Intégration des Opérateurs de la Morphologie Mathématique dans un Réseau de Neurones

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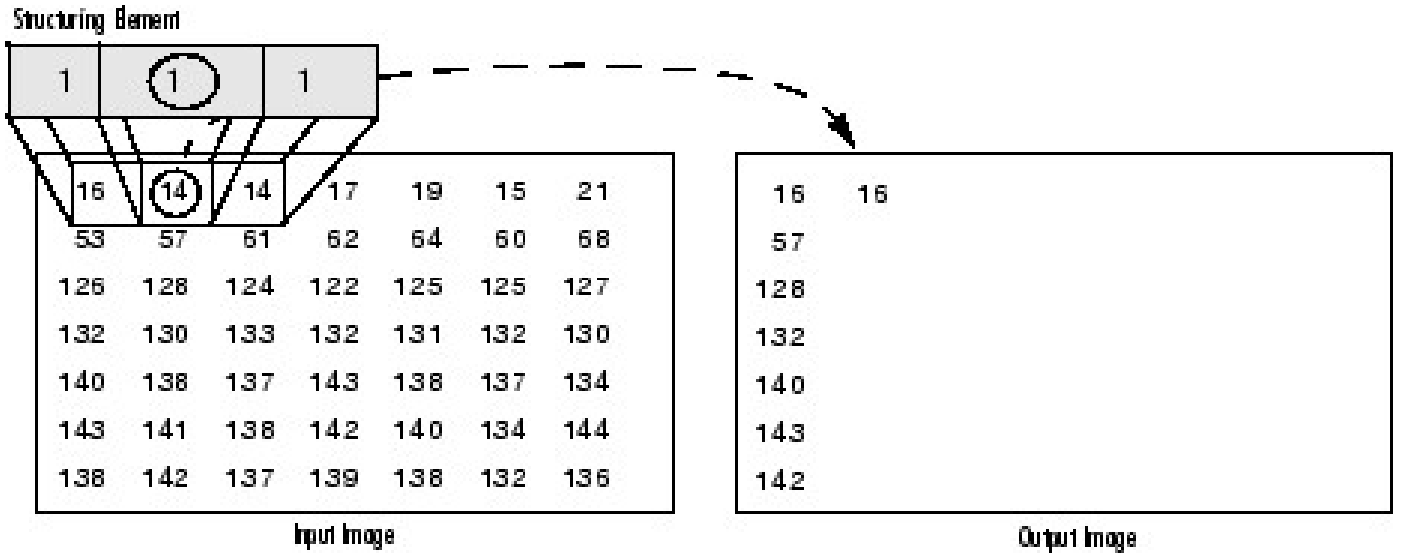
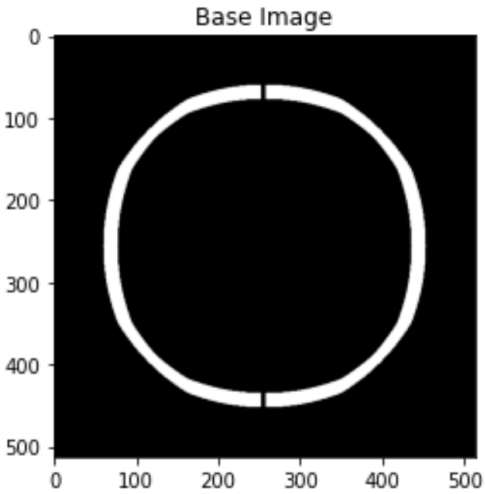
Morphologie Mathématique

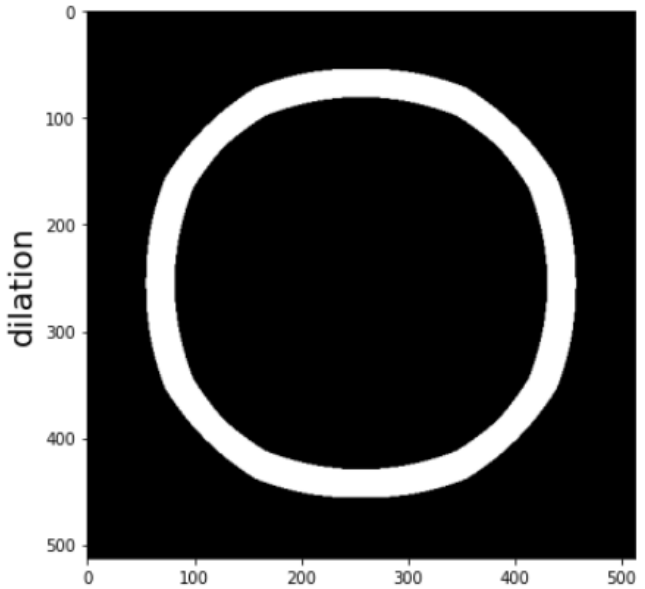
- Théorie et technique mathématique et informatique d'analyse de structures
- Application d'une matrice noyau (élément structurant)

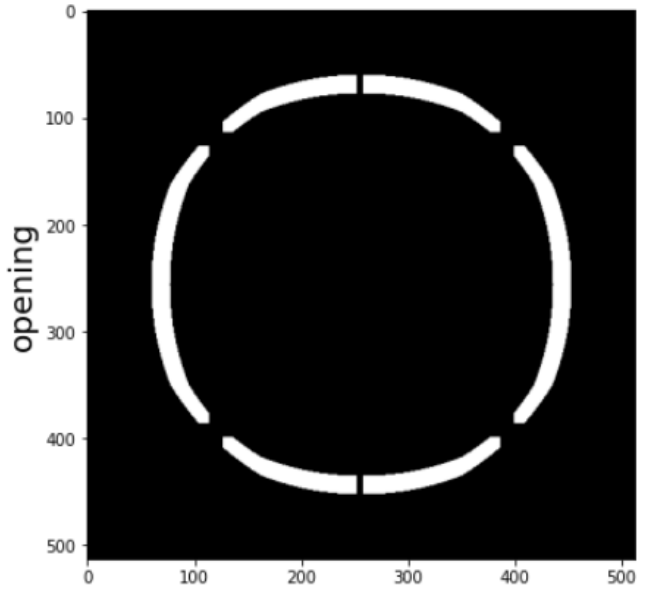


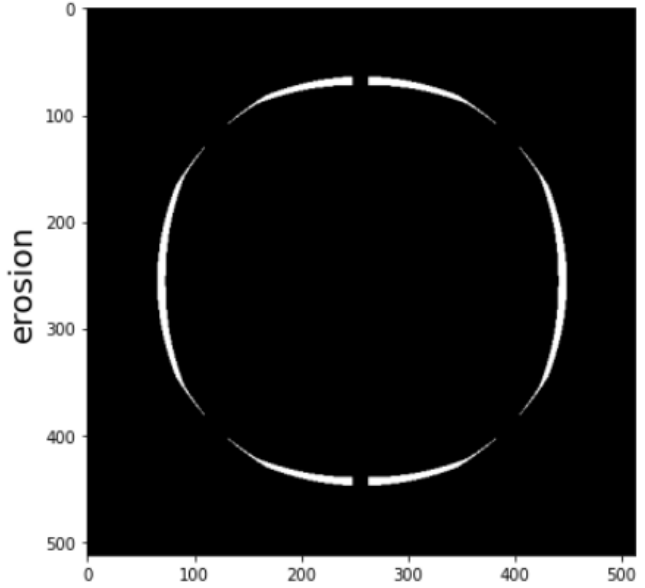
Source : Mathworks

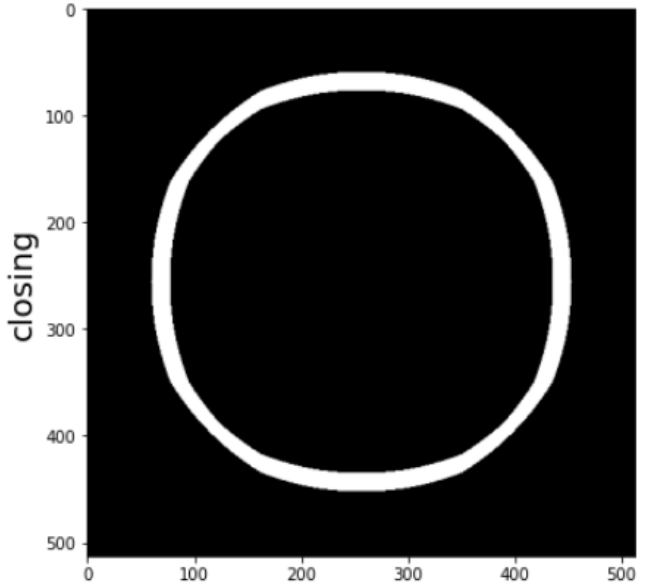
Morphologie Mathématique : Opérations de base



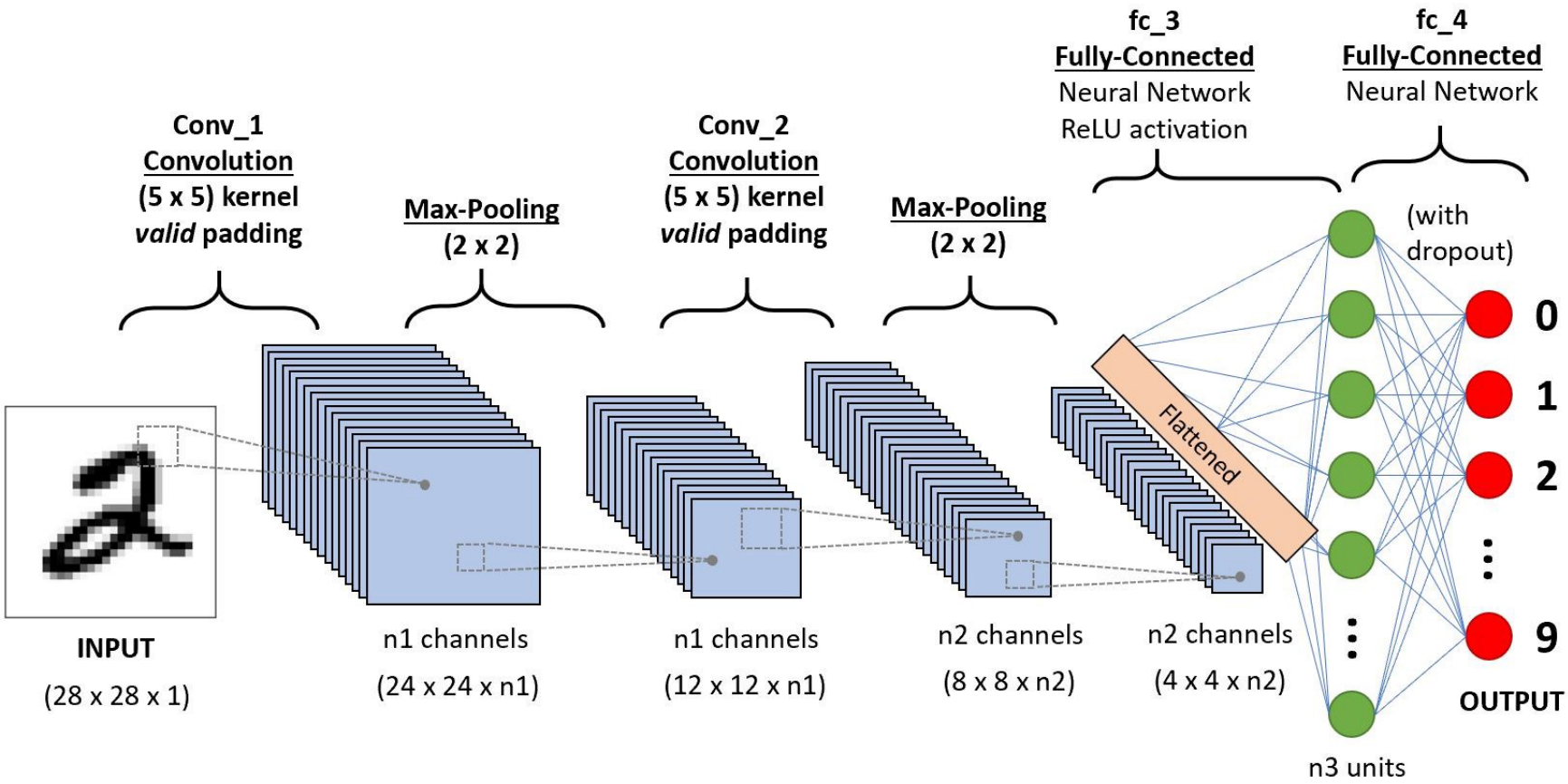






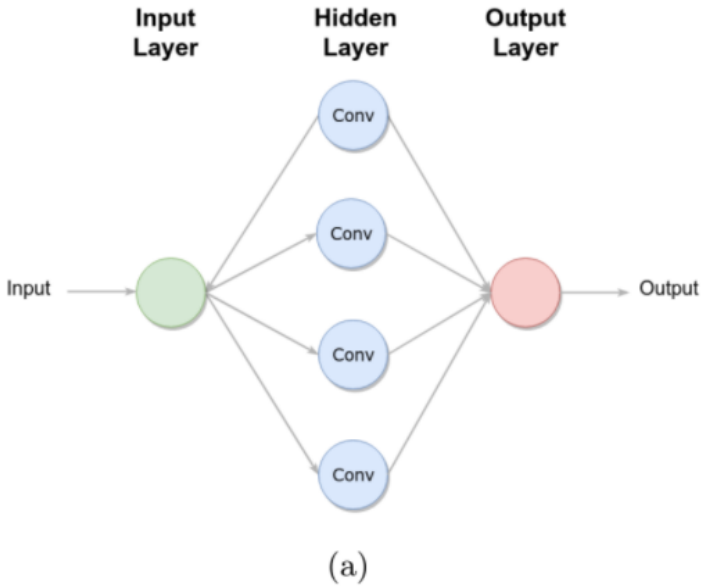


CNN

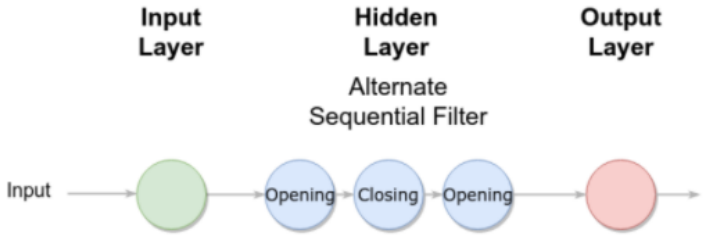


Source : Towards Data Science

Deep Morphological Networks [Franchi et al., 2020]

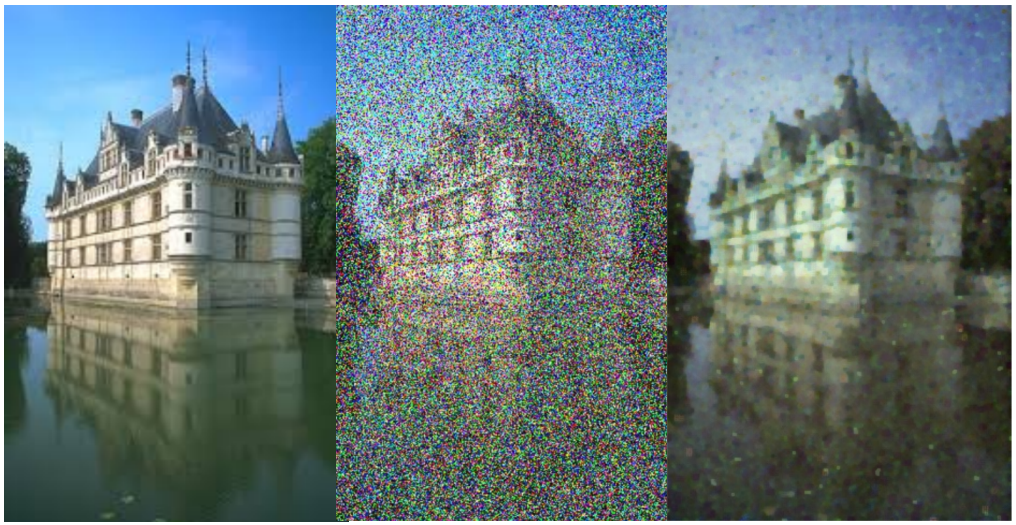


(a)



(b)

	MSE (↘)		PSNR (↗)		SSIM (↗)	
Noise level	DCNN	DMNN	DCNN	DMNN	DCNN	DMNN
10%	0.015	**0.009**	18.71	**20.89**	0.9994	**0.9995**
20%	0.022	**0.016**	16.64	**18.34**	0.9988	**0.9990**
30%	0.030	**0.022**	15.38	**16.89**	0.9980	**0.9985**
40%	0.038	**0.029**	14.35	**15.66**	0.9972	**0.9978**
50%	0.047	**0.040**	13.44	**14.26**	0.9961	**0.9966**
60%	0.058	**0.051**	12.59	**13.19**	0.9945	**0.9953**
70%	0.069	**0.063**	11.86	**12.29**	0.9930	**0.9934**
80%	0.080	**0.079**	11.25	**11.36**	0.9907	**0.9908**
90%	0.089	**0.088**	10.83	**10.85**	0.9888	**0.9894**



PConv Layer [Masci et al., 2012]

- Moyenne Contre Harmonique d'ordre p (Moyenne de Lehmer)

$$Soit\ n \in \mathbb{N},\ \forall i \in \{1, 2, ..., n\}\ et\ x_i, w_i \in \mathbb{R}^+,$$

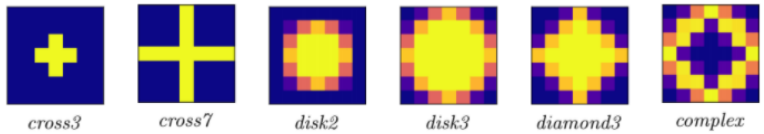
$$X := \{x_1, x_2, ..., x_n\},\ \forall p \in \mathbb{R}$$

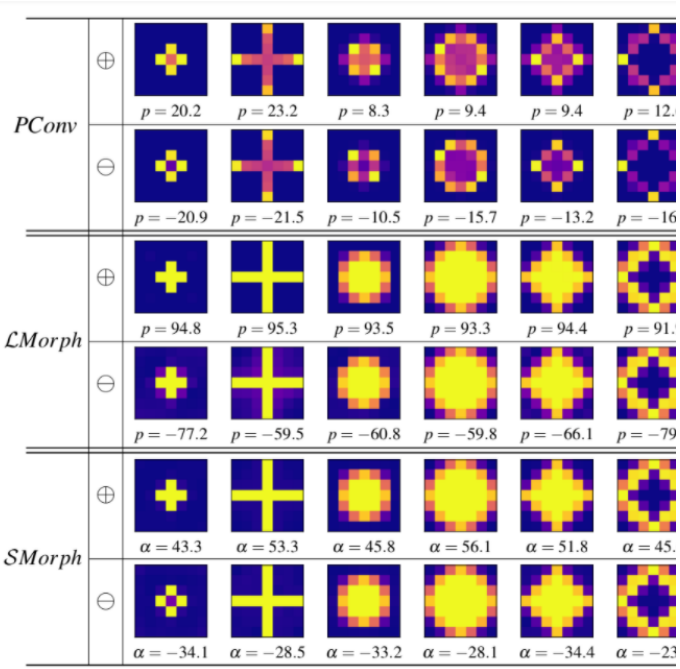
$$L_{p,w}(X) := \frac{\sum_{k=1}^{n} w_k . x_k^p}{\sum_{k=1}^{n} w_k . x_k^{p-1}}$$

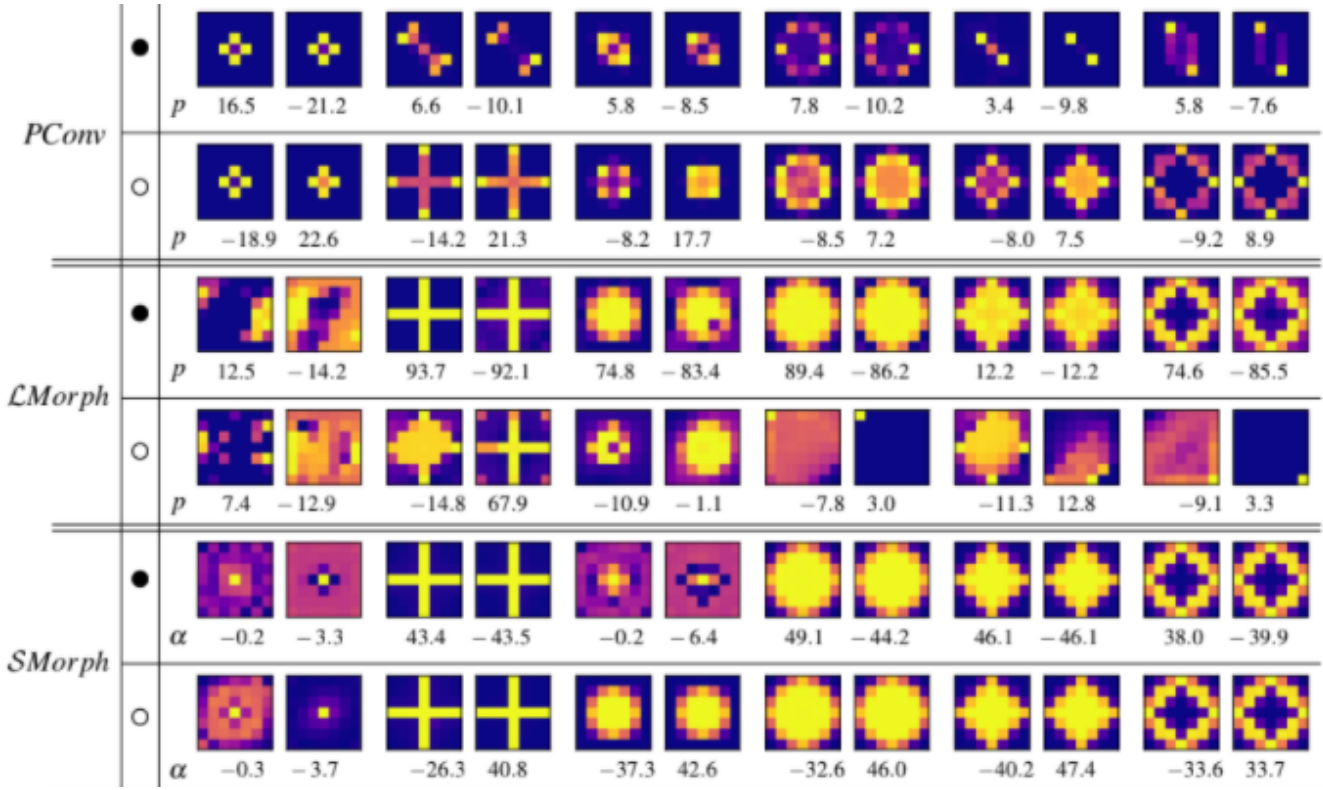
$$\lim_{p \to +\infty} (L_{p,w}(X)) = max(X),$$

$$\lim_{p \to -\infty} (L_{p,w}(X)) = min(X)$$

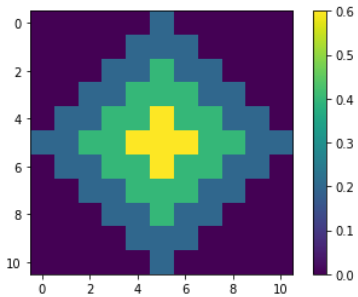
Le Sujet [Kirszenberg et al., 2021]







Travail Personnel



Projet

Travail Effectué :

- Lire et comprendre en détail les articles recommandés, chercher d'autres sources
- Découvrir les bibliothèques scikit-learn, PyTorch, CUDA
- Coder et optimiser un algorithme de MM pour un élément structurant en niveaux de gris
- Commencer à prendre en main le code et essayer de l'installer sur *node*9

Travail à venir :

- Prendre en main tout le code
  - Python (PyTorch) : 1.3k
  - C++ (CUDA, PyTorch) : 650
  - Rust : 1.7k
- Réparer tout le code
- Refaire les tests
- Contacter J. Angulo pour avoir son point de vue

Références

Franchi, G., Fehri, A., and Yao, A. (2020).
Deep morphological networks.
HAL article, HAL Id : hal-02922299.

Kirszenberg, A., Tochon, G., Puybareau, E., and Angulo, J. (2021).
Going beyond p-convolutions to learn grayscale morphological operators.
arXiv preprint arXiv:2102.10038v1.

Masci, J., Angulo, J., and Schmidhuber, J. (2012).
A learning framework for morphological operators using counter–harmonic mean.
arXiv preprint arXiv:1212.2546v1.