

Benchmark	Time (s)	Instructions	Rel to start	Rel to prev	Improvement
midmark (small)	10.88	49,630,189,163	1.00	1.00	No improvement (starting point)
advent (intermediate)	93.58	421,401,013,254	1.00	1.00	
sandmark (large)	271.39	1,232,078,485,575	1.00	1.00	
midmark (small)	7.73	38,933,068,525	0.710	0.710	Compile with -O1 and link with -lci40-O1
advent (intermediate)	65.60	NA	0.701	0.701	
sandmark (large)	193.18	NA	0.712	0.712	
midmark (small)	6.40	36,237,424,773	0.588	0.828	Compile with -O2 and link with -lci40-O2
advent (intermediate)	55.17	NA	0.590	0.841	
sandmark (large)	159.77	NA	0.589	0.827	
midmark (small)	4.35	16,217,095,037	0.400	0.680	Replaced bitpack_getu functional calls with one-line right/left shifts in instruction value getter functions
advent (intermediate)	39.22	NA	0.419	0.711	
sandmark (large)	108.26	NA	0.399	0.678	
midmark (small)	4.32	16,217,094,052	0.397	0.993	Replace instruction-value getter functions with inline bit shifts
advent (intermediate)	39.08	NA	0.418	0.996	
sandmark (large)	107.77	NA	0.397	0.995	
midmark (small)	4.34	16,217,094,776	0.399	1.005	Moved all functions from segment module into read_and_execute module
advent (intermediate)	39.16	NA	0.418	1.002	
sandmark (large)	108.49	NA	0.400	1.007	
midmark (small)	4.33	16,211,372,261	0.398	0.998	Remove bitpack module by adding remaining function calls directly inline in read_instructions function
advent (intermediate)	38.79	NA	0.415	0.991	
sandmark (large)	108.37	NA	0.399	0.999	
midmark (small)	4.33	16,211,312,041	0.398	1.000	Replaced defined constant int with hardcoded values - realized this won't have an impact
advent (intermediate)	38.83	NA	0.415	1.001	
sandmark (large)	108.06	NA	0.398	0.997	
midmark (small)	1.21	6,050,173,032	0.111	0.279	Isolated zero_segment by removing it from the sequence of segment and set it as an array of uint32_t. This also required moving the load_program function from the operations module directly into the switch statement.
advent (intermediate)	7.98	NA	0.085	0.206	
sandmark (large)	31.15	NA	0.115	0.288	
midmark (small)	1.15	5,515,831,885	0.106	0.950	Move seg_load and seg_store directly into switch statement
advent (intermediate)	7.38	NA	0.079	0.925	
sandmark (large)	29.13	NA	0.107	0.935	
midmark (small)	1.02	4,995,430,935	0.094	0.887	Changed all UArrays of uint32_t to arrays of uint32_t. This required moving map_segment into the switch statement directly and adding a sequence to keep track of segment lengths.
advent (intermediate)	6.93	NA	0.074	0.939	
sandmark (large)	26.54	NA	0.098	0.911	
midmark (small)	0.97	4,697,676,482	0.089	0.951	Move the remaining operations from the operations module into inside the switch statement
advent (intermediate)	5.67	NA	0.061	0.818	
sandmark (large)	24.82	NA	0.091	0.935	
midmark (small)	0.95	4,697,676,482	0.087	0.979	Remove enums from inside switch statement and replace with instruction numbers (ints) - realized the compiler must do this already since this does not change the number of instructions
advent (intermediate)	5.66	NA	0.060	0.998	
sandmark (large)	24.71	NA	0.091	0.996	
midmark (small)	0.84	4,714,824,059	0.077	0.884	Replacing switch statement with if else statements
advent (intermediate)	4.69	NA	0.050	0.829	
sandmark (large)	22.03	NA	0.081	0.892	
midmark (small)	0.81	4,620,956,747	0.074	0.964	Condense functions in read_and_execute module (including word_at and free_all_segments, excluding new_address_space) into one function
advent (intermediate)	4.69	NA	0.050	1.000	
sandmark (large)	21.31	NA	0.079	0.967	
midmark (small)	0.83	4,621,196,171	0.076	1.025	Move new_address_space function into the single function in read_and_execute module
advent (intermediate)	4.73	NA	0.051	1.009	
sandmark (large)	22.18	NA	0.082	1.041	
midmark (small)	0.77	4,427,728,324	0.071	0.928	Remove address_space struct by initializing struct content (Seq_T in_use, Seq_T unmapped, Seq_T lengths) within um_driver function
advent (intermediate)	4.45	NA	0.048	0.941	
sandmark (large)	20.35	NA	0.075	0.917	
midmark (small)	0.83	4,585,380,776	0.076	1.078	Move the condensed function in read_and_execute into the main function in um.c to make the program one single function - slower so undid
advent (intermediate)	4.74	NA	0.051	1.065	
sandmark (large)	21.71	NA	0.080	1.067	
midmark (small)	0.77	4,427,715,941	0.071	0.928	Moved the condensed function in read_and_execute into um.c so that the program is in one file - undid this change
advent (intermediate)	4.46	NA	0.048	0.941	
sandmark (large)	20.57	NA	0.076	0.947	
midmark (small)	0.64	3,723,393,947	0.059	0.831	Remove assertion statements since the program is allowed to fail in any way on failure modes
advent (intermediate)	4.04	NA	0.043	0.906	
sandmark (large)	17.37	NA	0.064	0.844	

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midmark (small)	0.64	3,723,393,947	0.059	1.000	Remove mod in add and multiply function as it is not necessary with uint32_t types
advent (intermediate)	4.05	NA	0.043	1.002	
sandmark (large)	17.70	NA	0.065	1.019	
midmark (small)	0.64	3,748,267,473	0.059	1.000	Remove sys/stat.h since the program is allowed to fail if at the beginning of a machine cycle, the program counter points to an invalid instruction, so no need to check if the file contains valid all instructions - undid this
advent (intermediate)	4.17	NA	0.045	1.030	
sandmark (large)	17.74	NA	0.065	1.002	
midmark (small)	0.64	3,723,393,947	0.059	1.000	Changed all i++ increments to i += 1
advent (intermediate)	4.00	NA	0.043	0.959	
sandmark (large)	17.53	NA	0.065	0.988	
midmark (small)	0.67	3,764,235,414	0.062	1.047	When freeing segments, start at the highest index and remove high so that remaining segments do not have to be shifted as they are removed
advent (intermediate)	4.51	NA	0.048	1.128	
sandmark (large)	17.75	NA	0.065	1.013	
midmark (small)	0.56	3,314,147,282	0.051	0.836	Changed Seq_T lengths to a dynamic array of uint32_t
advent (intermediate)	3.67	NA	0.039	0.814	
sandmark (large)	14.69	NA	0.054	0.828	
midmark (small)	0.40	2,812,793,247	0.037	0.714	Change Seq_T in_use to a dynamic array of uint32_t *
advent (intermediate)	3.10	NA	0.033	0.845	
sandmark (large)	10.60	NA	0.039	0.722	
midmark (small)	0.48	3,430,504,737	0.044	1.200	Change Seq_T unmapped to a dynamic array of uint32_t - undid this
advent (intermediate)	3.12	NA	0.033	1.006	
sandmark (large)	11.83	NA	0.044	1.116	
midmark (small)	0.36	2,276,728,919	0.033	0.750	Reorder if-else statements based on frequency in advent. umz instructions (from greatest to least)
advent (intermediate)	2.70	NA	0.029	0.865	
sandmark (large)	9.60	NA	0.035	0.811	