1.

Data size	Configuration	Training error	Validation error	Time of execution
1000	1 hidden layer 4 nodes	0.0004	0.0004	246.11
10000	1 hidden layer 4 nodes	0.0004	0.0004	237.40
100000	1 hidden layer 4 nodes	0.0004	0.0004	235.19
1000	2 hidden layers of 4 nodes each	0.0005	0.0005	293.67
10000	2 hidden layers of 4 nodes each	0.0005	0.0005	294.95
100000	2 hidden layers of 4 nodes each	0.0005	0.0005	293.98

2.

The model with one hidden layer containing four nodes demonstrates the best performance among all deep learning models tested. The model with one hidden layer of four nodes produces training and validation errors at 0.0004 which outperforms the model with two hidden layers of four nodes which reaches 0.0005 regardless of data size. The single hidden layer model outperforms the two-layer model regarding computational efficiency because its execution times decrease as data size increases (246.11s to 235.19s) while the two-layer model maintains execution times around 294 seconds. The training and validation errors show no change when data sizes vary for each architecture because both models have achieved their maximum

performance potential yet the single hidden layer model delivers superior accuracy at a lower computational cost.

3.

Method used	Dataset size	Testing-set predictive performance	Time taken for the model to be fit
XGBoost in Python via scikit-learn and 5-fold CV	1000	0.9530	0.19
	10000	0.9766	0.54
	100000	0.9871	2.69

XGBoost demonstrates superior performance than the deep learning models based on the results achieved for this problem. XGBoost proved better than deep learning models by showing higher predictive performance as the dataset size grew. It obtained 0.9530 validation accuracy for 1000 observations and 0.9766 accuracy for 10000 observations as well as 0.9871 accuracy for 100000 observations. XGBoost outperforms deep learning models in terms of efficiency because it completes the three dataset sizes in 0.19, 0.54, and 2.69 seconds while deep learning models take 235-295 seconds regardless of architecture or data size. The evaluation indicates that XGBoost sets itself apart with two leading advantages: better learning capacity and scalability that yields 0.9871 prediction accuracy plus 100 times quicker performance relative to deep learning models. The combination of outstanding performance and efficiency makes XGBoost the optimal solution for this specific problem.