Deep learning

2.4. Proper evaluation protocols

François Fleuret
https://fleuret.org/dlc/
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Running 100 times the MNIST experiment, with randomized weights, we get:

<table>
<thead>
<tr>
<th></th>
<th>Worst</th>
<th>Median</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.3%</td>
<td>1.0%</td>
<td>0.82%</td>
</tr>
</tbody>
</table>
The ideal development cycle is

[Diagram: Write code → Train]
The ideal development cycle is

Write code → Train → Test
The ideal development cycle is

Write code → Train → Test → Paper
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Write code → Train → Test → Paper

or in practice something like

Write code → Train → Test → Paper → Write code
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Write code → Train → Test → Paper

or in practice something like

Write code → Train → Test → Paper

There may be over-fitting, but it does not bias the final performance evaluation.
Unfortunately, it often looks like

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![Diagram](image)

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When data is scarce, one can use cross-validation: average through multiple random splits of the data in a train and a validation sets.
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There is no unbiased estimator of the variance of cross-validation valid under all distributions (Bengio and Grandvalet, 2004).
Some data-sets (MNIST!) have been used by thousands of researchers, over millions of experiments, in hundreds of papers.
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The global overall process looks more like

```
Write code → Train → Test → Paper
```

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“Cheating” in machine learning, from bad to “are you kidding?”:

• “Early evaluation stopping”,
• meta-parameter (over-)tuning,
• data-set selection,
• algorithm data-set specific clauses,
• seed selection.
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- “Early evaluation stopping”,
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- seed selection.

Top-tier conferences are demanding regarding experiments, and are biased against “complicated” pipelines.

The community pushes toward accessible implementations, reference data-sets, leader boards, and constant upgrades of benchmarks.
The end
References