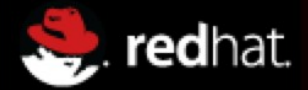


**RED HAT®
TRAINING**



Comprehensive, hands-on training that solves real-world problems

Red Hat Performance Tuning

DAY ONE	DAY TWO	DAY THREE	DAY FOUR
Introduction	Hardware Profiling	Large Memory Workload Tuning	Tuning a Database Server
Collecting and Graphing	Software Profiling	CPU Intensive Workload Tuning	Power Usage Tuning
General Tuning	Using SystemTap	File Server Tuning	Tuning For Virtualization
Limiting Resource Usage	Small File Tuning		Comprehensive Review

Welcome

Course Objectives and Structure

DAY ONE	DAY TWO	DAY THREE	DAY FOUR
Introduction	Hardware Profiling	Large Memory Workload Tuning	Tuning a Database Server
Collecting and Graphing	Software Profiling	CPU Intensive Workload Tuning	Power Usage Tuning
General Tuning	Using SystemTap	File Server Tuning	Tuning For Virtualization
Limiting Resource Usage	Small File Tuning		Comprehensive Review

Orientation to Classroom Network

Internationalization

DAY ONE

Introduction

Collecting, Graphing,
and Interpreting Data

General Tuning

Limiting Resource
Usage

Chapter 1: Introduction to Performance Tuning

- What is Performance Tuning?
- Performance-level Agreements
- Performing System Changes

Goal:

Present a high-level overview of performance tuning and its goals.

Objectives:

- Describe Performance Tuning
- Describe Performance Level Agreements
- Perform system changes.

What is Performance Tuning?

Practice: Performance Tuning Techniques

Performance-level Agreements

Practice: Service-level Agreement or Performance-level Agreement

Performing System Changes

Practice: Steps to Take When Applying a Tuning Change

Lab: Introduction to Performance Tuning

Summary

DAY ONE

Introduction

**Collecting, Graphing,
and Interpreting Data**

General Tuning

Limiting Resource
Usage

Chapter 2: Collecting, Graphing, and Interpreting Data

- Units and Unit Conversions
- Profiling Tools
- Using awk to Format Data
- Plotting Data
- Performance Co-Pilot

Goal:

Collect, graph, and analyze data.

Objectives:

- Convert from one unit to another
- Gather and analyze data using `sar`, `iostat`, and `vmstat`
- Format data with `awk`
- Utilize common regular expressions with `awk`
- Graph data with `gnuplot`
- Gather and display data with Performance Co-Pilot

Units and Unit Conversions

Practice: Converting Units

Profiling Tools

Practice: Install and Configure sar

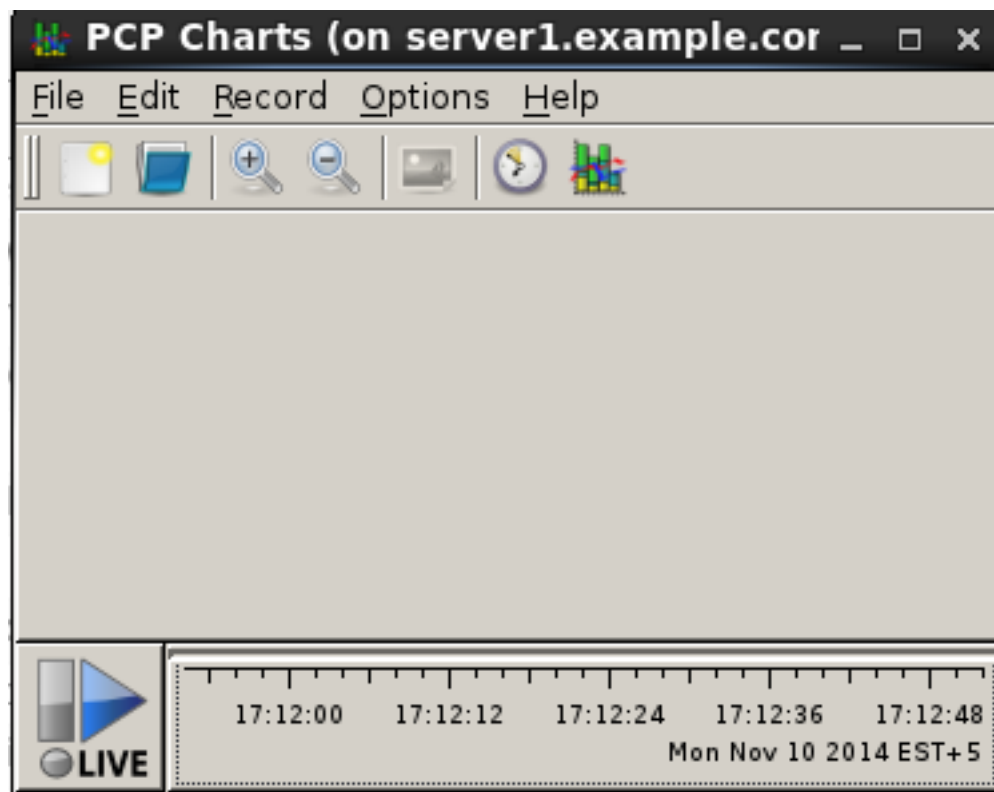
Using awk to Format Data

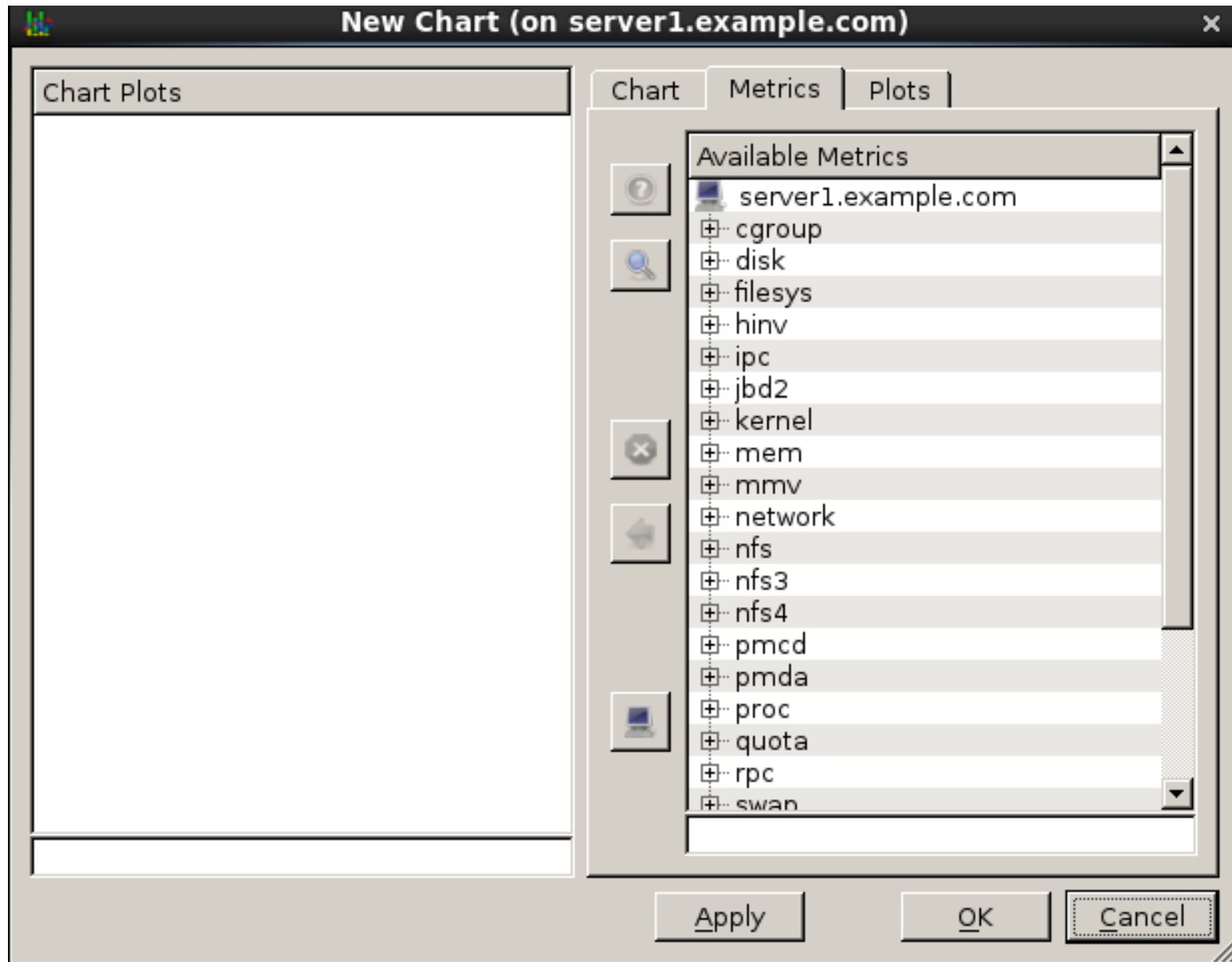
Practice: Formatting Data with awk

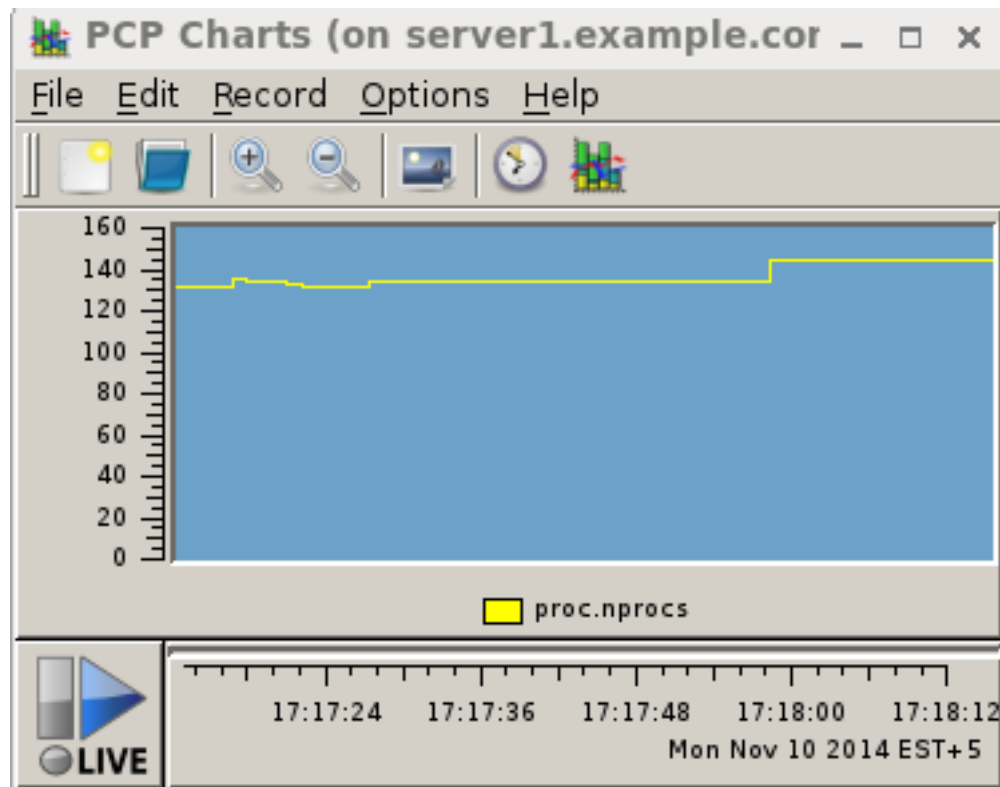
Plotting Data

Practice: Plotting Load-Average Data with gnuplot

Performance Co-Pilot







Practice: Configuring Performance Co-Pilot

Lab: Collecting, Graphing, and Interpreting Data

Summary

DAY ONE

Introduction

Collecting, Graphing,
and Interpreting Data

General Tuning

Limiting Resource
Usage

Chapter 3: General Tuning

- Queueing Theory
- Configuring System Tunables
- Installing and Enabling tuned
- Creating Custom tuned Profiles

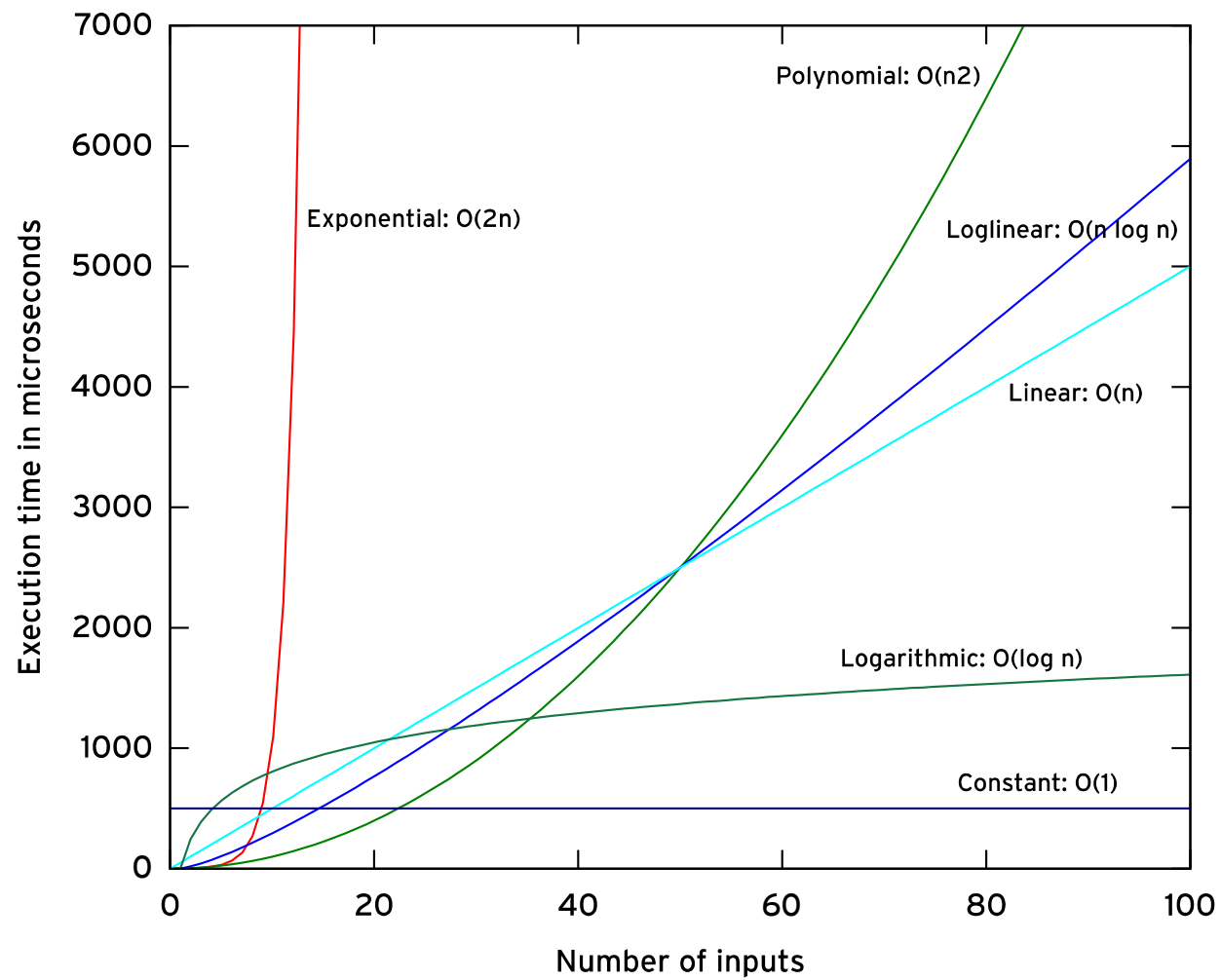
Goal:

Describe the basics of performance tuning.

Objectives:

- Describe the basics of queueing theory
- Configure system tunables
- Deploy the automatic tuning daemon tuned
- Create a customized tuned profile

Queueing Theory



Practice: Queueing Theory

Configuring System Tunables

Practice: Configuring System Tunables

Installing and Enabling tuned

Practice: Installing and Enabling tuned

Creating Custom tuned Profiles

Practice: Creating Custom tuned Profiles

Lab: General Tuning

Summary

DAY ONE

Introduction

Collecting, Graphing,
and Interpreting Data

General Tuning

**Limiting Resource
Usage**

Chapter 4: Limiting Resource Usage

- Configuring POSIX Resource Limits
- Understanding Control Groups

Goal:

To allocate resources for best performance by limiting resource usage.

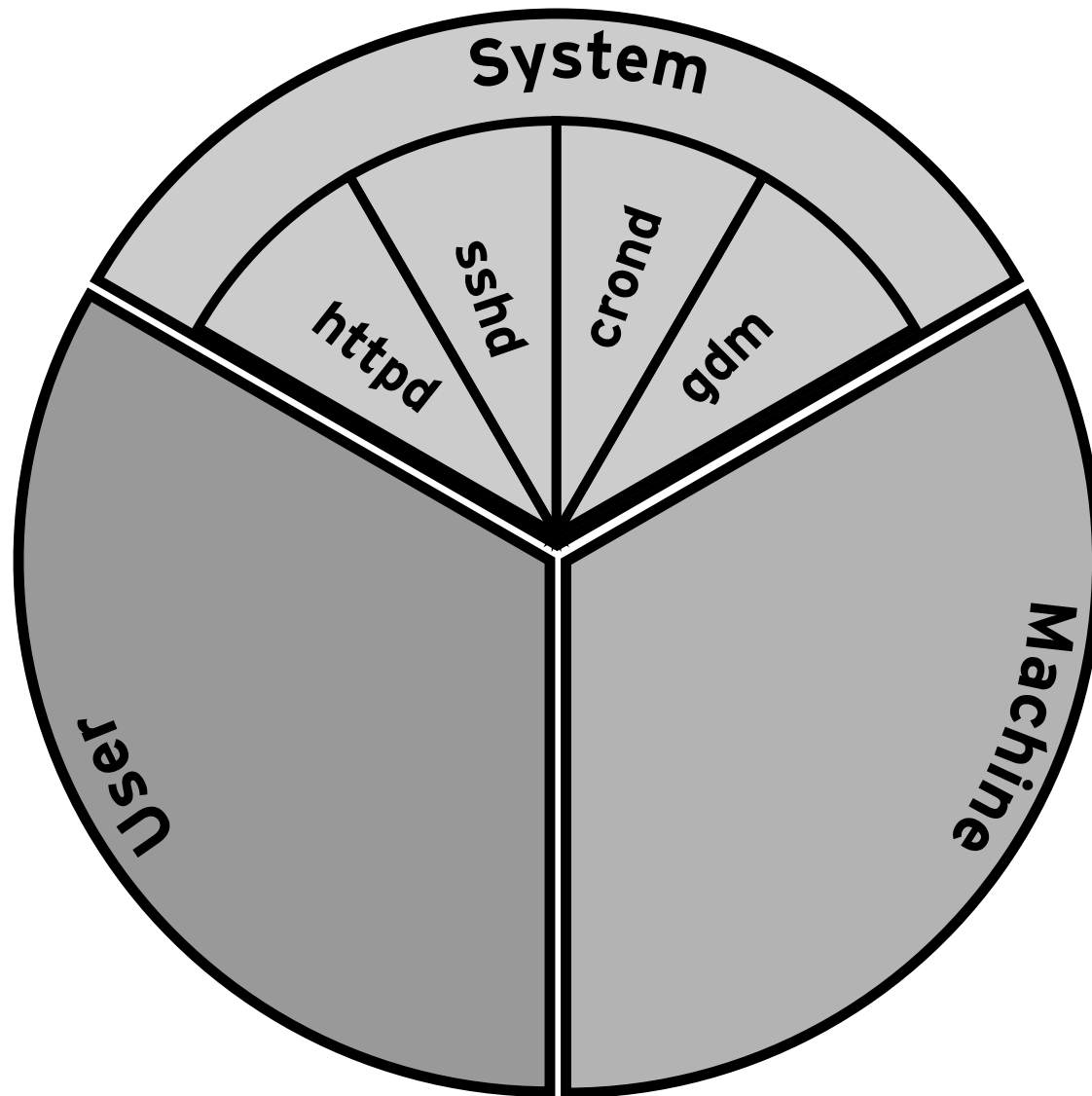
Objectives:

- Configure POSIX resource limits
- Describe Linux Control Groups

Configuring POSIX Resource Limits

Practice: Configuring POSIX resource limits

Understanding Control Groups



Practice: Configure systemd CGroup Limits

Lab: Limiting Resource Usage

Summary

DAY TWO

Hardware Profiling

Software Profiling

Using SystemTap

Small File Tuning

Chapter 5: Hardware Profiling

- Generating a Hardware Profile
- Profiling Storage

Goal:

Describe and use tools to generate a hardware profile.

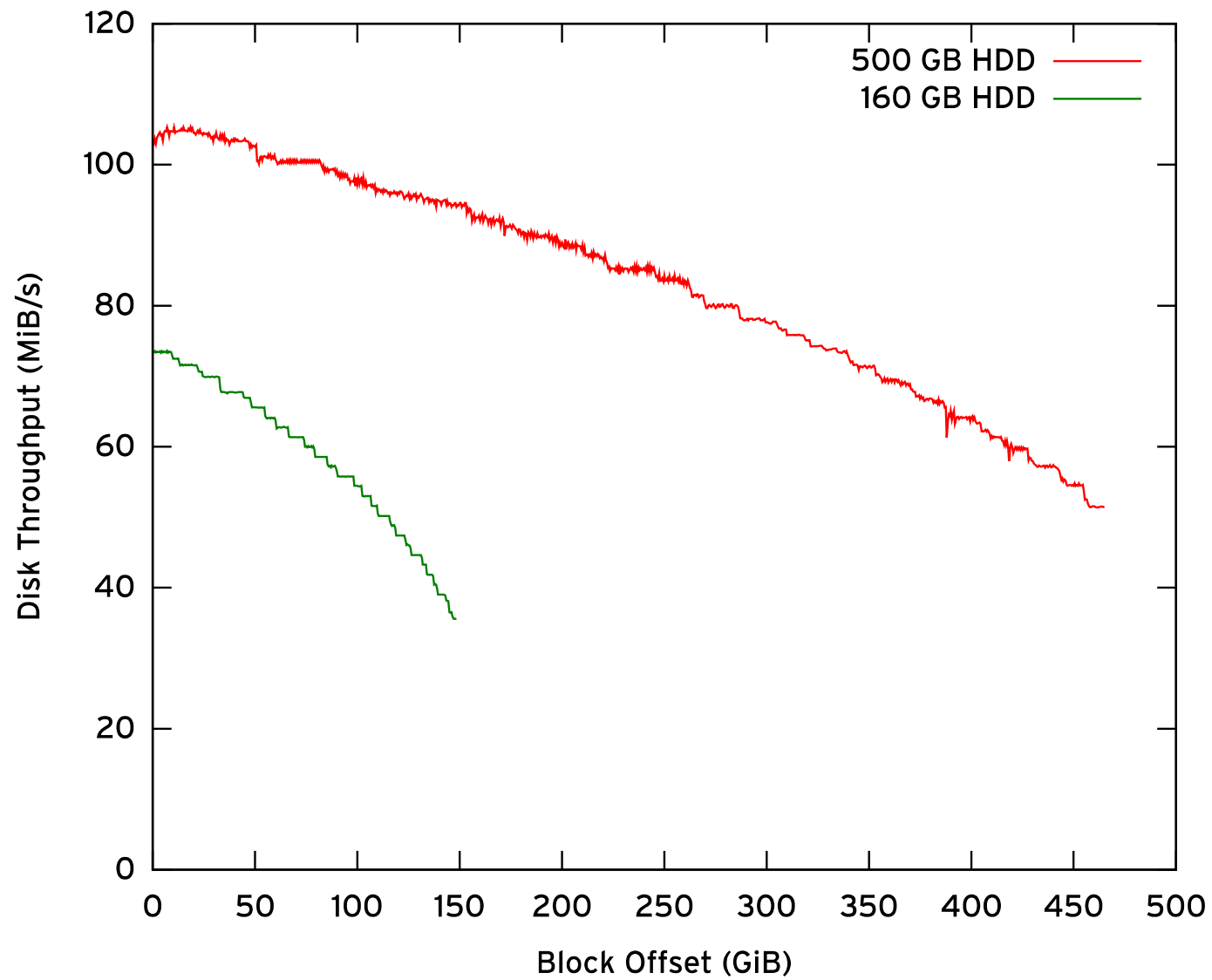
Objectives:

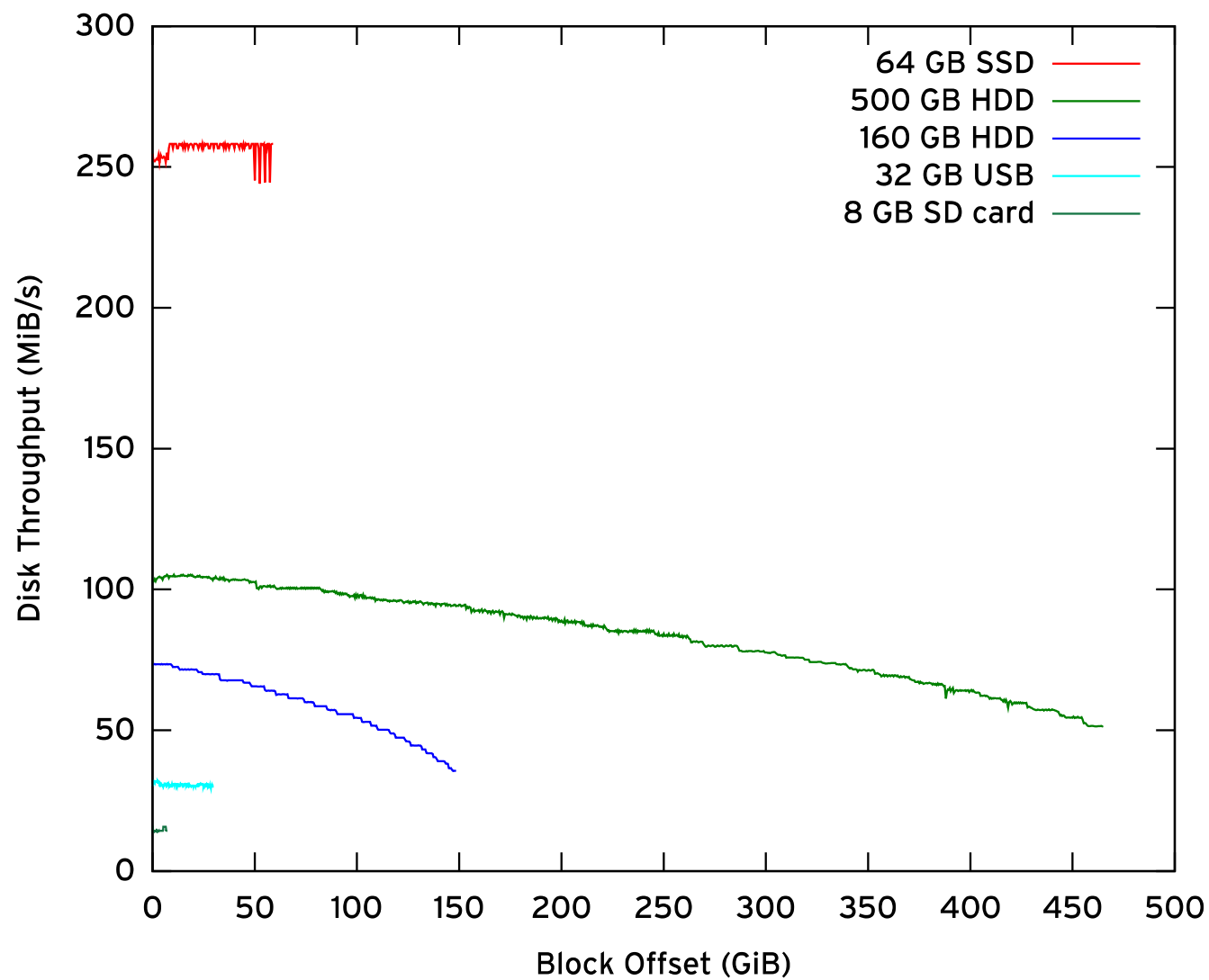
- Generate a hardware profile
- Profile a storage system

Generating a Hardware Profile

Practice: Generating a Hardware Profile

Profiling Storage





Practice: Profiling Storage

Lab: Hardware Profiling

Summary

DAY TWO

Hardware Profiling

Software Profiling

Using SystemTap

Small File Tuning

Chapter 6: Software Profiling

- CPU Scheduling
- Tracing System and Library Calls
- Profiling CPU Cache Usage

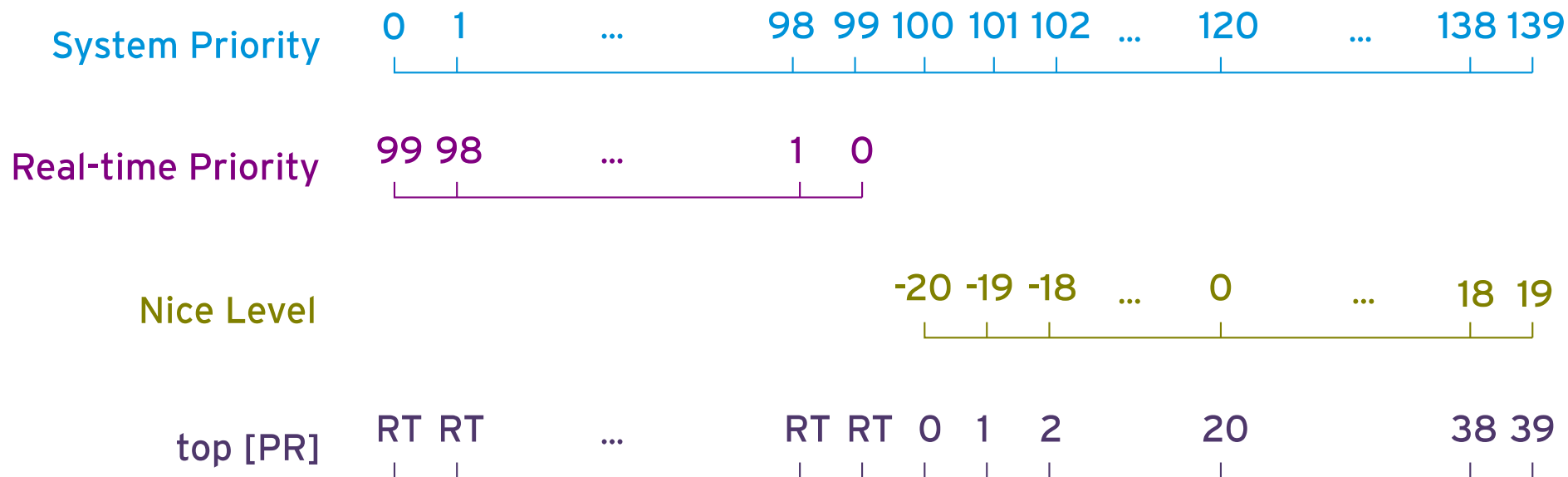
Goal:

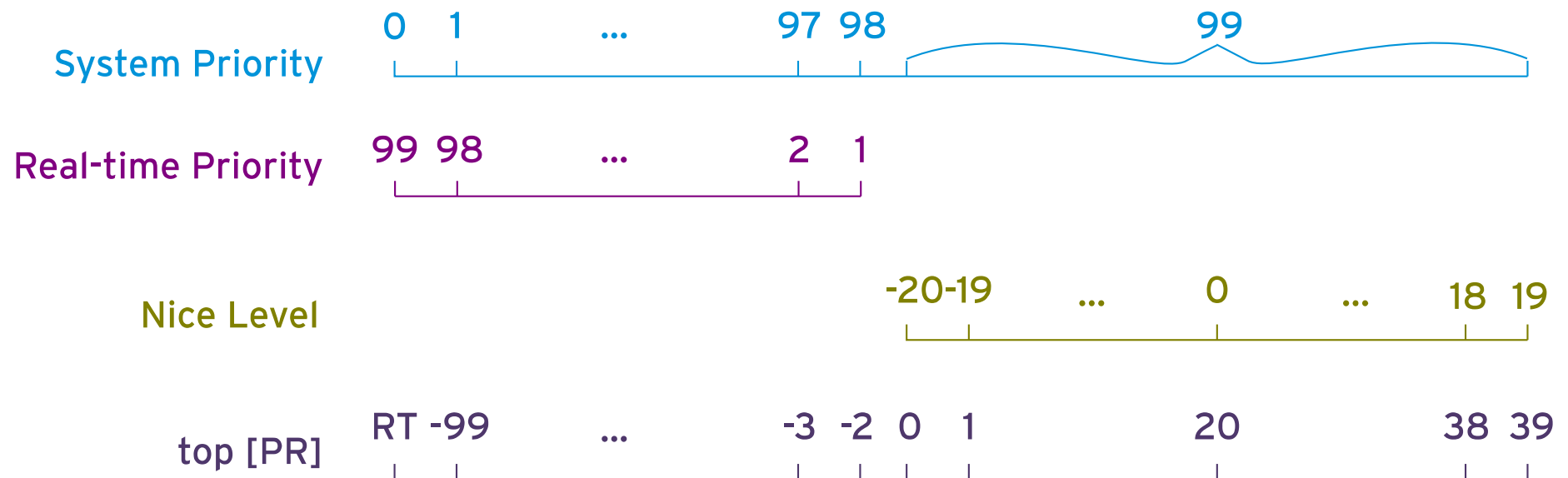
To describe and use the basic tools for generating a software performance profile.

Objectives:

- Describe and influence CPU scheduling
- Trace system and library calls for a process
- Profile how the various CPU caches are used by applications

CPU Scheduling





Practice: CPU Scheduling

Tracing System and Library Calls

Practice: Tracing System and Library Calls

Profiling CPU Cache Usage

CORE 0

CORE 1

Latency

HT

HT

HT

HT

L1:
3 cycles

L1 i

32 kiB

64 lines / 8-way

L1 d

32 kiB

32 lines / 4-way

L1 i

32 kiB

64 lines / 8-way

L1 d

32 kiB

32 lines / 4-way

L2:
15 cycles

L2

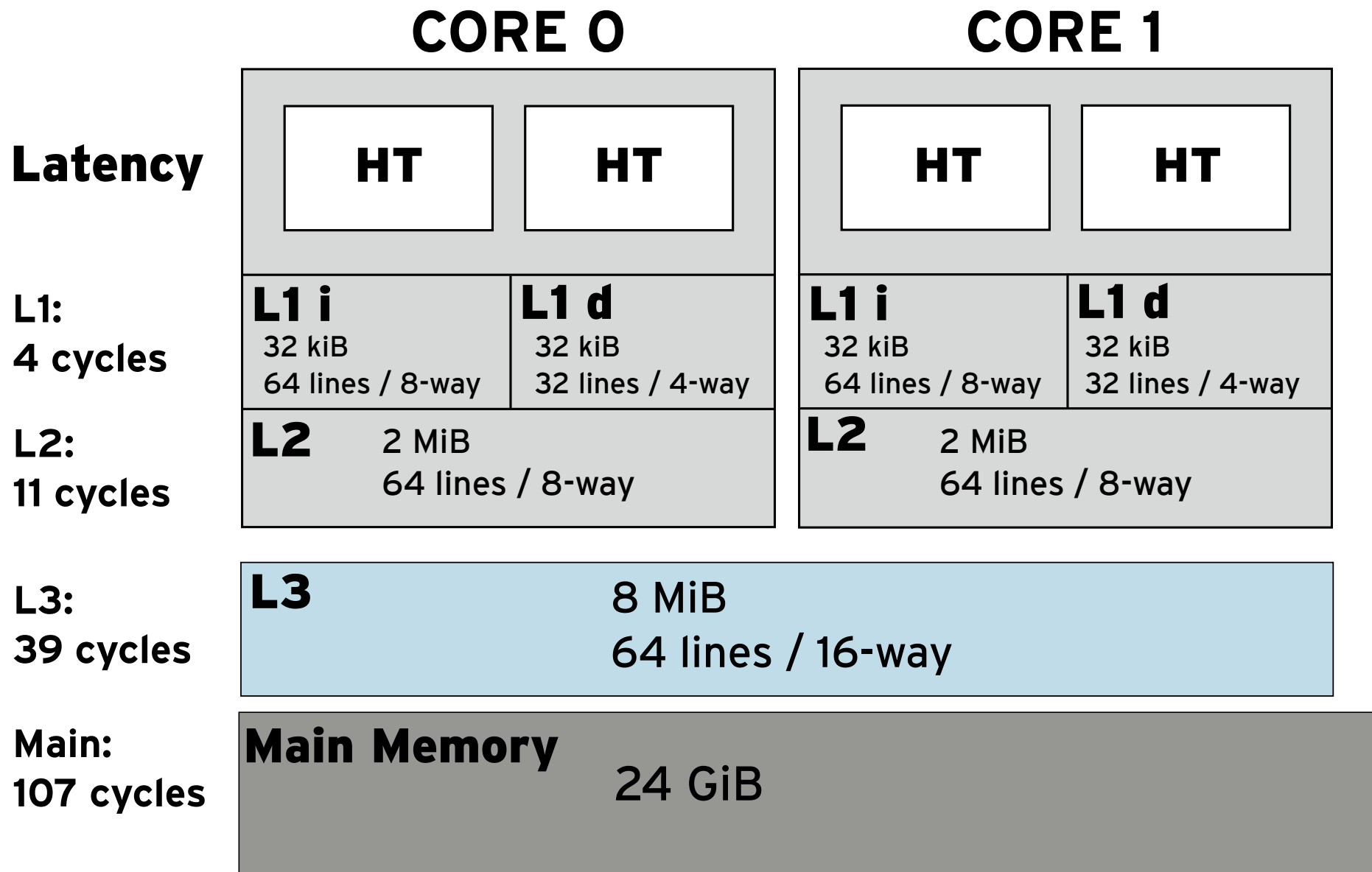
4 MiB

64 lines / 16-way

Main:
160 cycles

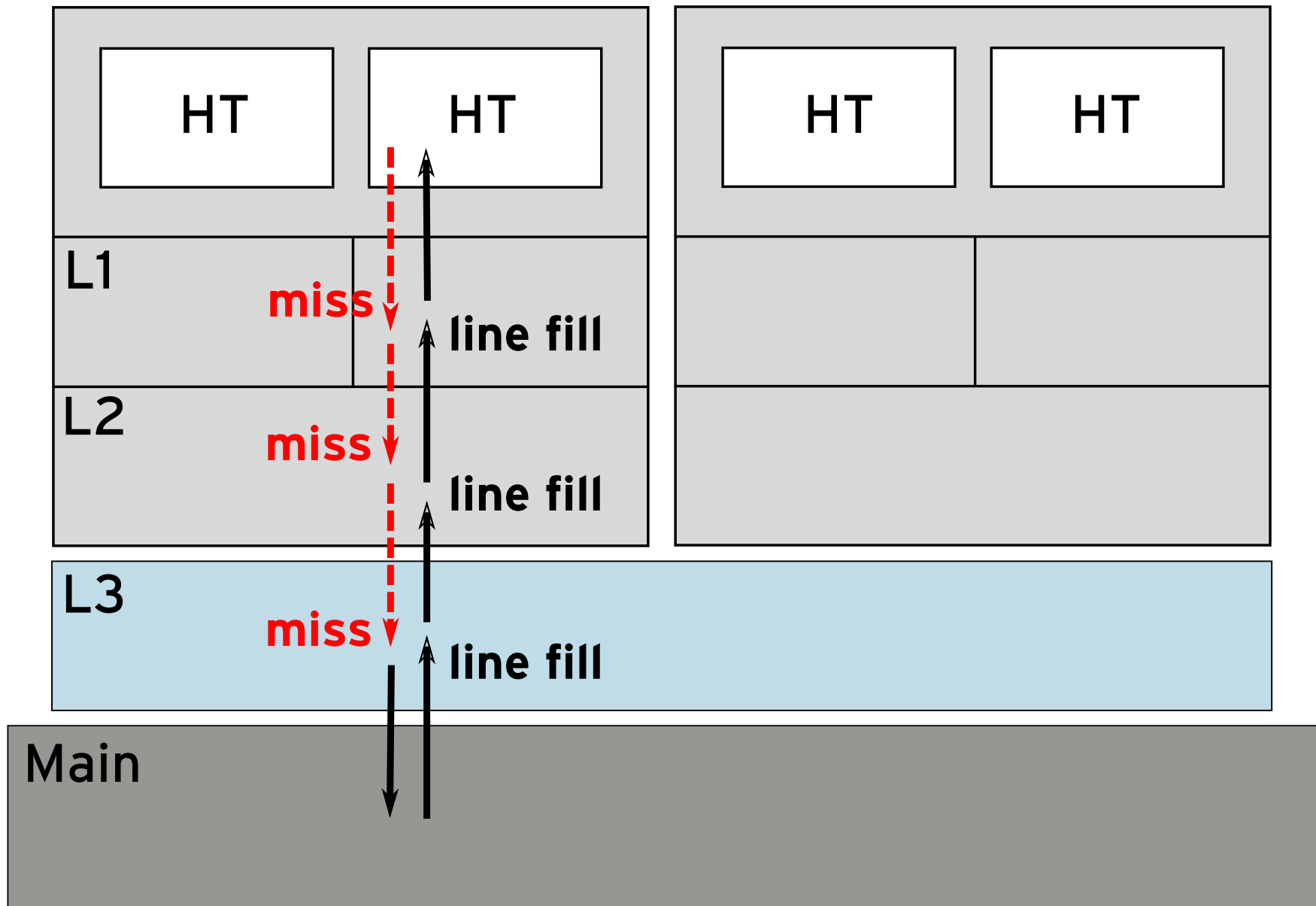
Main Memory

4 GiB



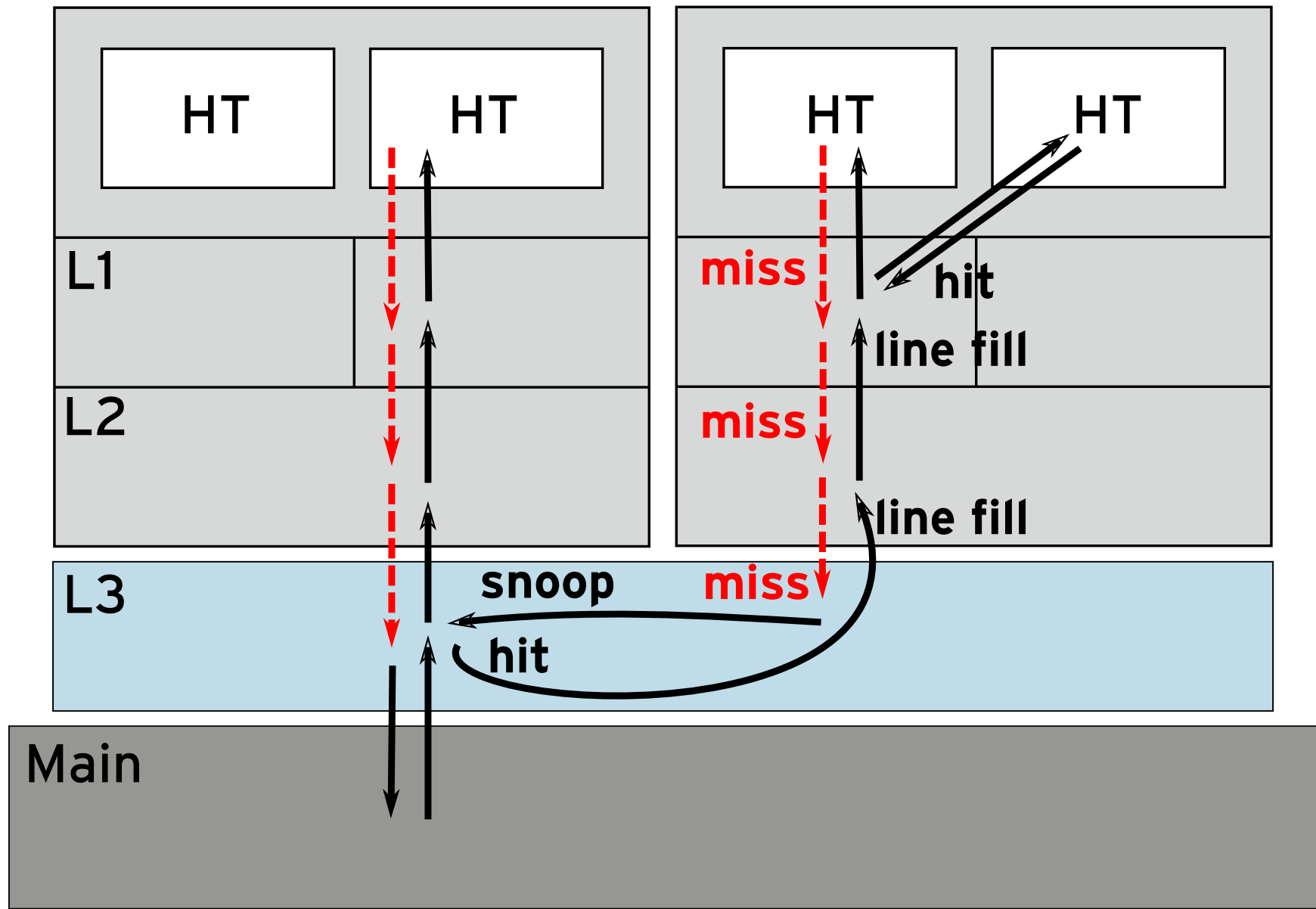
CORE 0

CORE 1



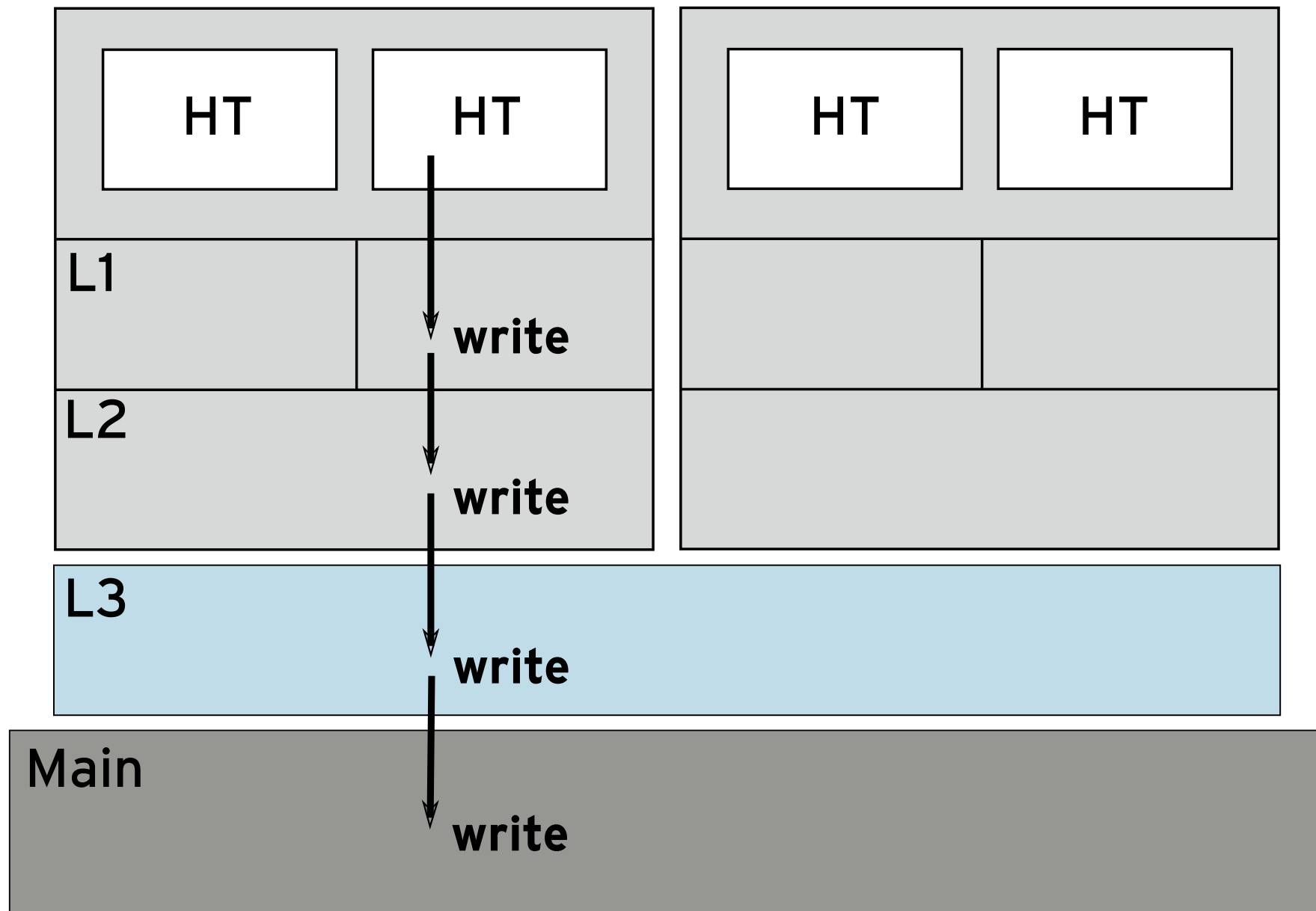
CORE 0

CORE 1



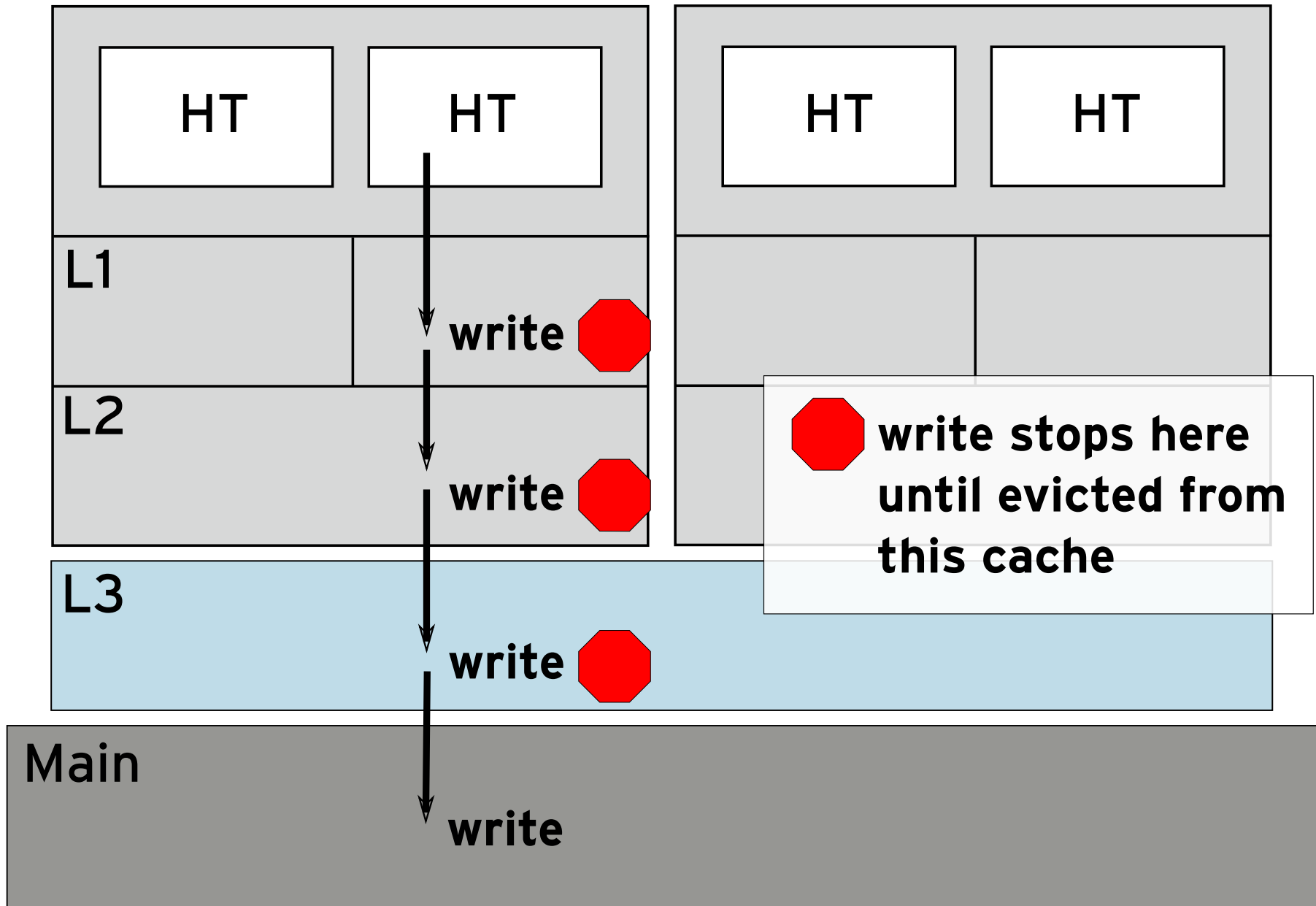
CORE 0

CORE 1



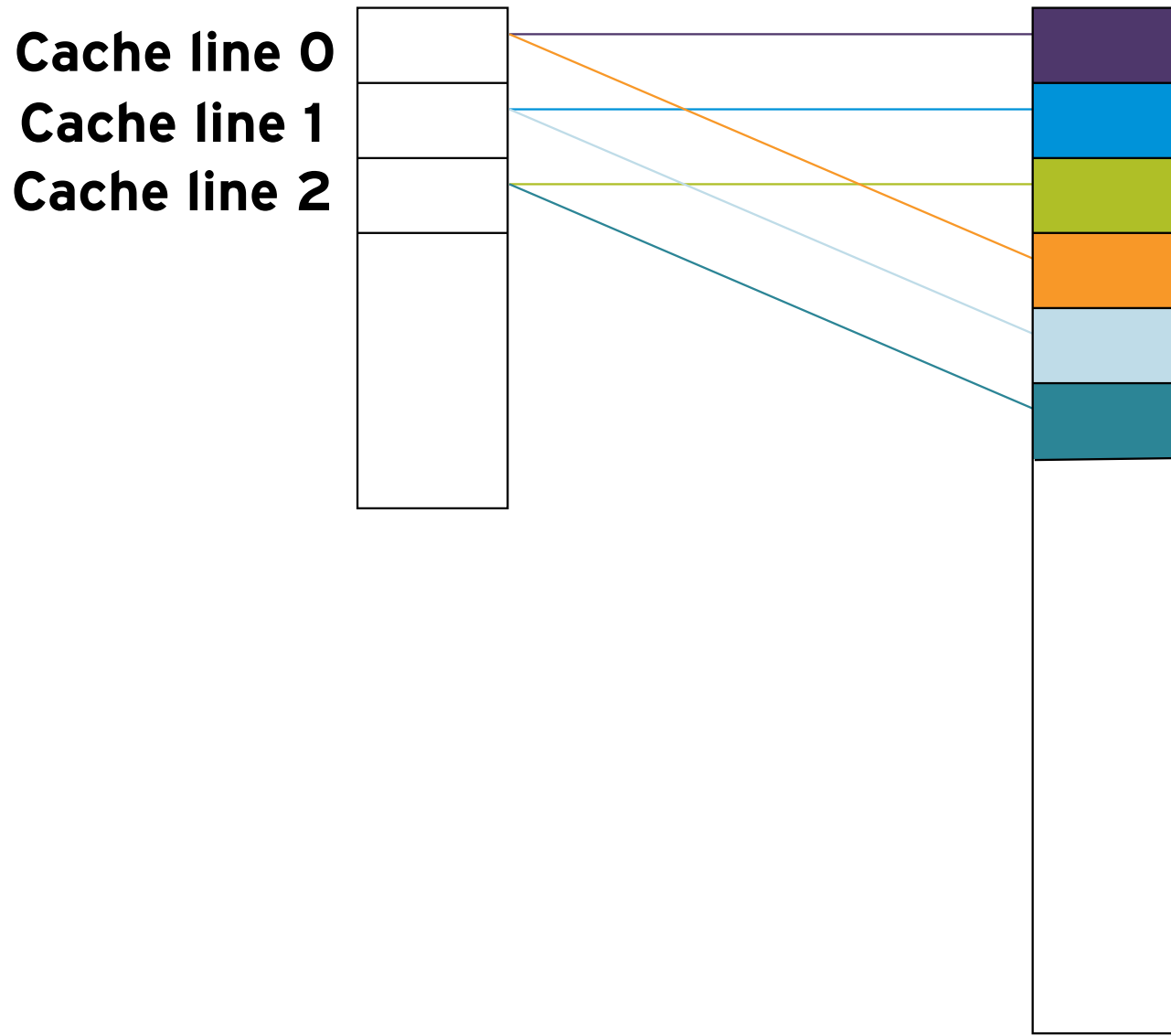
CORE 0

CORE 1



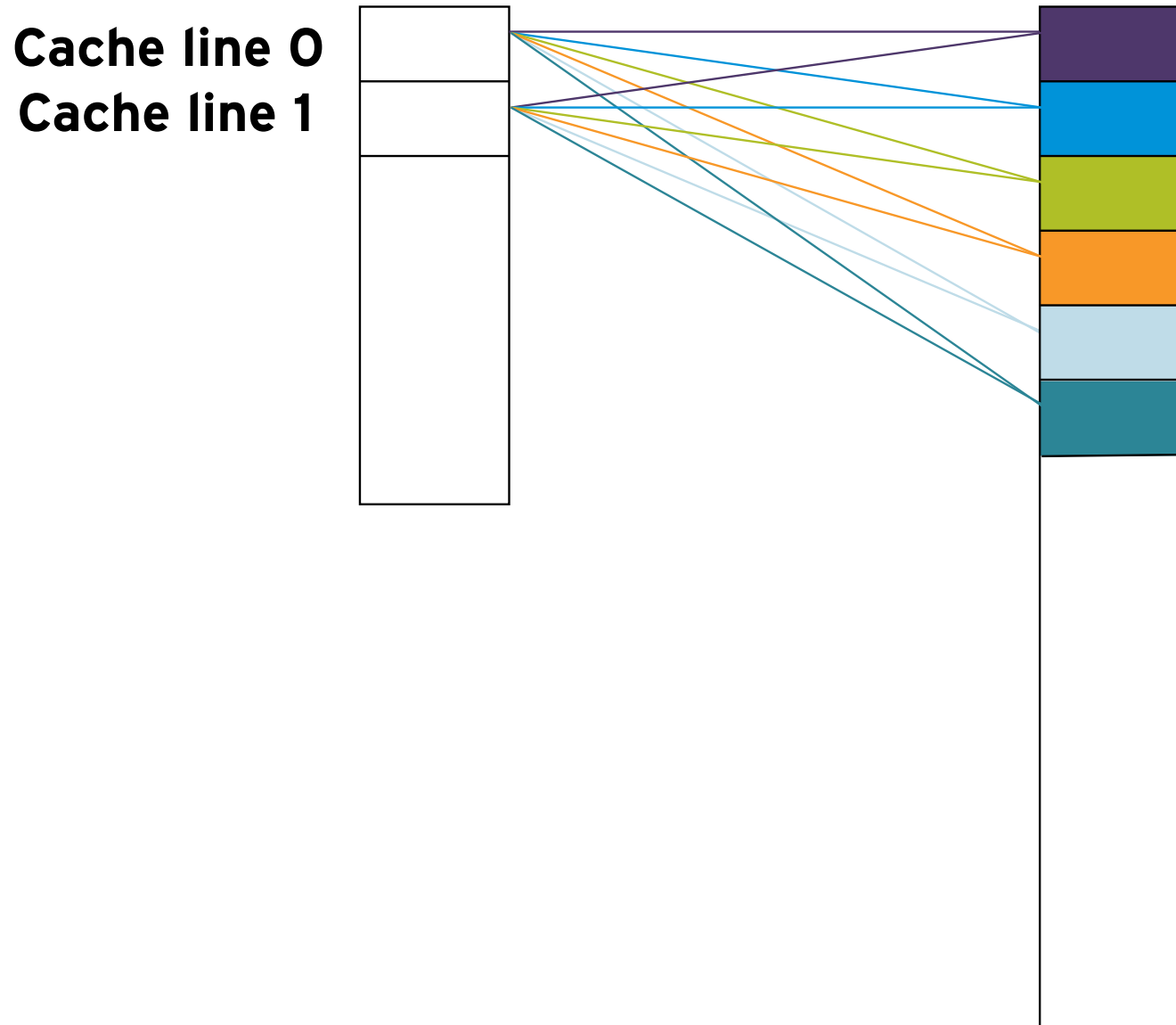
Cache

Main memory



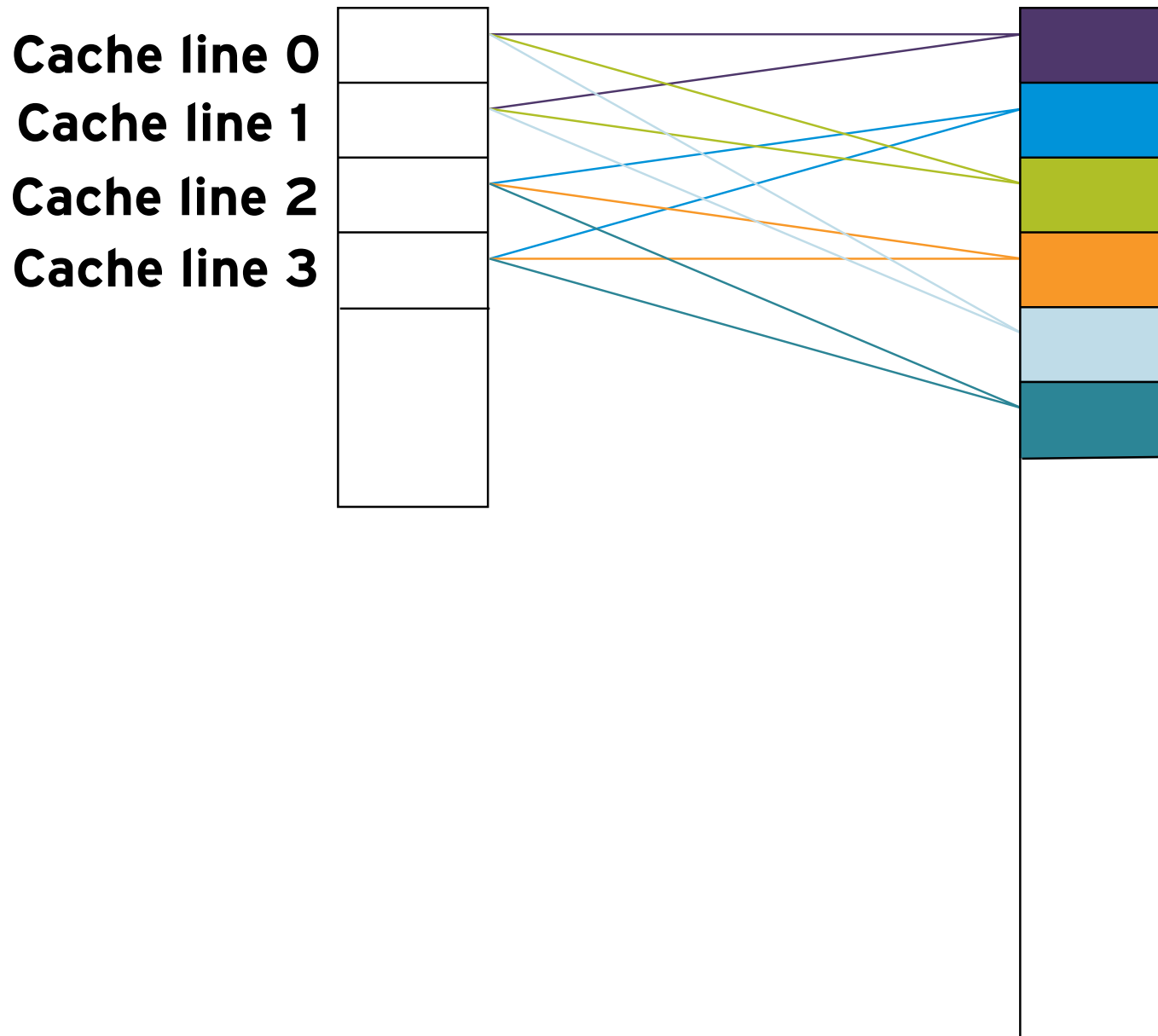
Cache

Main memory



Cache

Main memory



Practice: Profiling CPU Cache Usage

Lab: Software Profiling

Summary

DAY TWO

Hardware Profiling

Software Profiling

Using SystemTap

Small File Tuning

Chapter 7: Using SystemTap

- Introduction to SystemTap
- Running SystemTap Scripts
- Deploying SystemTap Instrumentation Modules

Goal:

Provide experience building and running SystemTap instrumentation modules.

Objectives:

- Install software required to compile and run SystemTap modules.
- Use the `stap` and `staprun` commands to compile and run SystemTap modules.
- Provide additional permissions to users to run compiled SystemTap modules.

Introduction to SystemTap

Practice: Installing SystemTap

Running SystemTap Scripts

Practice: Running SystemTap Scripts

Deploying SystemTap Instrumentation Modules

Practice: Deploying SystemTap Instrumentation Modules

Lab: Using SystemTap

Summary

DAY TWO

Hardware Profiling

Software Profiling

Using SystemTap

Small File Tuning

Chapter 8: Small File Tuning

- Analyzing a Small File Workload
- Selecting a File System
- Tuning for a Mail Server

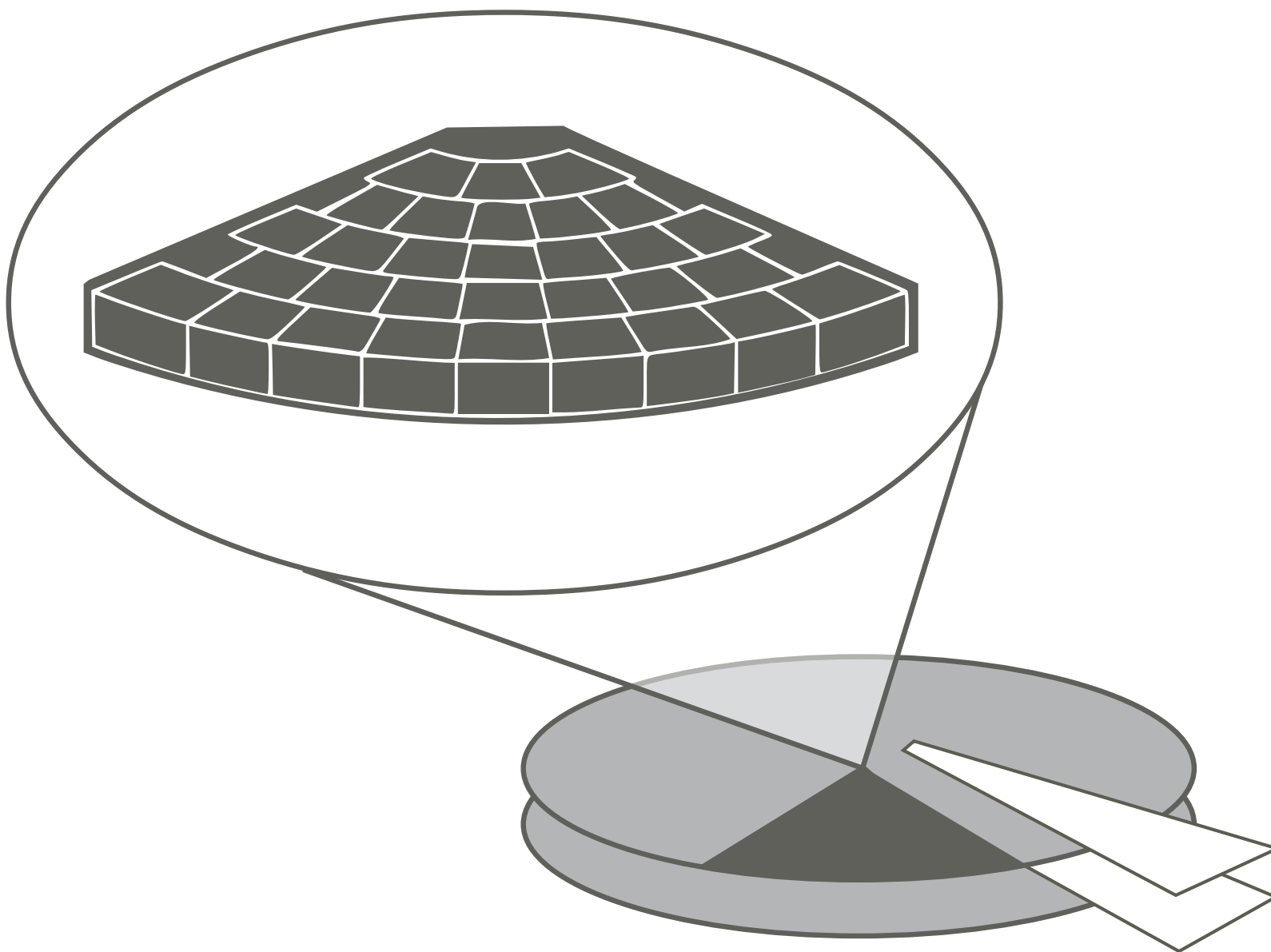
Goal:

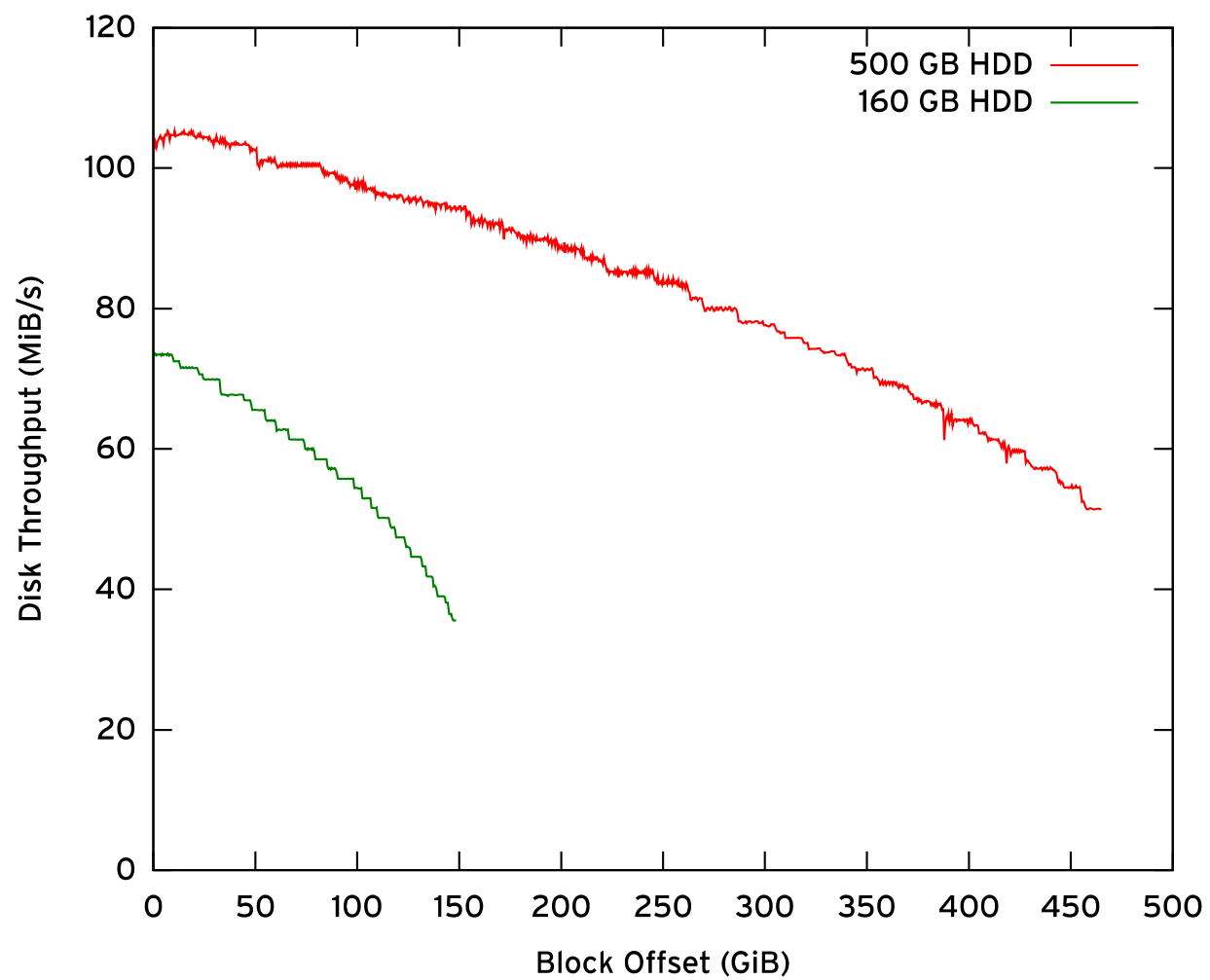
Analyze a workload involving frequent reads and writes to small files.

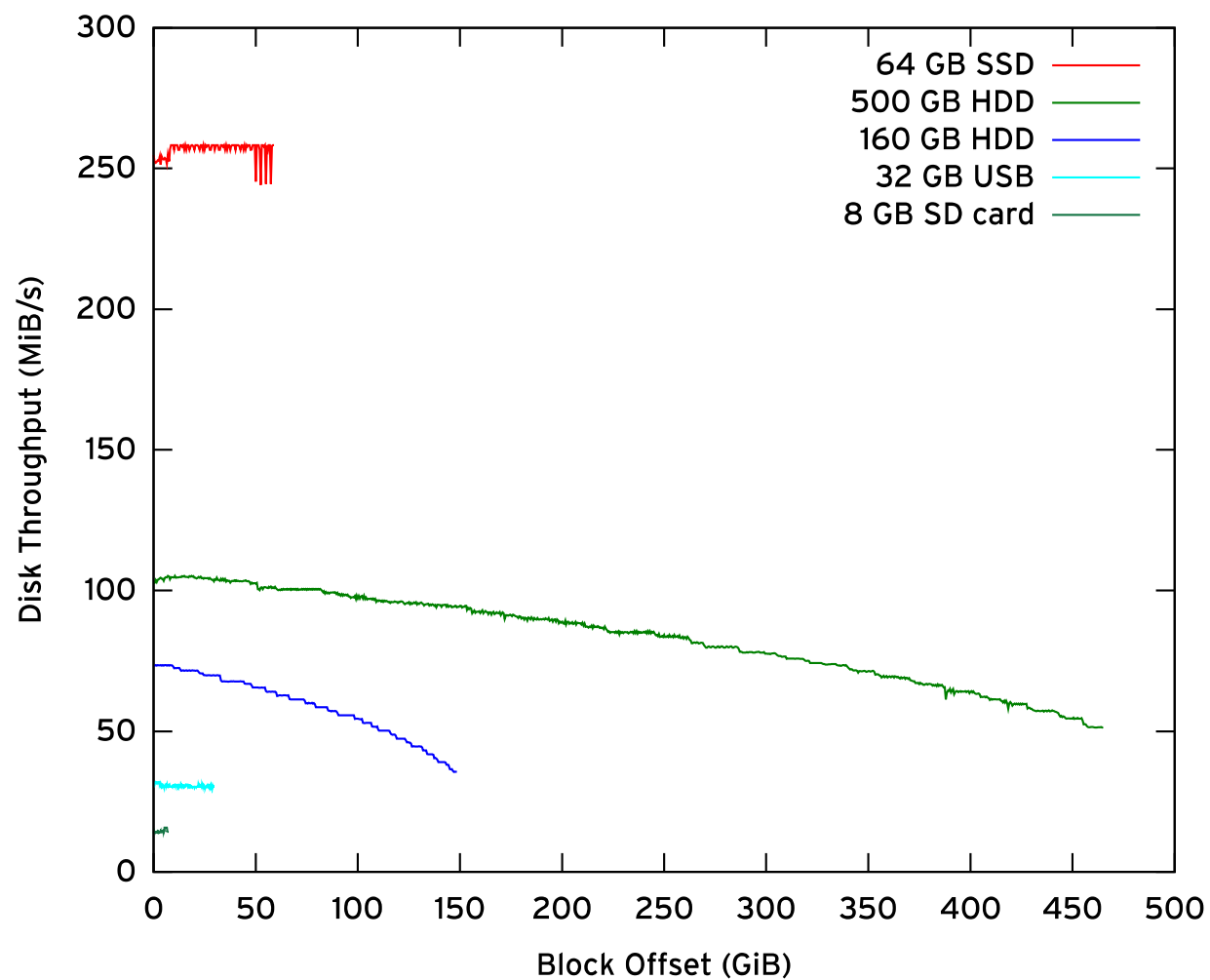
Objectives:

- Analyze a workload involving frequent reads and writes to small files.
- Select a file system based on performance criteria.
- Tune specific settings for a mail server.

Analyzing a Small File Workload







Practice: Analyzing a Small File Workload

Selecting a File System

Practice: Selecting a File System

Tuning for a Mail Server

Quiz: Tuning for a Mail Server

Lab: Tuning for Small File Workload

Summary

DAY THREE

Large Memory Workload Tuning

CPU Intensive
Workload Tuning

File Server Tuning

Chapter 9: Large Memory Workload Tuning

- Memory Management
- Finding Memory Leaks
- Tuning Swap
- Managing Memory Reclamation
- Managing Non-Uniform Memory Access

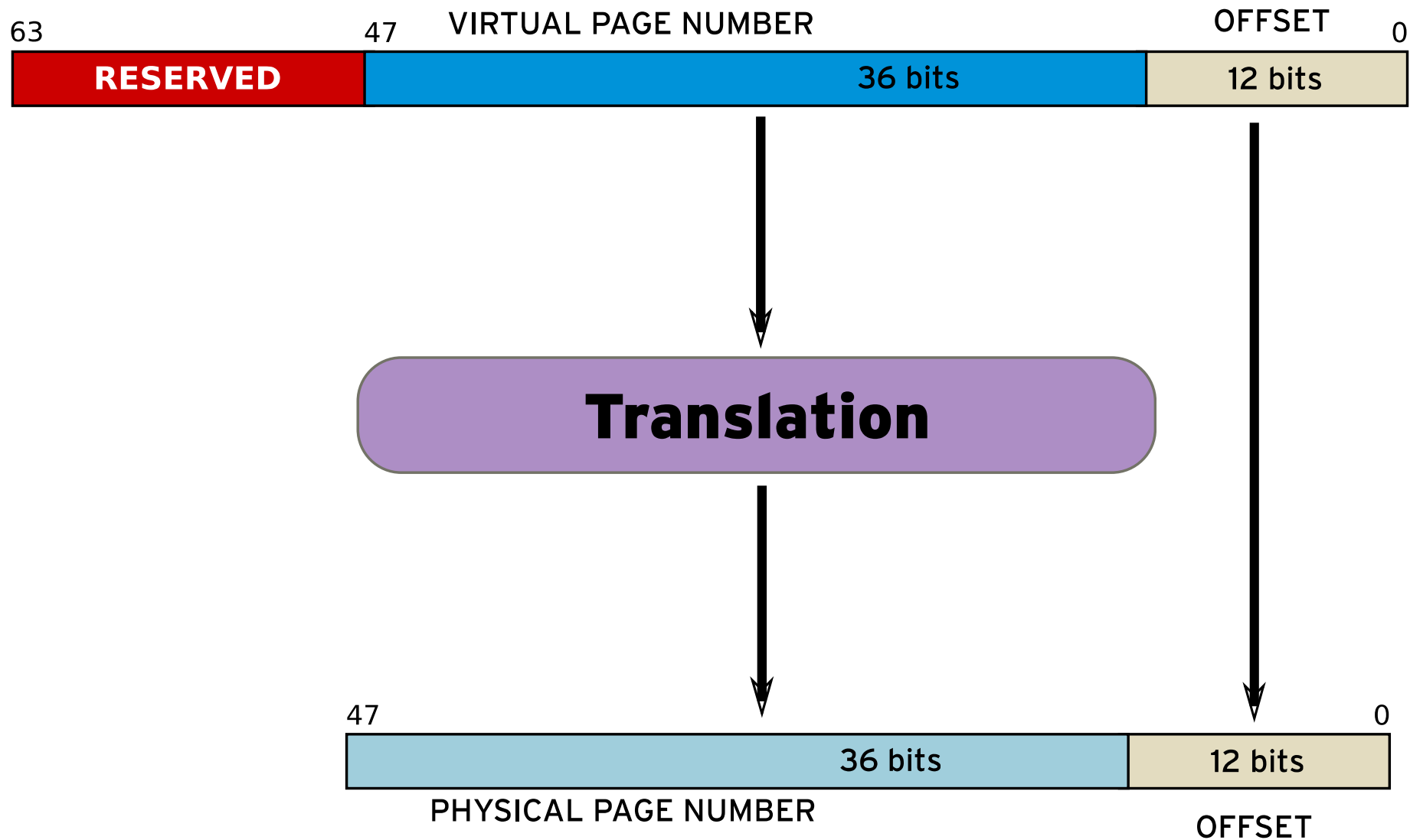
Goal:

To tune a server for a large memory workload.

Objectives:

- Describe how the Linux kernel manages memory.
- Investigate memory leaks.
- Tune swap usage of a system.
- Configure how the Linux kernel reclaims unused memory.
- Manage NUMA for optimal memory speeds.

Memory Management

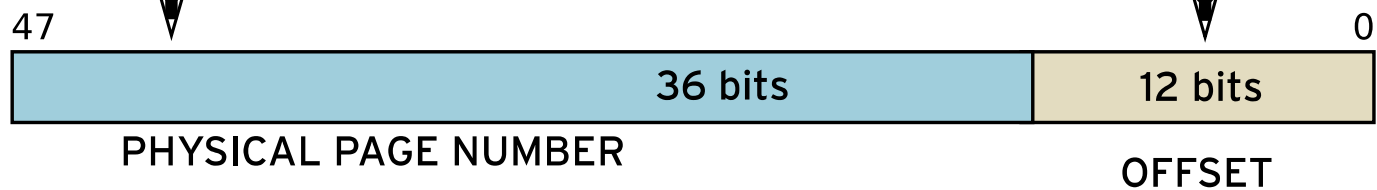
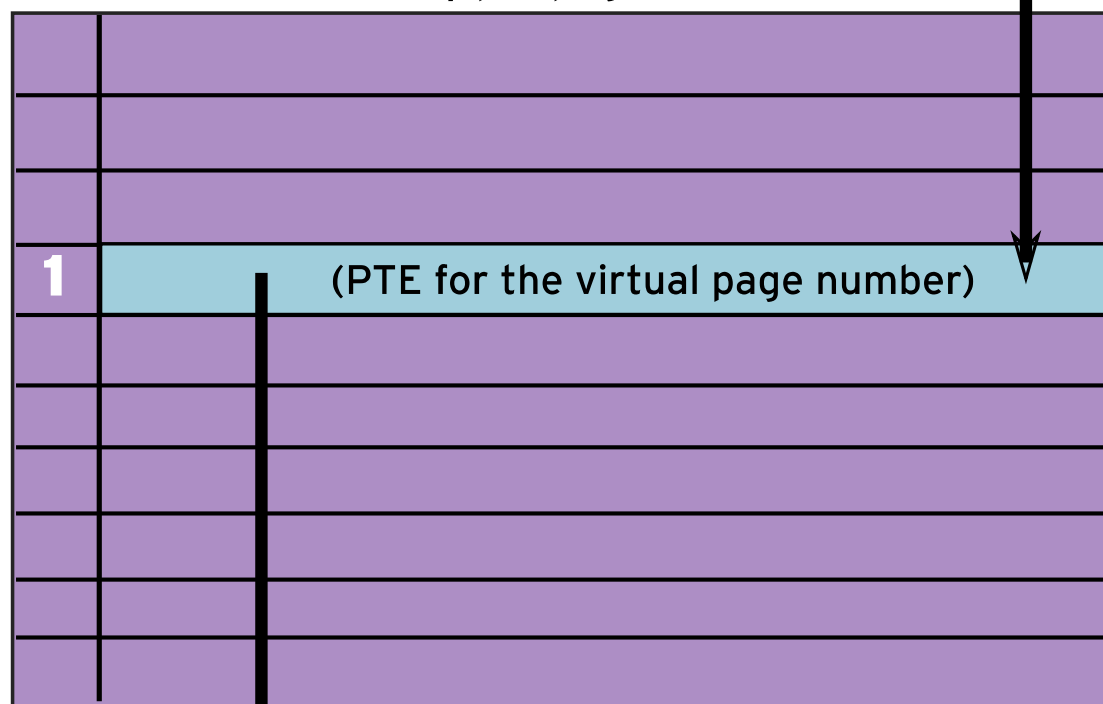




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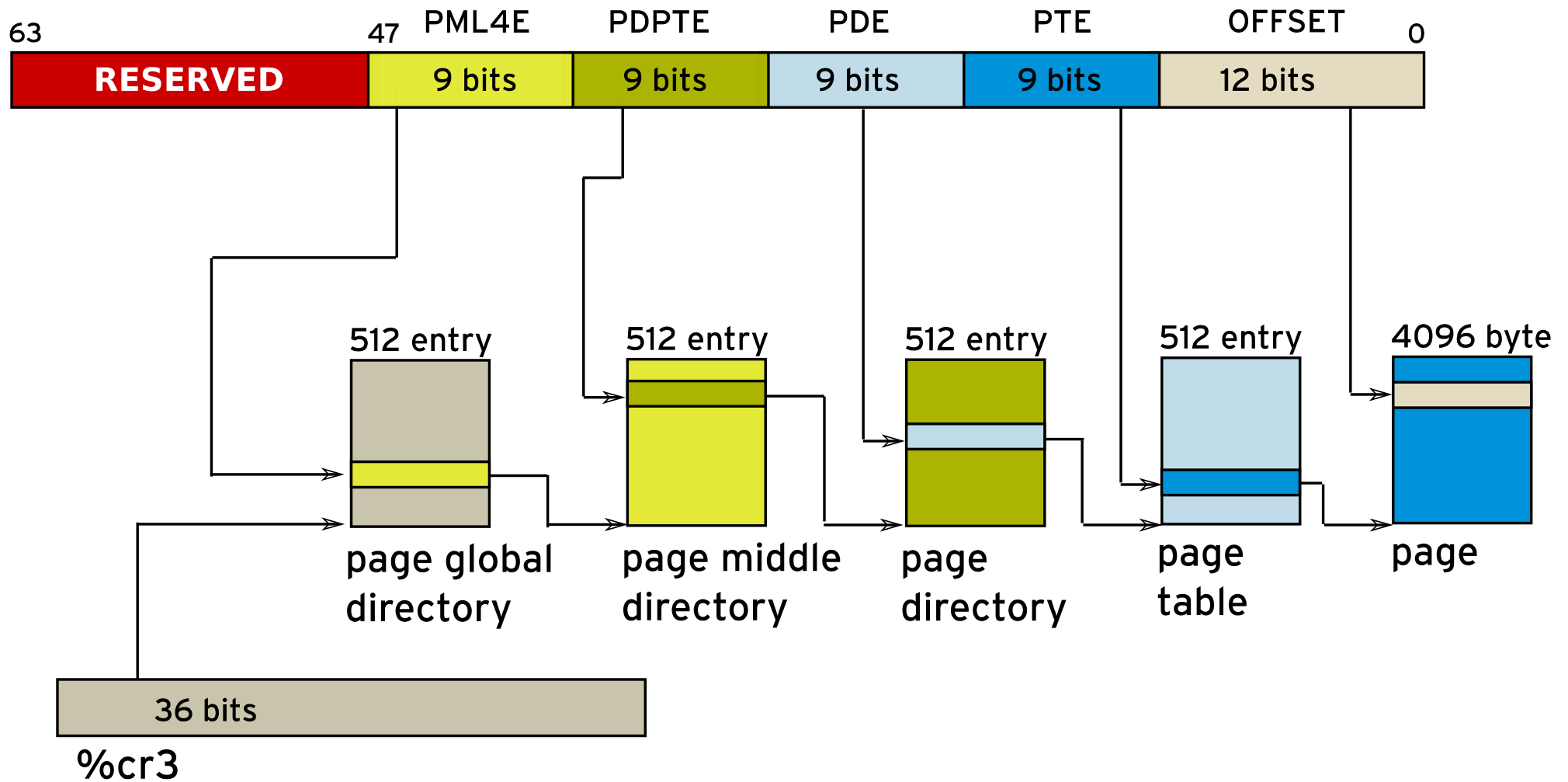
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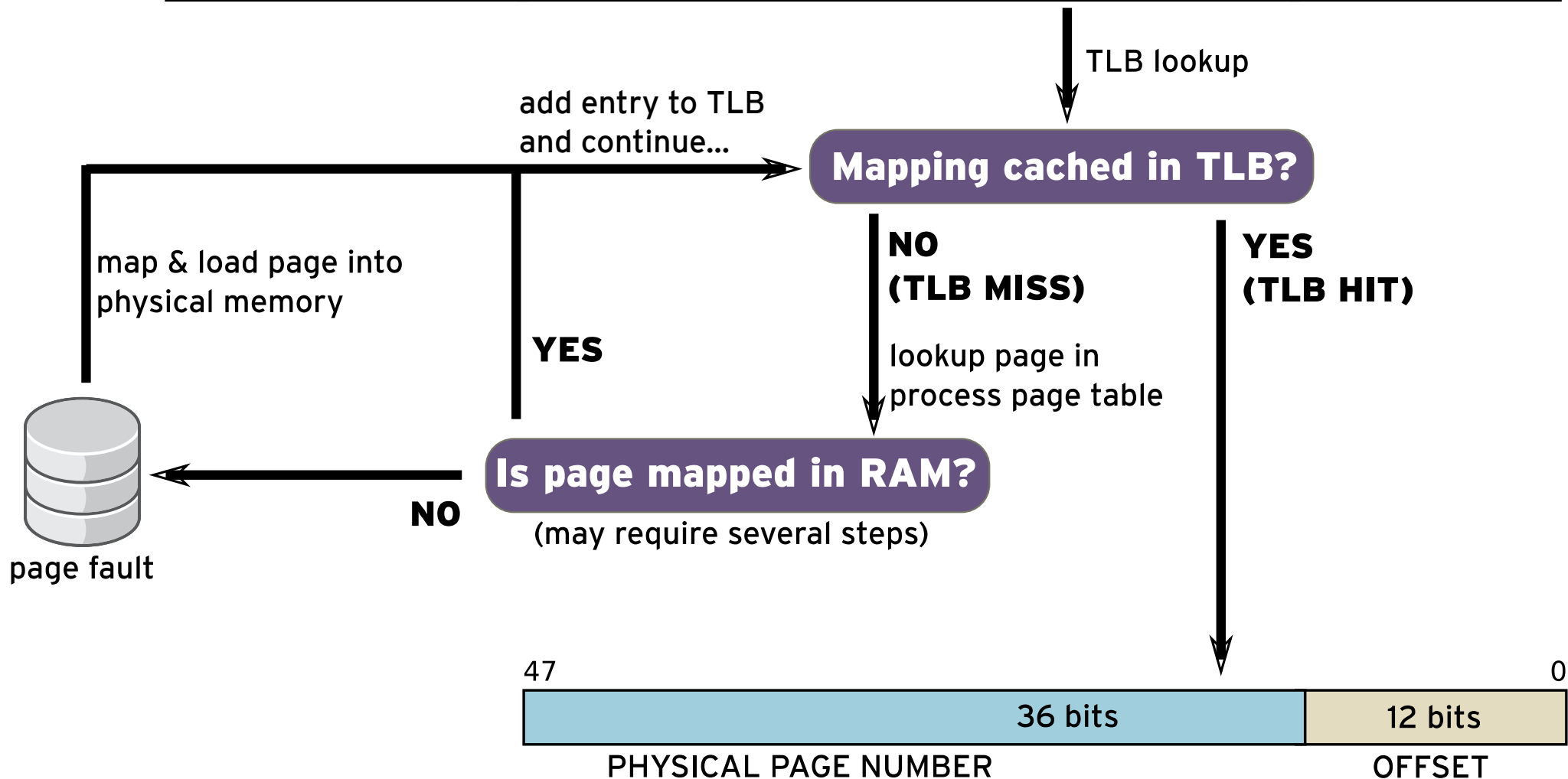


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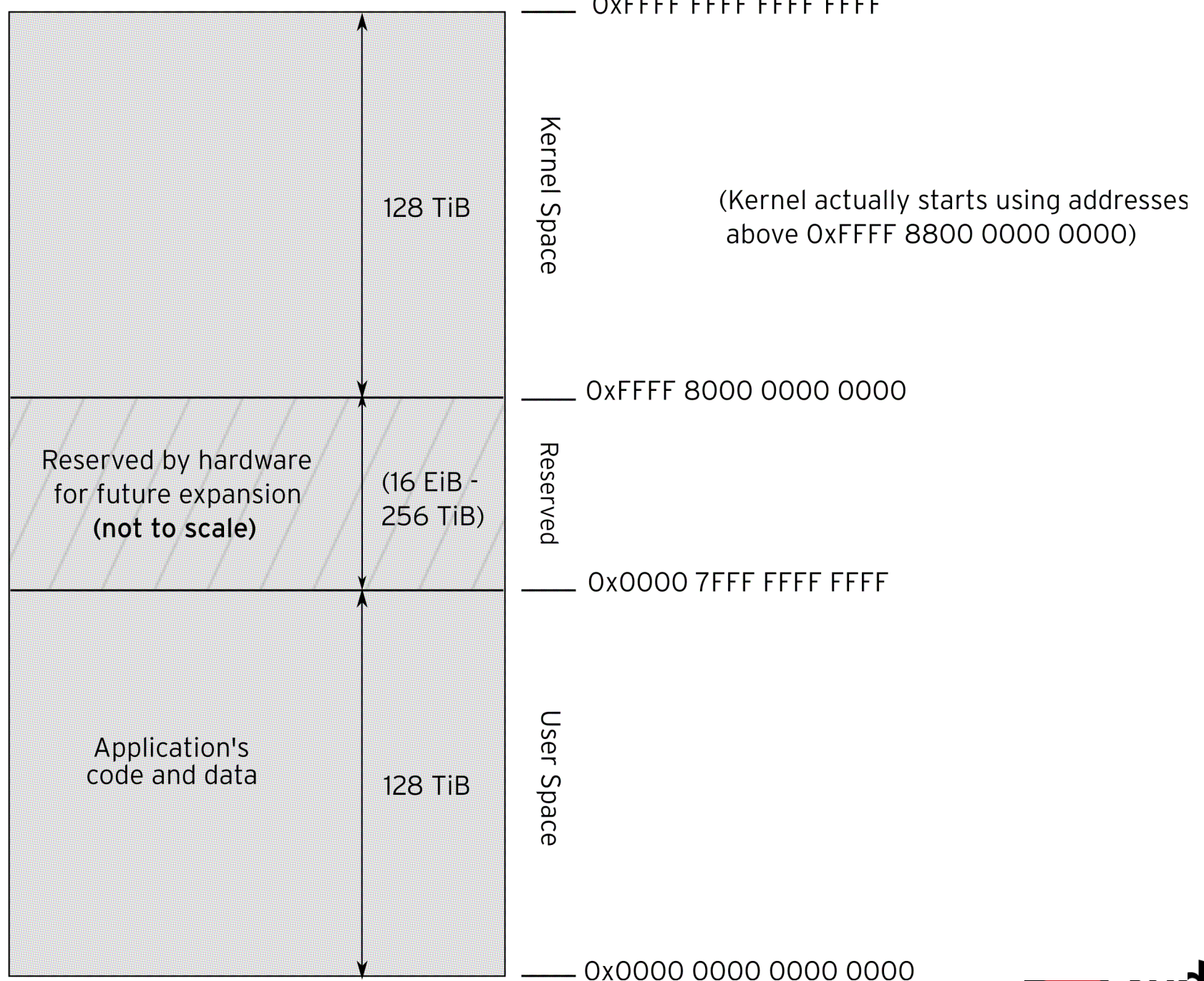
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VIRTUAL ADDRESS SPACE (x86-64)



Practice: Memory Management

Finding Memory Leaks

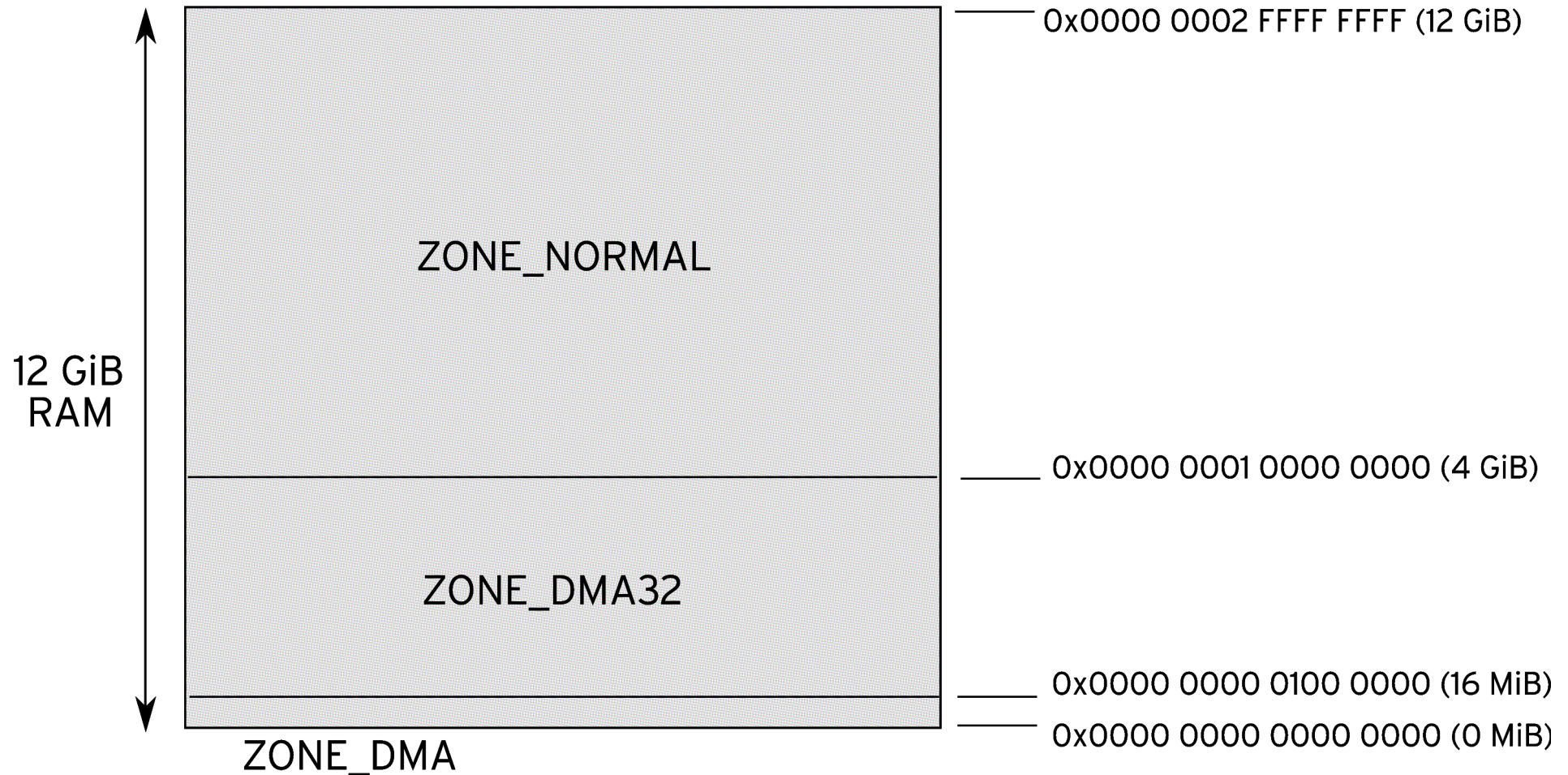
Practice: Finding Memory Leaks

Tuning Swap

Practice: Tuning Swap

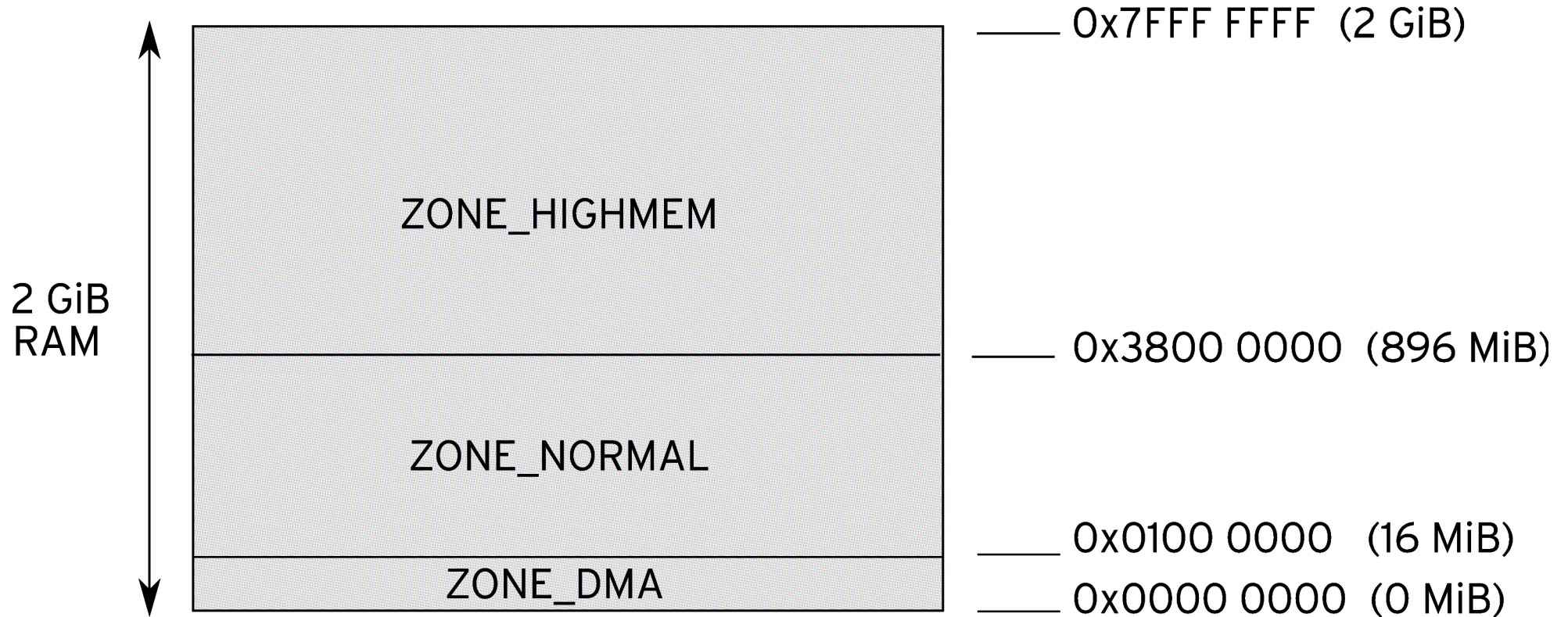
Managing Memory Reclamation

PHYSICAL ADDRESS SPACE (12 GiB)



This example system has 12 GiB of physical RAM installed. A different system may have a larger or smaller amount of physical address space.

PHYSICAL ADDRESS SPACE (2 GiB)



This example system has 2 GiB of physical RAM installed. A different system may have a larger or smaller amount of physical address space.

Practice: Managing Memory Reclamation

Managing Non-Uniform Memory Access

Practice: Managing Non-Uniform Memory Access

Lab: Large Memory Workload Tuning

Summary

DAY THREE

Large Memory
Workload Tuning

**CPU Intensive
Workload Tuning**

File Server Tuning

Chapter 10: CPU Intensive Workload Tuning

- Limiting CPU Usage with CGroups
- Pinning Processes
- Balancing Interrupts
- Realtime Scheduling

Goal:

To tune a server for a CPU intensive workload

Objectives:

- To limit the amount of CPU available to processes
- To limit on which CPUs a process can run
- To limit which CPUs get used for interrupt handling
- To employ realtime scheduling policies

Limiting CPU Usage with CGroups

Practice: Limiting CPU Usage with CGroups

Pinning Processes

Practice: Pinning Processes

Balancing Interrupts

Practice: Balancing Interrupts

Realtime Scheduling

Practice: Realtime Scheduling

Lab: Tuning for a CPU Intensive Workload

Summary

DAY THREE

Large Memory
Workload Tuning

CPU Intensive
Workload Tuning

File Server Tuning

Chapter 11: File Server Tuning

- Selecting a Tuned Profile for a File Server
- File System Performance
- Network Performance Tuning
- Tuning Network Queues
- Bonding and Link Aggregation

Goal:

To tune a server for a workload involving network transmission of larger files.

Objectives:

- Select a tuned profile for a file server workload
- Configure an external ext4 journal
- Measure network performance
- Calculate and implement BDP
- Configure 802.3ad link aggregation

Selecting a Tuned Profile for a File Server

Practice: Selecting a Tuned Profile for a File Server

File System Performance

Practice: File System Performance

Network Performance Tuning

Practice: Network Performance Tuning

Tuning Network Queues

Practice: Tuning Network Queues

Bonding and Link Aggregation

Practice: Configuring Network Teaming

Lab: File Server Tuning

Summary

DAY FOUR

Tuning a Database Server

Power Usage Tuning

Tuning For
Virtualization

Comprehensive
Review

Chapter 12: Tuning a Database Server

- Analyzing a Database Server Workload
- Managing Inter-Process Communication
- Managing Hugepages
- Overcommitting Memory

Goal:

To tune a server for a database workload.

Objectives:

- Select a tuned profile to support database usage.
- Examine and tune System V IPC mechanisms.
- Improve memory performance by creating and managing huge pages.
- Adjust memory overcommit, swappiness, and dirty page management.

Analyzing a Database Server Workload

Practice: Analyzing a Database Server Workload

Managing Inter-Process Communication

Practice: Managing Inter-Process Communication

Managing Hugepages

Practice: Managing Hugepages

Overcommitting Memory

Practice: Overcommitting Memory

Lab: Database Server Tuning

Summary

DAY FOUR

Tuning a
Database Server

Power Usage Tuning

Tuning For
Virtualization

Comprehensive
Review

Chapter 13: Power Usage Tuning

- Power Saving Strategies
- Power Usage Profiling and Tuning

Goal:

To tune a server for power-efficient operation.

Objectives:

- Tuning a system for efficient power usage.
- Profiling and tuning power usage.

Power Saving Strategies

Practice: Power Saving Strategies

Power Usage Profiling and Tuning

Practice: Power Usage Profiling and Tuning

Lab: Power Usage Tuning

Summary

DAY FOUR

Tuning a
Database Server

Power Usage Tuning

**Tuning for
Virtualization**

Comprehensive
Review

Chapter 14: Tuning for Virtualization

- Tuning Virtualization Hosts
- Tuning Virtual Guests

Goal:

To tune virtualization hosts and guests.

Objectives:

- Configuring tuned profiles
- Pinning guests to use specific host CPUs
- Enabling Kernel Samepage Merging (KSM)
- Assigning resource limits to guests

Tuning Virtualization Hosts

Practice: Tuning Virtualization Hosts

Tuning Virtual Guests

Practice: Tuning Virtual Guests

Lab: Virtualization Tuning

Summary

DAY FOUR

Tuning a
Database Server

Power Usage Tuning

Tuning for
Virtualization

Comprehensive
Review

Chapter 15: Comprehensive Review

- Red Hat Performance Tuning Comprehensive Review

Goal:

To practice and demonstrate knowledge and skills learned in Red Hat Performance Tuning.

Objectives:

- Review the course chapters to reinforce knowledge and skills.

Red Hat Performance Tuning Comprehensive Review

Lab: Red Hat Performance Tuning Comprehensive Review

Thank you for attending this Red Hat Training Course!

To plan your learning path:

<https://www.redhat.com/training/paths/linux-development.html>

