The three scripts load the unshredded image, estimate the width of the shreds or take it as an input parameter, un-shred the image, save the unshredded image to a file, display a miniature of the shredded image, and display a miniature of the un-shredded image.

The elapsed time is the number of seconds between start and end of script execution.

The tests were executed on a Macbook Pro, with Mac OS Sierra 10.12.1, 8 Gb of RAM and 2.9 GHz Intel Core i5 processor.

A grey cell with the word "Interrupted" means I stopped the execution because it was taking too long.

A red cell means something went wrong: the image was not un-shredded correctly, or the width was estimated to a wrong value.

Dimension of the image is width x height x number of channels.

The scripts are not robust when shreds are two-pixels wide.

The scripts do not guess correctly the width of the shreds when there are few shreds.

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_1.py** (Uses all image bands; Matching metric is simple difference and uses a loop)					
				Width of shreds given		Width of shreds estimated			
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)	
shr_bay_10.png	550 x 550 x 3	G	10	Y	8.53071689606	10	Y	10.2637908459	
shr_bay_5.png	550 x 550 x 3	G	5	Y	30.9767208099	5	Y	34.7914021015	
shr_bolt_13.png	650 x 366 x 4	C	13	Y	4.84588003159	13	Y	6.36621785164	
shr_bolt_26.png	650 x 366 x 4	C	26	Y	1.64084911346	26	Y	2.90336513519	
shr_bubble_32.png	800 x 800 x 3	G	32	Y	3.40318989754	32	Y	6.30875706673	
shr_bubble_8.png	800 x 800 x 3	G	8	Y	39.7769351006	8	Y	43.3614399433	
shr_bubble_80.png	800 x 800 x 3	G	80	Y	1.35331916809	80	Y	4.4741859436	
shr_carygrant_2.png	500 x 313 x 3	G	2	N	97.1259732246	4	N	25.2122118473	
shr_carygrant_25.png	500 x 313 x 3	G	25	Y	0.913941144943	25	Y	1.70011210442	
shr_carygrant_5.png	500 x 313 x 3	G	5	Y	15.4135811329	5	Y	15.8863780499	
shr_carygrant_50.png	500 x 313 x 3	G	50	Y	0.63582611084	50	Y	1.42832708539	
shr_cat_2.png	880 x 542 x 3	G	2		Interrupted	4	N	Interrupted	
shr_cat_4.png	880 x 542 x 3	G	4	Y	124.276376963	4	Y	129.769486189	
shr_cat_8.png	880 x 542 x 3	G	8	Y	32.9805989265	8	Y	36.0300300121Y	
shr_cat_80.png	880 x 542 x 3	G	80	Y	1.36282896996	80	Y	3.76861405373	
shr_churchill_3.png	267 x 298 x 4	G	3	Y	11.3343009949	3	Y	11.6140809059	
shr_churchill_89.png	267 x 298 x3	G	89	Y	0.18889093399	3	N	11.8595650196	
shr_crowd1_20.png	500 x 398 x 4	C	20	Y	1.62040805817	20	Y	2.53376817703	
shr_crowd1_25.png	500 x 398 x 4	C	25	Y	1.20519709587	25	Y	2.15166592598	
shr_crowd1_50.png	500 x 398 x 4	C	50	Y	0.59458899498	50	Y	1.64582705498	
shr_crowd2_7.png	553 x 368 x 4	C	7	Y	11.8161051273	7	Y	12.5232980251	
shr_crowd2_79.png	553 x 368 x 4	C	79	Y	0.55587220192	79	Y	1.53841209412	

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_1.py** (Uses all image bands; Matching metric is simple difference and uses a loop)					
				Width of shreds given		Width of shreds estimated			
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)	
shr_crowd3_26.png	650 x 421 x 4	C	26	Y	1.75951004028	26	Y	3.13549995422	
shr_crowd3_50.png	650 x 421 x 4	C	50	Y	0.900043964386	50	Y	2.1932990551	
shr_crowd3_65.png	650 x 421 x 4	C	65	Y	0.753726959229	65	Y	2.10509610176	
shr_eye_4.png	3476 x 2317 x 3	G	4		Interrupted	4		Interrupted	
shr_frogs_100.png	1600 x 1000 x 4	C	100	Y	6.32727599144	100	Y	13.7000470161	
shr_frogs_32.png	1600 x 1000 x 4	C	32	Y	24.2303462029	32	Y	32.3895931244	
shr_frogs_64.png	1600 x 1000 x 4	C	64	Y	9.55750799179	64	Y	17.9725930691	
shr_phelps_100.png	300x200x3	C	100	Y	0.157281160355	4	Y[1]	5.93031907082	
shr_phelps_25.png	300 x 200 x 4	C	25	Y	0.361295223236	25	Y	0.681553125381	
shr_rose_25.png	800 x 600 x 4	C	25	Y	3.89041399956	25	Y	6.52631998062	
shr_rose_32.png	800 x 600 x 4	C	32	Y	2.73546385765	32	Y	5.50318098068	
shr_silence_25.png	700 x 467 x 4	C	25	Y	2.46853494644	25	Y	4.0448949337	
shr_silence_35.png	700 x 467 x 4	C	35	Y	1.65643382072	35	Y	3.35883593559	
shr_stadium_43.png	344 x 257 x 3	C	43	Y	0.390470027924	43	Y	0.818885803223	
shr_stadium_8.png	344 x 257 x 3	C	8	Y	2.43625092506	8	Y	2.90131783485	
shr_steve_2.png	214 x 317 x 3	G	2	N	34.3852620125	92233…	N	error	
shr_tokyo_32.png	640 x 359 x 4	C	32	Y	1.53467798233	32	Y	2.74043798447	
shr_tokyo_grey_32.png	640 x 359 x 1	G	32	N	0.78123998642	32	N	1.80981397629	
shr_watch_120.png	3840 x 1311 x 3	G	120	Y	16.7319340706	120	Y	40.388299942	
shr_watch_3.png	3840 x 1311 x 3	G	3		Interrupted	3		Interrupted	

[1] The width of the shreds is wrongly estimated as 4, but being this a submultiple of 100 (the real width), the image is reconstructed correctly. The algorithm is just doing more work than what would be strictly necessary.

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_1.py** (Uses all image bands; Matching metric is simple difference and uses a loop)					
				Width of shreds given		Width of shreds estimated			
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)	
shr_watch_32.png	3840 x 1311 x 3	G	32		Interrupted	32		Interrupted	
shr_watch_40.png	3840 x 1311 x 3	G	40		Interrupted	40		Interrupted	

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_2.py** (Converts to 1 band image; Matching metric is simple difference, array version – no loop)				
				Width of shreds given		Width of shreds estimated		
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)
shr_bay_10.png	550 x 550 x 3	G	10	Y	0.436585187912	10	Y	0.471920013428
shr_bay_5.png	550 x 550 x 3	G	5	Y	0.858043909073	5	Y	0.874574899673
shr_bolt_13.png	650 x 366 x 4	C	13	Y	0.566031932831	13	Y	0.514894008636
shr_bolt_26.png	650 x 366 x 4	C	26	Y	0.421855926514	26	Y	0.499113082886
shr_bubble_32.png	800 x 800 x 3	G	32	Y	0.611273050308	32	Y	0.648587942123
shr_bubble_8.png	800 x 800 x 3	G	8	Y	1.23657083511	8	Y	1.24340415001
shr_bubble_80.png	800 x 800 x 3	G	80	Y	0.554018974304	80	Y	0.613354921341
shr_carygrant_2.png	500 x 313 x 3	G	2	N	1.84060311317	4	N	0.525110006332
shr_carygrant_25.png	500 x 313 x 3	G	25	Y	0.217725038528	25	Y	0.244888067245
shr_carygrant_5.png	500 x 313 x 3	G	5	Y	0.474954843512	5	Y	0.503504991531
shr_carygrant_50.png	500 x 313 x 3	G	50	Y	0.218456933566	50	Y	0.230882883072
shr_cat_2.png	880 x 542 x 3	G	2	Y	8.78673791885	4	N	2.39098882675
shr_cat_4.png	880 x 542 x 3	G	4	Y	2.53373789787	4	Y	17.9570400715
shr_cat_8.png	880 x 542 x 3	G	8	Y	0.947104215622	8	Y	0.995769023895
shr_cat_80.png	880 x 542 x 3	G	80	Y	0.41631102562	80	Y	0.455022096634
shr_churchill_3.png	267 x 298 x 4	G	3	Y	0.332794189453	3	Y	0.344437837601
shr_churchill_89.png	267 x 298 x3	G	89	Y	0.116486787796	3	N	0.335867166519
shr_crowd1_20.png	500 x 398 x 4	C	20	Y	0.285663843155	20	Y	0.303195953369
shr_crowd1_25.png	500 x 398 x 4	C	25	Y	0.285063028336	25	Y	0.294780015945
shr_crowd1_50.png	500 x 398 x 4	C	50	Y	0.269052028656	50	Y	0.288850069046
shr_crowd2_7.png	553 x 368 x 4	C	7	Y	0.50907897492	7	Y	0.549312829971
shr_crowd2_79.png	553 x 368 x 4	C	79	Y	0.31227016449	79	Y	0.317711114883

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_2.py** (Converts to 1 band image; Matching metric is simple difference, array version – no loop)					
				Width of shreds given		Width of shreds estimated			
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)	
shr_crowd3_26.png	650 x 421 x 4	C	26	Y	0.35803103447	26	Y	0.373917102814	
shr_crowd3_50.png	650 x 421 x 4	C	50	Y	0.31945681572	50	Y	0.369976997375	
shr_crowd3_65.png	650 x 421 x 4	C	65	Y	0.332252025604	65	Y	0.369120121002	
shr_eye_4.png	3476 x 2317 x 3	G	4		Interrupted	4		Interrupted	
shr_frogs_100.png	1600 x 1000 x 4	C	100	Y	2.41870212555	100	Y	2.49634099007	
shr_frogs_32.png	1600 x 1000 x 4	C	32	Y	2.62958097458	32	Y	2.75893115997	
shr_frogs_64.png	1600 x 1000 x 4	C	64	Y	2.37967610359	64	Y	2.57075119019	
shr_phelps_100.png	300x200x3	C	100	Y	0.10949587822	4	Y[2]	0.215590000153	
shr_phelps_25.png	300 x 200 x 4	C	25	Y	0.141710996628	25	Y	0.14994096756	
shr_rose_25.png	800 x 600 x 4	C	25	Y	0.673640012741	25	Y	0.719804048538	
shr_rose_32.png	800 x 600 x 4	C	32	Y	0.643445014954	32	Y	0.72127699852	
shr_silence_25.png	700 x 467 x 4	C	25	Y	0.56530380249	25	Y	0.589632034302	
shr_silence_35.png	700 x 467 x 4	C	35	Y	0.553310871124	35	Y	0.603060007095	
shr_stadium_43.png	344 x 257 x 3	C	43	Y	0.165817022324	43	Y	0.178823947906	
shr_stadium_8.png	344 x 257 x 3	C	8	Y	0.18371796608	8	Y	0.187442064285	
shr_steve_2.png	214 x 317 x 3	G	2	N	0.403502941132	92233…	N	error	
shr_tokyo_32.png	640 x 359 x 4	C	32	N	0.313729047775	32	N	0.34116101265	
shr_tokyo_grey_32.png	640 x 359 x 1	G	32	N	0.12220287323	32	N	0.140931129456	
shr_watch_120.png	3840 x 1311 x 3	G	120	Y	3.80867195129	120	Y	4.41610193253	

[2] The width of the shreds is wrongly estimated as 4, but being this a submultiple of 100 (the real width), the image is reconstructed correctly. The algorithm is just doing more work than what would be strictly necessary.

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_2.py** (Converts to 1 band image; Matching metric is simple difference, array version – no loop)					
				Width of shreds given		Width of shreds estimated			
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)	
shr_watch_3.png	3840 x 1311 x 3	G	3	Y[3]	170.632855892	3	Y[4]	171.540729046	
shr_watch_32.png	3840 x 1311 x 3	G	32	Y	5.11547112465	32	Y	5.6434841156	
shr_watch_40.png	3840 x 1311 x 3	G	40	Y	5.54394602776	40	Y	6.06360721588	

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[3] As this is more tan 1K shreds and the reconstruction functions are recursive, I had to add a line sys.setrecursionlimit(1300) at the beginning to avoid a recursion limit error. If do not want to do this is to write iterative versions of the reconstruction functions.
[4] Same comment as before.

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_3.py** (Converts to 1 band image; Matching metric is difference of lateral second derivatives, array version – no loop)				
				Width of shreds given		Width of shreds estimated		
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)
shr_bay_10.png	550 x 550 x 3	G	10	Y	0.449193000793	10	Y	0.480679035187
shr_bay_5.png	550 x 550 x 3	G	5	Y	0.889271020889	5	Y	0.924673080444
shr_bolt_13.png	650 x 366 x 4	C	13	Y	0.470202922821	13	Y	0.509229898453
shr_bolt_26.png	650 x 366 x 4	C	26	Y	0.43052816391	26	Y	0.448754072189
shr_bubble_32.png	800 x 800 x 3	G	32	Y	0.608407020569	32	Y	0.656121015549
shr_bubble_8.png	800 x 800 x 3	G	8	Y	1.21955704689	8	Y	1.27383089066
shr_bubble_80.png	800 x 800 x 3	G	80	Y	0.60170507431	80	Y	0.626791000366
shr_carygrant_2.png	500 x 313 x 3	G	2	N	1.99331498146	4	N	0.613083839417
shr_carygrant_25.png	500 x 313 x 3	G	25	Y	0.225320100784	25	Y	0.234342098236
shr_carygrant_5.png	500 x 313 x 3	G	5	N	0.431095123291	5	N	0.44575092316
shr_carygrant_50.png	500 x 313 x 3	G	50	Y	0.217975854874	50	Y	0.229177951813
shr_cat_2.png	880 x 542 x 3	G	2	Y	9.57032608986	4	N	2.55229091644
shr_cat_4.png	880 x 542 x 3	G	4	Y	2.69988799095	4	Y	2.76103115082
shr_cat_8.png	880 x 542 x 3	G	8	Y	1.00480484962	8	Y	1.0507349968
shr_cat_80.png	880 x 542 x 3	G	80	Y	0.414534091949	80	Y	0.456472873688
shr_churchill_3.png	267 x 298 x 4	G	3	Y	0.357905864716	3	Y	0.364932060242
shr_churchill_89.png	267 x 298 x3	G	89	Y	0.121345996857	3	Y[5]	0.404424905777

[5] As before, the width of the shreds is wrongly estimated to 3. 3 is a submultiple of 90, which is very close to the actual width of the shreds (89). With this new metrics, the image is reconstructed almost perfectly. There are only three columns (one pixel each) wrongly

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_3.py** (Converts to 1 band image; Matching metric is difference of lateral second derivatives, array version – no loop)				
				Width of shreds given		Width of shreds estimated		
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)
shr_crowd1_20.png	500 x 398 x 4	C	20	Y	0.285880088806	20	Y	0.323135137558
shr_crowd1_25.png	500 x 398 x 4	C	25	Y	0.28747010231	25	Y	0.323540210724
shr_crowd1_50.png	500 x 398 x 4	C	50	Y	0.27205108337	50	Y	0.295054912567
shr_crowd2_7.png	553 x 368 x 4	C	7	Y	0.567464828491	7	Y	0.567464828491
shr_crowd2_79.png	553 x 368 x 4	C	79	Y	0.301094055176	79	Y	0.332392930984
shr_crowd3_26.png	650 x 421 x 4	C	26	Y	0.340330123901	26	Y	0.40519785881
shr_crowd3_50.png	650 x 421 x 4	C	50	Y	0.337634801865	50	Y	0.36651802063
shr_crowd3_65.png	650 x 421 x 4	C	65	Y	0.329440832138	65	Y	0.382097959518
shr_eye_4.png	3476 x 2317 x 3	G	4	Y	145.572994947	4		147.772680044
shr_frogs_100.png	1600 x 1000 x 4	C	100	Y	2.37768101692	100	Y	2.47446489334
shr_frogs_32.png	1600 x 1000 x 4	C	32	Y	2.52282810211	64	N	1.4372689724
shr_frogs_64.png	1600 x 1000 x 4	C	64	Y	2.38460898399	64	Y	2.52201604843
shr_phelps_100.png	300x200x3	C	100	Y	0.108706951141	4	Y[6]	0.224473953247
shr_phelps_25.png	300 x 200 x 4	C	25	Y	0.141582012177	25	Y	0.155494213104
shr_rose_25.png	800 x 600 x 4	C	25	Y	0.67859005928	25	Y	0.746127128601
shr_rose_32.png	800 x 600 x 4	C	32	Y	0.671079158783	32	Y	0.735759973526
shr_silence_25.png	700 x 467 x 4	C	25	Y	0.558784008026	25	Y	0.609889030457

placed, but those are at the extremes of the picture and are practically unnoticeable. The portrait of Winston Churchill is clearly recognized.

[6] The width of the shreds is wrongly estimated as 4, but being this a submultiple of 100 (the real width), the image is reconstructed correctly. The algorithm is just doing more work than what would be strictly necessary.

Image	Dimensions	Colour / Grey	Width of shreds	Algorithm **unshr_3.py** (Converts to 1 band image; Matching metric is difference of lateral second derivatives, array version – no loop)					
				Width of shreds given		Width of shreds estimated			
				Correct reconstruction?	Elapsed Time (in seconds)	Guessed width	Correct reconstruction?	Elapsed Time (in seconds)	
shr_silence_35.png	700 x 467 x 4	C	35	Y	0.53782916069	35	Y	0.593689203262	
shr_stadium_43.png	344 x 257 x 3	C	43	Y	0.173519134521	43	Y	0.192093849182	
shr_stadium_8.png	344 x 257 x 3	C	8	Y	0.184126853943	8	Y	0.185374975204	
shr_steve_2.png	214 x 317 x 3	G	2	N	0.431221961975	92233…	N	error	
shr_tokyo_32.png	640 x 359 x 4	C	32	Y	0.328979969025	32	Y	0.356523036957	
shr_tokyo_grey_32.png	640 x 359 x 1	G	32	Y	0.137993097305	32	Y	0.154281139374	
shr_watch_120.png	3840 x 1311 x 3	G	120	Y	3.97688293457	120	Y	4.5213239193	
shr_watch_3.png	3840 x 1311 x 3	G	3	Y[7]	184.289448023	3	Y[8]	192.066843033	
shr_watch_32.png	3840 x 1311 x 3	G	32	Y	6.6210091114	32	Y	7.25081896782	
shr_watch_40.png	3840 x 1311 x 3	G	40	Y	5.68816995621	40	Y	6.29486107826	

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[7] As this is more tan 1K shreds and the reconstruction functions are recursive, I had to add a line sys.setrecursionlimit(1300) at the beginning to avoid a recursion limit error. If do not want to do this is to write iterative versions of the reconstruction functions.
[8] Same as before.