



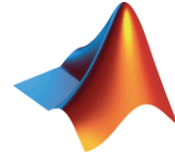
Convolutional Neural Networks in MATLAB

28 March 2019



| Welcome

Opti-Num
Solutions

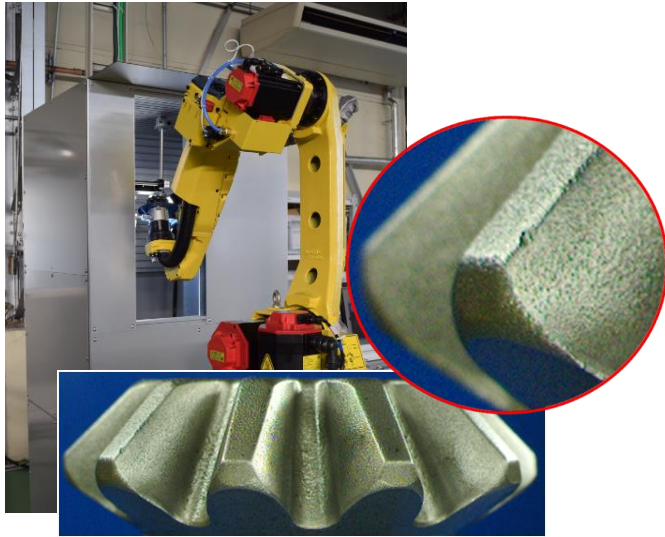


MathWorks®

- Danielle Winter
Application Engineer – AI and Data Science in Engineering
- Adri van Nieuwkerk
Business Development Consultant - Education



| Why are we here today?



Musashi Seimitsu
Industry Co.,Ltd.

Shell

Identified tags ready for OCR and integration into SAP

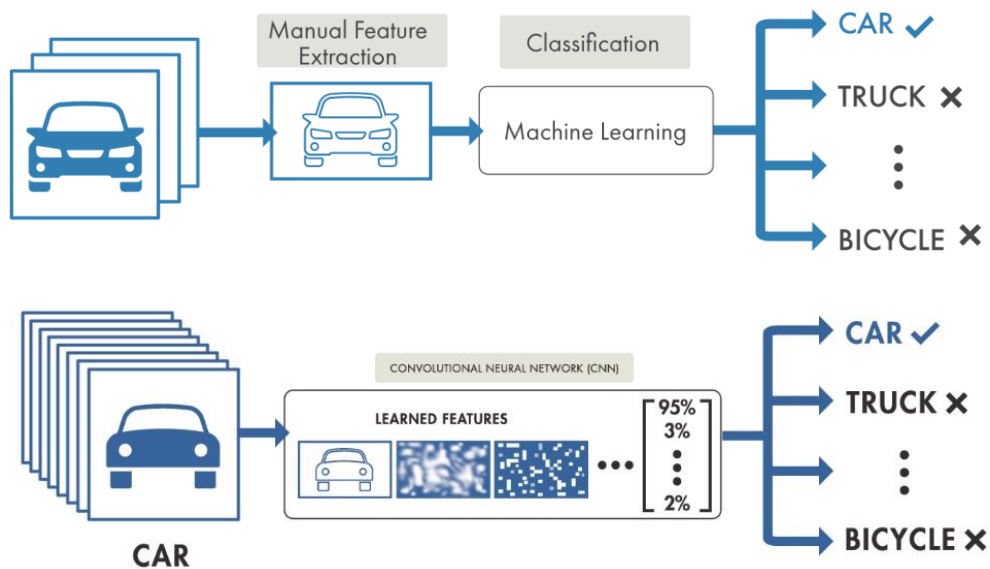


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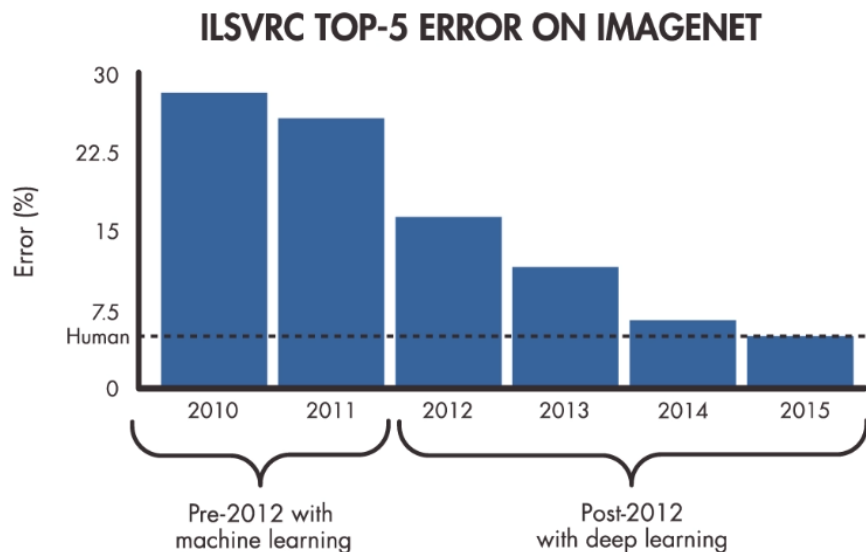
| Why are we here today?

- Feature extraction is painful



| Why are we here today?

- Deep learning is getting more accurate



zecedms:

fencer-x:

tigerlizii:

what a strange cat

that's not a cat. it let you pet its belly without biting.

dogs like rolling over on their back. maybe dog??

Look at this weird dog.

Source: veidolon



| Agenda

- Introduction to concepts
 - Deep Learning checklist
 - Convolutional Neural Networks and layer architecture
- CNNs for non-image applications
- Some challenges and how to mitigate them
- Take Aways



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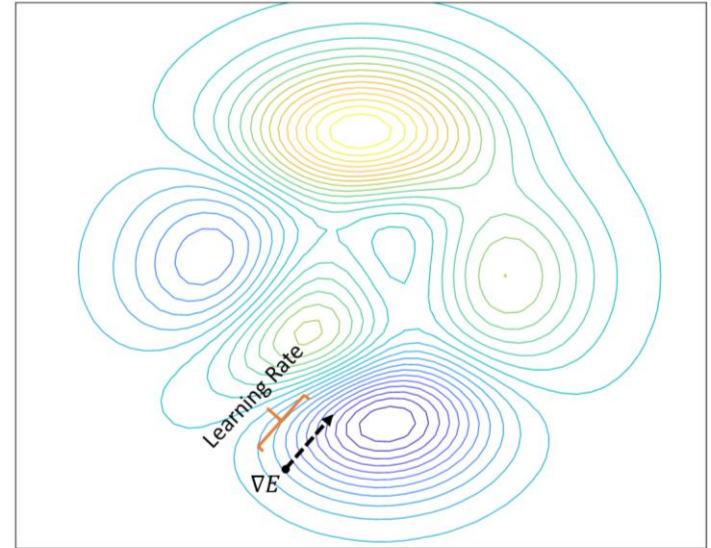
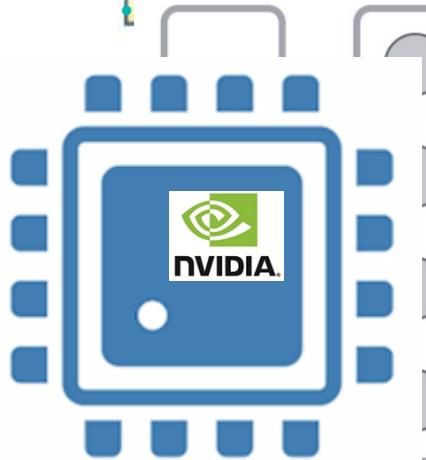
Deep Learning Workflow

Deep Learning Checklist

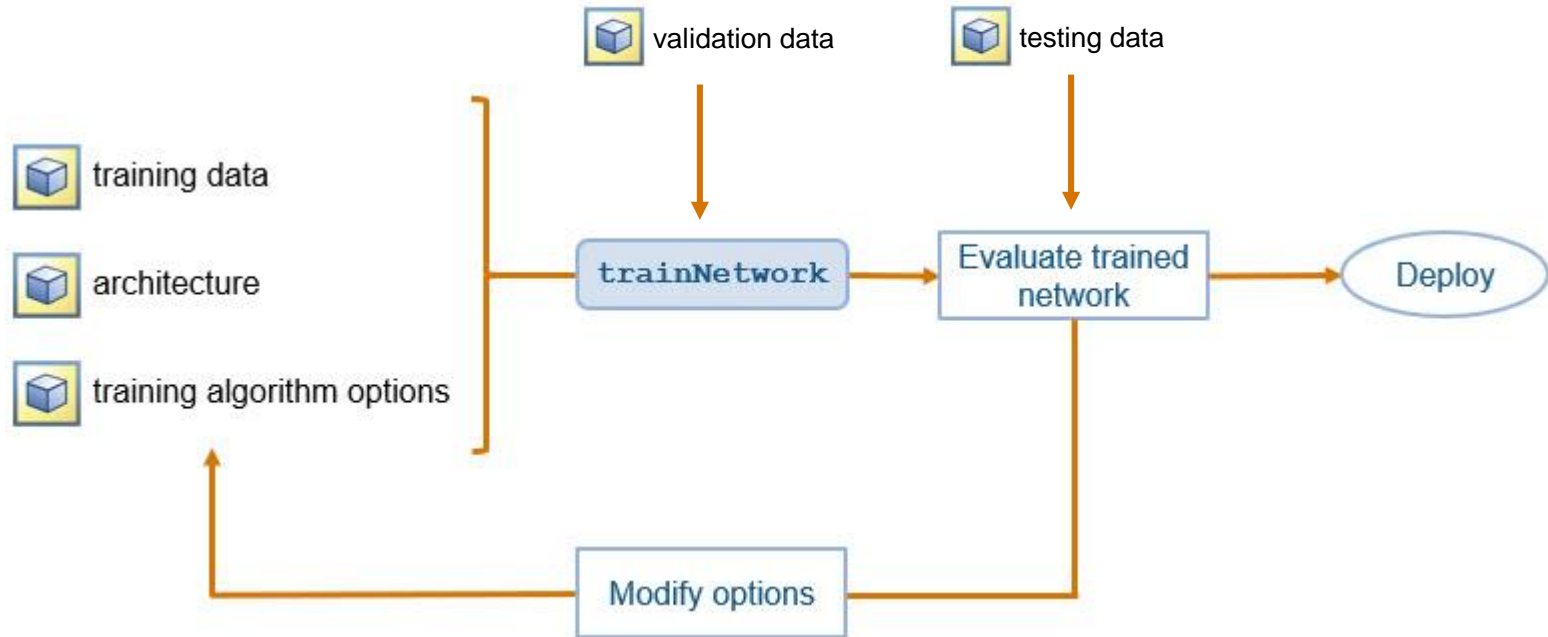
- Data
- Network Layers
- Training options

Training Options

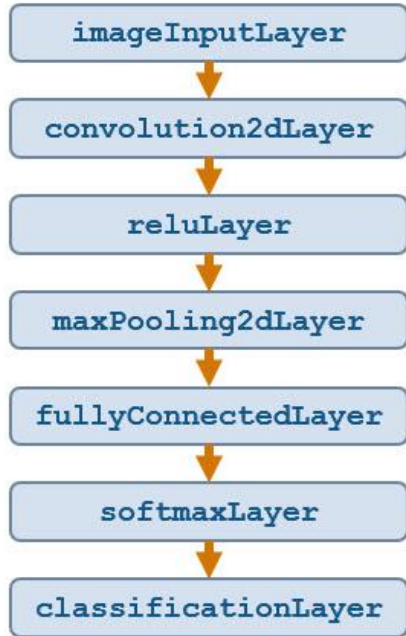
- Algorithm
- Learning Rate
- Mini-Batch
- Validation



| Deep Learning Workflow



| Convolutional Neural Networks

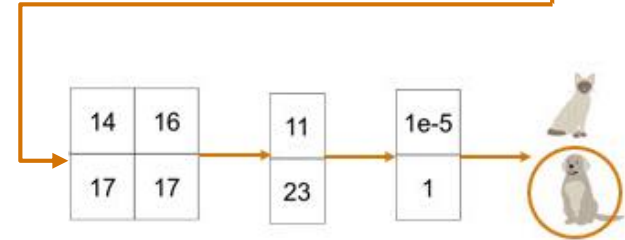


7	14	-9	-2	5
13	-5	-3	4	6
-6	-4	3	10	12
0	2	9	11	-7
1	8	15	-8	-1

1	0
0	1

2	11	-5	4
9	-2	7	16
-4	5	14	3
8	17	1	10

2	11	0	4
9	0	7	16
0	5	14	3
8	17	1	10



| CNN Architecture – Input Layer

`imageInputLayer([5,5])`

7	14	-9	-2	5
13	-5	-3	4	6
-6	-4	3	10	12
0	2	9	11	-7
1	8	15	-8	-1

Image size: $m*n*a$

Colour image: $a = 3$

Multispectral image: $a = \text{many}$

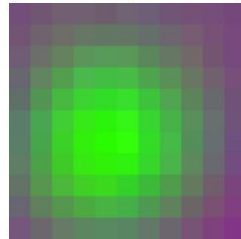


| CNN Architecture – Middle Layers

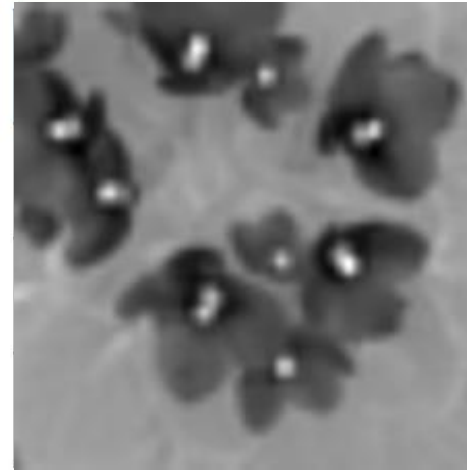
- Convolution of spatial filters with input image
`convolution2dLayer ([2,2] , 50)`



*



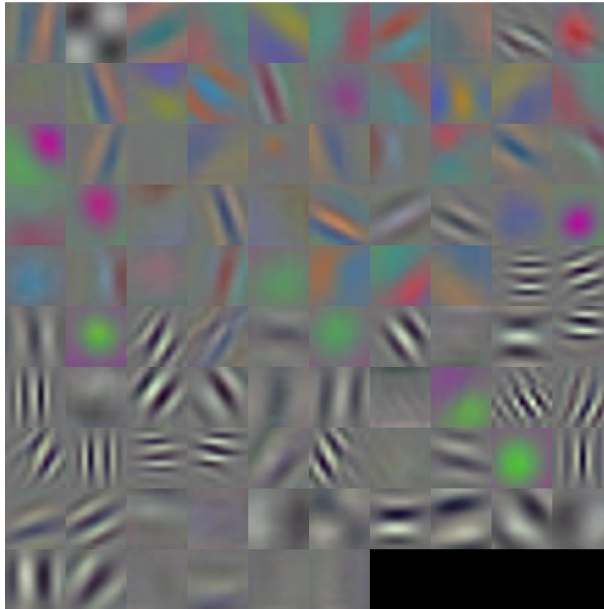
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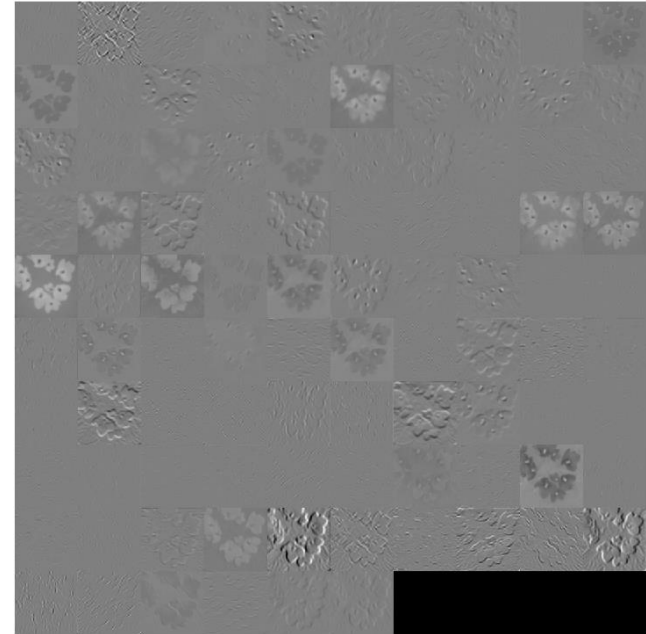
| CNN Architecture – Middle Layers

- Convolution of spatial filters with input image

`convolution2dLayer([2,2],50)`



`activations(net, X, layer)`



| CNN Architecture – Middle Layers

reluLayer

maxPooling2dLayer ([3, 3])

2	11	-5	4
9	-2	7	16
-4	5	14	3
8	17	1	10



2	11	0	4
9	0	7	16
0	5	14	3
8	17	1	10



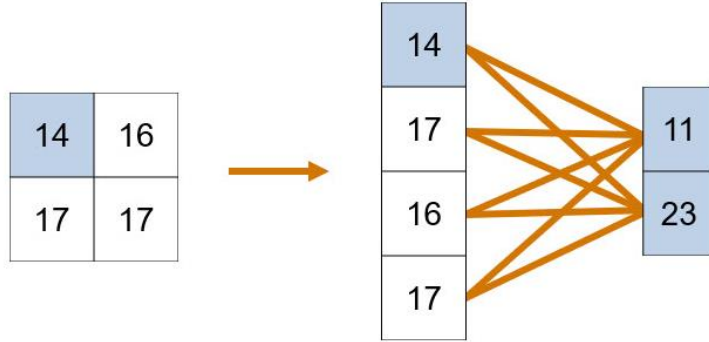
14	16
17	17

$$f(x) = \begin{cases} x, & x \geq 0 \\ 0, & x < 0 \end{cases}$$



| CNN Architecture – Final Layers

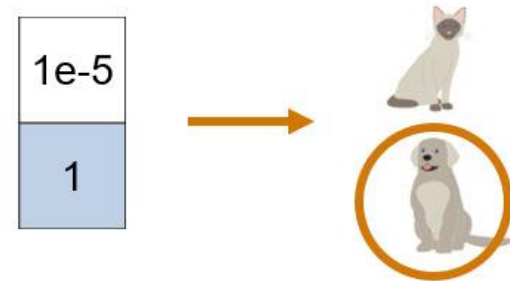
fullyConnectedLayer (2)



softmaxLayer ()



classificationLayer ()

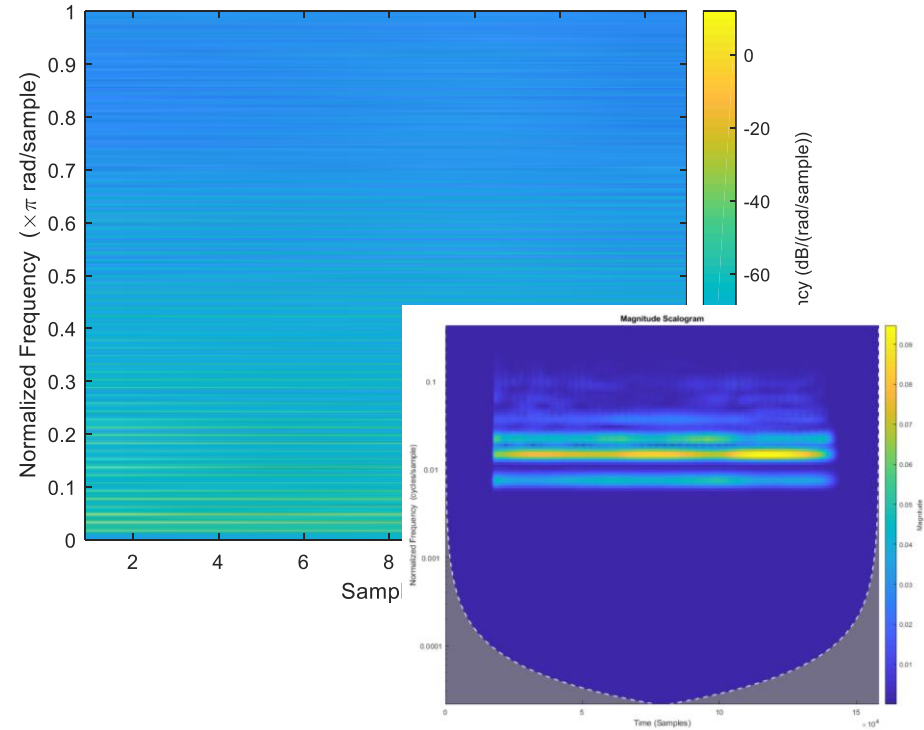
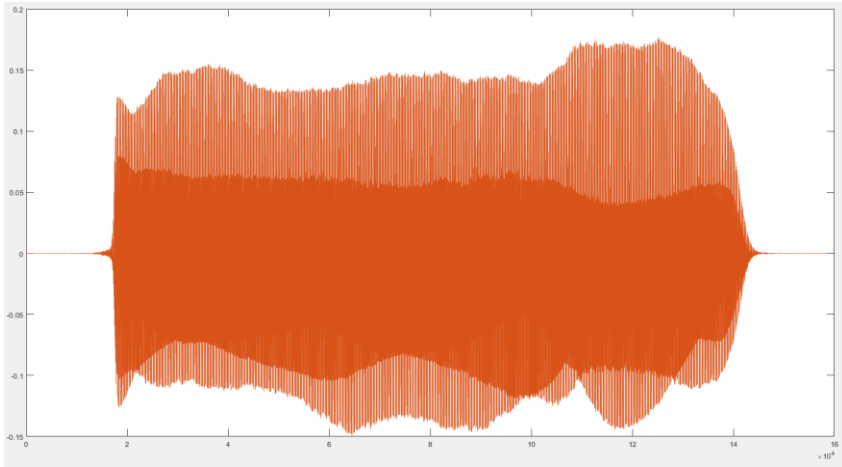


| Agenda

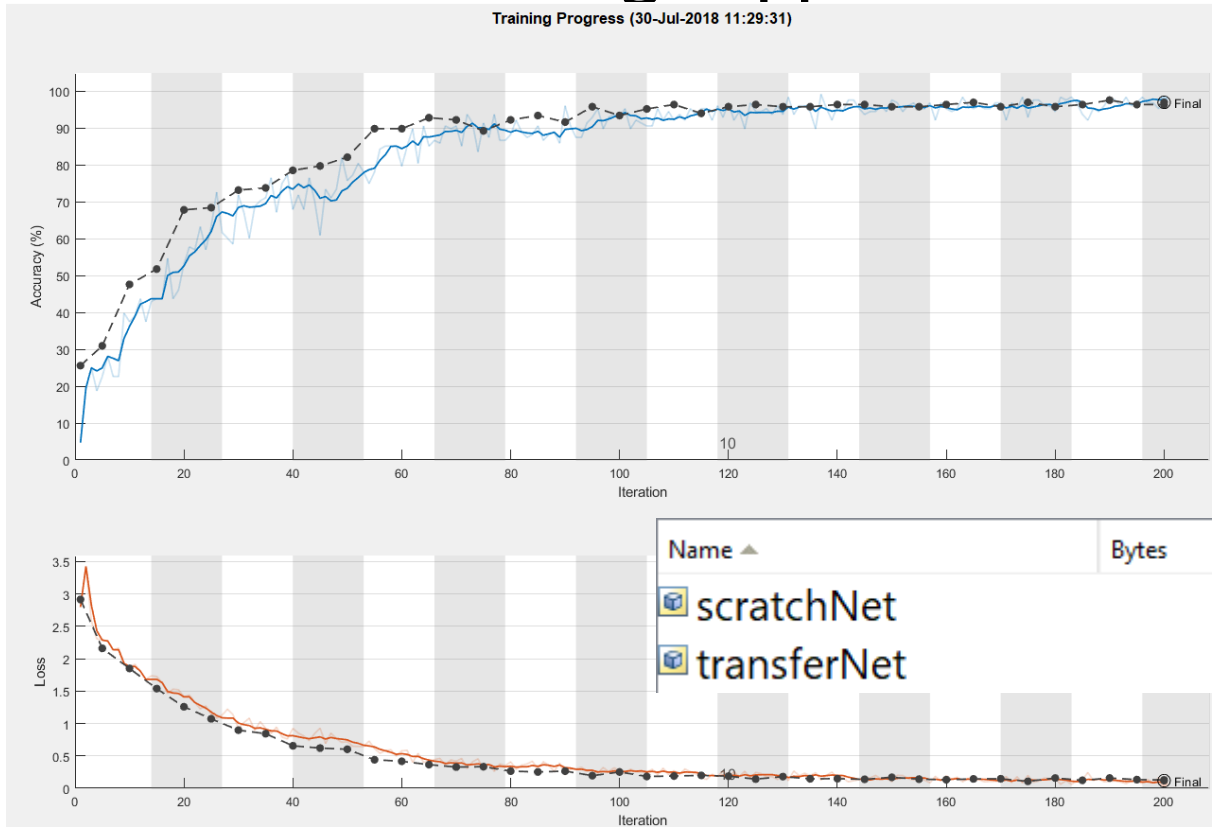
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| CNNs for Non-Image Applications



CNNs for Non-Image Applications



Name ▲	Bytes	Class
scratchNet	764159	SeriesNetwork
transferNet	228334047	SeriesNetwork



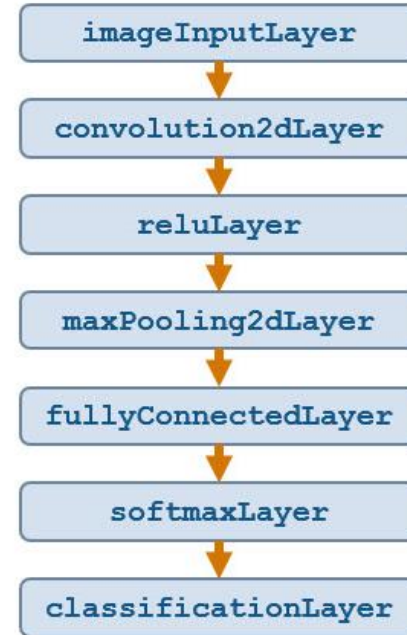
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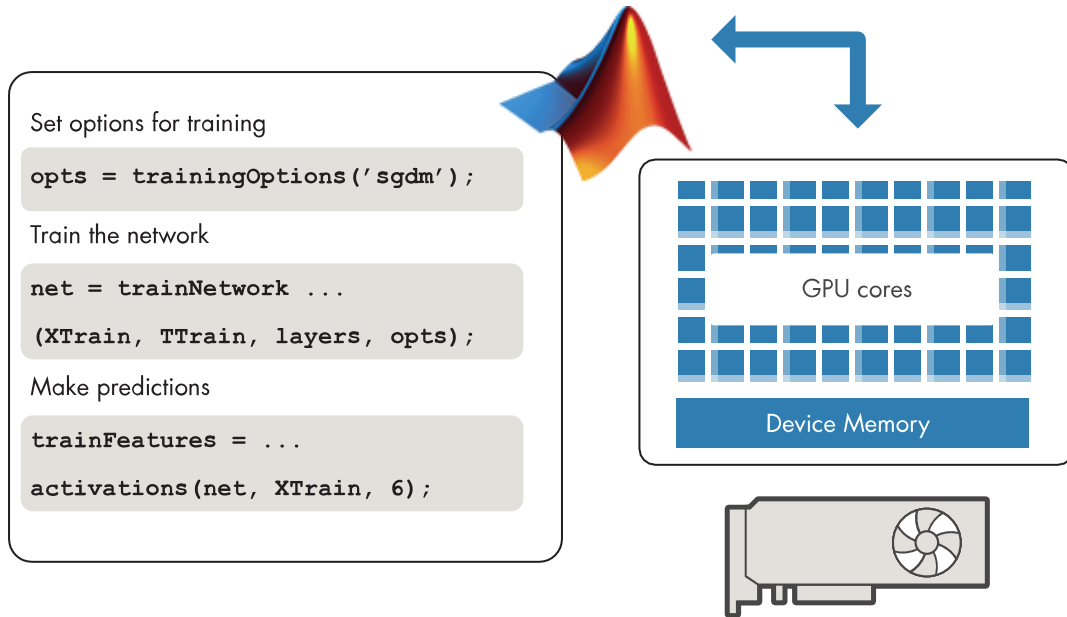
| Some Challenges

- Building layer architecture



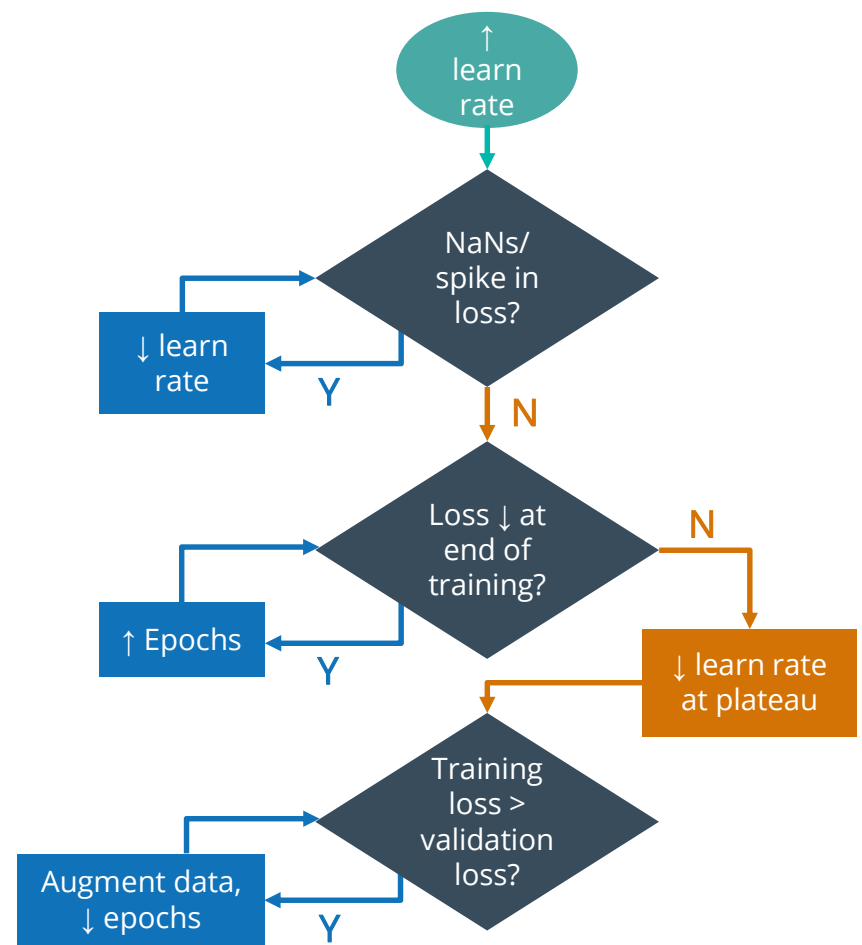
| Some Challenges

- Building layer architecture
- Training Time
 - Use GPU



| Some Challenges

- Building layer architecture
- Training Time
 - Use GPU
- Getting better performance
 - Learning rate
 - Epochs
 - Amount of data



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| Take-Aways

- Growing the Deep Learning Community in South Africa
 - Application-based research
- Deep Learning in MATLAB
 - Deep Learning Onramp Tutorial
 - MATLAB Onramp Tutorial



