



Deep Learning Explained

Module 1: Introduction and Overview

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Roland Fernandez, Senior Researcher, Microsoft

Course outline

What is deep learning?

Who are the audience?

What to expect from this course?

What to expect

Deep learning basics (6 modules):

- Module 1: Introduction and high-level modeling workflow
- Module 2: Logistic regression for optical character recognition
- Module 3: Multi-layer perceptron
- Module 4: Convolution networks
- Module 5: Recurrence for time-series modeling
- Module 6: Long-short term memory (LSTM) recurrence for text modeling

Assignments:

- 5 hands-on lab and 5 quizzes (required for certification)
- Use Python Jupyter notebooks

Upon completion, students will:

- Have a working knowledge of deep learning concepts and algorithms
- Be able to build deep neural network models
- Solve practical problems in AI involving large data

Who are the audience?

Data Scientists and Engineers who are new to deep learning

Technical Managers who are interested and involved in development of AI based technologies

Machine learning scientists looking to build deep models with agility and ease

Who are the instructors?

Sayan Pathak, PhD.



Industry

- Principal ML Scientist @ Microsoft
- Principal Investigator, National Institutes of Health funded projects in Healthcare
- Allen Institute for Brain Sciences
- Practical ML experience in Computer Vision, On-line Advertisement, Social Networks, Neuro and healthcare informatics

Academic

- Instructor at AI School @ Microsoft
- Affl Faculty @ University of Washington in Bioengineering / EE (from 2001)
- Affl Professor @ IIT (Indian Institute of Technology), Kharagpur in CS (from 2012)
- Courses taught:
 - Image Computing Systems, Information Retrieval, Social Computing, Machine Learning

Who are the instructors?

Roland Fernandez



- Researcher and AI School instructor @ Microsoft
- Research Areas:
 - reinforcement learning, autonomous multitask learning, symbolic representation,
 - information visualization, and Computer Human Interaction
- Worked in the areas of Natural User Interfaces, activity based computing, advanced prototyping, programmer tools, operating systems, and databases.
- Actively involved in AI education efforts within Microsoft

Programming environment



Toolkit:

- Microsoft Cognitive Toolkit (CNTK) Tutorials with Python Notebooks

Environments:

- Install locally (recommended)
- Use pre-installed notebooks in Azure Notebooks (CPU only) for free
- Azure Data Science Virtual Machines (sign up trial account)

References

Deep Learning by I. Goodfellow, Y. Bengio & A. Courville, MIT Press, <http://www.deeplearningbook.org>, 2016

Stanford CS231n: <http://cs231n.github.io/>

Neural Networks Tutorials by G. Hinton
<https://www.cs.toronto.edu/~hinton/nntut.html>

Acknowledgement

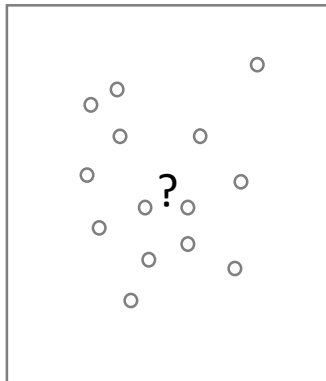
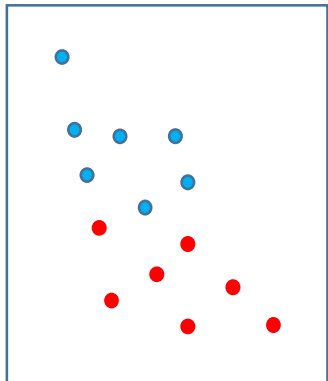
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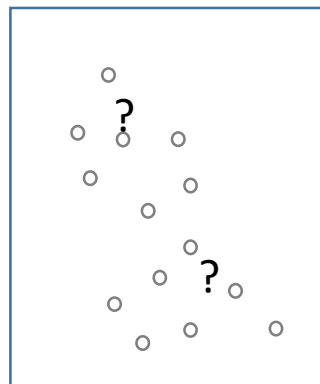
Jonathan Sanito, Content Developer @ Microsoft,
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for help with course material preparation (especially the Text Classification tutorial).

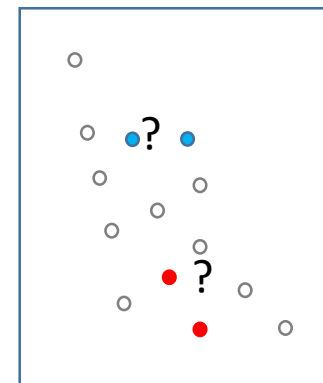
Machine Learning (ML)



Supervised
Learning



Unsupervised
Learning



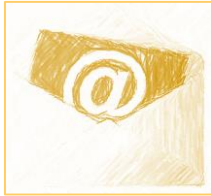
Semi-supervised
Learning

Supervised Machine Learning

Input

Model

Predicted



Data: E-mail
Label: Spam / not Spam

Classification



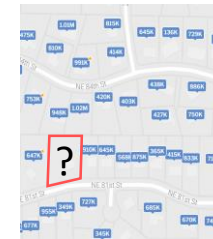
SPAM
vs.
Not SPAM

Categories: Spam / Not Spam



Data: House features
Label: Price

Regression



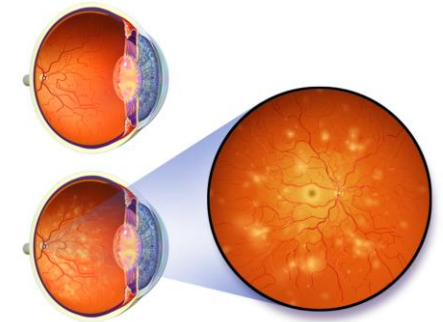
850k

House Price: a real number

Real-world applications

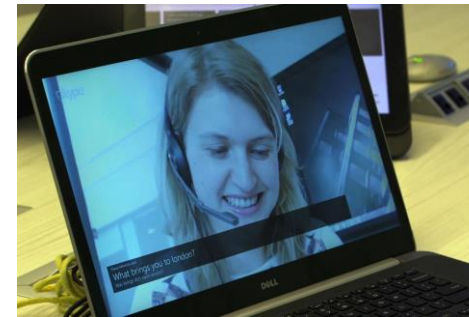
Image

- Autonomous Driving
- Disease detection



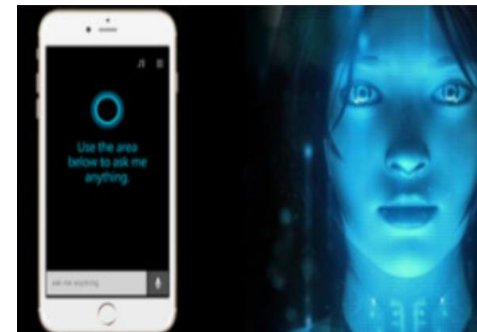
Text

- Machine translation
- Document comprehension



Speech

- Voice recognition
- Speech to text



What is deep learning?

Deep learning = Deep Neural Networks (DNN)

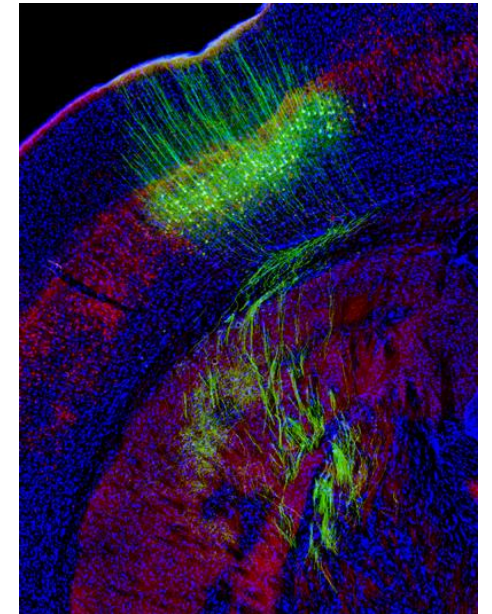
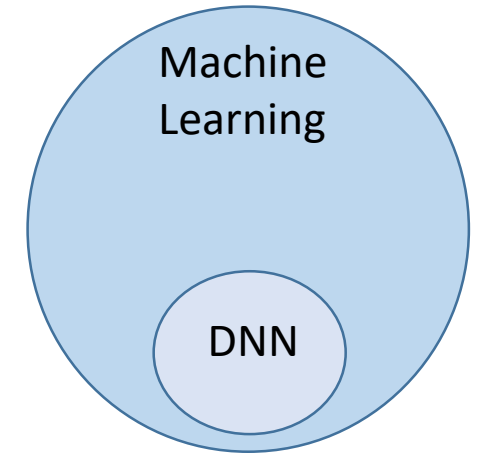
- Mimics several layers in the brain

Deep Neural Networks

- Have multiple layers
- Each layer learns a higher abstraction on the input from the layer before it
- Requires fitting a large number of parameters (100+ Millions)
- Facilitated by (1) large amount of data and (2) computing capabilities

Application domains

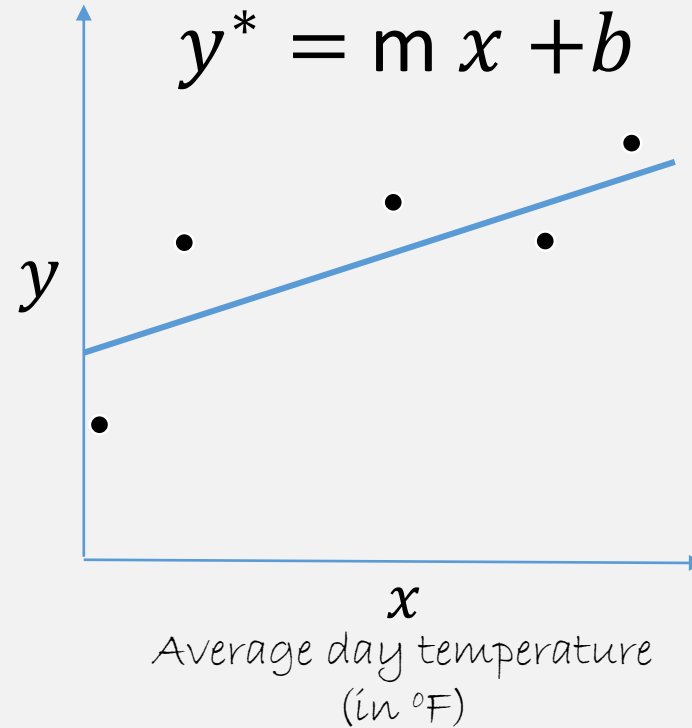
- Image / Videos
- Speech
- Text
- Multimodality and IOT data



ML recap



Solar panel Output
(in W)



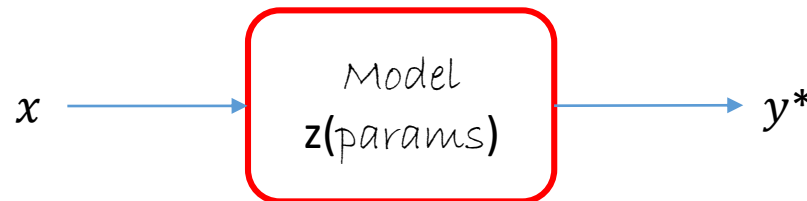
Input

x = Feature

Output

y = observed output (labels)

y^* = predicted output



Model function (z)

m : Slope

b : Intercept

are model parameters

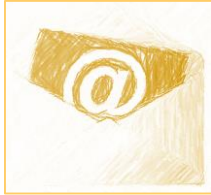
ML Recap

Input

Model

Predicted

Classification



Data: E-mail
Label: Spam / not Spam



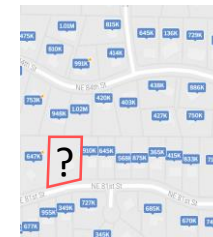
SPAM
vs.
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Categories: Spam / Not Spam

Regression



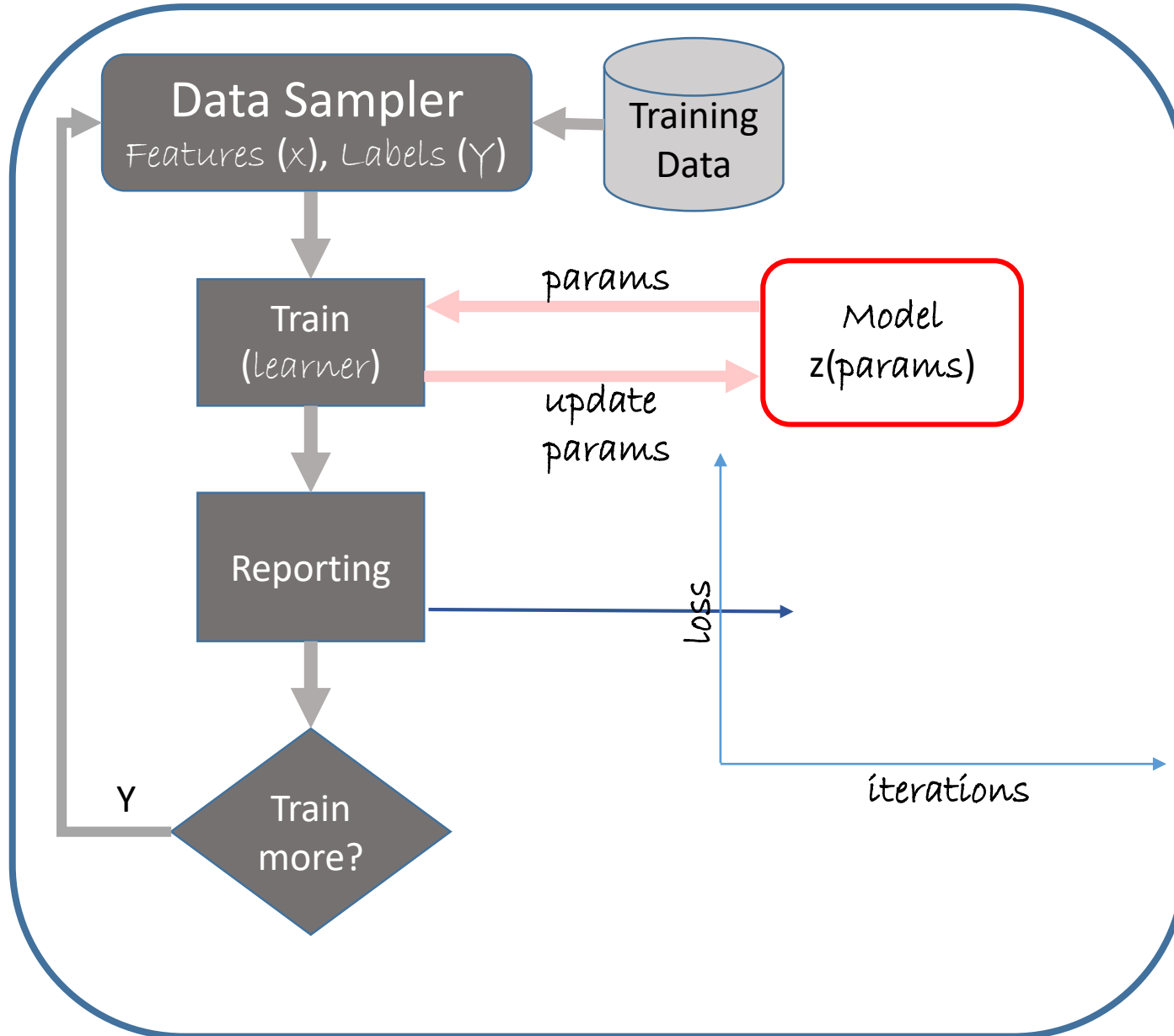
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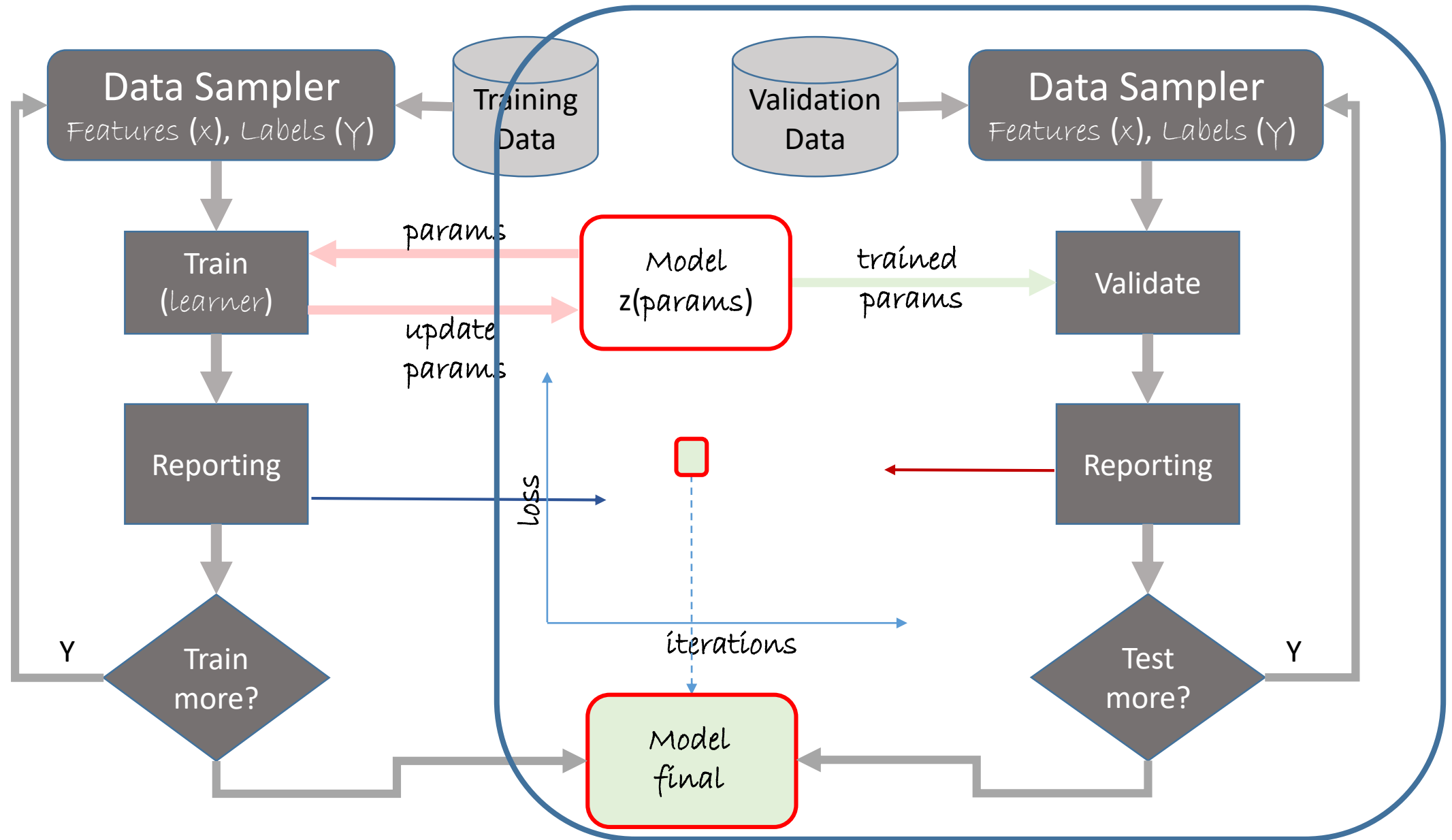
850k

House Price: a real number

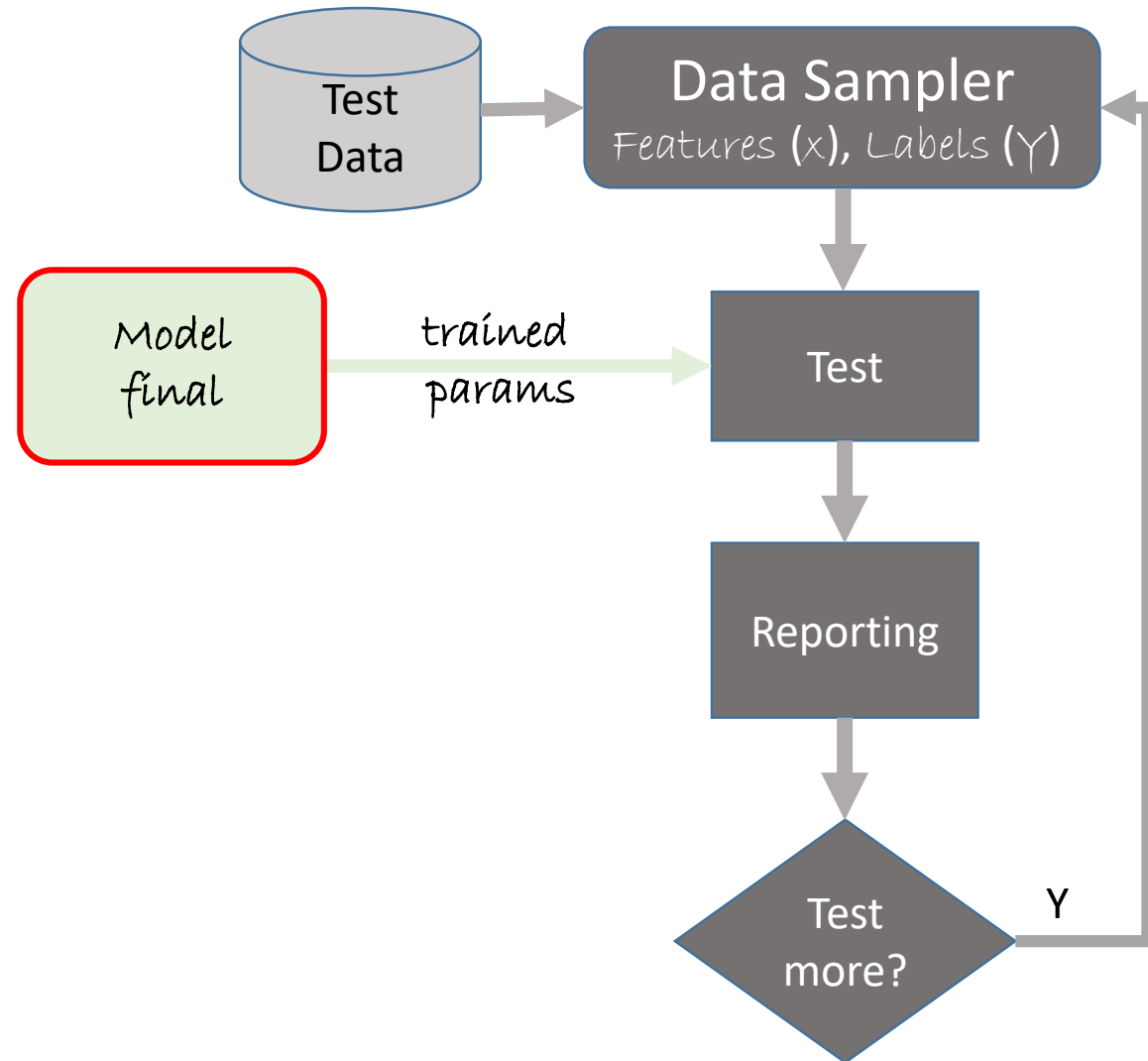
Train Workflow



Validation Workflow



Test Workflow



Where to begin with Cognitive Toolkit ?

On GitHub: <https://github.com/Microsoft/CNTK/wiki>

GitHub, Inc. [US] github.com/Microsoft/CNTK/wiki

The Microsoft Cognitive Toolkit

The Microsoft Cognitive Toolkit - CNTK - is a unified deep-learning toolkit by Microsoft Research. [This video](#) provides a high-level view of the toolkit.

The latest release of the Microsoft Cognitive Toolkit 2.0 is RC1 (release candidate 1). If you are a previous user of the toolkit, see [this page](#) for more information about (breaking) changes in this release.

It can be included as a library in your Python or C++ programs, or used as a standalone machine learning tool through its own model description language (BrainScript). CNTK supports 64-bit Linux or 64-bit Windows operating systems. To install you can either choose pre-compiled binary packages, or compile the Toolkit from the source provided in Github.

Here are a few pages to get started:

- [Setting up CNTK on your machine](#)
- [Tutorials, Examples, etc..](#)
 - Try the [tutorials on Azure Notebooks](#) with pre-installed CNTK
- [The CNTK Library APIs](#)
 - [Using CNTK from Python](#)
 - [Using CNTK from C++](#)
- CNTK as a machine learning tool through [BrainScript](#)
- [How to contribute to CNTK](#)
- Give us feedback through these [channels](#).

Pages 200

- [Home](#)
- [What's new](#)
- [Breaking changes](#)
- [CNTK installation](#)
- [Python API / Docs](#)
- [FAQ](#)
- [How do I...](#)
- [Troubleshoot CNTK](#)

Getting Started

- [Setting up CNTK](#)
- [CNTK on Azure](#)
- [CNTK Usage Overview](#)
- [Tutorials](#)

Additional Documentation

- [Examples](#)
- [Articles](#)
- [Presentations](#)
- [Conference Appearances](#)

How to use CNTK

- [Using CNTK with Python](#)

Seek help on Stack Overflow:

<http://stackoverflow.com/search?q=cntk> (please add *cntk* tag)