Comment développer des outils d'apprentissage automatique pour les géosciences ?

Un aperçu de différents usages de réseaux de neurones convolutifs.

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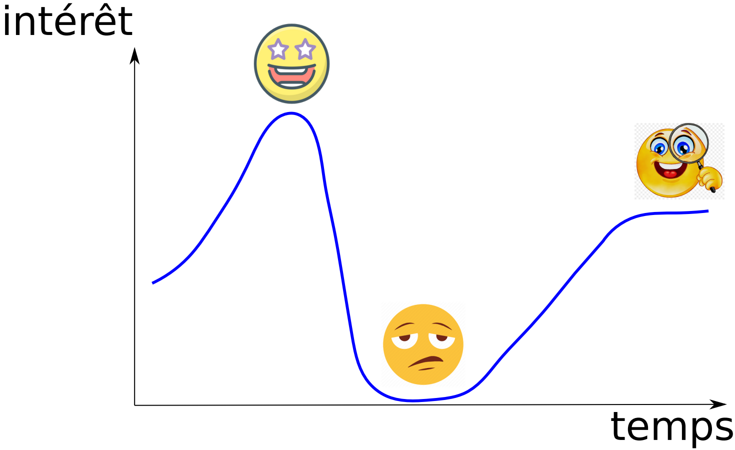
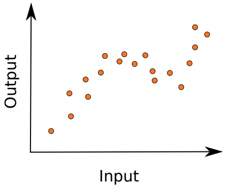
Intérêt des géoscientifiques pour l'IA / machine learning



Machine learning: what is it?

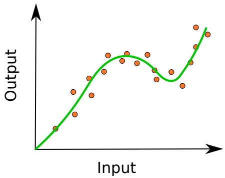
1) database collection

Use information from existing examples ...



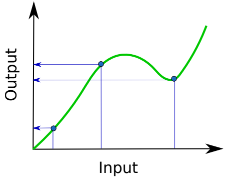
2) training

... to learn from them patterns or relations ...

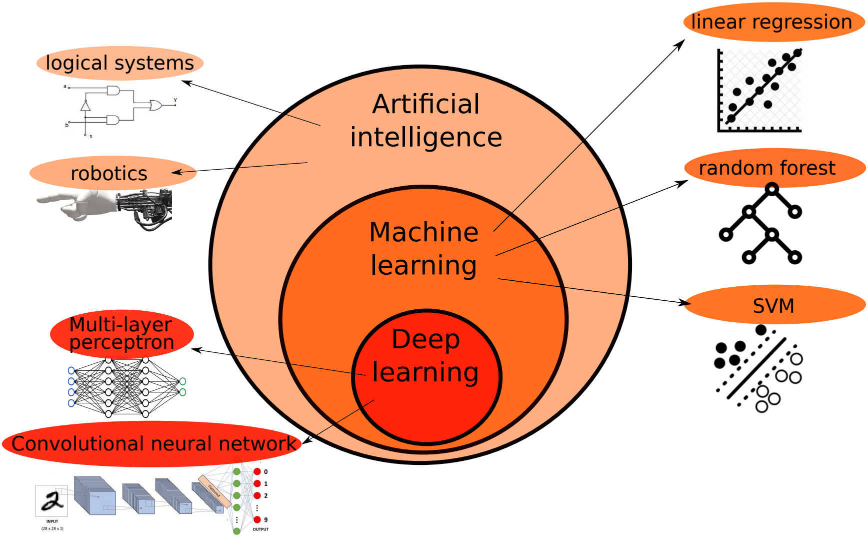


3) prediction

... that can then be applied to new examples



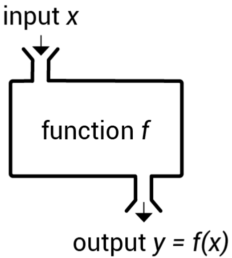
Artificial Intelligence and Machine learning



Machine learning: what for?

- *Big data*: data is often easy to collect
- But we don't always know the relations between variables (ex. physics)
- ML = algorithm that will learn from the data directly

Machine learning model = function approximation



Where is it used today?

Natural language processing: translation

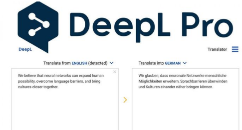


Image detection

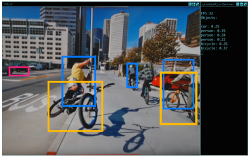
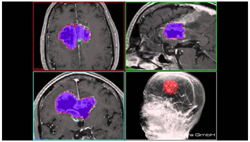
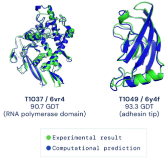


Image segmentation



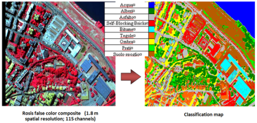
Personalised advertising

Protein unfolding

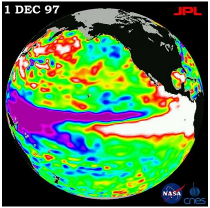


And in geosciences?

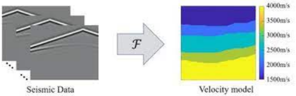
Remote sensing processing



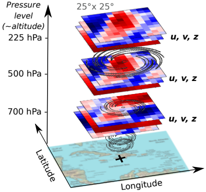
El nino prediction



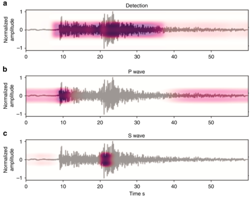
Seismic inversion



Tropical cyclone trajectory prediction



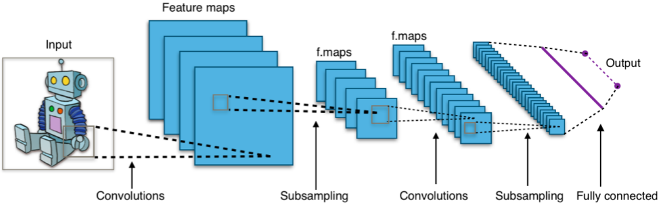
Earthquake detection



Outline

Convolutional neural network

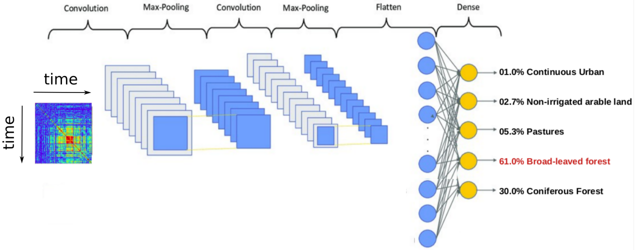
$$f_\theta(img) = output$$



- Suited for image-like data
- Non-linear/complex relationships

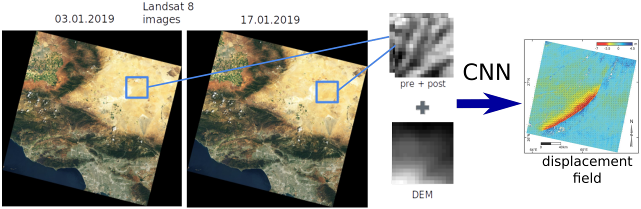
Temporal coherence InSAR matrix classification

Marie-Pierre Doin, Salah-Eddine Boudaour (M2)



Optical image correlation for deformation estimation

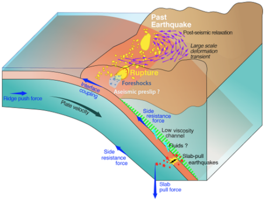
James Hollingsworth, Tristan Montagnon



Outline

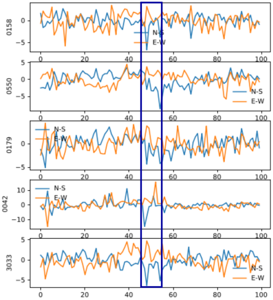
GPS time series for characterizing earthquakes (and SSEs)

ERC Deep-Trigger - Anne Socquet

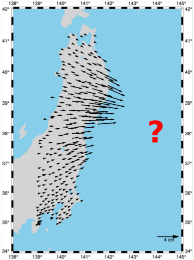


Giuseppe Costantino (PhD)

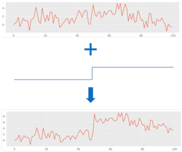
GPS time series for characterizing earthquakes (and SSEs)



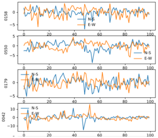
- location
- magnitude



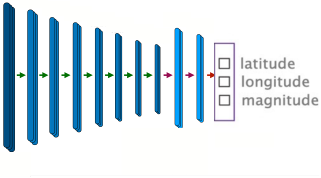
- Learn from synthetic database (20 K samples)
- Okada dislocation model + realistic noise



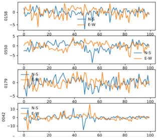
Data: list of time series



–> 1D convolutional n. network



Data: list of time series



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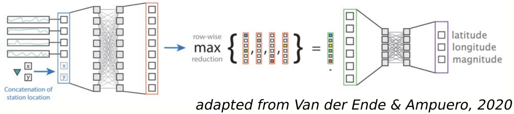
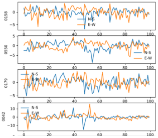
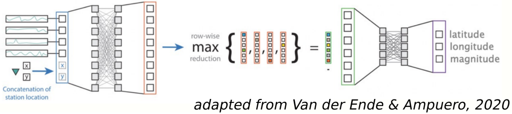


adapted from Van der Ende & Ampuero, 2020

Data: list of time series

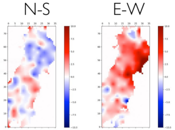


–> 1D convolutional n. network

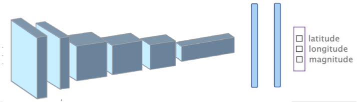


adapted from Van der Ende & Ampuero, 2020

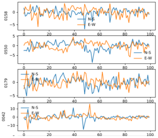
interpolated images



–> 2D convolutional n. network



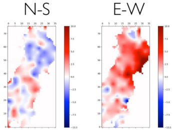
Data: list of time series



–> 1D convolutional n. network

adapted from Van der Ende & Ampuero, 2020

interpolated images



–> 2D convolutional n. network

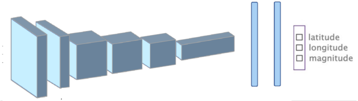
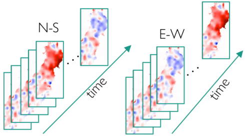
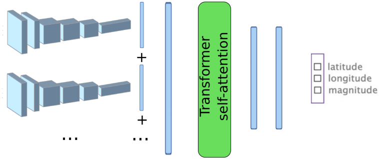


image time series



–> 2D CNN + transformer



Suite de la session:

- Introduction et machine learning pour problèmes 2D

- **Detection de séismes (1D CNN) et interprétabilité**

  Josipa Majstorović

- **Détection de signaux sismologiques précoces par IA**

  Kevin Juhel

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