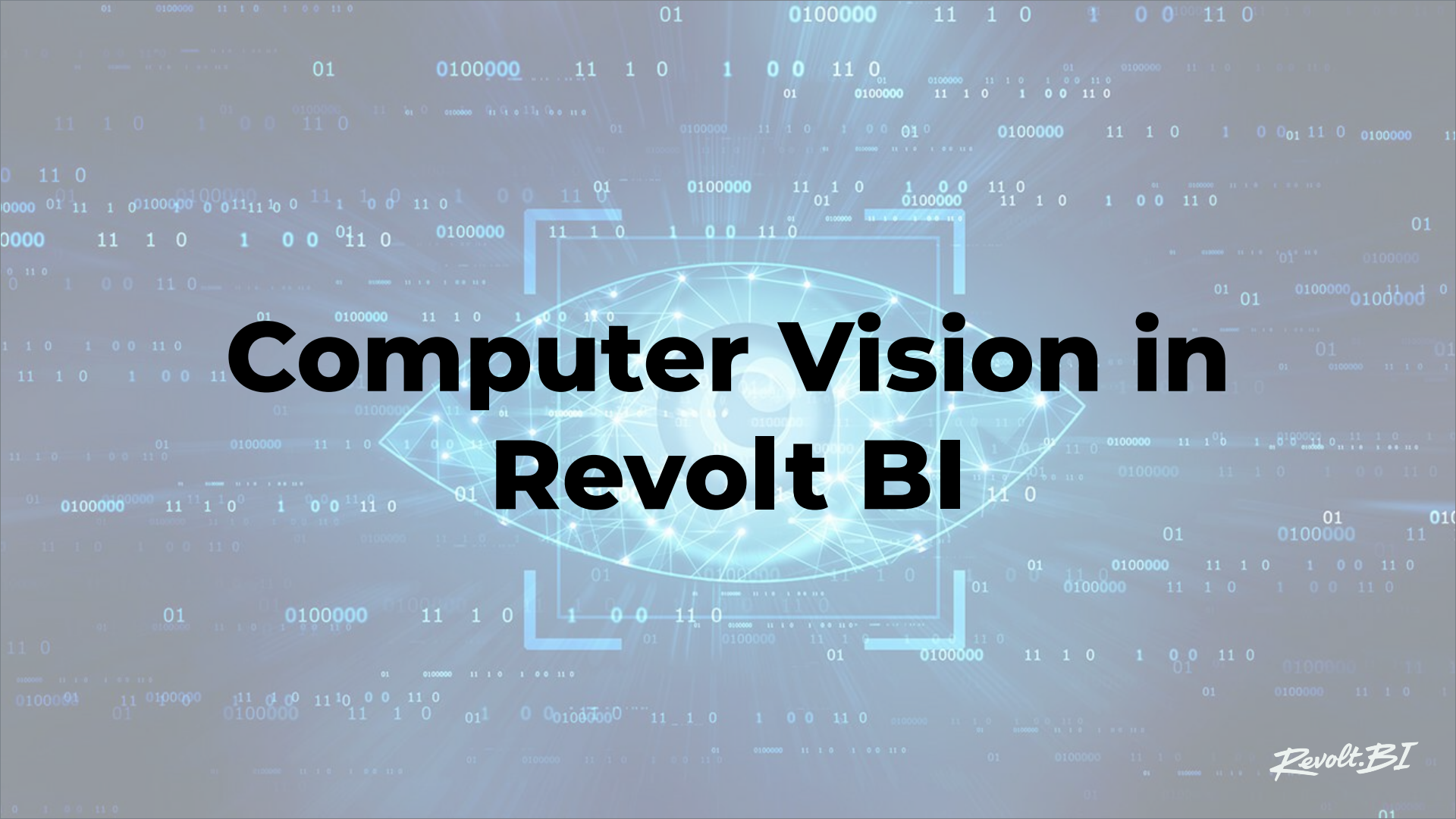
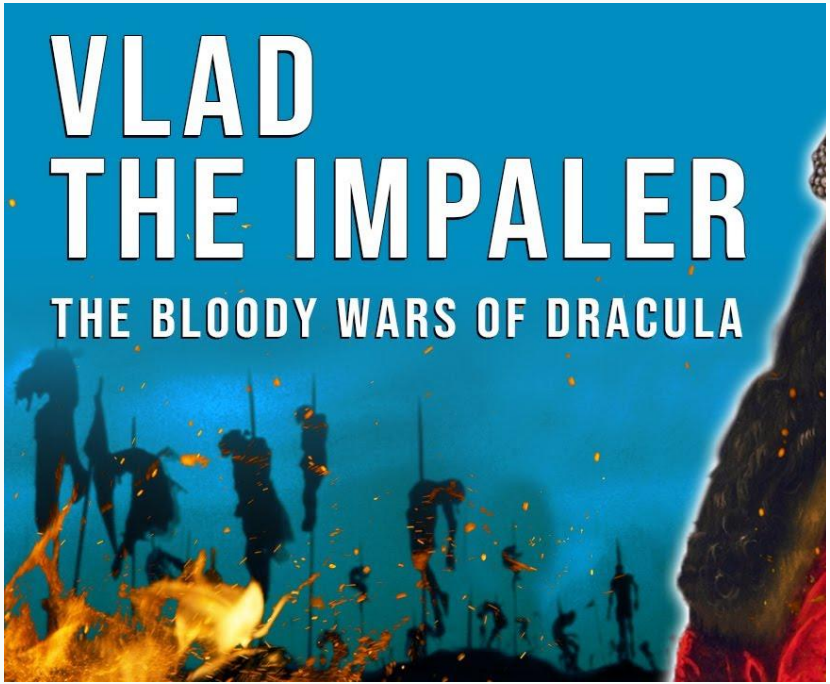

Computer Vision in
Revolt BI
Revolt.BI

Who am I? - Data Scientist.



Are you really Data Scientist?

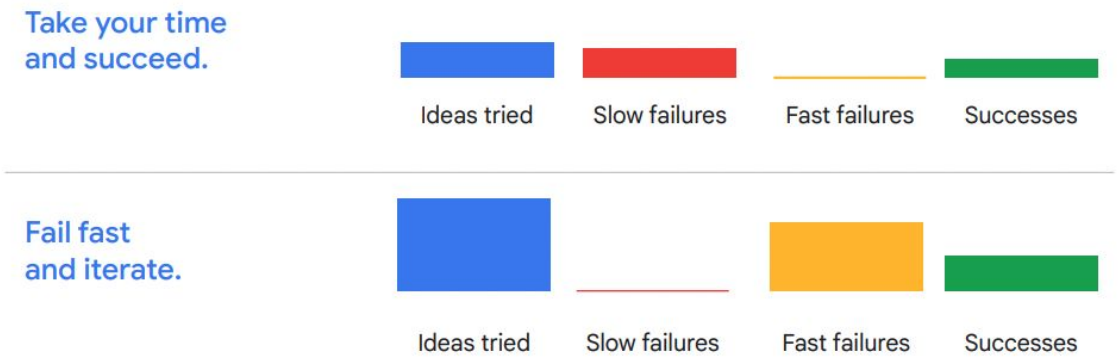
Revolt.BI


INTRO TO ML
Revolt.BI

Computer Vision Project.

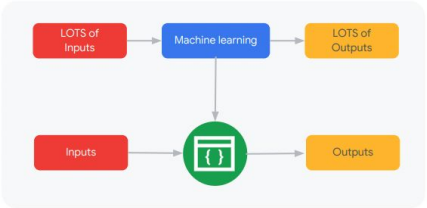
Revolt.BI

Freedom to experiment (and fail) is important

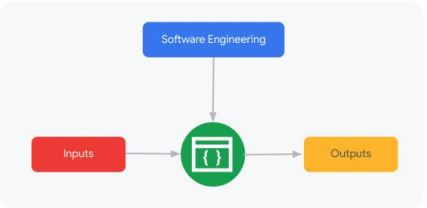


ML vs SE

Machine learning figures out program rules



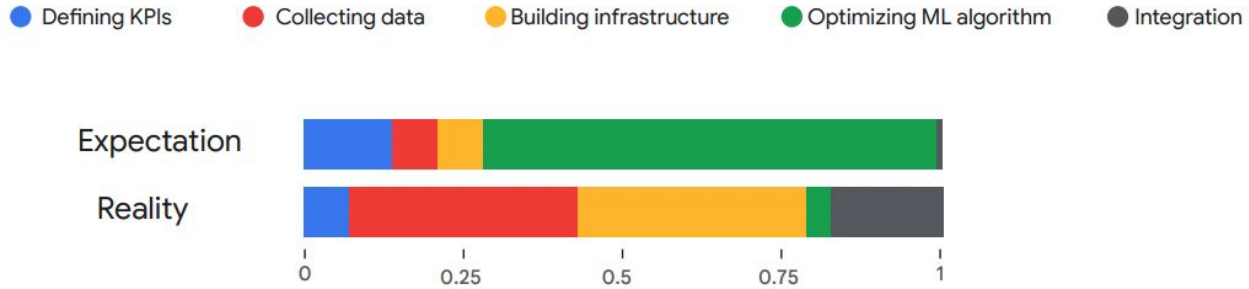
Software engineers write program rules



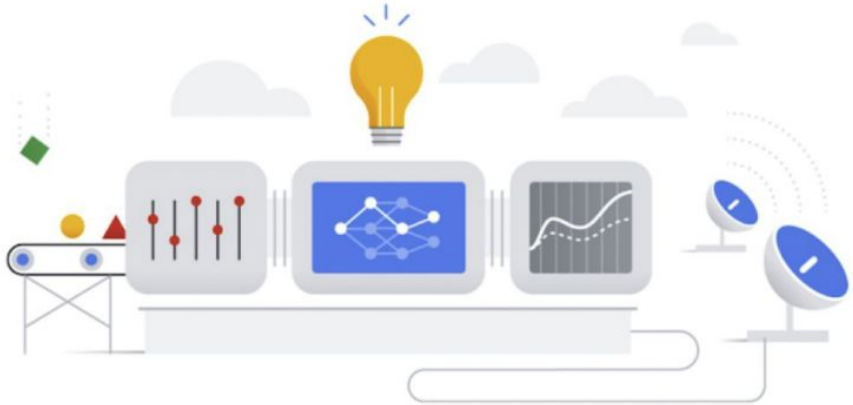
Your Expectation vs Reality

Revolt.BI

ML effort allocation



ML Project Start



All machine learning starts with a business requirement or goal you are trying to solve.

ML workflow

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To build a machine learning model for production

1	2	3	4	5	6
Identify goal	Acquire + explore data + prepare data	Build a model	Train the model	Evaluate the model	Deploy + monitor + maintain

ML Experimentations.

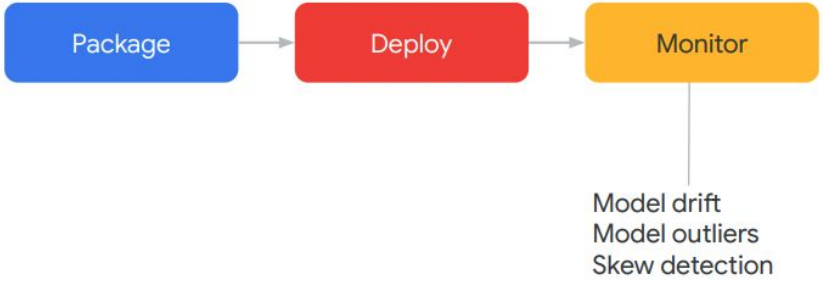
Revolt.BI

Typical ML development during experimentation

Different architectures	Different input data sets	Different hyperparameters	Different hardware
• CNN • RNN • Sorting/Clustering • GANs			

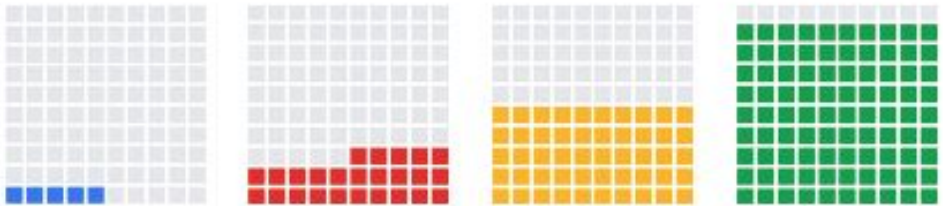
ML production.

Moving from experimentation to production requires packaging, deploying, and monitoring your model



ML CODE

What percent of system code
does the ML model account for?



ML OTHER PART

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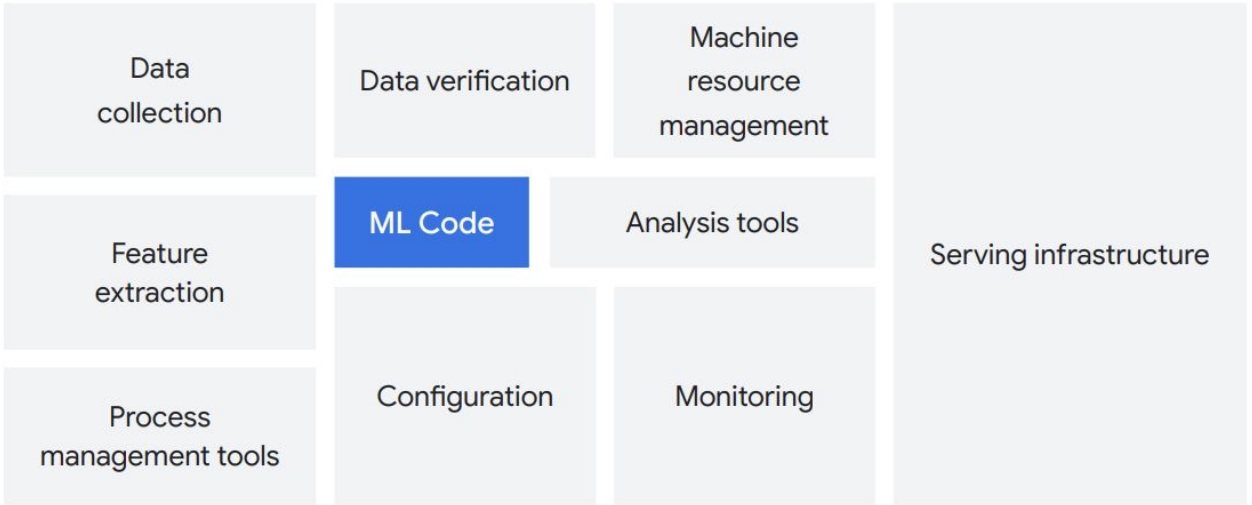
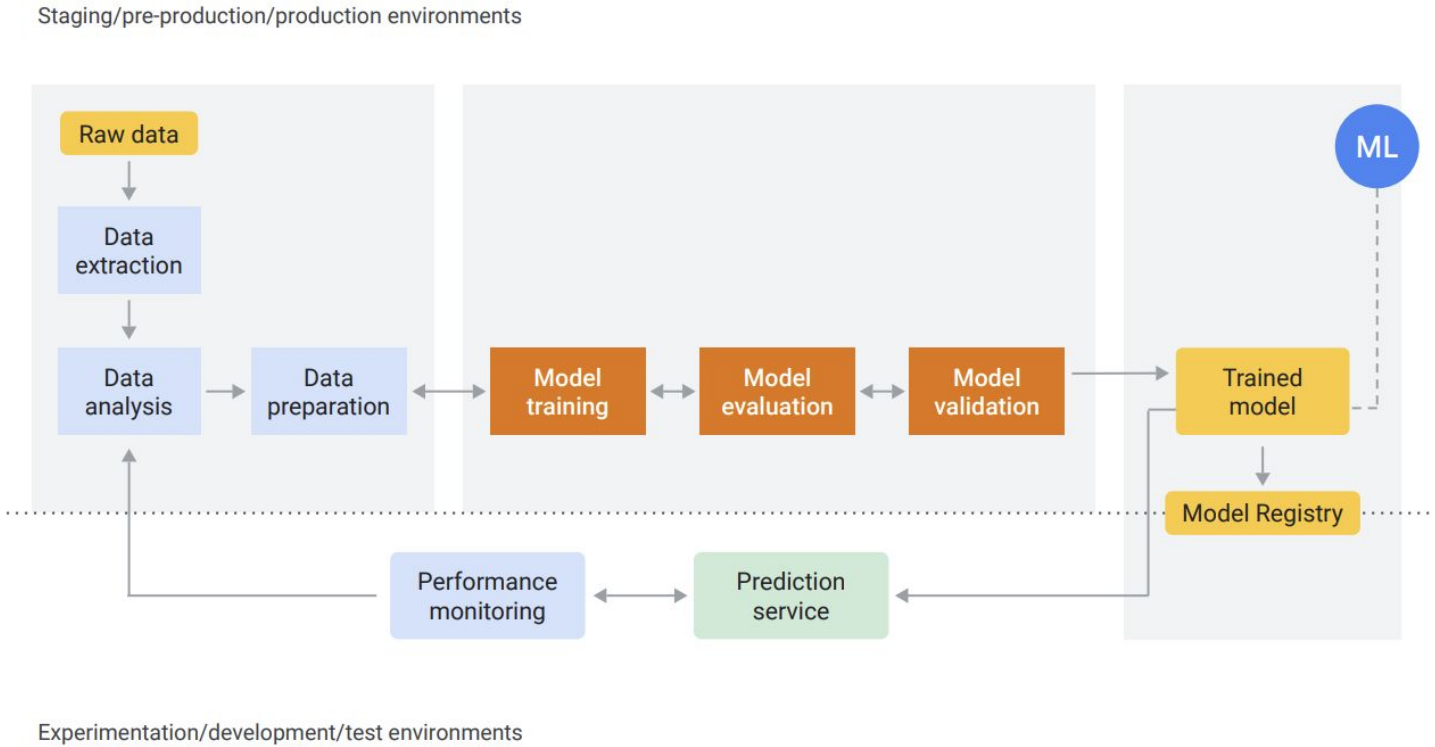


ML workflow


Staging/pre-production/production environments
Raw data
Data extraction
Data analysis
Data preparation
Model training
Model evaluation
Model validation
ML
Trained model
Model Registry
Performance monitoring
Prediction service
Experimentation/development/test environments

ML problems.

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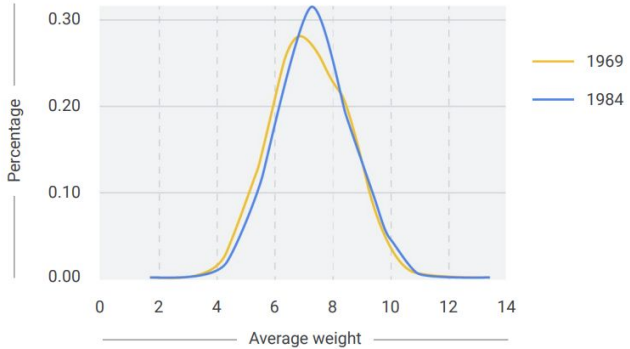
Changes in label distribution



Changes in feature distribution

Postal code → Population movement patterns

ML Protection

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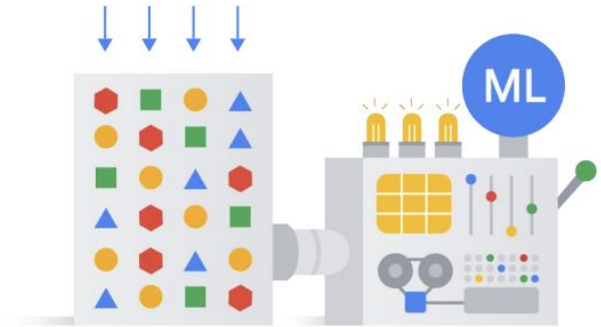
Protect from changing distributions

- Monitoring
- Check residuals
- Emphasize data recency
- Regularly retrain your model



ML drift

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Types of drift in ML models

Data drift

A change in *P(X)* is a shift in the model's input data distribution.

Concept drift

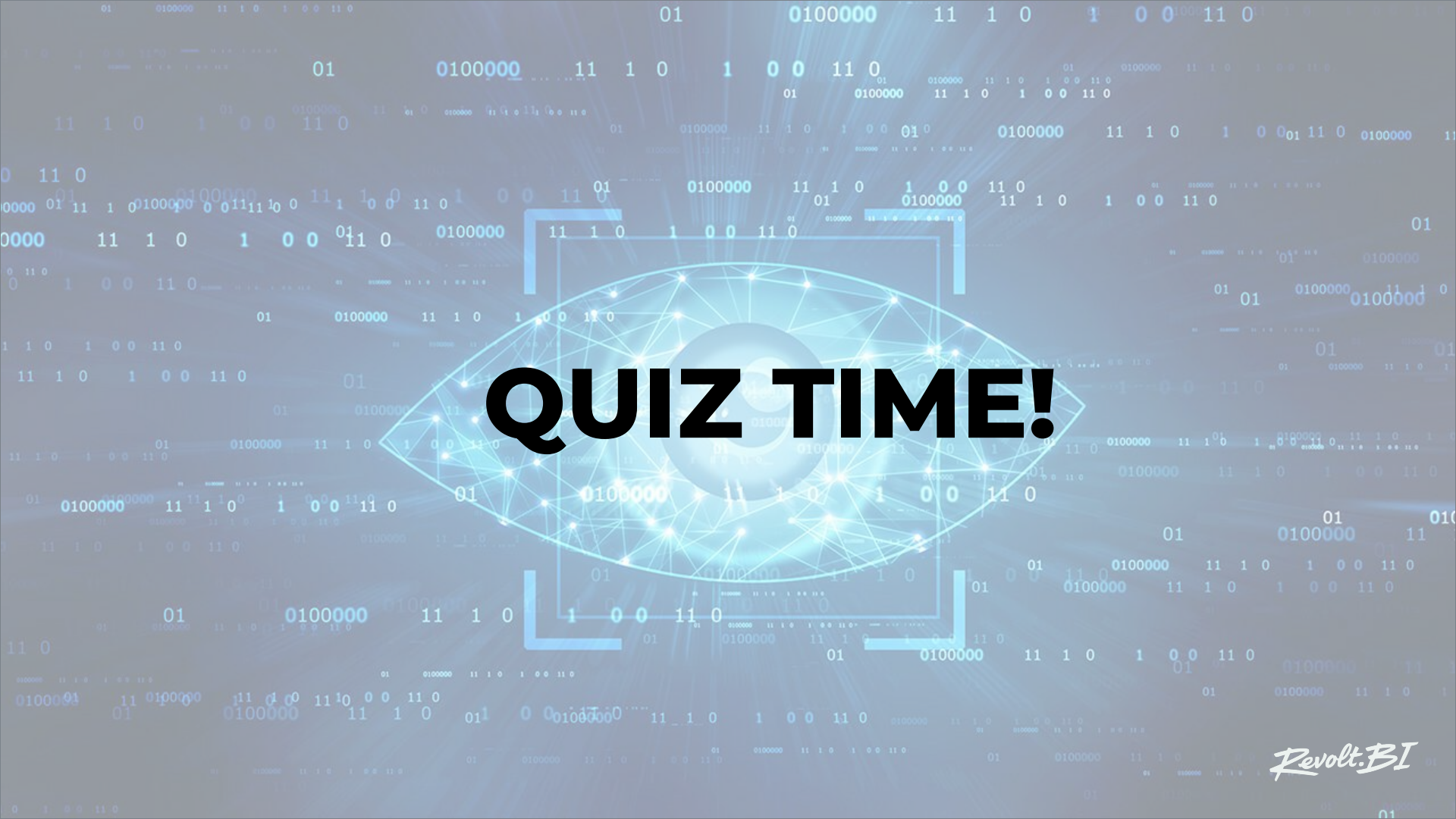
A change in *P(Y|X)* is a shift in the actual relationship between the model inputs and the output.

Prediction drift

A change in *P(Ŷ |X)* is a shift in the model's predictions.

Label drift

A change in *P(Y Ground Truth)* is a shift in the model's output or label distribution.


QUIZ TIME!

1. What is the name of the famous image recognize competition?

2. What year this competition win by NN model?

3. Surname of the winner NN model of 2012 year

Revolt:BI

1. **What is the name of the famous image recognize competition?**

   ImageNet Large Scale Visual Recognition Challenge (ImageNet Competition)

2. **What year ImageNet win by NN model?**

   2012

3. **Surname of the winner NN model of 2012 year**

   Alex Krizhevsky.

Revolt:BI

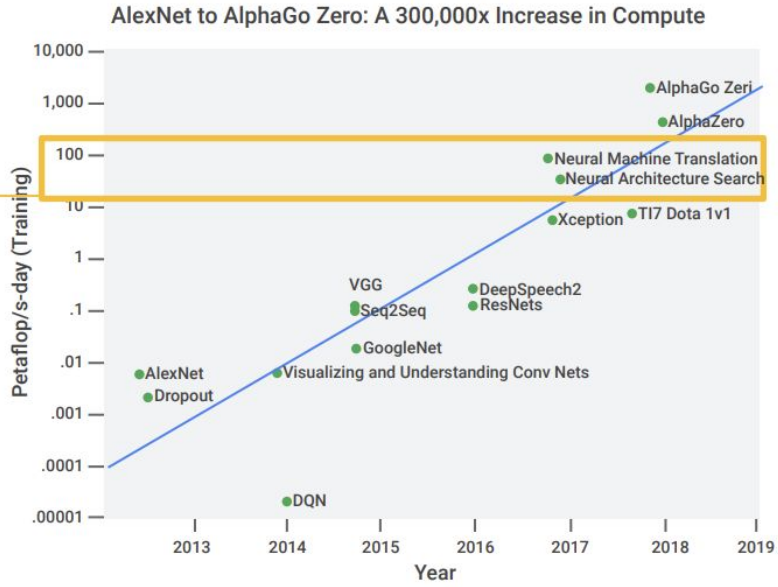
ML training

The compute required keeps increasing

Neural Architecture Search

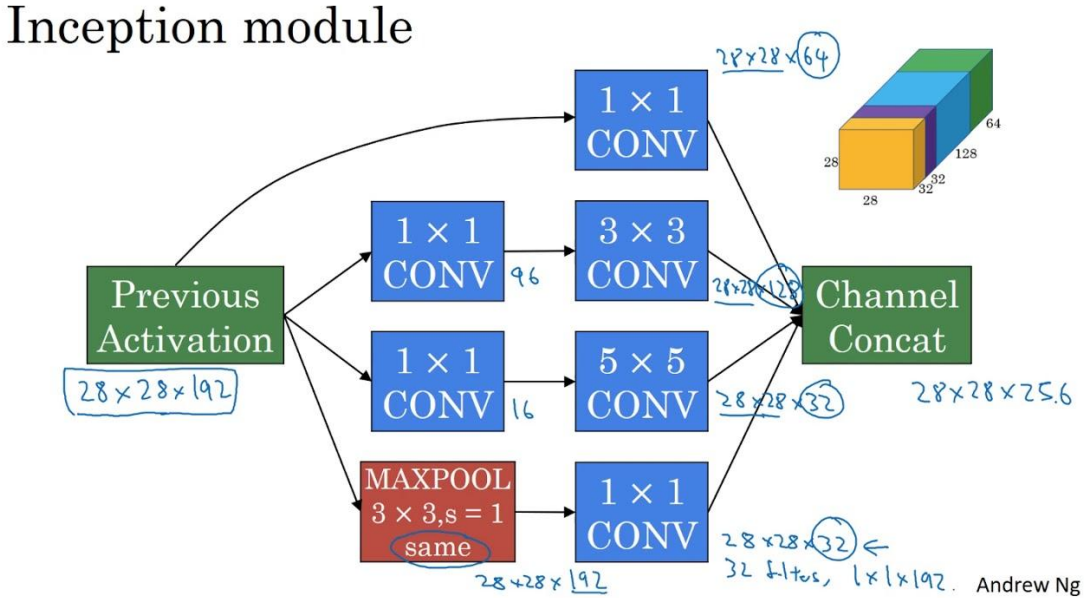
100 petaflops per second-day

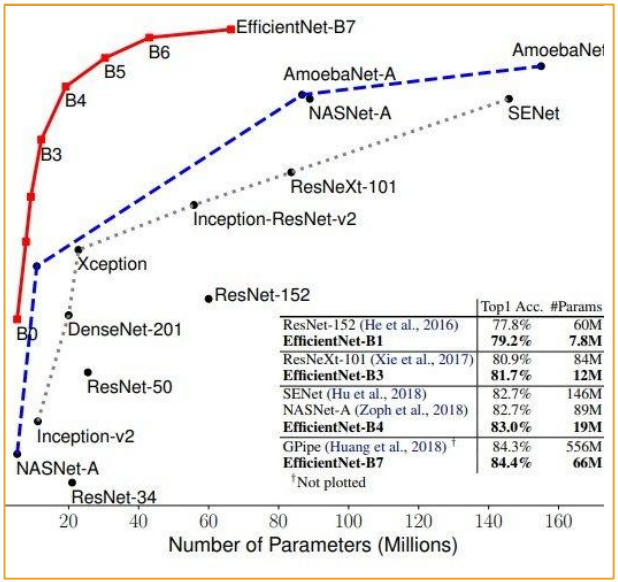
(1000x more compute than you needed for AlexNet)



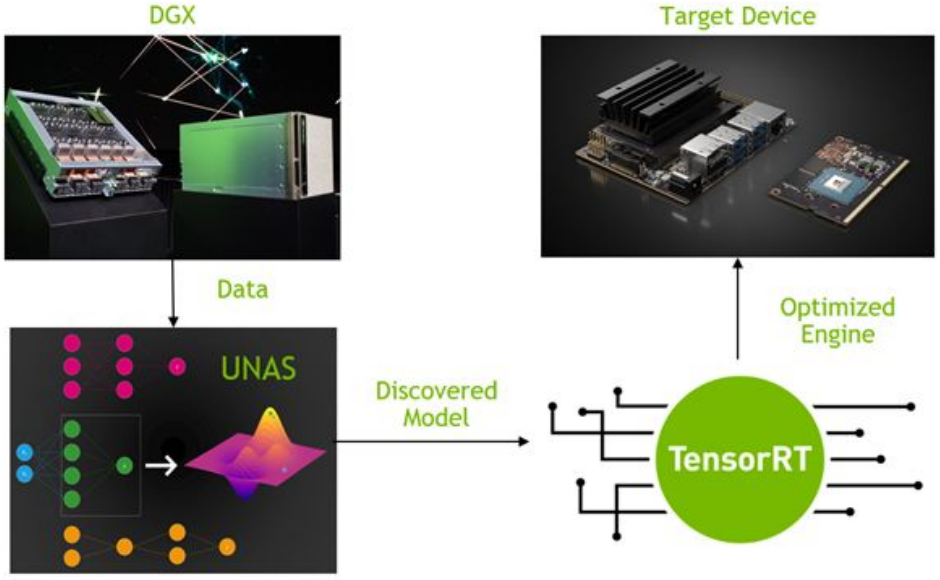
https://blog.openai.com/ai-and-compute/

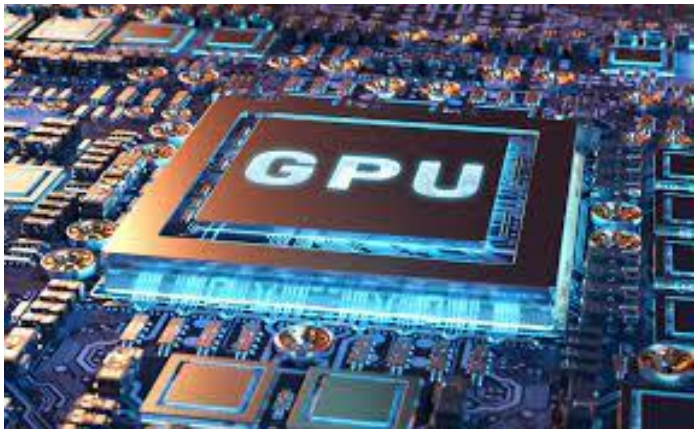
Computer Vision State Of The Art.





Computer Vision on GPU or Clusters.



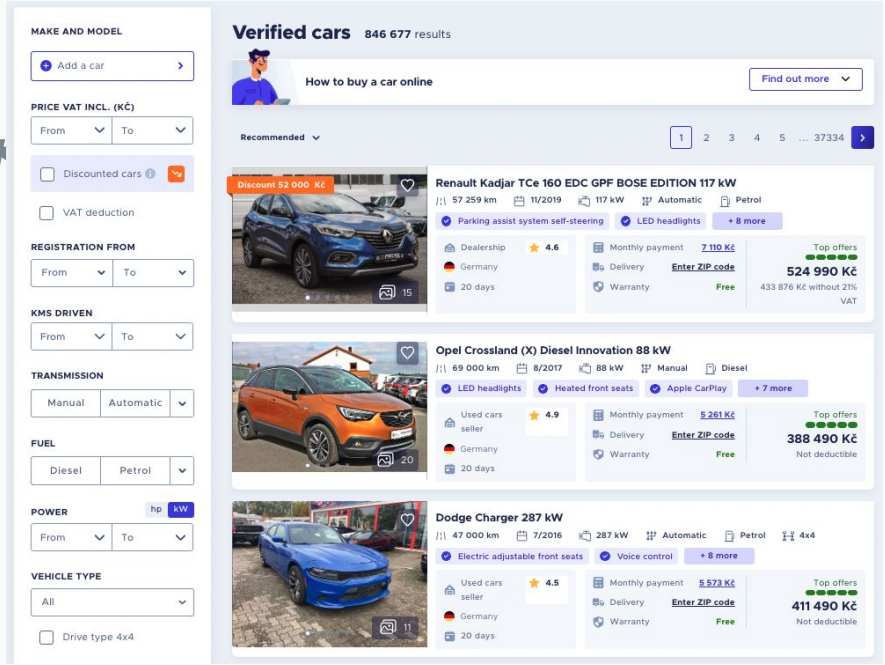


CASE 1

Revolt.BI

Carvago.

1. *Car Position On Photo. Binary Classification.*
2. *Choose best Image.*
3. *Paint Symbols of Seller**



Carvago Req.

1. *Inference on backend.*
2. *Container.*
3. *Fast inference.*

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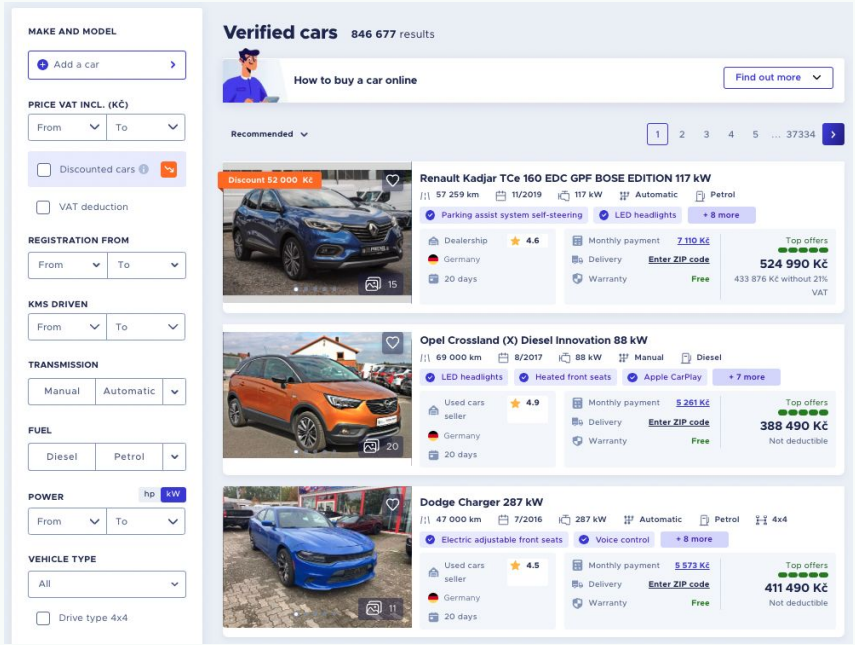
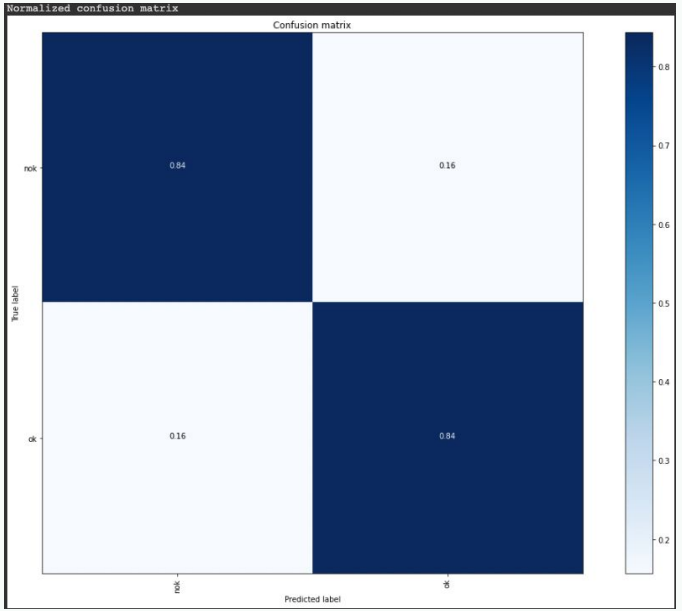
Carvago TRAIN.

1. *ResNet.*
2. *Dataset Balanced. About 2k.*
3. *Manual Labeled images.*
4. *Trained in Google Colab.*
5. *Python,Pytorch,Pandas.*

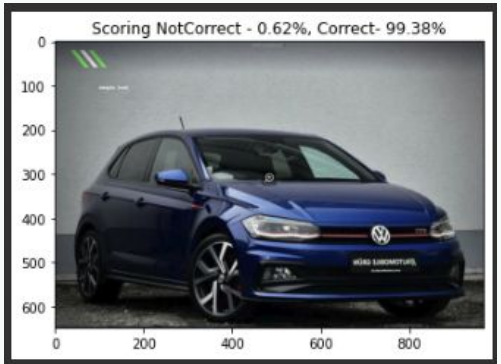


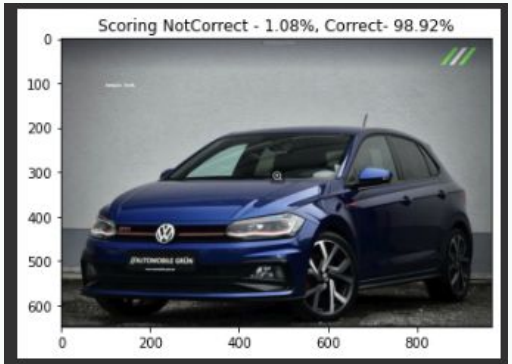
Car Classification.

1. *ResNet.*
2. *Dataset Balanced. About 2k.*
3. *Manual Labeled images.*
4. *Trained in Google Colab.*
5. *Python,Pytorch,Pandas.*

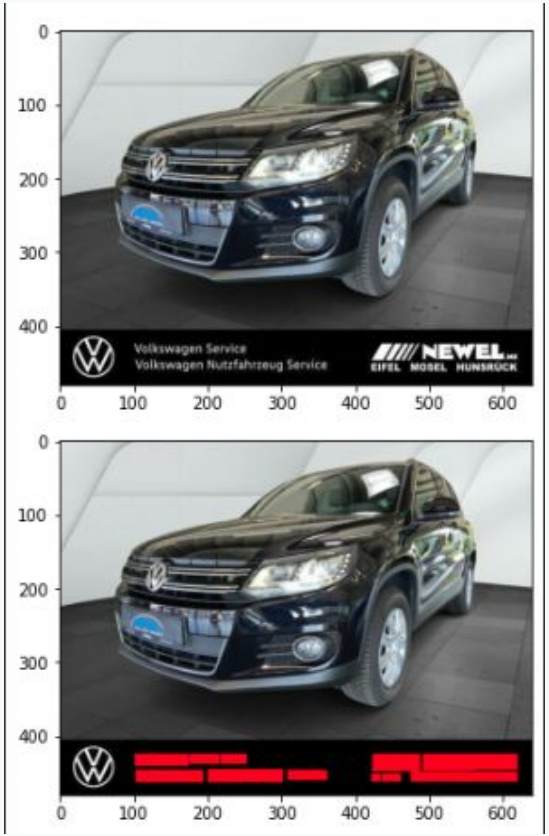


Carvago Result.





Carvago Text Over Paint.



Carvago Images Sort.

0	https://carvago.com/car/43052456/audi-q2-35-tdi-quattro-s-tronic-110-kw	1.64	
1	https://carvago.com/car/43052456/audi-q2-35-tdi-quattro-s-tronic-110-kw	38.48	
2	https://carvago.com/car/43052456/audi-q2-35-tdi-quattro-s-tronic-110-kw	20.00	
3	https://carvago.com/car/43052456/audi-q2-35-tdi-quattro-s-tronic-110-kw	13.40	
4	https://carvago.com/car/43052456/audi-q2-35-tdi-quattro-s-tronic-110-kw	0.30	

0	https://carvago.com/car/42272392/mazda-mx-30-107-kw	27.39	
1	https://carvago.com/car/42272392/mazda-mx-30-107-kw	96.24	
2	https://carvago.com/car/42272392/mazda-mx-30-107-kw	22.28	
3	https://carvago.com/car/42272392/mazda-mx-30-107-kw	99.69	
4	https://carvago.com/car/42272392/mazda-mx-30-107-kw	4.19	

CASE 2

Revolt.BI

Zadání na projektu znělo jednoduše...

Revolt:BI


Dataset 50 000 karet.
A každý rok přibývá
2 000 nových.
Revolt.BI


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to any target.
The sparkmage shrieked, calling on the rage of the storms of his youth. To his surprise, the sky responded with a fierce energy he'd never thought to see again.


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.
The sparkmage shrieked, calling on the rage of the storms of his youth. To his surprise, the sky responded with a fierce energy he'd never thought to see again.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Lightning Bolt
Instant
Lightning Bolt deals 3 damage to any target.
The sparkmage shrieked, calling on the rage of the storms of his youth. To his surprise, the sky responded with a fierce energy he'd never thought to see again.


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.
The sparkmage shrieked, calling on the rage of the storms of his youth. To his surprise, the sky responded with a fierce energy he'd never thought to see again.


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to any target.
Christopher Moeller


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.
The sparkmage shrieked, calling on the rage of the storms of his youth. To his surprise, the sky responded with a fierce energy he'd never thought to see again.


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.
Illus. Christopher Rush


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.
Illus. Christopher Rush


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.
Illus. Christopher Rush


Foudre
Éphémère
La Foudre inflige 3 points de dégâts à une cible quelconque.
Illus. Christopher Rush


Lightning Bolt
Instant
Lightning Bolt deals 3 damage to target creature or player.
Illus. Christopher Rush


Lightning Bolt
Instant
Lightning Bolt does 3 damage to one target.
Illus. © Christopher Rush


Foudre
Éphémère
La Foudre inflige 3 points de dégâts à une cible quelconque.
Illus. Christopher Rush

Computer Vision Tasks. MTG Card Classification.

Revolt.BI

Revolt.BI

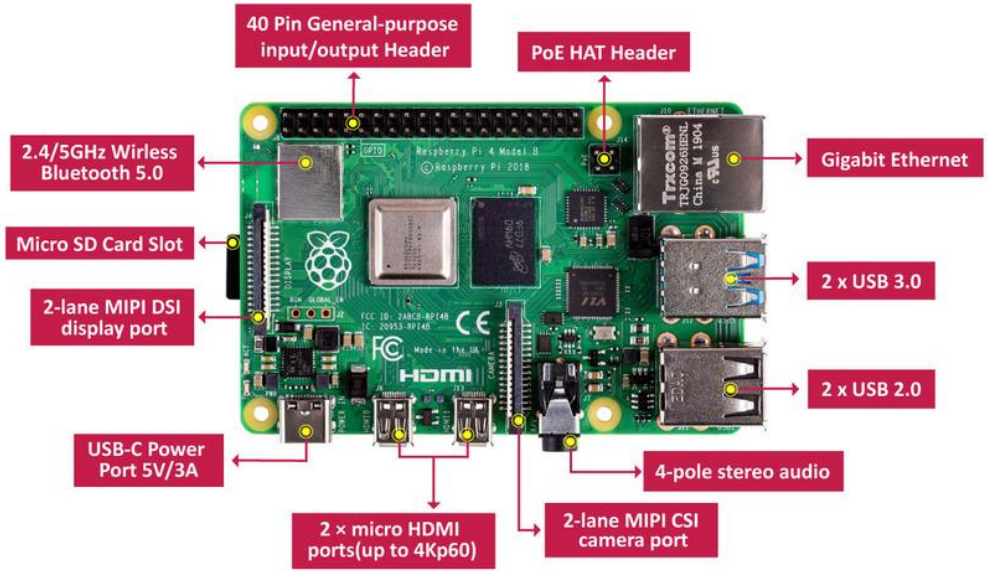
“How do you put a giraffe into a refrigerator?”

MTG Card Specification.

1. *Cards Sets - About 300*
2. *Cards Features - More than 20*
3. *Total Cards EN - More 50,000*

MTG Typical Card Variation.

Main System Requirement.
Raspberry Pi 4 1.5GHz Quad-Core



Data Scientist Tragedy!

1. *NO GPU!*
2. *No Powerful CPU.*
3. *Small Form Factor.*
4. *Only 4 threads.*
5. *Other programs runs.*
6. *No Internet connection.*
7. *No Balanced Dataset.*

Case For Computer Vision.
Foil or Non Foil Card?

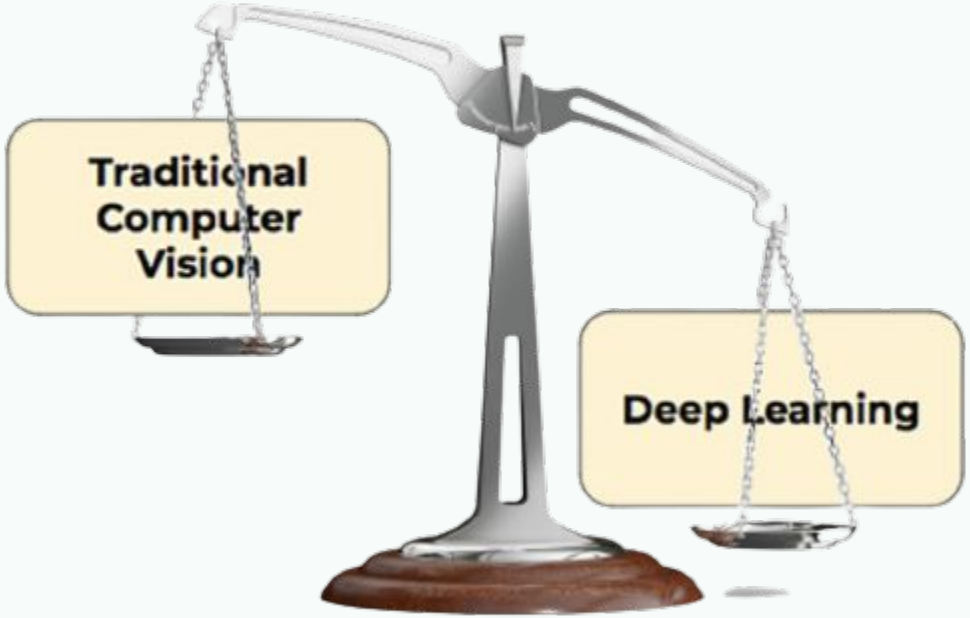
Revolt.BI

FOIL

NON FOIL

More Foil Examples:

What To Choose?



Revolt.BI

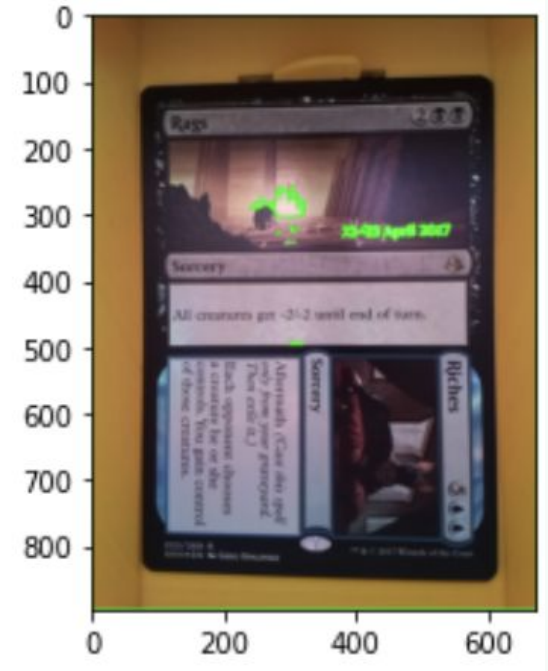
FAIL

1.) CCV

1. *Contours Counting.*
2. *Usually Foil images have more contours.*

Disadvantages.

1. *Accuracy - 70-80%*
2. *Light Condition Sensitive.*
3. *Very Unstable.*



FAIL

2.) Classic CV

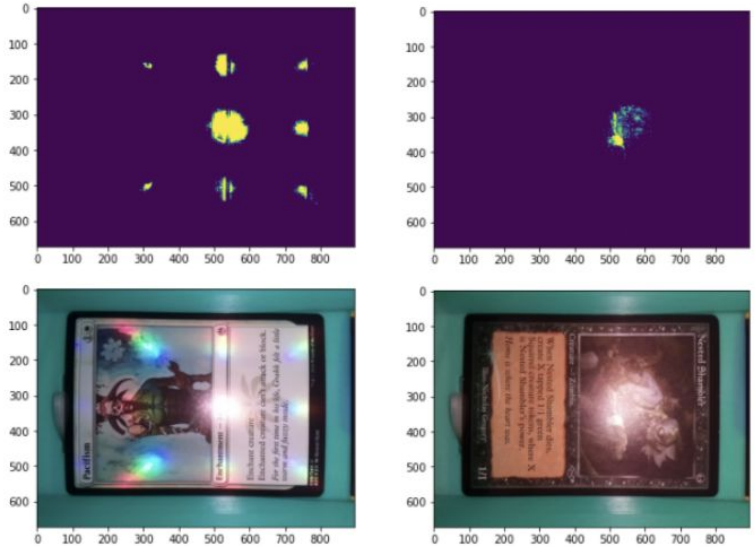
1. *Classic CV.*
2. *Multi Glare or Single Glare.*

Disadvantages.

1. *Accuracy - 70%*
2. *Unstable.*
3. *Cards have diff. glare*

2. Multi Glare

Single Glare.



Tensorflow on RPI?

1. *You DO NOT need Tensorflow.*
2. *You DO NOT need Tensorflow Lite.*
3. *You need **1** inference function from Tensorflow Lite!*

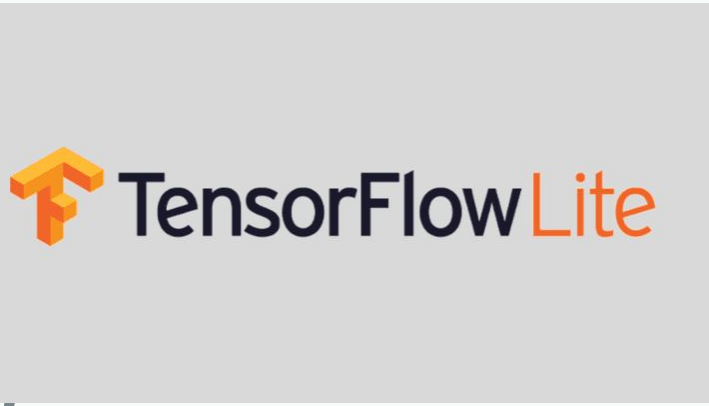
1. *TF Hub - Mobile Net - Feature Vector.*
2. *Train model in local PC with TF.*
3. *Convert TF model to TF Lite.*
4. *Inference model on RPI.*

3.) DL

1. *NN Model as Universal Feature Extractor.*
2. *Tensorflow Hub - Mobile Net.*
3. *Dataset - about 1k of each class.*

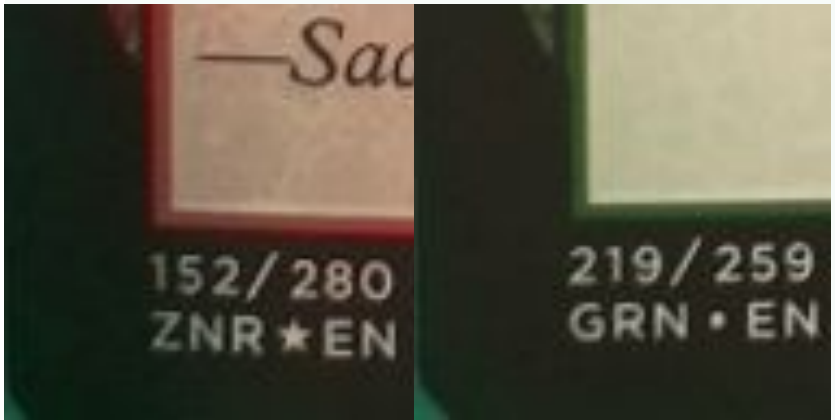
Disadvantages.

1. *Accuracy - 85%*
2. *Augmentation Not Work.*
3. *Too small dataset.*
4. *Foil Features not expressed clear.*



Why Domain Knowledge Helps?

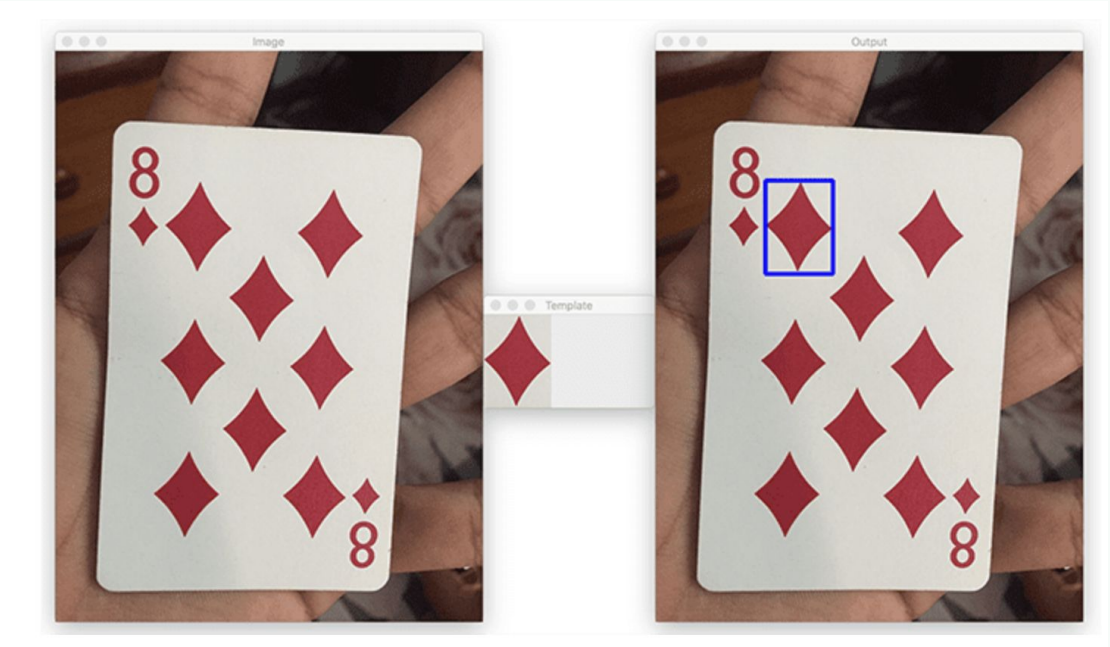
1. *First card 1993. Card Design changed in 2015.*
2. *In New Design card it have dot and star symbol for the foil indication.*
3. *Why you need accuracy of the old card design?*



SUCCESS

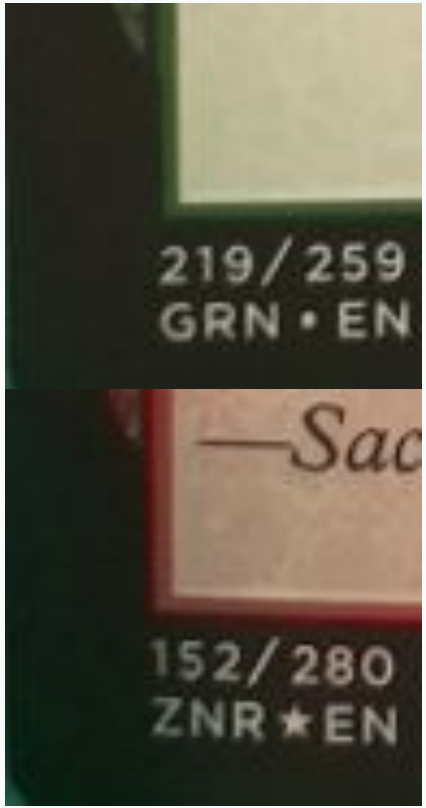
Classic CV + Deep Learning.

1. *Pattern Matching CV2*



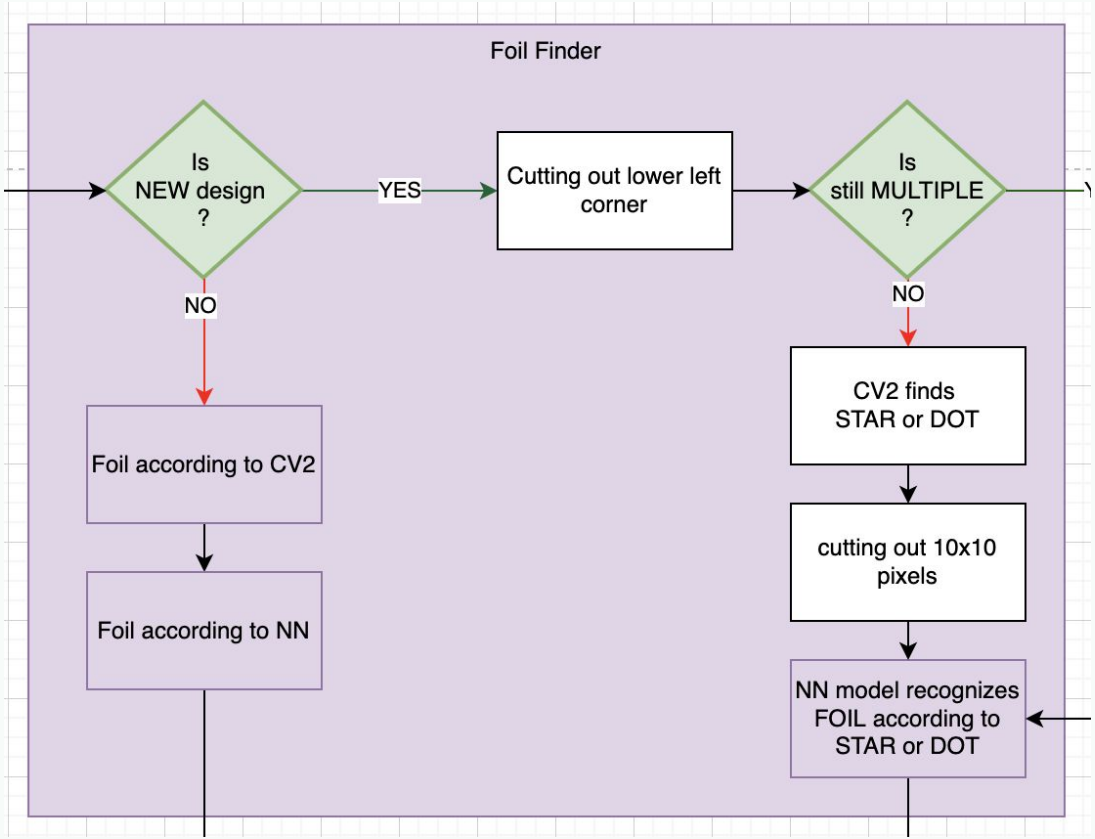
SUCCESS

Classic CV + Deep Learning.



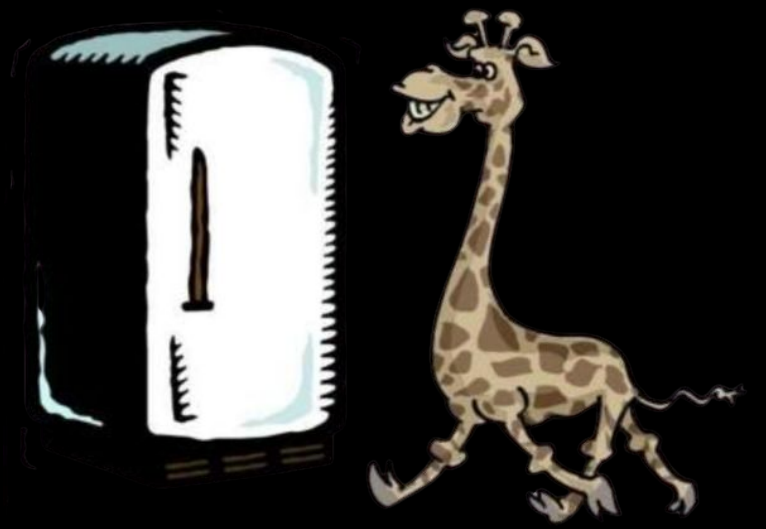
1. *What is the card design?*
2. *Old? CV2 model + Foil NN model accuracy 85%.*
3. *New? “★”/“•” NN model accuracy over 95%.*
    - *3.1 We have pattern image of a star size of 10*10 px.*
    - *3.2 CV2 find the pattern on card and cut it.*
    - *3.3 NN model recognize dot or star.*

Final Foil Model Diagram.



How do you put a giraffe into a refrigerator?

1. *Open the refrigerator.*
2. *Put the giraffe in.*
3. *Close the door.*



Revolt.BI

Revolt.BI

Lesson Learned.

1. *Cut Big Problem to Small Cases.*
2. *Inform-Educate Client What He Really Need.*
3. *Use both Classic CV and Deep Learning.*
4. *Not afraid to FAIL!*
5. *YOU CAN DO IT!*

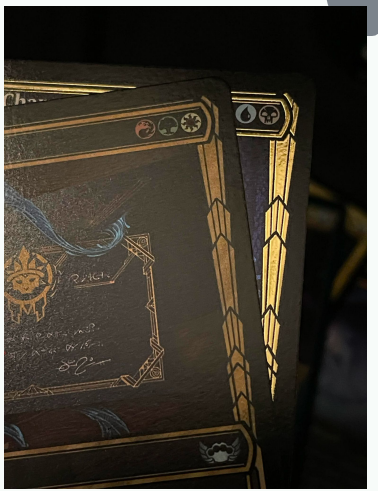
Our Team.

Zadání

Traditional

Etched

Galaxy



Gilded