Data compression benchmark results

File	bw94	bw94-t-hirsch	bw94-t-greedy	bw94-t-gupdate	bcm	bcm-t-hirsch	bcm-t-greedy	bcm-t-gupdate	xz	zpaq
alice29.txt	2.354	2.354	2.354	2.354	2.130	2.129	2.129	2.129	2.552	2.032
asyoulik.txt	2.635	2.631	2.630	2.630	2.393	2.388	2.387	2.387	2.849	**2.289**
cp.html	2.505	2.462	2.462	2.461	2.428	2.361	2.361	2.362	2.488	**2.215**
fields.c	2.201	2.194	2.191	2.191	2.288	2.268	2.265	2.265	2.175	**1.883**
grammar.lsp	2.775	2.797	2.797	2.797	2.833	2.850	2.850	2.850	2.777	**2.461**
kennedy.xls	1.496	1.496	1.496	1.496	0.594	0.594	0.594	0.594	0.402	**0.260**
lcet10.txt	2.114	2.111	2.111	2.111	1.866	1.861	1.860	1.860	2.239	**1.767**
plrabn12.txt	2.542	2.541	2.541	2.541	2.235	2.234	2.234	2.234	2.746	**2.181**
ptt5	0.832	0.832	0.832	0.832	0.704	0.704	0.704	0.704	**0.621**	0.693
sum	2.779	2.657	2.651	2.654	2.557	2.389	2.377	2.384	**1.987**	2.186
xargs.1	3.315	3.336	3.336	3.336	3.366	3.382	3.382	3.382	3.429	**3.047**
bible.txt	1.663	1.660	1.659	1.659	1.440	1.435	1.433	1.434	1.750	**1.391**
E.coli	2.010	1.990	1.990	1.990	1.939	1.915	**1.914**	1.915	2.045	1.952
world192.txt	1.438	1.433	1.432	1.432	1.290	1.282	1.280	1.280	1.568	**1.269**
dickens	2.113	2.108	2.108	2.108	1.761	1.752	**1.752**	1.752	2.222	1.775
mozilla	2.939	2.913	2.912	2.912	2.495	2.454	2.451	2.452	**2.089**	2.120
mr	2.083	2.083	2.083	2.083	**1.699**	1.699	1.699	1.699	2.208	1.795
nci	0.339	0.327	0.327	0.327	0.292	0.276	**0.274**	0.275	0.345	0.362
ooffice	3.821	3.796	3.795	3.795	3.306	3.271	3.268	3.269	3.156	**2.931**
osdb	2.250	2.238	2.238	2.238	1.784	1.771	**1.771**	1.771	2.256	1.886
reymont	1.470	1.469	1.469	1.469	1.186	1.184	**1.184**	1.184	1.588	1.271
samba	1.805	1.747	1.744	1.747	1.488	1.418	1.413	1.418	1.384	**1.196**
sao	5.949	5.949	5.949	5.949	5.155	5.155	5.155	5.155	**4.882**	4.980
webster	1.481	1.479	1.479	1.479	1.239	1.236	1.236	1.236	1.614	**1.209**
xml	0.664	0.640	0.639	0.641	0.590	0.558	0.556	0.559	0.650	**0.530**
x-ray	4.244	4.244	4.244	4.244	**3.452**	3.452	3.452	3.452	4.239	3.560
sources	1.383	1.351	1.348	1.349	1.222	1.175	1.169	1.171	1.184	**0.989**
pitches	2.838	2.649	2.640	2.647	2.664	2.424	2.409	2.419	1.980	**1.963**
proteins	2.289	1.972	1.965	1.977	2.331	1.912	**1.901**	1.920	2.222	2.609
dna	1.829	1.807	1.806	1.807	1.720	1.696	**1.696**	1.696	1.778	1.859
english	1.711	1.470	1.469	1.471	1.478	1.184	**1.183**	1.186	1.985	1.683
dblp.xml	0.751	0.745	0.744	0.744	0.628	0.619	0.618	0.618	0.819	**0.605**
Escherichia-Coli	0.776	0.526	0.516	0.525	0.796	0.519	0.506	0.517	**0.368**	1.941
cere	0.237	0.120	0.118	0.121	0.238	0.118	0.115	0.119	**0.087**	1.771
coreutils	0.232	0.148	0.147	0.156	0.229	0.133	**0.132**	0.144	0.144	0.618
einstein.de.txt	0.015	0.010	0.010	0.010	0.022	0.011	0.010	0.011	0.008	**0.007**
einstein.en.txt	0.007	0.005	0.005	0.005	0.015	0.007	0.007	0.007	0.005	**0.004**
influenza	0.120	0.116	0.115	0.115	0.119	0.113	0.112	0.112	**0.082**	0.351
kernel	0.130	0.069	0.068	0.074	0.136	0.062	0.061	0.069	0.064	**0.058**
para	0.308	0.173	0.168	0.177	0.315	0.171	0.165	0.176	**0.113**	1.854
world-leaders	0.121	0.100	0.098	0.100	0.126	0.097	0.094	0.097	**0.088**	0.093
hg38	1.754	1.723	1.723	1.723	1.645	1.608	**1.607**	1.608	1.716	1.826
mm10	1.714	1.699	1.699	1.699	1.618	1.598	**1.598**	1.598	1.669	1.840
rn6	1.787	1.726	1.725	1.726	1.695	1.628	**1.628**	1.628	1.705	1.819

Table 1: Compression results in bits per symbol. The best compression result of each file is highlighted bold.

File	bw94-t-hirsch	bw94-t-greedy	bw94-t-gupdate	bw94-t-debruijn	bcm-t-hirsch	bcm-t-greedy	bcm-t-gupdate	bcm-t-debruijn
alice29.txt	0.00 %	0.00 %	0.00 %	−18.99 %	0.05 %	0.05 %	0.05 %	−17.75 %
asyoulik.txt	0.15 %	0.19 %	0.19 %	−14.42 %	0.21 %	0.25 %	0.25 %	−13.62 %
cp.html	1.72 %	1.72 %	1.76 %	−10.10 %	2.76 %	2.76 %	2.72 %	−7.37 %
fields.c	0.32 %	0.46 %	0.46 %	−22.13 %	0.87 %	1.01 %	1.01 %	−16.57 %
grammar.lsp	−0.79 %	−0.79 %	−0.79 %	−15.32 %	−0.60 %	−0.60 %	−0.60 %	−9.74 %
kennedy.xls	0.00 %	0.00 %	0.00 %	−78.74 %	0.00 %	0.00 %	0.00 %	−92.76 %
lcet10.txt	0.14 %	0.14 %	0.14 %	−20.72 %	0.27 %	0.32 %	0.32 %	−20.31 %
plrabn12.txt	0.04 %	0.04 %	0.04 %	−15.97 %	0.04 %	0.04 %	0.04 %	−15.93 %
ptt5	0.00 %	0.00 %	0.00 %	−478.37 %	0.00 %	0.00 %	0.00 %	−532.81 %
sum	4.39 %	4.61 %	4.50 %	−32.74 %	6.57 %	7.04 %	6.77 %	−33.71 %
xargs.1	−0.63 %	−0.63 %	−0.63 %	−13.73 %	−0.48 %	−0.48 %	−0.48 %	−9.42 %
bible.txt	0.18 %	0.24 %	0.24 %	−26.70 %	0.35 %	0.49 %	0.42 %	−27.22 %
E.coli	1.00 %	1.00 %	1.00 %	−17.01 %	1.24 %	1.29 %	1.24 %	−13.25 %
world192.txt	0.35 %	0.42 %	0.42 %	−18.57 %	0.62 %	0.78 %	0.78 %	−18.22 %
dickens	0.24 %	0.24 %	0.24 %	−19.02 %	0.51 %	0.51 %	0.51 %	−19.48 %
mozilla	0.89 %	0.92 %	0.92 %	−33.55 %	1.64 %	1.76 %	1.72 %	−35.99 %
mr	0.00 %	0.00 %	0.00 %	−129.24 %	0.00 %	0.00 %	0.00 %	−133.25 %
nci	3.54 %	3.54 %	3.54 %	−22.42 %	5.48 %	6.17 %	5.82 %	−22.60 %
ooffice	0.65 %	0.68 %	0.68 %	−14.81 %	1.06 %	1.15 %	1.12 %	−16.36 %
osdb	0.53 %	0.53 %	0.53 %	−4.89 %	0.73 %	0.73 %	0.73 %	−6.67 %
reymont	0.07 %	0.07 %	0.07 %	−14.56 %	0.17 %	0.17 %	0.17 %	−16.10 %
samba	3.21 %	3.38 %	3.21 %	−16.62 %	4.71 %	5.04 %	4.71 %	−16.73 %
sao	0.00 %	0.00 %	0.00 %	−0.99 %	0.00 %	0.00 %	0.00 %	−0.99 %
webster	0.14 %	0.14 %	0.14 %	−18.64 %	0.24 %	0.24 %	0.24 %	−18.89 %
xml	3.61 %	3.76 %	3.46 %	−14.16 %	5.42 %	5.76 %	5.26 %	−12.54 %
x-ray	0.00 %	0.00 %	0.00 %	−10.23 %	0.00 %	0.00 %	0.00 %	−10.26 %
sources	2.31 %	2.53 %	2.46 %	−18.73 %	3.85 %	4.34 %	4.17 %	−17.02 %
pitches	6.66 %	6.98 %	6.73 %	1.69 %	9.01 %	9.57 %	9.20 %	3.98 %
proteins	13.85 %	14.15 %	13.63 %	8.69 %	17.98 %	18.45 %	17.63 %	12.53 %
dna	1.20 %	1.26 %	1.20 %	−14.93 %	1.39 %	1.39 %	1.39 %	−12.21 %
english	14.09 %	14.14 %	14.03 %	10.75 %	19.89 %	19.96 %	19.76 %	16.51 %
dblp.xml	0.80 %	0.93 %	0.93 %	−14.25 %	1.43 %	1.59 %	1.59 %	−14.33 %
Escherichia-Coli	32.22 %	33.51 %	32.35 %	23.58 %	34.80 %	36.43 %	35.05 %	27.64 %
cere	49.37 %	50.21 %	48.95 %	43.88 %	50.42 %	51.68 %	50.00 %	45.80 %
coreutils	36.21 %	36.64 %	32.76 %	18.54 %	41.92 %	42.36 %	37.12 %	24.02 %
einstein.de.txt	33.33 %	33.33 %	33.33 %	20.00 %	50.00 %	54.55 %	50.00 %	45.46 %
einstein.en.txt	28.57 %	28.57 %	28.57 %	14.29 %	53.33 %	53.33 %	53.33 %	60.00 %
influenza	3.33 %	4.17 %	4.17 %	−46.67 %	5.04 %	5.88 %	5.88 %	−42.86 %
kernel	46.92 %	47.69 %	43.08 %	40.77 %	54.41 %	55.15 %	49.26 %	47.79 %
para	43.83 %	45.45 %	42.53 %	29.55 %	45.71 %	47.62 %	44.13 %	32.06 %
world-leaders	17.36 %	19.01 %	17.36 %	−4.13 %	23.02 %	25.40 %	23.02 %	3.18 %
hg38	1.77 %	1.77 %	1.77 %	−0.23 %	2.25 %	2.31 %	2.25 %	0.67 %
mm10	0.88 %	0.88 %	0.88 %	−1.52 %	1.24 %	1.24 %	1.24 %	−0.87 %
rn6	3.41 %	3.47 %	3.41 %	1.01 %	3.95 %	3.95 %	3.95 %	1.89 %

Table 2: Tunneling compression improvements. The numbers show the encoding size differences between the normal and the enhanced BWT compressor relative to the encoding size of the normal BWT compressor.

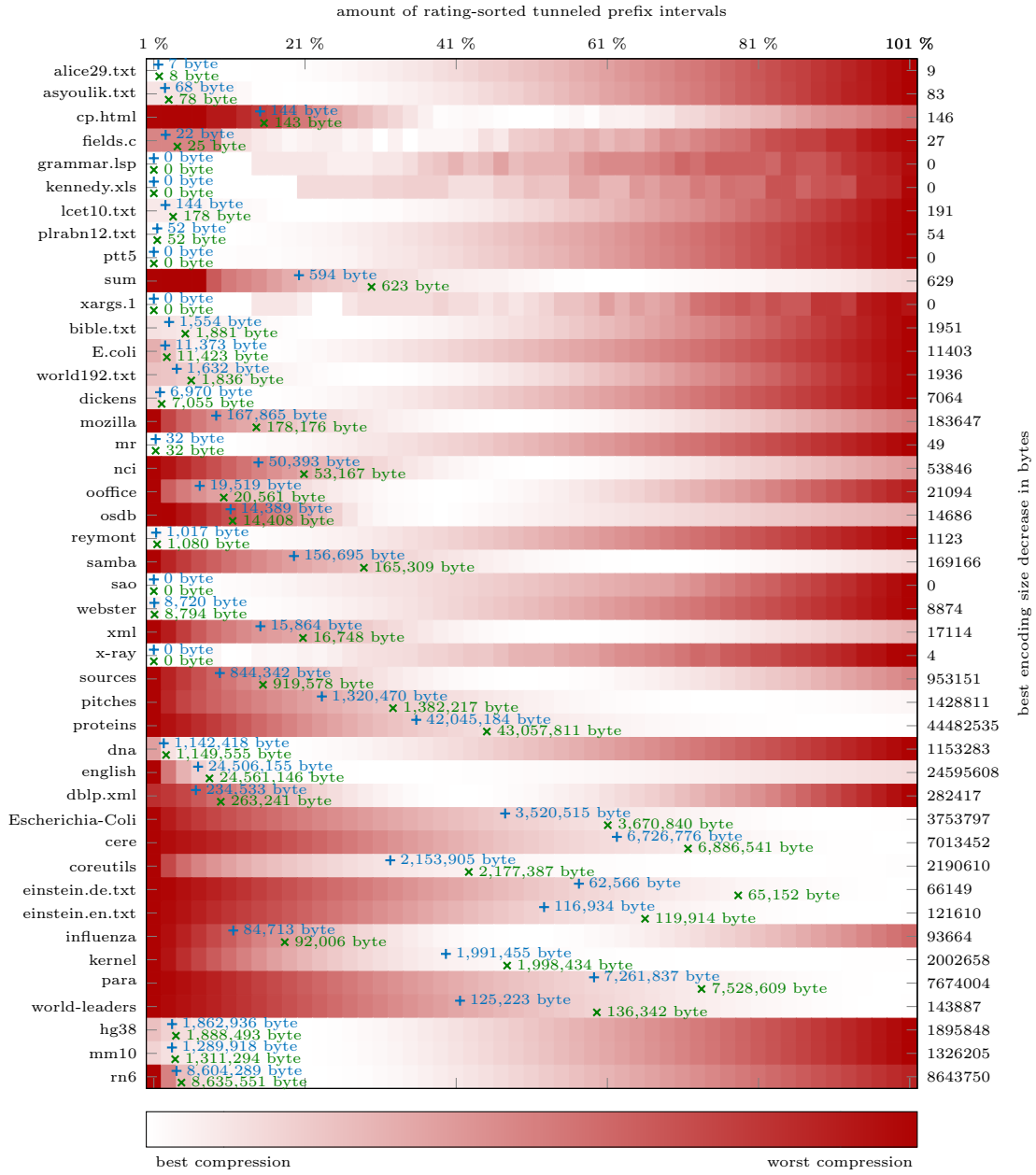

Figure 1: Optimality of the hirsch and greedy strategy in the bw94 post stage compressor. The amount of tunneled prefix intervals using the hirsch strategy is indicated with blue pluses. The amount of tunneled prefix intervals using the greedy strategy is indicated with green crosses. The best encoding size decrease compared to an compression without tunneling is shown on the right. The encoding size decrease of the hirsch and greedy strategy is shown right beside of the pluses/crosses.

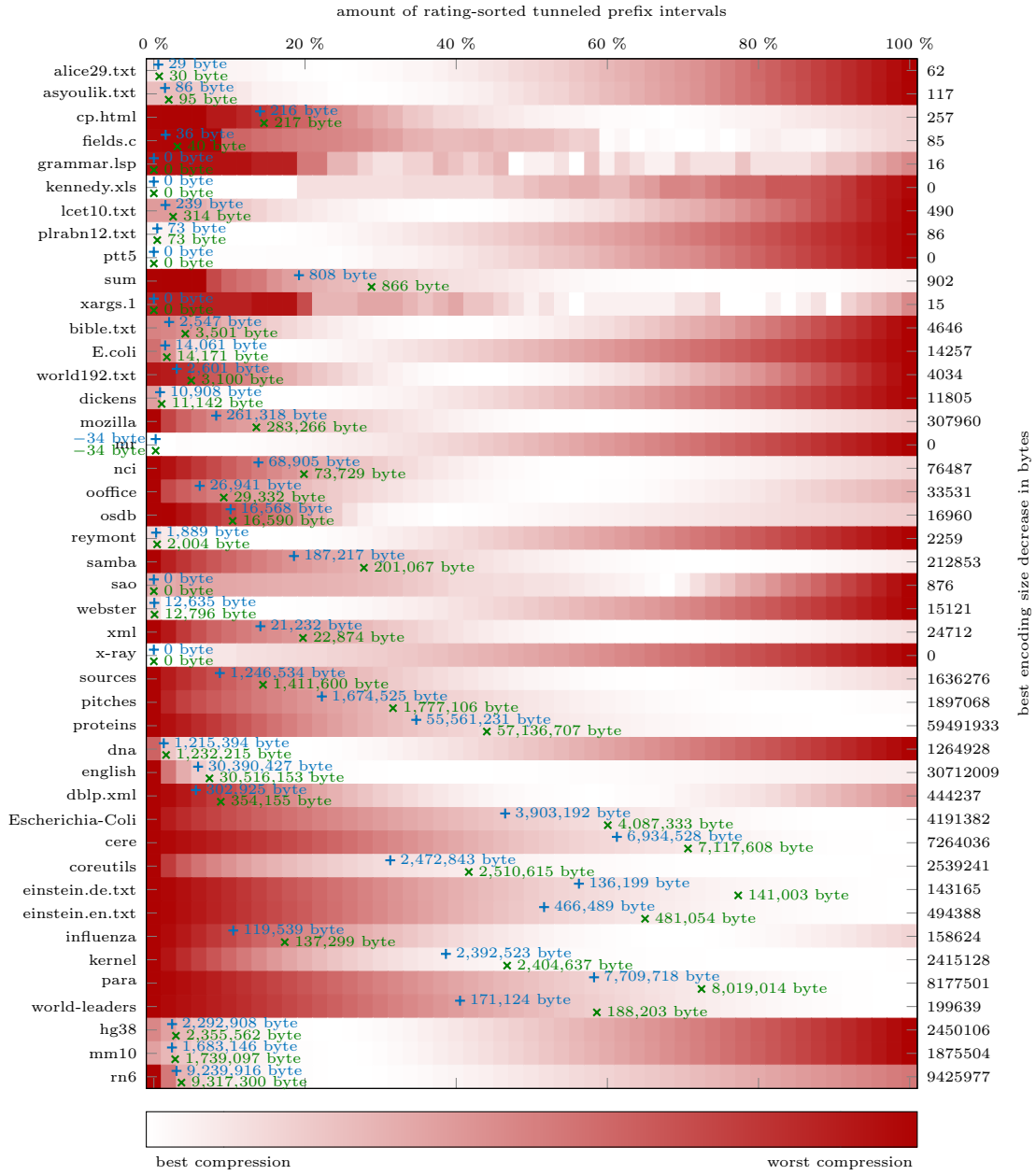

Figure 2: Optimality of the hirsch and greedy strategy in the bcm post stage compressor. The amount of tunneled prefix intervals using the hirsch strategy is indicated with blue pluses. The amount of tunneled prefix intervals using the greedy strategy is indicated with green crosses. The best encoding size decrease compared to an compression without tunneling is shown on the right. The encoding size decrease of the hirsch and greedy strategy is shown right beside of the pluses/crosses.

File	bw94	bw94-t-hirsch	bw94-t-greedy	bw94-t-gupdate	bcm	bcm-t-hirsch	bcm-t-greedy	bcm-t-gupdate	xz	zpaq
alice29.txt	**6.90**	4.67	2.84	3.53	6.90	3.53	2.37	2.84	1.79	0.48
asyoulik.txt	**10.85**	3.85	2.91	3.85	5.68	2.91	2.34	2.91	1.47	0.39
cp.html	**23.46**	2.13	2.13	2.13	23.46	2.13	2.13	2.13	0.75	0.17
fields.c	10.63	0.96	**10.63**	10.63	10.63	10.63	0.96	0.96	0.96	0.11
grammar.lsp	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54	**3.54**	0.06
kennedy.xls	**9.72**	7.49	6.96	8.11	7.49	8.11	6.09	5.42	0.81	0.74
lcet10.txt	**7.98**	4.47	3.10	4.02	7.98	3.10	2.38	3.10	1.92	0.63
plrabn12.txt	**11.20**	4.13	3.04	4.13	7.53	3.04	2.53	3.04	1.98	0.62
ptt5	**23.30**	11.93	9.59	9.59	8.02	5.37	4.84	4.84	1.22	0.72
sum	3.31	**3.31**	3.31	3.31	3.31	1.73	1.73	3.31	0.88	0.27
xargs.1	4.03	**4.03**	4.03	4.03	4.03	4.03	4.03	4.03	0.36	0.05
bible.txt	**10.69**	5.75	4.53	5.13	6.88	4.33	3.47	4.05	2.22	0.72
E.coli	**9.39**	5.26	3.00	4.75	6.49	3.74	2.51	3.56	1.31	0.81
world192.txt	**11.17**	6.91	5.11	5.73	7.34	5.23	3.99	4.36	2.31	0.74
dickens	**8.99**	5.25	3.66	4.90	5.39	4.24	3.06	3.65	1.62	0.64
mozilla	**8.39**	4.71	3.10	3.84	6.64	4.06	2.68	3.16	1.97	0.65
mr	**9.99**	7.30	4.97	7.25	6.59	5.36	4.07	4.24	1.49	0.66
nci	**12.94**	8.64	7.82	6.17	6.73	5.62	4.90	4.37	1.45	0.84
ooffice	**8.13**	4.84	3.27	4.27	6.04	4.12	2.96	3.68	2.32	0.57
osdb	**9.90**	7.28	4.16	7.33	6.53	6.12	4.57	6.16	2.27	0.67
reymont	**10.34**	6.50	5.17	6.44	6.93	4.82	3.89	4.64	1.71	0.68
samba	**9.36**	4.87	3.73	2.83	7.00	3.81	3.20	2.82	1.69	0.69
sao	5.85	4.54	2.67	4.45	**6.00**	3.63	2.16	4.37	2.55	0.60
webster	**8.63**	5.52	3.96	5.02	5.57	3.71	3.25	3.79	1.44	0.73
xml	**15.88**	8.07	6.87	6.13	7.71	5.78	5.36	4.63	2.68	0.78
x-ray	**7.08**	5.49	3.36	5.45	5.80	4.64	3.02	4.58	2.62	0.63
sources	**7.70**	2.91	2.42	1.78	5.28	2.43	2.16	1.61	1.62	0.73
pitches	**8.17**	2.65	2.03	1.64	6.19	2.41	1.83	1.52	2.06	0.68
proteins	**4.35**	1.02	0.93	0.62	3.47	0.98	0.90	0.58	0.93	0.66
dna	**4.71**	2.65	1.87	2.22	3.67	2.19	1.66	1.91	0.66	0.79
english	**4.11**	0.75	0.67	0.37	3.39	0.70	0.63	0.37	1.01	0.73
dblp.xml	**7.50**	5.28	4.39	4.24	4.91	3.98	3.43	3.37	1.58	0.74
Escherichia-Coli	**6.79**	1.55	1.47	0.14	4.75	1.48	1.43	0.14	0.96	0.81
cere	**6.18**	2.44	2.38	0.16	4.20	2.30	2.23	0.16	1.08	0.82
coreutils	**8.42**	2.47	2.36	0.62	5.40	2.38	2.37	0.59	2.84	0.75
einstein.de.txt	**8.10**	7.18	7.06	6.92	5.23	6.62	6.56	5.54	7.07	0.74
einstein.en.txt	5.98	5.16	5.32	5.06	4.08	4.77	4.60	4.28	**7.47**	0.76
influenza	**7.92**	4.89	4.80	3.41	5.02	3.70	3.56	2.88	2.16	0.84
kernel	**8.45**	3.04	2.97	1.45	5.26	2.98	3.12	1.46	3.28	0.74
para	**6.08**	2.64	2.52	0.42	4.21	2.57	2.52	0.42	1.05	0.83
world-leaders	**19.38**	7.13	6.89	3.85	7.74	5.73	4.81	3.27	2.71	0.84
hg38	**4.05**	2.13	1.52	1.65	3.31	1.81	1.39	1.54	0.64	0.79
mm10	**3.98**	2.35	1.65	1.85	3.21	1.96	1.46	1.62	0.65	0.80
rn6	**4.08**	1.74	1.34	1.22	3.29	1.54	1.22	1.15	0.65	0.80

Table 3: Compression speed in MiB per second. The fastest compression of each file is highlighted bold.

File	bw94	bw94-t-hirsch	bw94-t-greedy	bw94-t-gupdate	bcm	bcm-t-hirsch	bcm-t-greedy	bcm-t-gupdate	xz	zpaq
alice29.txt	3.53	3.53	3.53	3.53	3.53	4.67	3.53	4.67	**13.18**	0.53
asyoulik.txt	3.85	3.85	3.85	3.85	3.85	5.68	3.85	3.85	**119.37**	0.41
cp.html	2.13	23.46	23.46	2.13	2.13	23.46	23.46	2.13	**23.46**	0.21
fields.c	10.63	10.63	10.63	10.63	10.63	0.96	10.63	10.63	**10.63**	0.11
grammar.lsp	3.54	3.54	3.54	3.54	3.54	3.54	3.54	3.54	**3.54**	0.06
kennedy.xls	4.44	4.65	4.44	4.25	6.09	5.74	5.74	6.09	**46.76**	0.72
lcet10.txt	5.02	4.02	4.02	4.02	5.02	6.67	4.47	6.67	**36.99**	0.59
plrabn12.txt	3.50	3.50	3.50	3.50	4.54	4.13	4.13	4.13	**21.88**	0.62
ptt5	6.89	6.04	6.04	6.04	6.89	8.02	6.04	5.37	**44.49**	0.70
sum	1.73	3.31	1.73	1.73	3.31	3.31	3.31	3.31	**36.46**	0.20
xargs.1	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03	**4.03**	0.06
bible.txt	7.70	6.88	7.26	7.13	6.75	6.42	6.42	6.42	**47.65**	0.61
E.coli	10.03	9.59	9.59	9.80	7.12	5.26	5.89	5.97	**48.61**	0.81
world192.txt	6.72	6.19	6.72	7.83	6.53	6.35	6.19	6.53	**46.25**	0.69
dickens	4.90	4.45	3.93	4.47	5.58	5.08	5.51	5.08	**53.70**	0.70
mozilla	2.84	2.73	2.82	2.79	5.80	4.96	5.25	5.06	**49.29**	0.65
mr	3.80	3.18	3.23	3.40	7.09	5.33	5.33	5.22	**36.43**	0.76
nci	10.45	7.78	7.82	8.01	5.52	5.35	5.46	5.54	**151.65**	0.82
ooffice	2.27	2.33	2.35	2.35	5.69	5.52	6.04	5.42	**25.39**	0.62
osdb	3.57	3.95	3.69	3.89	6.00	7.62	6.72	7.45	**41.63**	0.63
reymont	3.45	3.45	3.43	3.19	6.57	6.50	6.44	6.57	**52.23**	0.75
samba	3.93	4.23	4.21	4.19	6.79	7.33	7.68	7.57	**68.45**	0.73
sao	1.99	2.03	2.02	1.98	4.93	5.04	4.11	4.66	**20.89**	0.58
webster	5.45	4.60	4.42	4.54	5.15	4.78	4.64	4.67	**77.37**	0.71
xml	11.30	11.82	11.55	11.55	8.34	9.60	9.78	9.08	**83.56**	0.75
x-ray	2.47	2.26	2.44	2.44	5.93	5.68	5.72	5.72	**23.02**	0.63
sources	3.63	3.44	3.45	3.25	5.88	5.38	5.59	5.47	**96.17**	0.71
pitches	3.61	4.04	4.18	3.78	6.06	5.70	5.70	5.93	**51.64**	0.70
proteins	6.00	4.92	4.95	4.73	4.45	4.15	4.19	4.07	**54.49**	0.65
dna	5.45	4.18	4.19	4.11	4.42	3.38	3.28	3.29	**78.27**	0.79
english	2.35	2.39	2.30	2.29	4.34	3.61	3.63	3.46	**75.93**	0.70
dblp.xml	8.09	6.15	6.62	6.40	6.15	5.43	5.52	5.40	**109.84**	0.71
Escherichia-Coli	6.93	6.40	6.80	6.48	4.93	6.00	5.72	5.84	**206.27**	0.77
cere	7.42	6.91	6.98	6.99	4.93	6.26	6.55	6.03	**382.20**	0.80
coreutils	6.34	12.30	13.48	9.44	5.52	13.85	14.89	9.75	**305.41**	0.70
einstein.de.txt	15.65	18.12	19.78	18.08	6.84	14.84	16.34	13.42	**352.43**	0.76
einstein.en.txt	14.20	12.29	12.69	12.62	6.53	9.36	9.48	8.70	**484.21**	0.72
influenza	11.88	7.67	7.76	7.67	6.01	4.82	4.71	4.88	**278.03**	0.80
kernel	6.70	18.83	16.77	12.99	4.88	20.03	19.53	13.30	**383.79**	0.75
para	7.46	6.61	6.89	6.37	4.76	6.08	6.16	5.99	**343.72**	0.80
world-leaders	9.90	8.90	10.06	8.49	5.74	6.99	7.61	6.22	**247.47**	0.81
hg38	5.85	3.85	3.65	3.72	4.41	2.76	2.84	2.97	**78.99**	0.76
mm10	5.89	3.97	3.80	3.95	4.30	3.06	3.04	3.03	**86.31**	0.81
rn6	5.96	3.89	3.59	3.82	4.43	3.04	3.08	3.12	**82.75**	0.79

Table 4: Decompression speed in MiB per second. The fastest decompression of each file is highlighted bold.

File	bw94	bw94-t-hirsch	bw94-t-greedy	bw94-t-gupdate	bcm	bcm-t-hirsch	bcm-t-greedy	bcm-t-gupdate	xz	zpaq
alice29.txt	**236.35**	268.66	278.36	302.92	239.79	279.65	287.19	301.20	1624.94	5040.30
asyoulik.txt	278.78	330.61	347.62	348.93	**270.93**	338.99	349.98	365.95	1903.58	6064.66
cp.html	**1303.90**	1342.52	1385.14	1390.47	1329.20	1415.77	1426.43	1442.41	7202.75	29654.08
fields.c	**2850.66**	2953.52	2944.71	2968.22	2991.73	3035.81	3050.50	3068.14	8070.03	47041.91
grammar.lsp	**8260.24**	8806.23	9035.19	8682.94	8709.36	8999.97	9184.90	8991.16	15622.26	89400.89
kennedy.xls	70.86	71.34	**69.72**	87.95	70.54	70.86	71.78	90.97	277.10	765.40
lcet10.txt	**109.49**	129.99	137.59	155.87	110.10	129.53	135.37	154.79	823.66	1833.14
plrabn12.txt	**100.64**	136.14	144.84	160.35	102.20	139.67	147.09	167.49	633.10	1591.95
ptt5	101.90	99.73	101.77	101.19	**98.96**	100.56	100.30	102.34	731.19	1533.06
sum	874.04	905.74	905.74	903.17	**840.62**	904.03	931.45	944.30	5760.96	20319.75
xargs.1	**7217.17**	7504.00	8000.13	7767.57	7612.53	7945.87	7961.37	8031.14	17302.62	99784.64
bible.txt	**47.30**	58.17	64.15	85.95	47.61	58.43	64.16	86.61	144.15	196.78
E.coli	**46.45**	106.91	120.38	144.65	46.74	107.27	120.54	144.70	77.45	63.69
world192.txt	**51.94**	53.04	57.04	78.00	52.51	52.67	57.05	78.27	265.94	324.32
dickens	43.12	67.06	75.79	100.21	**43.07**	67.37	75.78	100.24	116.62	84.59
mozilla	40.58	58.11	66.82	93.02	40.62	58.12	66.82	93.03	82.96	**17.96**
mr	43.22	55.70	62.97	86.25	**42.89**	55.71	62.88	86.28	122.31	86.36
nci	40.90	40.96	40.92	41.03	40.91	40.96	40.93	41.04	77.09	**26.59**
ooffice	**44.78**	80.75	91.47	114.89	44.88	81.15	91.35	115.32	163.38	135.74
osdb	**42.82**	52.23	58.95	82.24	42.89	52.29	59.10	82.54	127.51	85.92
reymont	**44.61**	50.73	56.11	78.16	44.90	50.91	56.45	78.51	153.72	126.42
samba	**41.40**	41.41	45.82	69.94	41.42	41.42	45.96	69.94	97.99	42.59
sao	**43.96**	110.04	127.09	152.01	44.09	110.36	127.25	151.77	149.20	116.18
webster	40.73	47.17	53.29	78.53	40.73	47.18	53.28	78.51	84.78	**22.16**
xml	45.56	45.78	45.48	50.12	45.62	**45.45**	45.57	50.46	170.19	154.93
x-ray	**43.53**	84.42	97.07	121.80	43.60	84.61	97.15	121.69	138.23	100.80
sources	40.14	40.14	43.12	70.20	40.14	40.14	43.12	70.20	26.87	**4.36**
pitches	40.56	63.78	72.74	99.23	40.54	63.80	72.75	99.23	82.06	**16.44**
proteins	40.02	57.16	66.61	97.25	40.02	57.16	66.61	97.25	4.46	**0.74**
dna	40.07	87.20	102.11	131.99	40.07	87.20	102.11	131.99	12.74	**1.70**
english	37.96	45.08	51.82	81.17	37.96	45.08	51.82	81.17	2.56	**0.41**
dblp.xml	40.10	40.10	40.10	56.19	40.10	40.10	40.10	56.18	19.13	**3.10**
Escherichia-Coli	40.26	40.26	40.26	53.38	40.27	40.26	40.26	53.36	45.68	**6.17**
cere	40.06	40.06	40.06	40.06	40.06	40.06	40.06	40.06	11.12	**1.05**
coreutils	40.14	40.14	40.14	40.14	40.14	40.14	40.14	40.14	27.60	**4.47**
einstein.de.txt	40.32	40.33	40.32	40.32	40.32	40.32	40.32	40.33	58.52	**9.91**
einstein.en.txt	40.06	40.06	40.06	40.06	40.06	40.06	40.06	40.06	11.94	**1.96**
influenza	40.19	40.18	40.19	40.19	40.18	40.18	40.18	40.19	33.21	**4.39**
kernel	40.11	40.11	40.11	40.11	40.11	40.11	40.11	40.11	21.95	**3.56**
para	40.07	40.07	40.07	40.07	40.07	40.07	40.07	40.07	11.95	**1.18**
world-leaders	40.66	40.69	40.66	40.69	40.67	40.65	40.65	40.67	82.26	**19.46**
hg38	27.51	57.87	68.95	91.11	27.51	57.87	68.95	91.11	1.68	**0.12**
mm10	31.63	67.06	79.95	105.43	31.63	67.06	79.95	105.43	1.93	**0.14**
rn6	30.74	65.42	77.88	102.65	30.74	65.42	77.88	102.65	1.87	**0.14**

Table 5: Compression memory peak in bits per symbol. The compression with the lowest memory peak is highlighted bold.

File	bw94	bw94-t-hirsch	bw94-t-greedy	bw94-t-gupdate	bcm	bcm-t-hirsch	bcm-t-greedy	bcm-t-gupdate	xz	zpaq
alice29.txt	223.20	217.17	217.17	219.11	222.99	241.52	239.58	233.55	**173.43**	5019.18
asyoulik.txt	257.31	267.00	271.19	273.28	280.35	270.66	276.42	272.76	**207.84**	6055.24
cp.html	1309.22	1313.22	1311.89	1267.94	1351.84	1322.54	1341.19	1375.82	**1060.16**	29540.87
fields.c	2841.85	2830.09	2809.52	2824.21	2962.34	2938.83	2882.99	2906.50	**2392.21**	46836.19
grammar.lsp	8383.53	8154.57	8330.69	8436.37	8594.88	8762.20	8506.82	8630.11	**7221.11**	88388.17
kennedy.xls	66.85	69.24	68.60	68.28	69.27	70.16	71.31	70.23	**27.52**	764.76
lcet10.txt	105.42	104.42	106.19	106.42	108.57	109.26	110.79	109.49	**64.03**	1823.93
plrabn12.txt	96.97	101.52	101.39	102.20	100.57	102.48	100.91	99.96	**56.71**	1588.68
ptt5	95.32	96.15	94.87	96.79	95.64	99.09	102.09	100.36	**53.18**	1529.99
sum	810.63	884.32	835.48	841.47	876.61	868.04	860.33	868.90	**712.94**	20288.05
xargs.1	7170.66	7286.94	7519.50	7379.97	7651.29	7612.53	7798.58	7550.51	**6503.98**	99521.07
bible.txt	46.81	48.34	48.32	48.33	47.45	49.04	49.02	48.95	**12.88**	196.11
E.coli	45.93	47.16	47.26	47.18	45.82	47.45	47.70	47.45	**12.17**	63.26
world192.txt	51.09	51.31	50.19	50.36	51.46	51.07	51.37	50.99	**16.03**	323.57
dickens	42.94	44.08	44.07	44.00	42.85	44.18	44.19	44.20	**10.00**	84.46
mozilla	40.55	39.97	39.62	39.95	40.55	39.98	39.66	40.00	**8.39**	17.91
mr	42.86	44.80	44.82	44.86	42.85	44.94	44.95	44.89	**10.05**	86.23
nci	40.85	37.25	36.55	36.98	40.83	37.28	36.61	37.01	**8.59**	26.55
ooffice	44.45	44.81	44.90	44.86	44.44	45.08	44.95	45.03	**11.12**	135.25
osdb	42.80	31.83	31.89	31.79	42.80	31.96	31.79	32.06	**9.92**	85.63
reymont	44.37	45.36	45.15	45.00	44.26	45.47	45.27	45.20	**11.00**	126.19
samba	41.29	34.69	34.04	34.94	41.28	34.77	34.13	34.99	**8.90**	42.46
sao	43.83	45.90	45.83	45.74	44.02	46.12	46.05	46.13	**10.64**	115.97
webster	40.66	42.06	42.05	42.06	40.67	42.07	42.11	42.06	**8.48**	22.11
xml	45.07	34.10	33.12	35.36	45.67	34.66	33.32	35.40	**11.58**	154.41
x-ray	43.28	45.38	45.33	45.23	43.37	45.46	45.62	45.51	**10.34**	100.44
sources	40.12	36.50	35.65	36.08	40.13	36.51	35.65	36.06	**2.63**	4.35
pitches	40.49	32.48	31.78	32.35	40.50	32.52	31.82	32.35	**8.35**	16.42
proteins	40.02	27.66	27.23	27.90	40.02	27.66	27.23	27.90	**0.47**	0.74
dna	40.06	41.39	41.38	41.38	40.07	41.40	41.38	41.38	**1.37**	1.70
english	37.96	27.87	27.82	27.94	37.96	27.87	27.82	27.94	**0.25**	0.41
dblp.xml	40.09	33.48	32.96	33.86	40.09	33.49	32.96	33.87	**1.87**	3.09
Escherichia-Coli	40.24	13.36	12.52	13.23	40.26	13.36	12.56	13.23	**4.94**	6.15
cere	40.06	8.24	7.85	8.43	40.06	8.25	7.86	8.43	1.20	**1.04**
coreutils	40.13	6.18	5.82	10.93	40.13	6.18	5.83	10.95	**2.70**	4.47
einstein.de.txt	40.29	8.01	6.94	10.41	40.31	8.02	6.97	10.41	**6.00**	9.88
einstein.en.txt	40.05	12.62	11.64	14.53	40.06	12.62	11.64	14.54	**1.19**	1.96
influenza	40.17	38.38	37.55	37.92	40.18	38.39	37.56	37.92	**3.59**	4.38
kernel	40.10	2.21	**2.12**	3.75	40.11	2.21	2.12	3.75	2.15	3.55
para	40.06	8.14	7.53	8.47	40.06	8.14	7.54	8.48	1.29	**1.17**
world-leaders	40.58	21.84	19.97	23.32	40.59	21.87	19.99	23.32	**8.43**	19.43
hg38	27.51	28.38	28.36	28.37	27.51	28.38	28.36	28.37	0.18	**0.12**
mm10	31.63	32.70	32.66	32.70	31.63	32.70	32.66	32.70	0.20	**0.14**
rn6	30.73	30.76	30.74	30.76	30.73	30.76	30.73	30.76	0.20	**0.14**

Table 6: Decompression memory peak in bits per symbol. The decompression with the lowest memory peak is highlighted bold.