Intro to AI and IBM i

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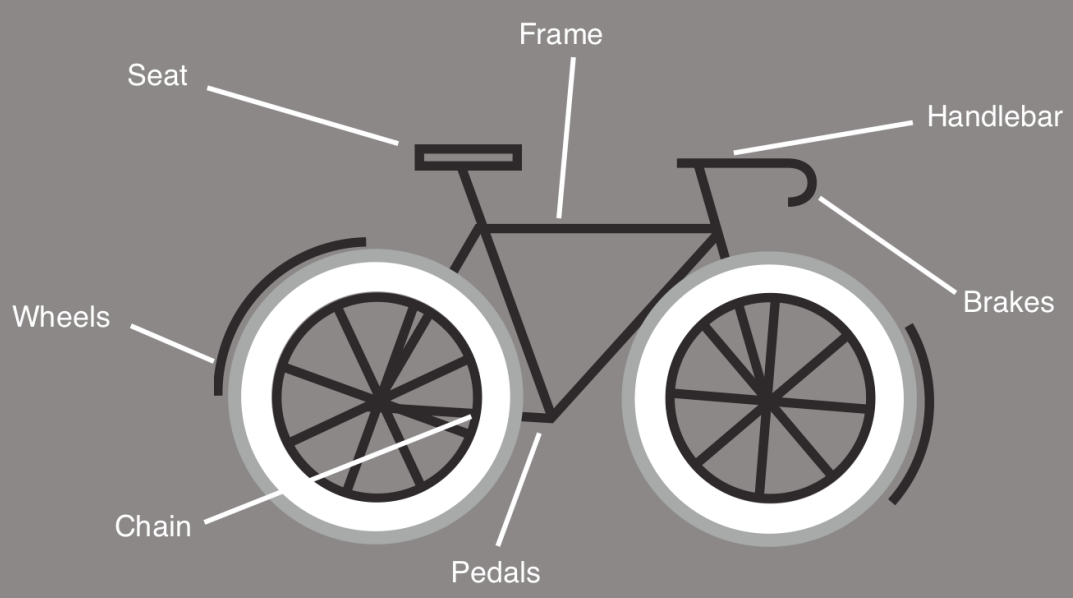
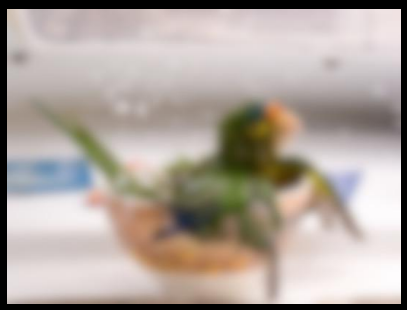
0. Warmup Exercise

What's a bicycle look like?

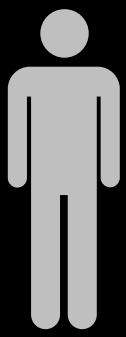


2011



26% error rate

Machine Learning Based



5% error rate

Humans

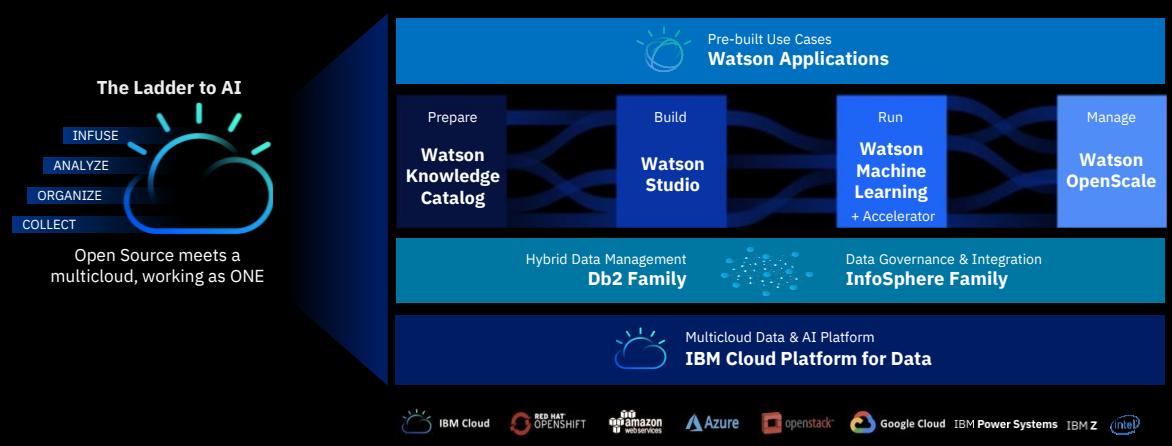
2016

3% error rate

Deep Learning Based

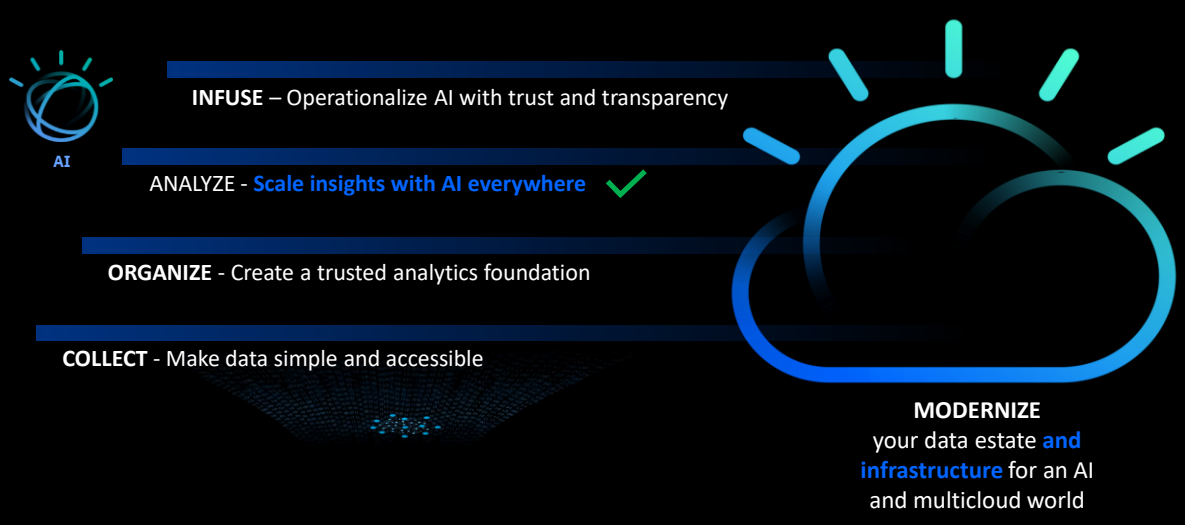
IBM Data & AI Portfolio

Everything you need for Enterprise AI, on any cloud

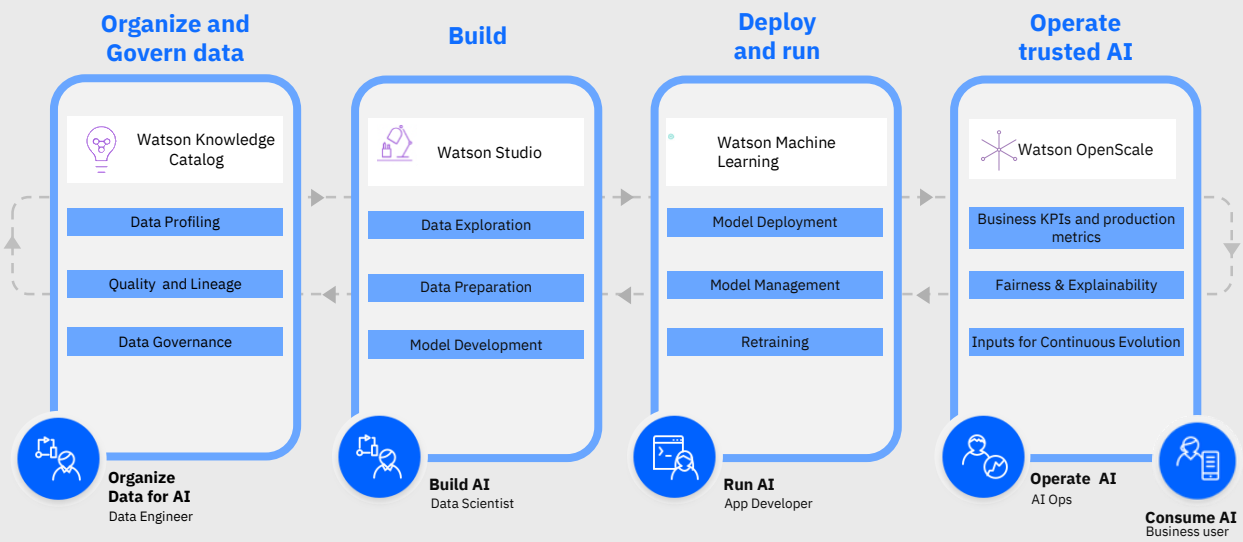


The AI Ladder

A prescriptive approach to accelerating the journey to AI



Watson Studio, WML and Watson OpenScale enable clients to operationalize AI across the enterprise



OFFICIAL NOTICE

- **I am not a data scientist!**
- Data scientists spend **years learning how to analyze data**, I spent years learning how to develop software.
- I do not know all of the correct algorithms, models, or statistical tests to get the most out of your data.
- If you want a personalized understanding of your data, **you are going to have to hire a data scientist.**

Machine Learning

- Machine learning is about training your computer on lots of data so it can learn how to do things you don't want to (or can't) do.
- Through machine learning, computers can learn things that we know, but just don't want to do.
  - Speech to text transcription
  - Language translation
- Through machine learning, computers can see relationships that are too complex for our brains to handle.
  - What factors indicate immediate failure of important components?
  - How can we identify credit accounts that are likely to default?

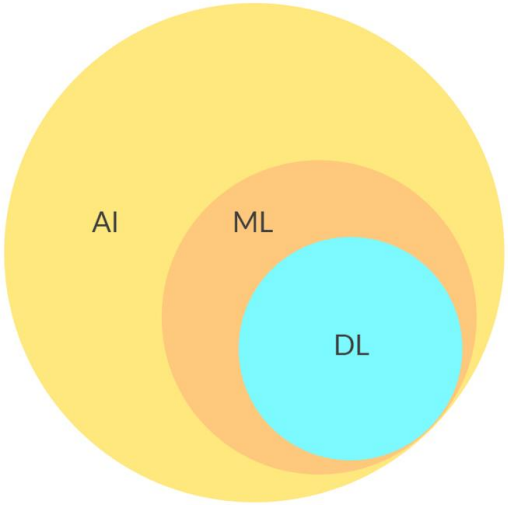
AI? ML? DL?

- There are three related terms used to describe machine learning:
  - **Artificial Intelligence (AI):** Computers mimicking human intelligence and make 'smart' decisions.
  - **Machine Learning (ML):** Algorithms and statistical techniques allowing computers to make smarter decisions with more data.
  - **Deep Learning (DL):** Computers training themselves on massive quantities of data using 'multilayered neural networks.'

AI? ML? DL?

- There are three related terms used to describe machine learning:
  - **Artificial Intelligence (AI):** Computers doing smart things.
  - **Machine Learning (ML):** Computers building a model with your help.
  - **Deep Learning (DL):** Computers building a model by themselves.

AI? ML? DL?



Training? Inferencing?

- **Training:** Taking your data, selecting an algorithm, and training a 'model' that can make educated predictions
- **Inferencing:** Drawing inferences between data points of a record to draw some conclusion.
- **A model is trained with data** records that you have known results for. **Your model inferences on new data with unknown outcomes** it to try and deliver new insight.

Fuzzy Logic, Stochastic Computing

- Machine learning is about getting 'good enough'
- Like humans, machines are not 100% accurate (yet)
- Machine learning is about different business needs than your deterministic RPG, C, CL, and COBOL programs!

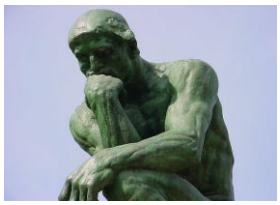
So how does it work?

Automate

One “RIGHT” Answer

Payroll Calculation

Understand



The “BEST” Answer

Influencing a decision

Approximate data

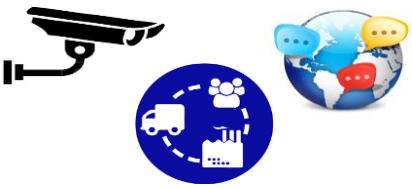
- Key requirements
  - approximation should only be in non-critical data
    - approximating critical data could lead to disastrous consequences
  - Identifying the section(s) of an application that could be approximated
    - Need application programmer & application domain expert involved

Modern Workloads

DETERMINISTIC

100s of GBs of Data
Noise Intolerant
High Precision
High Energy/Computation
High Cost

STOCHASTIC



10s of PBs of Data
Noise tolerant
Amenable to lower Precision
Lower Energy/Computation
Lower Cost

Machine Learning for Modern Workloads

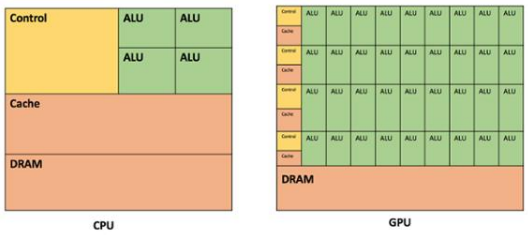
Machine Learning with the IBM i

Why on the i?

- Machine learning requires **heaps of data** to be accurate.
  - Your IBM i machines have been **accumulating data for years**, plenty of insights to be drawn
- **IBM is at the forefront** of a machine learning revolution
  - ~~Watson Services and APIs~~ **Watson Machine Learning Services** comes pre-trained, can be used with your data for data predictions.
  - **Watson Machine Learning Studio** allows you to easily create your own models in the cloud.
  - ~~PowerAI~~ **Watson Machine Learning Accelerator or Community Edition** is a suite of tools for your to train your own models on your own data with an AC922.

But…

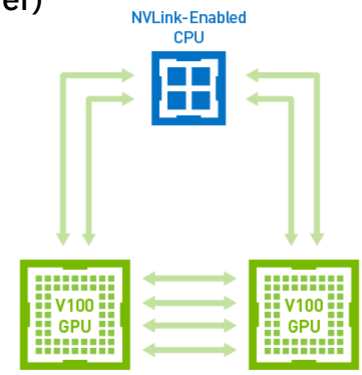
- Training your ML/DL model requires **a lot of simple matrix calculations.**
- CPUs like the POWER processors in your IBM i machines are *OK*, but **pale in comparison to GPUs.**
- IBM i **currently has no GPU support.**



A GPU has more Arithmetic Logic Units (ALU) than a typical CPU.
- Increased ability to process simple operations in parallel

Watson Machine Learning Community Edition

- POWER chips using NVLink quickly send and receive data to GPUs
- No GPUs on IBM i means you must:
  - Buy Power Systems servers (or time on the server)
  - Send your data over to be quickly trained
  - Return the model to your IBM i (or send data to your server to do inferencing).



Popular ML Software

- Scikit Learn
- TensorFlow
- Caffe
- Pytorch
- Theano
- Spark

Popular ML Software on the IBM i

- Scikit Learn
- ~~TensorFlow~~
- ~~Caffe~~
- ~~Pytorch~~
- ~~Theano~~
- ~~Spark~~

Some good news

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

Packages that enable ML are readily 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

Near future

The DL frameworks on our todo list

- Tensorflow
- Pytorch
- Caffe

Possible enhancements from low level of system

- Enhance BLAS or other math libraries to improve performance
- Expose more AI-helpful features from Power 9 or higher
- GPU support on IBM i

Popular ML Software on the IBM i (soon?)

- Scikit Learn
- **TensorFlow**
- **Caffe**
- **Pytorch**
- ~~Theano~~
- ~~Spark~~

IBM i Machine Learning Example

Machine Learning on IBM i example

Credit default prediction on a publicly available dataset:

- https://github.com/elenalowery/DSX-Local-Credit-Card-Default/tree/master/data
- 2 files: CUST_HISTORY.csv, NEW_CUSTOMERS.csv
  - CUST_HISTORY.csv: Holds 26 data columns about 1000 customers, including **whether they defaulted**.
  - NEW_CUSTOMERS.csv: Holds 25 data columns about 93 new customers (**don't know whether they defaulted**).

Machine Learning on IBM i example

- CUST_HISTORY.csv

Q	R	S	T	U	V	W	X	Y	Z	AA
PROP_UNKN	ESTABLISHED_MONTH	OTHER_INSTALL_PLAN	RENT	OWN_RESIDENCE	NUMBER_CREDITS	RFM_SCORE	BRANCHES	TELEPHONE	SHIP_INTERNATIONAL	IS_DEFAULT
NO	38	YES	NO	YES	2	2	1	NO	YES	No
NO	34	NO	NO	YES	2	3	1	YES	NO	No
NO	29	NO	NO	YES	2	3	1	YES	NO	No
NO	31	YES	NO	YES	1	4	2	YES	NO	No
NO	28	NO	YES	NO	1	4	1	YES	NO	No
NO	35	NO	NO	YES	1	3	1	NO	YES	No
NO	33	YES	YES	NO	1	2	1	NO	NO	No
NO	42	NO	NO	YES	1	3	1	NO	NO	Yes
NO	43	YES	YES	NO	1	3	1	YES	NO	Yes
NO	44	NO	NO	YES	2	3	1	YES	NO	No
YES	42	NO	NO	NO	2	3	1	NO	NO	No
NO	40	NO	YES	NO	1	3	1	YES	NO	No
NO	36	NO	NO	YES	1	4	1	YES	NO	No
NO	20	NO	YES	NO	1	4	2	YES	NO	No
NO	24	NO	NO	YES	1	2	1	NO	YES	No
NO	27	NO	NO	YES	1	3	1	NO	NO	No
NO	46	NO	NO	YES	2	2	1	NO	NO	No
NO	33	NO	NO	YES	1	2	1	NO	NO	No
NO	34	NO	NO	YES	2	3	1	NO	NO	No
NO	25	YES	NO	YES	1	2	1	NO	NO	Yes
NO	25	NO	NO	YES	1	3	1	NO	NO	No
NO	28	NO	NO	YES	1	3	1	YES	NO	No
NO	31	NO	YES	NO	1	3	1	YES	NO	Yes
NO	32	YES	NO	YES	1	4	1	YES	YES	Yes
NO	32	NO	NO	YES	1	3	2	NO	NO	No
YES	68	YES	NO	YES	1	4	1	YES	NO	Yes

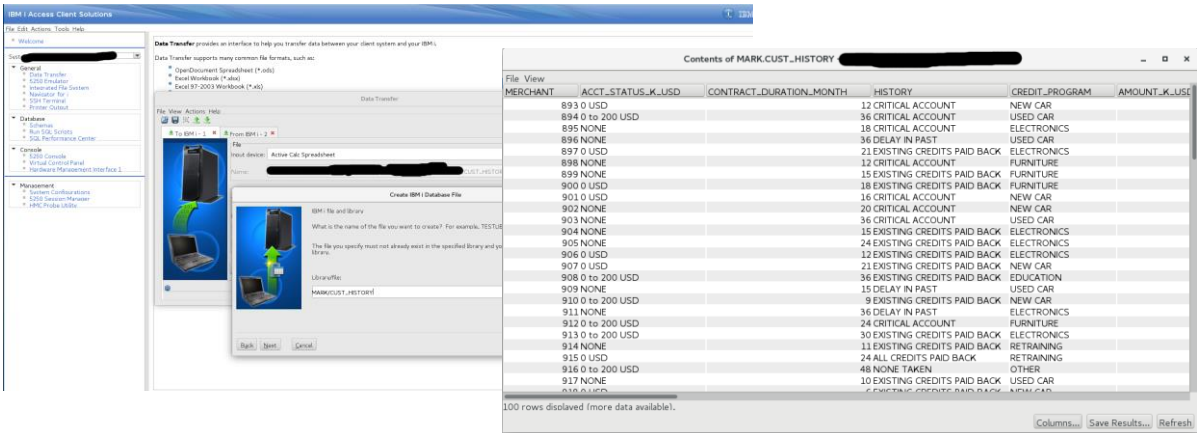
Machine Learning on IBM i example

- NEW_CUSTOMERS.csv

Q	R	S	T	U	V	W	X	Y	Z	AA
PROP_UNKN	ESTABLISHED_MONTH	OTHER_INSTALL_PLAN	RENT	OWN_RESIDENCE	NUMBER_CREDITS	RFM_SCORE	BRANCHES	TELEPHONE	SHIP_INTERNATIONAL	
NO	49	NO	NO	YES	1	2	2	NO	NO	
NO	28	NO	NO	YES	2	4	1	NO	NO	
NO	48	NO	YES	NO	2	2	2	NO	YES	
NO	26	YES	NO	YES	1	2	2	NO	NO	
YES	52	NO	NO	YES	1	4	1	YES	NO	
NO	23	NO	NO	YES	1	4	1	NO	NO	
NO	46	NO	YES	NO	2	2	1	YES	NO	
NO	24	NO	YES	NO	1	2	1	NO	NO	
NO	52	NO	NO	YES	1	2	1	NO	NO	
NO	36	YES	YES	NO	2	4	2	YES	NO	
NO	30	NO	NO	YES	1	3	1	YES	YES	
NO	35	NO	NO	YES	1	3	1	YES	NO	
NO	28	NO	YES	NO	1	2	1	NO	NO	
NO	36	NO	NO	YES	1	4	1	YES	NO	
NO	36	NO	YES	NO	1	4	1	YES	NO	
NO	48	NO	NO	YES	2	3	2	NO	YES	
YES	70	YES	NO	NO	1	4	1	YES	NO	
NO	25	NO	YES	NO	1	3	1	YES	NO	
NO	68	NO	NO	NO	3	1	1	YES	NO	
NO	21	NO	YES	NO	1	3	1	NO	NO	
NO	24	NO	YES	NO	1	2	1	NO	NO	
YES	35	NO	NO	YES	1	3	1	NO	NO	
NO	42	NO	NO	YES	3	2	2	NO	NO	
NO	24	NO	NO	YES	1	3	1	YES	NO	
NO	55	NO	NO	YES	1	3	1	NO	NO	
NO	36	NO	NO	YES	2	3	1	NO	NO	
NO	25	NO	NO	YES	2	3	1	NO	NO	

Machine Learning on IBM i example

- **You already have your data in Db2 on IBM i**.
- So I import the data into the IBM i through Access Client Solutions (ACS).

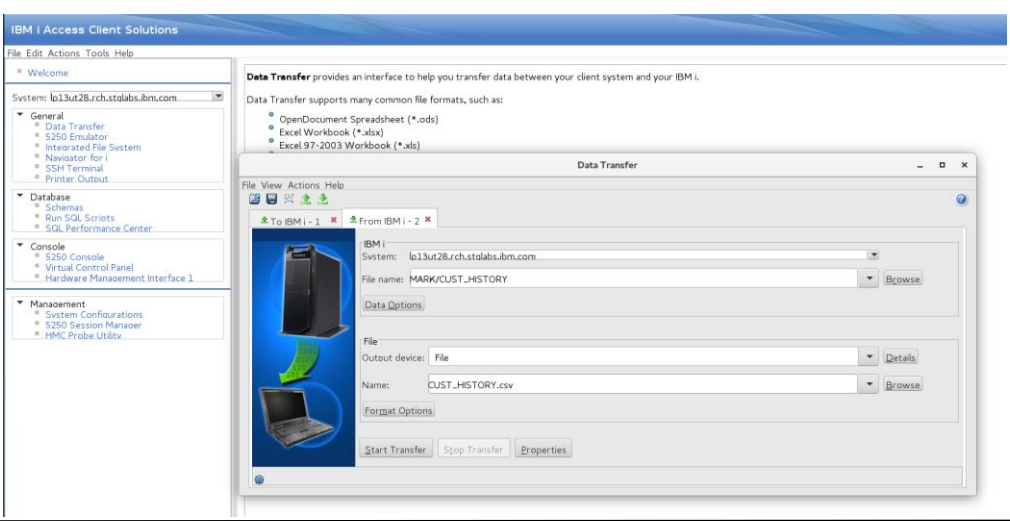


Machine Learning on IBM i example

- First, we will use Watson Studio for Watson Machine Learning to build a model for our data.
- https://www.ibm.com/cloud/garage/dte/tutorial/ibmr-watson-studio-mldl-made-easy
- Instead of using 'customer_churn.csv', use the data from your own table. In this case, from MARK/NEW_CUSTOMER and MARK/CUST_HISTORY.
- Need to get our data in .csv format… (this is where you might start)

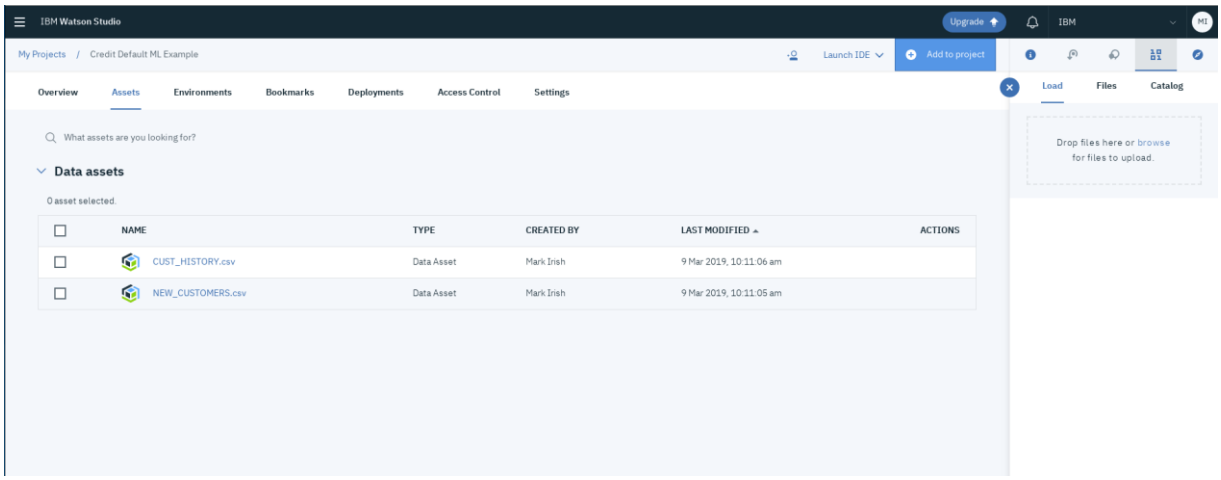
Machine Learning on IBM i example

- ACS can be used to transfer data from IBM i to a .csv file.



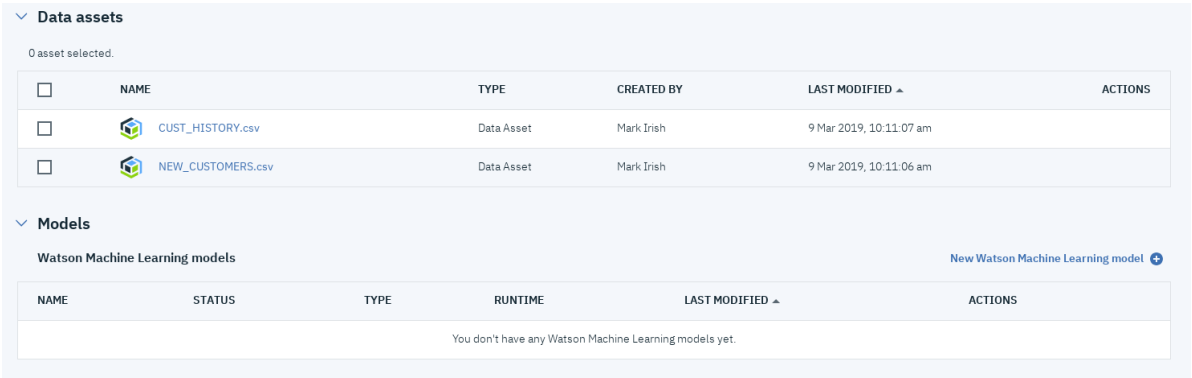
Machine Learning on IBM i example

- With the .csv files of our data, we can import them into Watson Studio



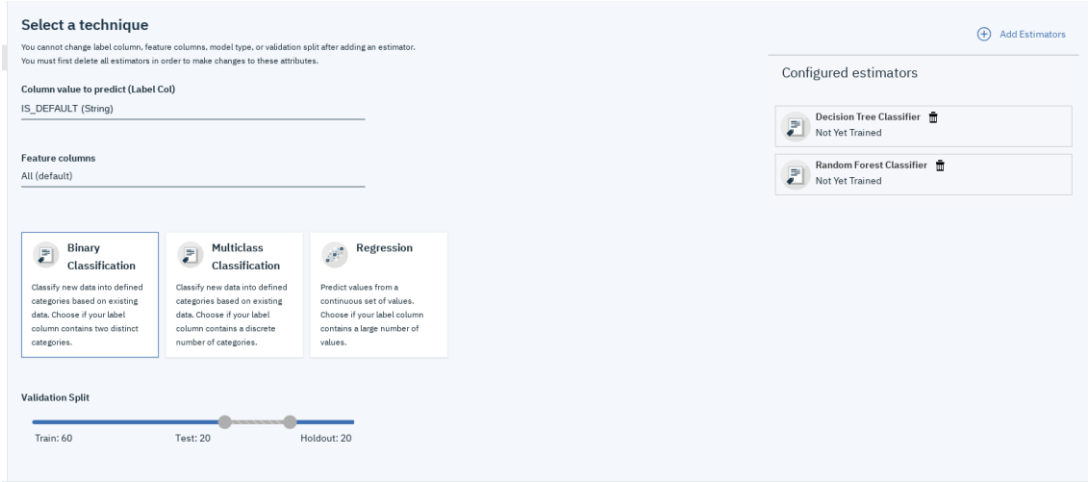
Machine Learning on IBM i example

- We have our data, but no models…



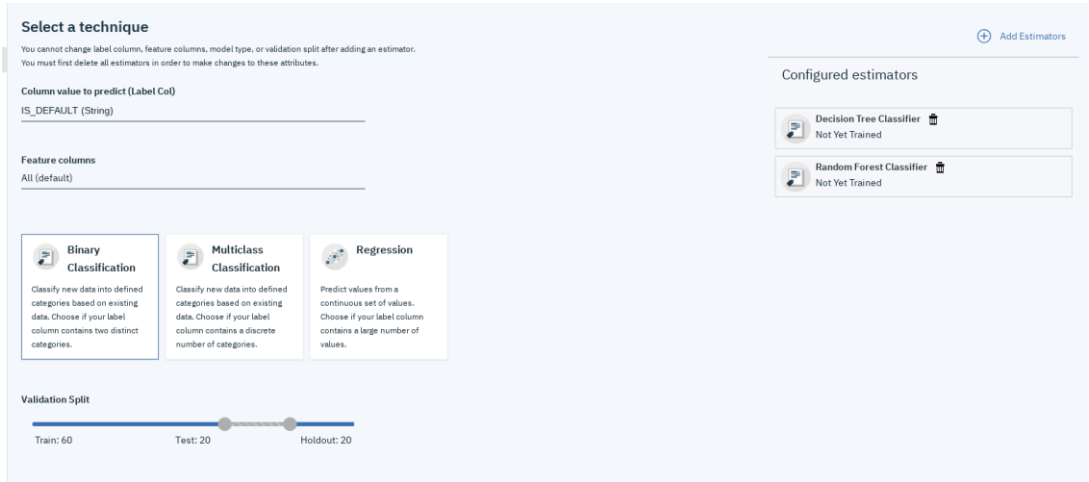
Machine Learning on IBM i example

- ...so we create a model, and have two different estimators...



Machine Learning on IBM i example

- ...and see which model performs better.



Machine Learning on IBM i example

- ...and see which model performs better.

Select model

	ESTIMATOR TYPE	STATUS	PERFORMANCE	AREA UNDER ROC CURVE	AREA UNDER PR CURVE
●	RandomForestClassifier	Trained & Evaluated	Fair	0.76497	0.46623
○	DecisionTreeClassifier	Trained & Evaluated	Fair	0.70093	0.36183

Machine Learning on IBM i example

- We save our model, then deploy it as a web service.

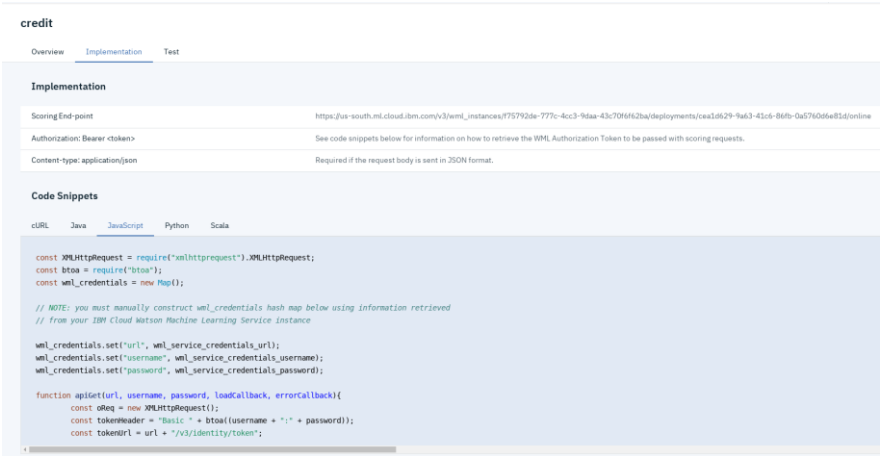
Credit Default Analysis

Overview | Evaluation | Deployments | Lineage

NAME	STATUS	DEPLOYMENT TYPE
credit	DEPLOY_SUCCESS	Web Service

Machine Learning on IBM i example

- Watson Studio will tell you how to send data to your service in a number of programming languages and utilities.



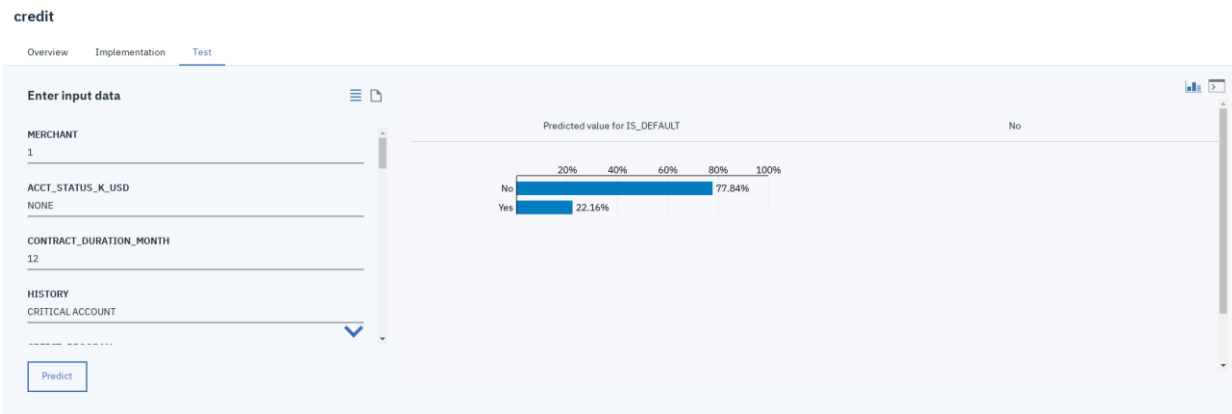
Machine Learning on IBM i example

- Results from Node.js:

```
        [Array],
        0,
        'No',
        [Array] ] ] }
[ 26,
  [ 0, 2, 3, 4, 5, 7, 8, 14, 15, 17, 21, 22, 23 ],
  [ 0.003586656685545,
    0.9776464063731196,
    0.9145825466646116,
    3.4333491482067946,
    0.7152380740805903,
    2.331738584515539,
    0.9159623110504432,
    1.96907856389488,
    2.209072203437452,
    4.196511861662977,
    1.7129974283616016,
    3.1235357358694746,
    5.7705132812785145 ] ]
[ 16.06982302958149, 3.9301769704185125 ]
[ 0.8034911514790745, 0.19650884852092562 ]
[redacted] ml-example]$
```

Machine Learning on IBM i example

- Watson Studio will also let you test your model out.



Machine Learning on IBM i example

- Credit default prediction on a publicly available dataset:
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Machine Learning on IBM i example

- Same thing can be done by hand!
- 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

Machine Learning on IBM i example

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

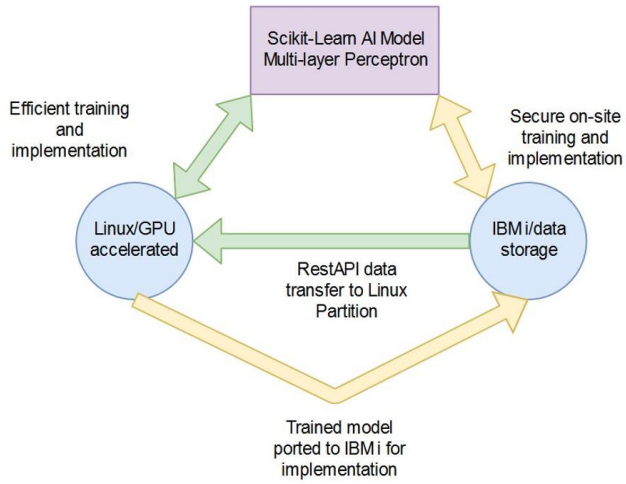
0 = No Default, 1 = Default

Chance of No Default Chance of Default

```
Prediction: 1 Actual: 0  Probability: ( 0.39931058938110997 , 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?

Machine Learning on IBM i example



Machine Learning on IBM i example

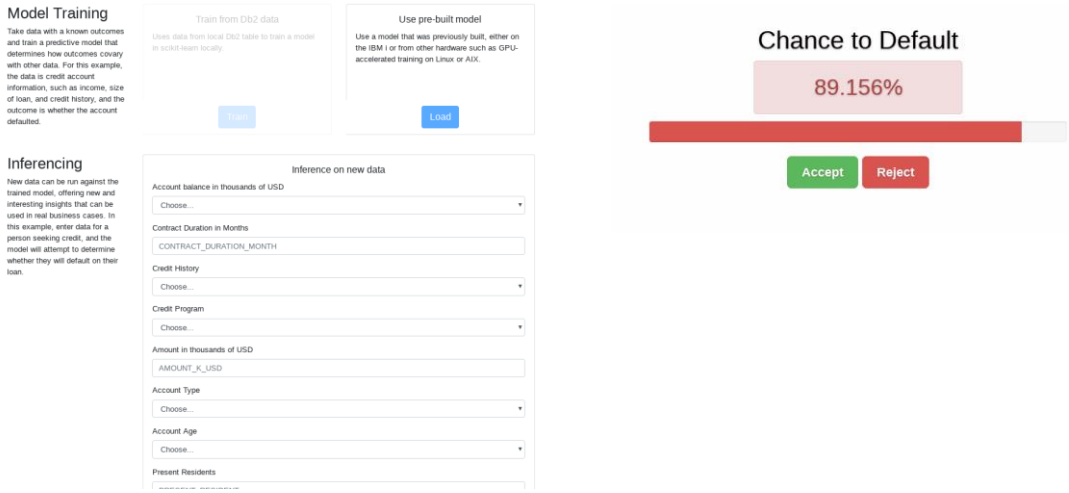
```python
def main():
    # Connect to Db2 and get the data
    conn = db2.connect()
    cur = conn.cursor()
    cur.execute("SELECT * FROM MARK.NEW_CUST")

    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.

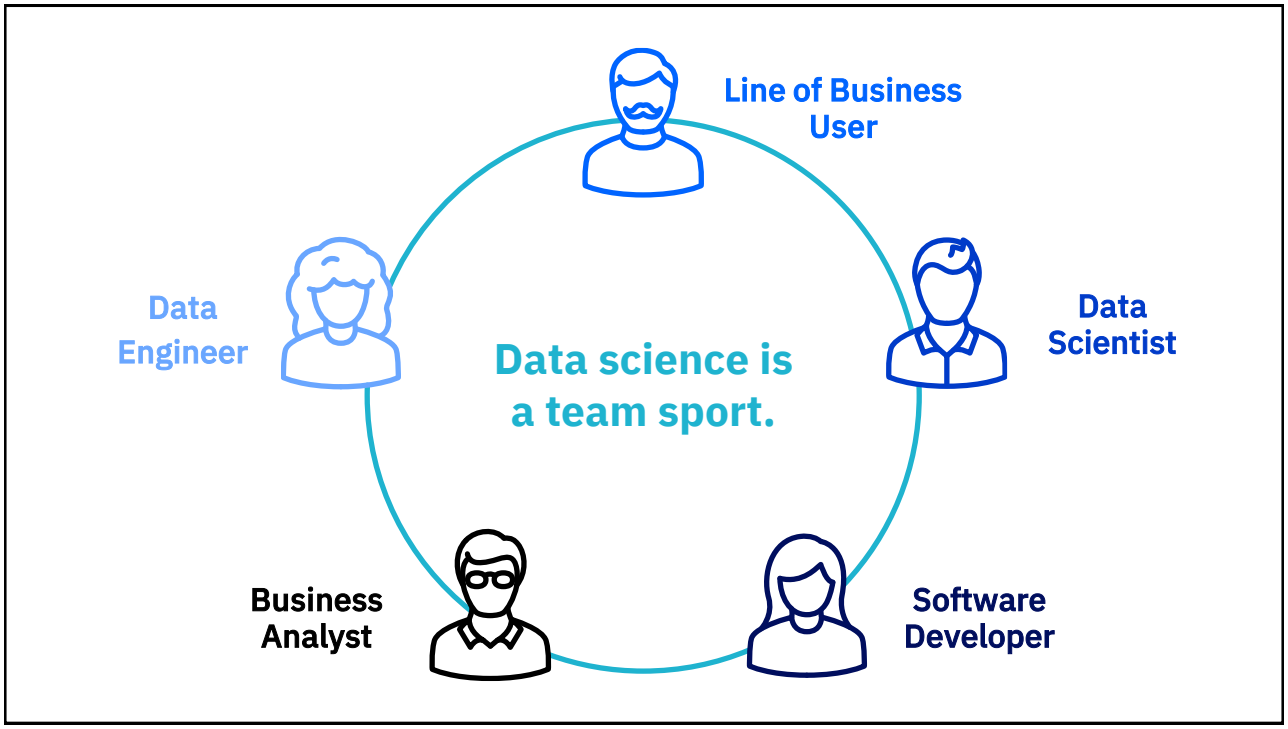
```
-bash-4.4$ python predict.py
Gold Acoustics        Not likely to default ( 0.013 )
Wood Corp             Likely to default     ( 0.8644 )
Bridge Acoustics      Not likely to default ( 0.013 )
Rabbitechnologies     Might default         ( 0.2911 )
Rhinotainment         Not likely to default ( 0.1454 )
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     ( 0.6415 )
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 )
Soul[illegible]       Not likely to default  ( 0.1261 )
Wave Acoustics        Not likely to default ( 0.0771 )
Spectertainment       Not likely to default ( 0.1118 )
```

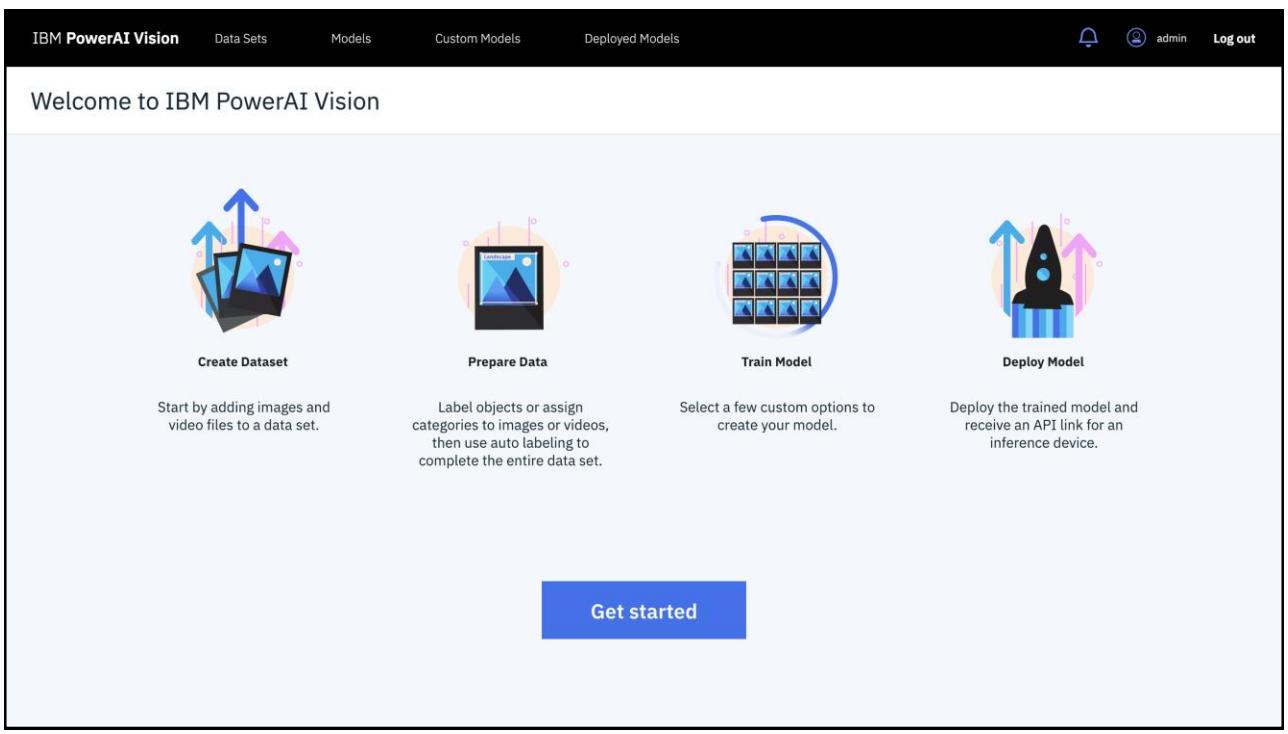
For each entry in the database, run against the model and print (and color) the output

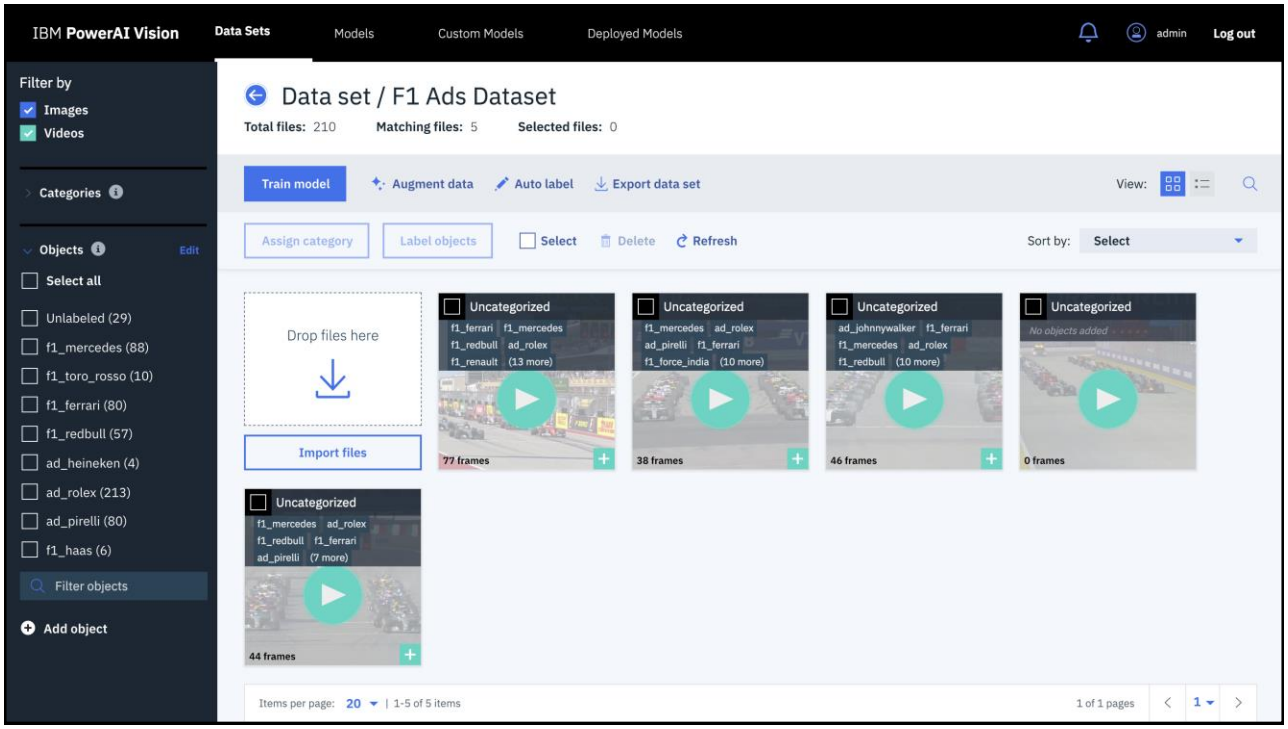
Machine Learning on IBM i example

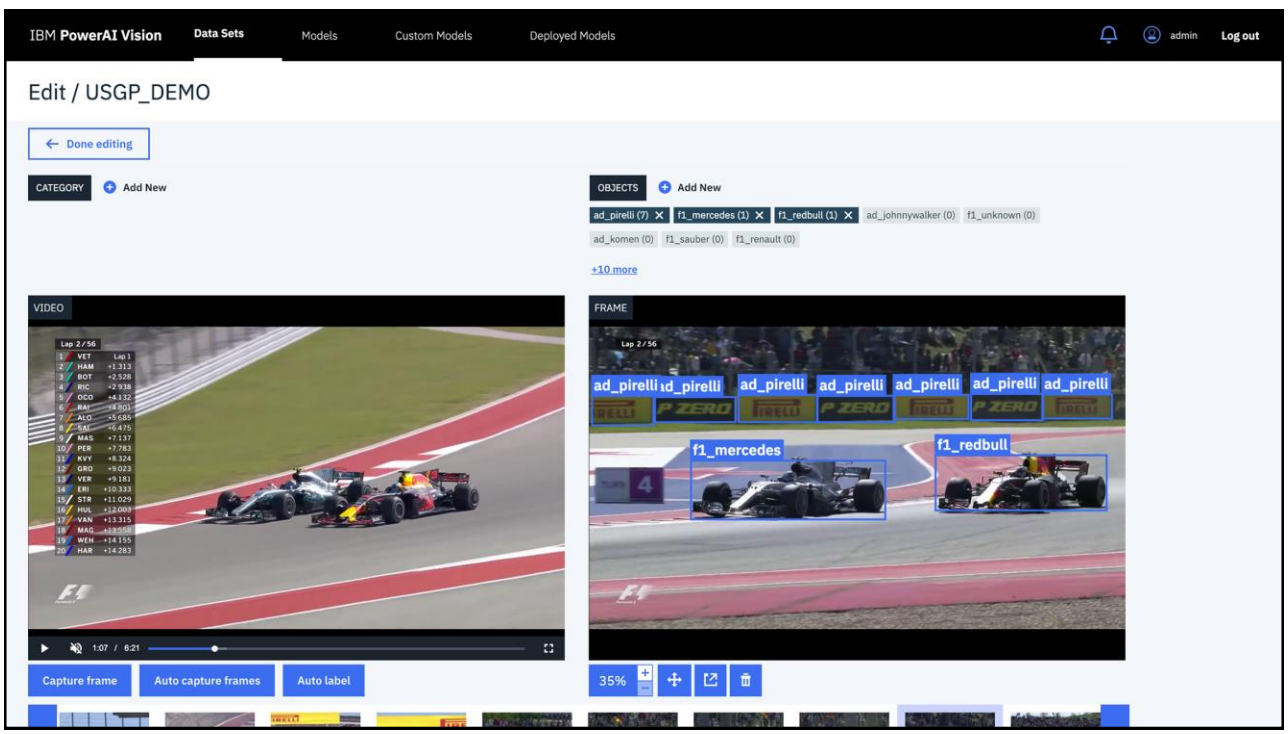


PowerAI Vision: Advertising


Line of Business User
Data Scientist
Software Developer
Business Analyst
Data Engineer
Data science is a team sport.


IBM PowerAI Vision
Data Sets
Models
Custom Models
Deployed Models
admin
Log out
Welcome to IBM PowerAI Vision
Create Dataset
Start by adding images and video files to a data set.
Prepare Data
Label objects or assign categories to images or videos, then use auto labeling to complete the entire data set.
Train Model
Select a few custom options to create your model.
Deploy Model
Deploy the trained model and receive an API link for an inference device.
Get started


IBM PowerAI Vision
Data Sets
Models
Custom Models
Deployed Models
admin
Log out
Filter by
Images
Videos
Categories
Objects
Edit
Select all
Unlabeled (29)
f1_mercedes (88)
f1_toro_rosso (10)
f1_ferrari (80)
f1_redbull (57)
ad_heineken (4)
ad_rolex (213)
ad_pirelli (80)
f1_haas (6)
Filter objects
Add object
Data set / F1 Ads Dataset
Total files: 210
Matching files: 5
Selected files: 0
Train model
Augment data
Auto label
Export data set
View:
Assign category
Label objects
Select
Delete
Refresh
Sort by:
Select
Drop files here
Import files
Uncategorized
f1_ferrari f1_mercedes f1_redbull ad_rolex f1_renault (13 more)
77 frames
Uncategorized
f1_mercedes ad_rolex ad_pirelli f1_ferrari f1_force_india (10 more)
38 frames
Uncategorized
ad_johnnywalker f1_ferrari f1_mercedes ad_rolex f1_redbull (10 more)
46 frames
Uncategorized
No objects added
0 frames
Uncategorized
f1_mercedes ad_rolex f1_redbull f1_ferrari ad_pirelli (7 more)
44 frames
Items per page: 20
1-5 of 5 items
1 of 1 pages
1


IBM PowerAI Vision
Data Sets
Models
Custom Models
Deployed Models
admin
Log out
Edit / USGP_DEMO
Done editing
CATEGORY
Add New
OBJECTS
Add New
ad_pirelli (7)
f1_mercedes (1)
f1_redbull (1)
ad_johnnywalker (0)
f1_unknown (0)
ad_komen (0)
f1_sauber (0)
f1_renault (0)
+10 more
VIDEO
FRAME
ad_pirelli
f1_mercedes
f1_redbull
Capture frame
Auto capture frames
Auto label
35%

IBM **PowerAI Vision** | Data Sets | **Models** | Custom Models | Deployed Models | admin | **Log out**

Data set
USGP_DEMO

Objects

Trained model / USGP_DEMO_model

Trained models are created from prepared data sets.
The model can be validated, exported, and deployed for production for Graphics Processing Units (GPU).

Object detection
Optimized for accuracy (faster R-CNN)

Created
12/5/2018, 2:24:50 PM

Deploy model | Export model | Advanced metrics: Off On

33% Accuracy | 47% Precision | 47% mAP | 40% Recall | 70% IoU

OBJECT	AVERAGE PRECISION	RECALL	IOU
f1_ferrari 111 objects / 95 images	0.892	0.6	0.892
ad_dhl 69 objects / 18 images	0.394	0.125	0.394
f1_unknown 84 objects / 31 images	0.005	0	0
f1_redbull 102 objects / 96 images	0.792	0.462	0.792
ad_emirates 105 objects / 19 images	0.027	0.065	0.027

IBM **PowerAI Vision** | Data Sets | Models | Custom Models | **Deployed Models** | admin | **Log out**

Data set
USGP_Autolabel

Objects

API endpoint: api/dlapis/efd9b10c-a1f9-45e3-9df7-18c3f5445a87 | Copy | GET | POST

Test Model

Drop files here

Import files

To test a video using the API endpoint, click open.

Open

External URL

URL

Upload

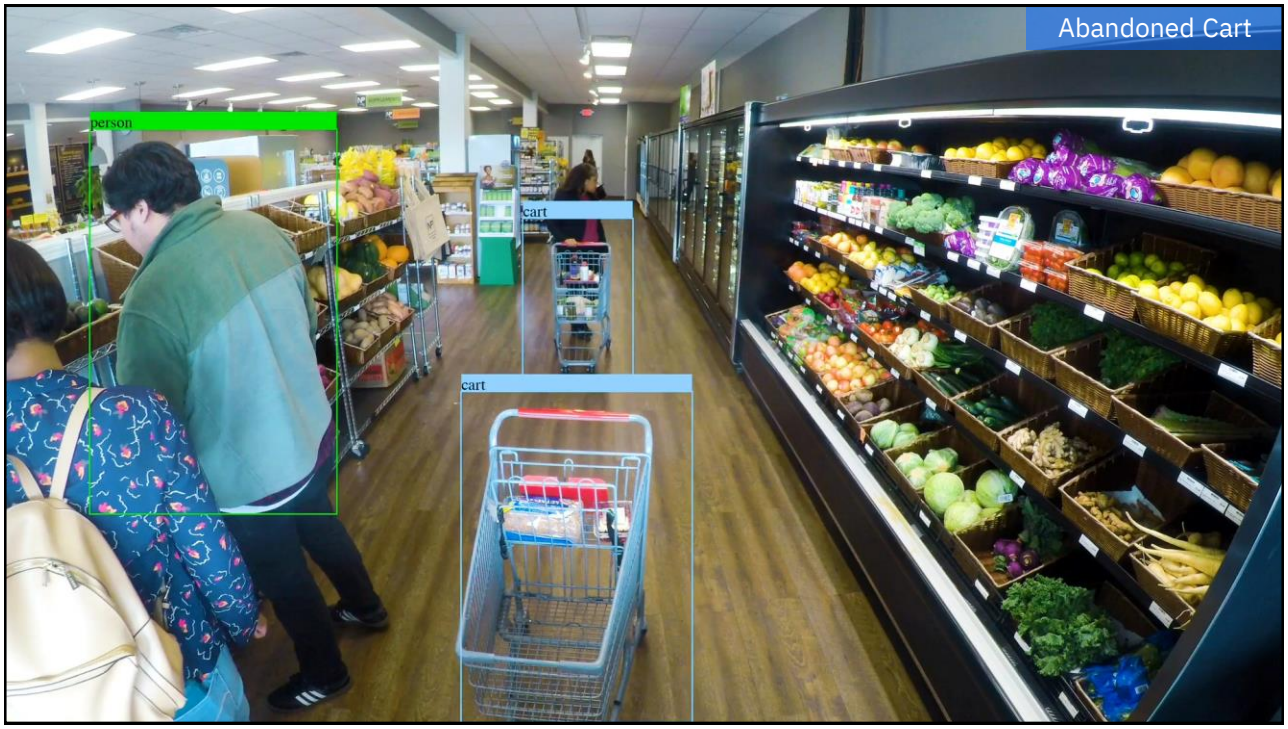
60% Accuracy

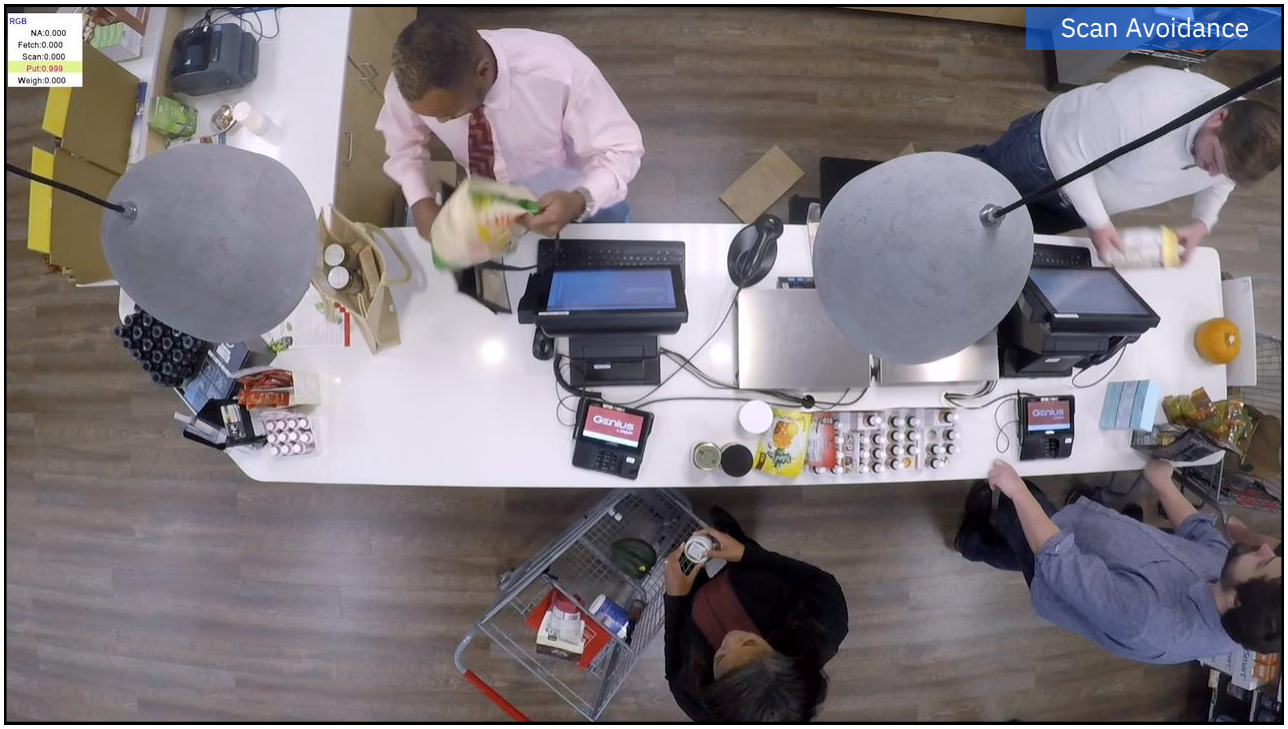
Results

OBJECTS	RESULT	AVERAGE
f1_mercedes 2 objects	-	0.991
f1_force_india 2 objects	-	0.934
f1_ferrari 1 objects	0.980	-
f1_redbull 1 objects	0.985	-

PowerAI Vision: Retail Analytics

60


Abandoned Cart
person
cart
cart


Scan Avoidance
RGB
NA:0.000
Fetch:0.000
Scan:0.000
Put:0.999
Weigh:0.000

Conclusions

Machine Learning is about fuzzy logic

- Algorithms can tell you interesting things about your data without you writing custom code.
- Instead of writing code, you feed the algorithms data to build models.
- These models can make (very well-)educated guesses to draw new insights on your data.
- Machine learning can automate things that previously could not be automated
- Machine learning can also find relationships too complex for us to see

Machine Learning is the present

- In the Information Age, data is growing faster than we realize
- A lot of the data is 'uncertain', in that we have data points but not the complete picture
- Machine learning helps draw conclusions about this uncertain data
- The most successful companies of the future will be those that utilize machine learning **NOW** to get ahead of the competition.

Machine Learning is possible on IBM i

- There are **many avenues for doing machine learning** with the data on your IBM i.
  - Watson Machine Learning **(Easiest)**
  - Watson Machine Learning Community Edition **(Harder, Fast)**
  - Open-source Python packages on IBM i **(Harder, Slow)**
- You have options!

Machine Learning already bringing value

See http://ibm.biz/ibmistories

- Computer Merchants (B2B Computing, Australia)
  - Using custom app which leverages AI to "identify issues that most likely require an engineer's expertise"
- Vision Banco (Finance/Banking, Paraguay)
  - H2O Driverless AI on IBM Power Systems AC922 running Red Hat Enterprise Linux. The bank is now migrating all of their models to H20 Driverless AI. They are able to get insights into their data much faster than on traditional x86 infrastructure.
  - Saved time and increased revenue by building and deploying models that have doubled the number of credit products accepted per customer. Additionally, the team was able to pinpoint credit and default risks with greater accuracy than previously.

Machine Learning already bringing value

See http://ibm.biz/ibmistories

- Jori (Furniture, Belgium)
  - Leveraging scikit-learn to predict where to build retail locations. Also doing language translation.
- Robertet (Fragrance & Flavors, France)
  - Running chatbots based on Java and Watson
- Caixa Geral de Depositos (Finance/Banking, France)
  - A hybrid cloud credit-scoring application that uses advanced machine learning with IBM Watson to rapidly and accurately determine each customer's credit-worthiness. Consumed via simple API call

Resources to help you get started

- IBM i OSS examples github
  - Tutorials and sample code for machine learning (and python, Node.js, ...)
  - https://github.com/ibm/ibmi-oss-examples
- Watson Machine Learning Demos
  - Available online, and so easy to use!
  - https://www.ibm.com/cloud/garage/dte/tutorial/ibmr-watson-studio-mldl-made-easy
  - There are free subscriptions that allow you to try before you buy!

Leaders everywhere are monetizing data & developing strategies to embed AI in business

Retail
Market basket analysis, Next best offer, Customer churn, Propensity to buy

Marketing
Email optimization, Lifetime client value, Discount targeting

Healthcare
Medicare fraud, AI-assisted diagnosis, Drug demand forecast, Medical Imaging

Manufacturing
Predictive maintenance, Process optimization, Demand forecast, Product inspection & quality

Energy and Utilities
Power usage prediction, Smart grid management, Asset inspection

Banking
Customer segmentation, Credit risk, credit card fraud detection, Market prediction, ATM fraud

Security
Malicious activity detection, Logs analysis, Fraud analysis, Video Analysis

Travel & transportation
Dynamic pricing, Call center assistants, Tourism forecasting, Self-driving vehicles


Imagine the
possibilities for deep
learning
71


Imagine the
possibilities for deep
learning
...and for your
business.
72

Let’s put smart to work.™