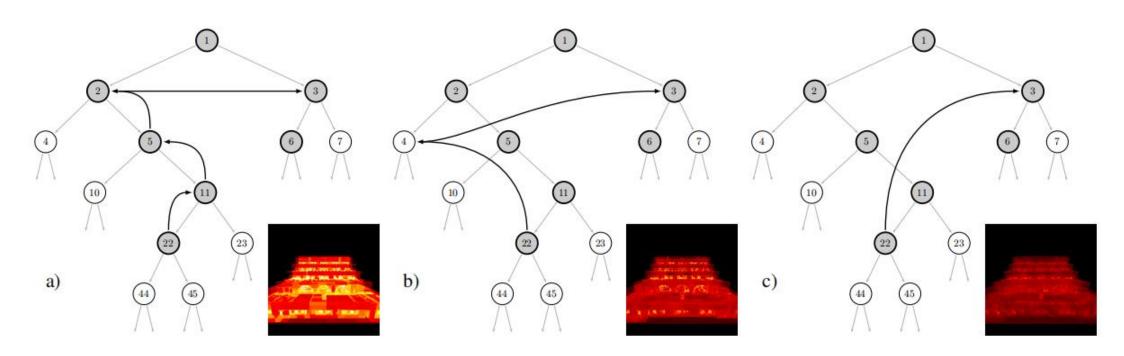
Efficient Stackless Hierarchy Traversal on GPUs with Backtracking in Constant Time

Nikolaus Binder[†] and Alexander Keller[‡]

NVIDIA Corporation







OutLine

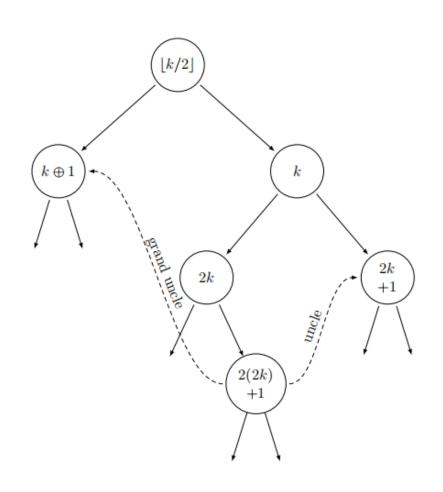


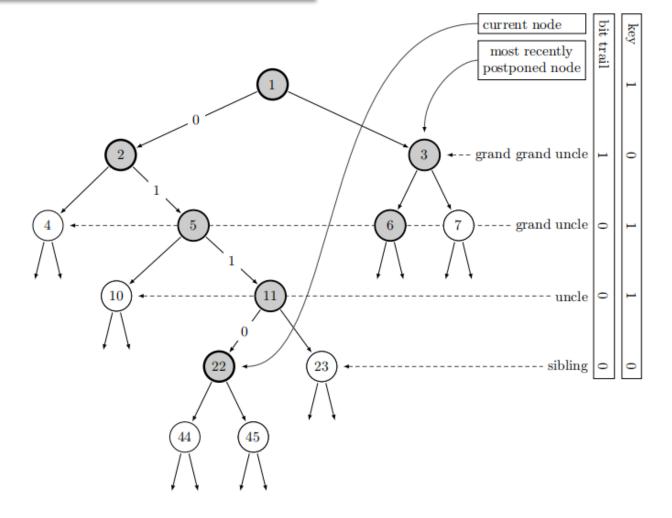
- Introduction
- Backtracking in Constant Time
- Perfect Hashing
- Parallel Construction of Hash Tables
- Disjoint t-Intervals Mask
- Pausing and Resuming
- Other tricks



Backtracking in Constant Time







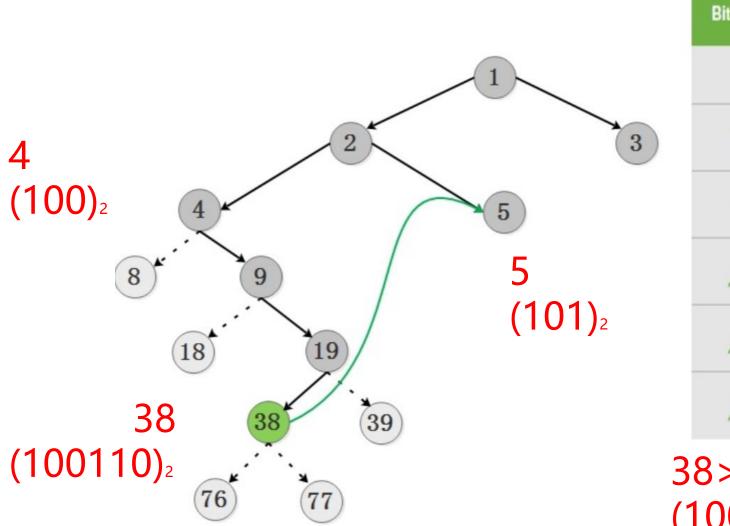
a)

b)



Backtracking in Constant Time





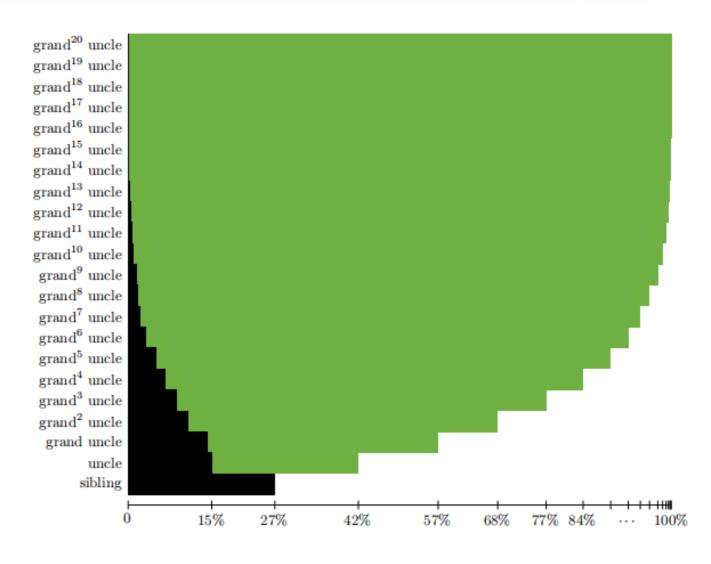


38>>3 (100)₂



Backtracking in Constant Time



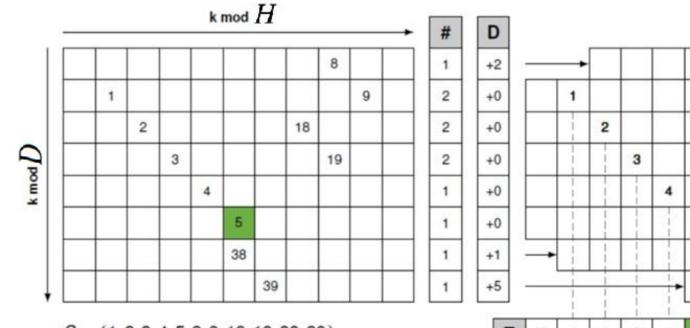




Perfect Hashing



$$h(k) := (k + d_{k \mod D}) \mod H$$

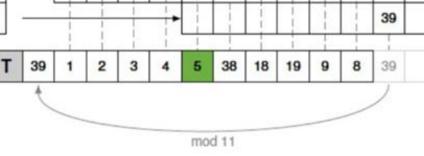




$$|S| = 11$$

 $|T| = 11 = |S| \Rightarrow \text{minimal perfect hash table}$

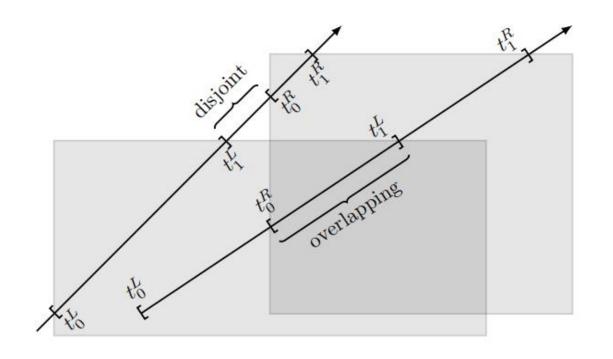
$$|D| = 8$$





Disjoint t-Intervals Mask





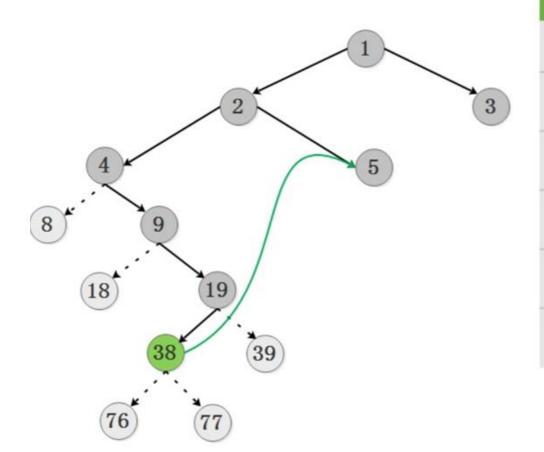


Disjoint t-Intervals Mask



bitTrail &= disjointIntervalsTrail (bitTrail & -bitTrail) & disjointIntervalsTrail

bitTrial=(10010)₂ lowbit(.)=(10)₂



Bit Trail

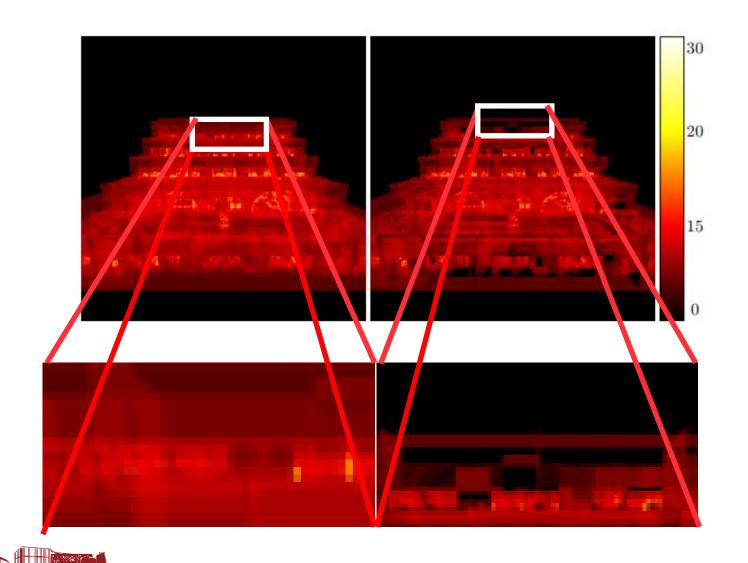
disjointIntervalsTrail

1

1

Disjoint t-Intervals Mask









Thanks for listening!





Performance









Performance



Table 2: Performance for primary rays (P), diffuse shadow rays (S) and diffuse closest hit rays (D) in M rays/s and relative to [AL09].

Algorithm	[AL09]			[ÁSK14]						our new algorithm					
	P	S	D	P		S		D		P		S		D	
Tears In The Rain	947	338	310	823	87%	302	89%	267	86%	1042	110%	431	128%	393	127%
Sibenik	790	292	231	628	79%	247	85%	169	73%	803	102%	316	108%	237	103%
Fairy-Forest	426	232	188	351	82%	189	81%	147	78%	452	106%	254	109%	207	110%
Armadillo	837	236	214	731	87%	212	90%	191	89%	981	117%	312	132%	288	135%
CrytekSponza	514	246	165	413	80%	207	84%	125	76%	541	105%	275	112%	178	108%
Conference	786	399	253	662	84%	392	98%	221	87%	820	104%	498	125%	304	120%
Powerplant	692	250	189	578	84%	233	93%	158	84%	743	107%	297	119%	225	119%
Arabic-City	673	332	261	543	81%	279	84%	206	79%	698	104%	384	116%	300	115%
Classroom	457	234	175	399	87%	190	81%	135	77%	513	112%	263	112%	195	111%
Persian-City	570	304	201	461	81%	255	84%	144	72%	587	103%	337	111%	203	101%
Dragon	743	212	194	624	84%	184	87%	164	85%	866	117%	280	132%	254	131%
Emily	676	254	234	542	80%	224	88%	201	86%	737	109%	320	126%	293	125%
Buddha	1237	210	185	1089	88%	187	89%	162	88%	1419	115%	281	134%	245	132%
Veyron	752	180	144	610	81%	157	87%	114	79%	829	110%	224	124%	167	116%
Levi	667	232	213	559	84%	197	85%	181	85%	770	115%	305	131%	277	130%
Bubs	709	335	237	586	83%	262	78%	179	76%	797	112%	358	107%	261	110%
Soda Hall	649	362	262	513	79%	323	89%	192	73%	666	103%	414	114%	266	102%
Hairball	190	77	65	147	77%	72	94%	57	88%	192	101%	96	125%	79	122%
Pipers Alley	558	199	164	464	83%	175	88%	134	82%	580	104%	232	117%	186	113%
Enchanted Forest	237	81	64	205	86%	77	95%	56	88%	250	105%	99	122%	76	119%
San-Miguel	246	149	81	198	80%	138	93%	65	80%	257	104%	184	123%	89	110%
Average					83%		88%		81%		108%		120%		117%



Thanks for listening!

