Utilizing GitHub and Introduction to Programming in Geophysics

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Live Forum Github (HMGI)
Himpunan Mahasiswa Geofisika Indonesia

HIGHLIGHT

- What is GitHub? Know Git first!
- GitHub features, let’s Practice
- Basic Python Programming (if necessary)
- Programming in Geophysics: Convolution

COURSE REQUIREMENTS

- GitHub Account
- Python 3
- PyCharm IDE

NECESSITY OF VERSION CONTROL SYSTEM (VCS)

- Tracking the changes (version) of source code: what, who, when
- Facilitating better collaborative work
- Return to previous version

- Example: git is an open source, distributed version control system designed for speed and efficiency

WHAT IS GitHub?

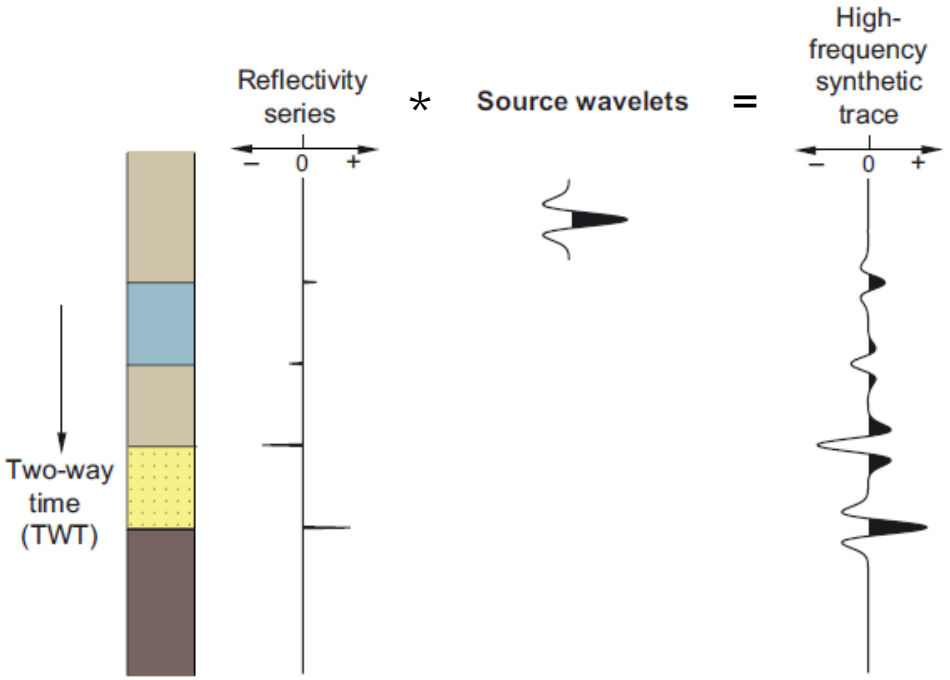
- Provider of Internet hosting for software development and version control using Git
- Cloud provider for storing and managing git project (repository)

TERMINOLOGY

- Repository: directory of the project containing source code files
- Commit: snapshot of changes in the source code
- Branch: subsidiary of free commit
- Merge: combine two branch
- Push: sent commit to repo
- Remote: source of repo which stored online
- Clone: copy repository to local machine
- Fork: copy repository from another GitHub account
- Pull Request: receive / admit commit from other GitHub account

(*) CONVOLUTION IN GEOPHYSICS

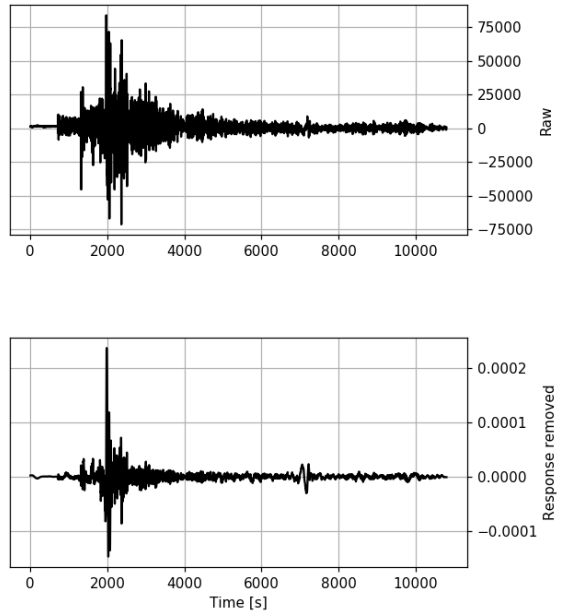
- Synthetic Seismic Trace



(Dentith and Mudge, 2014)

- Instrument Remove Response

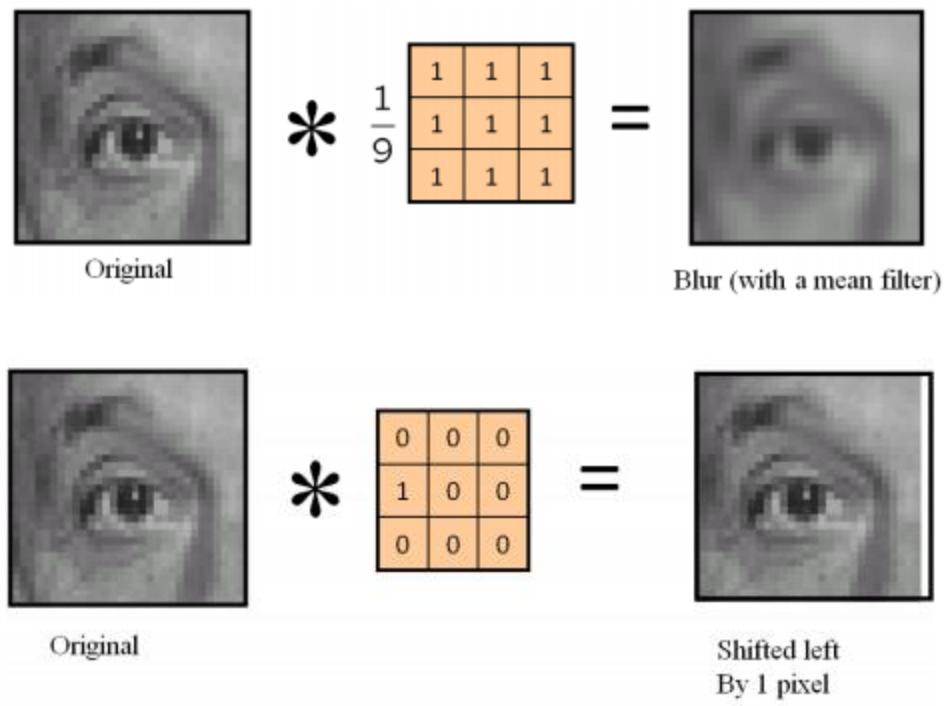
$$x(t) * i(t) = y(t)$$



(ObsPy Documentation 1.2.0)

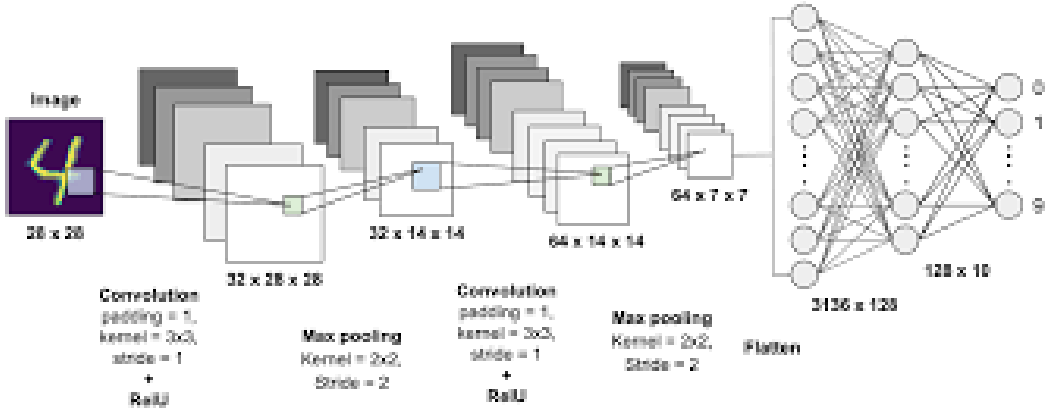
CONVOLUTION APPLICATION

- Image Processing (w/ kernel matrix)



(http://www.cs.cornell.edu) CS1114

- Foundation of Convolutional neural network (CNN)

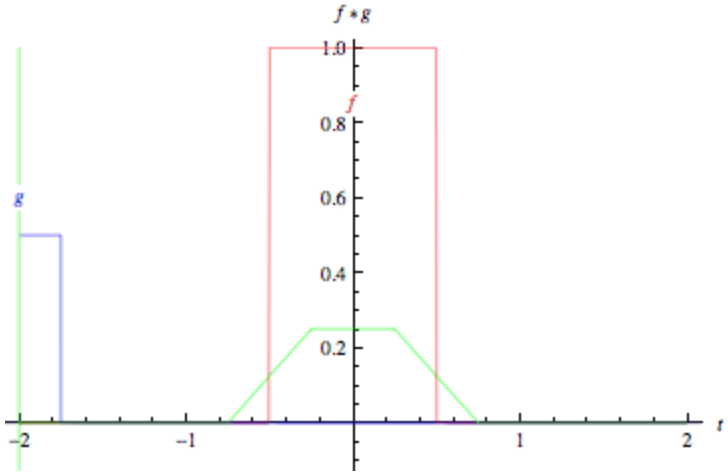


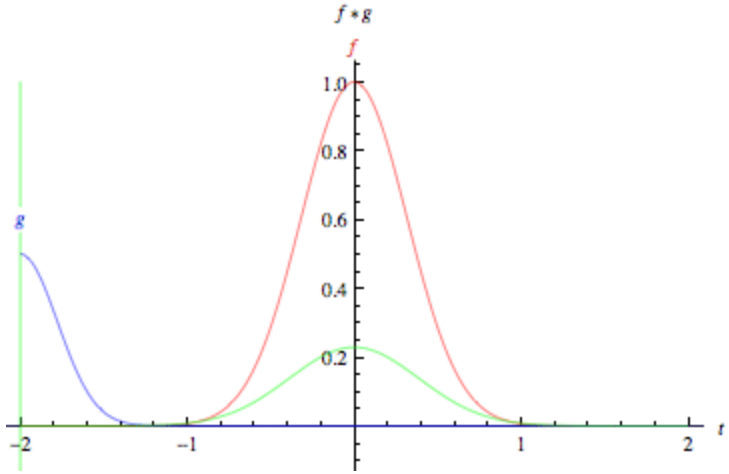
(https://towardsdatascience.com)

CONVOLUTION REVIEW

$$f(t) * g(t) = \int_{-\infty}^{\infty} f(\tau)\, g(t-\tau) d\tau$$

Convolution of two continuous function





https://mathworld.wolfram.com/Convolution.html

CONVOLUTION IN DISCRETE WORLD

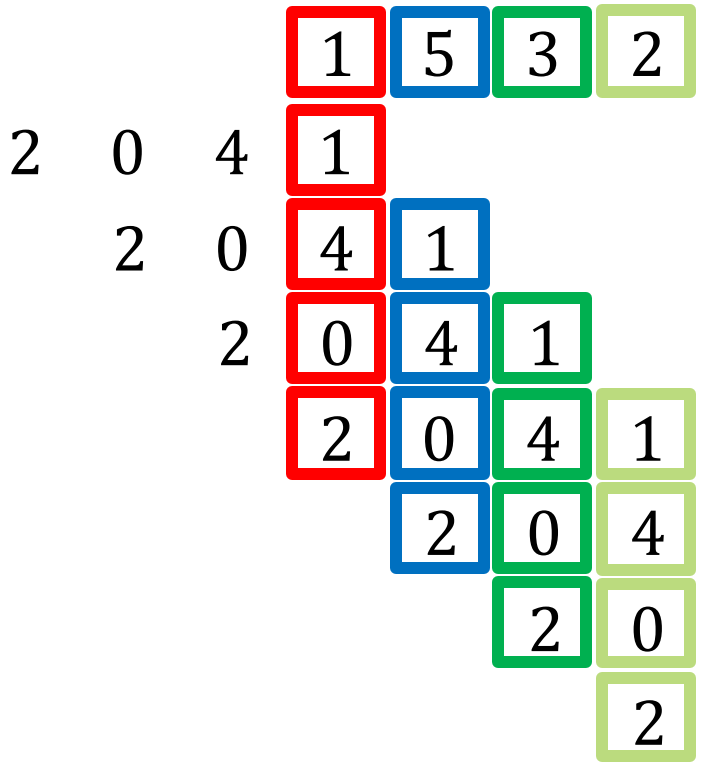
$$(f * g)[n] = \sum_{m=-M}^{M} f[n]\, g[n-m]$$

Convolution of two vectors (1D array)

1. Flip one vector
2. Shift flipped vector along the other
3. Product the intersection
4. Sum the product

EXAMPLE

$$[1\ 5\ 3\ 2] * [1\ 4\ 0\ 2]$$



$$= (1 \times 1) = 1$$

$$= (1 \times 4) + (5 \times 1) = 9$$

$$= (1 \times 0) + (5 \times 4) + (3 \times 1) = 23$$

$$= (1 \times 2) + (5 \times 0) + (3 \times 4) + (2 \times 1) = 16$$

$$= (5 \times 2) + (3 \times 0) + (2 \times 4) = 18$$

$$= (3 \times 2) + (2 \times 0) = 6$$

$$= (2 \times 2) = 4$$

$$[1\ 5\ 3\ 2] * [1\ 4\ 0\ 2] = [1 \quad 9 \quad 23 \quad 16 \quad 18 \quad 6 \quad 4]$$

(Pranowo, *Geophysics Signal Analysis Lecture*)

EXAMPLE

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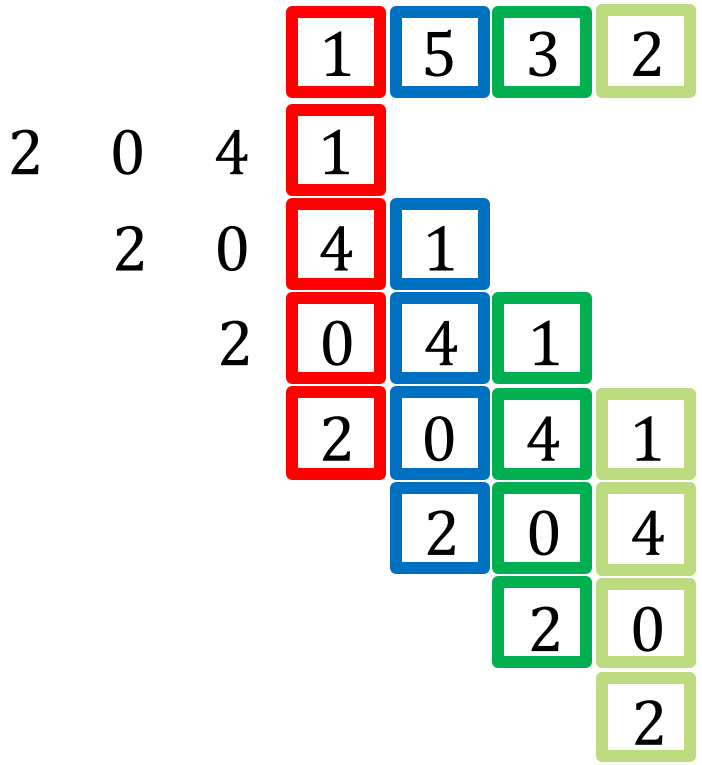

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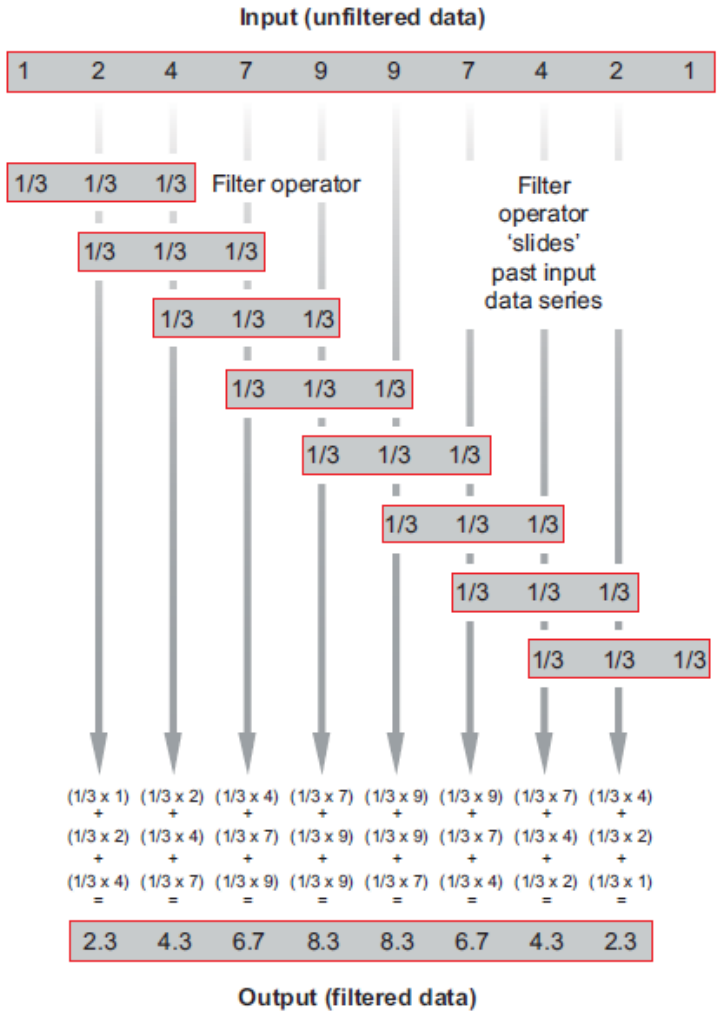
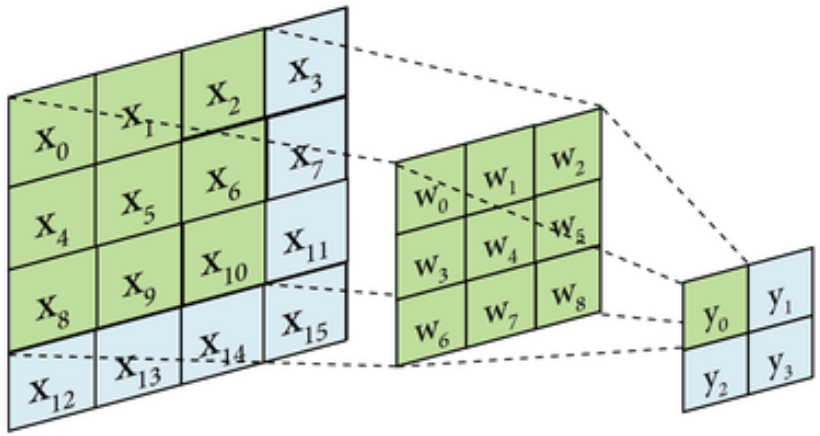
CONVOLUTION FOR FILTER OPERATION



- Moving Average: Convolve input data with kernel matrix which contain same value (1/window length)
- 1D Derivative: Convolve vector with kernel matrix [1/2, 0, -1/2]

2D CONVOLUTION



(Mosser et.al, 2018)

- Convolution of two Matrix (2D array)