UC Santa Cruz

Active projects, Norcal DB Day'23
From Peter's Norcal DB day slides, circa 2016

Members

• Regular Faculty
  - Peter Alvaro
  - Lise Getoor
  - Phokion Kolaitis
  - Wang-Chiew Tan

• Affiliates, Adjuncts, Visiting Faculty
  - Balder ten Cate
  - Shel Finkelstein
  - Janice Lee
  - Ike Nassi
  - Alkis Polyzotis
My panel talk in 2016

Erosion?

Or subsumption?
My panel talk in 2016

A Field in Decline

New Operating Systems at SOSP

Today

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Still, here are 5 DB-adjacent projects (in as many minutes)

1. **Twizzler**, a data-centric operating system for far-out memories
2. **Magpie**, a hands-free programming model for all the data
3. **Shimmer**, exploiting ZNS SSDs for DB workloads, and
4. **Decomposing queries** to grow computational storage
5. **CabinDB**, a hybrid transactional/analytics/archival store
Trends

Persistent storage is *getting ever closer*

Memory is *moving farther away*

Storage is CONVERGING?

Compute is diverging!
Persistent data should be operated on *directly* and *like memory*

Pointers should last forever and have the same meaning anywhere
Magpie: a runtime for data and compute mobility

Databases effectively abstract distribution away. Can we enable this for applications?

- Why does the database approach work?
  - Programs only make reference to the data they touch, not the computers that data resides on
- Traditionally, distribution is
  - explicit (making the application programmer’s life hard) or
  - transparent (behind data-oriented but restrictive programming models)
- Combining the best of all worlds
  - Application data in a global address space decoupled from ephemeral contexts
  - Computation as transactional functions over local data
  - Distributed protocol subsumed by the runtime
Team

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UC Santa Cruz

Peter Alvaro
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Achilles Benetopoulos
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Allen Aboytes
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Pankaj Mehra
Elephance Memory

Darrell D. E. Long
UC Santa Cruz

Ethan L. Miller
UC Santa Cruz & Pure Storage

George Neville-Neil
MSB Associates
Optimizing Database File Operations

Interposing to provide better hints

- New SSD designs depend on the host for grouping decisions
- Files created by databases and containers have deterministic relations with workloads
  - Creation, type of access
  - Relations of file lifetimes
- We can interpose between the filesystem and storage backend, and indicate hardware hints for data
- Reduction in wear, write amplification, tail latency
Shimmer
Shim layer to intercept storage operations

Dev Purandare  Eugene Chou  Ethan L. Miller  Shel Finkelstein
Decomposable queries

Use case: single-cell gene analysis

Target: Computational Storage Systems

Approach:
Team

Computer Science

Aldrin Montana  Jeff LeFevre  Carlos Maltzahn  Peter Alvaro

Systems Biology

Bianca Xue  Josh Stuart

Philip Kufeldt

Storage Technologist

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CabinDB: A Scale-out HTAP with RocksDB on Ceph

- Unified user interface for transaction and analytical workloads
- Inherited benefits from both RocksDB and Ceph
- Scale-out LSM Tree Design abstracted with memtable in RocksDB, and other levels in Ceph storage cluster
- Compaction across Column Families to enable data physical design transformation throughout data life cycle
- Compaction and transformation performed in the pushed-down storage to minimize network traffic, and to offload from computing
Team

Holly Casaletto  Carlos Maltzahn  Peter Alvaro
Support

National Science Foundation
Defense Advanced Research Projects Agency
Intel
Seagate
and gifts from Ebay and Meta.
Thanks!