



From Code to Paper: Translating ML Experiments into Research Contributions

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- **Why Convert Code to Research?**
- **The Research Process in AI/ML**
- **Where Research Thrives**
- **Writings the paper**

Why Convert Code to Research?



Research Paper matters !!!!

Why Convert Code to Research?



- ❑ Publishing research gives credibility to your work.
- ❑ Helps advance the field of AI/ML.
- ❑ Essential for academic and industry recognition.
- ❑ Connect with like-minded researchers and experts.
- ❑ Research papers help secure funding for further research.

The Research Process in AI/ML



Paper = Claim + Evidence + Story (Table and Graphs)

Three Level Of AI Modeling



Level 1 (Fine Tuning)

Implement/Lego-build a well-understood model, train the model, evaluate its performance and tune the model hyper-parameters (e.g., # of layers/neurons, change types of activation, etc.)

Three Level Of AI Modeling



Level 1 (Fine Tuning)

```
import torch.nn as nn

model = nn.Sequential(
    nn.Linear(8, 12),
    nn.ReLU(),
    nn.Linear(12, 8),
    nn.ReLU(),
    nn.Linear(8, 1),
    nn.Sigmoid()
)
```

You can easily tune this model:

- change # of layers
- change type of layers from linear to conv
- change # of neurons in each layer
- ...

Three Level Of AI Modeling



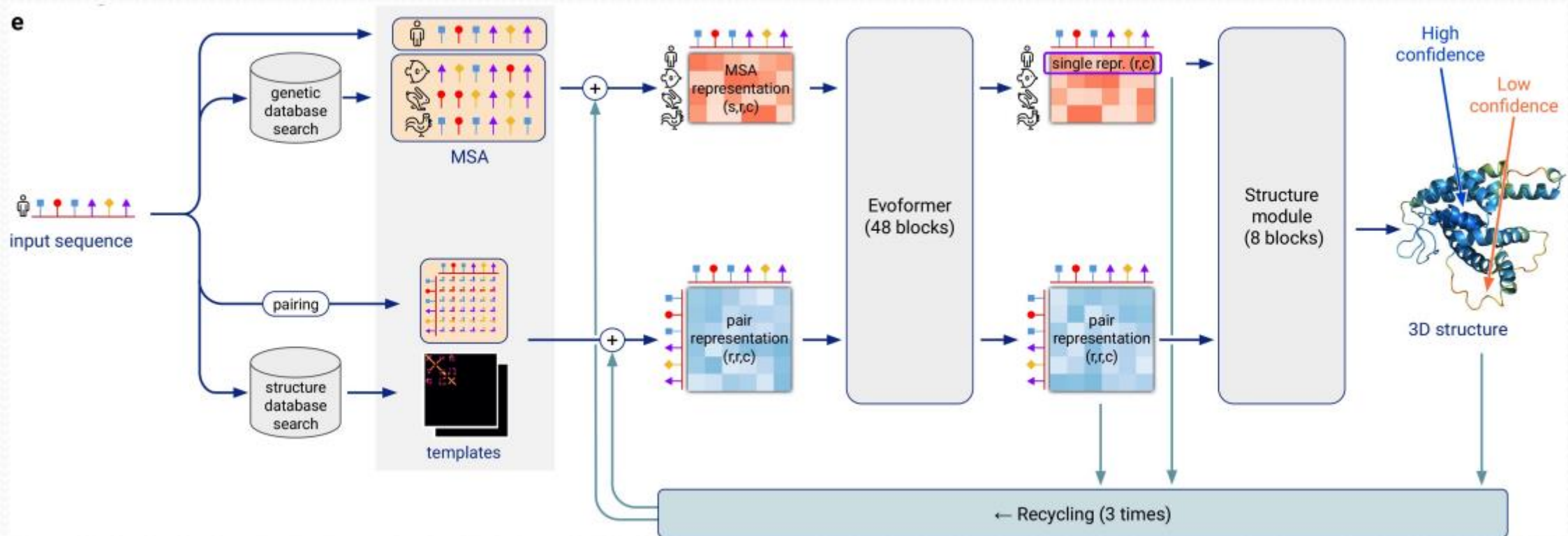
Level 3 (Advanced Modeling)

Develop large-scale, very complex models, in which you may need to code many components from scratch using only the basic operators from the DL framework.

Three Level Of AI Modeling



Level 3 (Advanced Modeling)



Three Level Of AI Modeling



Level 2 (More than Fine Tuning !!!)

Make significant modification to a model (more than the tuning in level 1). Develop customized models, components (classes) and operators for the underlying DL framework

From level 1 to level 2



- ☐ Identify Model Limitations
- ☐ Modify Model Architecture
- ☐ Develop **custom loss functions** for better optimization
- ☐ Modify the **forward and backward propagation logic** if necessary

You have to understand the model well

We have the Story (Table and Graph)



- ☐ Claims
- ☐ Evidence
- ☐ Tables and graphs (story)



Work Backward !!!!

- ❑ Clearly define the **problem**, key variables, and mathematical notation.
- ❑ Introduce any **symbols** or conventions used throughout the paper.
- ❑ Understanding the Problem (Qualitative Analysis)
- ❑ Building on Previous Ideas
- ❑ Key Insight of Your Approach (Overview)
- ❑ Algorithm Description (Pseudo-Code)
- ❑ Clearly state any assumptions made in your approach.
- ❑ Address the limitations and possible edge cases where the method may struggle.

Evidence (Experimental Study)



- ☐ Goal of the experiment (Clearly define the research questions or hypotheses being tested)
- ☐ Experiment structure (Outline how the experiments are designed)
- ☐ Describe the datasets used for evaluation.
- ☐ List the baseline algorithms or models used for benchmarking.
- ☐ Results of the experiments
- ☐ Discussion of the results

Claim (Introduction + Background)



- ☐ Goal of the experiment (Clearly define the research questions or hypotheses being tested)
- ☐ Explain the significance of solving this problem and its impact on real-world applications.
- ☐ Provide a brief summary of existing research and approaches in this domain.
- ☐ Highlight gaps in the current methods and their limitations.
- ☐ State the key contribution of your research and what makes it different.

Claim (Introduction + Background)



- ❑ Summarize the experimental setup and evaluation methods to support your claim.
- ❑ Clearly outline the main takeaway from your research—no suspense, be direct.
- ❑ Describe the level of understanding in the field and recent advancements.
- ❑ Discuss prior research efforts and methodologies relevant to the problem.
- ❑ Explain why current solutions are inadequate and how your approach improves upon them.

Current state of knowledge about the problem (Background)

- Review of existing work
- Existing solutions and their shortcomings

Claim (Abstract)



- ☐ Provide a brief background of the topic to set the context.
- ☐ Clearly state the problem and why it is important.
- ☐ Highlight the research gap or limitations of existing solutions.
- ☐ Define the main objective or purpose of the study.
- ☐ Briefly describe the methodology used in the research.
- ☐ Summarize key findings and results from the experiments.
- ☐ Discuss the significance and implications of the results.
- ☐ Conclude with how the study contributes to the field and future research directions.

References



<https://web.engr.oregonstate.edu/~tgd/talks/new-in-ml-2019.pdf>



Discussion...

If you have any questions, please ask!