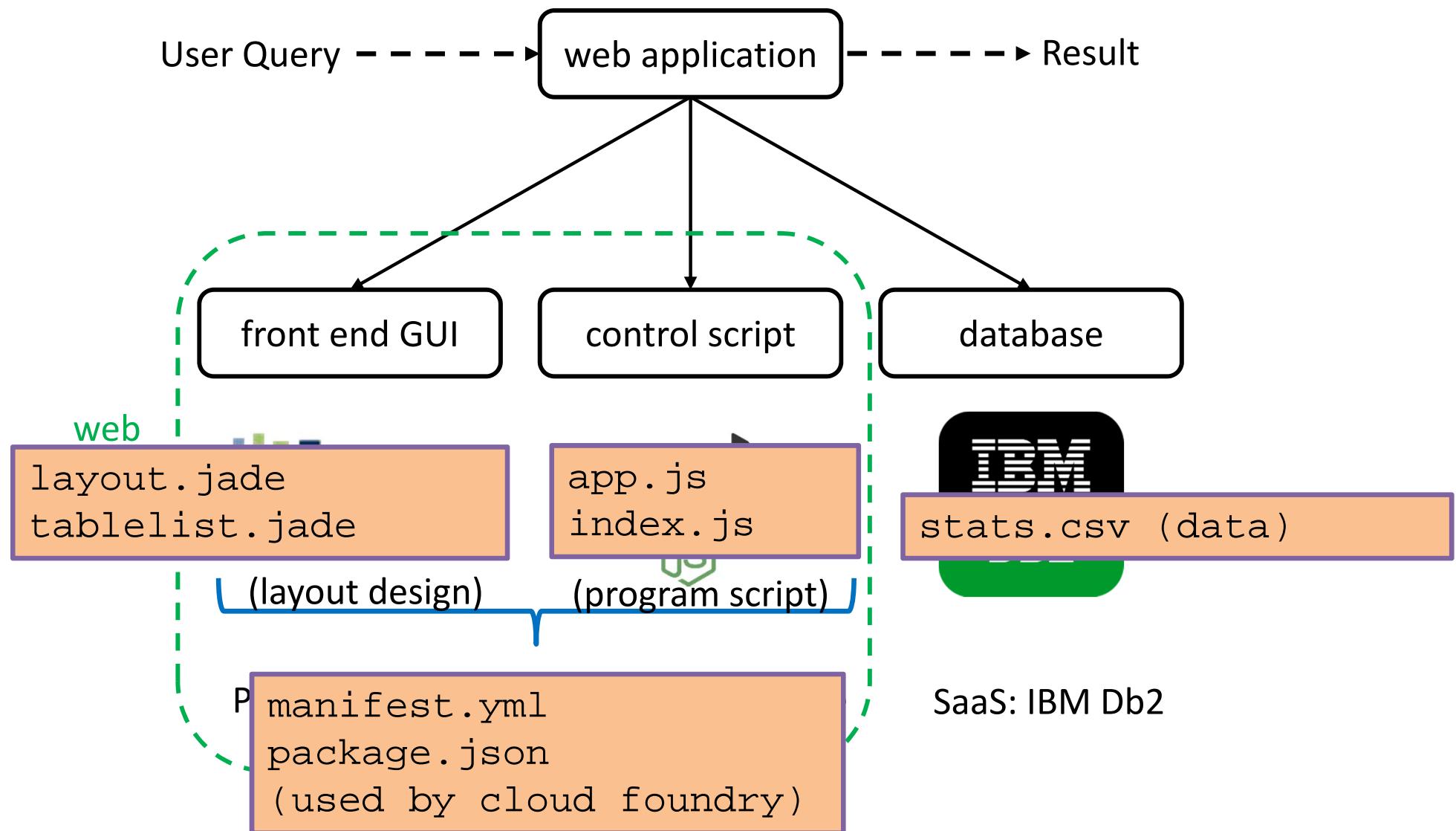
- Objective: set up a web server application using to retrieve data from an in-cloud database and display on a browser
- Example: Web application to retrieve and display employee details of a company stored in a IBM Db2 database, running on a cloud-based web server using node.js boilerplate
- Services can be added on top of the boilerplate runtime (eg. database service)
- Data file: Employee data file which contains name, email and phone number

Developing a Web Application

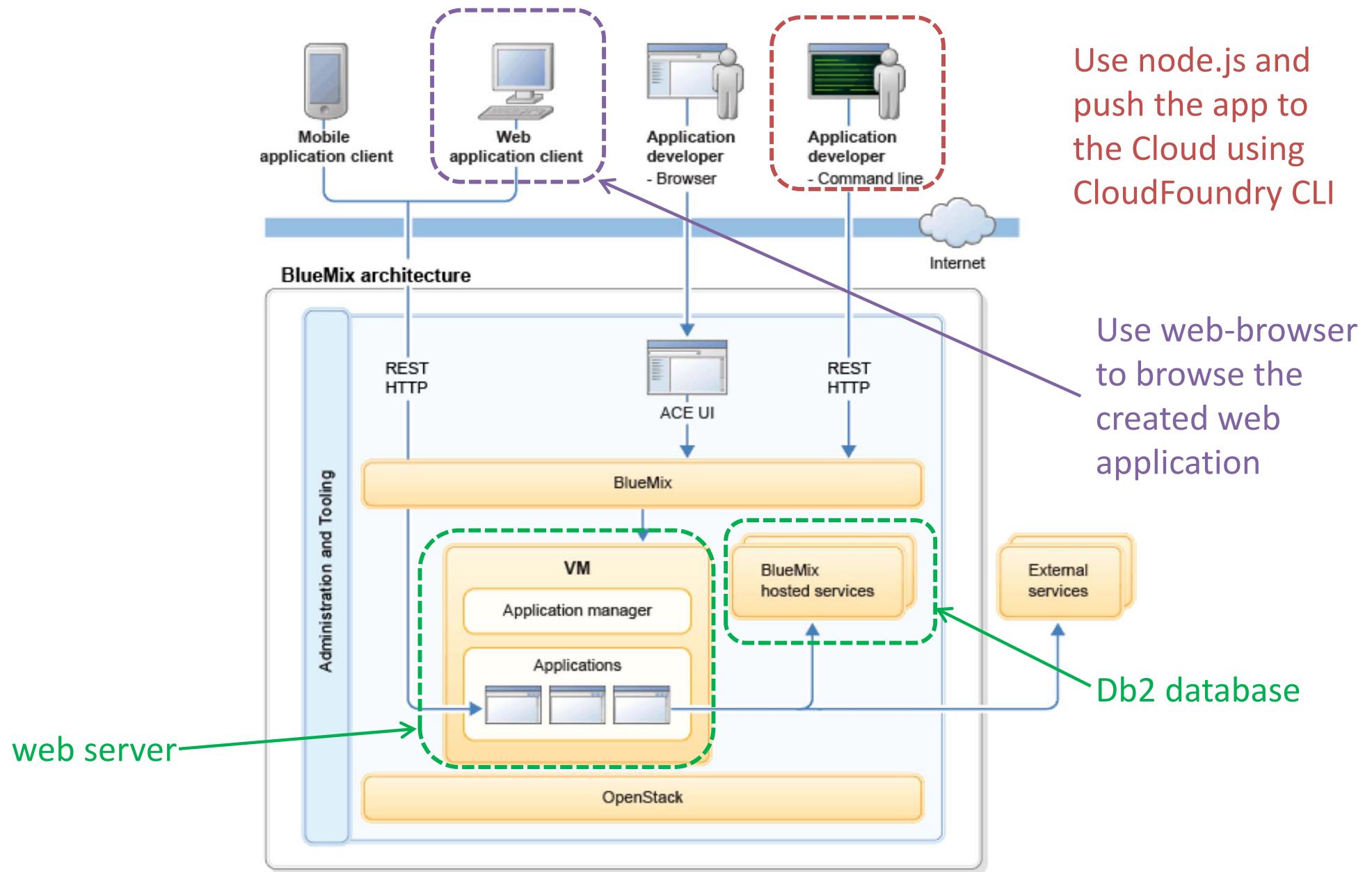


Developing a Web Application (relevant files)

What we are going to use for Example 1:



Web Application Architecture



Developing a Web Application: Main Steps

- Setup a database service on IBM Db2 SaaS
- Upload data to the database
- Start a new web application with IBM Node.JS boilerplate
- Assign a hostname URL
- Create/modify the GUI layout with Jade
- Write/modify the control JavaScript script
- View output web application on a browser

Db2 Database Service Setup

The screenshot shows the IBM Cloud Catalog interface. On the left, there's a sidebar with categories like All Categories, Infrastructure, Platform, and Data & Analytics (which is selected). The main area lists various database services:

- Compose for Redis
- Compose for RethinkDB
- Compose for ScyllaDB
- Data Catalog
- Data Refinery
- Data Science Experience
- Db2
- Db2 Hosted
- Db2 Warehouse (highlighted with a red oval)
- Decision Optimization
- Geospatial Analytics
- Information Server
- Informix
- Lift
- Machine Learning
- Master Data Management
- Streaming Analytics
- Weather Company Data
- ClearDB Managed MySQL Database
- Cupenya Insights
- ElephantSQL

Each service entry includes a brief description, an icon, and status indicators (IBM, Lite, Beta).

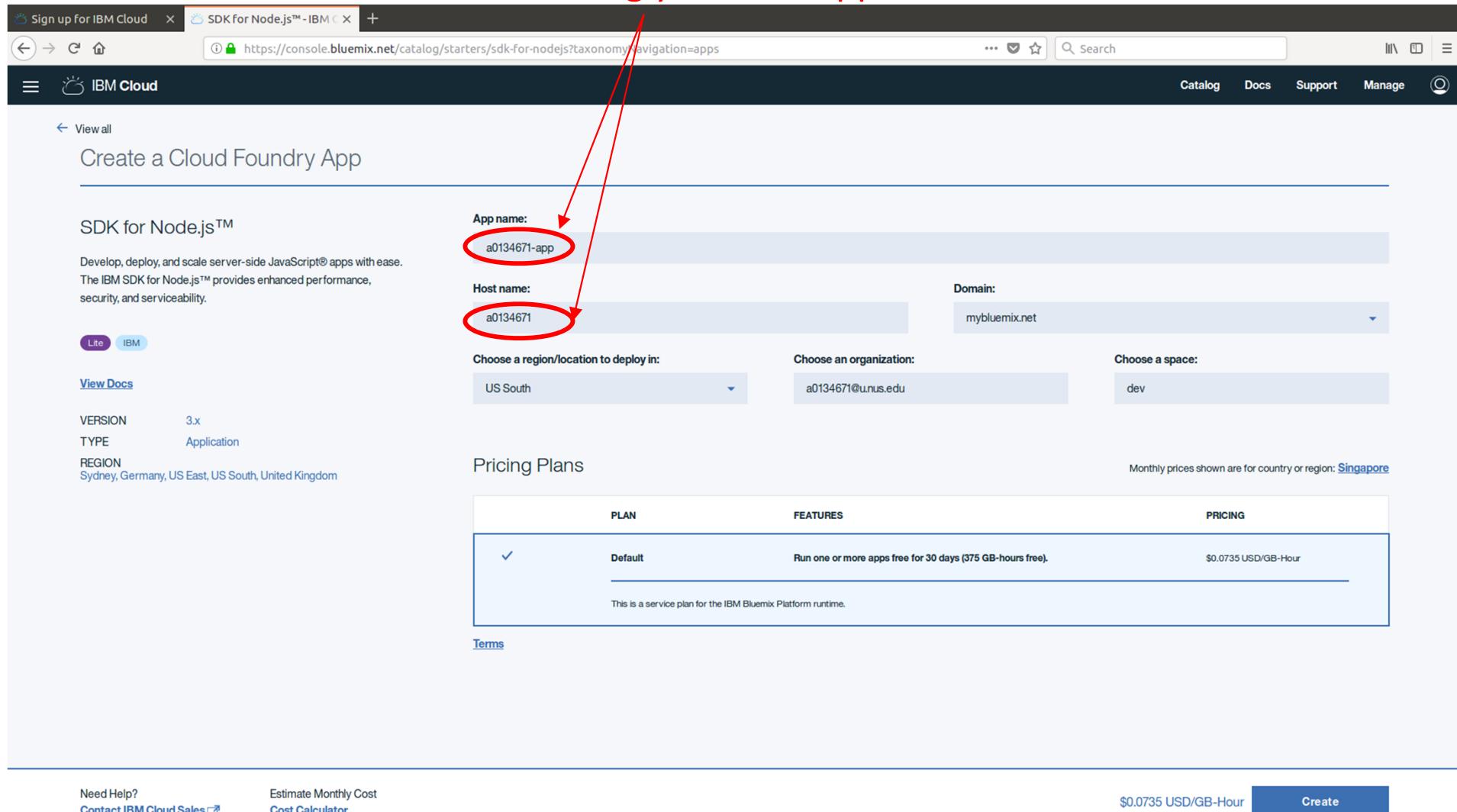
Setup Web Application with Node.JS Boilerplate

- Go to catalog and select SDK for Node.js

The screenshot shows the IBM Cloud Catalog interface. On the left, there's a sidebar with categories like All Categories, Infrastructure, Platform, and Cloud Foundry Apps. Under Cloud Foundry Apps, 'Cloud Foundry Apps' is selected. The main area displays various application runtime options. One option, 'SDK for Node.js™', is highlighted with a large red oval. This option is described as 'Develop, deploy, and scale server-side JavaScript® apps with ease. The IBM SDK for Node.js™ provides...'. Other visible options include Liberty for Java™, Runtime for Swift, PHP, Tomcat, XPages, Python, Go, .NET Core, and Ruby.

Assign a Host URL for the Web Application

Use a unique app name and hostname. Hostname is the used for viewing your web app on the browser



The screenshot shows the IBM Cloud catalog page for the "SDK for Node.js™ - IBM" starter. The "App name:" field contains "a0134671-app" and the "Host name:" field contains "a0134671", both of which are circled in red. Red arrows point from the text above to these circled fields. The page also displays deployment options like "US South", "a0134671@u.nus.edu", and "dev", and a pricing table for the "Default" plan.

SDK for Node.js™

Develop, deploy, and scale server-side JavaScript® apps with ease. The IBM SDK for Node.js™ provides enhanced performance, security, and serviceability.

App name: a0134671-app

Host name: a0134671

Domain: mybluemix.net

Choose a region/location to deploy in: US South

Choose an organization: a0134671@u.nus.edu

Choose a space: dev

Pricing Plans

PLAN	FEATURES	PRICING
✓ Default	Run one or more apps free for 30 days (375 GB-hours free).	\$0.0735 USD/GB-Hour

This is a service plan for the IBM Bluemix Platform runtime.

Need Help? Contact IBM Cloud Sales [Cost Calculator](#)

Estimate Monthly Cost [Cost Calculator](#)

\$0.0735 USD/GB-Hour [Create](#)

GUI Layout with Jade

```
extends layout

block content
  h1=message
  h2=tableName

  form#list-form
    div#main
      table#list
        thead
          tr
            for hdr in Object.keys(tablelist[0])
              th #{hdr}
        tbody
          if tablelist && tablelist.length > 0
            each row in tablelist
              tr
                each col in row
                  td #{col}
```

simple layout to display a table as a list of entries in the web site body

Javascript Script: Application Logic

```
var express = require('express');
var routes = require('./routes');
var http = require('http');
var path = require('path');
var ibmdb = require('ibm_db');
require('cf-deployment-tracker-client').track();

var app = express();

// all environments
app.set('port', process.env.PORT || 3000);
app.set('views', path.join(__dirname, 'views'));
app.set('view engine', 'jade');
app.use(express/favicon());
app.use(express.logger('dev'));
app.use(express.json());
app.use(express.urlencoded());
app.use(express.methodOverride());
app.use(express.cookieParser('your secret here'));
app.use(express.session());
app.use(app.router);
app.use(express.static(path.join(__dirname, 'public')));
var db2;
var hasConnect = false;

// development only
if ('development' == app.get('env')) {
  app.use(express.errorHandler());
}

if (process.env.VCAP_SERVICES) {
  var env = JSON.parse(process.env.VCAP_SERVICES);
  if (env['dashDB']) {
    hasConnect = true;
    db2 = env['dashDB'][0].credentials;
  }
}

if ( hasConnect == false ) {

  db2 = {
    db: "BLUDB",
    hostname: "xxxx",
    port: 50000,
    username: "xxxx",
    password: "xxxx"
  };
}

var connString = "DRIVER={DB2};DATABASE=" + db2.db + ";UID=" + db2.username + ";PWD=" + db2.password + ";HOSTNAME=" + db2.hostname + ";port=" + db2.port;

app.get('/', routes.listSysTables(ibmdb,connString));

http.createServer(app).listen(app.get('port'), function(){
  console.log('Express server listening on port ' + app.get('port'));
});
```

defines program environment variables, external libraries used, authentication information for accessing database, and, application start-up logic

Javascript Script: Database Query

```
exports.listSysTables = function(ibmdb, connString) {
    return function(req, res) {

        ibmdb.open(connString, function(err, conn) {
            if (err) {
                res.send("error occurred " + err.message);
            }
            else {
                conn.query("SELECT FIRST_NAME, LAST_NAME, EMAIL, WORK_PHONE from GOSALESHR.employee FETCH FIRST 10 ROWS ONLY",
function(err, tables, moreResultSets) {

                if ( !err ) {
                    res.render('tablelist', {
                        "tablelist" : tables,
                        "tableName" : "10 rows from the GOSALESHR.EMPLOYEE table",
                        "message": "Congratulations. Your connection to dashDB is successful."
                    });
                }
                else {
                    res.send("error occurred " + err.message);
                }
                /*
                Close the connection to the database
                param 1: The callback function to execute on completion of close function.
                */
                conn.close(function(){
                    console.log("Connection Closed");
                });
            );
        );
    );
}
}
```

SQL script for retrieving data from the database

Web Application Output

Congratulations. Your connection to Db2 (dashDB) is successful.

10 rows from the GOSALESHR.EMPLOYEE table

FIRST_NAME	LAST_NAME	EMAIL	WORK_PHONE
Denis	Page	DPage@grtd123.com	+33 1 68 94 52 20
Élizabeth	Michel	EMichel@grtd123.com	+33 1 68 94 52 20
Émile	Clermont	EClermont@grtd123.com	+33 1 68 94 52 20
Étienne	Jauvin	EJauvin@grtd123.com	+33 1 68 94 52 20
Elsbeth	Wiesinger	EWiesinger@grtd123.com	+49 40 663 1990
Else	Mörike	EMörike@grtd123.com	+49 40 663 1990
Frank	Fuhlroth	FFuhlroth@grtd123.com	1 (403) 232-5986
Gunter	Erler	GERler@grtd123.com	+49 40 663 1990
Björn	Winkler	BWinkler@grtd123.com	+49 89 882 3456
Fritz	Hirsch	FHirsch@grtd123.com	+49 89 882 3456

This is the output
of the node.js code
viewed on a web
browser.

Content retrieved from
on-cloud Db2 database

EXAMPLE 2

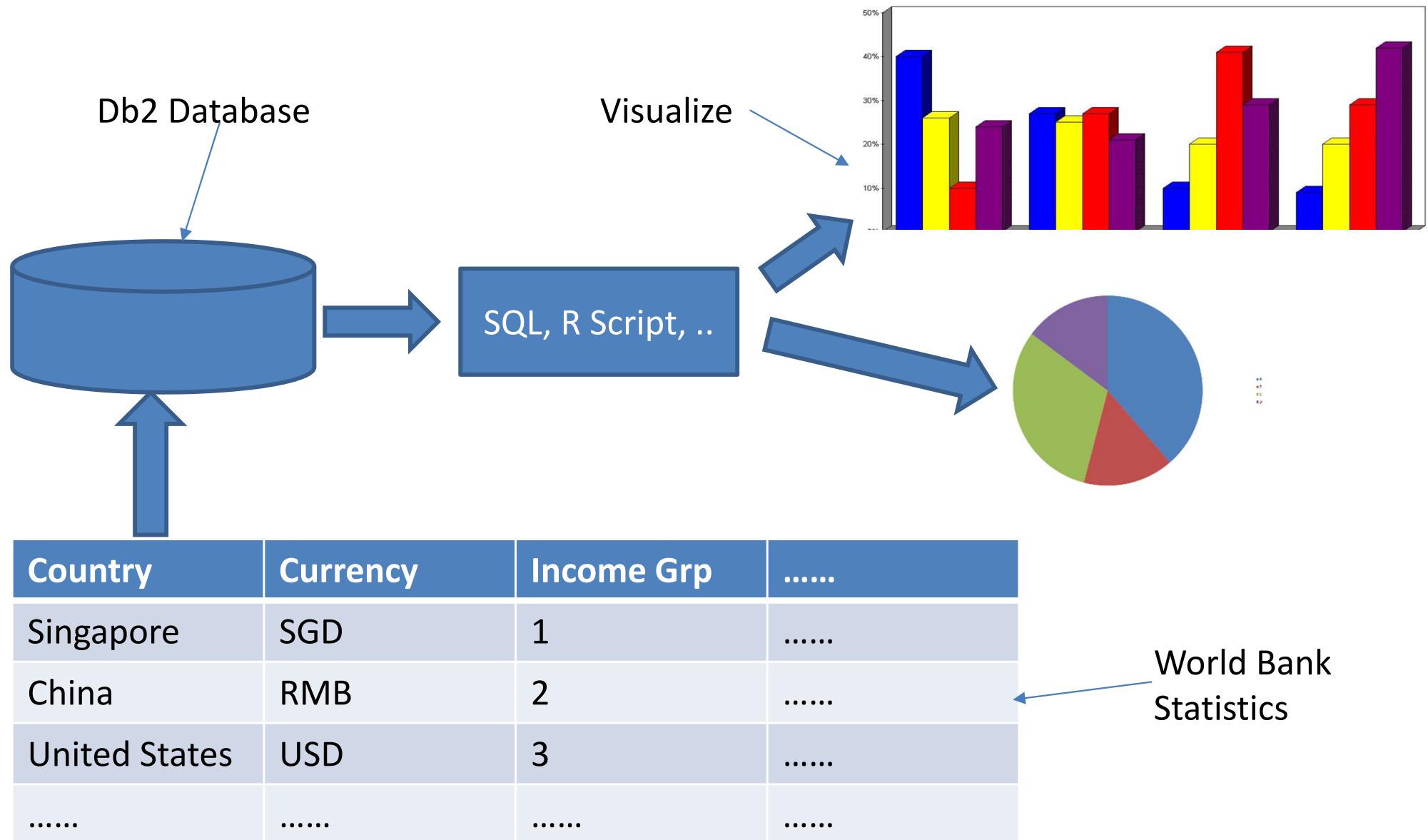
SaaS: Analytics using in-Cloud Db2 Database Service, R Script and Visualization

- Objective
- Analytics using Db2 service
- R Scripting
- Visualization

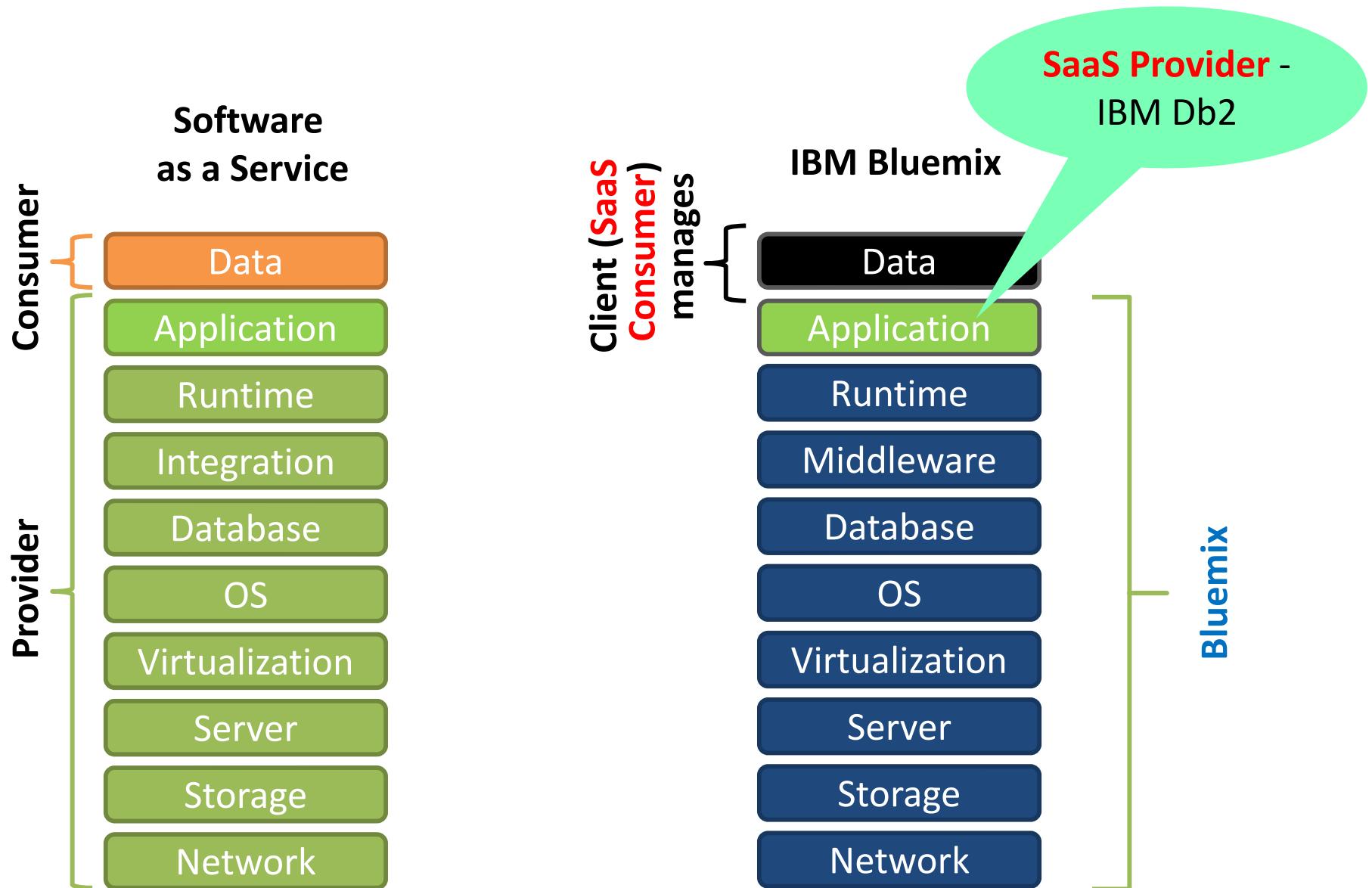
Analytics using In-cloud Database Service

- Objective: use SaaS service (Data & Analytics) to perform data analytics
- SaaS service: **Db2** is a “data warehousing and analytics solution”; stores relational data, supports querying and in cloud data analytics
- Sample Data: World development indicators for financial sector from World Bank; data is listed by countries with fields including currency, income groups, etc.
- Example: store data on database (Db2), run queries (SQL) and visualize data using statistical and numerical analysis tools (R)

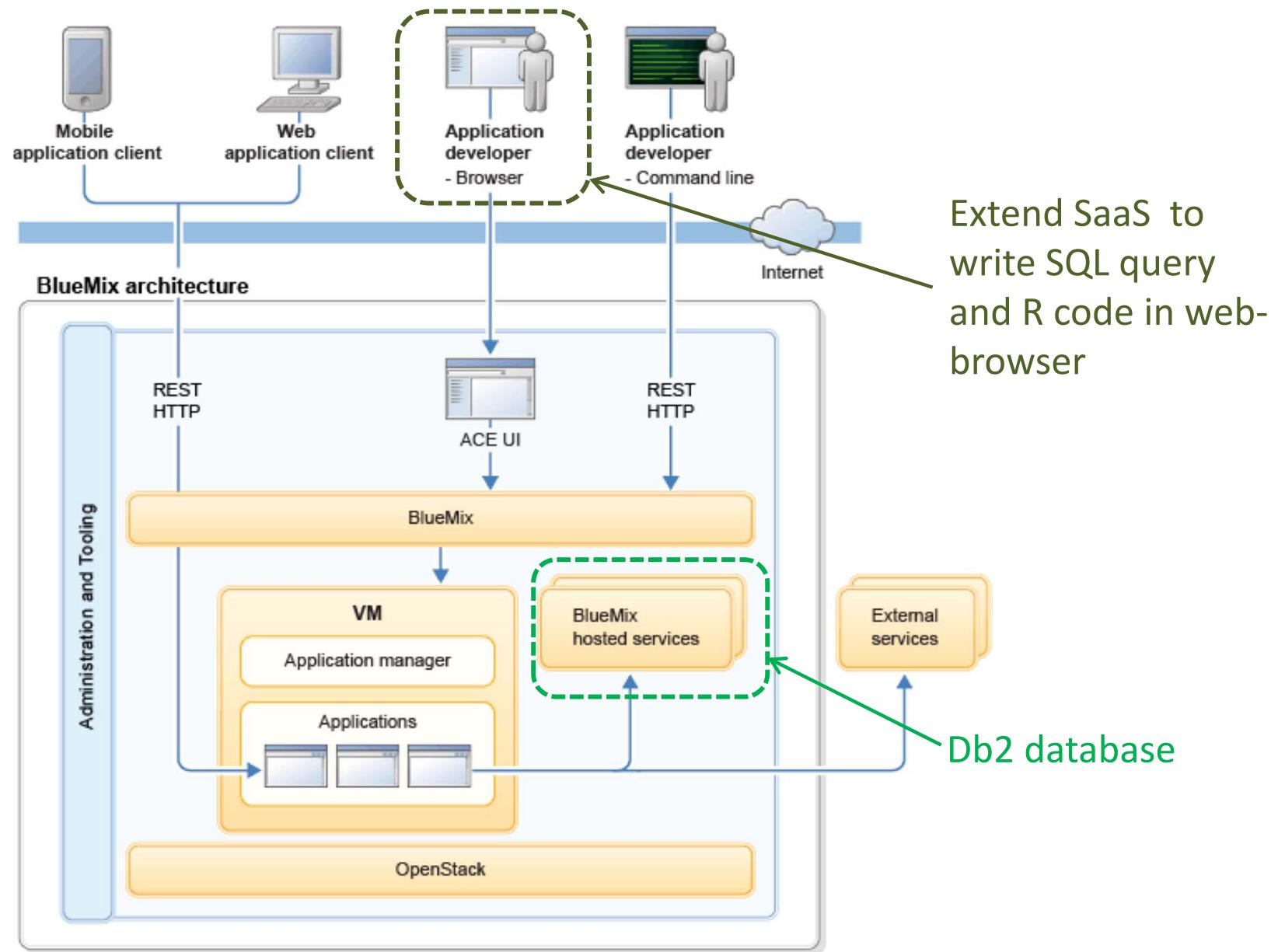
Analytics using Db2 Service



IBM Cloud Services - SaaS



Analytics using Db2 Service



In Built SQL Querying in Db2

The screenshot shows the IBM Db2 Warehouse on Cloud interface. At the top, there's a navigation bar with various tabs and links. Below it is a toolbar with buttons for Load, Explore, Run SQL, and Analyze. The main area is divided into two sections: a SQL editor on the left and a results table on the right.

SQL editor:

```
1 -- Enter SQL statements below or Load a SQL script into the editor from the toolbar.
2 SELECT "Country_Code", "Long_Name", "Currency_Unit", "Income_Group", "System_of_trade"
3 FROM DASH6649.EDSTATS
4 WHERE "Income_Group" LIKE 'Low%' AND "Country_Code" LIKE 'S%';
```

Jobs:

- Finished successfully:
All (1) Failed (0)
- Finished with errors:
All (1) Failed (1)

Results:

	COUNTRY_CODE	LONG_NAME	CURRENCY_UNIT	INCOME_GROUP	S
1	SLV	Republic of El Salvador	U.S. dollar	Lower middle income	Sp
2	SLB	Solomon Islands	Solomon Islands dollar	Lower middle income	Sp
3	SOM	Somali Democratic Republic	Somali shilling	Low income	

Analytics with R Scripting

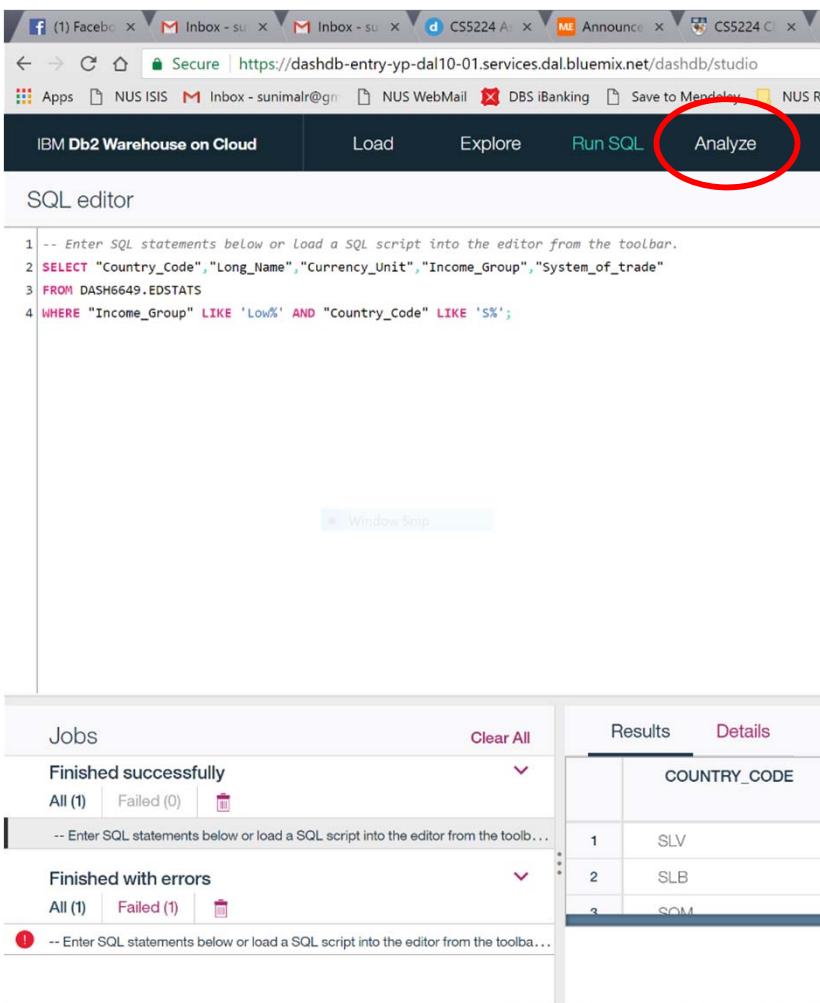
- R is a scripting language used for statistical computing including big data analysis, and data mining
- IBM Cloud offers R language support with IBM Data Science Experience service also known as DSX service
- Data loaded in an existing on-cloud database can be analyzed in a DSX project after properly linking the database to the SDX project



IBM Data Science Experience

In Built Analytics with IBM DSX

- Step1: Load data into a Db2 Database
- Step2: Launch DSX

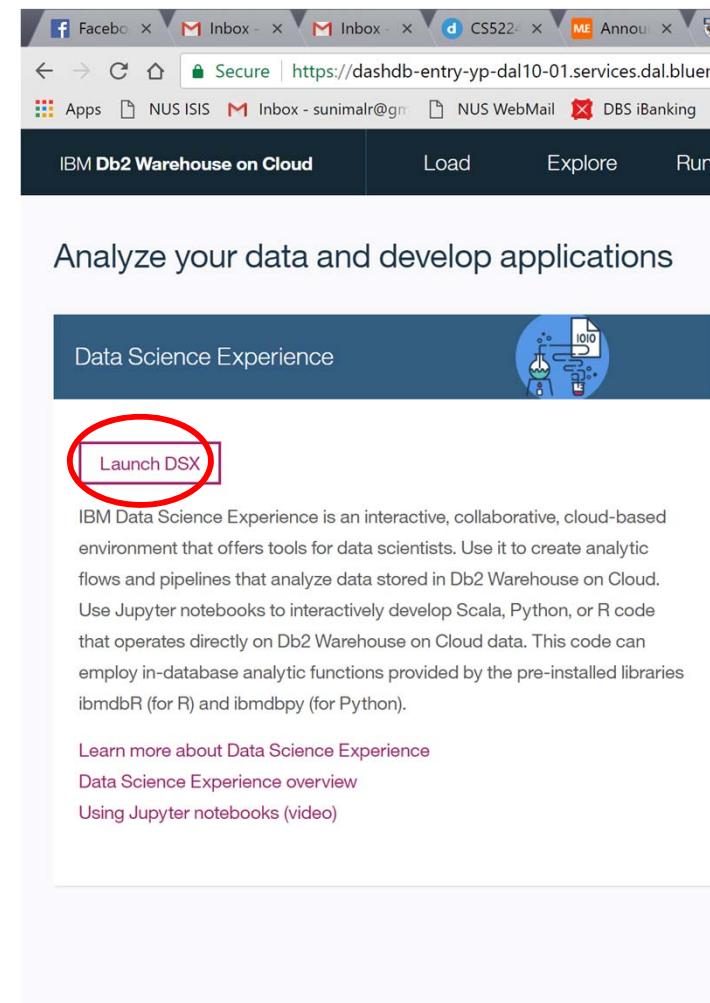


The screenshot shows the IBM Db2 Warehouse on Cloud interface. At the top, there is a navigation bar with tabs: 'Load', 'Explore', 'Run SQL', and 'Analyze'. The 'Analyze' tab is circled in red. Below the navigation bar is a 'SQL editor' section containing a block of SQL code:

```
1 -- Enter SQL statements below or Load a SQL script into the editor from the toolbar.
2 SELECT "Country_Code", "Long_Name", "Currency_Unit", "Income_Group", "System_of_trade"
3 FROM DASH6649.EDSTATS
4 WHERE "Income_Group" LIKE 'Low%' AND "Country_Code" LIKE 'S%';
```

At the bottom left, there is a 'Jobs' section with two categories: 'Finished successfully' and 'Finished with errors'. The 'Results' tab is selected in the main content area, displaying a table with three rows of data:

	COUNTRY_CODE
1	SLV
2	SLB
3	SOM



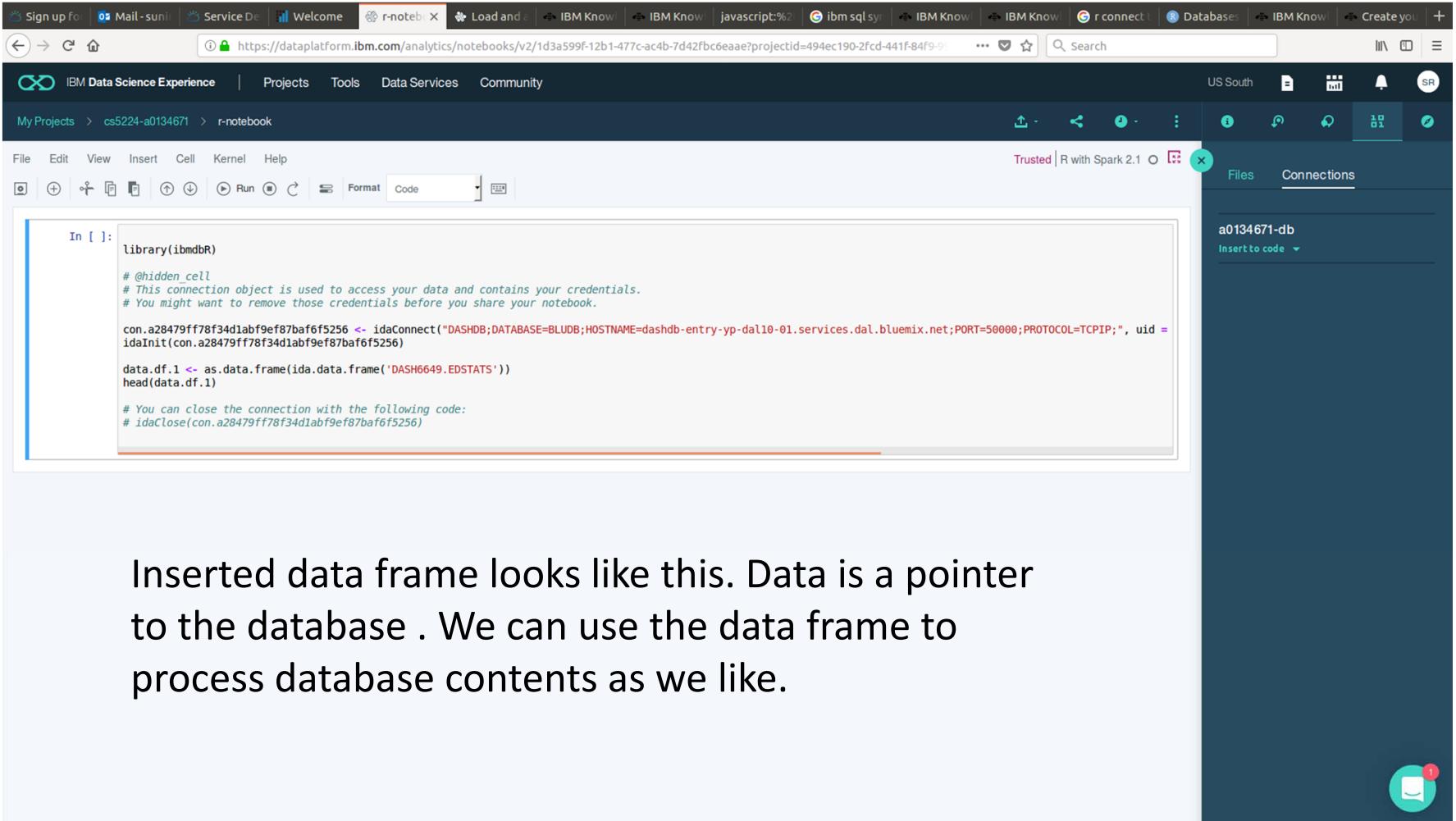
The screenshot shows the Data Science Experience interface. At the top, there is a header with the text 'Analyze your data and develop applications'. Below the header is a section titled 'Data Science Experience' featuring an icon of laboratory glassware. At the bottom of this section, the 'Launch DSX' button is circled in red. To the right of the button, there is a descriptive text block:

IBM Data Science Experience is an interactive, collaborative, cloud-based environment that offers tools for data scientists. Use it to create analytic flows and pipelines that analyze data stored in Db2 Warehouse on Cloud. Use Jupyter notebooks to interactively develop Scala, Python, or R code that operates directly on Db2 Warehouse on Cloud data. This code can employ in-database analytic functions provided by the pre-installed libraries ibmdbR (for R) and ibmdbpy (for Python).

Learn more about Data Science Experience
Data Science Experience overview
Using Jupyter notebooks (video)

Analytics Scripting Tools on DSX (e.g. R script)

- Process data in database using R scripts



The screenshot shows the IBM Data Science Experience R notebook interface. The URL in the browser is <https://dataplatform.ibm.com/analytics/notebooks/v2/1d3a599f-12b1-477c-ac4b-7d42fbcb6aae?projectId=494ec190-2fcf-441f-84f9-9>. The notebook title is "r-notebook". The code cell contains R code for connecting to a database:

```
In [ ]:
library(ibmdbR)

# @hidden_cell
# This connection object is used to access your data and contains your credentials.
# You might want to remove those credentials before you share your notebook.

con.a28479ff78f34d1abf9ef87baf6f5256 <- idaConnect("DASHDB;DATABASE=BLUDB;HOSTNAME=dashdb-entry-yp-dal10-01.services.dal.bluemix.net;PORT=50000;PROTOCOL=TCPIP;", uid =
idaInit(con.a28479ff78f34d1abf9ef87baf6f5256)

data.df.1 <- as.data.frame(ida.data.frame('DASH6649.EDSTATS'))
head(data.df.1)

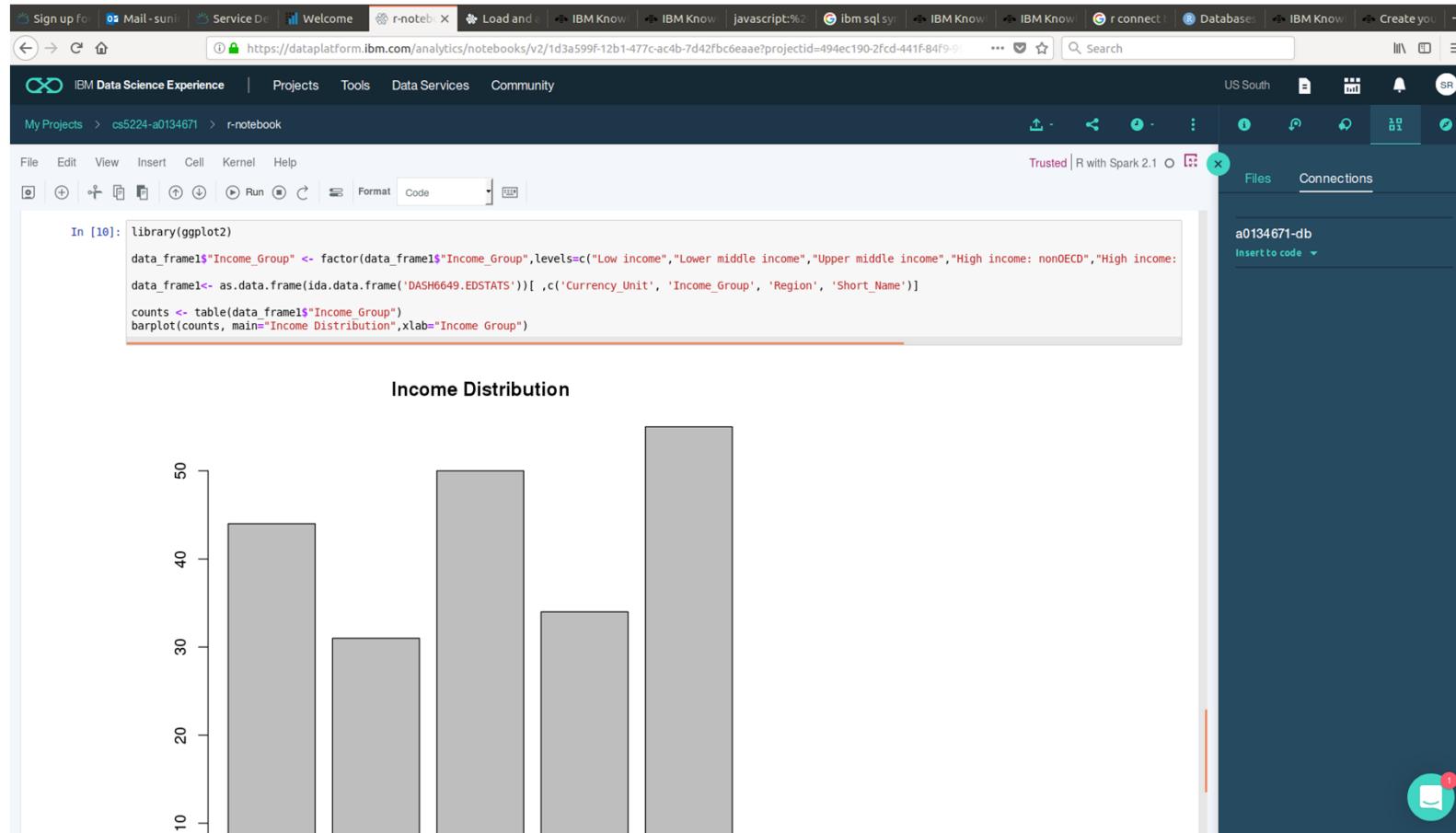
# You can close the connection with the following code:
# idaClose(con.a28479ff78f34d1abf9ef87baf6f5256)
```

The right sidebar shows a database connection named "a0134671-db" under the "Connections" tab.

Inserted data frame looks like this. Data is a pointer to the database . We can use the data frame to process database contents as we like.

In-built Visualization

- Different libraries are available on cloud for visualization of processed data



EXAMPLE 3

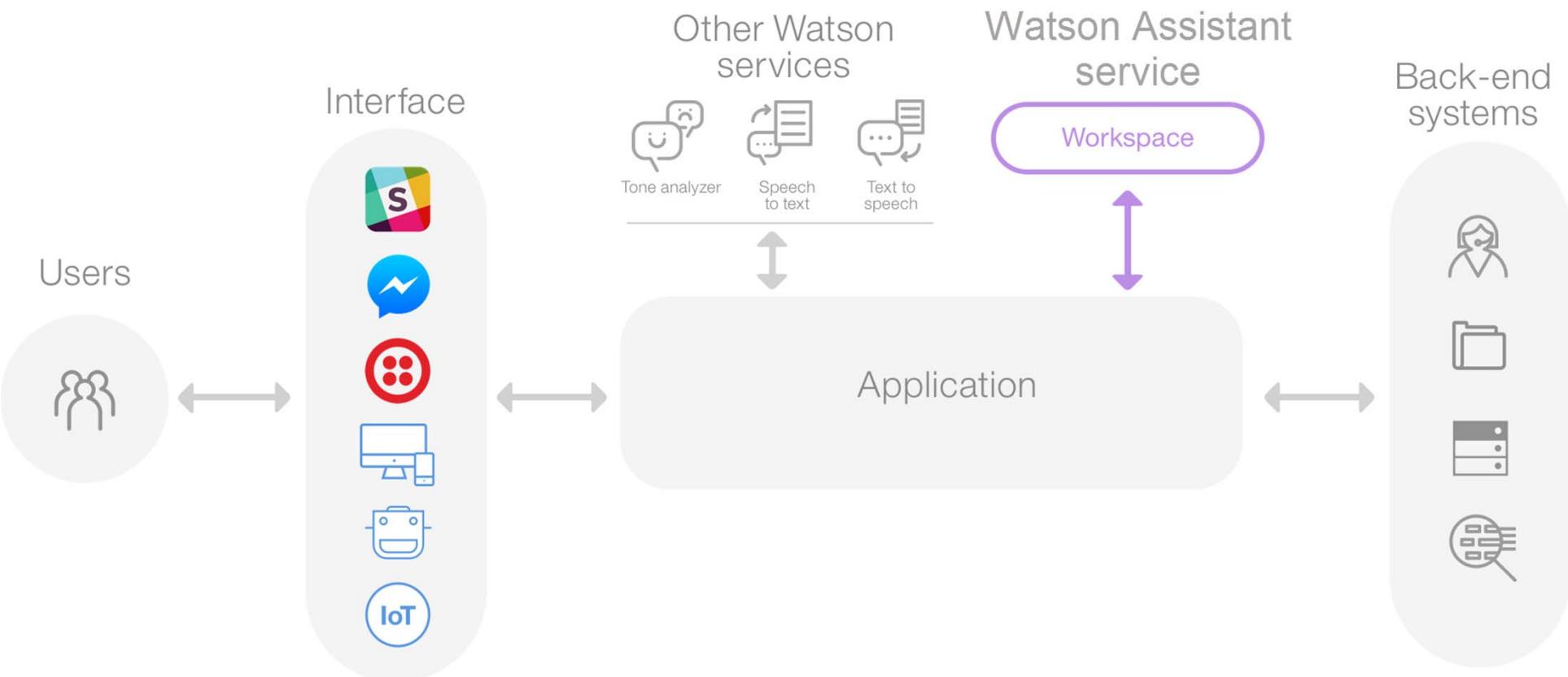
SaaS: IBM Watson Analytics

- Overview
- Application Architecture
- Example of Personality Insights

IBM Watson

- Watson is a cognitive analysis service powered by different AI techniques
- Watson could be used for different cognitive tasks such as
 - summarize a text to filter important points
 - analyze a person's personality based on a their resume
 - build interactive chat-bots to communicate with clients and answer their questions
 -
- Watson comes with a comprehensive API that helps integrate it with other IBM tools and services such as database, machine learning, web applications, among others

Example of Watson Application Architecture



IBM Watson Personality Insights: Obama's Speech

Well, thank you very much, Jim, for this opportunity. I want to thank Governor Romney and the University of Denver for your hospitality.

There are a lot of points I want to make tonight, but the most important one is that 20 years ago I became the luckiest man on Earth because Michelle Obama agreed to marry me.

And so I just want to wish, Sweetie, you happy anniversary and let you know that a year from now we will not be celebrating it in front of 40 million people.

You know, four years ago we went through the worst financial crisis since the Great Depression.

Millions of jobs were lost, the auto industry was on the brink of collapse. The financial system had frozen up.

And because of the resilience and the determination of the American people, we've begun to fight our way back. Over the last 30 months, we've seen 5 million jobs in the private sector created. The auto industry has come roaring back. And housing has begun to rise.

But we all know that we've still got a lot of work to do. And so the question here tonight is not where we've been, but where we're going.

Governor Romney has a perspective that says if we cut taxes, skewed towards the wealthy, and roll back regulations, that we'll be better off. I've got a different view.

I think we've got to invest in education and training. I think it's important for us to develop new sources of energy here in America, that we change our tax code to make sure that we're helping small businesses and companies that are investing here in the United States, that we take some of the money that we're saving as we wind down two wars to rebuild America and that we reduce our deficit in a balanced way that allows us to make these critical investments.

Now, it ultimately is going to be up to the voters — to you — which path we should take. Are we going to double on top-down economic policies that helped to get us into this mess or do we embrace a new economic patriotism that says America does best when the middle class does best? And I'm looking forward to having that debate.

Well, let me talk specifically about what I think we need to do. First, we've got to improve our education system and we've made enormous progress drawing on ideas both from Democrats and Republicans that are already starting to show gains in some of the toughest to deal with schools. We've got a program called Race to the Top that has prompted reforms in 46 states around the country, raising standards, improving how we train teachers.

So now I want to hire another 100,000 new math and science teachers, and create 2 million more slots in our community colleges so that people can get trained for the jobs that are out there right now. And I want to make sure that we keep tuition low for our young people.

.....
.....
.....

source: <https://personality-insights-demo.ng.bluemix.net/>



Analyzing
Obama's
speech,
Watson derives
Obama's
personality!

Summary

You are particular, analytical and shrewd.

You are assertive: you tend to speak up and take charge of situations, and you are comfortable leading groups. You are philosophical: you are open to and intrigued by new ideas and love to explore them. And you are empathetic: you feel what others feel and are compassionate towards them.

Your choices are driven by a desire for organization.

You are relatively unconcerned with both achieving success and taking pleasure in life. You make decisions with little regard for how they show off your talents. And you prefer activities with a purpose greater than just personal enjoyment.

You are likely to _____

- be sensitive to ownership cost when buying automobiles
- like historical movies
- volunteer for social causes

You are unlikely to _____

- be influenced by social media during product purchases
- prefer style when buying clothes
- like rap music

Video

[How-to's & Demos: A Tour of Bluemix 2017](#)

[IBM Watson: How it Works 2015](#)

Summary

- IBM datacenter organization and Bluemix services
- PaaS: Developing a Web Application
- SaaS: Simple SQL query using Db2 service with simple R script to plot analysis results
- SaaS: Watson Analytics with Example

References

- [NodeJS-DashDB example](#)
- Demo: Getting Started with [Node.js](#) on Bluemix 2016- https://www.youtube.com/watch?v=sHhNoV-S_I&list=PLJxa6lsF8C5qFbRinR2ZaEZ3AiIFTdLqx (13 mins)
- [IBM Bluemix The Cloud Platform for Creating and Delivering Applications](#), IBM Redbooks, 2015.
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