面向分布式系统的复制数据类型理论研究概述

(CCF 2018 第九届优博论坛)

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2018 年 08 月 08 日

面向分布式系统的复制数据类型理论研究概述

1. 研究背景

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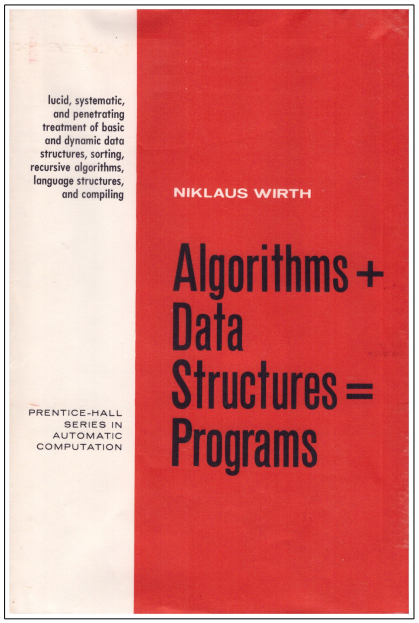
1. 研究背景

Abstract Data Types (ADT)

[Liskov and Zilles, 1974]

(单线程; 顺序语义)



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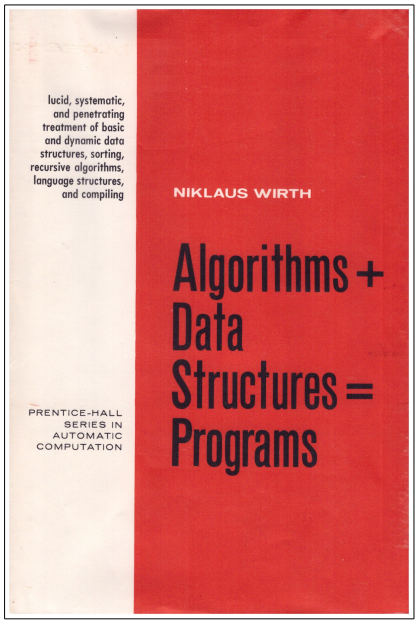
[Liskov and Zilles, 1974]

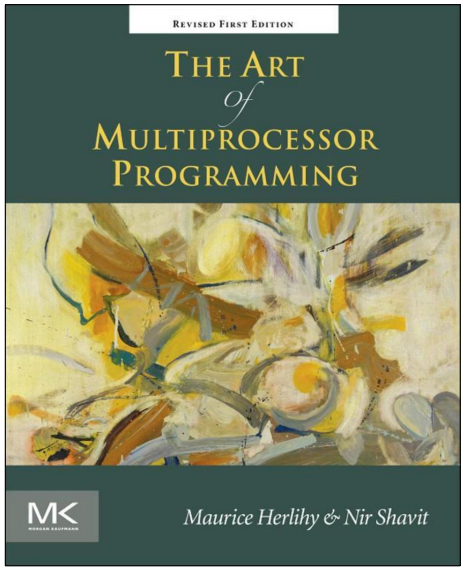
(单线程; 顺序语义)



Concurrent Data Types

[Herlihy and Wing, 1990]

(多线程; 并发语义)



Replicated Data Types (RDT; ≈ 2010 年)

[Burckhardt et al., 2014]

(多副本; 复制语义)

Replicated Data Types: Specification, Verification, Optimality

Sebastian Burckhardt Alexey Gotsman Hongseok Yang Marek Zawirski

Replicated Data Types (RDT; ≈ 2010 年)

[Burckhardt et al., 2014]

(多副本; 复制语义)

Replicated Data Types: Specification, Verification, Optimality

Sebastian Burckhardt　Alexey Gotsman　Hongseok Yang　Marek Zawirski

新平台, 新问题, 新挑战

新浪微博社交应用 [1]:

- 日均用户近一亿名
- 日均消息近一亿条

[1] 2015 第三季度; 数据来自 China Internet Watch.

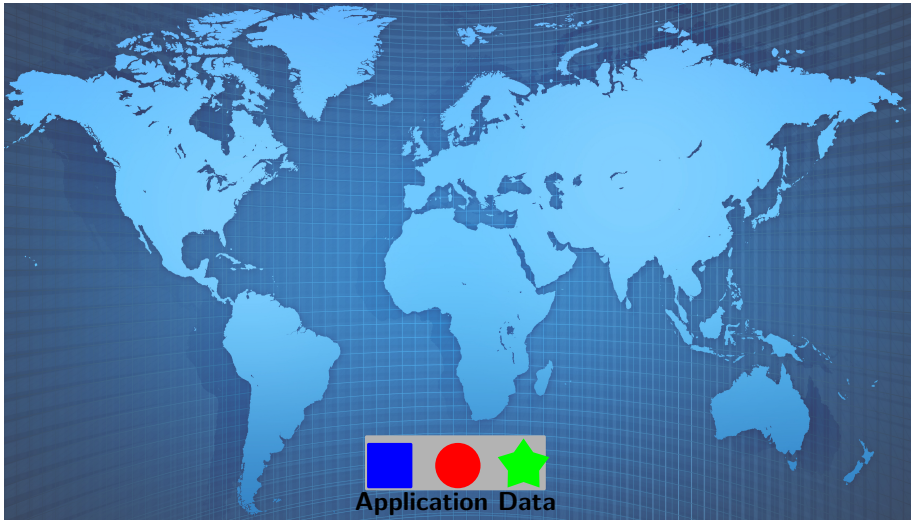
新浪微博社交应用 [1]:

- 日均用户近一亿名
- 日均消息近一亿条

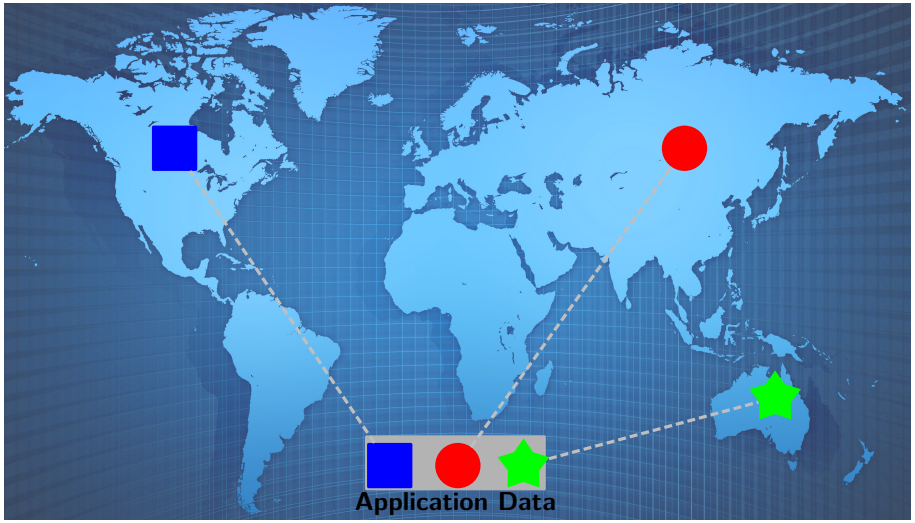
底层数据服务系统特性需求 (H^3L):

- 低延迟, 高可用性 (4 个 9 [2])
- 高容错性, 高可扩展性

[1] 2015 第三季度; 数据来自 China Internet Watch.
[2] 数据来自 InfoQ.

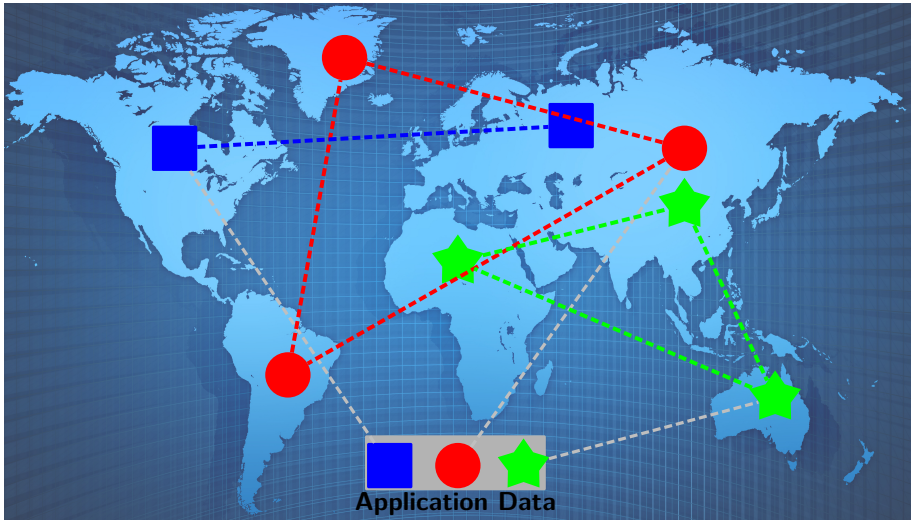


分布数据 (distributed data):



分布数据 (distributed data):

1. 分区 (partition): 水平扩展

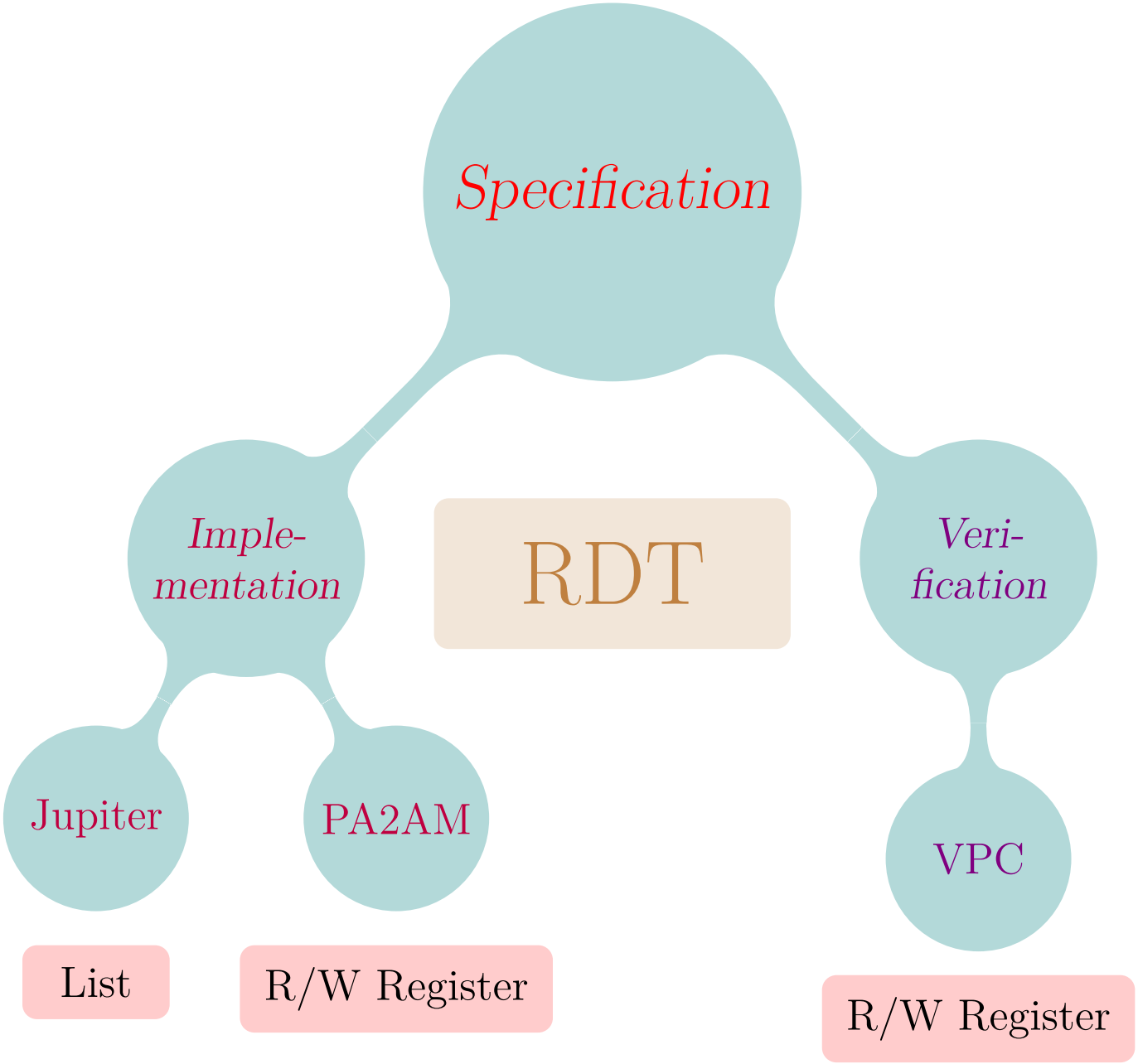


分布数据 (distributed data):

1. 分区 (partition): 水平扩展
2. 副本 (replication): 就近访问, 容灾备份

复制数据类型 [Shapiro et al., 2011]

- Read/Write Register
- Counter
- Set
- List
- Hash Map
- Disjoint Set
- Graph


Specification
Imple-
mentation
RDT
Veri-
fication
Jupiter
PA2AM
VPC
List
R/W Register
R/W Register

Burckhardt, Sebastian et al. (2014). "Replicated Data Types: Specification, Verification, Optimality". In: *Proceedings of the 41st ACM SIGPLAN-SIGACT Symposium on Principles of Programming Languages*. POPL '14. San Diego, California, USA: ACM, pp. 271–284. ISBN: 978-1-4503-2544-8. DOI: 10.1145/2535838.2535848. URL: http://doi.acm.org/10.1145/2535838.2535848.

Herlihy, Maurice P. and Jeannette M. Wing (1990). "Linearizability: A Correctness Condition for Concurrent Objects". In: *ACM Trans. Program. Lang. Syst.* 12.3, pp. 463–492. ISSN: 0164-0925. DOI: 10.1145/78969.78972. URL: http://doi.acm.org/10.1145/78969.78972.

Liskov, Barbara and Stephen Zilles (1974). "Programming with Abstract Data Types". In: *Proceedings of the ACM SIGPLAN Symposium on Very High Level Languages*. Santa Monica, California, USA: ACM, pp. 50–59. DOI: 10.1145/800233.807045. URL: http://doi.acm.org/10.1145/800233.807045.

Shapiro, Marc et al. (2011). *A comprehensive study of Convergent and Commutative Replicated Data Types*. Research Report RR-7506. Inria – Centre Paris-Rocquencourt ; INRIA, p. 50. URL: https://hal.inria.fr/inria-00555588.

Thank
You!

Q/A