The

COMFORT

Automatic Tuning Project

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Why Automatic Tuning?

- there are typically 20-100 parameters just for system startup profile
- there is virtually no help in choosing settings in an intelligent way
- human resources are very cost intensive ("tuning gurus")

Question: Is automatic tuning indeed feasible or simply wishful thinking?

Introduction

Comfortable Performance Tuning

- **started in 1990**
- **aims:**
  - simplifying the job of human tuning experts
  - automating the entire tuning process
- **two lines of research:**
  - exploring architectural principles
  - building a prototype system

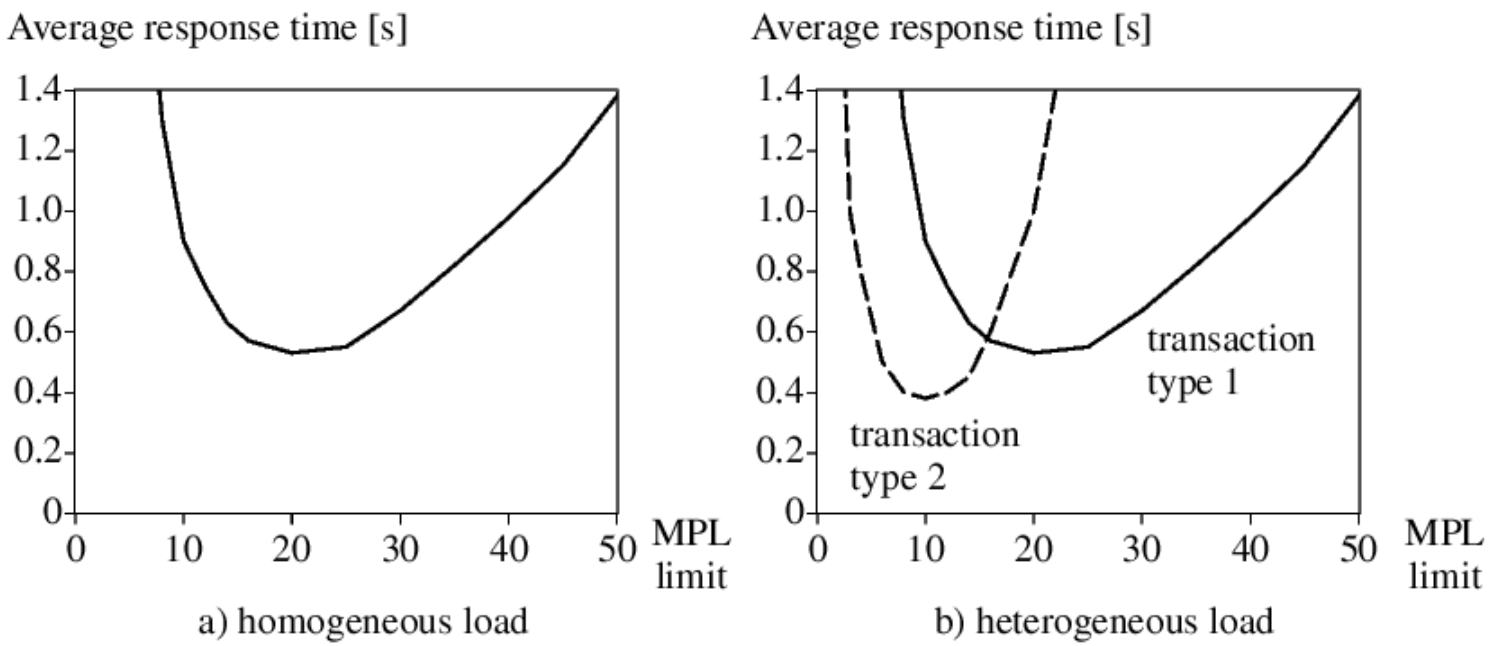
Self-Tuning Load Control for Locking

Tuning Problem

- **transactions are executed concurrently:**
  ACID-Properties must be kept
  ⇨ strict two-phase locking protocol
- **lock conflicts can result in deadlocks**
- **probability of thrashing is influenced by:**
  - number of concurrently executed transactions
  - access frequency of database objects
  - granularity of locking
  - length of transactions (number of locks, locking-time)
  - variance of transactions length

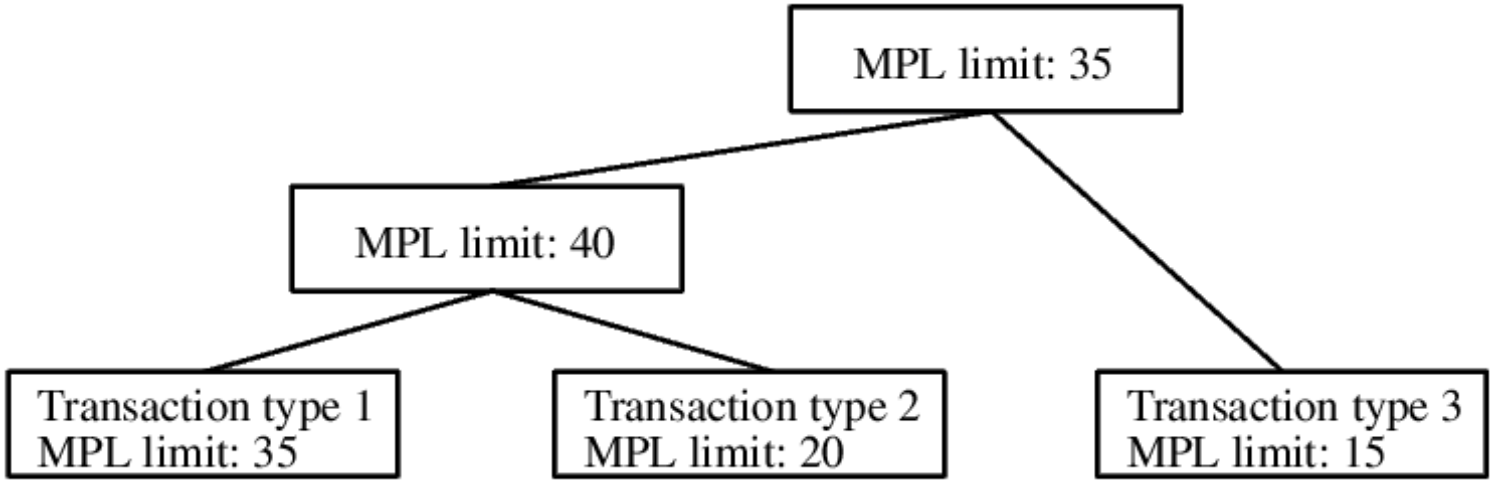
Sphinx Method

- **MPL (multiprogramming level) limits number of concurrently executed transactions**



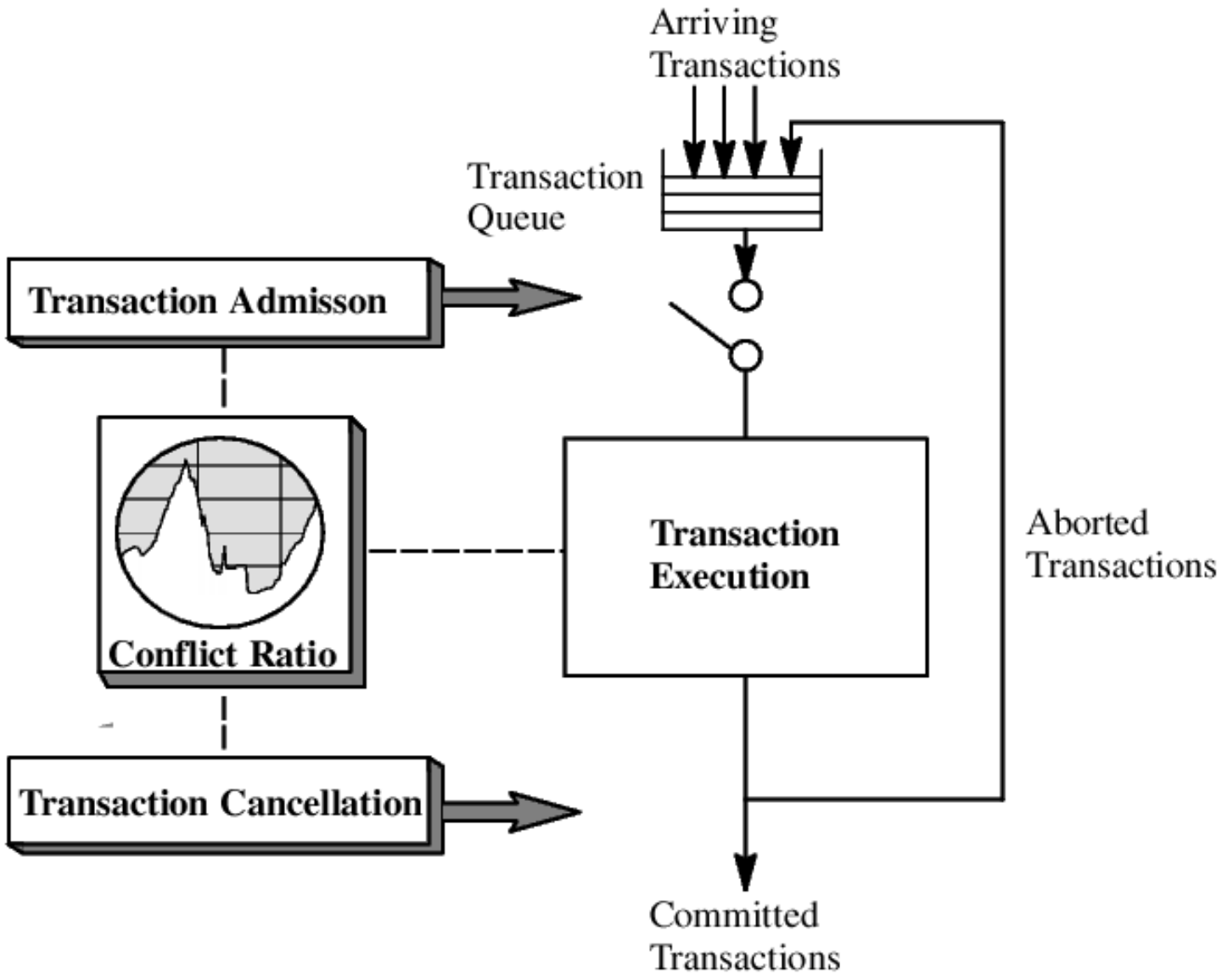
Sisyphus Method

- **specific MPL-limit for each transaction type**
- **scheduling-tree**



Conflict-driven Load Control

- **Idea: adjusting the MPL limit in real-time**
- **Problem: which metric should be used?**
  - interval-based (e.G. ratio of lock waits for lock requests)
  - status-based (e.G. blocked TAs / processed TAs)
  - $$\text{conflict ratio} = \frac{\text{num. locks}}{\text{num. locks (non-blocked transactions)}}$$


Arriving
Transactions
Transaction
Queue
Transaction Admisson
Conflict Ratio
Transaction
Execution
Aborted
Transactions
Transaction Cancellation
Committed
Transactions

Experiments

- **CONF guarantees acceptable response time**
- **response time never worse than 150% of best methods response time**
- **results do not depend on load-specific fine-tuning of critical conflict ratio** (values 1.3-1.9 acceptable)
  - **is a self-tuning and robust method**

Self-Tuning Memory Management

Tuning Problem

- **much memory is used to buffer popular pages**
- **goal: reduce the overall disk I/O rate**
- **"Five-minute Rule":** pages accessed more often than every five minutes should reside in memory
- **data access frequencies may change over time**
- **popular pages have to be estimated correctly**
- **LRU (Least Recently Used) decides-bad in many practically relevant situations**

Tuning Methods

- **LFU (Least Frequently Used):** poor in reactivity to evolving workloads
- **"Spinx Method":** density-based buffering (LRD-V2)
- **"Sisyphus Method":** subdividing memory into several buffer pools (which are managed by LRU)

Automatic Tuning: LRU-K

- **best metric for tuning: reference frequency**
- **basic idea: record the last K references for each page**
- **compute the interarrival time**
- **problem: storage overhead**
- **solution: if page was not re-referenced in the right time, the information can be dropped** (can not be hot in this case)

Summary

- truly, self-reliant solutions have been lacking for most problems
- need of automatic performance tuning
- self-tuning approaches are feasible
- the authors hoped that their "work encourages more research in this increasingly important area"