Supplementary Material – MCFlow: Monte Carlo Flow Models for Data Imputation

1 Additional Quantitative Experiment Results

Tables 1 and 2 depict the training performance of competing methods for imputation of data missing completely at random (MCAR) on image datasets. It is worthwhile to note that, when operating on incomplete training data sets, existing imputation methods report performance on the training set itself [29] or are unclear about the way the training/test partition is performed [12]. Since there is no standard training/test partition for Celeb-A, we abstain from presenting results on that dataset. Table 3 depicts performance on the test set for competing methods on the image datasets from the perspective of peak signal-to-noise ratio (PSNR).

Table 1 Imputation Training Results on Image Datasets - RMSE (lower is better)

	Missing Rate →	.1	.2	.3	.4	.5	.6	.7	.8	.9
	GAIN	.09102	.09694	.10787	.10992	.12438	.13901	.14734	.17209	.27108
MNIST	MisGAN	.11771	.10909	.11267	.11200	.12091	.13369	.15465	.19635	.27842
	MCFlow	**.07409**	**.07899**	**.08497**	**.09203**	**.10080**	**.11305**	**.13073**	**.15897**	**.20801**
	GAIN	.10248	.12542	.13176	.11562	.12158	.12800	.13459	.18598	.53676
CIFAR-10	MisGAN	.18850	.15312	.14703	.12633	.12833	.13772	.16980	.22972	.31533
	MCFlow	**.05805**	**.06058**	**.06411**	**.06971**	**.07924**	**.09359**	**.11520**	**.13802**	**.16459**

Table 2 Imputation Training Results on Image Datasets - PSNR (higher is better)

	Missing Rate →	.1	.2	.3	.4	.5	.6	.7	.8	.9
	GAIN	20.82	20.27	19.34	19.18	18.10	17.14	16.63	15.28	11.34
MNIST	MisGAN	18.58	19.24	18.96	19.02	18.35	17.48	16.21	14.14	11.11
	MCFlow	**22.60**	**22.05**	**21.41**	**20.72**	**19.93**	**18.93**	**17.67**	**15.97**	**13.64**
	GAIN	19.79	18.03	17.60	18.74	18.30	17.86	17.42	14.61	5.04
CIFAR-10	MisGAN	14.49	16.30	16.65	17.97	17.83	17.22	15.40	12.78	10.02
	MCFlow	**24.72**	**24.35**	**23.86**	**23.13**	**22.02**	**20.58**	**18.77**	**17.20**	**15.67**

Table 3 Imputation Results on Image Datasets - PSNR (higher is better)

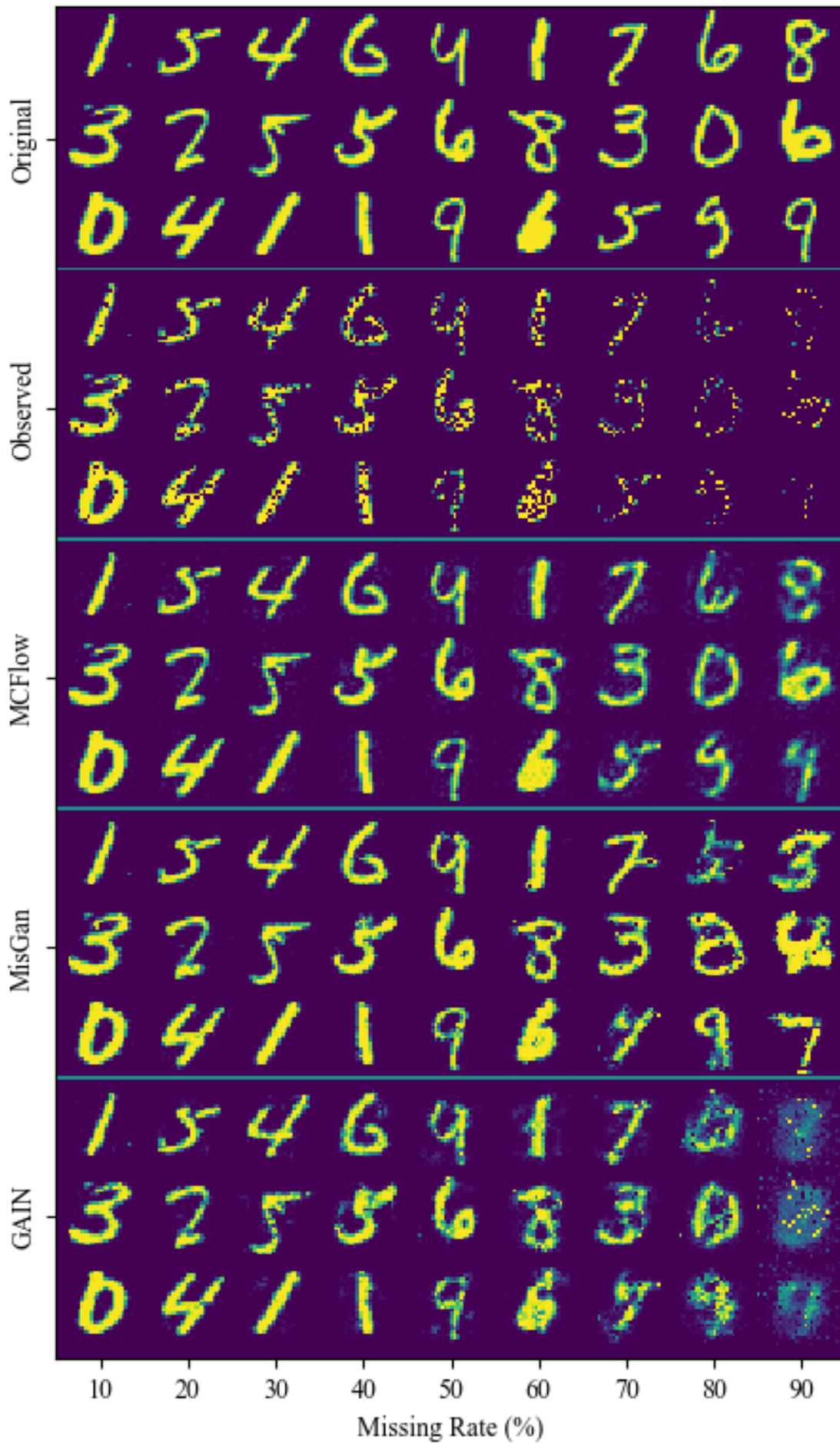|	Missing Rate →	.1	.2	.3	.4	.5	.6	.7	.8	.9
	GAIN	18.780	18.103	17.085	16.627	15.766	14.783	13.666	12.331	11.290
MNIST	MisGAN	18.607	19.175	18.879	18.941	18.291	17.462	16.224	14.219	11.117
	MCFlow	**22.541**	**22.016**	**21.403**	**20.737**	**19.961**	**18.973**	**17.724**	**16.024**	**13.638**
	GAIN	19.954	17.924	17.557	18.573	18.096	17.635	17.182	14.550	5.3960
CIFAR-10	MisGAN	14.460	16.350	16.627	17.757	17.703	16.627	15.222	12.374	9.9728
	MCFlow	**24.420**	**24.107**	**23.497**	**22.835**	**21.607**	**19.958**	**17.633**	**16.469**	**15.422**
	GAIN	23.411	22.507	21.549	21.433	20.638	19.487	18.621	17.051	5.6716
CelebA	**MCFlow**	**24.832**	**24.092**	**24.060**	**23.165**	**22.780**	**22.058**	**21.425**	**19.115**	**18.255**

2 Additional Qualitative Results

Figure 1: Sample imputation results for MNIST across tested rates of missingness.

Imputation Comparison on MCAR CIFAR-10

<div align="center">(a)   (b)   (c)   (d)   (e)</div>

Figure 2: Sample imputation results for CIFAR-10 at 0.9 missingess rate: (a) Original, (b) observed, (c) GAIN-imputed, (d) MisGAN-imputed, and (e) MCFlow-imputed images.