

# Machine Learning Specialization

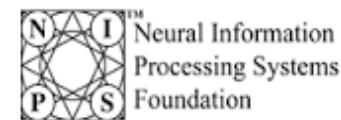
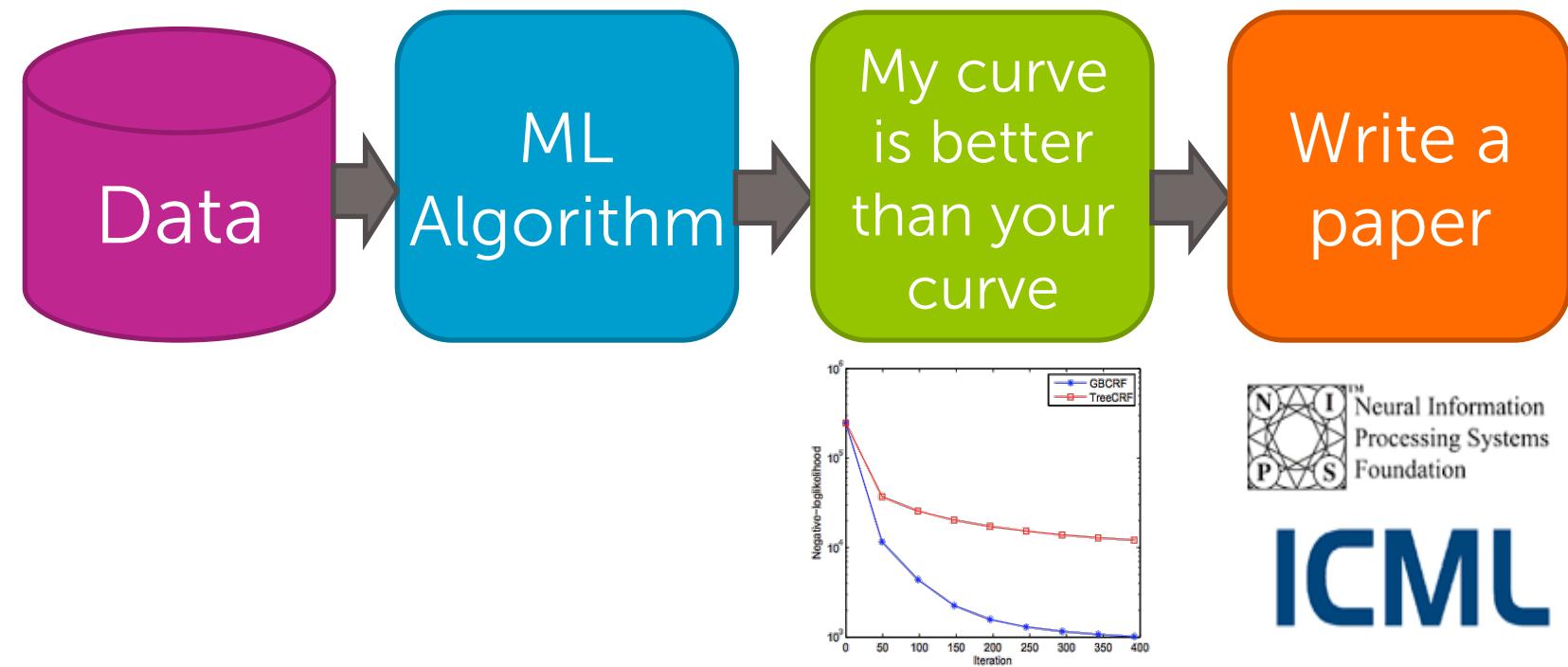
# Welcome

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Machine Learning Specialization  
University of Washington

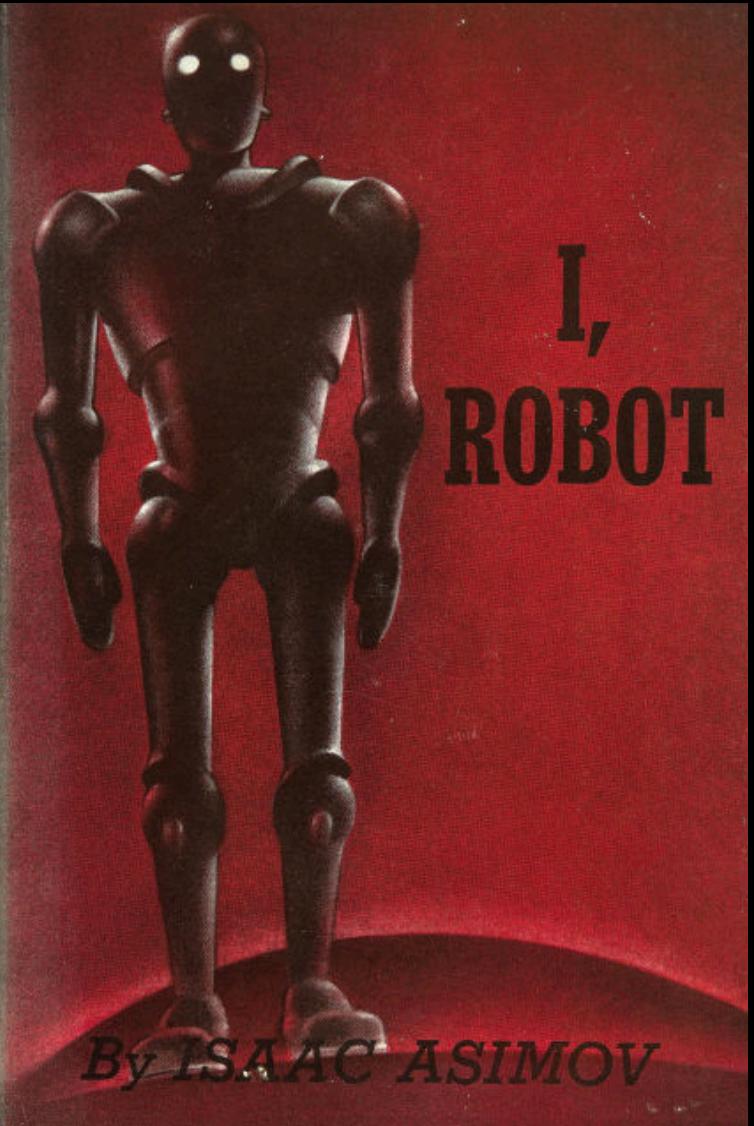


Machine learning is  
changing the world

# Old view of ML



ICML



PANDORA  
Music

Google  
AdSense  
Advertising

glassdoor™  
Human  
Resources

eHarmony®  
Dating

amazon®  
Retail

NETFLIX  
Movie  
Distribution

Google  
PageRank  
Search

livingsocial®  
Coupons

LinkedIn  
Networking

Obama'08  
Campaigning

Zillow®  
Real Estate

Avvo™  
Legal  
Advice

U  
BER  
Taxis

RelateIQ  
CRM

fitbit  
Wearables

Disruptive companies  
differentiated by  
**INTELLIGENT  
APPLICATIONS**  
using

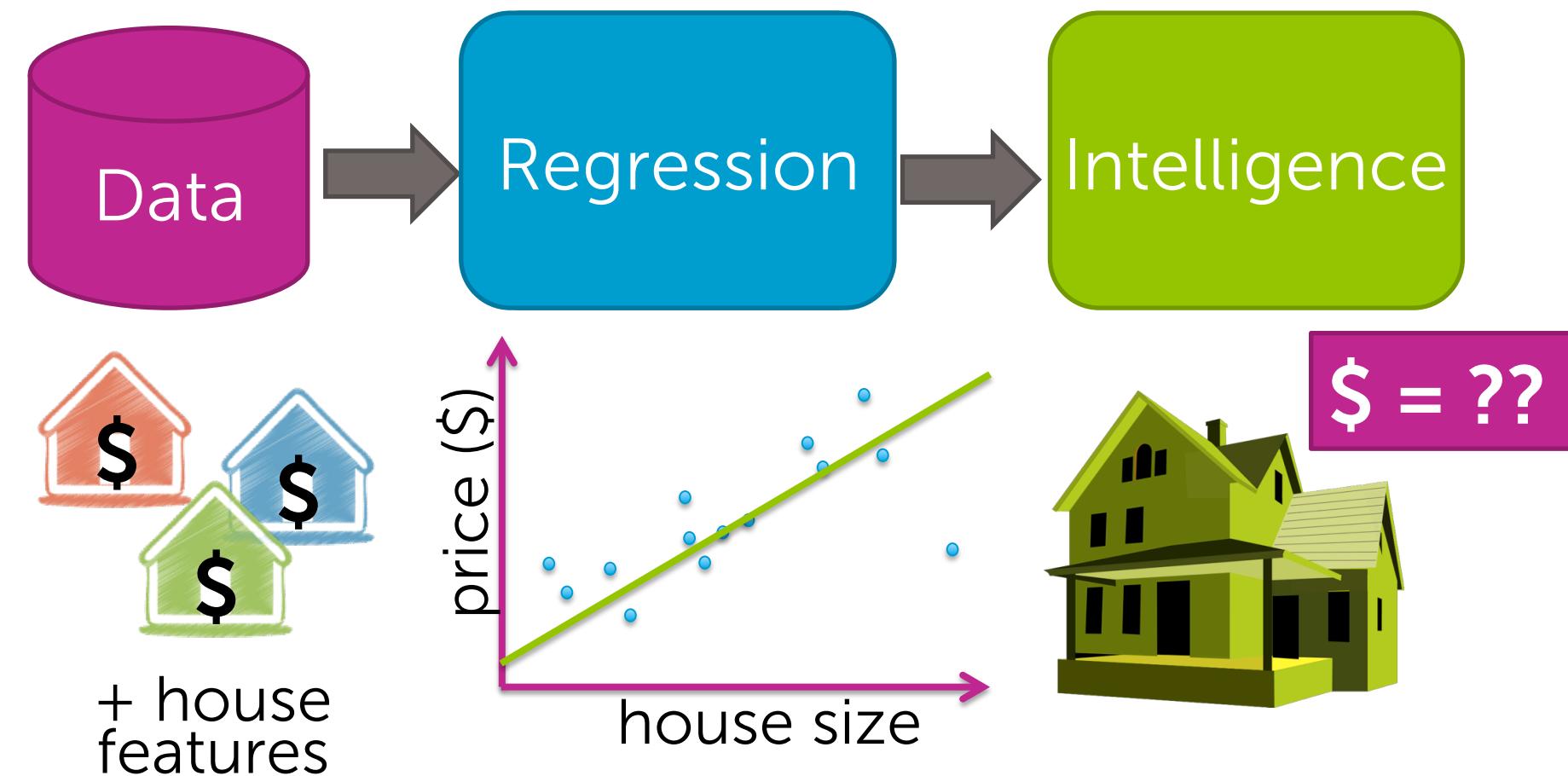
Machine Learning

# The machine learning pipeline



# ML case studies

# Case Study 1: Predicting house prices



# Case Study 2: Sentiment analysis



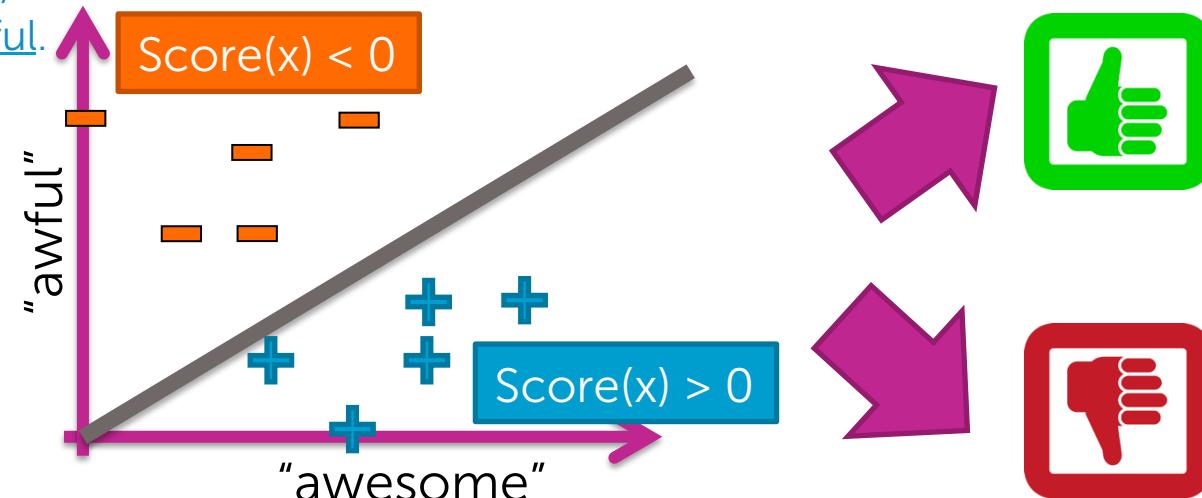
Sushi was awesome,  
the food was awesome,  
but the service was awful.

All reviews:

★★★★★ 7/21/2015  
This is probably my favorite place to eat Japanese in Seattle. My boyfriend and I ordered nigiri of scallop, Japanese snapper (seasonal), and the agedashi tofu and 2 special rolls. I would skip the special rolls, because the nigiri and sashimi cuts is where this place excels. The tofu, as recommended by other Yelpers was amazing. It's more chewy and the sauce/gravy is the perfect amount of flavor for the delicate tofu.

★★★★★ 6/11/2015  
Dining here at the sushi bar made me feel like sitting front row to an amazing performance. We didn't have reservations, banged down to the last seat after work, got here breathlessly at 6:10pm, and got the last two seats in the place.

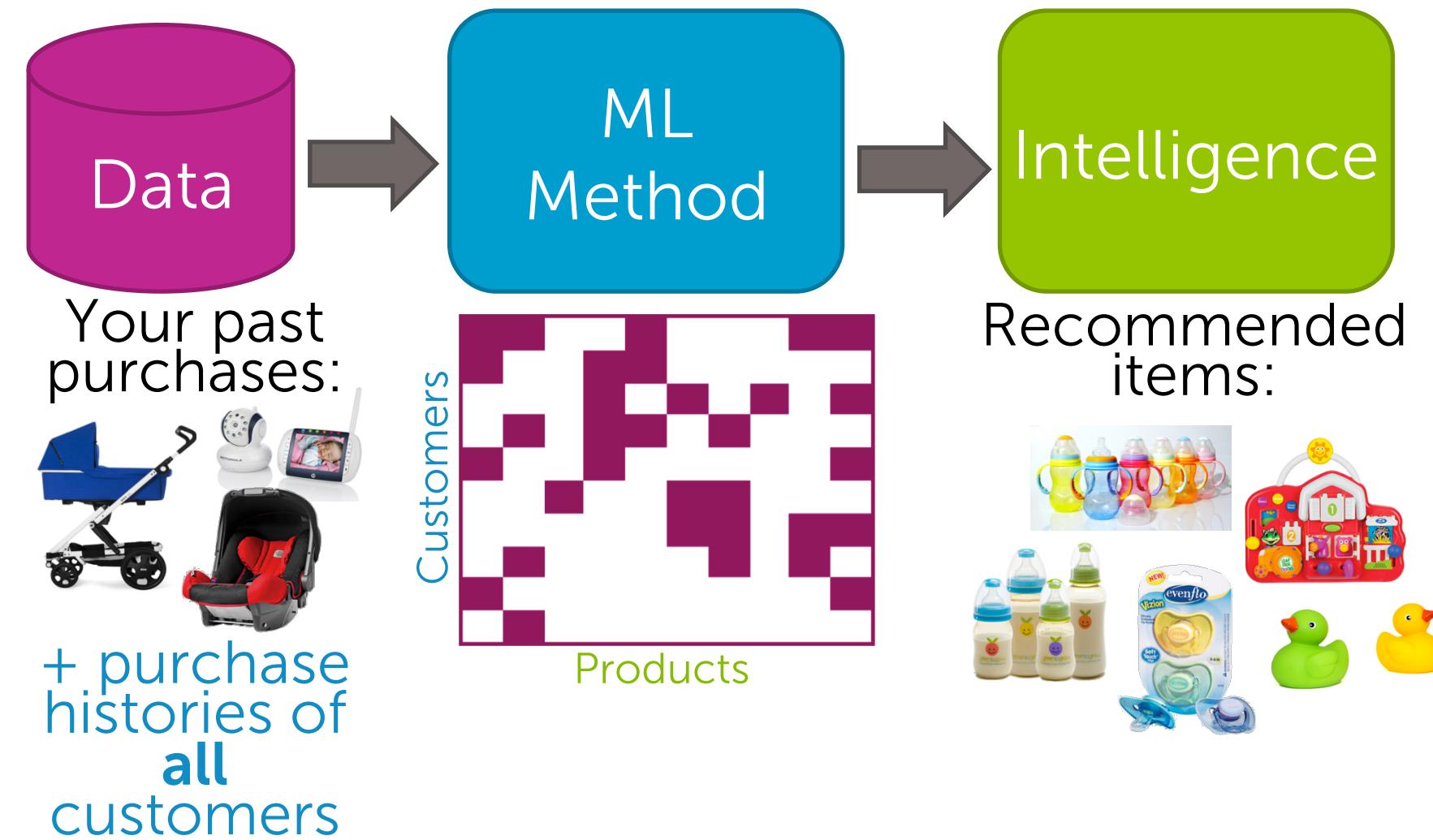
★★★★★ 6/9/2015  
I came here having high expectations due to the reviews of this place, but I was bit disappointed. The restaurant is small so do make reservations when you come here. Dishes cost from \$4-26 each and dishes are small.



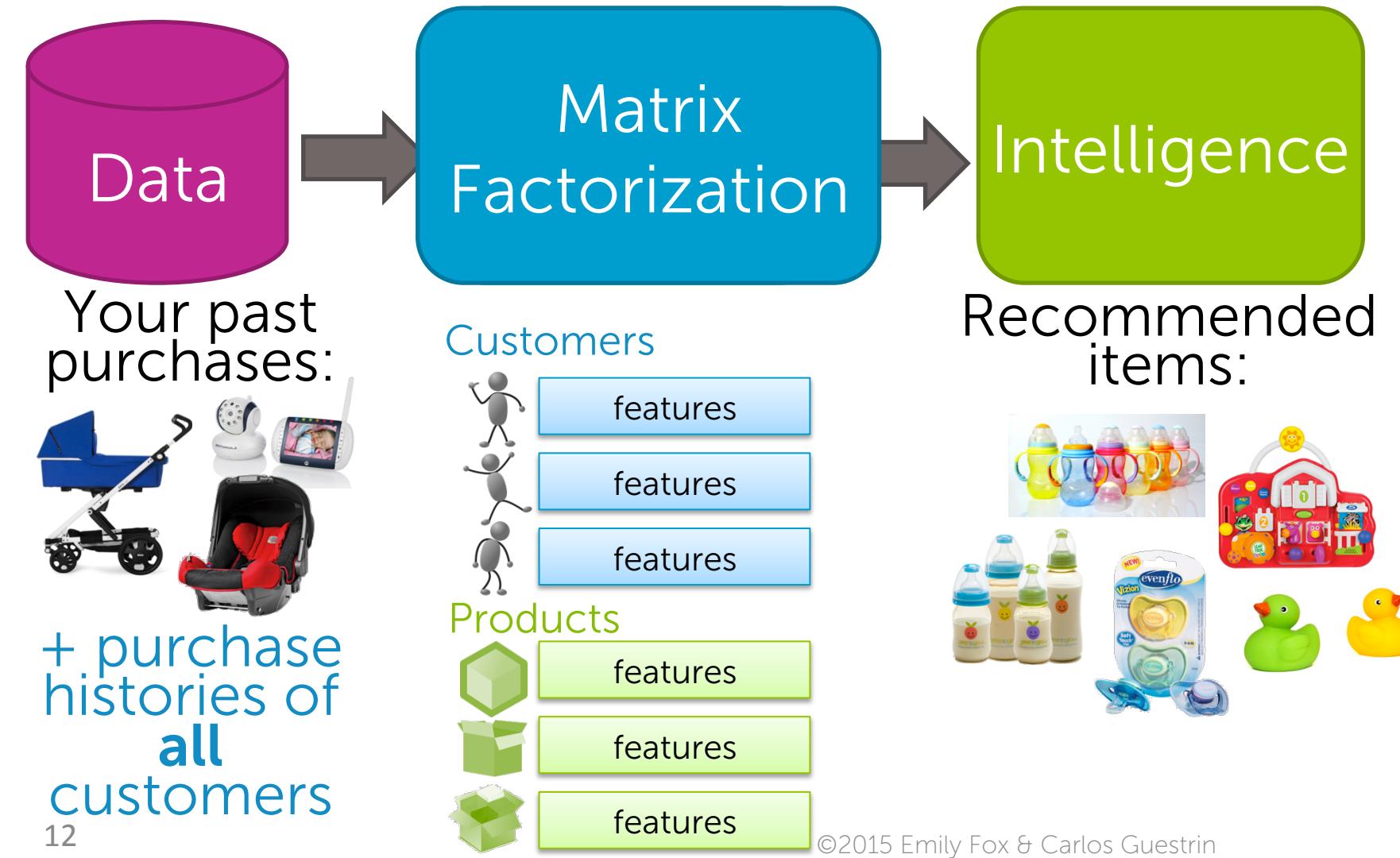
# Case Study 3: Document retrieval



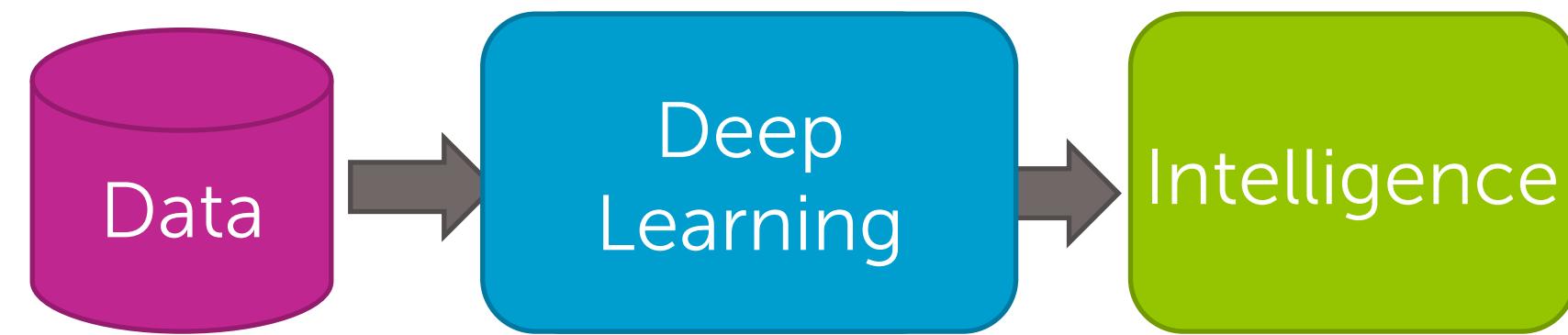
# Case Study 4: Product recommendation



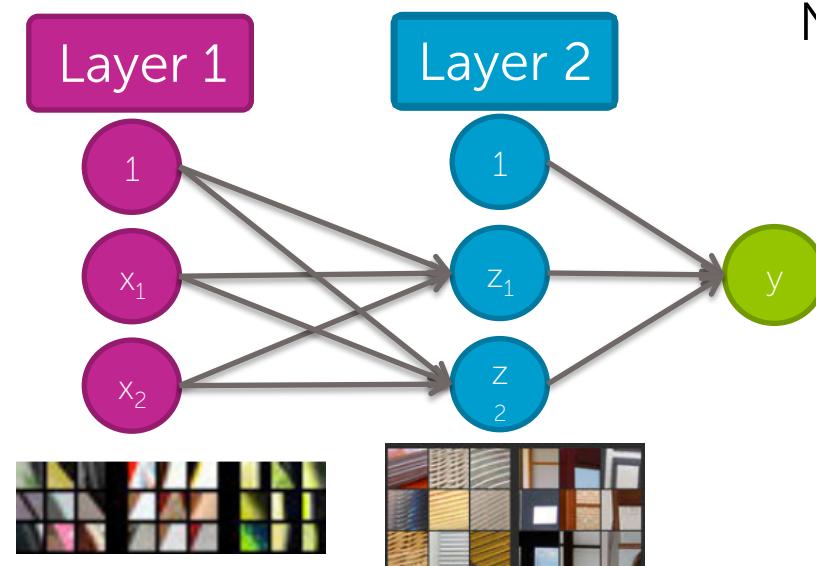
# Case Study 4: Product recommendation



# Case Study 5: Visual product recommender



Input images:



Nearest neighbors:



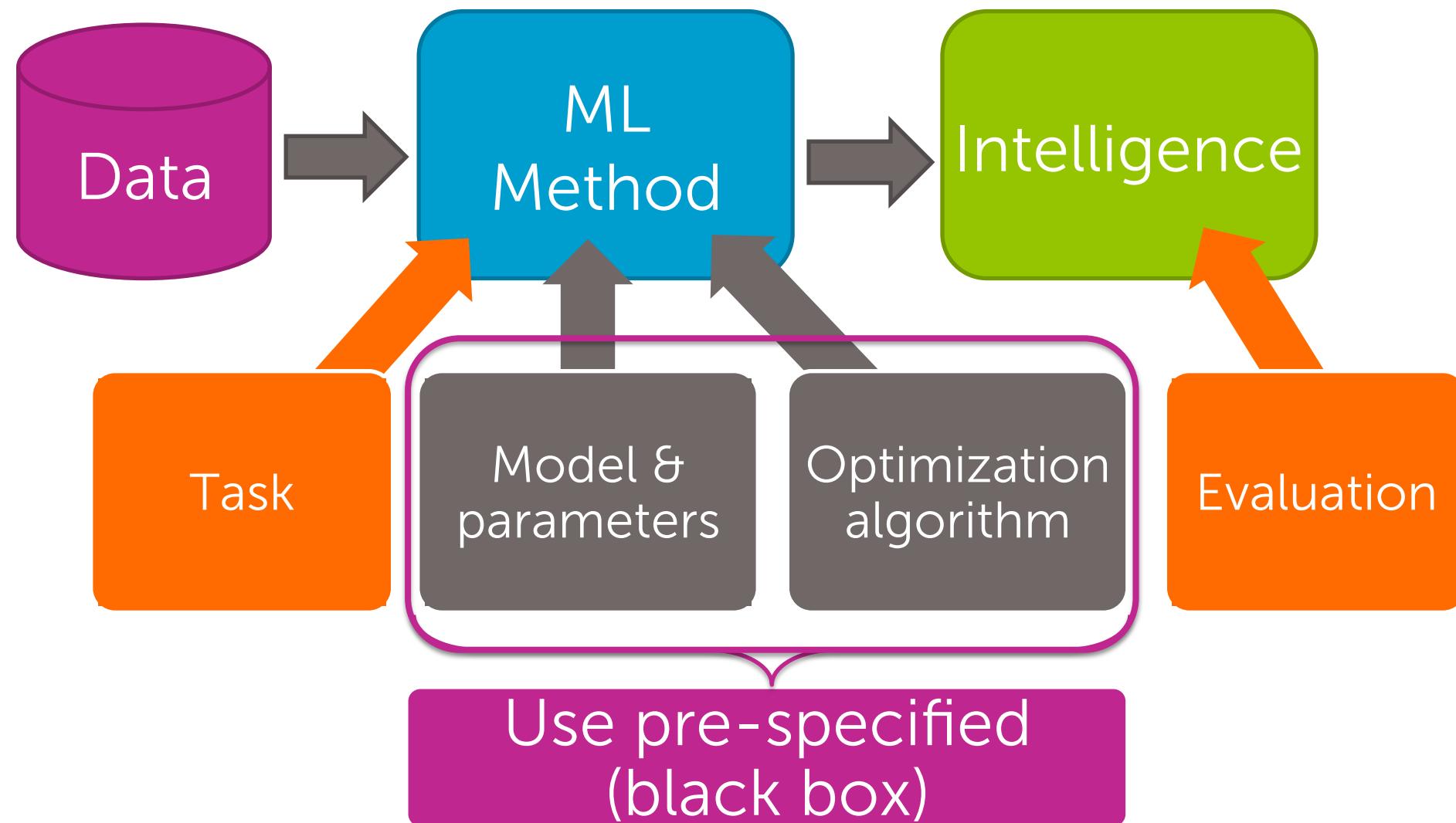
# A unique ML specialization



Not like other ML  
courses out there...

From use cases to  
models & algorithms

# First course is about building, evaluating and deploying *intelligence* in each case study...



Subsequent courses provide depth in  
models & algorithms, but still use case studies

2. Regression
3. Classification
4. Clustering & Retrieval
5. Matrix Factorization &  
Dimensionality Reduction
6. Capstone: Build an  
Intelligent Application  
with Deep Learning

## 2. Regression

### *Case study: Predicting house prices*

#### Models

- Linear regression
- Regularization:  
Ridge (L2), Lasso (L1)

#### Algorithms

- Gradient descent
- Coordinate descent

#### Concepts

- Loss functions, bias-variance tradeoff, cross-validation, sparsity, overfitting, model selection

# 3. Classification

## *Case study: Analyzing sentiment*

Models

- Linear classifiers  
(logistic regression, SVMs, perceptron)
- Kernels
- Decision trees

Algorithms

- Stochastic gradient descent
- Boosting

Concepts

- Decision boundaries, MLE, ensemble methods, random forests, CART, online learning

# 4. Clustering & Retrieval

## *Case study: Finding documents*

### Models

- Nearest neighbors
- Clustering, mixtures of Gaussians
- Latent Dirichlet allocation (LDA)

### Algorithms

- KD-trees, locality-sensitive hashing (LSH)
- K-means
- Expectation-maximization (EM)

### Concepts

- Distance metrics, approximation algorithms, hashing, sampling algorithms, scaling up with map-reduce

# 5. Matrix Factorization & Dimensionality Reduction

## *Case study: Recommending Products*

Models

- Collaborative filtering
- Matrix factorization
- PCA

Algorithms

- Coordinate descent
- Eigen decomposition
- SVD

Concepts

- Matrix completion, eigenvalues, random projections, cold-start problem, diversity, scaling up

# 6. Capstone:

## *An intelligent application using deep learning*

Build & deploy  
a recommender using  
product images and  
text sentiment



This specialization is for you if...

# Level of the specialization

**Motto:**

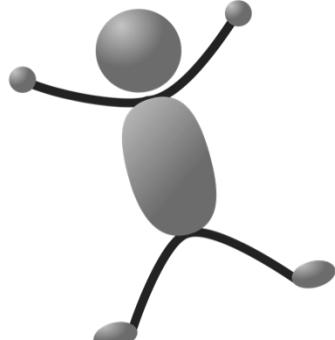
*tough concepts made intuitive  
and applicable*

minimize prereq knowledge  
maximize ability to develop and deploy  
learn concepts through case studies

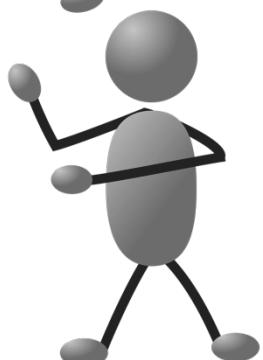
# Target audience



Software engineer



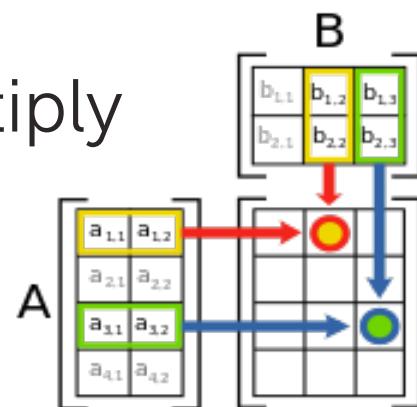
Scientist



Data enthusiast

# Math background

- Basic calculus
  - Concept of derivatives
- Basic linear algebra
  - Vectors
  - Matrices
  - Matrix multiply



# Programming experience

- Basic Python used
  - Can pick up along the way if knowledge of other language

```
    def get_user(self, user):
        """
        Returns a QuerySet of connections for user.
        """
        set1 = self.filter(from_user=user).select_related(depth=1)
        set2 = self.filter(to_user=user).select_related(depth=1)
        return set1 | set2

    def are_connected(self, user1, user2):
        if self.filter(from_user=user1, to_user=user2).count() > 0:
            return True
        if self.filter(from_user=user2, to_user=user1).count() > 0:
            return True
        return False

    def remove(self, user1, user2):
        """
        Deletes proper object regardless of the order of users in argument
        """
        connection = self.filter(from_user=user1, to_user=user2)
        if not connection:
            connection = self.filter(from_user=user2, to_user=user1)
        connection.delete()
---:--- models.py Top L1 (Python AC yas)---
```



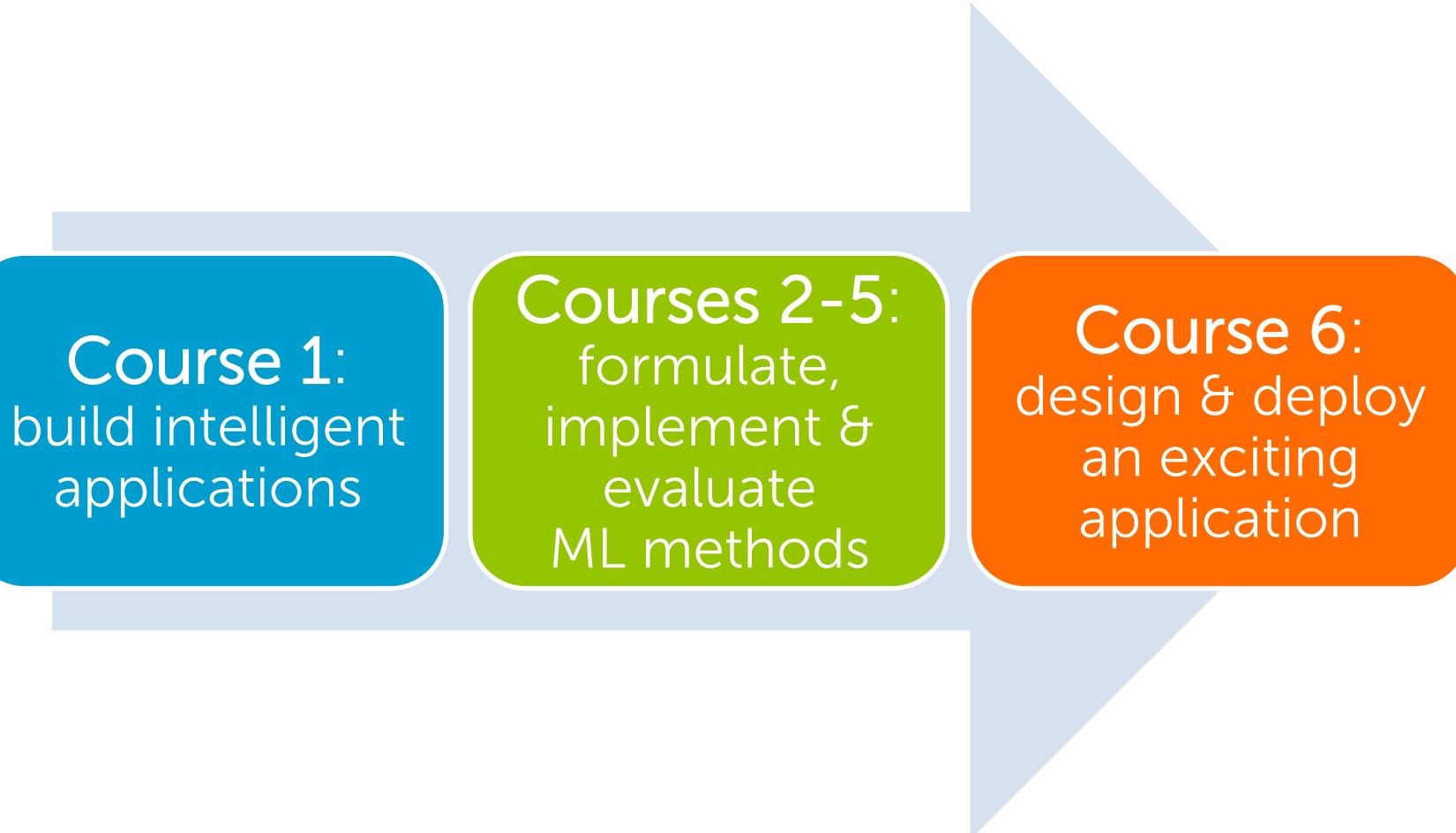
# Computing needs

- Basic desktop or laptop
- Access to internet
- Ability to:
  - Install and run Python
  - Store a few GB of data



You'll be able to do  
amazing things...

# Our journey together...



# The Capstone Project: *Build and deploy an intelligent application with deep learning*

# An intelligent recommender using images & text

# We will do something even more exciting...

