INSTITUTO FEDERAL
Ceará

Programa de Pós-Graduação
em Ciência da Computação

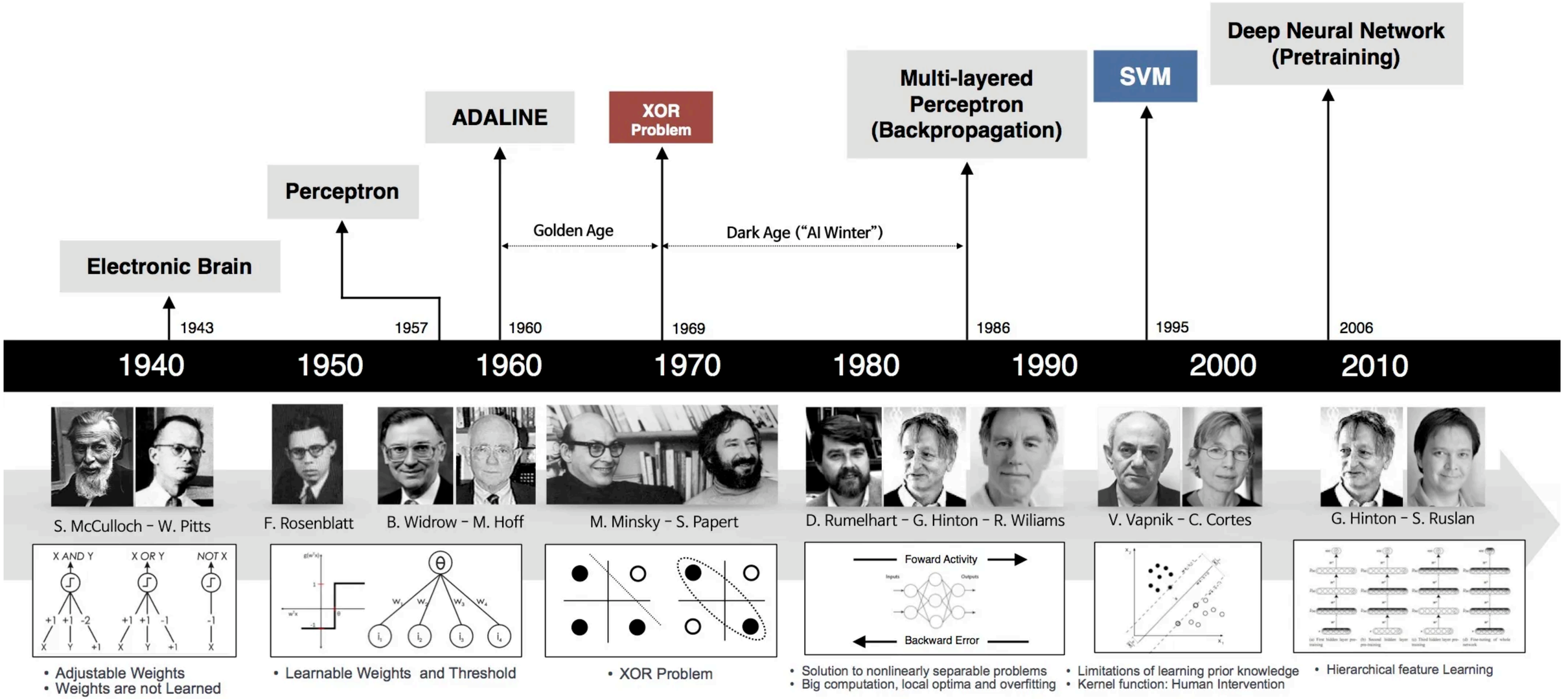
09 REDES CONVOLUCIONAIS FAMOSINHAS

APRENDIZAGEM PROFUNDA

PPGCC – 2023.1

Prof. Saulo Oliveira <saulo.oliveira@ifce.edu.br>

Evolução das Redes Neurais Artificiais

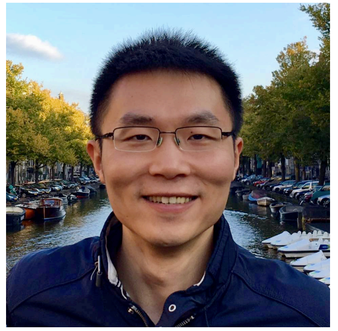


Fonte: https://sefiks.com/2017/10/14/evolution-of-neural-networks/

EXISTEM 1000 MANEIRAS DE FAZER NESTON™

EXISTEM 1000 MANEIRAS
DE FAZER ~~NEXTONE~~
REDES PROFUNDAS.
CRIE UMA!

ImageNet



>53K

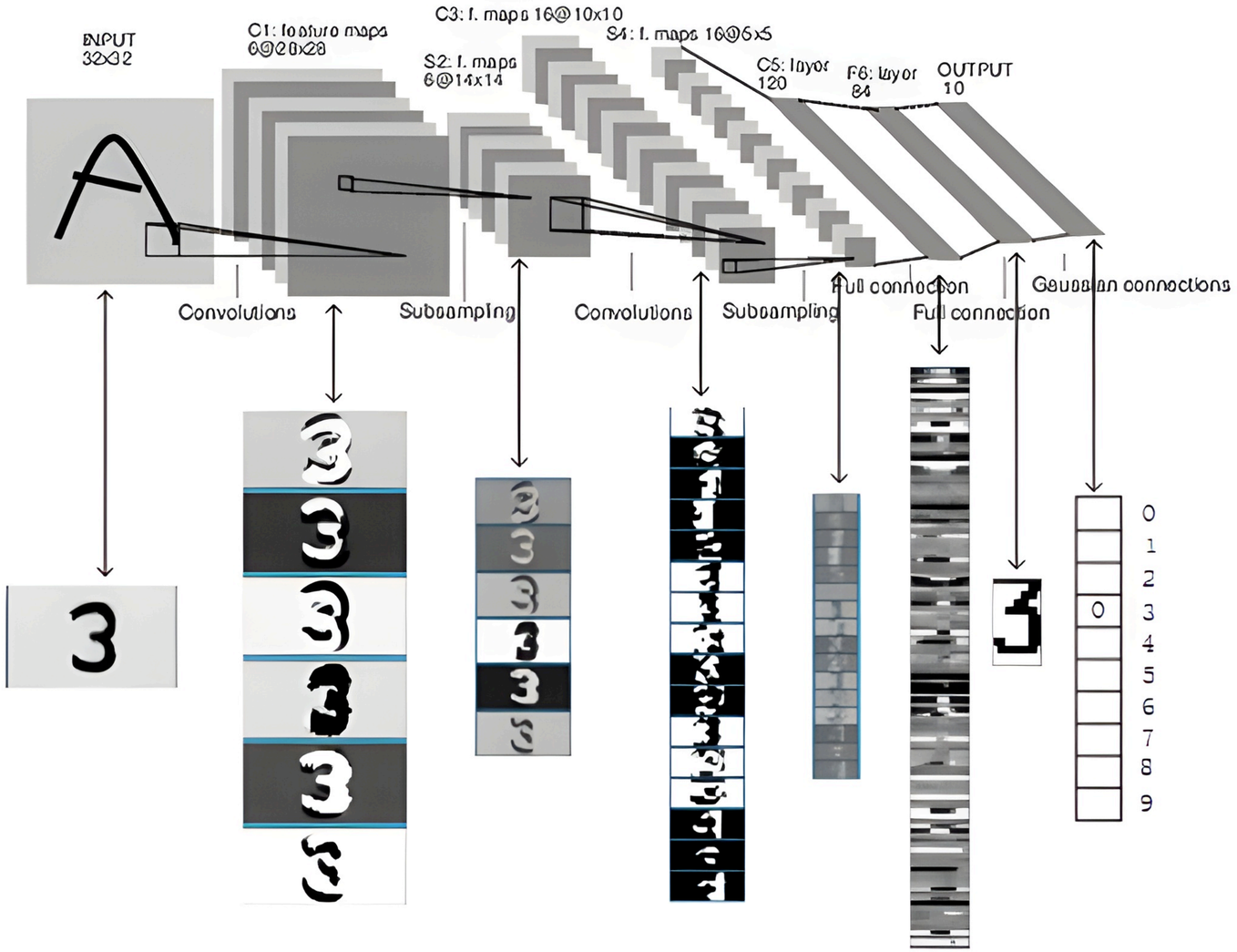
citações

Fonte: DENG, Jia et al. ImageNet: A large-scale hierarchical image database. In: 2009 IEEE conference on computer vision and pattern recognition. IEEE, 2009. p. 248-255.

O projeto **ImageNet** é um grande banco de dados visual projetado para uso em pesquisa de software de reconhecimento de objetos visuais. Nele, mais de **14M** de imagens foram anotadas manualmente para indicar quais objetos, em **>20K categorias**, são retratados e, **≈1M** de imagens, caixas delimitadoras também são fornecidas.

Fonte: https://www.image-net.org/index.php

LeNet



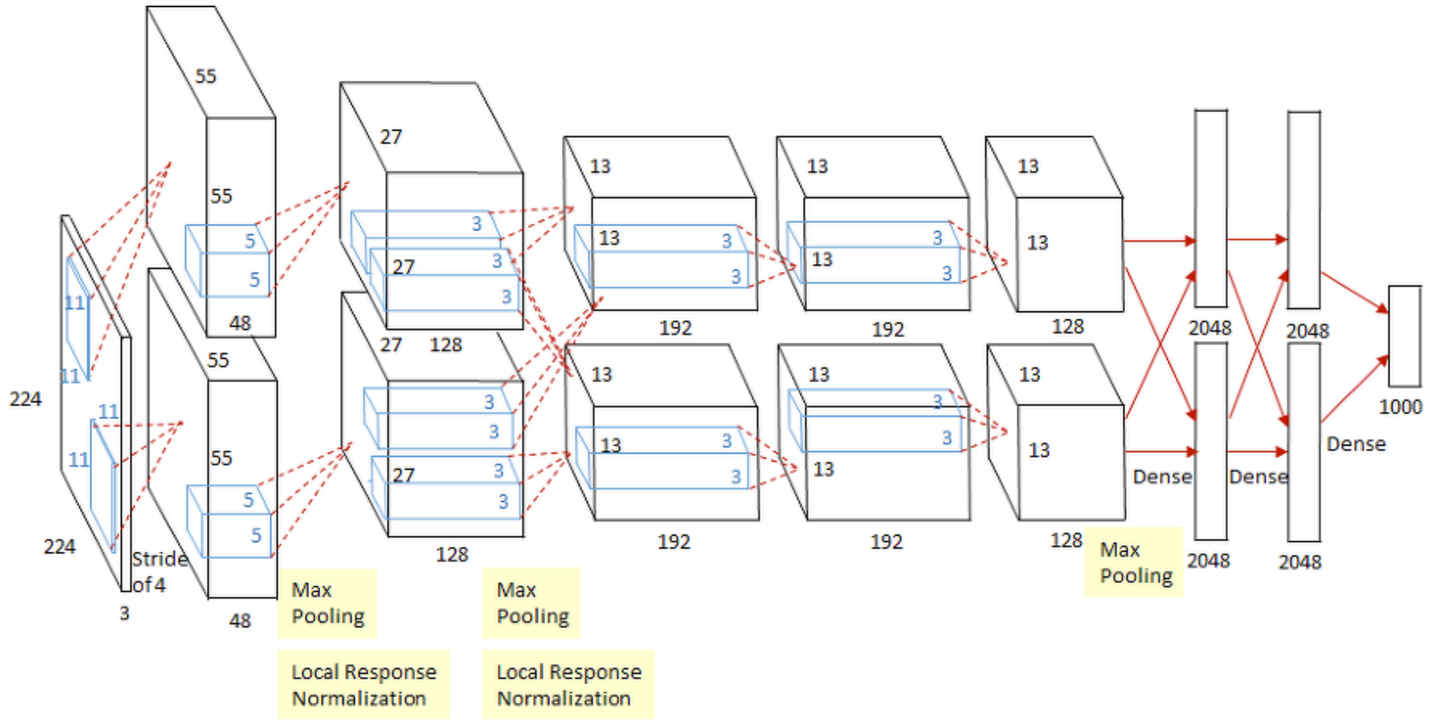
	Camada	Feature	Tam	Filtro	Stride	Activation
In	Image	1	32x32	-	-	-
1	Convolution	6	28x28	5x5	1	tanh
2	Average pool	6	14x14	2x2	2	tanh
3	Convolution	16	10x10	5x5	1	tanh
4	Average pool	16	5x5	2x2	2	tanh
5	Convolution	120	1x1	5x5	1	tanh
6	FC	-	84	-	-	tanh
Out	FC	-	10	-	-	softmax

>54K

citações

Fonte: LECUN, Yann et al. Gradient-based learning applied to document recognition. Proceedings of the IEEE, v. 86, n. 11, p. 2278-2324, 1998.

AlexNet



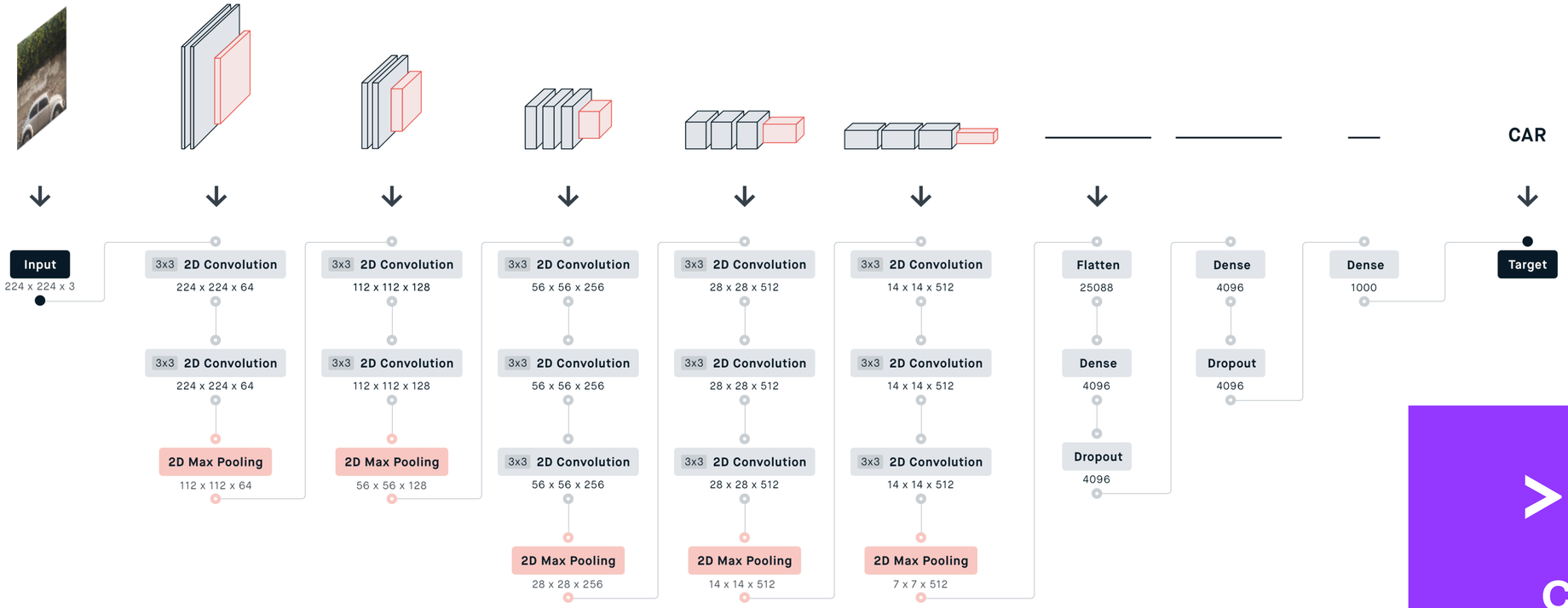
>131K

citações

Fonte: KRIZHEVSKY, Alex; SUTSKEVER, Ilya; HINTON, Geoffrey E. ImageNet classification with deep convolutional neural networks. Communications of the ACM, v. 60, n. 6, p. 84-90, 2017.

Camada	Tamanho	Nº de pesos	Nº de viéses	Total
Input Image	227x227x3	0	0	0
Conv-1	55x55x96	34,848	96	34,944
MaxPool-1	27x27x96	0	0	0
Conv-2	27x27x256	614,400	256	614,656
MaxPool-2	13x13x256	0	0	0
Conv-3	13x13x384	884,736	384	885,120
Conv-4	13x13x384	1,327,104	384	1,327,488
Conv-5	13x13x256	884,736	256	884,992
MaxPool-3	6x6x256	0	0	0
FC-1	4096x1	37,748,736	4,096	37,752,832
FC-2	4096x1	16,777,216	4,096	16,781,312
FC-3	1000x1	4,096,000	1,000	4,097,000
Output	1000x1	0	0	0
Total				**62,378,344**

VGGNet



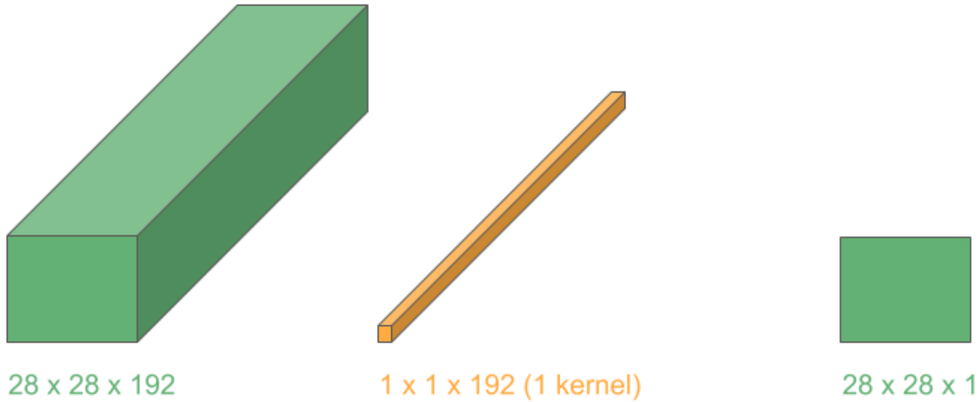
>100K
citações

138M de parâmetros!

Fonte: https://www.kaggle.com/code/blurredmachine/vggnet-16-architecture-a-complete-guide

Fonte: SIMONYAN, Karen; ZISSERMAN, Andrew. Very deep convolutional networks for large-scale image recognition. arXiv preprint arXiv:1409.1556, 2014.

GoogLeNet (Inception)



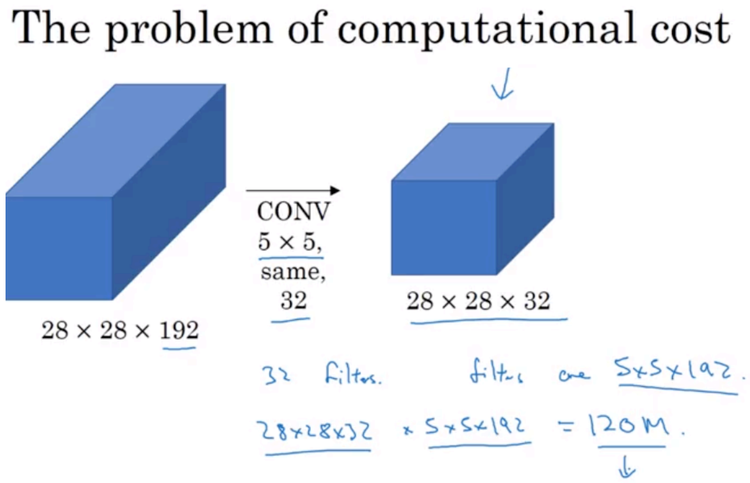
Fonte: https://www.baeldung.com/cs/ml-understanding-dimensions-cnn

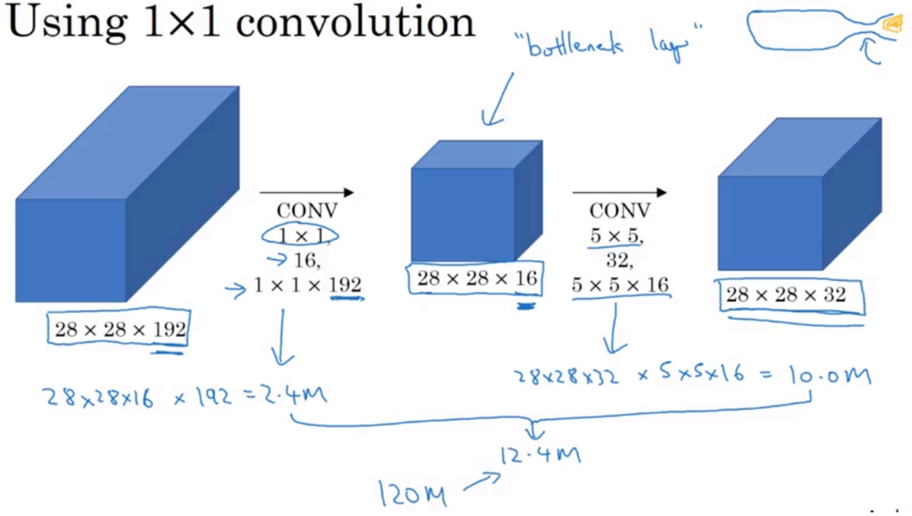
Vídeo adicional: https://youtu.be/qVP574skyuM

>49K

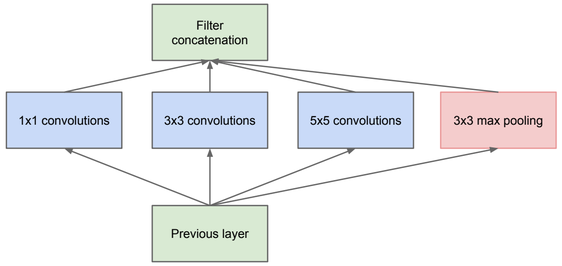
citações

Fonte: SZEGEDY, Christian et al. Going deeper with convolutions. In: Proceedings of the IEEE conference on computer vision and pattern recognition. 2015.

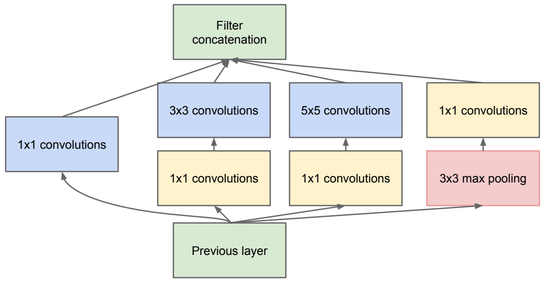




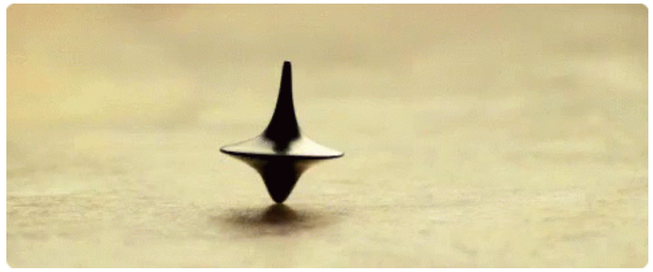
GoogLeNet (Inception)

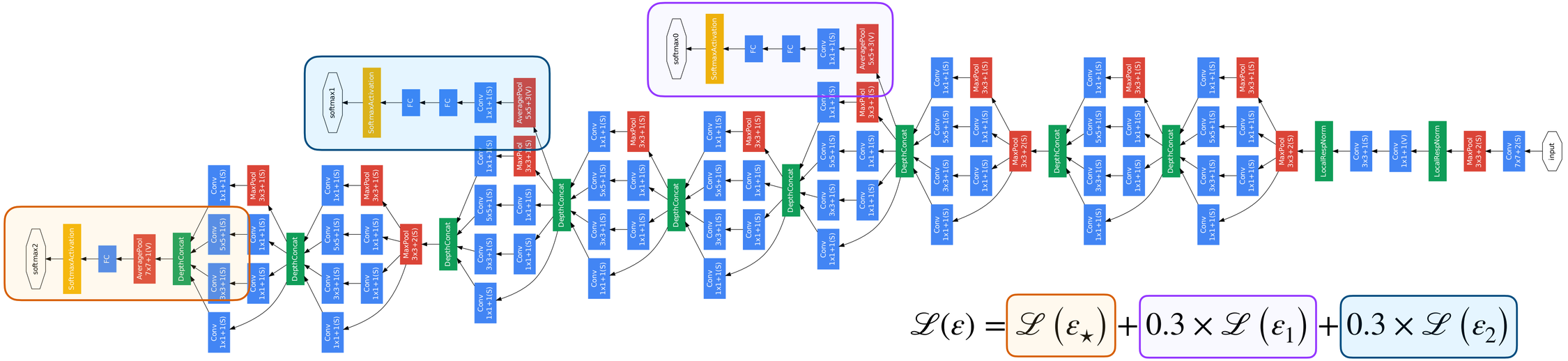


Módulo de *inception* ingênuo



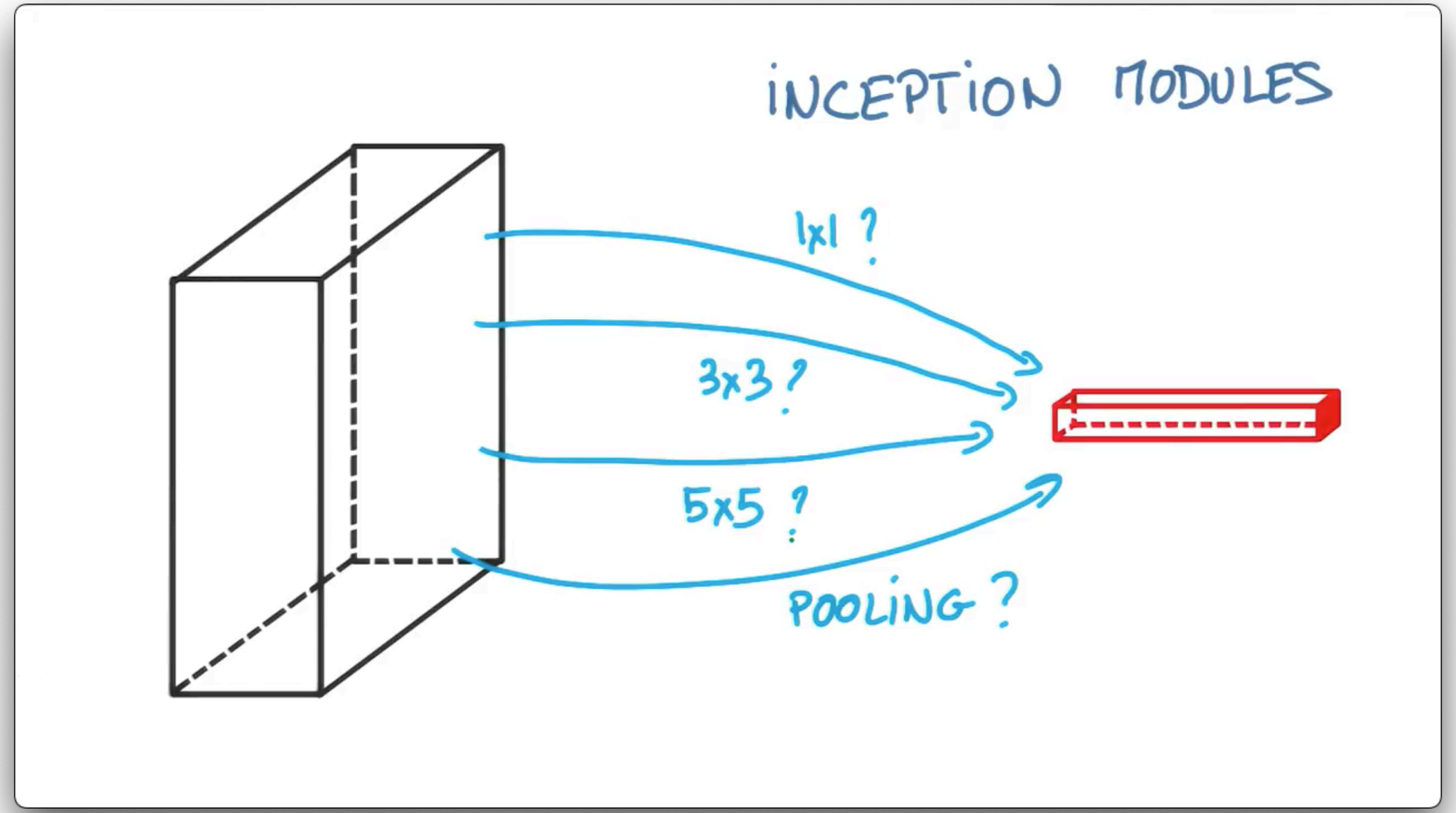
Módulo de *inception* com redução das dimensões





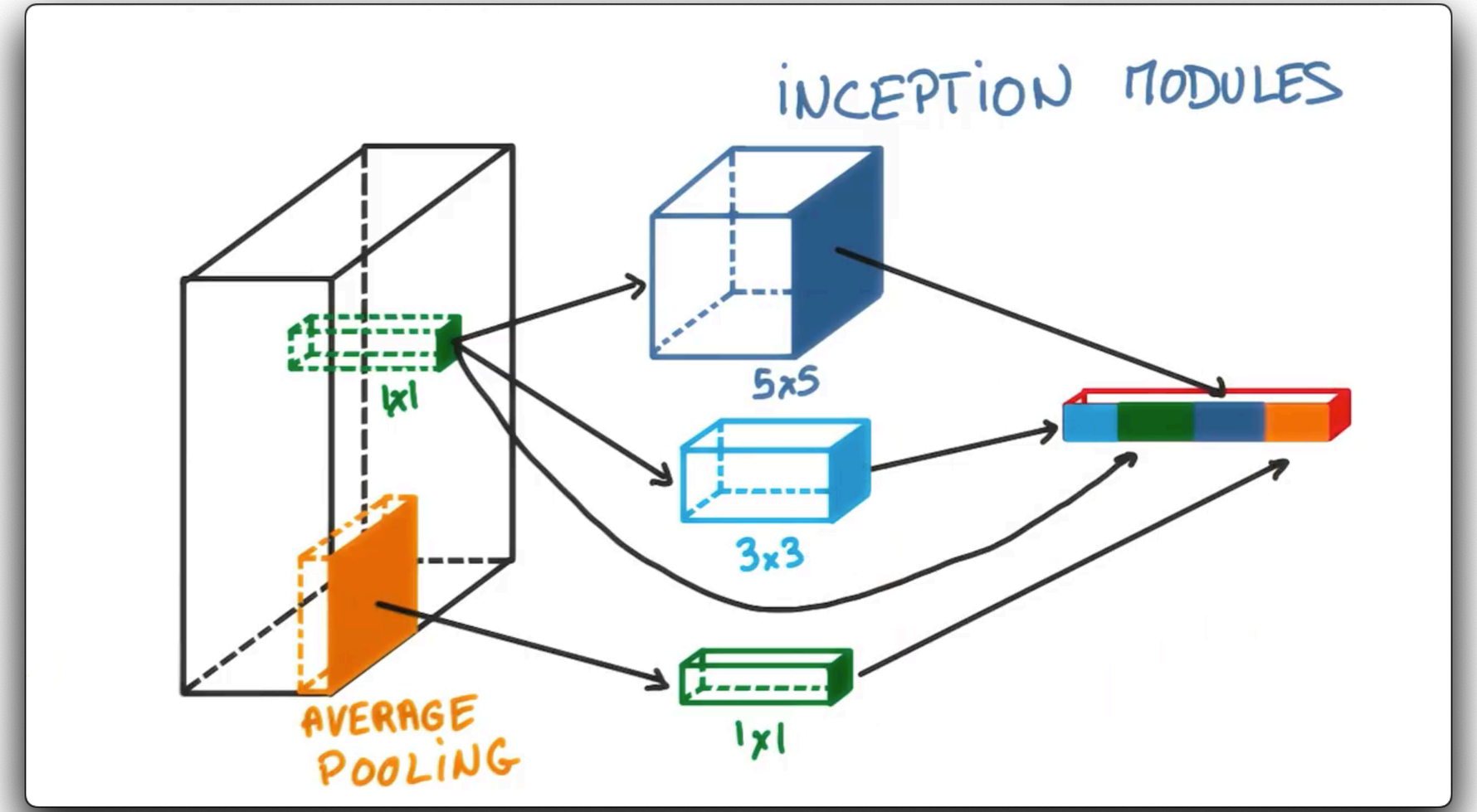
$$\mathscr{L}(\varepsilon) = \mathscr{L}\left(\varepsilon_\star\right) + 0.3 \times \mathscr{L}\left(\varepsilon_1\right) + 0.3 \times \mathscr{L}\left(\varepsilon_2\right)$$

GoogLeNet (Inception)



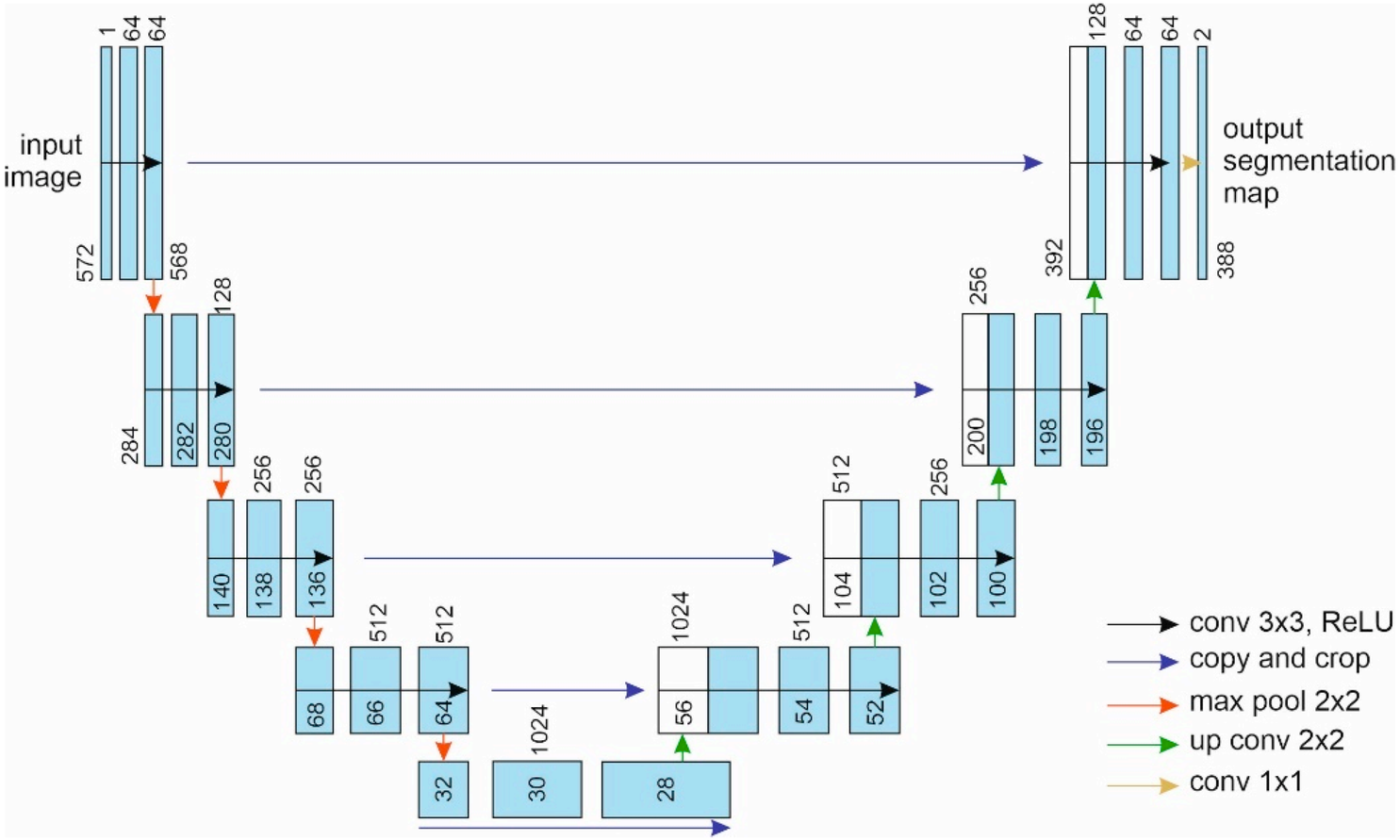
Fonte: https://www.youtube.com/watch?v=VxhSouuSZDY.

GoogLeNet (Inception)

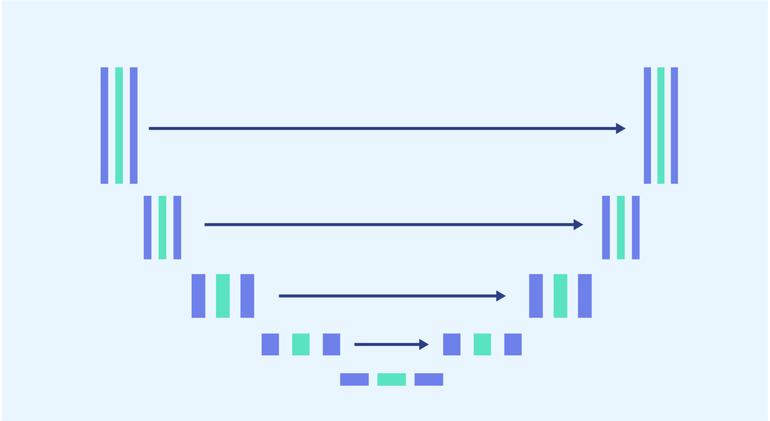


Fonte: https://www.youtube.com/watch?v=VxhSouuSZDY.

U-Net



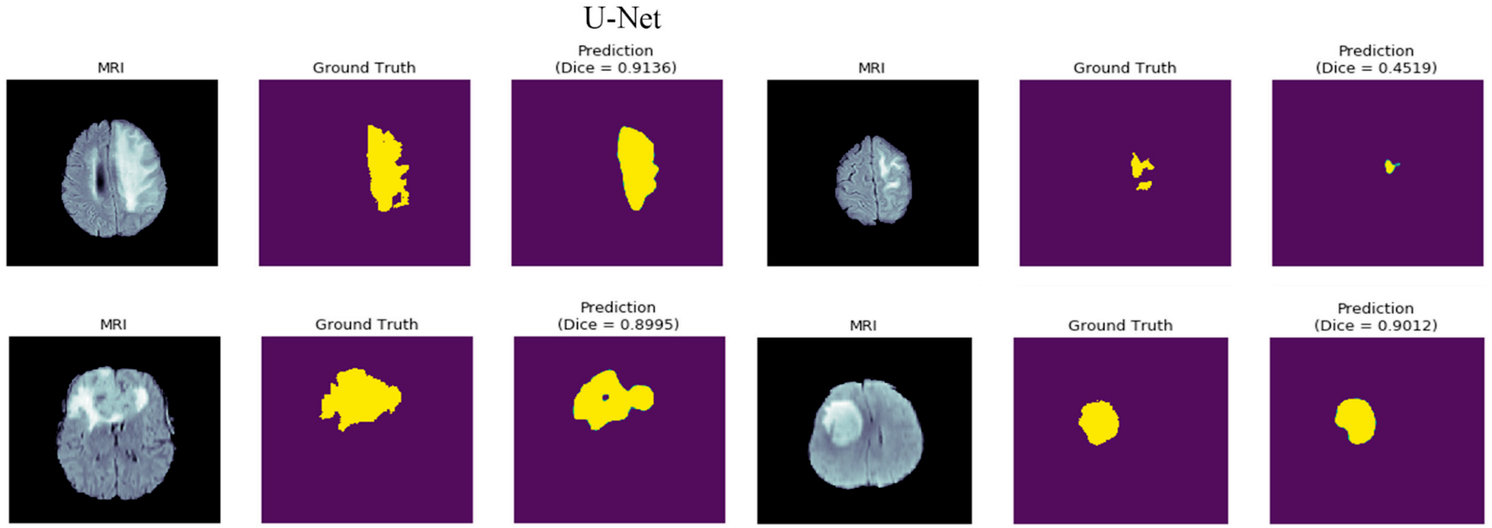
Fonte: KONOVALENKO, Ihor et al. Research of U-Net-based CNN architectures for metal surface defect detection. Machines, v. 10, n. 5, p. 327, 2022.



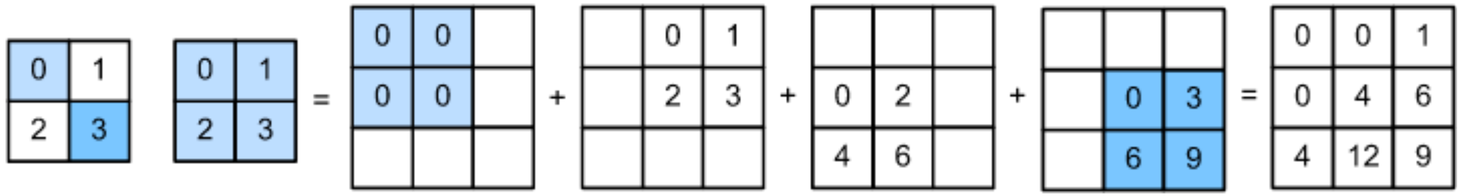
>61K
citações

Fonte: RONNEBERGER, Olaf; FISCHER, Philipp; BROX, Thomas. U-net: Convolutional networks for biomedical image segmentation. In: Medical Image Computing and Computer-Assisted Intervention–MICCAI, 2015. Springer International Publishing, 2015.

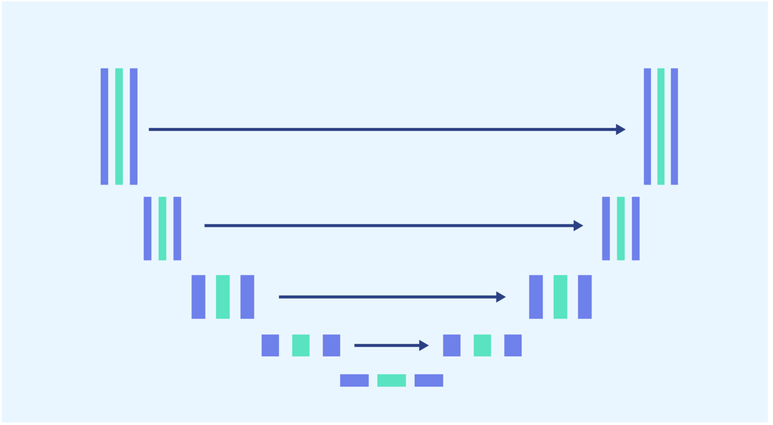
U-Net



Fonte: SD-UNET: Stripping down U-net for segmentation of biomedical images on platforms with low computational budgets. https://doi.org/10.3390/diagnostics10020110. (Adaptado).



Fonte: https://pt.d2l.ai/chapter_computer-vision/transposed-conv.html.



>61K
citações

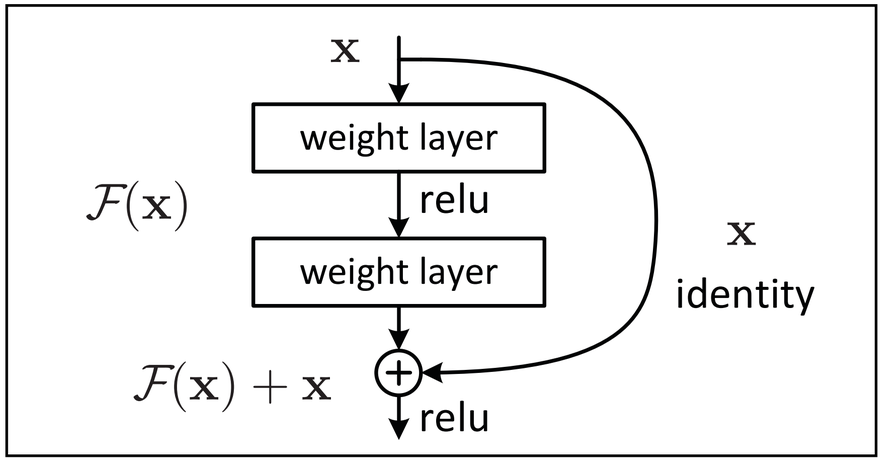
Fonte: RONNEBERGER, Olaf; FISCHER, Philipp; BROX, Thomas. U-net: Convolutional networks for biomedical image segmentation. In: Medical Image Computing and Computer-Assisted Intervention–MICCAI, 2015. Springer International Publishing, 2015.

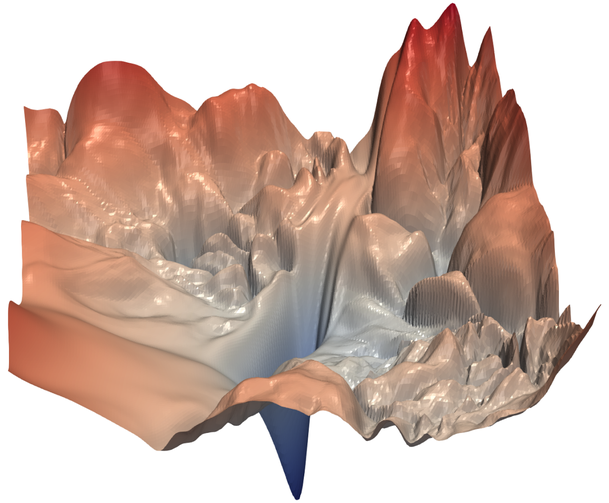
RestNet

>162K

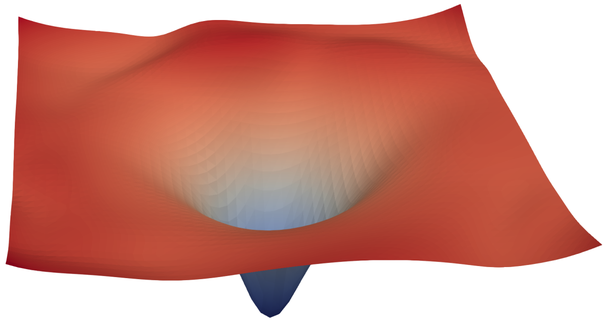
citações

Fonte: HE, Kaiming et al. Deep residual learning for image recognition. In: Proceedings of the IEEE conference on computer vision and pattern recognition. 2016.





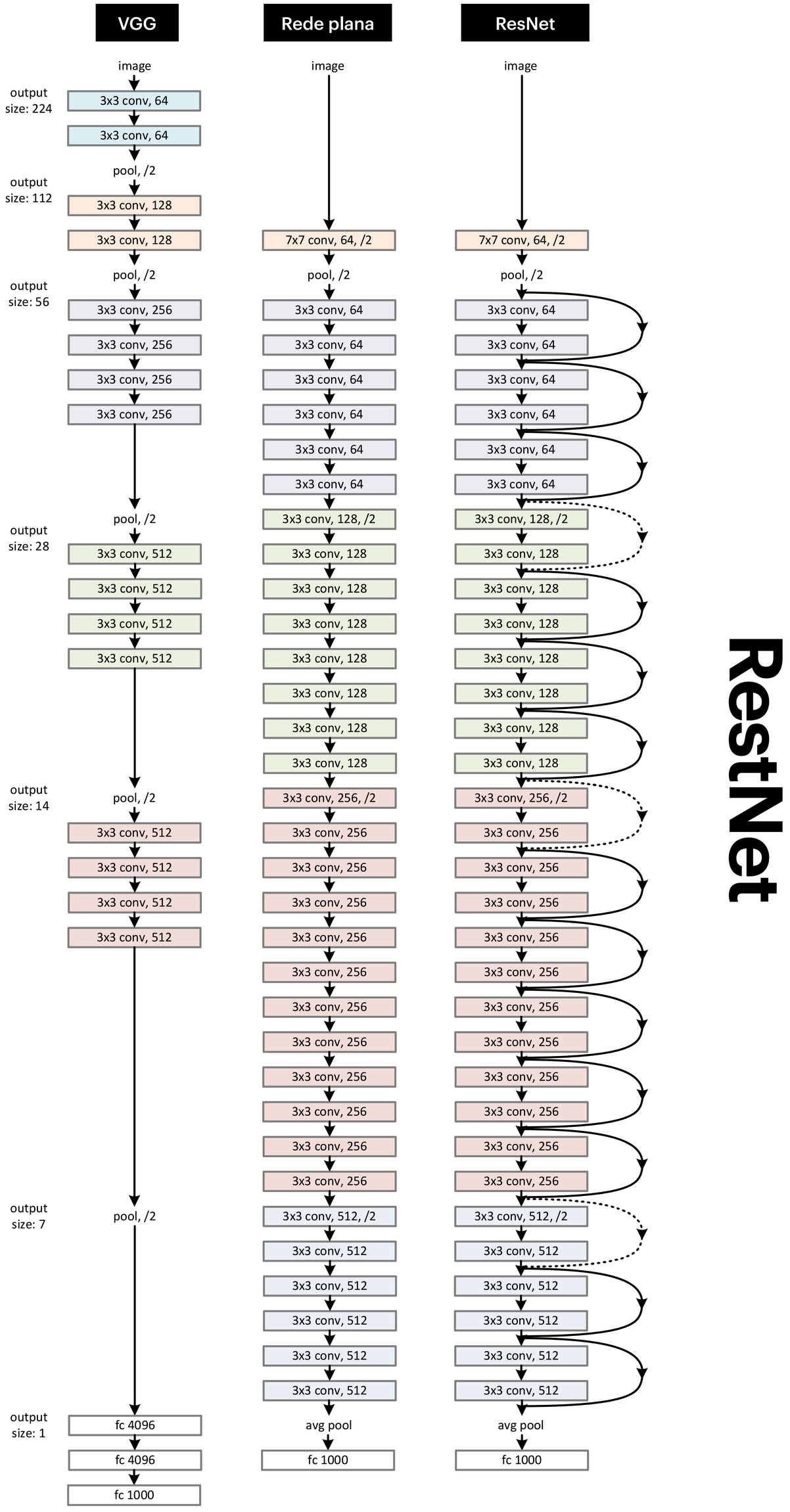
Sem conexão de travessia



Com conexão de travessia

Fonte: LI, Hao et al. Visualizing the loss landscape of neural nets. Advances in neural information processing systems, v. 31, 2018.

Em inglês, o termo é *skip connection*


VGG
Rede plana
ResNet
image
output size: 224
3x3 conv, 64
3x3 conv, 64
pool, /2
output size: 112
3x3 conv, 128
3x3 conv, 128
pool, /2
output size: 56
3x3 conv, 256
3x3 conv, 256
3x3 conv, 256
3x3 conv, 256
pool, /2
output size: 28
3x3 conv, 512
3x3 conv, 512
3x3 conv, 512
3x3 conv, 512
pool, /2
output size: 14
3x3 conv, 512
3x3 conv, 512
3x3 conv, 512
3x3 conv, 512
pool, /2
output size: 7
fc 4096
fc 4096
fc 1000
output size: 1
7x7 conv, 64, /2
pool, /2
3x3 conv, 64
3x3 conv, 128, /2
3x3 conv, 128
3x3 conv, 256, /2
3x3 conv, 256
3x3 conv, 512, /2
3x3 conv, 512
avg pool
fc 1000
RestNet

CNNs *vs* ImageNet

Ano	CNN	Desenvolvedor(es)	Posição	Taxa de erro	Nº de parâmetros
1998	LeNet	Yann LeCun et al			60K
2012	AlexNet	Alex Krizhevsky, Geoffrey Hinton, Ilya Sutskever	1º	15,3%	60M
2013	ZFNet	Matthew Zeiler and Rob Fergus	1º	14,8%	
2014	GoogLeNet	Google	1º	6,67%	4M
2014	VGG Net	Simonyan, Zisserman	2º	7,3%	138M
2015	ResNet	Kaiming He	1º	3,6%	

Fonte: https://iq.opengenus.org/evolution-of-cnn-architectures/.

Referências

- Aditya Chatterjee. **Evolution of CNN Architectures: LeNet, AlexNet, ZFNet, GoogleNet, VGG and ResNet**. https://iq.opengenus.org/evolution-of-cnn-architectures/. 2023, Acessado em mai, 2023.
- Bharath Raj. **A Simple Guide to the Versions of the Inception Network.** https://towardsdatascience.com/a-simple-guide-to-the-versions-of-the-inception-network-7fc52b863202. 2018. Acessado em mai, 2023.
- Richmond Alake. **Understanding and Implementing LeNet-5 CNN Architecture (Deep Learning)**. https://towardsdatascience.com/understanding-and-implementing-lenet-5-cnn-architecture-deep-learning-a2d531ebc342. 2020, Acessado em mai, 2023.
- Yinghan Xu. **Paper Review and Model Architecture for CNN (VGG, Inception, ResNet)**. https://medium.com/@rockyxu399/paper-review-and-model-architecture-for-cnn-classification-94972e40d96a. 2019, Acessado em mai, 2023.