Lifemapper Server Virtualization

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PACIFIC RIM APPLICATIONS AND GRID MIDDLEWARE ASSEMBLY

PRAGMA

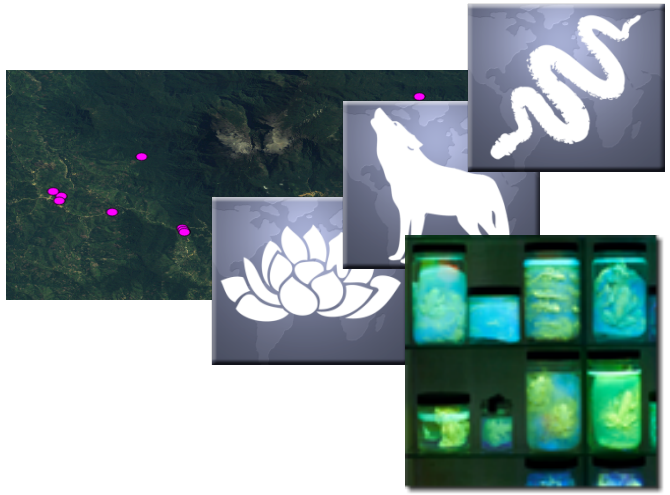
… Is Way Harder Than We Thought

THE UNIVERSITY OF KANSAS

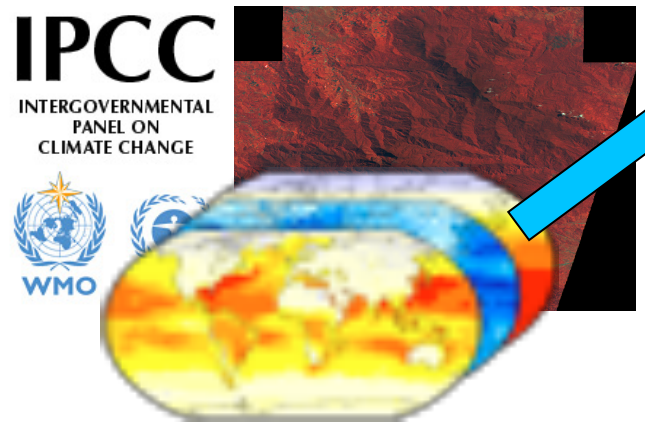
Lifemapper

- Data library
  - Climate
    - Observed
    - IPCC Predicted Future Climate
  - Species
    - Occurrence Points
    - Potential habitat maps
- Tools
  - LmSDM: Species Distribution Modeling
  - LmRAD: Range and Diversity

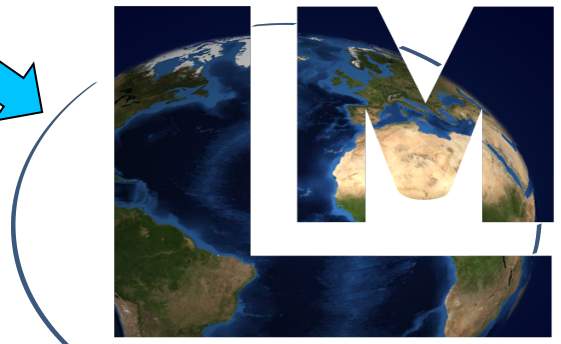
LmSDM:
Species Distribution Modeling

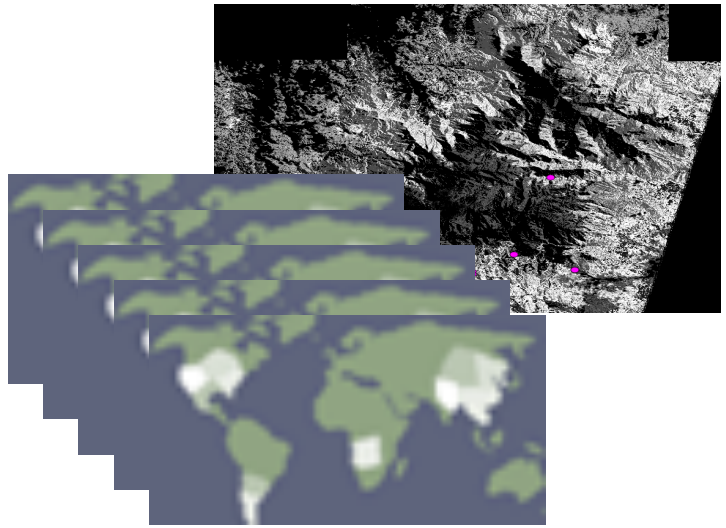


Species Occurrence Data



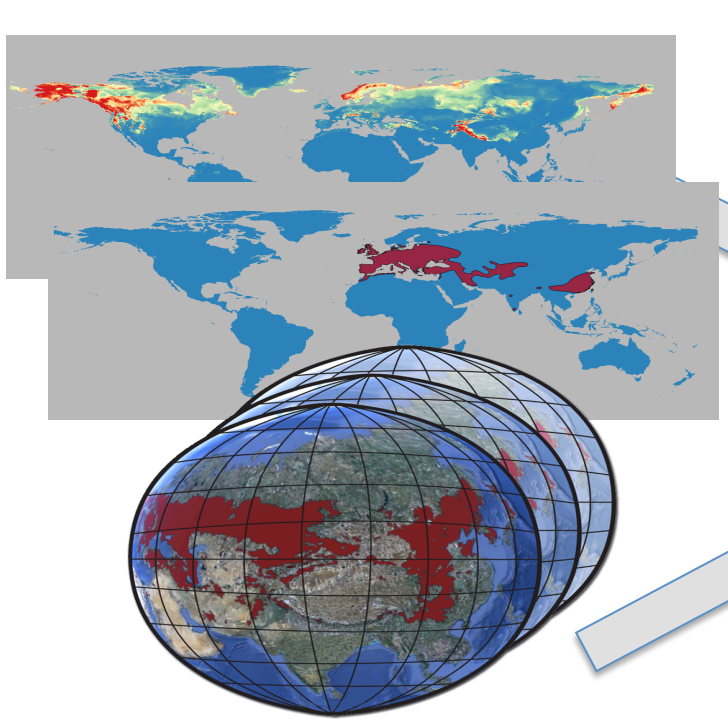
Environmental Data



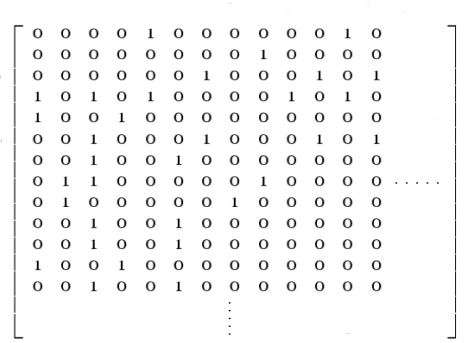


Potential Habitat

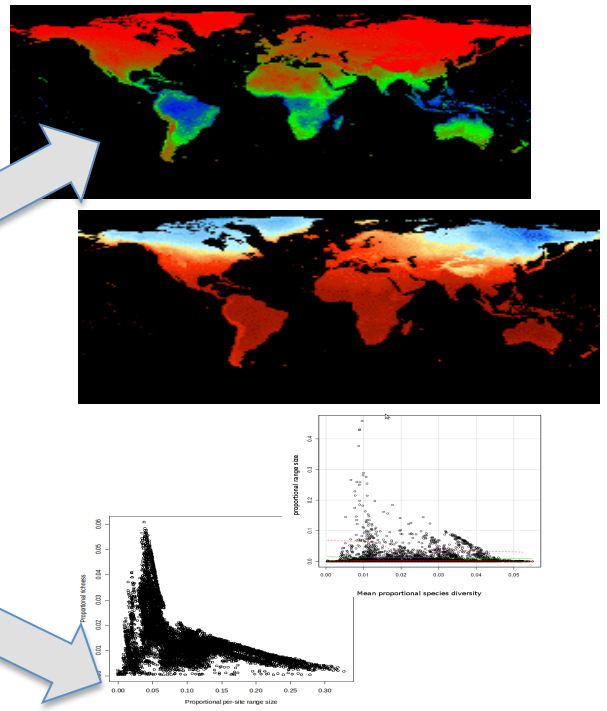
LmRAD:
Range and Diversity



Species Habitat Data



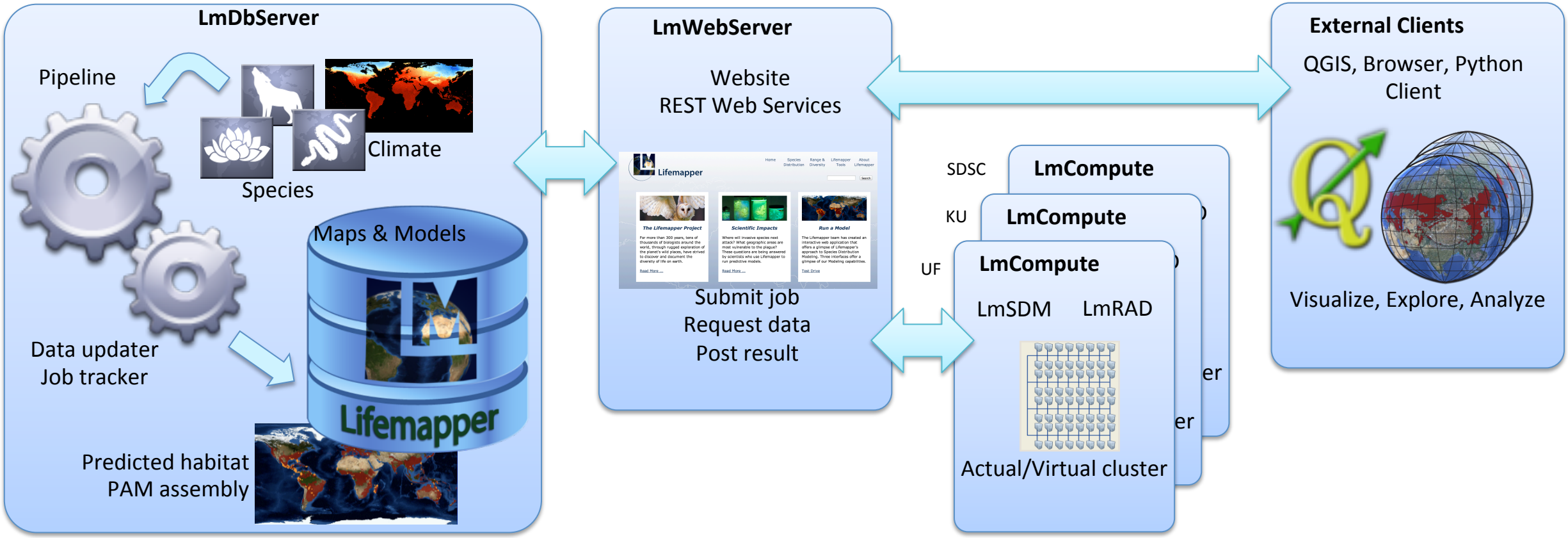
Presence Absence Matrix (PAM)



Multi-species analyses

Range and Diversity
Quantifications

Milestones: Lifemapper refactoring



PRAGMA 26 VBE Goals

PRAGMA 26 Goals: Decouple Lifemapper Server Components from KU

- *Enable configuration through initialization files*
- *Seed the database with site-specific inputs*
- *Connect the virtualized cluster (PRAGMA 25) to compute jobs*
- *Start the data pipeline to create computational jobs*

Issues:

- *We resolved KU-specific configuration problems*
- *Discovered data-specific bugs, not encountered in fully populated original installation*

Some further PRAGMA goals:

- **Instantiate Lifemapper with Mount Kinabalu data at UF**
- **Customize and extend data workflow through configuration**

Lifemapper Server Virtualization

Domain scientist's viewpoint:

1. Extend previous Lifemapper work to enable data management (LmDBServer) and web services (LmWebServer) components virtualization
2. Increase the availability and flexibility of Lifemapper to enable scientists to
   - *Assemble multi-species macro-ecology experiments*
   - *Perform other LM-facilitated data processing on:*

Unique datasets
Restricted use data
Very large datasets

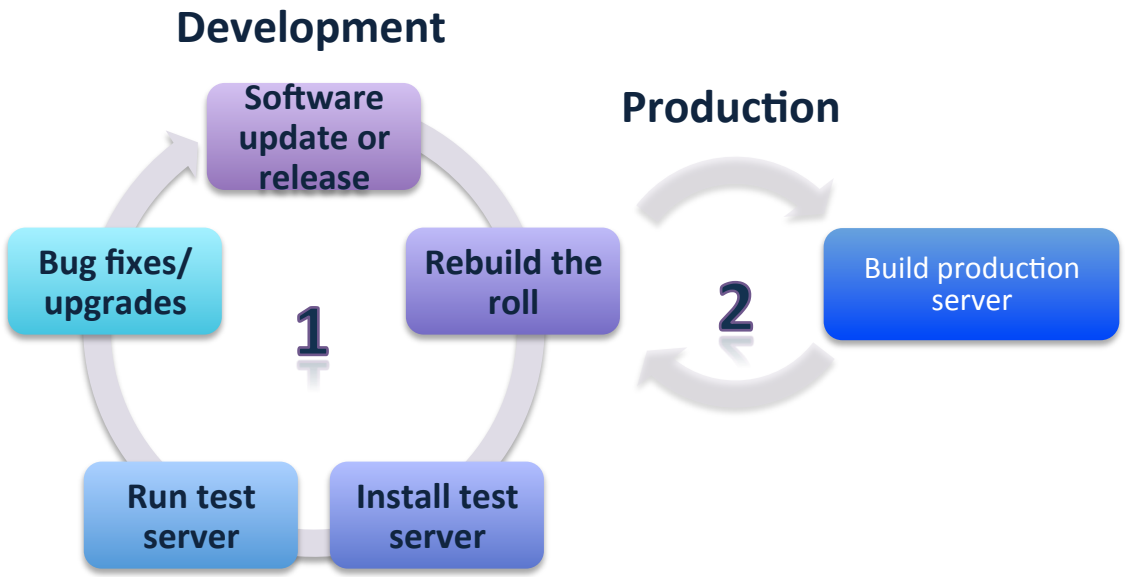
Cyber-infrastructure viewpoint:

1. Continue practical use of PRAGMA cloud infrastructure
2. Encapsulate the complexity of software build/configure in ROCKS rolls
3. Create a complete system as an end-to-end solution
4. Reduce cost of installing/configuring/replicating

What we are trying to do

- **Increase availability and flexibility of Lifemapper Server as a complete system**
  - reduce cost of installing/configuring/replicating and ease burden of integrating hardware and software
- **Enable a fast "workflow" from software update to server availability:**
  - Minimize time spent on software build and configuration
  - Automate most hands-on tasks.
  - Essential: have test cases for all installed components and their configuration
- **Prepare for greater quantity and quality of data and complexity of operations**
  - From low resolution climate data to high resolution satellite imagery for Mt. Kinabalu
  - From simple single-species SDM experiments to multi-species macro-ecology experiments with more species

This work is a part of PRAGMA's "Resources and Data" working group



Lifemapper

http://lifemapper.org

https://github.com/lifemapper/

Rocks

http://www.rocksclusters.org

Pragmagrid GitHub

https://github.com/pragmagrid/lifemapper

https://github.com/pragmagrid/lifemapper-server

Why Automate

Manual hands-on tasks:

- Software packages build
- Custom scripts
- User work-around
- Repetitive tedious functions
- Tracking errors, exceptions and problems

Time

Automation is no longer nice t… …t have that allows to:

- Know your system real-time status: what i… …nfigu…ation, data population
- Robust system: can reliably build and r…
- Address complexity of configuring – n…
- What issues need to be documented?

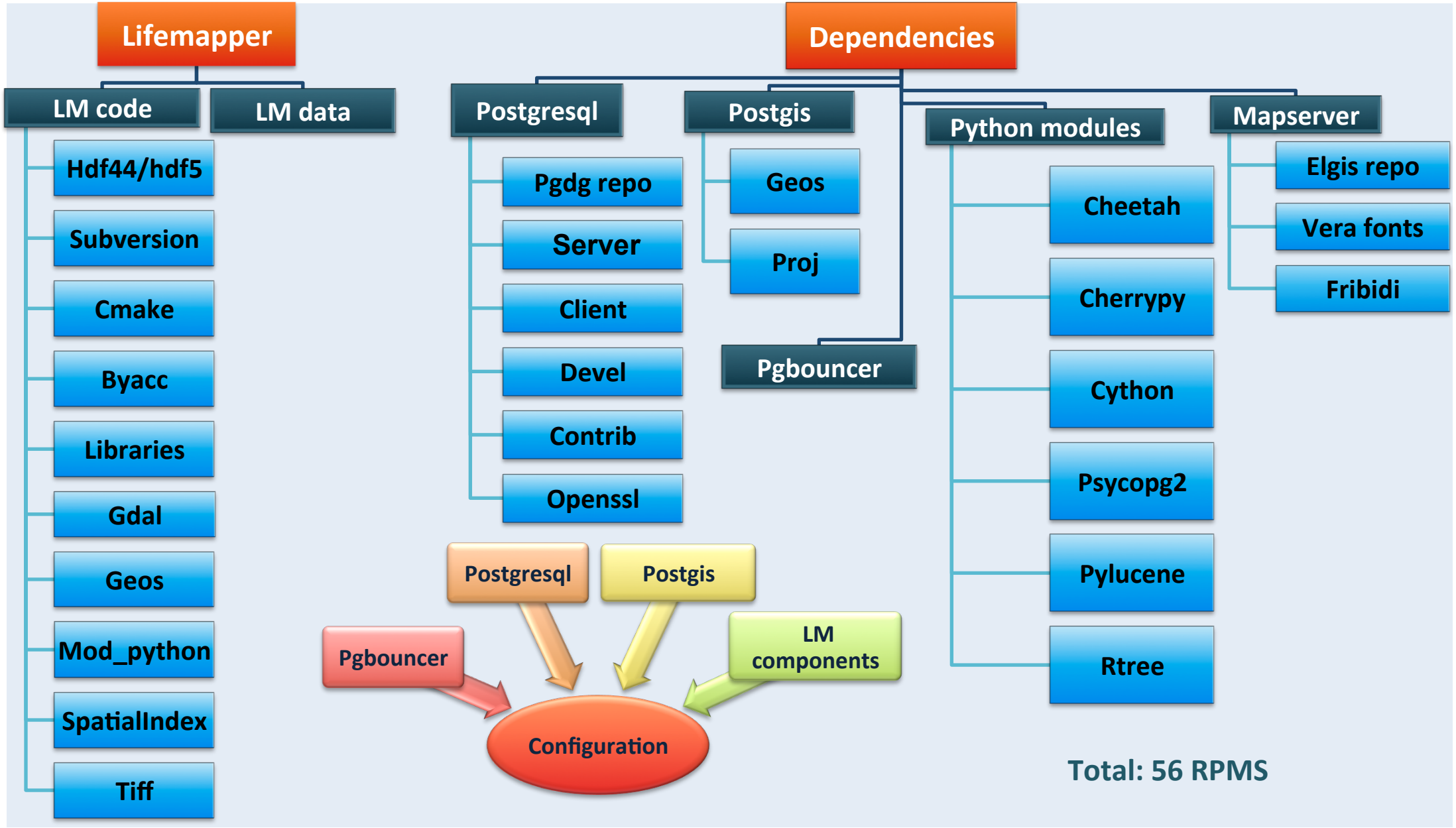
Time

Facilitate easy-to-use solution to provide seamless integration of hw/sw

- Allow to virtualize infrastructure to improve hw utilization and scalability
- Enable operational efficiency and flexibility: deployment and operation of virtual servers
- Enables to clone multiple servers

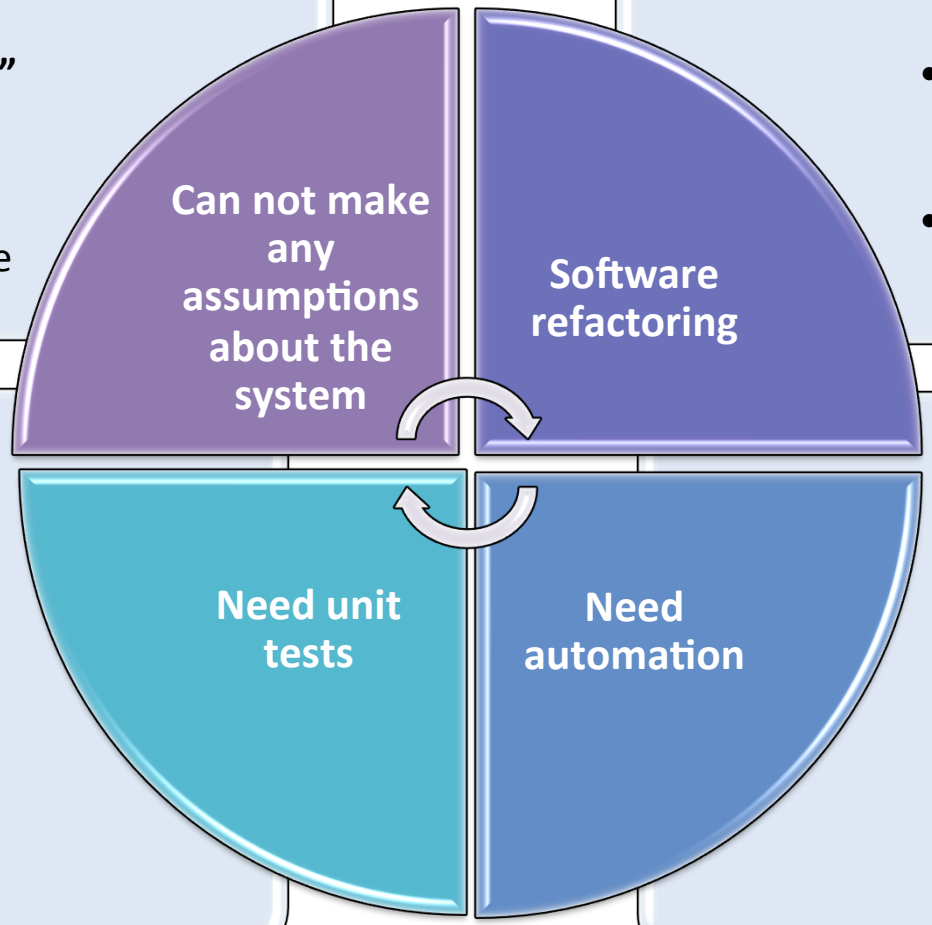
Time

Milestones: Lifemapper Server Roll



Issues Encountered

- **What are SW installation defaults and configuration**
- **Application "minimal resources" requirements** (i.e. what memory/disk/network/other is needed for application to work) changed with different hardware and data



- **Large changes in the build process**
- **Differences** in dependencies and configuration between Linux flavors: Ubuntu vs. CentOS
- **Simplify, harden and streamline code**

- **For build and post-install stages** for installed components and their configuration during the.
- **Datasets** to emulate application's run-time workflow

- Scripts for hands-on tasks (previously done only once):
- Software build
- Data population
- Configuration
- Monitoring
- Troubleshooting

Future Work

- Data integration – generalize more to use heterogeneous datasets from different sources
- Cloud approach – Extend and leverage with PCC and PRAGMA_Boot
- Virtualized environment testing
  - Storage system
  - Performance estimates
  - What I/O volume can we handle without degraded performance?
  - Check for "storage I/O blender effect"
- Need to define requirements for
  - performance
  - data storage
  - data management
- Need to "translate" application/data requirements when application is moved from physical to virtual servers
  - Is there a bottleneck?
  - What is needed for IO-intensive application (database)?

Acknowledgements

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PRAGMA

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Lifemapper

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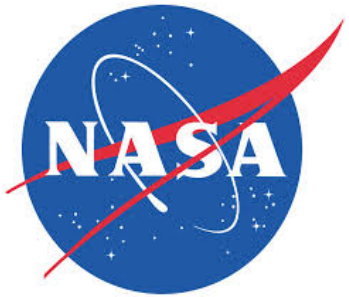
US NSF OCI/CI-TEAM 0753336

US NASA NNX12AF45A

Rocks

US NSF OCI-1032778

US NSF OCI-0721623



Questions?

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