A Probabilistic Model Revealing Shortcomings in Lua's Hybrid Tables

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Joint work with

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Introduction

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$\Rightarrow$ `Lua 5.0` introduced several innovations,
among them a new Table structure.

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- in worst case, but most importantly,
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- present also an analysis of the hybrid table-array.

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- Trouble for more realistic examples ?

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Simple Probabilistic model

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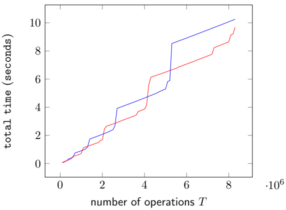

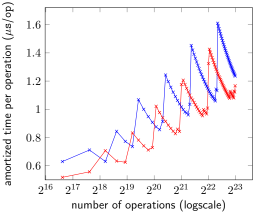

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With high probability time is $\Omega(T \log T)$.

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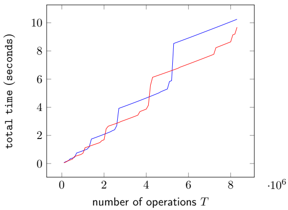

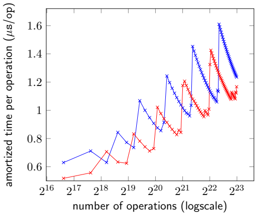

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Plan of the talk

1. The Lua hashmap
2. The probabilistic model
3. Conclusions and further work

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H	0	1	2	3	4	5	6	7
	120		a	d		b	e	c
	20		8	8		12	21	11
	7		5	nil		nil	nil	6

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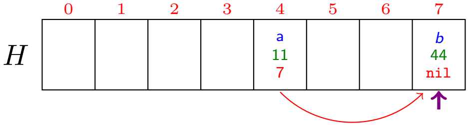

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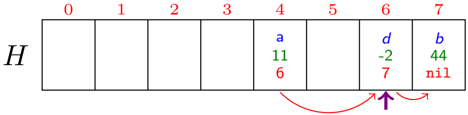

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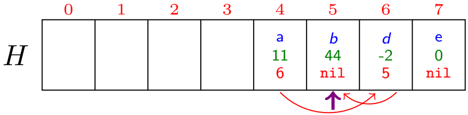

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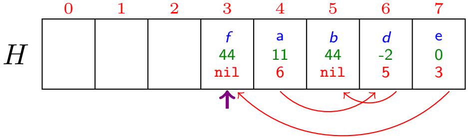

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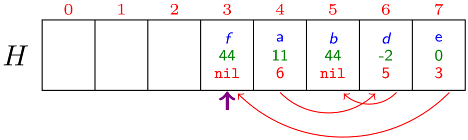

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… deleted spots are cleaned up during rehashing

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We set a more interesting yet simple model

Probabilistic model

Fix $p > \frac{1}{2}$ and apply T insertion/deletions from an empty table:

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- Each rehash costs linear time $\Theta(M)$. ☹

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Under these conditions, between two rehashes, the number of deleted cells satisfies the recurrence (starting from $\delta_{t_0} = 0$)

$$\delta_{t+1} = \begin{cases} \delta_t - 1 & \text{with probability } \frac{p\delta_t}{M} & [\textit{insertion at deleted key}], \\ \delta_t & \text{with probability } p\left(1 - \frac{\delta_t}{M}\right) & [\textit{insertion at free cell}], \\ \delta_t + 1 & \text{with probability } 1 - p & [\textit{deletion}]. \end{cases}$$

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- Tools: concentration inequalities.

Hybrid Tables and insertions

- Rehashes into same size hashtables pile up to $\Omega(T \log T)$.

Hybrid Tables and insertions

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Example: inserting $-(2^k - 1), -(2^k - 2), \ldots, -1, 0, 1, \ldots, 2^k$

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- Issue can be fixed by ensuring more room when rehashing.
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Conclusions

- Will Lua conceptors take this into account?
- Important to model and study algorithms implemented in practice.

Thank you!