

# To Iterate is Human, To Recurse is Divine

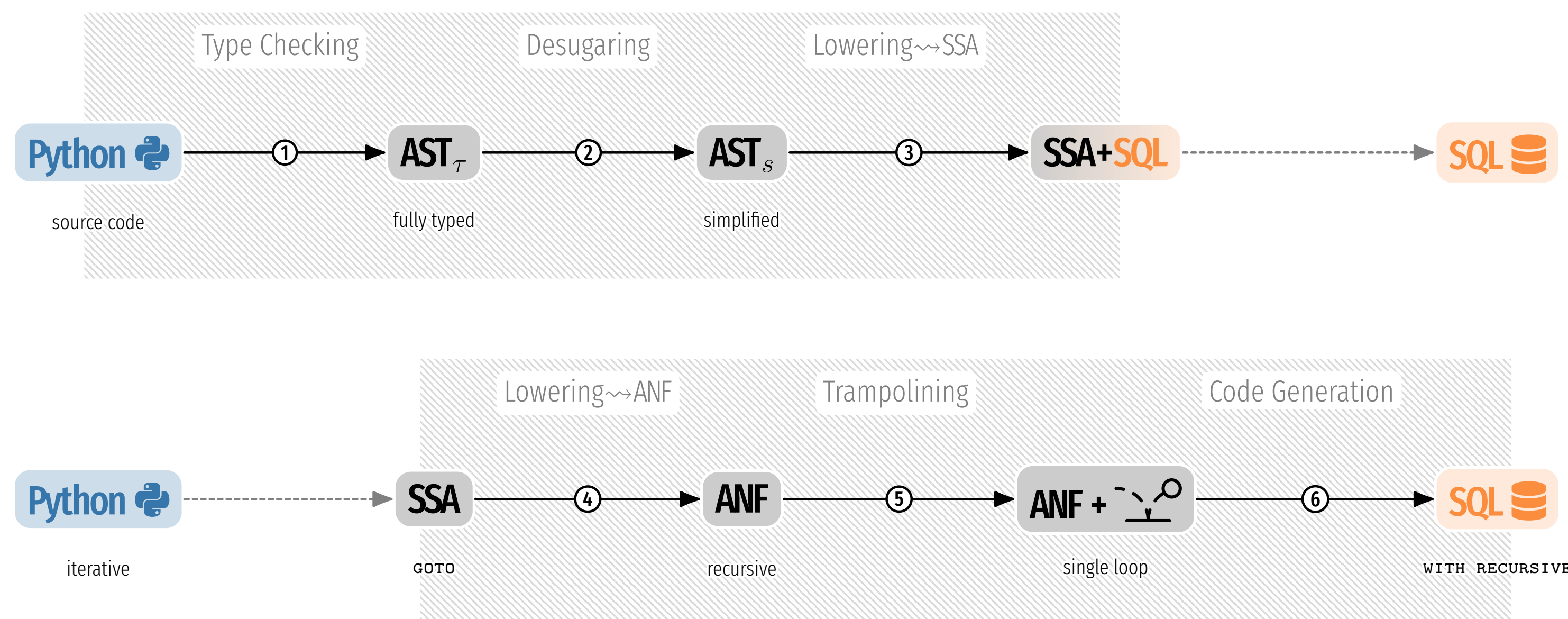
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## (Newly) Supported Python Features

- conditional statements as well as expressions (`if, elif, else`)
- conditional-, range-, and list-loops (`while, for`)
- flow control statements (`break, continue, return`)
- a large range of builtin operators (`+, in, is, None, ...`) and functions (`len, min, max, ...`)
- **arbitrarily nested** (augmented-)assignments (`l[1].a += {"key": True}`)
- embedded read-only queries (`SQL("...")`, `SQL("...$1...")`, `[1]`)
- composite types via dataclasses, attributes access (`thing.attr`)
- lists, indexed access and slicing (`l[1:4]`), stateful list methods (`l.pop()`)
- **dictionaries**, **key access** (`d["key"]`), **stateful dictionary methods** (`d.update({...})`)
- **delete statements** (`del d["key"]`, `del l[4:2]`)
- **implicit "truthiness"** (`... if [] else ...`)

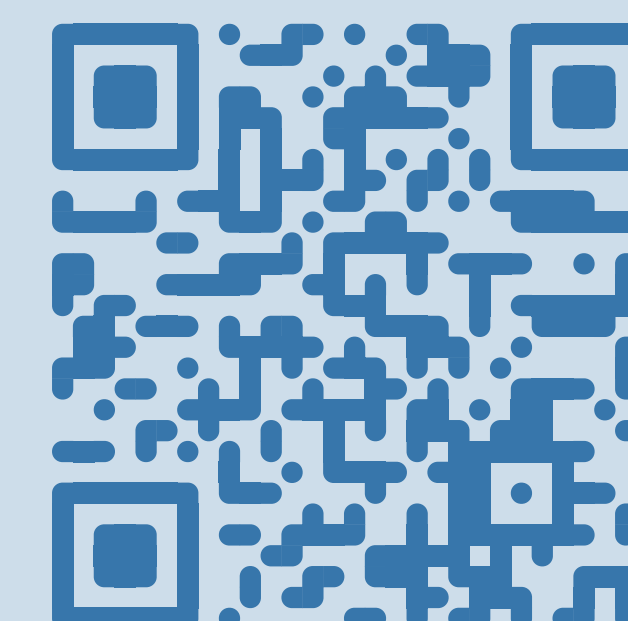
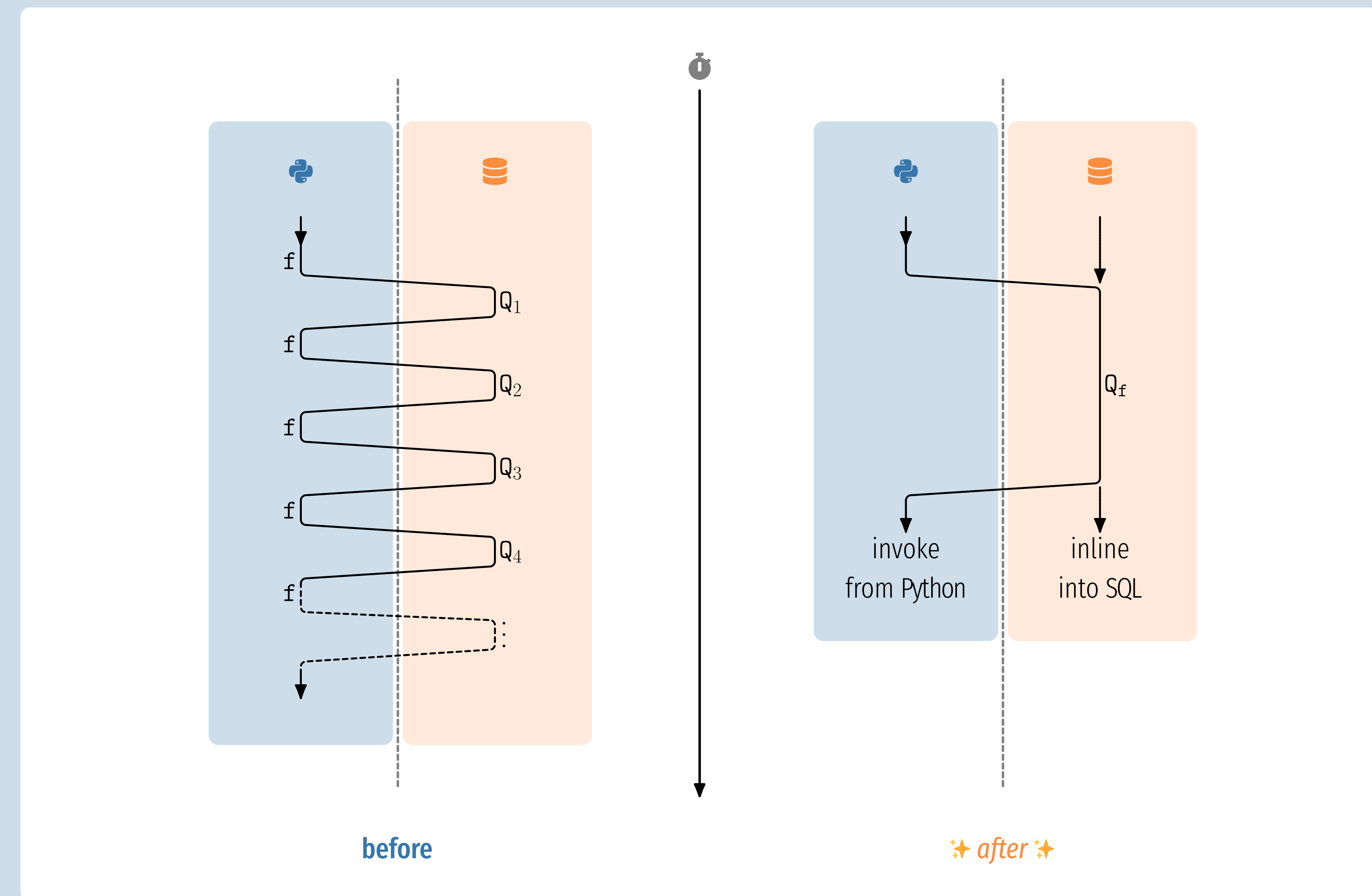
## Compiler Stages



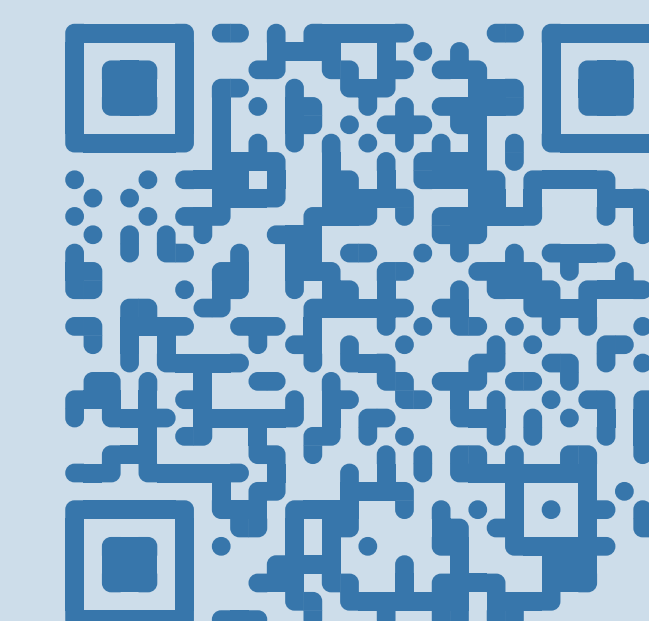
## A Collection of Compiled Python UDFs

Function	CC	Loops	#  per call	Runtime (Speedup) after compilation
<code>march</code> track border of 2D object (Marching Squares)	5 <u>Q</u>		2000	13% ( 7.6×)
<code>savings</code> optimize supply chain of a TPC-H order	4 <u>QQ</u> <u>QQQQ</u>		18	5% (19.5×)
<code>packing</code> pack TPC-H lineitems tightly into containers	9 <u>QQ</u> <u>Q</u>		45	16% ( 6.3×)
<code>force</code> <i>n</i> -body simulation (Barnes-Hut quad tree)	5 <u>Q</u> <u>Q</u>		126	27% ( 3.9×)
<code>margin</code> buy/sell TPC-H orders to maximize margin	5 <u>Q</u> <u>QQ</u>		61	24% ( 4.2×)
<code>markov</code> Markov-chain based robot control	5 <u>QQQ</u>		3000	39% ( 2.6×)
<code>vm-collatz</code> calculate the <i>collatz conjecture</i> on a simple VM	17 <u>Q</u>		67	30% ( 3.3×)
<code>vm-padovan</code> calculate the <i>padovan sequence</i> on a simple VM	17 <u>Q</u>		7100	12% ( 8.5×)

# Compile an iterative Python function into a single recursive SQL query.



Try the demo  
<https://apfel-db.cs.uni-tuebingen.de>



Download the full paper  
<https://db.cs.uni-tuebingen.de/publications/2023/btw/>