# World of Open Source on IBM i

Jesse Gorzinski
Business Architect
jgorzins@us.ibm.com

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## Agenda

- Strategy & Success Stories
- What is IBM i doing?
- Latest News

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# Strategy and Success Stories

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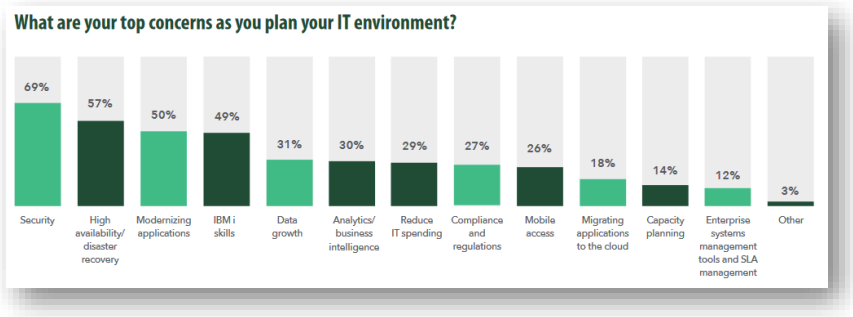
## IBM i Marketplace Survey (HelpSystems)




https://www.helpsystems.com/resources/guides/ibm-i-marketplace-survey-results

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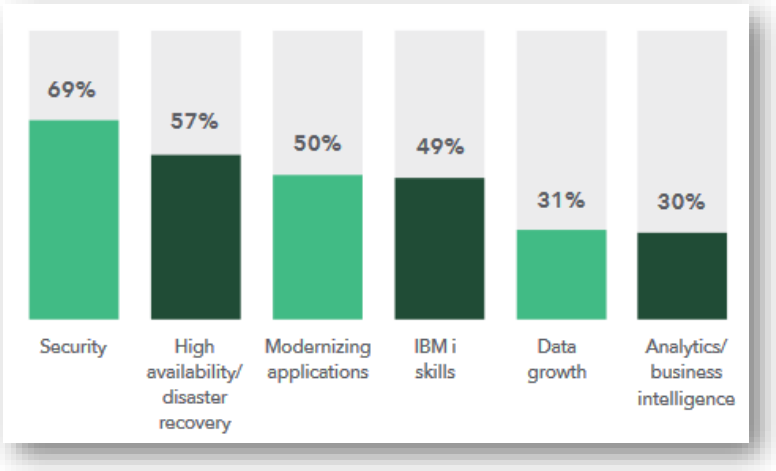
## What are your top concerns as you plan your IT environment? (check all that apply)




https://www.helpsystems.com/resources/guides/ibm-i-marketplace-survey-results

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JORI

https://www.ibm.com/case-studies/c223622o41231s41

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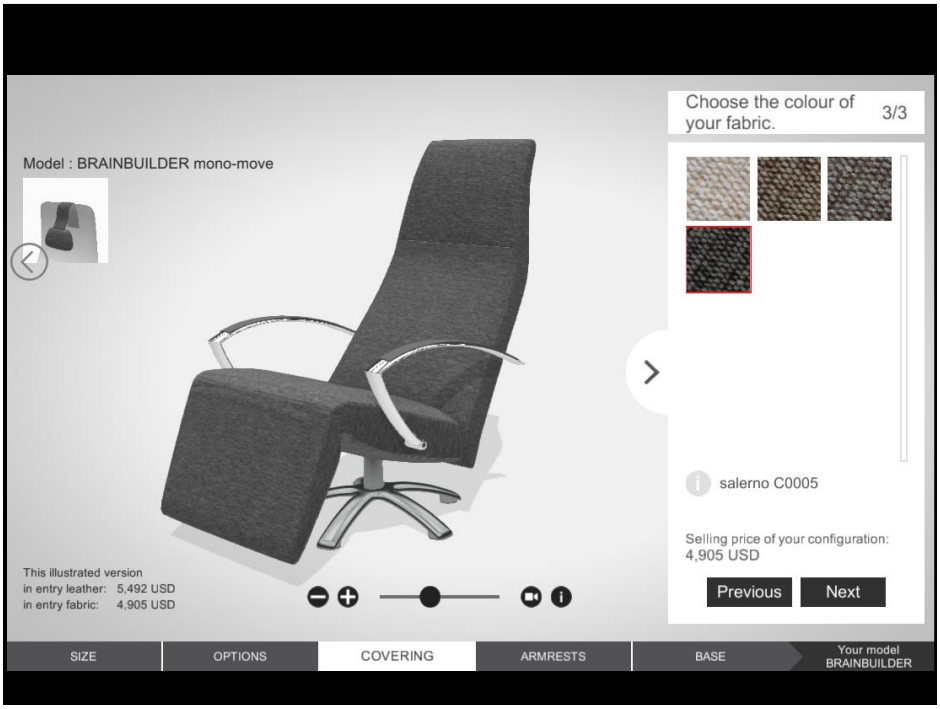
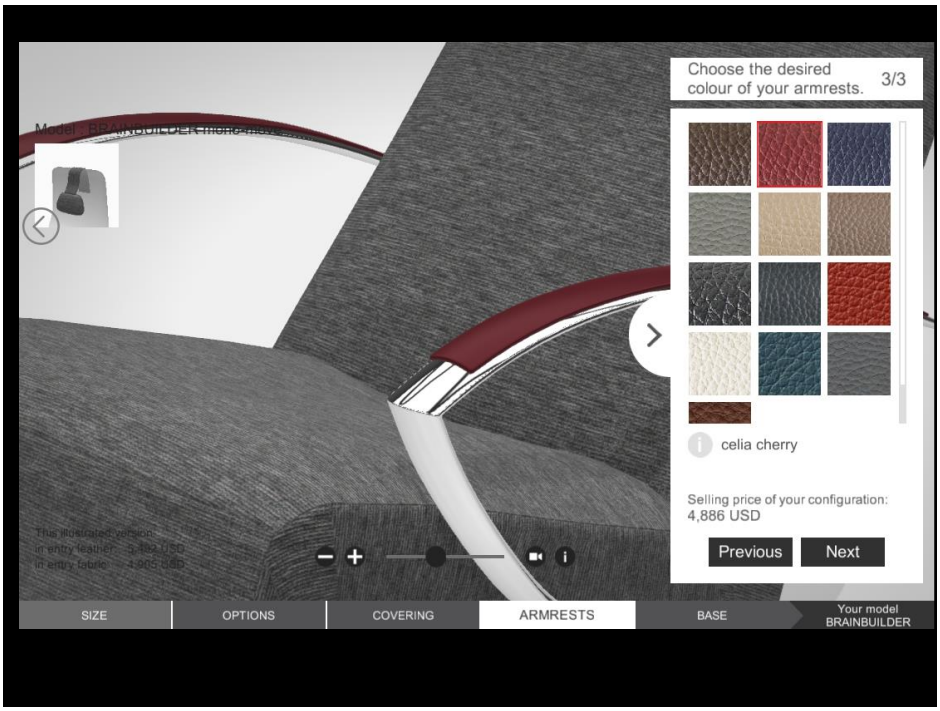

Model : BRAINBUILDER mono-move
This illustrated version
in entry leather: 5,492 USD
in entry fabric: 4,905 USD
Choose the colour of your fabric.
3/3
salerno C0005
Selling price of your configuration:
4,905 USD
Previous
Next
SIZE
OPTIONS
COVERING
ARMRESTS
BASE
Your model BRAINBUILDER


Choose the desired colour of your armrests.
3/3
celia cherry
Selling price of your configuration:
4,886 USD
Previous
Next
SIZE
OPTIONS
COVERING
ARMRESTS
BASE
Your model BRAINBUILDER

## Deknudt Frames

- https://www.ibm.com/case-studies/deknudt-frames

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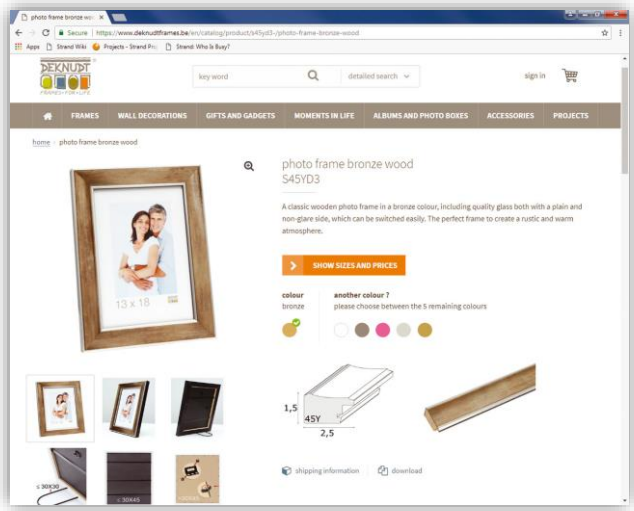
## Deknudt Frames

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## Deknudt Frames

"By launching its **new e-commerce platform on IBM i on the Power Systems platform**, Deknudt Frames has expanded its market reach, given retail partners an out-of-the-box web store they can integrate into their own websites, streamlined payment and inventory processing, and reduced the cost of IT administration.

Deknudt says: "We have also enabled our retail partners to offer a much wider selection of our products to their customers. Now, retailers can stock the most popular items, and if a shopper would like something slightly different, the retailer can easily place an order with us. The solution is enabling us to broaden our market reach—we anticipate that this will soon drive higher revenues."

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## Deknudt Frames

- "This e-commerce platform is another example of how we are using technology to generate competitive advantage. And what's really interesting is that this up-to-date, **open source solution runs side-by-side and fully integrated with trusted core business systems originally coded in the 1970s.** In all the years we've used IBM i and the Power Systems platform, we've never experienced any issues around stability or security, which contributes to the low total cost of ownership—for us, IBM i is a phenomenally stable platform for business that is also open to all kinds of future possibility."

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## Case studies galore

*"The ability to run the latest open source software alongside unmodified code from the 1980s is surely unheard of on any other platform, and this offers huge value to our business in terms of reducing both ongoing risk and costs in IT."*

https://www.ibm.com/case-studies/cras-systems-open-source

*"The fact that the platform supports open source solutions means that we can leverage the very best technology and benefit from the support and development of the open source community while avoiding inhibitive licensing costs.*

https://www.ibm.com/case-studies/fibrocit-systems-furniture-design

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## Case studies galore

*"Everything – both core business systems and the new open source solutions – runs on IBM i, so reliability is perfect as always. And the faster processes have certainly made our lives easier."*

https://cms.ibm.com/case-studies/winsol-systems-hardware-manufacturing-digitization

*"We can develop in C, PHP, Java – there's now a full range of open source software on the platform that meshes seamlessly with the core technologies that we've been running for decades."*

https://cms.ibm.com/case-studies/kube-pak-systems-gardening-wholesale

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## Case studies galore

Immo Bonehill

***"The website runs using a combination of RPG and open source software. All of it integrates seamlessly with the IBM i operating system"***

https://www.ibm.com/case-studies/immo-bonehill-systems-hardware-website-compliance

ORIS

***"The solution combines tried-and-trusted systems with the latest in open source innovation to create new value."***

https://www.ibm.com/case-studies/ORIS

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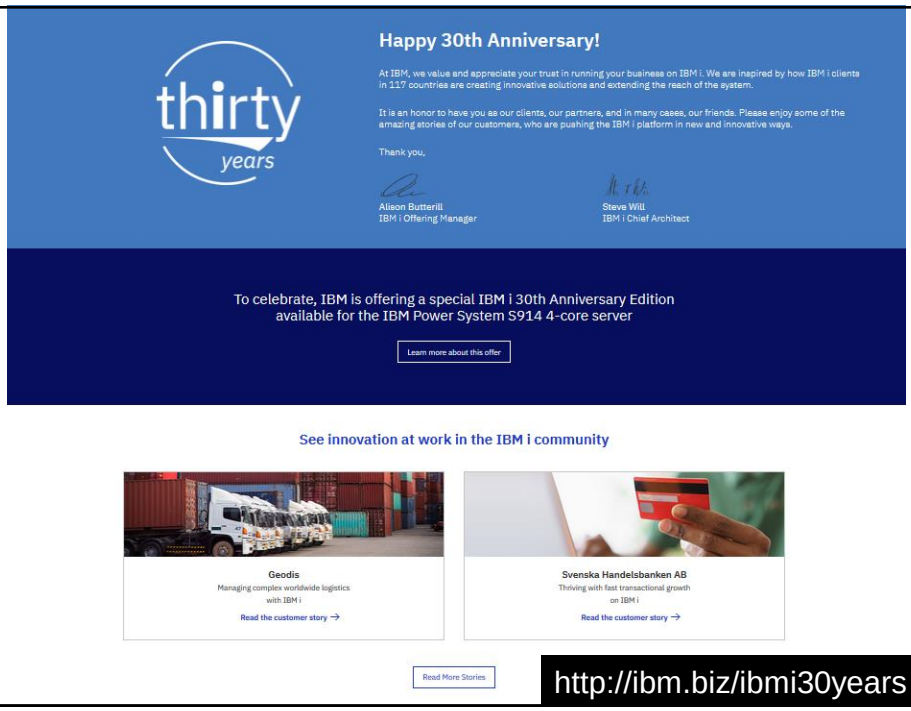


http://ibm.biz/ibmi30years

## IBM i 30th Anniversary Customer Stories

- Norwegian Air Ambulance Foundation: PHP
- FRS: PHP
- Sunstate: PHP
- Krengeltech: Node.js, Python, chroot
- Robertet: Java
- Kube-Pak: PHP, Java, More
- Mutual Distributing Company: Node.js, Ruby, Python, PHP
- Deknudt Frames: Web tech, Ghostscript, ImageMagick
- Mission Produce and Avocado Packing Company: PHP
- JORI: ibmichroot (containers), gaming software

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## IBM i 30th Anniversary Customer Stories – CONTINUED!!

- Geodis: Node.js
- RPC Superfos: Python, Node.js
- King III Solutions: PHP
- Fuyo General Lease: PHP, SugarCRM
- HT BENDIX A/S: Open Source Licensed Program
- ORIS: PHP, Drupal, curl, ImageMagick
- Assura: the latest open source solutions
- Cras: the latest open source components
- Kuehne + Nagel S.à.r.l.: Node.js
- Carnegie General Insurance Agency: .NET
- TMISI: Web technologies

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## Customer stories

- "Three Ways Open Source Brings Business Value" http://ibmsystemsmag.com/blogs/open-your-i/november-2018/three-ways-open-source-brings-business-value/

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# What is IBM i doing?

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## What are IBM i teams doing?

- Delivering open source technology
  - Languages (Node.js, Python, Lua, Perl, etc)
  - Machine Learning capabilities
  - Integration to RPG, Db2, etc.
  - User Tools (git, vim, Midnight Commander, lftp, rsync, bash, etc)
  - Developer Tools (compilers, build toolchain, RPM build tools)
  - Important ecosystem pieces
- Contributing to open source projects. Nature of contributions (50+ projects):
  - IBM i porting
  - General enhancements
  - Complete authorship
  - Documentation improvements
- Maintaining key partnerships
- Participating in the open source community

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## 5733-OPS Roadmap

**5733-OPS**

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## 5733-OPS Roadmap

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## 5733-OPS Roadmap

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## 5733-OPS Update

- Planning pages updated to reflect 5733-OPS end of life
  https://www-01.ibm.com/support/docview.wss?uid=nas8N1022039

"IBM i Open Source Solutions packages are now delivered via RPMs rather than via 5733-OPS Licensed Program Product (LPP) options. For more information on how to acquire the software via RPMs, refer to the documentation at http://ibm.biz/ibmi-rpms

Effective September 24, 2018, the following options no longer receive support or fixes:

Option 1 (Node.js beta release)
Option 3 (chroot and compiler enablement)
Option 5 (Node.js version 4)
Option 8 (Eclipse Orion)

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## 5733-OPS Update

The remaining options will no longer receive support or fixes beyond the following dates:

Option 2 (Python 3.4): February 28, 2019
Option 10 (Node.js version 6): April 4, 2019
Options 4, 6, 7, 9, and 11: December 15, 2019

All future open source packages are delivered via RPM only.

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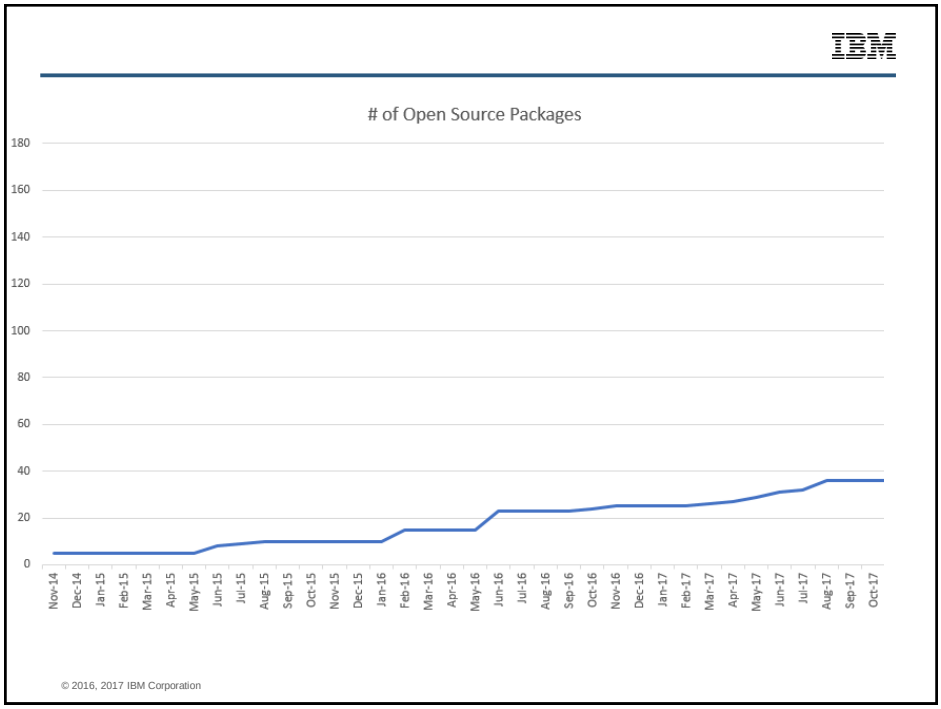
# of Open Source Packages
180
160
140
120
100
80
60
40
20
0
Nov-14
Dec-14
Jan-15
Feb-15
Mar-15
Apr-15
May-15
Jun-15
Jul-15
Aug-15
Sep-15
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Nov-15
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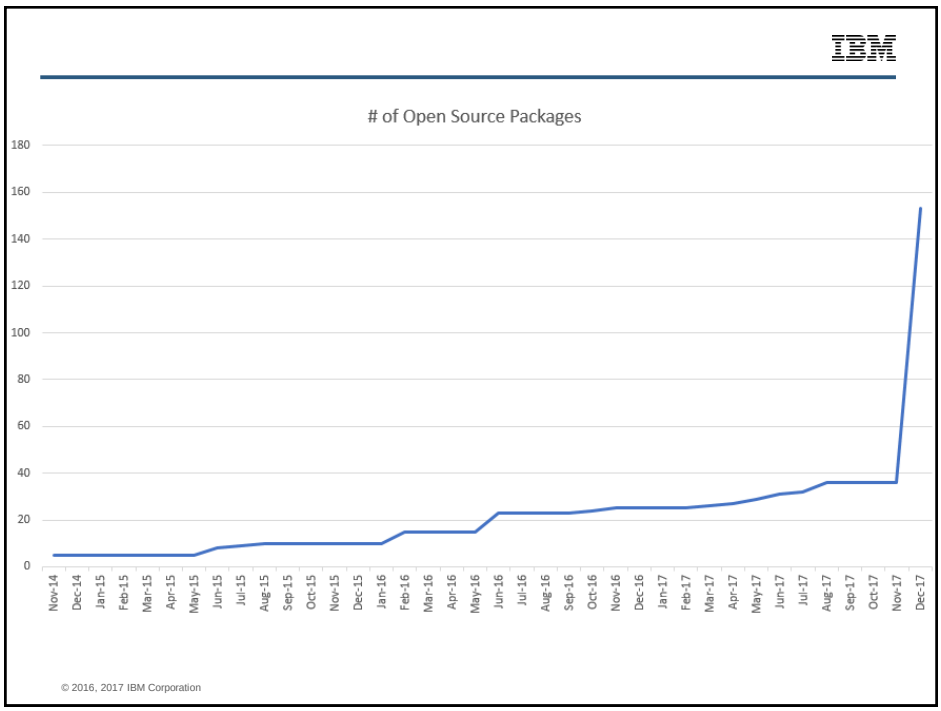
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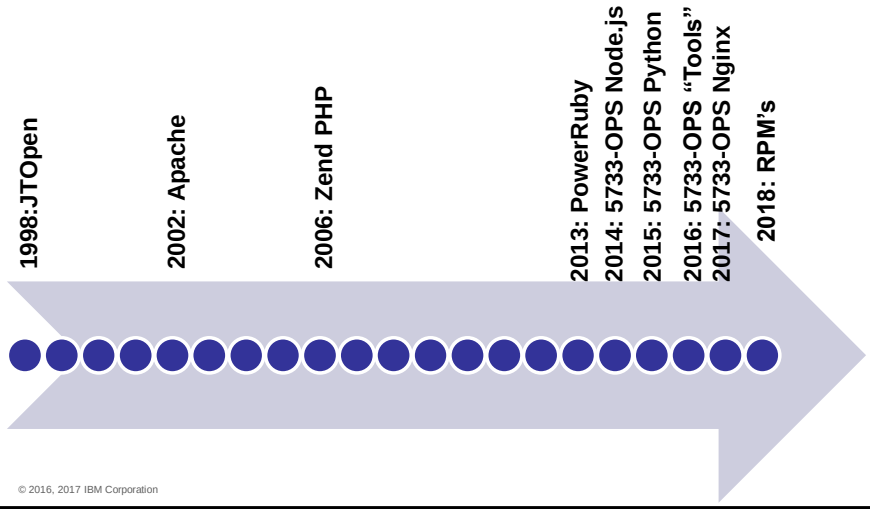
## Open Source on i: timeline

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## Move to RPM's significant

- 5733-OPS is no longer needed!
- Allows delivery of much more technology
  - Automated build+test, continuous integration, continuous delivery
  - Dozens of packages in 5733-OPS, hundreds in RPM
- Allows faster delivery of security fixes
- Install an entire open source ecosystem in a matter of minutes!!
- Allows more parties to build, support, or distribute open source technology

- To get started:
- http://ibm.biz/ibmi-rpms

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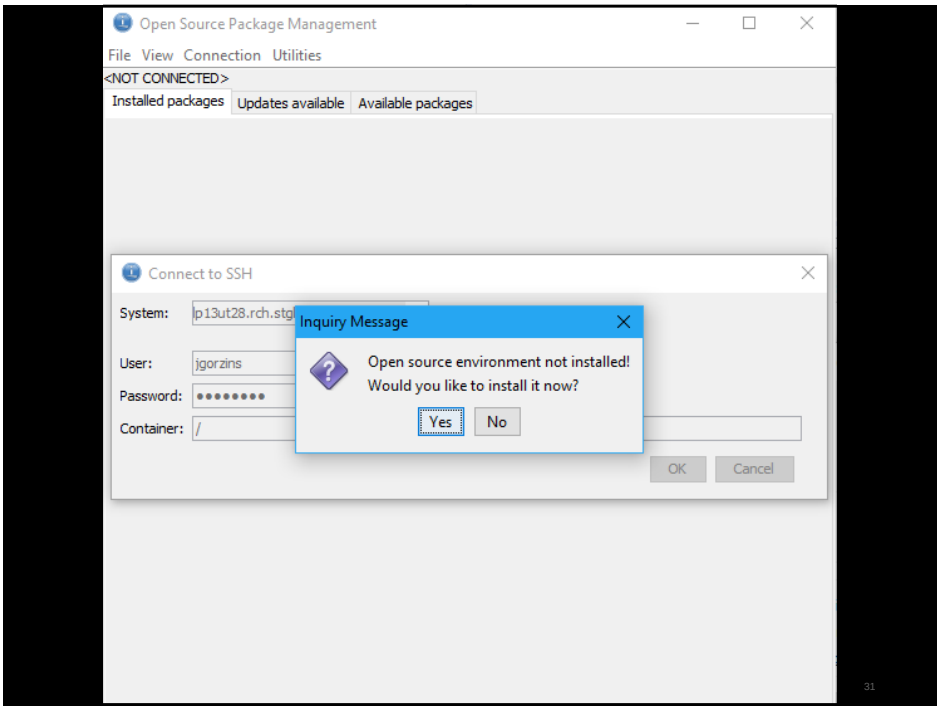
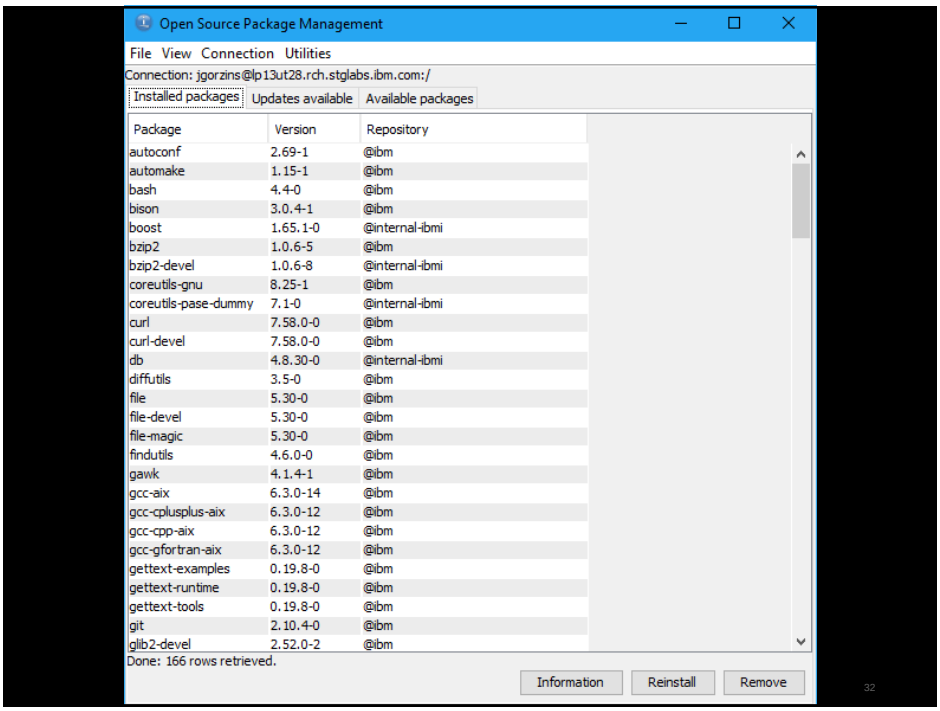

Open Source Package Management
File View Connection Utilities
<NOT CONNECTED>
Installed packages
Updates available
Available packages
Connect to SSH
System:
User:
jgorzins
Password:
Container:
/
OK
Cancel
Inquiry Message
Open source environment not installed!
Would you like to install it now?
Yes
No


Open Source Package Management
File View Connection Utilities
Connection: jgorzins@lp13ut28.rch.stglabs.ibm.com:/
Installed packages
Updates available
Available packages
Package | Version | Repository
autoconf | 2.69-1 | @ibm
automake | 1.15-1 | @ibm
bash | 4.4-0 | @ibm
bison | 3.0.4-1 | @ibm
boost | 1.65.1-0 | @internal-ibmi
bzip2 | 1.0.6-5 | @ibm
bzip2-devel | 1.0.6-8 | @internal-ibmi
coreutils-gnu | 8.25-1 | @ibm
coreutils-pase-dummy | 7.1-0 | @internal-ibmi
curl | 7.58.0-0 | @ibm
curl-devel | 7.58.0-0 | @ibm
db | 4.8.30-0 | @internal-ibmi
diffutils | 3.5-0 | @ibm
file | 5.30-0 | @ibm
file-devel | 5.30-0 | @ibm
file-magic | 5.30-0 | @ibm
findutils | 4.6.0-0 | @ibm
gawk | 4.1.4-1 | @ibm
gcc-aix | 6.3.0-14 | @ibm
gcc-cplusplus-aix | 6.3.0-12 | @ibm
gcc-cpp-aix | 6.3.0-12 | @ibm
gcc-gfortran-aix | 6.3.0-12 | @ibm
gettext-examples | 0.19.8-0 | @ibm
gettext-runtime | 0.19.8-0 | @ibm
gettext-tools | 0.19.8-0 | @ibm
git | 2.10.4-0 | @ibm
glib2-devel | 2.52.0-2 | @ibm
Done: 166 rows retrieved.
Information
Reinstall
Remove

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## yum command line tool

- Install/remove packages
- Check for updates
- Check what packages are available
- Check versions of packages
- Check what package ships a certain file
- See the activity history

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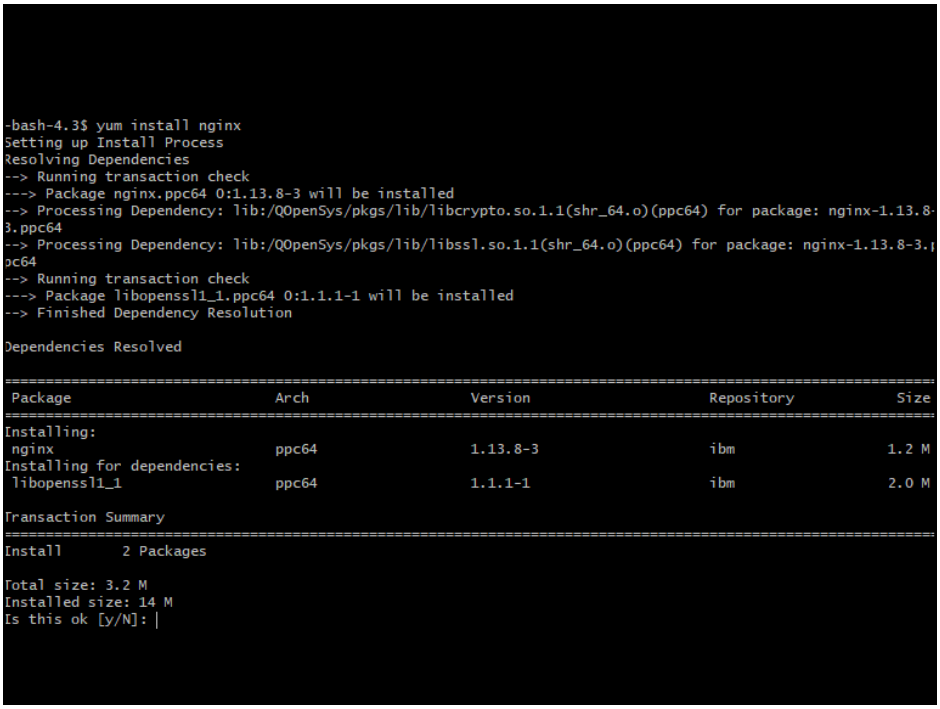

# What is IBM i doing? Languages

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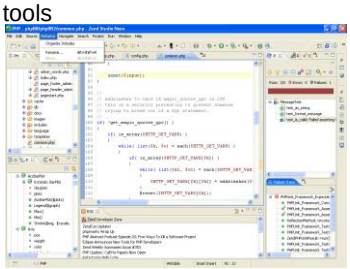
## What IBM i is doing –partnership Rogue Wave

- Zend Server for i
  - Preloaded with IBM i 7.1 and 6.1
  - One year of Silver Support from Zend
- Zend Server Development edition
  - Reduced cost – include Z-Ray and other dev tools
- Zend Studio for i
  - Eclipse-based development environment
  - One year of Silver support from Zend
- Zend DBi
  - MySQL implementation for IBM i
  - Db2 Storage Engine enables data storage in Db2 for i



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## IBM i Shops using php

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## What IBM i is doing – partnership with PowerRuby

- What is PowerRuby?
  - Freely available and commercially supported port of the Ruby language
  - Includes supporting infrastructure (i.e. Rails) for Ruby web applications on IBM i
  - Available for download from PowerRuby.com
  - Includes native DB2 database driver – MySQL not necessary
  - Integrates with XMLSERVICE for access to IBM i programs and objects
- Components
  - Ruby 2.0.0 and 1.9.3 (MRI implementation, a.k.a CRuby)
  - ibm_db (IBM supported - http://rubyforge.org/projects/rubyibm/)
  - Apache + Thin ← the web server stack (more Ruby app servers options coming)
  - Rails 3.2.x and 4.0.0 (Coffeescript support in the works)
- Learn more
  - PowerRuby.com for updates and news
  - twitter.com/rubyonpower

PowerRuby

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## Python

- What's Python?
  - A powerful general-purpose language
  - Interpreted

- Why Python?
  - Easy to use
    - Language is designed to be a "fun" language
    - Can be considered the 'CL language for the modern programmer'
    - Easy for IBM i programmers to learn
  - Very, very popular
    - Over 130,000 third-party extensions are available on http://pypi.org

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## Origin of the "Python" name?

"Now, it's quite simple to defend yourself against a man armed with a banana. First of all you force him to drop the banana; then, second, you eat the banana, thus disarming him. You have now rendered him helpless."

"This parrot is no more! He has ceased to be!"

"I'm sorry to have kept you waiting, but I'm afraid my walk has become rather sillier recently."

"I don't like Spam©!"

"That rabbit's dynamite!"

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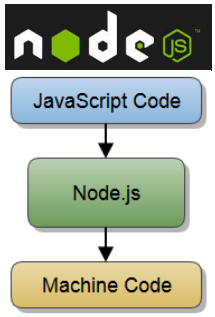
## Node.JS




- What's Node.JS?
  - Simply put, Node.js is server-side JavaScript
  - Based on Google Chrome V8 Engine.
- Why Node.JS?
  - Great for web development!
    - JavaScript is already widely used on the client side of web development
    - Can now do both
  - High Performance
    - Node.js is designed to maximize throughput and efficiency.
  - Increasing popularity:
    - More than 650,000 third-party extensions are available on www.npmjs.org now.

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## Some numbers

**125,000** Python modules

- Python Package Index (pypi.python.org)

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## Some numbers

**700,000** Node.js packages

- Npmjs.com

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# What is IBM i doing? Integration

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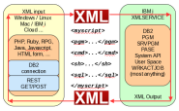
## Things we deliver with every new language/version

- FastCGI
  - Allows fast connection from HTTP server to backend PASE environment

- ILE Object Toolkit
  - Toolkit for each environment to easily allow connections to ILE objects and information – Built on XMLService




- SQL Connector
  - Easy integrated (from the open source language) way to transfer data to and from DB2 for i leveraging SQL

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## IBM i Services

- With every major language, we deliver a high-performance, robust database connector!
- Access system data through SQL!
  - PTF
  - Security
  - Message Handling
  - Librarian
  - Work Management
  - Communication
  - Storage
  - Product
  - System Health
  - Journal
  - Java
- More being continuously added

**http://ibm.biz/DB2foriServices**

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## IBM i Services - Examples

```
-- Description: Review the connections that are transferring the most data
SELECT BYTES_SENT_REMOTELY,BYTES_RECEIVED_LOCALLY, LOCAL_ADDRESS, LOCAL_PORT,
 REMOTE_ADDRESS, REMOTE_PORT
    FROM QSYS2.NETSTAT_INFO
    ORDER BY BYTES_SENT_REMOTELY + BYTES_RECEIVED_LOCALLY DESC LIMIT 10;
```

| BYTES_SENT_REMOTELY | BYTES_RECEIVED_LOCALLY | LOCAL_ADDRESS | LOCAL_PORT | REMOTE_ADDRESS | REMOTE_PORT |
|---|---|---|---|---|---|
| 485406 | 56674575 | 0.0.0.0 | 138 | 0 | 0 |
| 427724 | 39126540 | 0.0.0.0 | 137 | 0 | 0 |
| 12790347 | 19036432 | 0.0.0.0 | 657 | 0 | 0 |
| 0 | 1723680 | 0.0.0.0 | 427 | 0 | 0 |
| 0 | 1723680 | 0.0.0.0 | 427 | 0 | 0 |
| 0 | 1723680 | :: | 427 | :: | 0 |
| 89183 | 51089 | 9.5.36.187 | 8475 | 9.77.134.79 | 59508 |
| 54575 | 39915 | 9.5.36.187 | 446 | 9.77.134.79 | 59565 |
| 59148 | 20944 | 9.5.36.187 | 23 | 9.77.134.79 | 59530 |
| 22848 | 22848 | 0.0.0.0 | 123 | 0 | 0 |

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## IBM i Services - Examples

```
-- Description: Show me disk units and how full they are
SELECT ASP_NUMBER,UNITNBR,PERCENT_USED
    FROM QSYS2.SYSDISKSTAT;
```

| ASP_NUMBER | UNITNBR | PERCENT_USED |
|---|---|---|
| 1 | 1 | 30.062 |
| 1 | 2 | 28.535 |
| 1 | 3 | 28.531 |
| 1 | 4 | 28.529 |
| 1 | 5 | 28.529 |
| 1 | 6 | 28.537 |
| 1 | 7 | 28.529 |

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# What is IBM i doing? User and Developer Tools

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## Developer access to IBM i

- IBM i can be accessed with an SSH client
  - X11 forwarding is supported
- Filesystem can be accessed with
  - SMB
  - sftp/scp
  - sshfs
  - ftp/ftps
  - several IBM i-specific access tools
- Tools used for editing code
  - Visual Studio Code
  - Notepad++
  - Eclipse
  - Eclipse Orion
  - vi/emacs/joe
  - Rational Developer for i

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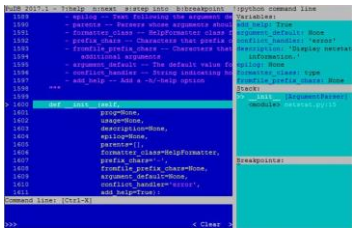
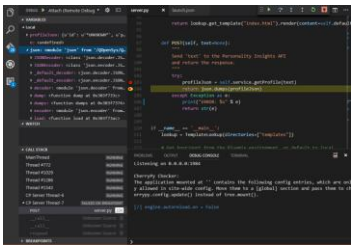
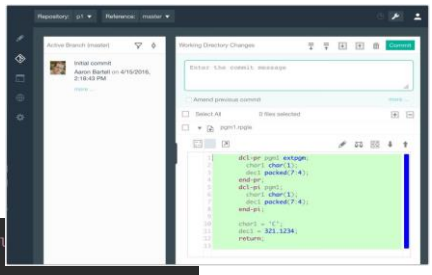
## Developer access to IBM i

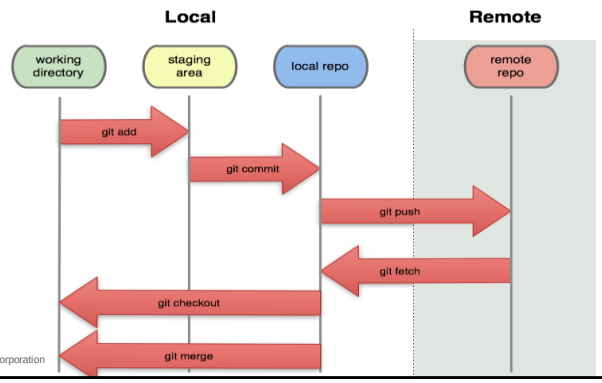






## Git

- Open Source distributed version control system
- Source control for virtually any language
- Powerful and flexible
- Can have hooks to perform custom actions when new code is integrated
- Already in use in the IBM i community

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# Some of the Latest News

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## .NET Available on IBM i!!

- Mono has been ported to IBM i!!
- Community Effort
- Available via third-party RPM repository

  https://bitbucket.org/ibmi/opensource/src/master/docs/yum/3RD_PARTY_REPOS.md

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## Easy install with yum!

```
-bash-4.4$ yum list mono\*
Available Packages
mono-complete.ppc64                                    5.21.0.500-0
mono-core.ppc64                                        5.21.0.500-0
mono-data.ppc64                                        5.21.0.500-0
mono-data-db2.ppc64                                    5.21.0.500-0
mono-data-oracle.ppc64                                 5.21.0.500-0
mono-data-sqlite.ppc64                                 5.21.0.500-0
mono-devel.ppc64                                       5.21.0.500-0
mono-extras.ppc64                                      5.21.0.500-0
mono-mvc.ppc64                                         5.21.0.500-0
mono-nunit.ppc64                                       5.21.0.500-0
mono-reactive.ppc64                                    5.21.0.500-0
mono-wcf.ppc64                                         5.21.0.500-0
mono-web.ppc64                                         5.21.0.500-0
mono-winforms.ppc64                                    5.21.0.500-0
mono-winfxcore.ppc64                                   5.21.0.500-0
monodoc-core.ppc64                                     5.21.0.500-0
```

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## Machine Learning enabled on IBM i

- RPM enablement
- Python enablement
- BLAS enablement
- Db2 connection

- Most famous ML packages available
  - Numpy, Pandas for data processing
  - Scipy, Scikit Learn for ML and scientific analysis
  - ipython, interactive python language support
  - nltk, natural language toolkit for natural language ML process.
  - matplotlib, jupyter notebook for visual/interactive ML/data analysis

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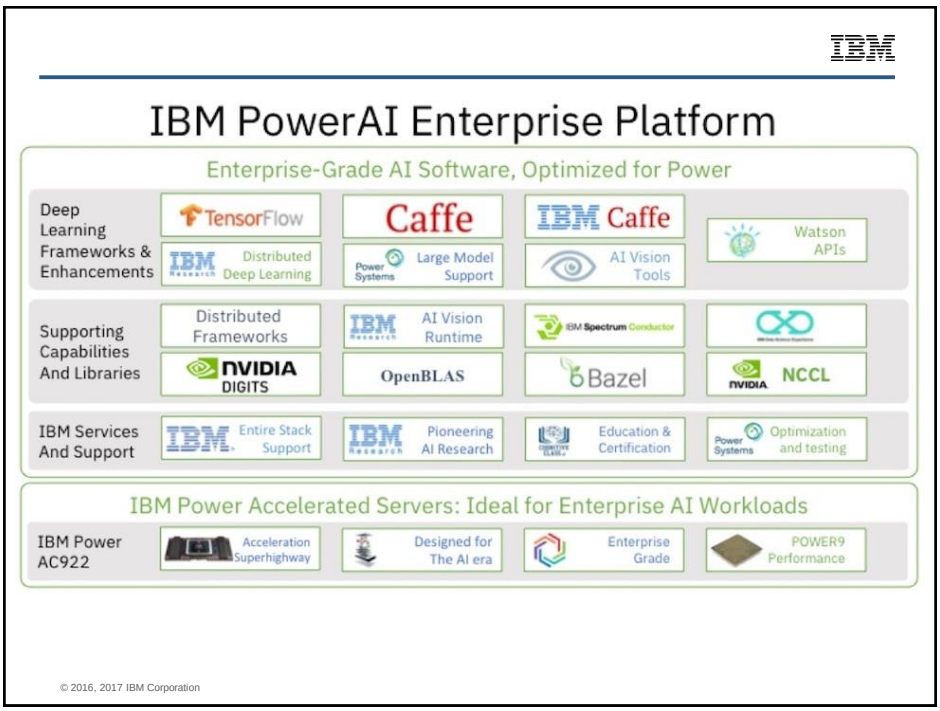
IBM Data Science
@IBMDataScience
Following
Learn how to analyze #data in #Python, using numpy, pandas, scipy, and scikit-learn! A free course via @CognitiveClass: bit.ly/2EvNMZO
python
10:00 AM - 1 Sep 2018


IBM
IBM PowerAI Enterprise Platform
Enterprise-Grade AI Software, Optimized for Power
Deep Learning Frameworks & Enhancements
TensorFlow
Caffe
IBM Caffe
Watson APIs
Distributed Deep Learning
Large Model Support
AI Vision Tools
Supporting Capabilities And Libraries
Distributed Frameworks
AI Vision Runtime
IBM Spectrum Conductor
NVIDIA DIGITS
OpenBLAS
Bazel
NCCL
IBM Services And Support
Entire Stack Support
Pioneering AI Research
Education & Certification
Optimization and testing
IBM Power Accelerated Servers: Ideal for Enterprise AI Workloads
IBM Power AC922
Acceleration Superhighway
Designed for The AI era
Enterprise Grade
POWER9 Performance
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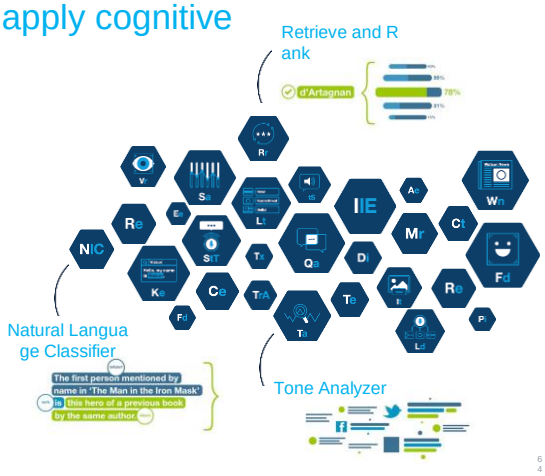
# Leverage Watson to apply cognitive capabilities.

50 underlying technologies

| | |
|---|---|
| Entity Extraction | Natural Language Classifier |
| Sentiment Analysis | Personality insights |
| Emotion Analysis (Beta) | Relationship Extraction |
| Keyword Extraction | Retrieve and Rank |
| Concept Tagging | Tone Analyzer |
| Taxonomy Classification | Emotive Speech to Text |
| Author Extraction | Text to Speech |
| Language Detection | Face Detection |
| Text Extraction | Image Link Extraction |
| Microformats Parsing | Image Tagging |
| Feed Detection | Text Detection |
| Linked Data Support | Visual Insights |
| Concept Expansion | Visual Recognition |
| Concept Insights | AlchemyData News |
| Dialog | Tradeoff Analytics |
| Document Conversion | |
| Language Translation | |

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65

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## Side-by-side

| | IBM Watson | IBM PowerAI | Python Libraries |
|---|---|---|---|
| On-prem or cloud? | Cloud | Either | Either |
| Performance | Great | Blazing | Let's not talk about it |
| Cost | Pay-as-you-go | Contact your IBM Rep. | Free |
| Db2 data access (best case) | Upload your data, or connect to cloud via API's | Connect to data from PowerAI | Direct access on-box |
| Available software packages | IBM Watson API set | Virtually all the major popular frameworks, including tensorflow, caffe, etc. | A small but growing subset |
| Hardware Stack | Built for AI and ML | Built for AI and ML | Built for business |

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# Open Source Support

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## Open Source Support: the past (adoption inhibitor)

- 5733-OPS: **No support** (except Node.js) ☹
- RPM pile: **Community support** (except Node.js) ☹
- A few community “integration pieces”: IBM support ☺

- Zend Server, PowerRuby, many others: vendor support ☺

- Most open source frameworks and other packages: **Community support**

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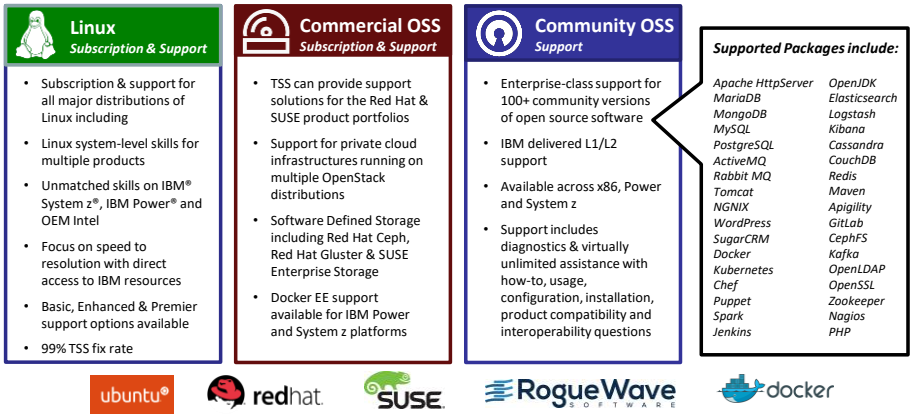
## Comprehensive support solutions

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## IBM Cloud Open Source Software Support

*Enterprise-class support for Open Source SW is now available for more than 100+ community packages*

### OSS Support Offering Overview

- L1-L3 support for 100+ community versions of OSS
- IBM delivered L1/L2 with L3 provided by Rogue Wave
- Coverage includes:
  - Support includes diagnostics & virtually unlimited assistance w/ how-to, usage, configuration, installation, product compatibility and interoperability questions
  - Rogue Wave subcontractor L3 defect/usage/patches/fixes support & Community defect support for OSS packages
  - Unlimited support incidents, Phone or electronic access
  - 24x7 and 9x5 options available

### Technology Support Services

- World Class support on Open Source SW for 18+ years
- System-level skills for multiple products (such as OS, hypervisor and middleware software)
- Agnostic support for all major Linux distributions
- Premium support options available
- Key contributor to the Linux development community, and major Open Source SW project communities, with 600 developers worldwide
- Access to over 7,000 skilled Linux consultants worldwide

***A single source provider for near-seamless collaboration on multivendor products***

***Our comprehensive support model helps clients deploy open source technologies across the enterprise with confidence***

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## With a continuously evolving product list, we can support virtually your entire ecosystem

| | | | | |
|---|---|---|---|---|
| 389DirectoryServer | CephFS | GNU sed | Maven | Python |
| ActiveMQ | Chef | GNU Wget | MongoDB | QEMU |
| Ansible | CoreOS | Grafana | MySQL | R |
| Apache Ant | Couchbase | Graylog | Nagios | Rabbit MQ |
| Apache Camel | CVS: Concurrent Versions System | gVim | Nagios Plugin | Redis |
| Apache Cassandra | Debian - x86 & Power only | HAProxy | Nginx | Relax and Recover (ReaR) |
| Apache CouchDB | DHCP (ISC DHCP) | Hibernate | Nmap | rsync |
| Apache Derby | Docker Engine | HornetQ | Node.js | Samba |
| Apache HttpServer | Docker Registry | iptables | OpenJDK | SELinux |
| Apache Maven | Docker Swarm | Java | OpenLDAP | Sendmail |
| Apache ServiceMix | Drupal | Jenkins | OpenSSL | Spring |
| Apache Solr | Elasticsearch (ELK) | Joomla! | OpenVPN | Subversion |
| Apache Spark | FluentD | Kafka | oVirt | SugarCRM |
| Apache Tomcat | Galera | Kibana | Perl | Vim |
| ApacheCXF | Gawk | Kubernetes | PhantomJS | vsftpd |
| Apigility | Git | KVM | PHP | WildFly |
| Artifactory | GitLab | lighttpd | Postfix | Wireshark |
| Atomic OS | GlassFish - 9x5 only | Logrotate | PostgreSQL | WordPress |
| BIND | Gluster / GlusterFS | Logstash (ELK) | Prometheus | Zookeeper |
| Celiometer | GNU Make | lsof | Puppet | |
| CentOS | GNU Privacy Guard | MariaDB | PuTTY | |

***Support is available for Community editions only through this offering. Enterprise editions are not supported***

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## More than just Break / Fix

**80%** of OSS support issues stem from either a lack of product knowledge, or something in the environment outside of the package [1]

**80%**

IBM Cloud Open Source Support includes diagnostics & virtually unlimited assistance with a wide variety of usage & how-to questions

***TSS can be a resource for your development team….at any stage of the SDLC!***

### Interoperability Issues
- Product compatibility and interoperability questions
- Discuss interdependencies between OSS packages

### Short Duration OSS Guidance
- We can provide advice on which OSS packages may be optimized or best suited for your solution

### Our Solution Approach
- Our breadth of expertise allows us to take a holistic approach and provide support for the solution stack
- Review problems from a systems perspective

### Installation & Configuration
- Answer specific installation questions for documented functions
- Provide available configuration samples

### Community Engagement
- Rogue Wave & IBM participate in a wide variety of community projects and leverage as a resource

### Additional Resources
- Our team can provide technical references to publications, such as redbooks or manuals and assist with interpretation of publications

[1] *2017 Open Source Support Report, Rogue Wave Software*

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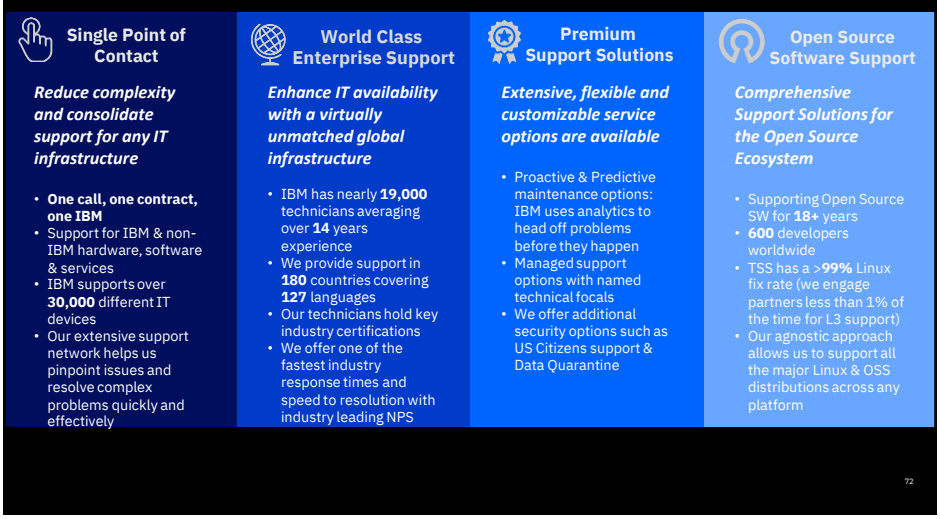
## Why clients choose IBM Technology Support Services

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## Significant supportables for IBM i

- Git
- Jenkins
- rsync
- Node.js
- Apache Tomcat
- WordPress
- Python

- For more resources, see my blog post: http://ibmsystemsmag.com/blogs/open-your-i/december-2018/a-game-changer-for-open-source-support/

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# Come join the community!!

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## Participate in the community!

- How?
  - Ask questions
  - Give advice
  - Share code, tips, tricks, etc!
  - Make code contributions
- Where?
  - Ryver
    - https://ibmioss.ryver.com/application/signup/members/9tJsXDG7_iSSi1Q
    - https://ibmioss.ryver.com
  - Club Seiden
    - http://club.seidengroup.com
  - Midrange “Open Source” thread
    - http://archive.midrange.com/opensource/
  - LinkedIn (IBMiOSS group, brand new!)
  - Twitter

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twitter

- For the latest news:
  - watch **#IBMiOSS**
  - Follow @IBMJesseG and other community members
- Information or questions, just tweet with #IBMiOSS!

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## Spread the word!

- Write or contribute to articles, blogs, etc.
- Speak at user groups and conferences
- Tweet with the #IBMiOSS hashtag!

COMMON
A USERS GROUP

LinkedIn

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# Appendix A: Machine Learning examples

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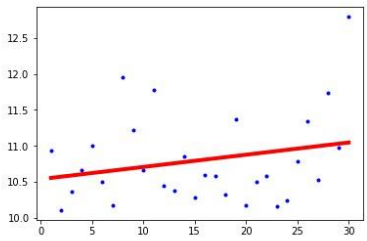
In [51]:
```
#implement a linear regression with Scikit-learn.

from sklearn.linear_model import LinearRegression

model = LinearRegression()
model.fit(xdata,ydata)
pred = model.predict(xdata)
#print("expect time:",(-model.intercept_/model.coef_)[0][0])
print("expect days to reach 40% CPU:",((40-model.intercept_)/model.coef_)[0][0])
plt.plot(xdata,ydata,"b.")
plt.plot(xdata,pred,'r',linewidth=4)
plt.show()
```

```
expect days to reach 40% CPU: 1740.8391
```

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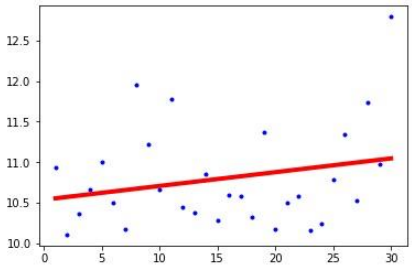
In [52]:
```
#implement a linear regression with scipy.
import scipy as sp

(w,b) = sp.polyfit(xdatald,ydatald,1)
print("expect days to reach 40% CPU:",(40-b)/w)
plt.plot(xdatald,ydatald,"b.")
plt.plot(xdatald,xdatald*w+b,'r',linewidth=4)
plt.show()
```

```
expect days to reach 40% CPU: 1740.838798780761
```

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## More Complex Demo: Credit Default Prediction

- Deep-learning application for loan default prediction
- Developed with **scikit-learn**
- Training on **IBM i or Linux (Snap ML)**, with **inferencing directly on the IBM i**
- Uses **REST API in Node.js to transfer data** between Linux and IBM I
- Front-end web UI for demonstration (written with **Flask**)

- Note: Still finding a landing page for documentation and example source code. If you are interested, e-mail mirish@ibm.com

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## Data from a dummy dataset, imported into Db2

| MERCHANT | ACCT_STATUS_K_USD | CONTRACT_DURATION_MONTH | HISTORY | CREDIT_PROGRAM | AMOUNT_K_USD | ACCOUNT_TYPE | ACCT_AGE | STATE | IS_URBAN |
|---|---|---|---|---|---|---|---|---|---|
| | 893 0 USD | | 12 CRITICAL ACCOUNT | NEW CAR | 2171 | up to 100 K USD | 1 to 4 YRS | NY | NO |
| | 894 0 to 200 USD | | 36 CRITICAL ACCOUNT | USED CAR | 5800 | up to 100 K USD | 1 to 4 YRS | CT | NO |
| | 895 NONE | | 18 CRITICAL ACCOUNT | ELECTRONICS | 1169 | UNKNOWN/NONE | 1 to 4 YRS | NY | NO |
| | 896 NONE | | 36 DELAY IN PAST | USED CAR | 8947 | UNKNOWN/NONE | 4 to 7 YRS | CT | NO |
| | 897 0 USD | | 21 EXISTING CREDITS PAID BACK | ELECTRONICS | 2606 | up to 100 K USD | up to 1 YR | NY | NO |
| | 898 NONE | | 12 CRITICAL ACCOUNT | FURNITURE | 1592 | above 1000 K USD | 4 to 7 YRS | CT | NO |
| | 899 NONE | | 15 EXISTING CREDITS PAID BACK | FURNITURE | 2186 | UNKNOWN/NONE | 4 to 7 YRS | PA | NO |
| | 900 0 USD | | 18 EXISTING CREDITS PAID BACK | FURNITURE | 4153 | up to 100 K USD | 1 to 4 YRS | NJ | NO |
| | 901 0 USD | | 16 CRITICAL ACCOUNT | NEW CAR | 2625 | up to 100 K USD | above 7 YRS | NJ | NO |
| | 902 NONE | | 20 CRITICAL ACCOUNT | NEW CAR | 3485 | UNKNOWN/NONE | up to 1 YR | NJ | YES |
| | 903 NONE | | 36 CRITICAL ACCOUNT | USED CAR | 10477 | UNKNOWN/NONE | above 7 YRS | NJ | NO |
| | 904 NONE | | 15 EXISTING CREDITS PAID BACK | ELECTRONICS | 1386 | UNKNOWN/NONE | 1 to 4 YRS | NY | NO |
| | 905 NONE | | 24 EXISTING CREDITS PAID BACK | ELECTRONICS | 1278 | up to 100 K USD | above 7 YRS | NY | NO |
| | 906 0 USD | | 12 EXISTING CREDITS PAID BACK | ELECTRONICS | 1107 | up to 100 K USD | 1 to 4 YRS | NJ | NO |
| | 907 0 USD | | 21 EXISTING CREDITS PAID BACK | NEW CAR | 3763 | UNKNOWN/NONE | 4 to 7 YRS | NJ | NO |
| | 908 0 to 200 USD | | 36 EXISTING CREDITS PAID BACK | EDUCATION | 3711 | UNKNOWN/NONE | 1 to 4 YRS | NJ | NO |
| | 909 NONE | | 15 DELAY IN PAST | USED CAR | 3594 | up to 100 K USD | up to 1 YR | PA | NO |
| | 910 0 to 200 USD | | 9 EXISTING CREDITS PAID BACK | NEW CAR | 3195 | UNKNOWN/NONE | 1 to 4 YRS | PA | NO |
| | 911 NONE | | 36 DELAY IN PAST | ELECTRONICS | 4454 | up to 100 K USD | 1 to 4 YRS | NY | NO |
| | 912 0 to 200 USD | | 24 CRITICAL ACCOUNT | FURNITURE | 4736 | up to 100 K USD | up to 1 YR | NJ | NO |
| | 913 0 to 200 USD | | 30 EXISTING CREDITS PAID BACK | ELECTRONICS | 2991 | UNKNOWN/NONE | above 7 YRS | NJ | NO |
| | 914 NONE | | 11 EXISTING CREDITS PAID BACK | RETRAINING | 2142 | above 1000 K USD | above 7 YRS | PA | YES |
| | 915 0 USD | | 24 ALL CREDITS PAID BACK | RETRAINING | 3161 | up to 100 K USD | 1 to 4 YRS | NY | NO |
| | 916 0 to 200 USD | | 48 NONE TAKEN | OTHER | 18424 | up to 100 K USD | 1 to 4 YRS | PA | NO |
| | 917 NONE | | 10 EXISTING CREDITS PAID BACK | USED CAR | 2848 | 100 to 500 K USD | 1 to 4 YRS | PA | NO |
| | 918 0 USD | | 6 EXISTING CREDITS PAID BACK | NEW CAR | 14896 | up to 100 K USD | above 7 YRS | PA | NO |
| | 919 0 USD | | 24 EXISTING CREDITS PAID BACK | FURNITURE | 2359 | 100 to 500 K USD | TBD | PA | YES |
| | 920 0 USD | | 24 EXISTING CREDITS PAID BACK | FURNITURE | 3345 | up to 100 K USD | above 7 YRS | NY | NO |
| | 921 NONE | | 18 CRITICAL ACCOUNT | FURNITURE | 1817 | up to 100 K USD | 1 to 4 YRS | NY | NO |
| | 922 NONE | | 48 DELAY IN PAST | ELECTRONICS | 12749 | 500 to 1000 K USD | 4 to 7 YRS | NY | NO |
| | 923 0 USD | | 9 EXISTING CREDITS PAID BACK | ELECTRONICS | 1366 | up to 100 K USD | up to 1 YR | CT | NO |
| | 924 0 to 200 USD | | 12 EXISTING CREDITS PAID BACK | NEW CAR | 2002 | up to 100 K USD | 4 to 7 YRS | CT | NO |
| | 925 0 USD | | 24 ALL CREDITS PAID BACK | FURNITURE | 6872 | up to 100 K USD | up to 1 YR | NJ | YES |
| | 926 0 USD | | 12 ALL CREDITS PAID BACK | NEW CAR | 697 | up to 100 K USD | up to 1 YR | NY | NO |
| | 927 0 USD | | 18 CRITICAL ACCOUNT | FURNITURE | 1049 | up to 100 K USD | up to 1 YR | NY | NO |
| | 928 0 USD | | 48 EXISTING CREDITS PAID BACK | USED CAR | 10297 | up to 100 K USD | 4 to 7 YRS | NY | NO |
| | 929 NONE | | 30 EXISTING CREDITS PAID BACK | ELECTRONICS | 1867 | UNKNOWN/NONE | above 7 YRS | NY | NO |
| | 930 0 USD | | 12 DELAY IN PAST | NEW CAR | 1344 | up to 100 K USD | 1 to 4 YRS | NY | NO |
| | 931 0 USD | | 24 EXISTING CREDITS PAID BACK | FURNITURE | 1747 | up to 100 K USD | up to 1 YR | NY | NO |
| | 932 0 to 200 USD | | 9 EXISTING CREDITS PAID BACK | ELECTRONICS | 1670 | up to 100 K USD | up to 1 YR | NY | NO |
| | 933 NONE | | 9 CRITICAL ACCOUNT | NEW CAR | 1224 | up to 100 K USD | 1 to 4 YRS | CT | NO |
| | 934 NONE | | 12 CRITICAL ACCOUNT | ELECTRONICS | 522 | 500 to 1000 K USD | above 7 YRS | NY | NO |

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## Training the model on the data...

Have 1000 known credit accounts. Train a model on 900 of them, then test model on the last 100 to determine model accuracy

0 = No Default, 1 = Default

Chance of No Default Chance of Default

```
Prediction: 1 Actual: 0  Probability: ( 0.3993105893811099 7 , 0.60068941061889 )
Prediction: 1 Actual: 1  Probability: ( 0.04396396724667273 , 0.9560360327533273 )
Prediction: 0 Actual: 1  Probability: ( 0.8267071417589261 , 0.17329285824107388 )
Prediction: 0 Actual: 0  Probability: ( 0.9813813065900909 , 0.01861869340990902 )
Prediction: 0 Actual: 0  Probability: ( 0.7665148240541815 , 0.23348517594581847 )
Prediction: 0 Actual: 0  Probability: ( 0.9913802276766168 , 0.008619772323383209 )
Prediction: 0 Actual: 0  Probability: ( 0.747153939982939 , 0.252846060017061 )
Prediction: 0 Actual: 0  Probability: ( 0.996098291035753 , 0.003901708964246974 )
Prediction: 0 Actual: 1  Probability: ( 0.5766529003502558 , 0.4233470996497442 )
Prediction: 1 Actual: 0  Probability: ( 0.4769135583636863 , 0.5230864416363137 )
Prediction: 1 Actual: 0  Probability: ( 0.2410664026582301 , 0.7589335973417699 )
Prediction: 0 Actual: 0  Probability: ( 0.6893280492796938 , 0.3106719507203061 )
Prediction: 0 Actual: 0  Probability: ( 0.9750926365935764 , 0.024907363406423657 )
Prediction: 0 Actual: 0  Probability: ( 0.7565012828390749 , 0.24349871716092514 )
Prediction: 1 Actual: 0  Probability: ( 0.15274769798760635 , 0.8472523020123937 )
Prediction: 0 Actual: 1  Probability: ( 0.9805121676881574 , 0.019487832311842587 )
Prediction: 1 Actual: 1  Probability: ( 0.1434059901966399 , 0.8565940098033601 )
Prediction: 1 Actual: 1  Probability: ( 0.14677280883158828 , 0.8532271911684117 )
Prediction: 0 Actual: 0  Probability: ( 0.9774938908491175 , 0.022506109150882463 )
Accuracy of Neural Network classifier on test set: 0.69
```

What number of the 100 known accounts did the model correctly predict?

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## Import model to IBM i, inference from Db2…

```
def main():
    # Connect to Db2 and get the data
    conn = db2.connect()
    cur = conn.cursor()
    cur.execute("SELECT * FROM MARK.NEW_CUST")

    rows = []

    # TODO: This is to convert to JSON, would help with transferring data because we could reuse
    class CursorByName():
        def __init__(self, cursor):
            self._cursor = cursor

        def __iter__(self):
            return self

        def __next__(self):
            row = self._cursor.__next__()
            return { description[0]: row[col] for col, description in enumerate(self._cursor.description) }

    for row in CursorByName(cur):
        rows.append(row)

    json_data = json.dumps(rows)

    model_path = './default_prediction_model.pkl'
    prepros_path = './feature_transform_model.pkl'
    model, le, scaler = load_model(model_path, prepros_path)
    processed_data, _, _ = process_file(json_data, le, scaler)
    predict_defaults(model, processed_data, rows)
```

Connect to Db2 to get data into Python, import the model, then inference on data with unknown outcomes.

```
bash-4.4$ python predict.py
Gold Acoustics          Not likely to default ( 0.013 )
Wood Corp               Likely to default     ( 0.8644 )
Bridge Acoustics        Not likely to default ( 0.013 )
Rabbitechnologies       Might default         ( 0.2911 )
Rhinotainment           Not likely to default ( 0.1454 )
Voyagetronics           Not likely to default ( 0.04 )
Webrews                 Not likely to default ( 0.0476 )
Silversun               Not likely to default ( 0.0081 )
Redware                 Not likely to default ( 0.1178 )
Leopardworth            Not likely to default ( 0.0225 )
Flux Networks           Likely to default     ( 0.6413 )
Storm Records           Not likely to default ( 0.0054 )
Petal Sports            Not likely to default ( 0.247 )
Midnightelligence       Not likely to default ( 0.0315 )
Pumpkinavigation        Not likely to default ( 0.1053 )
Canics                  Not likely to default ( 0.0021 )
Shadoworks              Not likely to default ( 0.0473 )
Squidmart               Not likely to default ( 0.0699 )
Wondercoms              Not likely to default ( 0.0287 )
Arcanesun               Likely to default     ( 0.6612 )
Turtle Enterprises      Might default         ( 0.5432 )
Goblin Acoustics        Might default         ( 0.2554 )
Frostfire Media         Not likely to default ( 0.084 )
Phenomenologies         Not likely to default ( 0.1106 )
Pixystems               Not likely to default ( 0.1683 )
Aces                    Not likely to default ( 0.0297 )
Sphinxecurity           Not likely to default ( 0.1738 )
Spikeshade              Likely to default     ( 0.86 )
Soulbeat                Not likely to default ( 0.1711 )
Bansheesys              Not likely to default ( 0.1485 )
Oyster Co.              Likely to default     ( 0.681 )
Soulli                  Not likely to default ( 0.1261 )
Wave Acoustics          Not likely to default ( 0.0771 )
Spectertainment         Not likely to default ( 0.1118 )
```

For each entry in the database, run against the model and print (and color) the output

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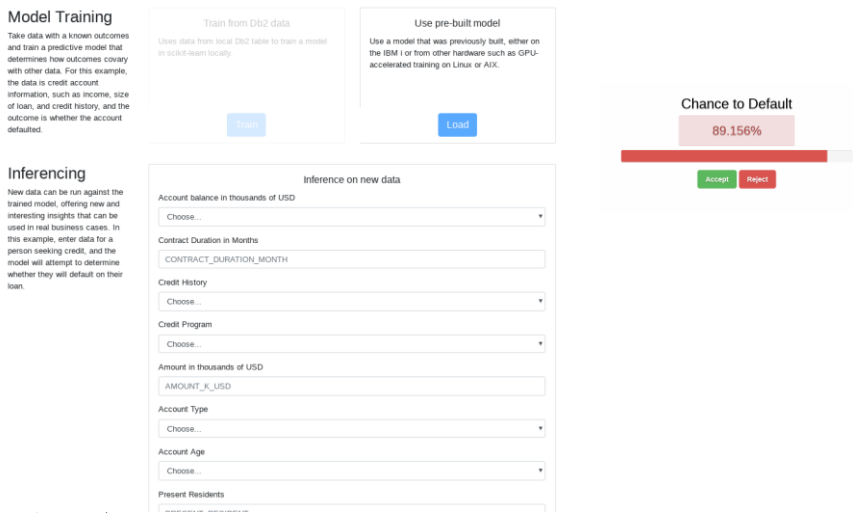
## … or from data entered in a web form!



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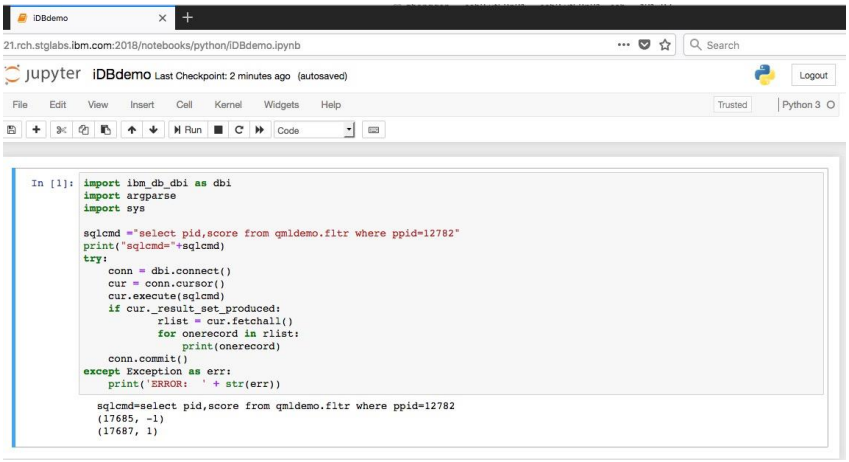
## Demos-ibm_db_dbi

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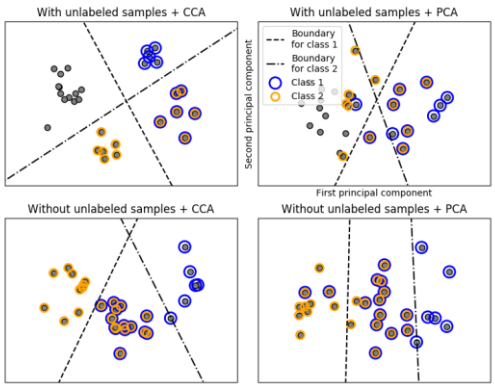
## Demo-scikit-learn

- multi-label classification.
  - Each sample has 20 features
  - We try to use Support Vector Machine (SVM) based on the chosen features(2 features selected) by canonical correlation analysis (CCA) or principal component analysis (PCA), which make it easier for us to show on plot.




refs: https://scikit-learn.org/stable/auto_examples/plot_multilabel.html#sphx-glr-auto-examples-plot-multilabel-py

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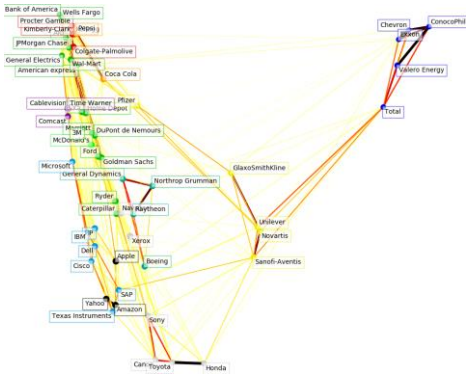
## Demo-scikit-learn

- visualizing the stock market structure.
  - try to get the stock open/close prices for some companies as training data.
  - Using the GraphLassoCV to train the data.
  - Using the trained model's covariance matrix to calculate the classes and labels.
  - Giving out the clusters output based on assinged labels.
  - Meanwhile, visualizing the results into a 2d plane.




```
Cluster 1: Apple, Amason, Yahoo
Cluster 2: Comcast, Cablevision, Time Warner
Cluster 3: ConocoPhillips, Chevron, Total, Valero Energy, Exxon
Cluster 4: Cisco, Dell, HP, IBM, Microsoft, SAP, Texas Instruments
Cluster 5: Boeing, General Dynamics, Northrop Grumman, Raytheon
Cluster 6: AIG, American express, Bank of America, Caterpillar, CVS, D
uPont de Nemours, Ford, General Electrics, Goldman Sachs, Home Depot,
JPMorgan Chase, Marriott, 3M, Ryder, Wells Fargo, Wal-Mart
Cluster 7: McDonald's
Cluster 8: GlaxoSmithKline, Novartis, Pfizer, Sanofi-Aventis, Unilever
Cluster 9: Kellogg, Coca Cola, Pepsi
Cluster 10: Colgate-Palmolive, Kimberly-Clark, Procter Gamble
Cluster 11: Canon, Honda, Navistar, Sony, Toyota, Xerox
```

refs: https://scikit-learn.org/stable/auto_examples/applications/plot_stock_market.html#sphx-glr-auto-examples-applications-plot-stock-market-py

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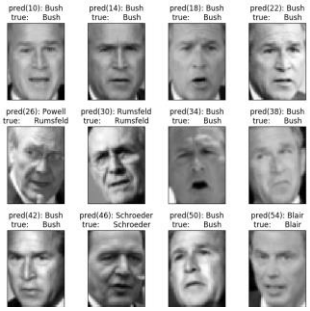
## Demo-scikit-learn

- faces recognition
  - Using LFW(Labeled Faces in the Wild)
  - PCA is used to reduce the features of training images
  - SVM is used to do te classification.
  - GridSearchCV is used to do the search for best hyper-params.
  - Use some some utilities to show the prediction result.




```
---classification_report---
                   precision    recall  f1-score   support

     Ariel Sharon       0.60      0.46      0.52        13
     Colin Powell       0.80      0.87      0.83        60
  Donald Rumsfeld       0.94      0.63      0.76        27
    George W Bush       0.83      0.98      0.90       146
Gerhard Schroeder       0.95      0.80      0.87        25
      Hugo Chavez       1.00      0.47      0.64        15
       Tony Blair       1.00      0.78      0.88        36

      avg / total       0.86      0.85      0.84       322
```

```
---confusion_matrix---
[[  6   2   0   5   0   0   0]
 [  2  52   0   6   0   0   0]
 [  1   2  17   7   0   0   0]
 [  0   3   0 143   0   0   0]
 [  0   1   0   4  20   0   0]
 [  0   4   0   3   1   7   0]
 [  1   1   1   5   0   0  28]]
```

refs: https://scikit-learn.org/stable/auto_examples/applications/plot_face_recognition.html#sphx-glr-auto-examples-applications-plot-face-recognition-py

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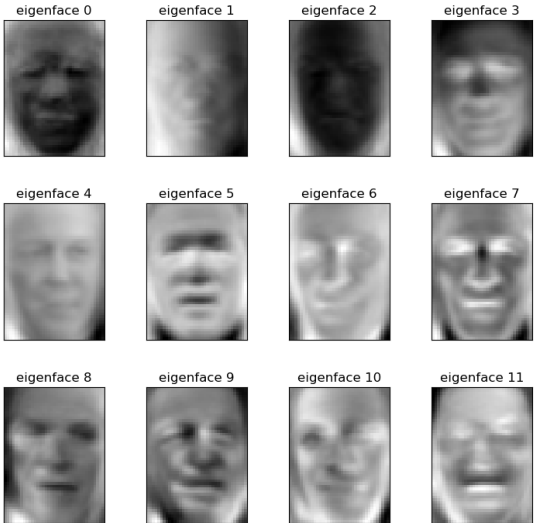
## eigenfaces

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## Lots more capabilities

- https://scikit-learn.org/stable/auto_examples/index.html
- Go explore!

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# Closing Thoughts

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## IBM i Open Source Architect

- Open source is an integral part of IBM i strategy
- Architect for open source: Jesse Gorzinski
- Read his “Open Your i“ blog at http://ibm.biz/open-your-i

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## Major Themes of the Open Source Revolution

- Explosion of languages
  - C/C++
  - RPG
  - CL
  - Cobol
  - Perl
  - Ublu
  - Kotlin
  - Lua
  - Python
  - PHP
  - bash
  - Ruby
  - JavaScript (Node.js)

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## Major Themes of the Open Source Revolution

- "Normalization" of IBM i Application Development
  - Familiar tools
  - Industry-standard technology
  - Industry-standard techniques
- More tools available
- More frameworks and configurations
- More solutions
- Unprecedented capabilities
- …… What can it do for you?

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# The end!

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