

# Improving Research Through Advanced REDCap Interfaces

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# EBRL

We study reading disabilities in children using behavioral and MR imaging measures

- Very wide databases
- Very expensive datasets
- Novel tasks (in & out of magnet)
- Many projects

# Before REDCap

- Members touched every piece of data
- Issues joining across paradigms
- Saved and shared data in spreadsheets
- Always behind in analyses
- No traceable analyses

Input » Output

# After REDCap

- Analyze some data within milliseconds
- Automate everything possible
- Automate the automation
- Start analyses from a single source

# Goals

Advocate for advanced data management workflows

# Goals

Discuss problems easily solved using the  
REDCap Application Programming Interface

# Goals

Explain how Data Entry Triggers can tie everything together

# Ideally...

Machines perform all **definable** analyses:

- Perform reproducible work
- Operate deterministically
- Orders of magnitude faster and cheaper



# REDCap

- Is:
  - A service for collecting and storing data
  - Secure for the storage of PHI
  - An online spreadsheet
- Is not:
  - A relational database

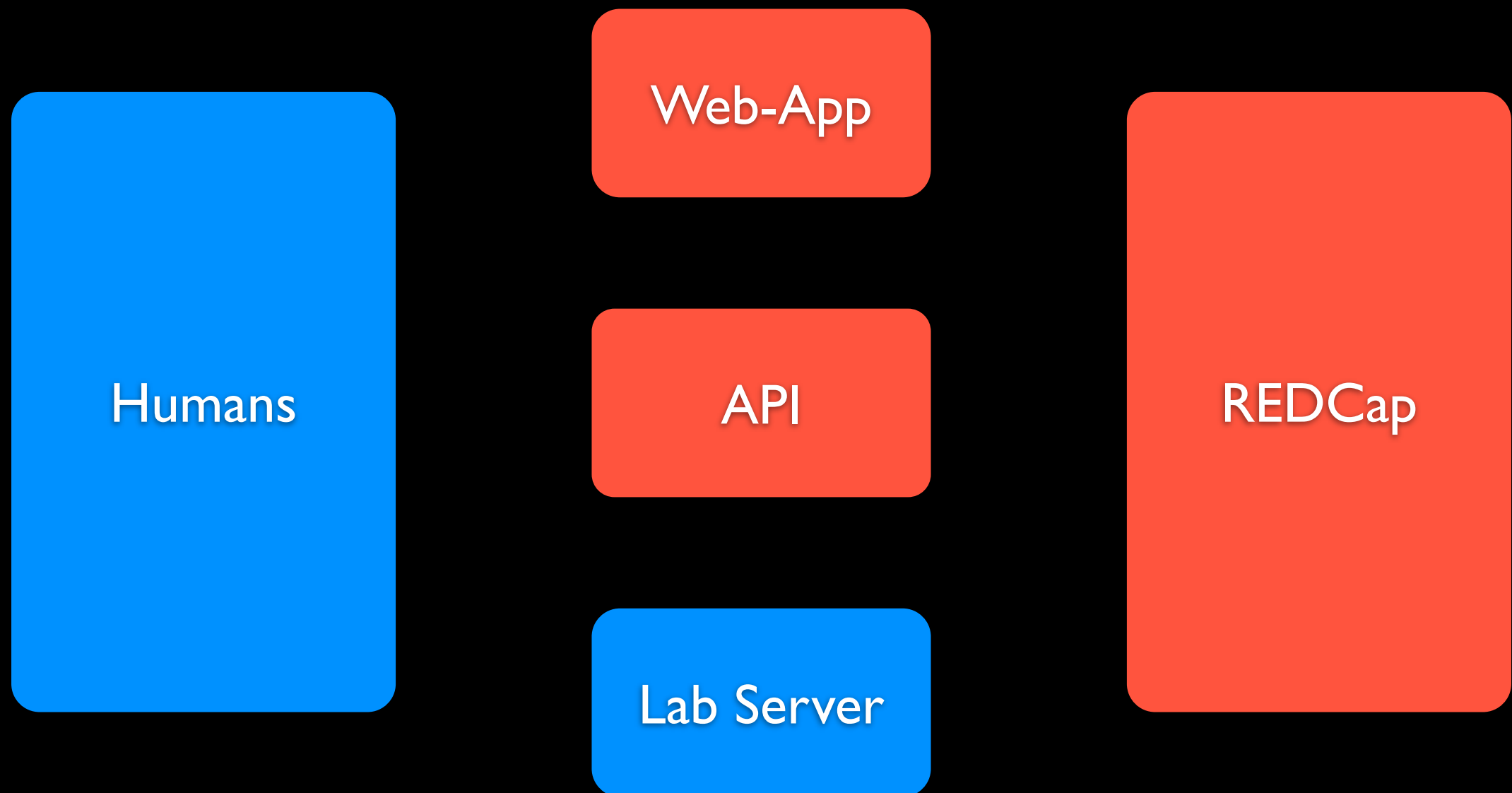
# Better than...

- A real database:
  - No administration
  - Easy schema definition
- A spreadsheet:
  - GUI is browser-based
  - Client-Server architecture
  - Advanced web features

# Vocabulary

REDCap	Excel/SQL/etc
Project	Table
Data Dictionary	Schema
Record	Row
Field	Column
Form	Set of columns

# General Architecture



# Advanced Features

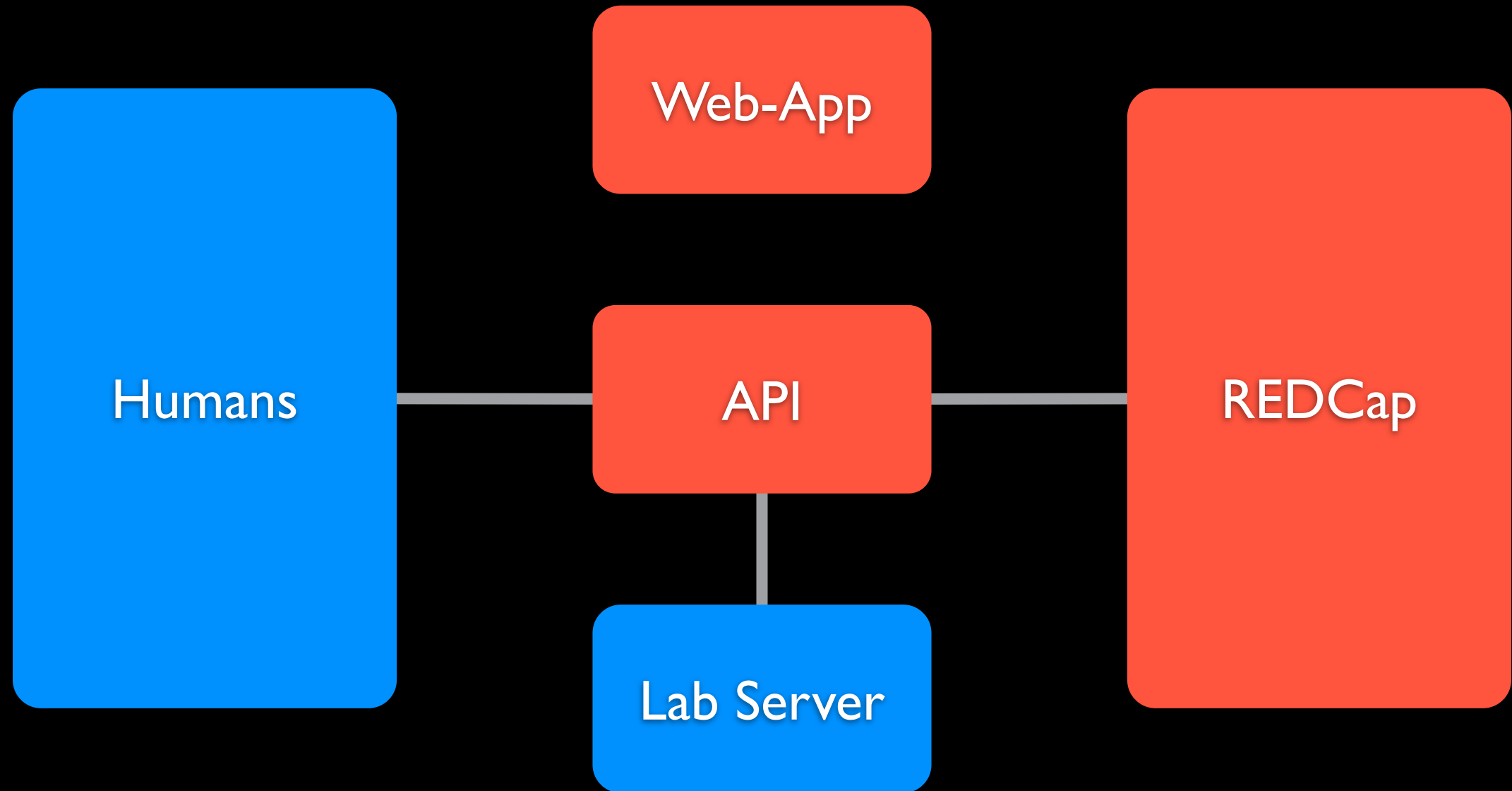
- Application Programming Interface (API)
  - Programmatic access to REDCap
- Data Entry Triggers
  - Automated notifications

All the building blocks we need

# API

A method for software programs to ask for and push data to REDCap projects

# API



# Using the API

HTTP POST to API URL

Any programming environment with an HTTP library can use the API

(<http://sburns.github.io/PyCap>)



# Major API Methods

- Metadata Export
- Data Export
- Data Import
- File Import, Export & Deletion

<https://redcap.vanderbilt.edu/api/help>

# API: Possible Uses

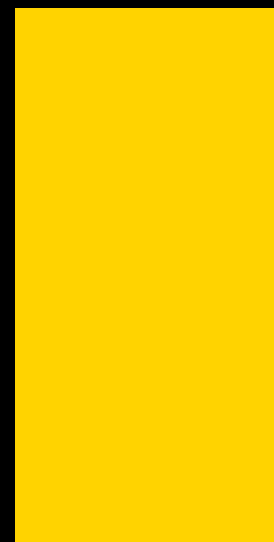
- Advanced & automated field calculation
- REDCap as the input for external systems
- Shared Filesystem
- Across-project data movement

# API: Field Calculation

Problem: How to update  
(many) fields across  
(many) records?



Download,  
Implement,  
Upload



REDCap  
Calculated  
Fields



API

# API: External Systems

- Hooks to external databases
- Reproducible cohort/group determination
- Automated database cleanup & backup

# API: Shared Filesystem

How to insert or generate *intermediate* data to/from our analysis infrastructure?

- Secure
- Easy
- Automated

# API: Shared Filesystem

File → fields:

- Member runs test, saves file in REDCap
- We write software to:
  - Download file locally
  - Analyze file
  - Upload results to REDCap

# API: Shared Filesystem

Fields → file:

- Given a record in the database
- We write software to:
  - Download data for that record
  - Substitute into a predefined template
  - Upload new report to REDCap
  - Alert lab members through email

# API: Shuttle Data

- Capture data in one project
- Put a copy and results in another
- Public-facing projects → private projects



# API



# API: Pitfall

API only serves external requests

- One-off scripts
- Scheduled programs

Better idea about *when* to run analyses?

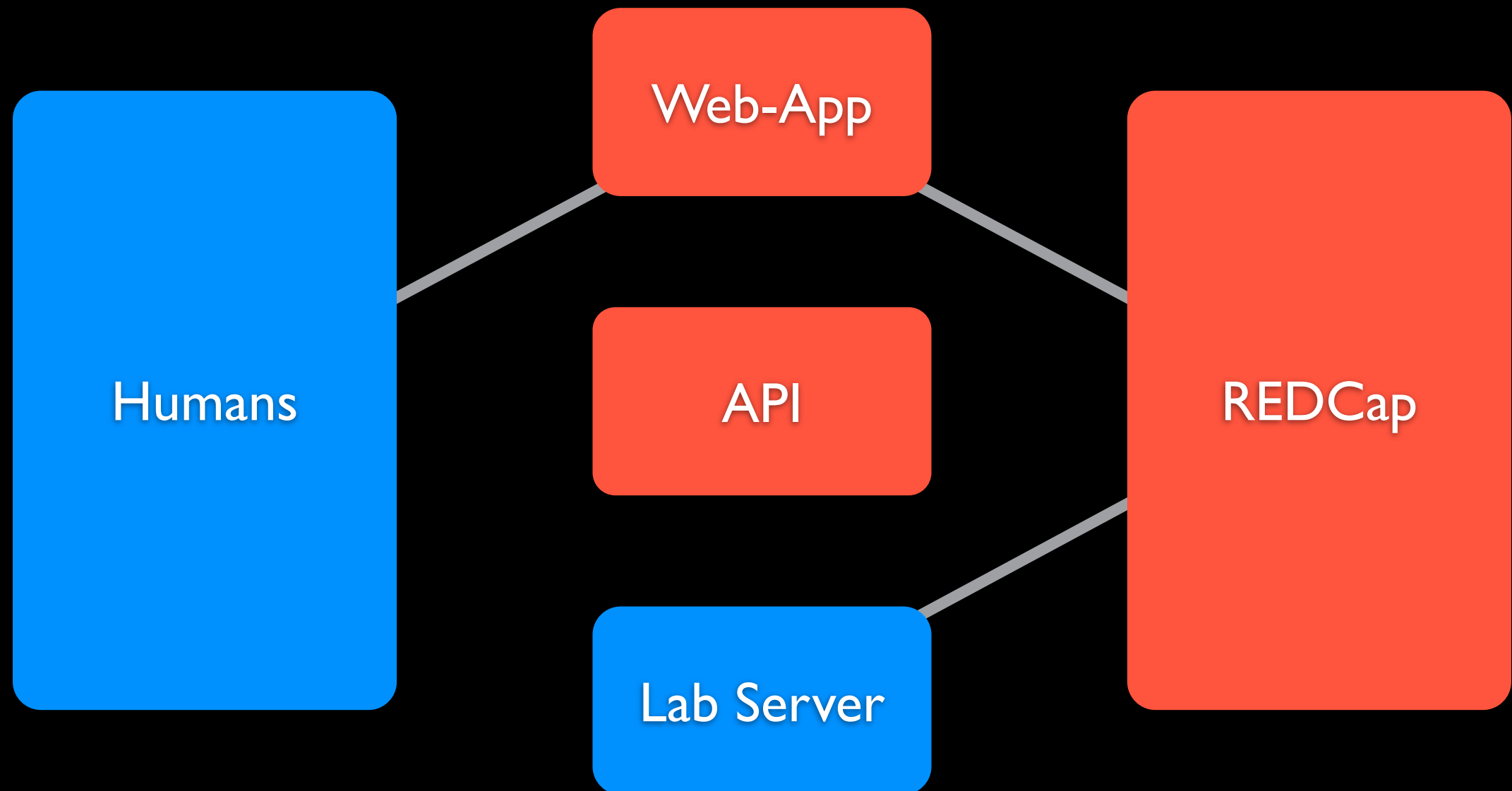
# Data Entry Triggers

- Independent of but complimentary to API
- Register a URL to your project
- Internet notification when data is saved
- Notification contains context of the save

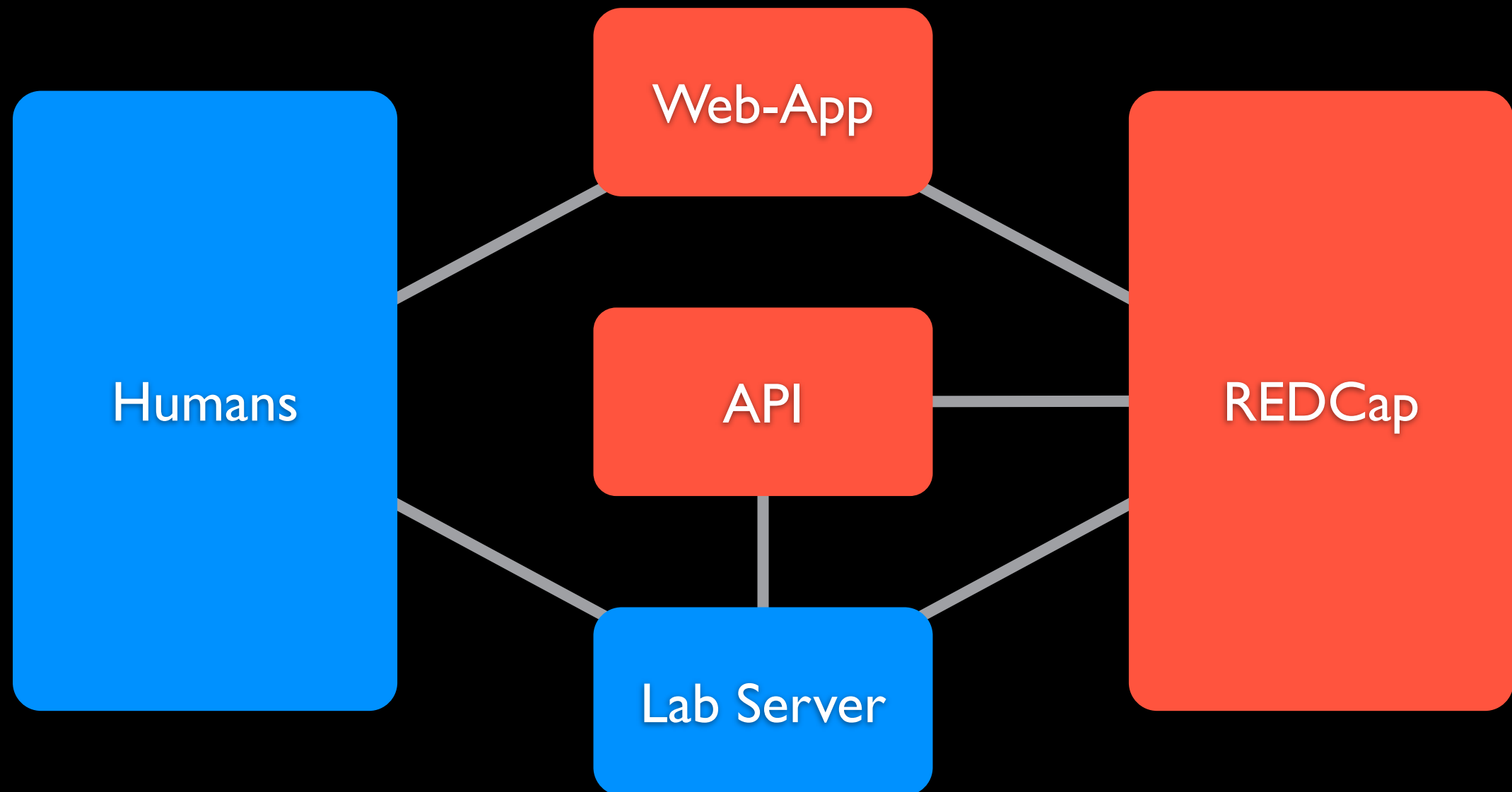
# Data Entry Triggers



# Data Entry Triggers



# (Super) Data Entry Triggers



# Data Entry Triggers: Pitfalls

- Not every research group:
  - Can setup, maintain & secure a web server
  - Has the resources to write the web-app
- But every lab should have access to this infrastructure!

# Switchboard

- I wrote a (tiny) web-app to:
  - Parse incoming REDCap requests
  - Execute functions that “match” the request
- **In production** for our lab

<http://github.com/sburns/switchboard>



# Data Entry Triggers

In a perfect world, we all share a  
Vanderbilt-wide web-server

- Just one server to maintain & protect
- Sharing is good
- Remove excuses for buy-in
- Everyone benefits from optimization

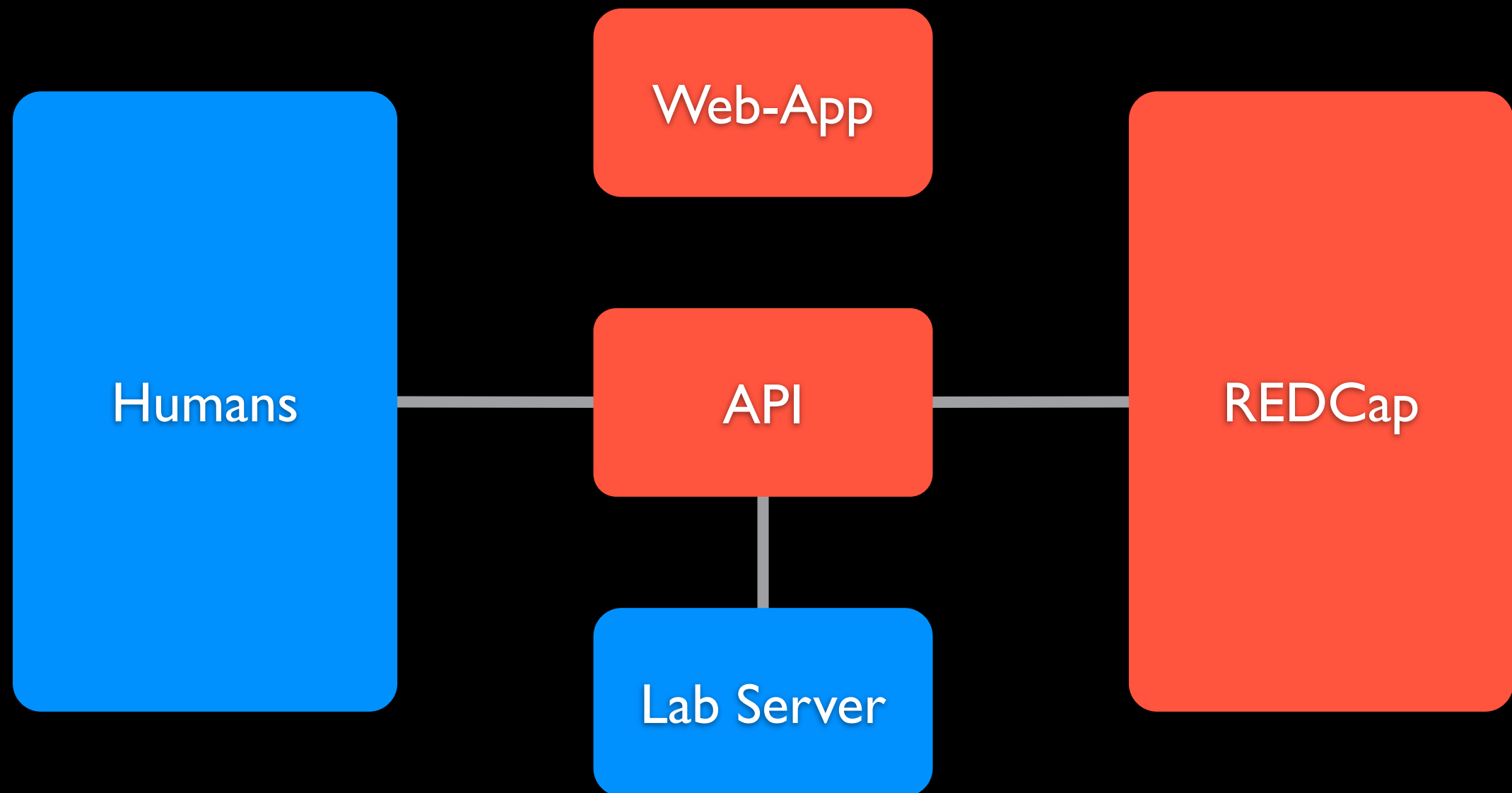
# Conclusions

# Engineering Better Science

- All the pieces exist to offload a massive amount of data-management work from humans to machines
- Cost-effective and improves work through improved accuracy and reproducibility
- Let machines do that which can be defined
- Let humans do the hard work

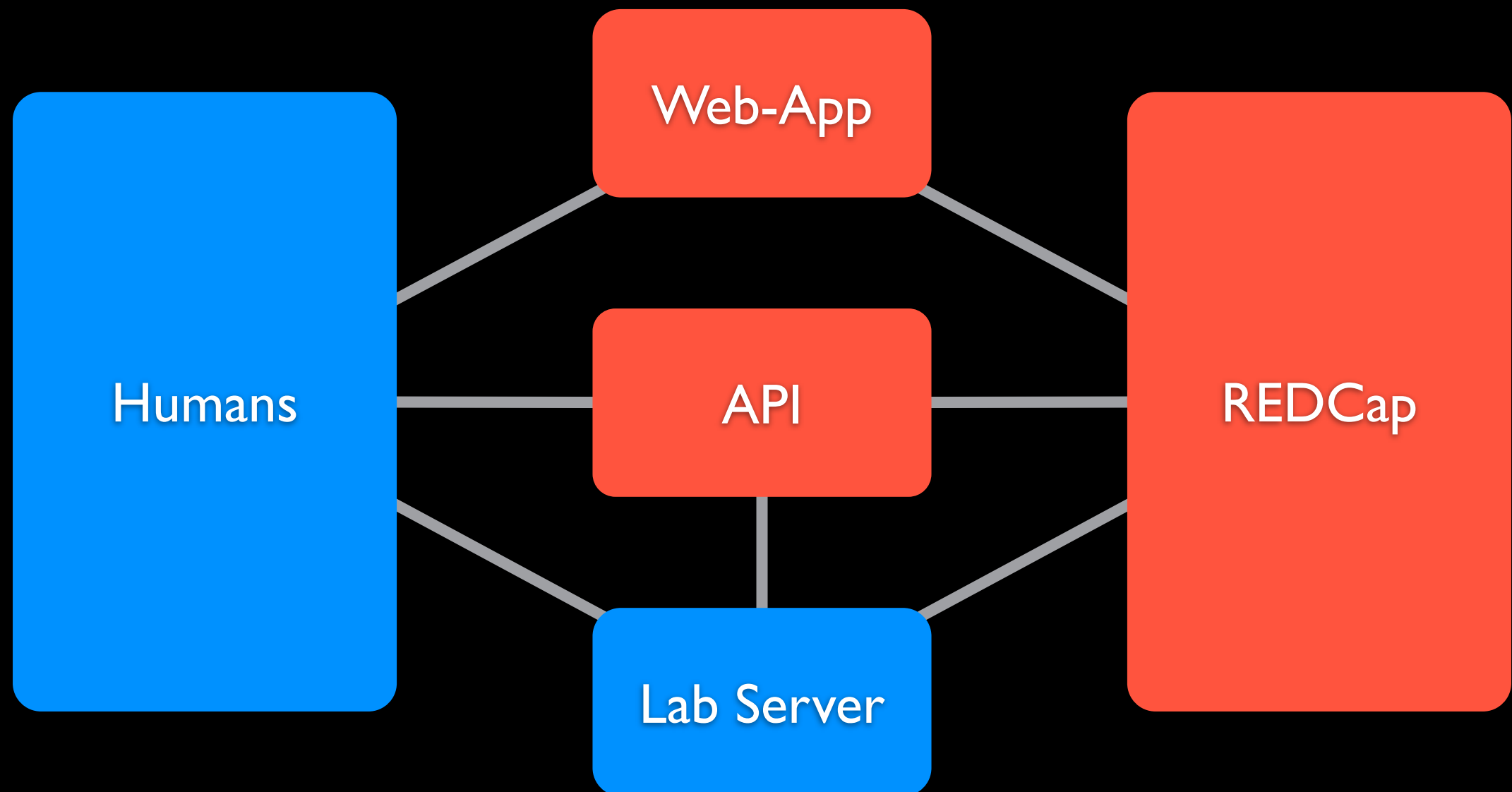
# Automation improves research

Easier to automate machines than humans



# Automate the automation

Machines don't make excuses



# Thank you



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Github: <http://github.com/sburns>

API & PyCap Tutorial: <http://bit.ly/pycap-tutorial>

Questions &  
Comments?