Yelp Image Classification

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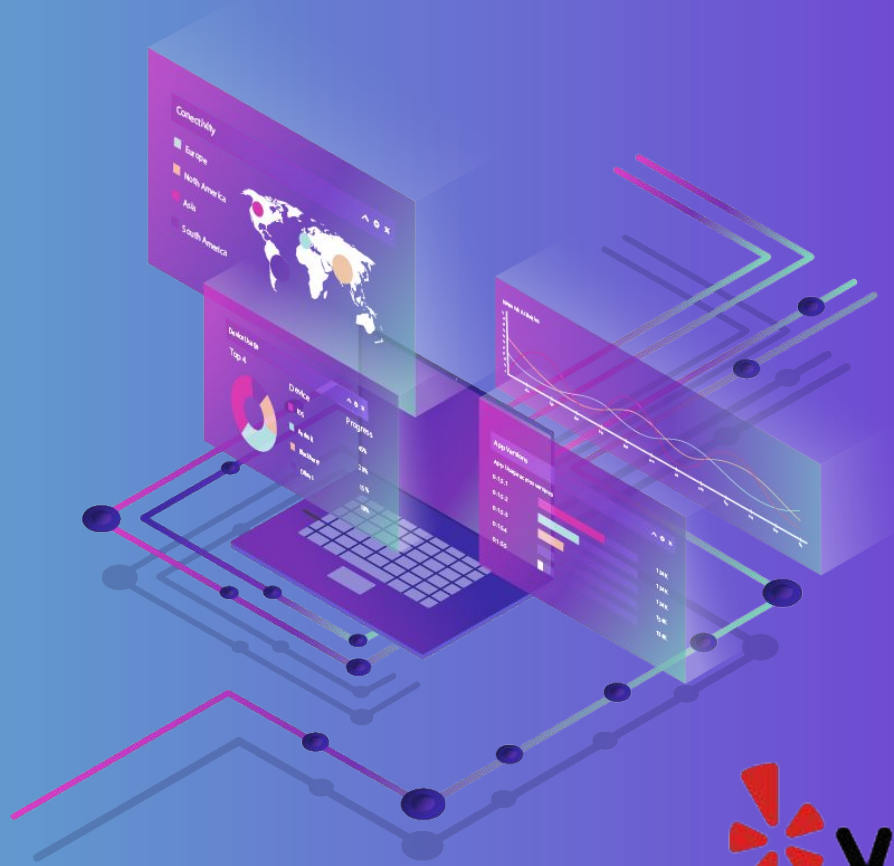

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01 WHAT

What is our data and what will we do with it

WHAT ARE WE EXPLORING

Yelp Dataset

- 200,000 images provided by Yelp
- Five categories
  - Food, Drink, Inside, Outside, Menu
  - Unevenly Distributed
  - 57.4%, 9.1%, 26.2%, 5.8%, 1.5%
- yelp.com/dataset

Image Classification

- Process how the computer sees our images
- Build a model around the images
- Attempt to classify the images into their respective categories

EXAMPLE IMAGES

Image ID: B0m2czTYp3ASdE4fL3DCVw
Label: ['0']

Image ID: T6FRRuNn6ag8ODqVDBIDRg
Label: ['3']

Image ID: b8GP0mCoSH-Xe3QKKJzzzA
Label: ['1']

Image ID: 9gy3rYm2dBNrGzCrGzukKA
Label: ['4']

Image ID: ZVqKpV614y6JyUpGb9QuTA
Label: ['3']

Image ID: OrJhn7u1J2oiVaGTnYvbvw
Label: ['0']

Image ID: _wGrLb3-mKLQojSLd2wr2Q
Label: ['0']

Image ID: HBm1kJ1lDw1OPvmyXipvsA
Label: ['0']

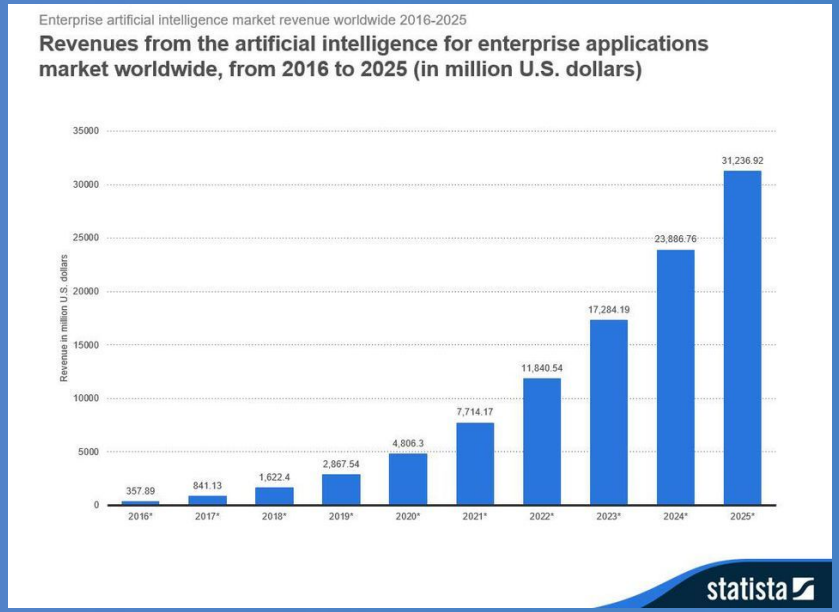
WHY

02

What's the point of going through these exercises

WHY

- Image recognition is one of the fastest growing fields in technology
- Social Media, National Security, Self-driving Vehicles, Medical Uses
- Error rates for image labeling have fallen from 28.5% to below 2.5% since 2010
- Global revenues from AI applications is projected to grow from $1.62B in 2018 to $31.2B in 2025 - 52.59% CAGR in the forecast period

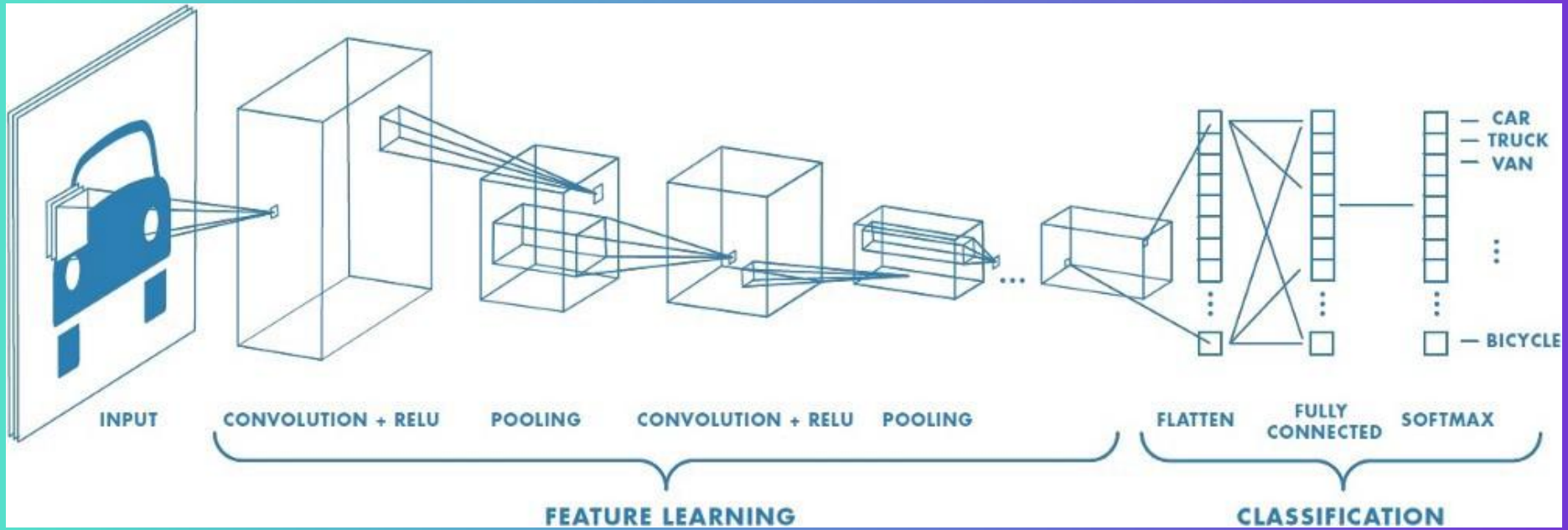


Source

03 HOW

How do we make this work?

CONVOLUTIONAL NEURAL NETWORK



USING A CONVOLUTIONAL NEURAL NETWORK

DATA GATHERING
The first step is always to gather the required data

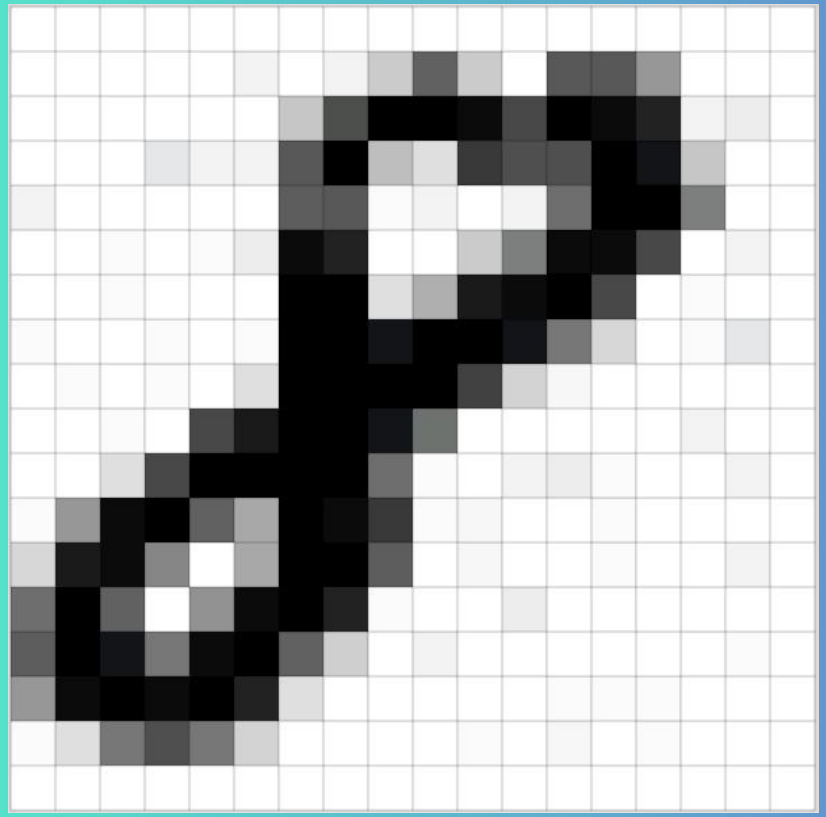
IMAGE PROCESSING
Process the image into something a computer can interpret

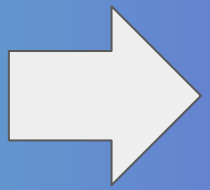
MODEL BUILDING
Construct the model using the appropriate layers (Convolutional, Pooling, Fully Connected)

MODEL TRAINING
Train the model using the appropriate data

IMAGE EVALUATION AND CLASSIFICATION
Make a prediction based on our trained model

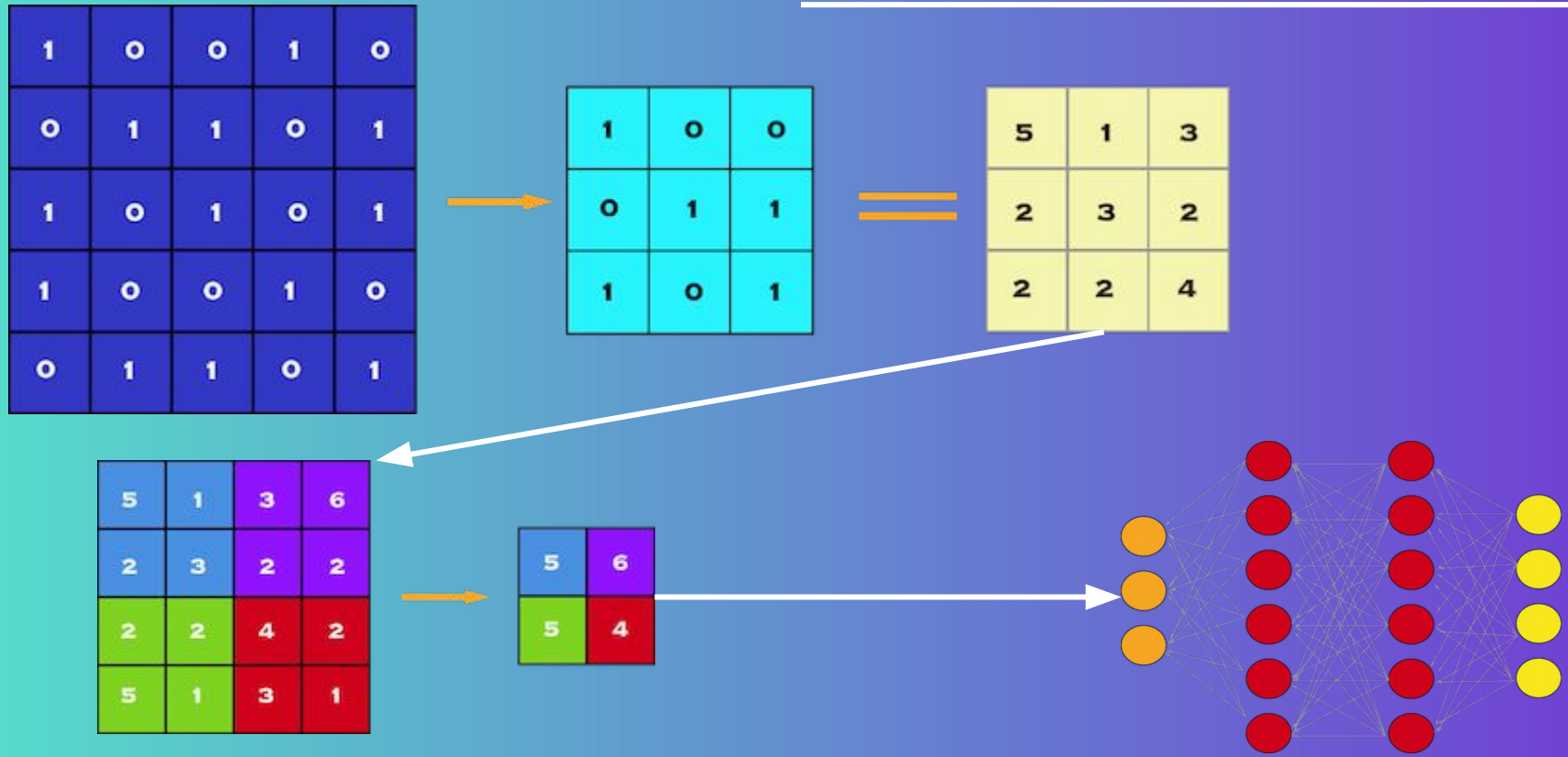
IMAGE PROCESSING SIMPLIFIED





0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	12	0	11	39	137	37	0	152	147	84	0	0	0
0	0	1	0	0	0	41	160	250	255	235	162	255	238	206	11	13	0
0	0	0	16	9	9	150	251	45	21	184	159	154	255	233	40	0	0
10	0	0	0	0	0	145	146	3	10	0	11	124	253	255	107	0	0
0	0	3	0	4	15	236	216	0	0	38	109	247	240	169	0	11	0
1	0	2	0	0	0	253	253	23	62	224	241	255	164	0	5	0	0
6	0	0	4	0	3	252	250	228	255	255	234	112	28	0	2	17	0
0	2	1	4	0	21	255	253	251	255	172	31	8	0	1	0	0	0
0	0	4	0	163	225	251	255	229	120	0	0	0	0	0	11	0	0
0	0	21	162	255	255	254	255	126	6	0	10	14	6	0	0	9	0
3	79	242	255	141	66	255	245	189	7	8	0	0	5	0	0	0	0
26	221	237	98	0	67	251	255	144	0	8	0	0	7	0	0	11	0
125	255	141	0	87	244	255	208	3	0	0	13	0	1	0	1	0	0
145	248	228	116	235	255	141	34	0	11	0	1	0	0	0	1	3	0
85	237	253	246	255	210	21	1	0	1	0	0	6	2	4	0	0	0
6	23	112	157	114	32	0	0	0	0	2	0	8	0	7	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

LAYERS WITHIN A CNN



RESULTS 04

How did our models perform

FIRST MODEL

- 150,000 Training Images
- 2 Convolutional Layers
- 2 Max Pooling Layers
- 2 Fully Connected Dense Layers
- 2 Dropout Layers
- 5 Epochs
- 15,757,061 Total Parameters

	Precision	Recall	F1-Score	Support
Food	0.57	0.77	0.66	5744
Inside	0.26	0.22	0.24	2622
Drink	0.00	0.00	0.00	906
Outside	0.00	0.00	0.00	577
Menu	0.00	0.00	0.00	151
Accuracy			0.50	10,000
Macro Avg	0.17	0.20	0.18	10,000
Weighted Avg	0.40	0.50	0.44	10,000

SECOND MODEL - ONE MORE LAYER AND MORE EPOCHS

- 150,000 Training Images
- 3 Convolutional Layers
- 2 Max Pooling Layers
- 2 Fully Connected Dense Layers
- 2 Dropout Layers
- 15 Epochs
- 3,712,293 Total Parameters

	Precision	Recall	F1-Score	Support
Food	0.57	0.61	0.59	5744
Inside	0.27	0.29	0.28	2622
Drink	0.09	0.05	0.06	906
Outside	0.04	0.03	0.04	577
Menu	0.03	0.02	0.02	151
Accuracy			0.43	10,000
Macro Avg	0.20	0.20	0.20	10,000
Weighted Avg	0.41	0.43	0.42	10,000

THIRD MODEL - EVEN MORE EPOCHS

- 142,500 Training Images
- 3 Convolutional Layers
- 2 Max Pooling Layers
- 2 Fully Connected Dense Layers
- 2 Dropout Layers
- 30 Epochs
- 3,712,293 Total Parameters

	Precision	Recall	F1-Score	Support
Food	0.57	0.62	0.60	5744
Inside	0.26	0.27	0.26	2622
Drink	0.10	0.07	0.08	906
Outside	0.07	0.04	0.05	577
Menu	0.02	0.02	0.02	151
Accuracy			0.44	10,000
Macro Avg	0.20	0.20	0.20	10,000
Weighted Avg	0.41	0.44	0.42	10,000

FOURTH MODEL - GET CONVOLUTED

- 142,500 Training Images
- 6 Convolutional Layers
- 4 Max Pooling Layers
- 2 Fully Connected Dense Layers
- 2 Dropout Layers
- 30 Epochs - Early Stop after 12 Epochs
- 1,530,373 Total Parameters

	Precision	Recall	F1-Score	Support
Food	0.57	0.60	0.59	5744
Inside	0.26	0.27	0.27	2622
Drink	0.10	0.06	0.08	906
Outside	0.05	0.04	0.04	577
Menu	0.02	0.02	0.02	151
Accuracy			0.43	10,000
Macro Avg	0.20	0.20	0.20	10,000
Weighted Avg	0.41	0.43	0.42	10,000

FIFTH MODEL - AN ATTEMPTED BALANCING ACT

- 9,000 Training Images
- 6 Convolutional Layers
- 4 Max Pooling Layers
- 2 Fully Connected Dense Layers
- 2 Dropout Layers
- 50 Epochs - Early Stop after 45 Epochs
- 1,530,373 Total Parameters

	Precision	Recall	F1-Score	Support
Food	0.00	0.00	0.00	5744
Inside	0.00	0.00	0.00	2622
Drink	0.09	0.97	0.17	906
Outside	0.06	0.03	0.04	577
Menu	0.00	0.00	0.00	151
Accuracy			0.09	10,000
Macro Avg	0.03	0.20	0.04	10,000
Weighted Avg	0.01	0.09	0.02	10,000

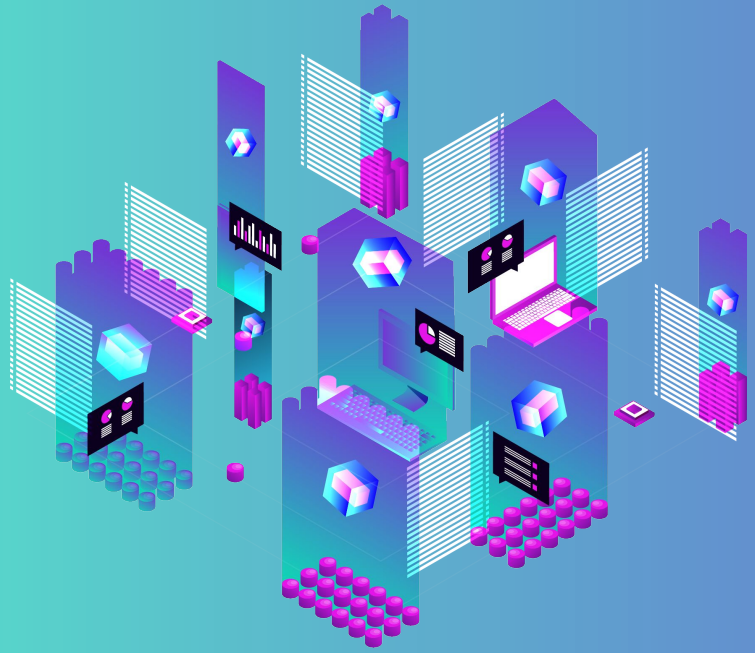
05 CHANGES

What changes could be effectuated to improve the models

THE BIGGEST ISSUE

ADDITIONAL CHANGES

- Increased complexity and / or additional layers
  - Increased computational power requirements
  - Timing
  - May not require balanced classes
- Balanced Dataset
  - Model learns about classes equally
  - May require more data
- Uniformity in pictures
  - Removes “noise” from the pictures
  - Easier for model to focus on target within image
- Team project
  - Spread the work out



CONCLUSIONS

06

General takeaways

CONCLUSIONS AND RECOMMENDATIONS

- Image classification has widespread uses
  - Facial Recognition / Biometrics, Medical Uses, Self-driving vehicles, Postal Services
- Computers have significantly increased accuracy
  - Sub 3% error rate since 2010
- Growing industry
  - Corporations investing billions in the field
- High computational requirements
- More data is always better to account for noise

THANK YOU

Any questions?

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