

## Checklist

### 1. For all authors...

- (a) Do the main claims made in the abstract and introduction accurately reflect the paper’s contributions and scope? [Yes]

**In our view both the abstract and introduction accurately reflect the paper as a whole.**

- (b) Did you describe the limitations of your work? [Yes]

**One limitation is that the proposed models are not universal function approximators; see section 3.1. Another limitation is that the linear model seems to outperform the rank-one quadratic model; we do not fully understand this effect, as discussed in the last paragraph of section 4. A third limitation is that models need to be averaged across time to obtain a single, deployable model: see Figure 5. A final limitation is that we do not yet have convergence theorems or regret bounds for the passive-aggressive updates in these models; see the second paragraph of section 5.**

- (c) Did you discuss any potential negative societal impacts of your work? [Yes]

**See the penultimate paragraph of section 5.**

- (d) Have you read the ethics review guidelines and ensured that your paper conforms to them? [Yes]

**The paper conforms to all of the published guidelines. The proposed method is evaluated on a data set that was made publicly available for research and that has not been associated with any personally identifiable or sensitive information.**

### 2. If you are including theoretical results...

- (a) Did you state the full set of assumptions of all theoretical results? [Yes]

**The paper contains no proofs, but several calculations. Every attempt was made to state the full set of assumptions behind each calculation (e.g., the footnote on page 5).**

- (b) Did you include complete proofs of all theoretical results? [Yes]

**The calculations should provide enough details to be followed and reproduced by a typical reader. In general where further details might help, the reader is referred to existing papers that provide them; see section 3 before eq. (??). One exception is that we omitted the derivation of eq. (??), which is a tedious (but not difficult) exercise in basic calculus and linear algebra. The paper is intended to be complete without a supplementary appendix.**

### 3. If you ran experiments...

- (a) Did you include the code, data, and instructions needed to reproduce the main experimental results (either in the supplemental material or as a URL)? [Yes]

**As part of the supplemental material we have submitted code and instructions to reproduce the main experimental results.**

- (b) Did you specify all the training details (e.g., data splits, hyperparameters, how they were chosen)? [Yes]

**We explained carefully how all models were initialized. The passive-aggressive updates in this paper do not involve learning rates, momentum parameters, or mini-batch sizes. There were no data splits: the models were evaluated in an online manner over an extremely large number (100M) of distinct examples. The averaged models were sampled at regular intervals of 50K training examples.**

- (c) Did you report error bars (e.g., with respect to the random seed after running experiments multiple times)? [N/A]

**We verified that the results on 10M examples were not materially different for five**

**different values of the random seed; this is reported in section 4. But we were not able to experiment with multiple seeds on the full data set of 100M examples.**

- (d) Did you include the total amount of compute and the type of resources used (e.g., type of GPUs, internal cluster, or cloud provider)? [Yes]

**See the footnote in section ??.**

4. If you are using existing assets (e.g., code, data, models) or curating/releasing new assets...

- (a) If your work uses existing assets, did you cite the creators? [Yes]

**The paper cites the researchers [? ? ] that introduced the INFIMNIST and MNIST data sets into the public domain.**

- (b) Did you mention the license of the assets? [N/A]

**These data sets appear to be distributed without a license.**

- (c) Did you include any new assets either in the supplemental material or as a URL? [Yes]

**We include sample code in the supplemental material.**

- (d) Did you discuss whether and how consent was obtained from people whose data you're using/curating? [N/A]

**The data sets that we use have been in the public domain for a long while.**

- (e) Did you discuss whether the data you are using/curating contains personally identifiable information or offensive content? [N/A]

**The data does not contain any personally identifiable information or offensive content.**

5. If you used crowdsourcing or conducted research with human subjects...

- (a) Did you include the full text of instructions given to participants and screenshots, if applicable? [N/A]

**This work did not use crowdsourcing or conduct research with human subjects.**

- (b) Did you describe any potential participant risks, with links to Institutional Review Board (IRB) approvals, if applicable? [N/A]

**This work did not use crowdsourcing or conduct research with human subjects.**

- (c) Did you include the estimated hourly wage paid to participants and the total amount spent on participant compensation? [N/A]

**This work did not use crowdsourcing or conduct research with human subjects.**