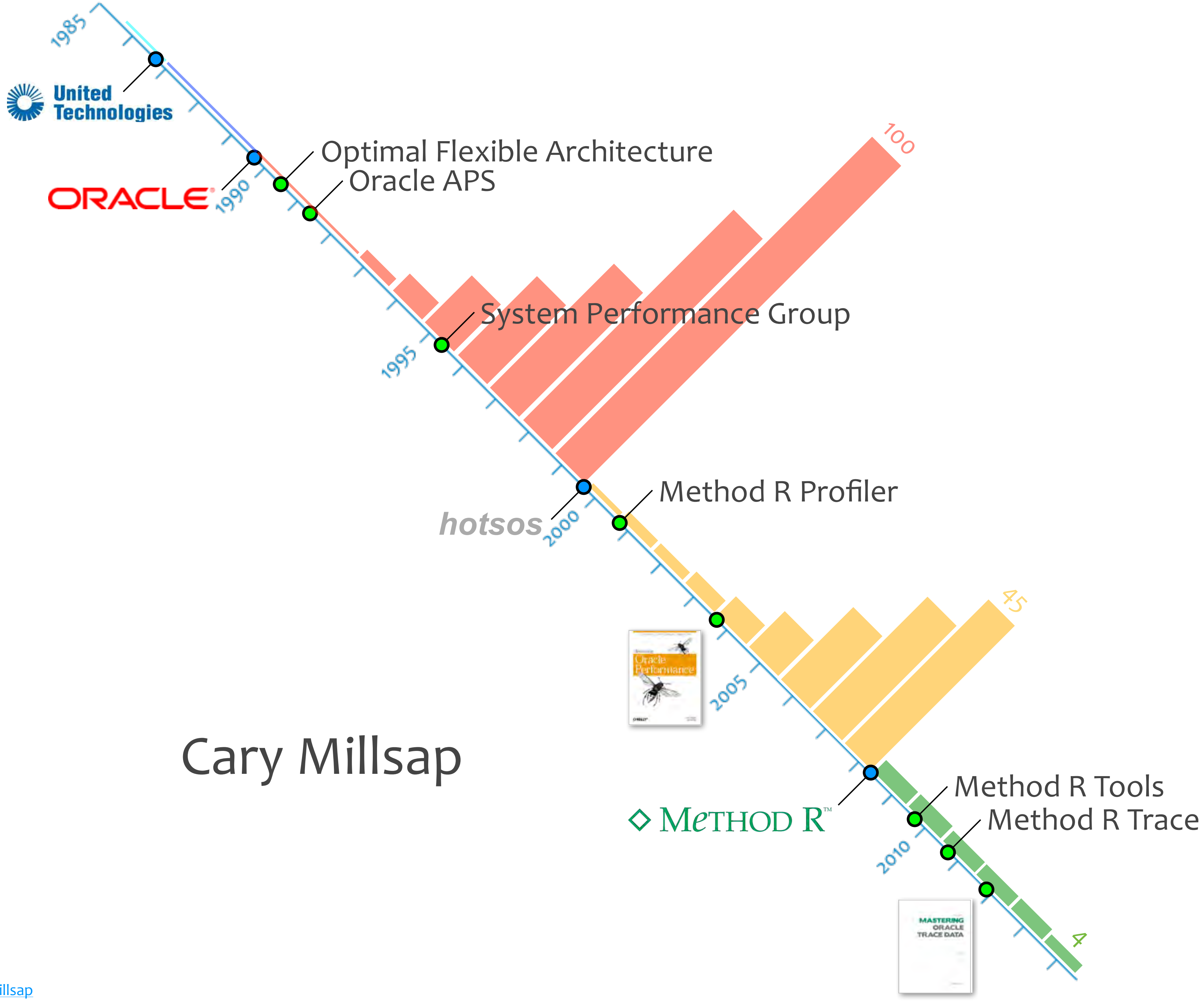
Performance is a Feature

Here is the Specification

Cary Millsap
Method R Corporation

@CaryMillsap · cary.millsap@method-r.com

Dallas Oracle Users Group · Richardson, Texas
5:00p–7:00p Thursday 30 January 2014



Cary Millsap

@CaryMillsap

◇ METHOD R™

🌎 method-r.com

🐦 @MethodR

create profiling tools

and other performance software

teach people

how to make software run faster

write applications

(primarily SQL and PL/SQL) for high-performance projects

fix problems

with performance on any Oracle-based system

1 What is performance?

PERFORMANCE IS NOT AN ATTRIBUTE OF A SYSTEM.

PERFORMANCE IS AN ATTRIBUTE OF EACH INDIVIDUAL EXPERIENCE WITH A SYSTEM.

What I mean...

Is performance **always** either fast for everyone,
or slow for everyone?

No.

It can be fast for some **clicks**, slow for others.
...fast for some **people**, slow for others.
...fast for some **clicks** for some **people** some**times**, slow for others.

PERFORMANCE IS AN ATTRIBUTE OF
INDIVIDUAL EXPERIENCES.

“My {
click
button
link
row
query
report
job
} has to finish quickly.”

This is what performance is.

How do you know when your user's { click / button / link / row / query / report / job } is fast?

Do you have to feel it?

Experience it first-hand?

How do you know when your user’s { click button link row query report job } is fast?

It would be better if you could look it up.

What have people been ***experiencing***?

What have people been ***experiencing***?

That’s a *feature*.

2 How to measure performance?

People feel performance two ways.

“How long does it take?”

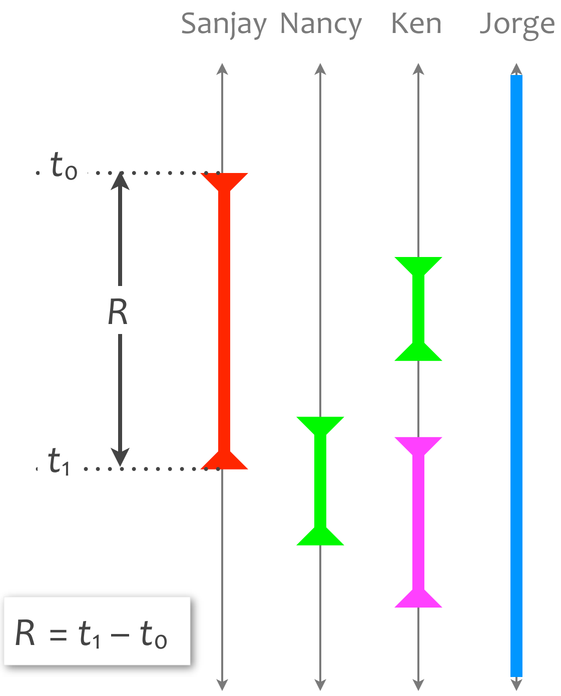
“How much stuff can we do?”

{ click
button
link
row
query
report
job }

“How long does it take?”

Response time (R)

Duration from service request to service fulfillment.

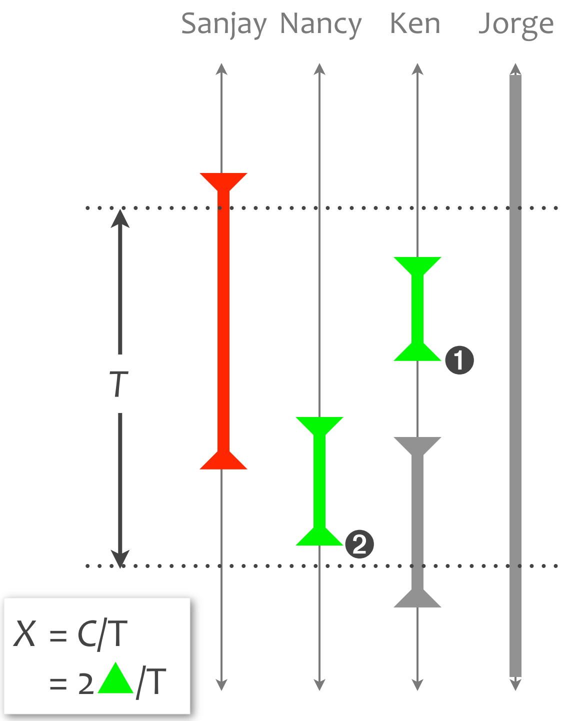


$R = t_1 - t_0$

“How much stuff can we do?”

Throughput (X)

Count of service fulfillments in a given time interval.



$X = C/T$
$= 2$▲$/T$

If you know t_0 and t_1
for each experience,

...you can compute
both *R* and *X*.

The key is to

record t_0 and **t_1**

...and just a few other things.

3 What do you get?

What have people been ***experiencing***?

That's a *feature*.

1

How long do people wait for their stuff?

Show response time for any user experience executed within the past 5 years.

1

How long do people wait for their stuff?

Show response time for any user experience executed within the past 5 years.

User name	IP address	Task name	Time requested	*R* (seconds)
nancy	192.164.1.103	Ship Order	2012-09-04T14:22:08	1.927
ron	192.164.1.138	Book Order	2012-09-04T14:22:12	0.223
ken	148.27.1.42	Pick Order	2012-09-04T14:22:18	0.891
alex	192.164.1.142	Book Order	2012-09-04T14:22:19	0.887
ron	192.164.1.138	Book Order	2012-09-04T14:23:11	0.270
harold	148.113.22.32	Ship Order	2012-09-04T14:23:27	2.084

Where do you get these things?

From code you write like this:

```
🔴 user_name     = sys_context('userenv','session_user');
🔴 ip_address    = sys_context('userenv','ip_address');
🟢 task_name     = "Book Order";
🔵 experience_id = randomUUID();
🔵 t0            = gettimeofday();

🟢 /* Your Book Order code path goes here. */

🔵 t1            = gettimeofday();
🟢 status        = log_task(user_name, ip_address, …, t0, t1);
```

🔴 Oracle function

🔵 OS function

🟢 Your function

1

How long do people wait for their stuff?

y response time fc ny user experience ecuted within the 5 years.

user _name

ip_address

task_name

t0

t1 - t0

User name	IP address	Task name	Time requested	*R* (seconds)
nancy	192.164.1.103	Ship Order	2012-09-04T14:22:08	1.927
ron	192.164.1.138	Book Order	2012-09-04T14:22:12	0.223
ken	148.27.1.42	Pick Order	2012-09-04T14:22:18	0.891
alex	192.164.1.142	Book Order	2012-09-04T14:22:19	0.887
ron	192.164.1.138	Book Order	2012-09-04T14:23:11	0.270
harold	148.113.22.32	Ship Order	2012-09-04T14:23:27	2.084

2

How long do tasks take?

Show response time grouped by task.

2

How long do tasks take?

Show response time grouped by task.

Task name	R_{mean}	$R_{99\%}$
Ship Order	2.084	9.597
Pick Order	1.260	4.803
Book Order	0.353	**1.626**

99% of Book Order experiences are better than **1.626**s.

1% of Book Order experiences are *worse* than 1.626s.

3

Which response times exceed our tolerance?

Store a performance tolerance for each task and compare each *R* to its tolerance.

3

Which response times exceed our tolerance?

Store a response time tolerance for each task and compare each *R* to its tolerance.

R experiences must not exceed 2.0s more often than 1 time in 100.

if and only if

$$R_{(1 - 1/100)} \leq 2.0\text{s}$$
$$R_{99\%} \leq 2.0\text{s}$$

3

Which response times exceed our tolerance?

Store a response time tolerance for each task and compare each *R* to its tolerance.

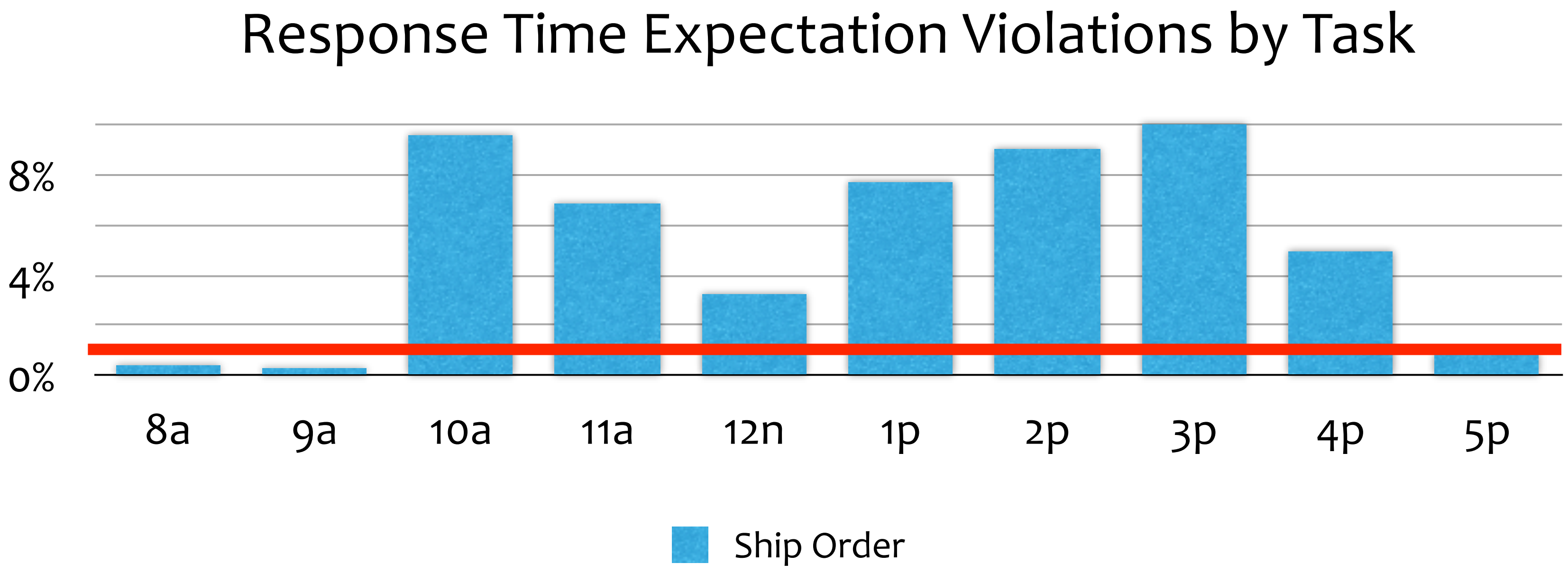
Task name	$T_{99\%}$	$R_{99\%}$	% experiences that exceed $T_{99\%}$ (mustn't exceed 1.0%)
Ship Order	5.000	9.597	8.21%
Pick Order	5.000	4.803	0.94%
Book Order	2.000	1.626	0.70%

Ship Order is not meeting our service level objective.

3

Which response times exceed our tolerance?

Store a response time tolerance for each task and compare each *R* to its tolerance.



4

Which task will next violate its R tolerance?

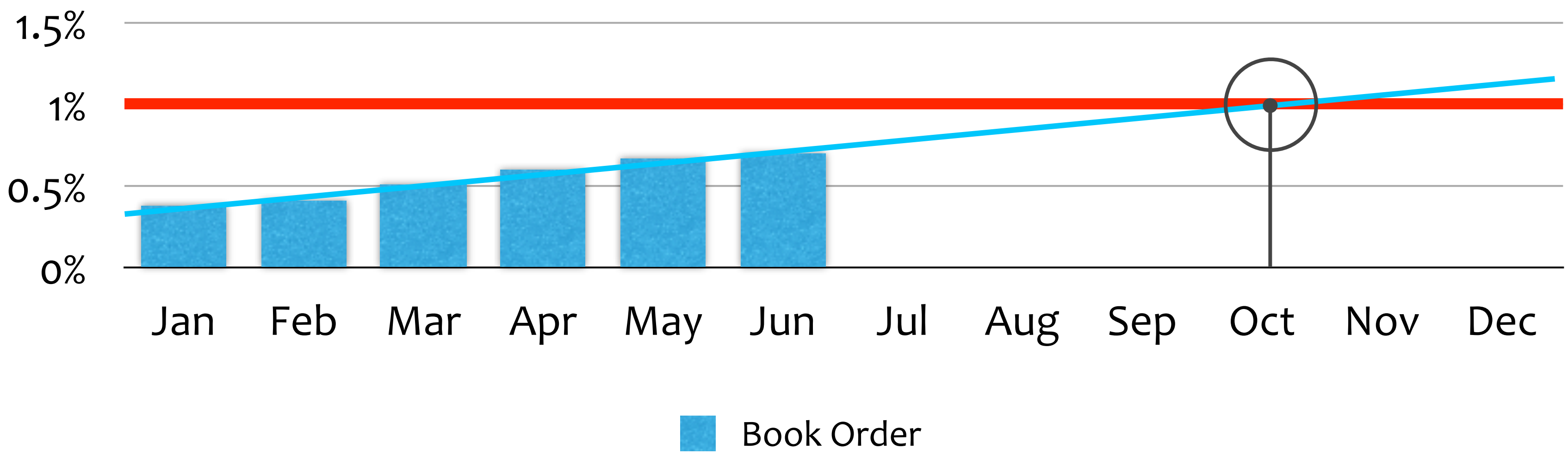
Compute when a daily $R_{99\%}$ for a task is expected to violate its tolerance.

4

Which task will next violate its tolerance?

Compute when a daily $R_{99\%}$ for a task is expected to violate its tolerance.

Response Time Expectation Violations by Task



4

Which task will next violate its tolerance?

Compute when a daily $R_{99\%}$ for a task is expected to violate its tolerance.

Task name	$T_{99\%}$	$R_{99\%}$	% experiences that exceed $T_{99\%}$ (mustn't exceed 1.0%)	Est. days until $R > T$ (i.e., until % > 1.0)
Ship Order	5.000	9.597	8.21%	–
Pick Order	5.000	4.803	0.94%	18
Book Order	2.000	1.626	0.70%	117

"Pick Order is on an 18-day collision course."

5

Does Nancy's stuff really take longer?

Show response time grouped by task and user.

5

Does Nancy’s stuff really take longer?

Show response time grouped by task and user.

Task name	User name	$T_{99\%}$	$R_{99\%}$	% experiences that exceed $T_{99\%}$ (mustn’t exceed 1.0%)
Ship Order	nancy	5.000	24.168	18.21%
Ship Order	ron	5.000	4.966	0.94%
Ship Order	ken	5.000	4.208	0.70%
Ship Order	harold	5.000	3.174	0.67%

“Nancy’s *Ship Orders* really do take longer.”

6

Is it just Nancy? Or a whole subnetwork?

Show response time grouped by task and subnetwork.

6

Is it just Nancy? Or a whole subnetwork?

Show response time grouped by task and subnetwork.

Task name	IP subnetwork	$T_{99\%}$	$R_{99\%}$	% experiences that exceed $T_{99\%}$ (mustn't exceed 1.0%)
Ship Order	192.164.1	5.000	18.211	12.89%
Ship Order	148.27.1	5.000	4.669	0.90%
Ship Order	148.13.22	5.000	4.812	0.72%

“Everybody in Atlanta is suffering.”

What have people been ***experiencing***?

That’s a *feature*.

The important thing is what you measure.

Performance is about measuring ***experiences***.

…Not resources.

4 Bonus: the *Traceable Experience* feature

7

Why did Nancy’s task take so long?

Show response time call-by-call, grouped by end-user experience.

How to distinguish

end-user **experiences**

from each other?

In Oracle,

module, action, clientid.

module = application name

action = task name

clientid = UUID + user + IP

In PL/SQL, use `dbms_application_info.set_module`
`dbms_session.set_identifier`

In Java, use `setEndToEndMetrics()`

What do you get?

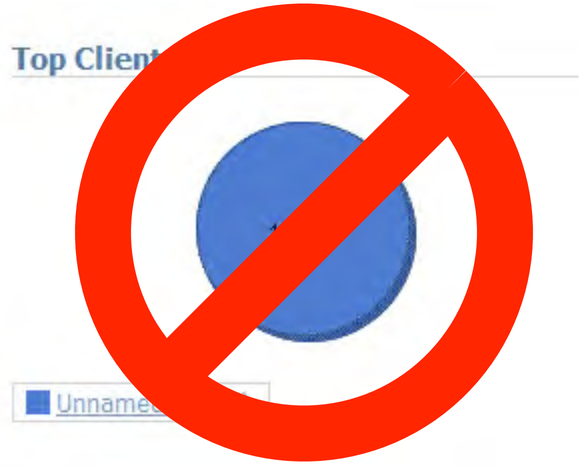
What do you get?

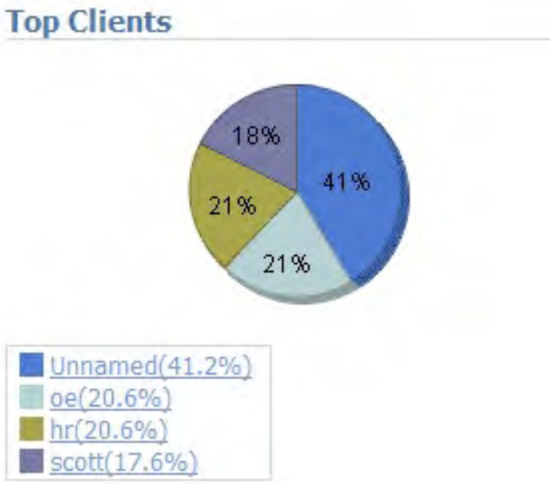
You get hooks in your v$ data to group by.

```
SQL> desc v$session
…
module
…
action
…
client_identifier
…
```

What do you get?

OEM (…ASH, etc.) can help you more.





What do you get?

You can control tracing.

```
dbms_monitor.serv_mod_act_trace_enable(:serv, :mod, :act, …)

dbms_monitor.client_id_trace_enable(:client_id)
```

What do you get?

You get hooks in your trace data to group by.

```
*** CLIENT ID:(798164fb-ad9a-43e1-b543-0e1cfa94195c PDRAKE 172.27.13.1
*** SERVICE NAME:(SYS$USERS) 2012-05-09 11:42:55.278
*** MODULE NAME:(oe) 2012-05-09 11:42:55.278
*** ACTION NAME:(book) 2012-05-09 11:42:55.278
```

What can your trace files tell you?

What have people been ***experiencing***?

```
EXPERIENCE-ID                        USER      IP-ADDRESS   MOD/ACT    DURATION
-------------------------------------------------------------------  ----------  ---
eec4c72f-b685-4b5b-8447-688b8aecbc6f NPHELPS   10.17.22.12  oe/book   49.699960    6
ab9fdc58-6c09-4fe2-b253-8b2c191e4671 VSAUNDERS 10.17.22.76  oe/book   48.977182    6
ab8e9d2c-8ba6-4c5f-8673-13a3c958af7a PDRAKE    10.17.23.174 oe/book   47.520700    6
ced4bdee-f0d8-44cd-a878-f0b938802bc0 VMICHAEL  10.17.24.138 oe/book   43.597261    5
5c01b8e5-e0d3-44c2-ada8-c8b1ed17abee MSTANLEY  10.17.22.115 pa/mtch   23.714088    3
2161468f-5504-419a-8226-f5ee0ad39b73 TIRWIN    10.17.22.249 pa/reco   22.946626    3
e463a90b-32a8-49fc-81e8-0c2559269e1e ESANDERS  10.17.21.167 pa/mtch   22.607869    3
8a41c465-e00f-43b2-afcd-ba4edd7df899 DHALEY    10.17.22.98  oe/pick   21.967559    3
052b3d18-e992-46a2-8ae3-87427c78598e UDECKER   10.17.21.239 oe/ship   20.312153    2
2270f4b4-1c46-4ad7-ac6a-2ed1fc13c283 LDILLARD  10.17.21.14  oe/ship   20.024742    2
158 others                                                           420.181628   56
-------------------------------------------------------------------  ----------  ---
TOTAL (168)                                                          741.549768  100
```

Why did Nancy’s program take so long?

```
CALL-NAME                       DURATION       %   CALLS      MEAN       MIN       MAX
---------------------------  ----------- ------  ------  --------  --------  --------
SQL*Net message from client    40.507440  81.5%  18,585  0.002180  0.000000  0.220486
FETCH                           9.010846  18.1%  18,583  0.000485  0.000000  0.120008
SQL*Net message to client       0.094487   0.2%  18,585  0.000005  0.000000  0.018525
EXEC                            0.061719   0.1%      19  0.003321  0.000000  0.011624
cursor: pin S wait on X         0.025463   0.1%       4  0.006366  0.000000  0.011166
cursor: pin S                   0.000005   0.0%       5  0.000001  0.000000  0.000005
PARSE                           0.000000   0.0%       2  0.000000  0.000000  0.000000
pooled connection free          0.000000   0.0%       1  0.000000  0.000000  0.000000
XCTEND                          0.000000   0.0%       1  0.000000  0.000000  0.000000
---------------------------  ----------- ------  ------  --------  --------  --------
TOTAL (9)                      49.699960 100.0%  74,351  0.000668  0.000000  0.220486
```

Why 40 sec of ‘SQL*Net message from client’ calls?

```
RANGE {min ≤ e < max}          DURATION      %   CALLS      MEAN       MIN      M
----------------------------- --------- ------ ------ --------- --------- ------
 1.     0.000000     0.000001  0.000000   0.0%      3  0.000000  0.000000 0.0000
 2.     0.000001     0.000010
 3.     0.000010     0.000100  0.000358   0.0%      5  0.000072  0.000041 0.0000
 4.     0.000100     0.001000  8.391000  20.7% 13,947  0.000602  0.000104 0.0009
 5.     0.001000     0.010000  9.307749  23.0%  3,822  0.002435  0.001000 0.0099
 6.     0.010000     0.100000 20.877546  51.5%    793  0.026327  0.010001 0.0994
 7.     0.100000     1.000000  1.930787   4.8%     15  0.128719  0.103157 0.2204
 8.     1.000000    10.000000
 9.    10.000000   100.000000
10.   100.000000 1,000.000000
11. 1,000.000000           +∞
----------------------------- --------- ------ ------ --------- --------- ------
TOTAL (11)                    40.507440 100.0% 18,585  0.002180  0.000000 0.2204
```

Were the calls all made by the same SQL?

```
SQLID              DURATION       %   CALLS      MEAN       MIN       MAX
-------------  ----------  ------  ------  --------  --------  --------
6m3a3v3yjvabh   40.506884  100.0%  18,584  0.002180  0.000000  0.220486
40kwnn4q98wqn    0.000556    0.0%       1  0.000556  0.000556  0.000556
-------------  ----------  ------  ------  --------  --------  --------
TOTAL (2)       40.507440  100.0%  18,585  0.002180  0.000000  0.220486
```

How many rows per database call?

```
CALL-NAME      ROWS       %   CALLS  MEAN  MIN  MAX
---------    ------  ------  ------  ----  ---  ---
FETCH        18,378  100.0%  18,583     1    0    1
EXEC              2    0.0%      19     0    0    1
PARSE             0    0.0%       2     0    0    0
XCTEND            0    0.0%       1     0    0    0
---------    ------  ------  ------  ----  ---  ---
TOTAL (4)    18,380  100.0%  18,605     0    0    1
```

ARRAY FETCH SIZE PROBLEM

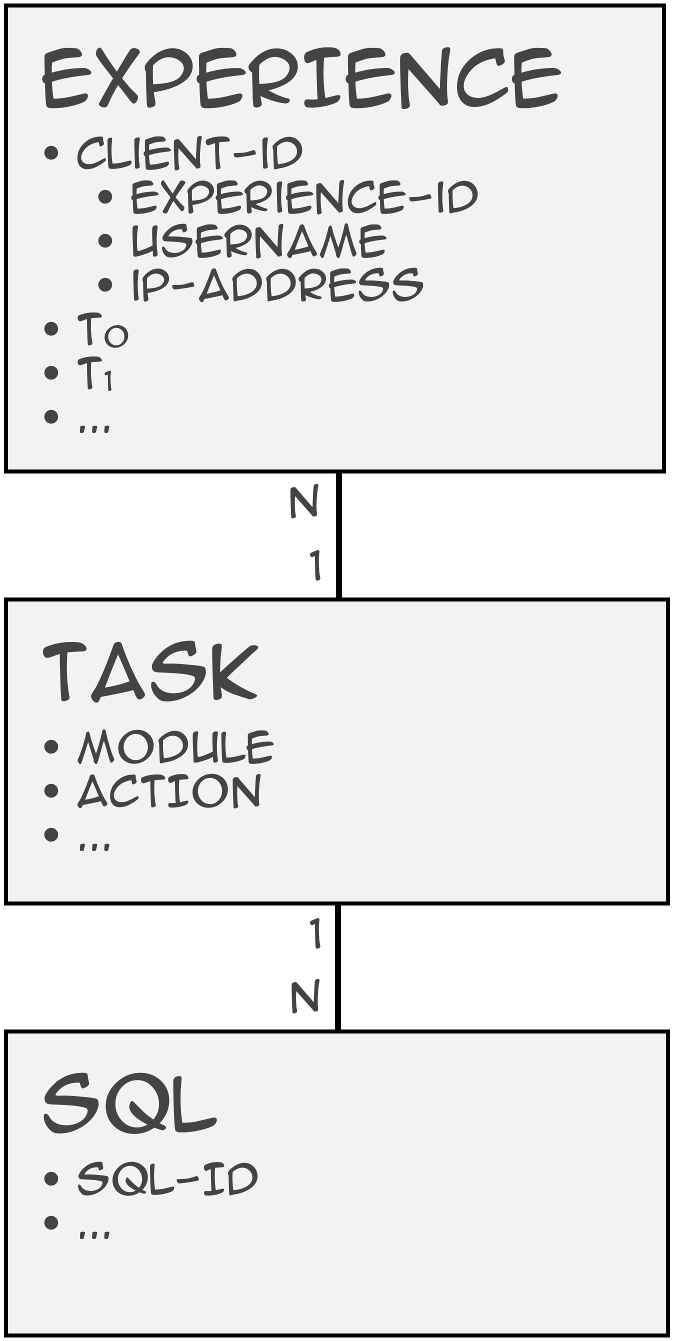
5 Conclusion

Performance is about

measuring ***experiences.***

You can **write apps** that make it easy to know what performance people have been ***experiencing*****.**

And you can retrofit **existing** apps.



EXPERIENCE

- CLIENT-ID
    - EXPERIENCE-ID
    - USERNAME
    - IP-ADDRESS
- T_0
- T_1
- ...

TASK

- MODULE
- ACTION
- ...

SQL

- SQL-ID
- ...

Performance is a ***feature***.

Everything you’ve seen today, we’ve already built.

✉ cary.millsap@method-r.com

@CaryMillsap

◇ METHOD R™

method-r.com

@MethodR

create profiling tools
and other performance software

teach people
how to make software run faster

write applications
(primarily SQL and PL/SQL) for high-performance projects

fix problems
with performance on any Oracle-based system

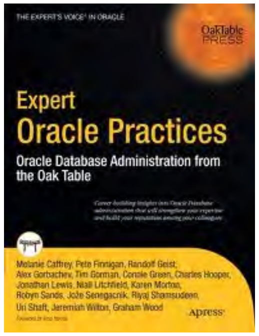
6 References

Ron Crisco, et al. 2011
Expert PL/SQL Practices
Apress

Detailed information about instrumenting your Oracle application code.

Cary Millsap, Jeff Holt. 2003
Optimizing Oracle Performance
O'Reilly

Detailed information about Oracle trace data and what to do with it.


THE EXPERT'S VOICE® IN ORACLE
OakTable PRESS
Expert
Oracle Practices
Oracle Database Administration from the Oak Table
Apress

Robyn Sands, et al. 2010
Expert Oracle Practices
Apress

Detailed information about instrumenting your Oracle application code.

Cary Millsap. 2011
Mastering Oracle Trace Data
Method R Corporation

Follow-up to *Optimizing Oracle Performance* teaches you how to master Oracle trace data.

Method R Corporation

High-Level Overview

Cary Millsap

cary.millsap@method-r.com

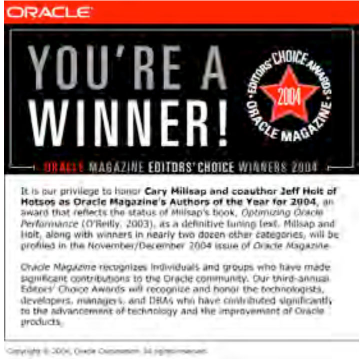
Why Method R?

“My {
click
button
link
row
query
report
job
} has to finish quickly.”

This is what performance is.

Performance is the economic effect of your system’s use of **time** upon your business.

A Practitioner's Guide to Optimizing Response Time
Optimizing
Oracle Performance
O'REILLY
Cary Millsap with Jeff Holt

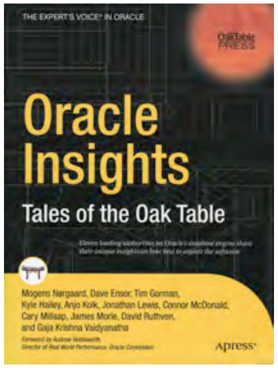

ORACLE
YOU'RE A WINNER!
EDITORS' CHOICE AWARDS 2004 ORACLE MAGAZINE

ORACLE MAGAZINE EDITORS' CHOICE WINNERS 2004

It is our privilege to honor **Cary Millsap and coauthor Jeff Holt of Hotsos as Oracle Magazine's Authors of the Year for 2004**, an award that reflects the status of Millsap's book, *Optimizing Oracle Performance* (O'Reilly, 2003), as a definitive tuning text. Millsap and Holt, along with winners in nearly two dozen other categories, will be profiled in the *November/December 2004* issue of *Oracle Magazine*.

Oracle Magazine recognizes individuals and groups who have made significant contributions to the Oracle community. Our third-annual Editors' Choice Awards will recognize and honor the technologists, developers, managers, and DBAs who have contributed significantly to the advancement of technology and the improvement of Oracle products.

Copyright © 2004, Oracle Corporation. All rights reserved.


THE EXPERT'S VOICE® IN ORACLE
OakTable PRESS
Oracle Insights
Tales of the Oak Table
Mogens Nørgaard, Dave Ensor, Tim Gorman, Kyle Hailey, Anjo Kolk, Jonathan Lewis, Connor McDonald, Cary Millsap, James Morle, David Ruthven, and Gaja Krishna Vaidyanatha
Apress®

COMMUNICATIONS OF THE ACM
Computers in
COMMUNICATIONS OF THE ACM
Peer-to-Peer Systems
How Offshoring Affects IT Workers
Linear Logic
Photoshop Scalability
Version Aversion

THE EXPERT'S VOICE® IN DATABASES
Expert
PL/SQL Practices
for Oracle Developers and DBAs
DEEP INSIGHTS INTO DATABASE PROGRAMMING WITH PL/SQL
John Beresniewicz, Adrian Billington, Martin Büchi, Melanie Caffrey, Ron Crisco, Lewis Cunningham, Dominic Delmolino, Sue Harper, Torben Holm, Connor McDonald, Arup Nanda, Stephan Petit, Michael Rosenblum, Robyn Sands, and Riyaj Shamsudeen
Apress®

Software development

Designing, building, and testing your application is way more difficult than you thought it would be. It needs to scale to outrageous workloads and data volumes. You're worried it won't.

Problem prevention

Every performance problem is a surprise and an emergency, and you're sick of it. How can you prevent your next performance problem from ever happening?

Performance optimization

Your users are hitting performance problems you can't seem to shake. How can you make your system go faster? What performance expectations are even reasonable?

Performance assessment

You're going live soon. Will your application be fast enough on the hardware you're planning to use? How can you make sure your next hardware upgrade will be a triumph, not an embarrassment?

The Method

Method C —conventional "tuning"

1. **Measure** everything a system lets you measure
2. **Look** for odd patterns in the measurements
3. **Try** things with the intent of improving the patterns
4. **Undo** any attempt that makes things worse
5. Not enough improvement? **Repeat** step 1
6. Satisfactory improvement? **Repeat** step 1 anyway

🚫 trial and error

Method R —response time-based optimization

1. **Identify** the *task* that's the most important to you
2. **Measure** its *response time* (R) in detail
3. **Optimize** that response time
4. Repeat until your system is **economically optimal**

Method R —response time-based optimization

1. **Identify** the *task* that's the most important to you
2. **Measure** its *response time* (R) in detail
3. **Optimize** that response time
4. Repeat until your system is **economically optimal**

These steps aren't always easy.

That's why we have
consulting, education, software.

Profiling…

Where did my code spend my time?

Where did it *not* spend my time?

How long *should* this task run?

Profiling is how you know your goal state.

Optimizing Oracle Performance

MASTERING ORACLE TRACE DATA

METHOD R™ Profiler

METHOD R™ Trace

METHOD R™ Tools

Software and Education

Method R™ Profiler

Response times in vivid color, with directed drill-down

Method R™ Tools

Flexible utilities for working with trace data

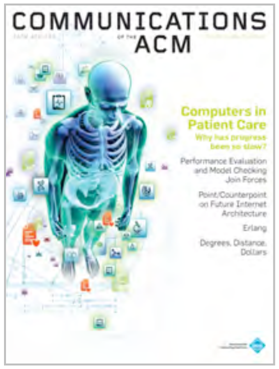
- Manage thousands of trace files
- Query trace data with unparalleled precision
- Repair problems with trace data
- Write batch programs to automate drill-down analyses

Method R™ Trace

Zero-click trace file collector/manager for Oracle SQL Developer

THINKING CLEARLY ABOUT PERFORMANCE

1 day · Cary Millsap


COMMUNICATIONS
OF THE ACM
Computers in Patient Care
Why has progress been so slow?
Performance Evaluation and Model Checking Join Forces
Point/Counterpoint on Future Internet Architecture
Erlang
Degrees, Distance, Dollars

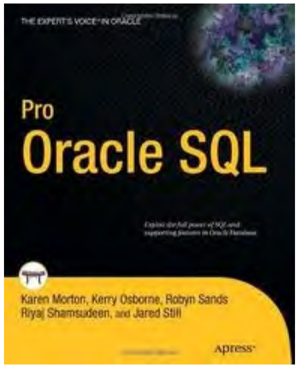
MASTERING ORACLE TRACE DATA

1 day · Cary Millsap

MASTERING
ORACLE
TRACE DATA

MASTERING ORACLE SQL

3–10 days · Ron Crisco


THE EXPERT'S VOICE™ IN ORACLE
Pro
Oracle SQL
Karen Morton, Kerry Osborne, Robyn Sands
Riyaj Shamsudeen, and Jared Still
Apress

◇ Method R™

🌎 method-r.com

🐦 @MethodR

create profiling tools

and other performance software

teach people

how to make software run faster

write applications

(primarily SQL and PL/SQL) for high-performance projects

fix problems

with performance on any Oracle-based system