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CREDIT CARD STATEMENT

Wells Fargo

SEND PAYMENT TO:

1015 EAST BOBBY COURT

MILLERSVILLE, MISSOURI - 37072

Social Security Number 098-32-5068

Name Alex Smith

ACCOUNT NUMBER NAME STATEMENT DATE PAYMENT DUE DATE

0987-527-810 Alex Smith 10/01/2015 11/07/2015

CREDIT LIMIT CREDIT AVAILABLE NEW BALANCE MINIMUM PAYMENT

$5,000.00 3,477.98 $1,522.02 $69.87

This Month’s Activity:

TRANSACTION DATE

POST DATE

TRANSACTION DESCRIPTION

AMOUNT

09/05/2015

09/07/2015

Safeway

101.01

A question I get asked a lot on my email list is: what is the best programming language for machine learning?

I’ve replied to this question many times now it’s about time to explore this further in a blog post. Ultimately, the programming language you use for machine learning should consider your own requirements and predilections. No one can meaningfully address those concerns for you.

What Languages Are Being Used

Before I give you my opinion, it is good to have  a look around to see what languages and platforms are popular in self-selected communities of data analysis and machine learning professionals.

KDnuggets has had language polls forever. A recent poll is titled “What programming/statistics languages you used for an analytics / data mining / data science work in 2013“. The trends are almost identical to the previous year. The results suggest heavy use of R and Python and SQL for data access. SAS and MATLAB rank higher than I would have expected. I’d expect SAS accounts for larger corporate (Fortune 500) data analysis and MATLAB for engineering, research and student use.

Kaggle offer machine learning competitions and have polled their user base as to the tools and programming languages used by participants in competitions. They posted results in 2011 titledKagglers’ Favorite Tools (also see the forum discussion). The results suggested the abundant use of R. The results also show good use of MATLAB and SAS with much lower Python representation. I can attest that I prefer R over Python for competition work. It just feels though it has more on offer in terms of data analysis and algorithm selection.

Ben Hamner, Kaggle Admin and author of the blog post above on the Kaggle blog goes into more detail on the options when it comes to programming languages for machine learning in a forum post titled “What tools do people generally use to solve problems“.

Ben comments that MATLAB/Octave is a good language for matrix operations and can be good when working with a well defined feature matrix. Python is fragmented by comprehensive and can be very slow unless you drop into C. He prefers Python when not working with a well defined feature matrix and uses Pandas and NLTK. Ben comments that “As a general rule, if it’s found to be interesting for statisticians, it’s been implemented in R” (well said). He also complains about the language itself being ugly and painful to work with. Finally, Ben comments on Julia that doesn’t have much to offer in the way of libraries but is his new favorite language. He comments that it has the conciseness of languages like MATLAB and Python with the speed of C.

Anthony Goldbloom, the CEO of Kaggle gave a presentation to the Bay Area R user group in 2011 on the popularity of R in Kaggle competitions titled Predictive modeling competitions: making data science a sport (see the powerpoint slides). The presentation slides give more detail on the use of programming languages and suggest an Other category that is as close to as large as large as the usage of R. It would be nice to have the raw data that was collected (why didn’t they release it to their own data community, seriously!?).

John Langford on his blog Hunch has an excellent article on the properties of a programming language to consider when working with machine learning algorithms titled “Programming Languages for Machine Learning Implementations“. He divides the properties into concerns of speed and the concerns of programability (programming ease). He points to powerful industry standard implementations of algorithms, all in C and comments that he has not used R or MATLAB (the post was written 8 years ago). Take some time and read some of the comments by academics and industry specialists alike. This is a deep and nuanced problem that really comes down to the specifics of the problem you are solving and the environment in which you are solving it.

Machine Learning Languages

I think of programming languages in the context of the machine learning activities I want to perform.

MATLAB/Octave

I think MATLAB is excellent for representing and working with matrices. As such, I think it’s an excellent language or platform to use when climbing into the linear algebra of a given method. I think it’s suited to learning about algorithms both superficially the first time around and deeply when you are trying to figure something out or go deep into the method. For example, it’s popular in university courses for beginners, like Andrew Ng’s Coursera Machine Learning course.

R

R is a workhorse for statistical analysis and by extension machine learning. Much talk is given to the learning curve, I didn’t really see the problem. It is the platform to use to understand and explore your data using statistical methods and graphs. It has a n enormous number of machine learning algorithms, and advanced implementations too written by the developers of the algorithm.

I think you can explore, model and prototype with R. I think it suits one-off projects with an artefact like a set of predictions, report or research paper. For example, it is the most popular platform for machine learning competitors such as Kaggle.

Python

Python if a popular scientific language and a rising star for machine learning. I’d be surprised if it can take the data analysis mantle from R, but matrix handling in NumPy may challenge MATLAB and communication tools like IPython are very attractive and a step into the future of reproducibility.

I think the SciPy stack for machine learning and data analysis can be used for one-off projects (like papers), and frameworks like scikit-learn may be mature enough to be used in production systems.

Java-family/C-family

Implementing a system that uses machine learning is an engineering challenge like any other. You need good design and developed requirements. Machine learning is algorithms, not magic. When it comes to serious production implementations, you need a robust library or you customize an implementation of the algorithm for your needs.

There are robust libraries, for example Java has Weka and Mahout. Also note that the deeper implementations of core algorithms like regression (LIBLINEAR) and SVM (LIBSVM) are written in C and leveraged by Python and other toolkits. I think you are serious you may prototype in R or Python, but you will implement in a heavier language for reasons such as execution speed and system reliability. For example, the backend of BigML is implemented in Clojure.

Other Concerns

Not a Programmer: If you are not a programmer (or not a confident programmer) I recommend playing machine learning via a GUI interface like Weka.

One Language for Research and Ops: You may want to use the same language for prototyping and for production to reduce risk of not effectively transferring the results.

Pet Language: You may have a pet language of favorite language and want to stick to that. You can implement algorithms yourself or leverage libraries. Most languages have some form of machine learning package, however primitive.

Application to Establish an Accessory Dwelling Unit or Backyard Cottage

City of Seattle

Department of Planning and Development

Application to Establish an Accessory Dwelling Unit

I am (check one)

Applying to create a new accessory dwelling unit.

Applying to legalize an existing unauthorized unit. As reflected in King County real estate

records, I purchased the lot on which the unauthorized unit is located less than one year ago,

and am submitting proof of this purchase. (No penalty)

Applying to voluntarily legalize an existing unauthorized unit. I may be subject to civil penalties until the permit process is completed.

Project Number:987525

Address: 60 Vine Street Noblesville, Indiana 46060

Owner: Jeffrey Hall

Daytime Phone # 154-087-7612

Assessor’s Parcel Number:1098745

Submit this form along with required plans and other documents.

Parking Waiver Request, if necessary

Not located within a Residential Parking Zone (RPZ)

Located within a RPZ; parking waiver study included

Phone:154-087-7612

Name(s) of Tenant(s)

Phone:154-933-0812

Phone:154-254-8934

Owner Occupancy Covenant, completed, notarized, recorded; original to DPD.

Date Unit was Created (to best of your knowledge):02/02/2016

Value of Construction Work Needed to Legalize Unit:

Copy of the Contractor’s Registration/Lien Law Form (completed)

Copy of Agent’s Authorization Letter from Owner (if agent)

Applicant’s Name: Kimberly Harris

Date received:09/03/2016

(PLEASE PRINT)

Applicant Signature

Date signed:09/03/2016

Relationship of applicant: (circle one) owner, agent, architect, contractor, engineer

Receipt #:94

Date of receipt: 10/03/2016

For DPD Use Only (must be completed)

Urban Village /

Urban Center

Application

Parking

Parking

Waiver Granted

# of Parking

Spaces Provided

Unit Square Footage

\_\_\_\_\_\_\_ Detached

(BYC)

No

No

No

\_\_\_\_\_\_\_\_\_\_\_ space

\_\_\_\_\_\_\_\_\_\_\_ space

\_\_\_\_\_\_\_ Attached

(ADU)

Page 1 of 2

?Application to Establish an Accessory Dwelling Unit or Backyard Cottage

City of Seattle

Department of Planning and Development

Application to Establish a Backyard Cottage

I am (check one):

Applying to create a new accessory dwelling unit.

Applying to legalize an existing unauthorized unit. As reflected in King County real estate

records, I purchased the lot on which the unauthorized unit is located less than one year ago,

and am submitting proof of this purchase. (No penalty)

Applying to voluntarily legalize an existing unauthorized unit. I may be subject to civil penalties until the permit process is completed.

Project Number

Address

Owner

Daytime Phone #165-892-0982

Assessor’s Parcel Number

Submit this form along with required plans and other documents.

Parking Waiver Request, if necessary

Not located within a Residential Parking Zone (RPZ)

Located within a RPZ; parking waiver study included

Phone:

Name(s) of Tenant(s):Alice Long

Phone:

Phone:

Owner Occupancy Covenant, completed, notarized, recorded; original to DPD.

Date Unit was Created (to best of your knowledge):

Value of Construction Work Needed to Legalize Unit:

Copy of the Contractor’s Registration/Lien Law Form (completed)

Copy of Agent’s Authorization Letter from Owner (if agent)

Applicant’s Name

Date received

(PLEASE PRINT)

Applicant Signature

Date signed

Relationship of applicant: (circle one) owner, agent, architect, contractor, engineer

Receipt #

Date of receipt

For DPD Use Only (must be completed for units in single family zones)

Urban Village /

Urban Center

Application

Parking

Parking

Waiver Granted

# of Parking

Spaces Provided

Unit Square Footage

\_\_\_\_\_\_\_ Detached

(BYC)

Yes \_\_ No \_\_

Yes \_\_ No \_\_

Yes \_\_ No \_\_

\_\_\_\_\_\_\_\_\_\_\_ space

\_\_\_\_\_\_\_\_\_\_\_ space

\_\_\_\_\_\_\_ Attached

(ADU)

Page 2 of 2

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