Alberta

- Who am I?
- Where does it come from?
- What is Deep Learning?
- How do we do it?
- Case Study
- Pros and Cons
- What's Next ?
- Q & A

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in Property Assessment

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Disclaimer

- *Materials presented at Association professional development events and activities and posted online are for training purposes.*
- *The respected opinions expressed are the considered and subjective views of the trainers/presenters.*
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- *The results of the case study will not affect the original assessments prepared by the subject municipality and will not impact the assessment quality of the same municipality.*

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Ning Zheng

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Appraisal Journey of

Ning Zheng

1

2004
- Master of Science
- Majored in **International Real Estate**

2

2006-2014
- Moved to Edmonton;
- Took Appraisal and Assessment Program;
- Joined the City of Edmonton as an assessor

3

2012
- Earned AACI designation;
- Earned AMAA designation from Alberta Assessors Association

4

2014-Now
- Joined the Government of Alberta - Assessment Audit as an Auditor;
- Developed in-house Annual Audit Application;
- Became a full-stack web developer through online learning during the pandemic years;
- Became a deep learning model developer through online learning during the pandemic years.

5

Current Main Focus:
- Developing deep learning use cases for proper Mass Appraisal functions;
- Developing quantitative assessment quality assurance system for Alberta;

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It originated from

a long time ago, even before we were born...

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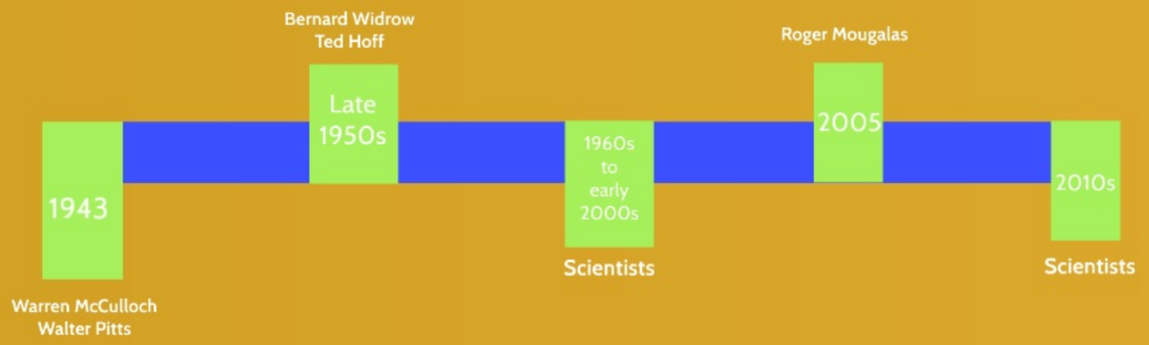
Deep Learning
Origin and Evolution



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1943

Warren McCulloch
Walter Pitts

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Bernard Widrow
Ted Hoff

Late
1950s

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1960s
to
early
2000s

Scientists

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Roger Mougalas

2005

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2010s

Scientists

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What is Deep Learning?

" a type of machine learning based on artificial neural networks in which multiple layers of processing are used to extract progressively higher level features from data."

-Oxford Dictionary

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Data Mining

"involves exploring and analyzing large blocks of information to glean meaningful patterns and trends" -Investopedia.com

Exploration

Data Cleaning, Count, Variance, Central Tendancy, Distribution, Correlation, Outliers review...

Analyses

Inferential Analysis, Text Analysis, Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis...

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DATA
MINING

Machine Learning

"Machine learning is a subset of artificial intelligence(AI) focused on building systems that can learn from historical data, identify patterns, and make logical decisions with little to no human intervention.

It is a data analysis method that automates the building of analytical models using data that encompasses diverse forms of digital information including numbers, words, clicks and images."

- microfocus.com

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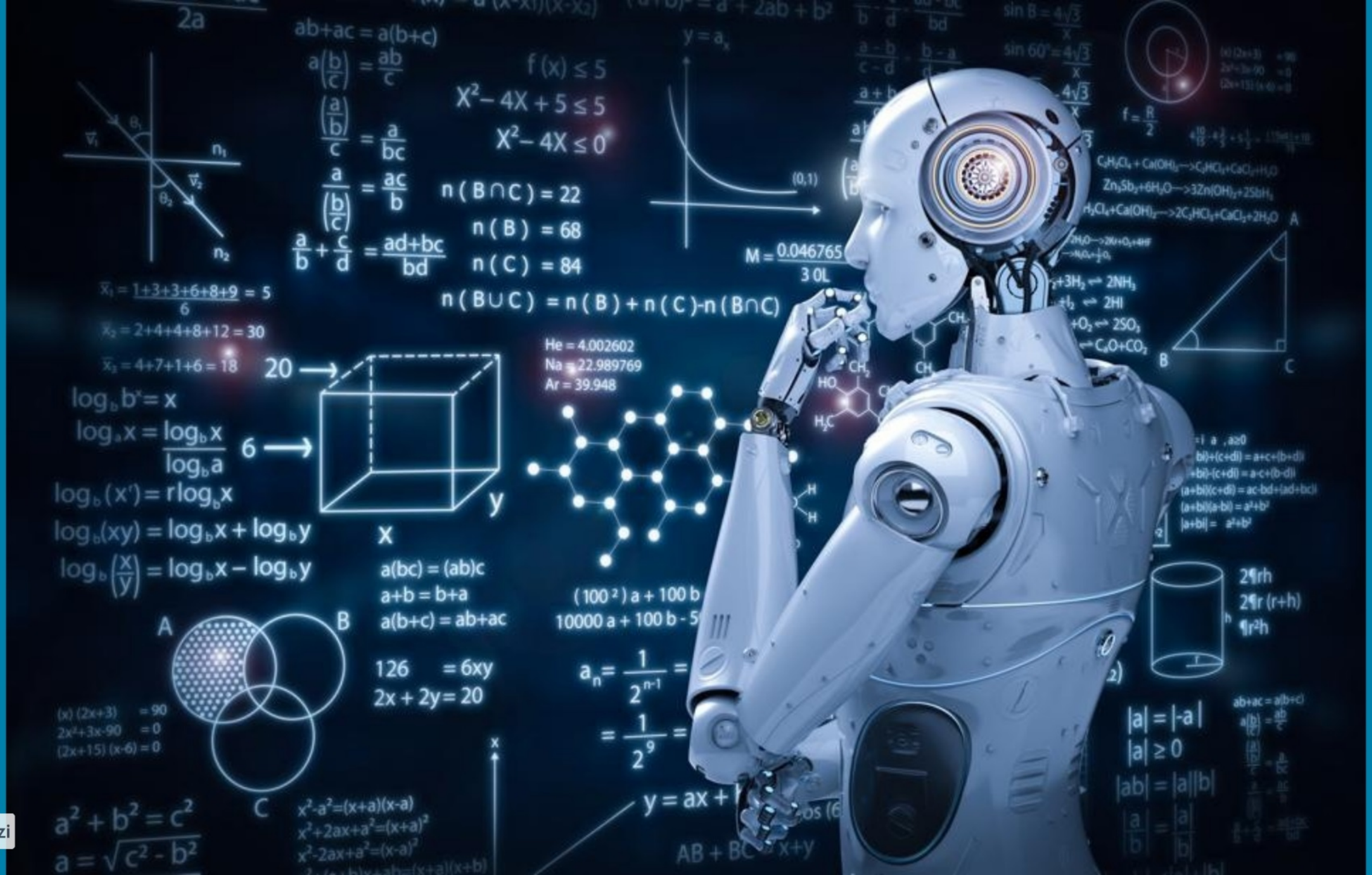
ab+ac = a(b+c)
f(x) ≤ 5
X² − 4X + 5 ≤ 5
X² − 4X ≤ 0
n(B∩C) = 22
n(B) = 68
n(C) = 84
n(B∪C) = n(B) + n(C) − n(B∩C)
y = a_x
(0,1)
M = 0.046765 / 3 0L
20
6
y
x
log_b b^x = x
log_a x = log_b x / log_b a
log_b (x^r) = r log_b x
log_b (xy) = log_b x + log_b y
log_b (x/y) = log_b x − log_b y
He = 4.002602
Na = 22.989769
Ar = 39.948
a(bc) = (ab)c
a+b = b+a
a(b+c) = ab+ac
126 = 6xy
2x + 2y = 20
(100²) a + 100 b
10000 a + 100 b - 5
a_n = 1 / 2^(n-1)
= 1 / 2^9
y = ax +
A
B
C
a² + b² = c²
a = √(c² - b²)
x²-a²=(x+a)(x-a)
x²+2ax+a²=(x+a)²
x²-2ax+a²=(x-a)²
AB + BC
x+y
|a| = |-a|
|a| ≥ 0
|ab| = |a||b|
2¶rh
2¶r (r+h)
¶r²h

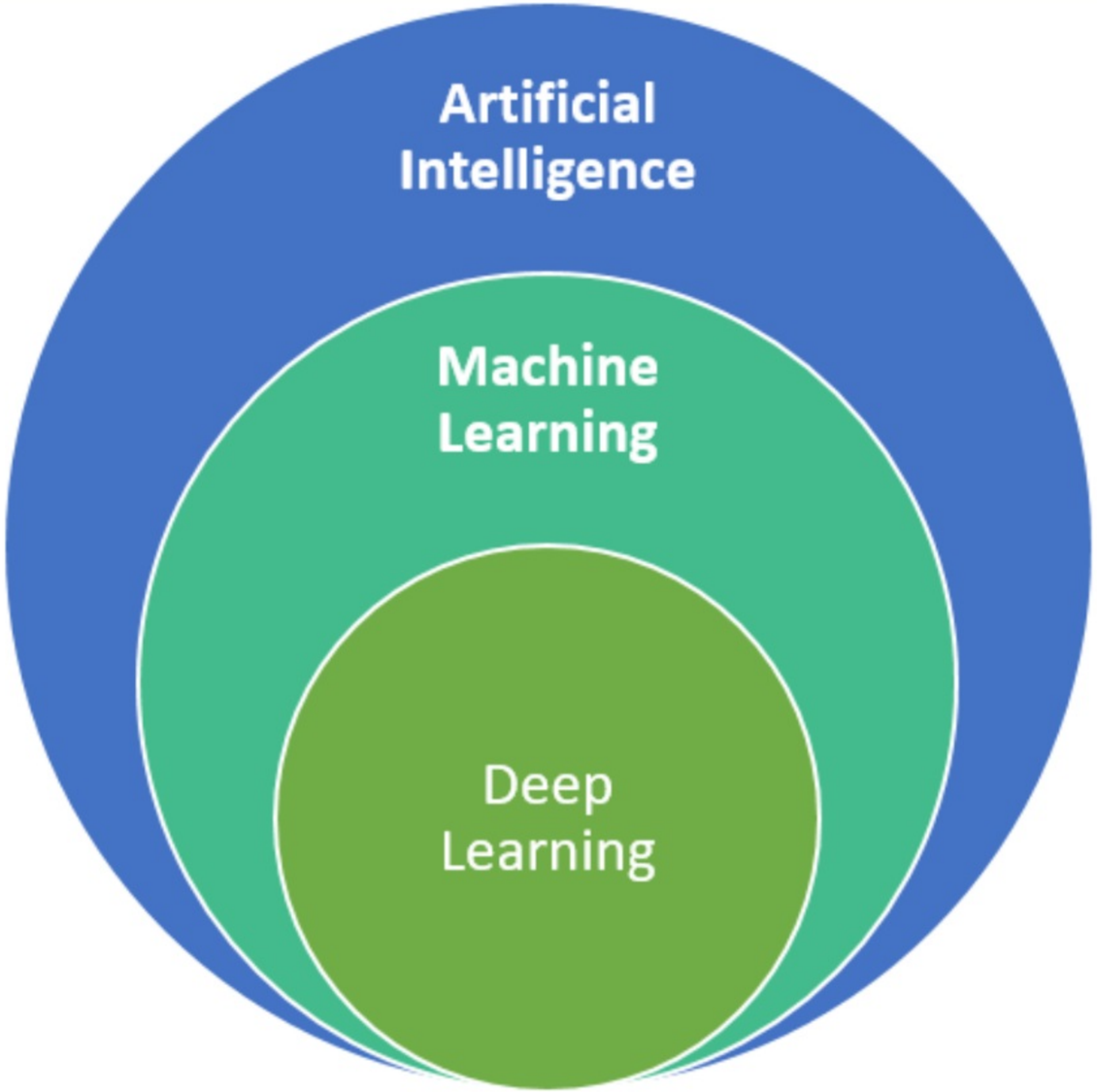

Figure 1: artificial intelligence, machine leaning and deep learning Source: Nadia BERCHANE (M2 IESCI, 2018)

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-Oxford Dictionary

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Deep Learning Tools

Theano

MILA, Python only

DeepLearningKit

Apple iOS, OSX, tvOS, etc.

TensorFlow

Google

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TensorFlow

Google

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TensorFlow

Google

Written in C++ and CUDA.

Developed by Google.

Provide interface to Python, Java, Javascript, Go, etc,.

Easy for beginners or experts to create deep learning models for mobile, web, desktop and cloud.

Solve deep learning problems like Classification, Perception, Understanding, Discovering, Prediction and Creation, etc,.

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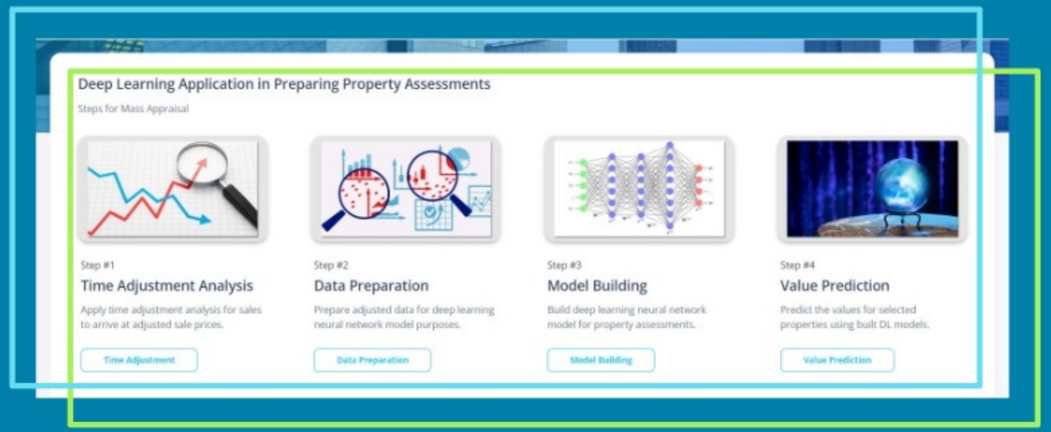
How to apply Deep Learning in Mass Appraisal?

Step 1: Time Adjustment Analysis

Step 2: Data Preparation

Step 3: Model Building

Step 4: Value Prediction



Step 1 Step 2 Step 3 Step 4

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Step 1: Time Adjustment Analysis

"an adjustment is done to account for changes in market prices since the date of the sale"

- UBC "Foundation of Real Estate Appraisal"

Output

Time Adjusted Sale Prices

Method

SAR or Unit Value

Algorithms

Simple Linear Regression or Multi-trend Linear Regression

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Step 2: Data Preparations

"Data preparation is the process of preparing raw data so that it is suitable for further processing and analysis. Key steps include collecting, cleaning, labeling, and transforming raw data into a form suitable for machine learning (ML) algorithms and then exploring and visualizing the data."

– www.amazon.com

Know Your Data

Summaries of data columns

Transform Data

Categorical and continuous data transformations

Split Datasets

Split whole dataset into training and testing datasets

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Step 3: Model Building

TensorFlow offers multiple levels of abstraction so you can choose the right one for your needs. Build and train models by using the high-level TensorFlow API, which makes getting started with TensorFlow and deep learning easy.

Assign Features and Labels

What feeds in and what expects out

Configure Neural Network Structure

Set layers, units, and activation functions

Set Training Parameters

Configure the training parameters for better results

Testing Built Model for Performance

Confirm the performance of trained model on test data

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Step 4: Value Prediction

Applying professionally built models back to the whole property inventory to predict the assessed values for property tax purposes.

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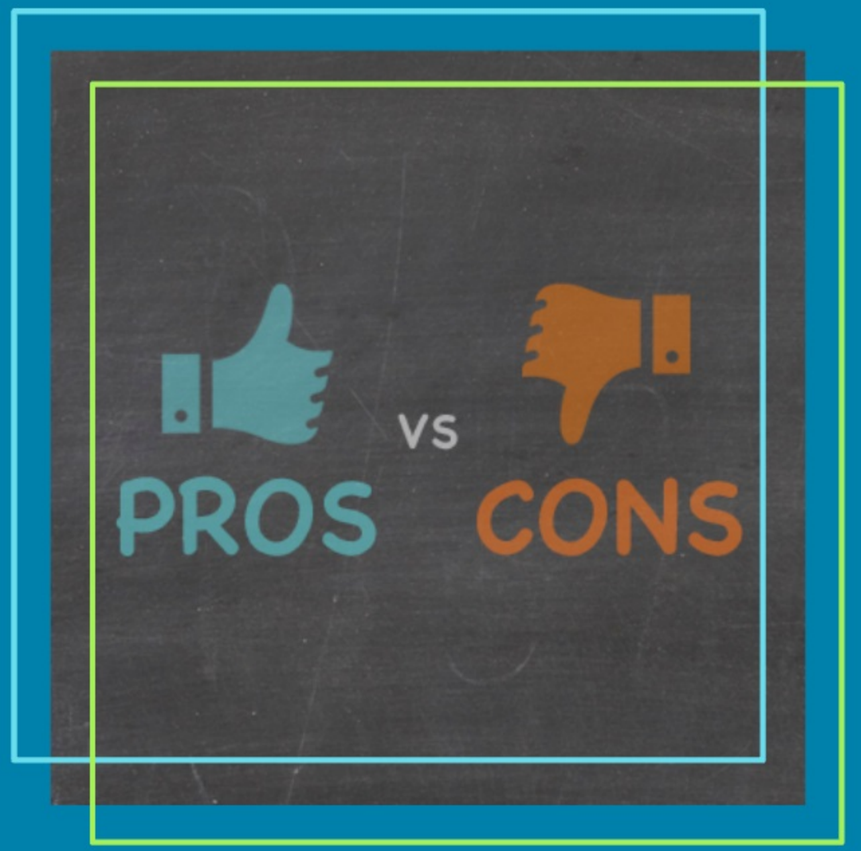
Pros and Cons of Applying DL

There's no doubt that deep learning is super-efficient for many tasks. However, they're not a silver bullet that will solve all problems.

Let's discuss some of the pros and cons of the Deep Learning technology.



Pros and Cons

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Pros


Handling Large and Complex Data


Improved Performance


Handling Non-linear relationship


Better Self-Learning, Less Human Intervention


Removed Appraiser's Own Bias

Cons


Data Hungry


Black Box Problem


High Computational Cost


Possible Overfitting


Requires Domain Expertise

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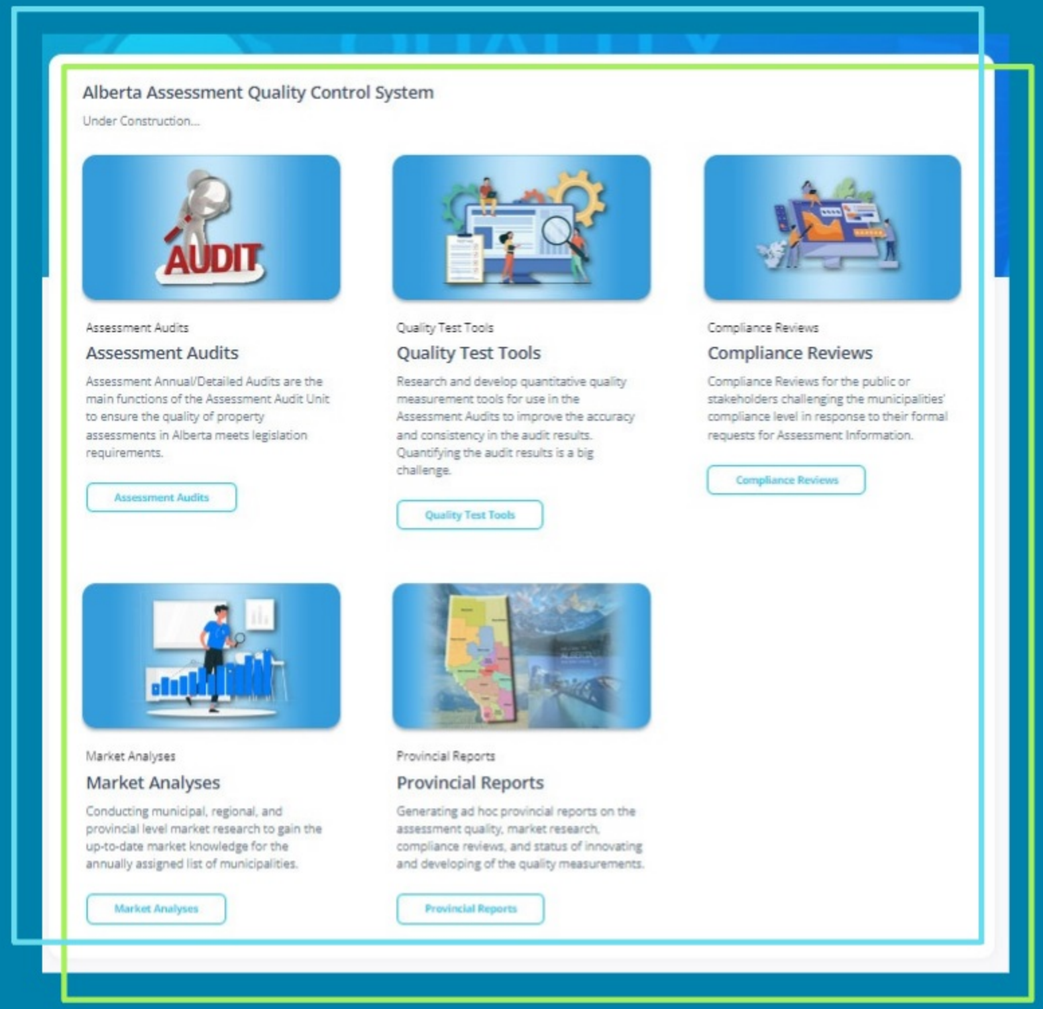
Post Modeling - Assessment Quality

Currently Under Construction...

- Assessment Audits
- Quality Tests Development
- Compliance Reviews
- Regional/Provincial Market Analyses
- Regional/Provincial Reports



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Q & A

Contact me if you have any ideas or questions about this topic:

ning.zheng@gov.ab.ca

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