Custom Software Development for Clinical and Basic Research
When Your Needs Go Beyond Standard Tools

Andrew Rupert, M.S.
Open Source Team Lead
Research IT Services Overview (http://bmi.cchmc.org)

- System Administrators (Windows, Linux, Mac)
- Storage Administrators
- Database Administrators (Oracle, MSSQL, MySQL, PostgreSQL)
- Help Desk
- Application Developers (.NET, Sharepoint, Open Source Expertise)
- Data Services
- Work very closely with CCHMC Information Services.
Research IT - Application Developers

• Open Source – Andrew Rupert
  – Uses open source languages such as PHP, Perl, Python for their applications. Many projects focus on applications that interface with the computational cluster.

• .NET – John Stullenberger
  – Uses the Microsoft .NET Framework for their projects. Also involved with developing custom Sharepoint tools.

• Data Services – Ron Bryson
  – Focuses on data extracts from Epic and Clarity.
What do the Research IT Application Development groups do?

• We develop custom software to make your life easier!
• This can range from large scale stand alone software packages to modifications of existing open source tools to suite your needs.
• If you have ideas, contact us! Our projects often come from casual chats.

help@bmi.cchmc.org
Types of Applications

• Web Applications / Services
• Desktop Applications
• Mobile Device Development

Uses of our Applications

• Electronic Data Capture
• Data Reporting
• Interactive Systems
• Collaboration Systems
• Alert / Notification Applications
• Utility / Automation
Custom Development vs Out of Box Key Differences

- *Cost
- *Time
- *Functionality
- Flexibility
- Security
- Accessibility
Custom Development vs Out of Box

- Out the Box
  - Pros
    - Less Expensive
    - Faster to Implement
  - Cons
    - Limited Functionality
    - Limited Customization
SIMPLY EXPLAINED

SOMETHING

DEVELOPMENT PROCESS

GREAT SOFTWARE
Research IT - Application Developers

• Work with a wide variety of divisions
  – Pediatric Neuroimaging Research Consortium
  – Sports Medicine
  – Rheumatology
  – Psychology
  – Anderson Center
  – Etc.

• Along with a variety of research cores
  – Flow Cytometry Core
  – Confocal Microscopy Core
Research IT - Application Developers

• We work on larger grant funded projects when a PI needs entire custom applications developed.

• We also help with smaller “one-off” tasks that are made easier with simple scripts or programs.

• Most applications are now web based. Can access them from anywhere. No need to install software on every computer!
Research IT - Application Developers

• We follow best practices in terms of programming structure and security, e.g. role based access and federation.

• We can help with integrating existing systems into your projects, e.g. TimeTracker – CORES, Active Directory authentication, etc.

• If you think you have a problem that we can help with, please don’t hesitate to contact us!

help@bmi.cchmc.org
WHEN YOU HEAR THIS:

YOU KNOW YOU'RE IN A SOFTWARE PROJECT

YESTERDAY IT WORKED
High Performance Computing Overview - Hardware

- ~1000 compute cores in 100 servers in production
- ~600 cores in 160 servers in development
- Intel / AMD processors
- Up to 24 cores
- Up to 256GB memory
- NVIDIA GPUs
Features

• Available for all CCHMC and collaborating external researchers on request.
• 10Gig Ethernet backend network.
• Direct connection to clustered High Performance storage servers.
• Consistent mount points for home directories and data directories across the HPC and all of the Linux systems.
• Command line and graphical interface.
Applications

- Whole-genome / exome analysis
- Microbial ecology
- Protein docking, folding and structure prediction
- Natural language processing
- Functional neuroimaging
LONI Pipeline

- Provides a graphical workflow builder that interfaces with the computation cluster through LSF.
- Allows investigators and researchers to easily change parameters without the need to edit code and shell scripts.
- Able to interface with web applications using Java Web Start.
# LONI Pipeline

## CASSI

### Tools
- Query
- Download File
- Delete File
- Trio Analysis
- Singleton
- Add to Cohort
- Custom pipe

### Trio sequencing analysis for potentially pathogenic variants
Click on LONI icon after selecting desired trios

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LONI Pipeline

Min GQ = 20

Filter Min Genotype Quality (GQ)
VCF analysis
bmilonpl1.chmres.cchmc.org

Filter Read Depth (DP)
VCF analysis
bmilonpl1.chmres.cchmc.org

Filter Alternate Allele Ratio
VCF analysis
bmilonpl1.chmres.cchmc.org

Keep Biallelic
VCF analysis
bmilonpl1.chmres.cchmc.org

Intersect
VCF analysis
bmilonpl1.chmres.cchmc.org

NonSynonomous Filter
VCF analysis
bmilonpl1.chmres.cchmc.org
Open Source Project Examples - Demos

• CASSI – Cincinnati Analytical Suite for Sequencing Informatics
  – John Harley, Ken Kaufman, Leah Kottyan, Sue Thompson
  – Repository and processing pipelines for Next-Generation Sequencing data.

• X-Ray Study Web Portal
  – Greg Myer (PI)
  – Surgeons will answer questions about an X-Ray Image
  – Measurements are made in browser about various lesions.
## Image Management

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A.) Standing AP

- Not Visible

**Width of OCD lesion:**

Measure the 'Width of OCD lesion' by clicking on the image to start the line and clicking to end the line. Must be less than 86.0

× Reset Measurement
Open Source Project Examples - Demos

• CpG Processing Pipeline and Variant Knowledge Base
  – Pete White and John Harley
  – Unified data intake, processing pipeline, and variant database for CCHMC next-generation sequencing data.
  – Allows for custom CCHMC annotations and queries.
  – Full permission system to allow sharing of data with collaborators.
  – Dashboard to allow researchers to view where their samples are in the pipeline.
Super Awesome Samples
PI: Super Man, Business: Batman, Type: Public Queryable

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Sample Info
- Type: Human
- Assay: Whole Exome

Specimen Info
- Study Group: g2
- Cell Line: 2
- Individuals: 4
- Race: Caucasian
- Gender: M
- Ethnicity: Non-Hispanic

©2015 Cincinnati Children's Hospital Medical Center 3333 Burnet Avenue, Cincinnati, Ohio 45229-3039, Hosted by Biomedical Informatics
Super Awesome Sample

PI: Super Man, Business: Batman, Type: Human, Assay: Whole Exome

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Super Awesome Permissions

Global Project Permission

Public: No Download

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Select a user   | Add User   | Done

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©2015 Cincinnati Children's Hospital Medical Center 3333 Burnet Avenue, Cincinnati, Ohio 45229-3039, Hosted by Biomedical Informatics
Region  chromosome 1 / 66000 - 75000

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Project Examples - Demos, Cont.

• Instrument Time Tracker
  – Andrew Rupert, Michael Wagner
  – Transparently tracks real time lab instrument usage for the Flow Cytometry and Confocal Microscopy cores.

• Scheduling Calendars
  – Sort Scheduler, MRBS, etc.
### My Announcements

Announcements as of 11/11/2015

- There are no announcements.

### My Reservations

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<td></td>
</tr>
<tr>
<td>5:00pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6:00pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7:00pm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**4-Laser Ariel**
- Startup
- Javid Mohammed [Shutdown]
- Jose Javier [Shutdown]
- Jonathan [Shutdown]

**5-laser Arnie**
- Startup
- Yutaka Maeda [Shutdown]
- Luis Queine [Shutdown]
- Javid Mohammed [Shutdown]

**MoFlo XDP**
- Startup
- Ramesh Nayak [Shutdown]
- Sarah Potter [Shutdown]

**Tuesday, 10/13/2015**
- 4-Laser Ariel
  - Startup
  - Heping Xu [Shutdown]
  - Sachin Kumar [Shutdown]
  - Damien [Shutdown]

**5-laser Arnie**
- Startup
- Megha Desai [Shutdown]
- Carine Bouffi [Shutdown]
- Rajeswari [Shutdown]

**MoFlo XDP**
- Startup
- Sara Meyer [Shutdown]
- Xian Li [Shutdown]
- Sarah Potter [Shutdown]

**Wednesday, 10/14/2015**
- 4-Laser Ariel
  - Startup
  - Jing Fang [Shutdown]
  - Ashwini Hinge [Shutdown]
  - Monica [Shutdown]

**5-laser Arnie**
- Startup
- David Muench [Shutdown]
- Oded Volovelsky [Shutdown]
- Mei Wang [Shutdown]

**MoFlo XDP**
- Startup
- Javid Mohammed [Shutdown]

**Thursday, 10/15/2015**
- 4-Laser Ariel
  - Startup
  - Staff Meeting
  - Maha Almanan [Shutdown]

- 5-laser Arnie
  - Startup
  - Staff Meeting
  - Heping Xu [Shutdown]

- MoFlo XDP
  - Startup
  - Staff Meeting
  - David Muench [Shutdown]
  - XiaoMeng Ren [Shutdown]
  - Takuji Suzuki [Shutdown]
You are modifying an existing reservation.

### Basic

<table>
<thead>
<tr>
<th>Location</th>
<th>R5001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone</td>
<td>636-2770</td>
</tr>
<tr>
<td>Notes</td>
<td>BL2 or BL2+</td>
</tr>
</tbody>
</table>

### Sort Set Up

<table>
<thead>
<tr>
<th>Type of Cells/Study</th>
<th>m BM</th>
</tr>
</thead>
</table>

Have you done this sort with us before?  
- [ ] Yes  
- [ ] No

- BSL Level/Agent: 2 retro and lenti >48hrs
- Cell Size (μm): 
- Number of Samples: 3
- Starting Cell Number: <5 e6 each
- Number of Cells Needed: 
- % of Target Cells Expected: 
- Nozzle Size:  
  - [ ] 70 μm  
  - [ ] 85 μm  
  - [ ] 100 μm  
  - [ ] 130 μm
- ND Filter:  
  - [ ] 1.0  
  - [ ] 1.5  
  - [ ] 2.0
- Purpose of Sort:  
  - [ ] RNA  
  - [ ] Transplant  
  - [ ] Culture  
  - [ ] Other
- Populations Collected:  
  - YFP+  
  - APcy7+  
  - AP
- Sample Tube:  
  - [ ] 1ml  
  - [ ] 5ml  
  - [ ] 15ml Conical
- Sort Type:  
  - [ ] 1-way
- Collection Tube:  
  - [ ] Eppendorf  
  - [ ] FACS Tubes  
  - [ ] 15ml  
  - [ ] ACDU
- Sample Temp (°C): 4
- Collection Temp (°C): 4

### Notes

- TMH, YFP+, APcy7+, APc-

Reminder: -- Never --  
before reservation

- [ ] Delete?
Project Examples - Demos, Cont.

- ADHD Team
  - Tanya Froehlich and Leanne Tamm
  - Mobile App (iOS and Android)
  - Daily SMS reminders to complete survey
  - Also accessible via a web browser
  - Current survey asks questions regarding ADHD (but can be extended/reused)
# Admin Control Panel

## Add Subject

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject ID</td>
<td></td>
</tr>
<tr>
<td>Password</td>
<td></td>
</tr>
<tr>
<td>Re-enter Password</td>
<td></td>
</tr>
<tr>
<td>User’s Cell Phone Number</td>
<td></td>
</tr>
<tr>
<td>Projected Start Date</td>
<td>Start date of Assessment (A1)</td>
</tr>
<tr>
<td>Projected End Date</td>
<td>End date of Assessment (A1)</td>
</tr>
<tr>
<td>Time for Reminders</td>
<td></td>
</tr>
</tbody>
</table>

[Continue]
EMA Ratings for Wednesday, November 11, 2015

7. Loses things necessary for tasks or activities (school assignments, pencils, or books)
   - Never
   - Occasionally
   - Often
   - Very Often
   - Skip Question
Project Examples - Demos, Cont.

- C-MIND - Cincinnati MR Imaging of NeuroDevelopment
  - Jennifer Vannest (Co-PI), Scott Holland (Co-PI)
  - Fully custom longitudinal data entry, querying, and processing application for fMRI images.
  - Demographic and behavioral data collected for healthy children.
If you need assistance with the development of custom software tools or help configuring existing software packages, please contact us!

help@bmi.cchmc.org
Andrew.Rupert@cchmc.org