# Reproducibility checklist: pre-screen your Deep Learning experiment prior to your submission or publication!

## Checklist Strategies to Improve the Reproducibility of Deep Learning Experiments with an Illustration

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### Reproducibility and Replicability (R&R):

The challenges of Reproducibility and Replicability have become a focus of attention in order to promote **open and accessible research**. Therefore, efforts have been made to develop good practices for R&R in the area of computer science. Nevertheless, **Deep Learning** (DL) based experiments **remain difficult to reproduce** by others due to the complexity of these techniques. In addition, several challenges concern the use of massive and heterogeneous data that contribute to the complexity of this R&R.

### Checklist:

We compiled a checklist (Table 1) with the most relevant items for Reproducibility to improve DL experiments.

This checklist is useful for: an **author reporting on an experiment**, and/or a **reviewer seeking to qualify the scientific contributions** of the work.

This table is based on state-of-the-art guidelines from Pineau's Machine Learning checklist [2], the recommendations from Renard's [3], and the FAIR sub-principles (Hartley & Olsson) [4]. Besides that, we organized these criterias according to a DL workflow.



**User 1** is the person who reports on his/her experiment (writes it down) and wants to achieve reproducibility of his/her work.

**User 2** is the person who reads a paper out of interest (e.g., a reviewer) and wants to check the validity or quality of the paper.

### How to use?

We report a review of the reproducibility of three publications for Poverty estimation using DL and Remote sensing imagery. For each experiment, we identified the methods and workflows used, if the experiments were not fully reproducible. Although the three use cases were proposed for a specific task (poverty estimation), we believe that the evaluation methods could be applied to more general Deep Learning tasks, where difficulties might include (a) a lack of dataset specificity (and the metadata related with it), (b) inadequate description of the DL methodology, (c) the implementation methodology, and the infrastructure used. We also feel that these recommendations can be extended to other domains such as medical, climatic, biodiversity, industrial, military, etc.

| The description of the dataset | The description of the DL architecture and hyper-parameter optimisation process |
|---|---|
| ☐ Are there relevant statistics? | ☐ Is there a clear description of the mathematical and/or DL model? |
| ☐ Is the dataset open access? | ☐ Does the paper use a Cross-Validation strategy? |
| ☐ Are there clear details of training / validation / test splits? | ☐ Is there a clear explanation of assumptions? |
| ☐ Is there an explanation of any data that was excluded, and all pre-processing steps? | ☐ Is there an analysis of the complexity of any algorithm? |
| ☐ Is there a link to a downloadable version of the dataset or simulation environment? | ☐ Does the paper use an Optimization procedure? Which one? |
| ☐ For new data collected, is there a complete description of the data collection process? | ☐ Were the Hyper-Parameters handcrafted (selected manually)? |
| **FAIR sub-principles (Findability, Accessibility, Interoperability, Reusability)** | ☐ Does the paper clearly mention the use of Learning rate? |
| ☐ Are (Meta)data assigned with a globally unique and persistent identifier? (F1) | ☐ Does the paper clearly mention the use of Batch size? |
| ☐ Are data described with rich metadata? (F2) | ☐ Does the paper use Dropout regularization? |
| ☐ Are (Meta)data retrievable by their identifier using a standardized communications protocol? (A1) | ☐ Are there a clear description of hyper-parameters? |
| ☐ Do (Meta)data include qualified references to other (meta)data? (I3) | ☐ Is there an exact number of training and evaluation runs? |
| ☐ Are Metadata richly described with a plurality of accurate and relevant attributes? (R1) | **The infrastructure and implementation** |
| ☐ Are (Meta)data associated with detailed provenance? (R1.2) | ☐ Does the paper detail the infrastructure adequately? |
| **Reported experimental results and theoretical claim** | ☐ Which framework was used? |
| ☐ Is there a clear measure or statistics used to report results? | **The shared code** |
| ☐ A description of results with central tendency & variation | ☐ Is the shared code Open source? |
| ☐ The average runtime for each result, or estimated energy cost | ☐ Is there a specification of dependencies? |
| ☐ Is there a clear statement of the claim? | ☐ Is there a training code? |
| ☐ Is there a complete proof of the claim? | ☐ Is there an evaluation code? |
| | ☐ Is there a (Pre-)trained model(s)? |
| | ☐ Is there a README file? |

**Table 1:** Compiled **Checklist** from Machine Learning checklist Pineau, (2020) [2], the recommendations from Renard et al, 2020 [3], and the FAIR sub-principles (following Hartley & Olsson 2020) [4] aiming to pre-screening Deep Learning experiments to achieve Reproducibility.
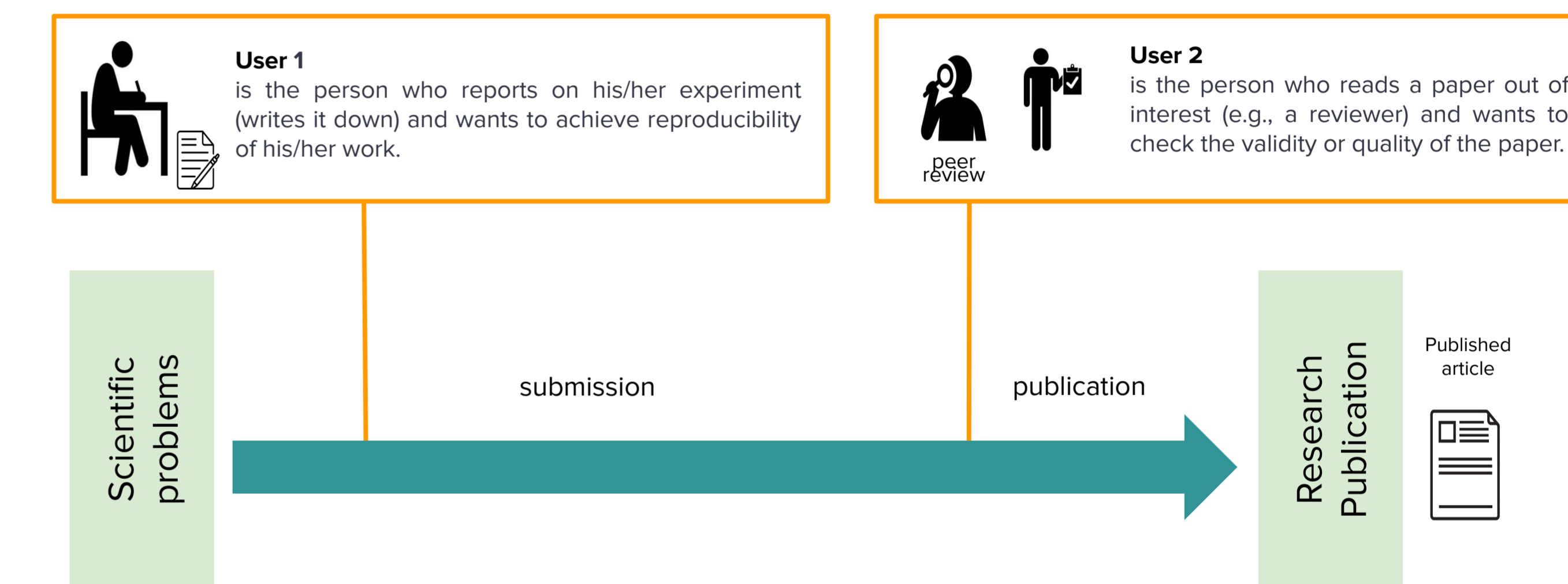
**References**:
[1] Peng, R. D. (2011), Reproducible Research in Computing Science. Science 334, 1226–1227.

[2] Pineau, J. (2020b). The Machine Learning reproducibility checklist (v2.0, Apr.7 2020). www.cs.mcgill.ca/~jpineau/ReproducibilityChecklist-v2.0.pdf

[3] Renard, F., Guedria, S., Palma, N.D., & Vuillerme, N. (2020). Variability and reproducibility in deep learning for medical image segmentation. Scientific Reports 10(1), 1–16.

[4] Hartley, M., & Olsson, T. S. G. (2020), dtoolAI: Reproducibility for Deep Learning. Patterns 1(5), 100073.

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