Image Management Using Orthanc in a Multi-Centre Research PET Study

OrthancCon I, 2019

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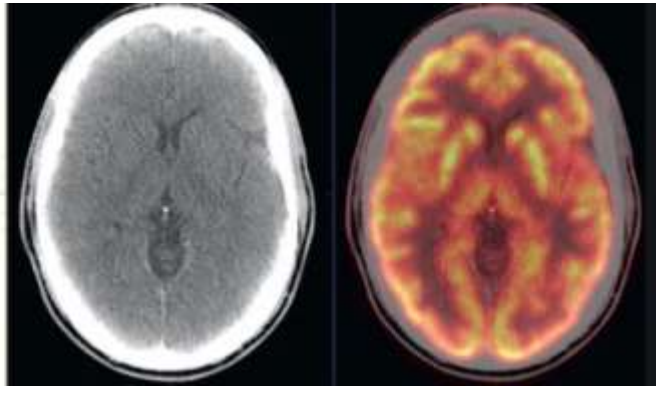
I Do Imaging

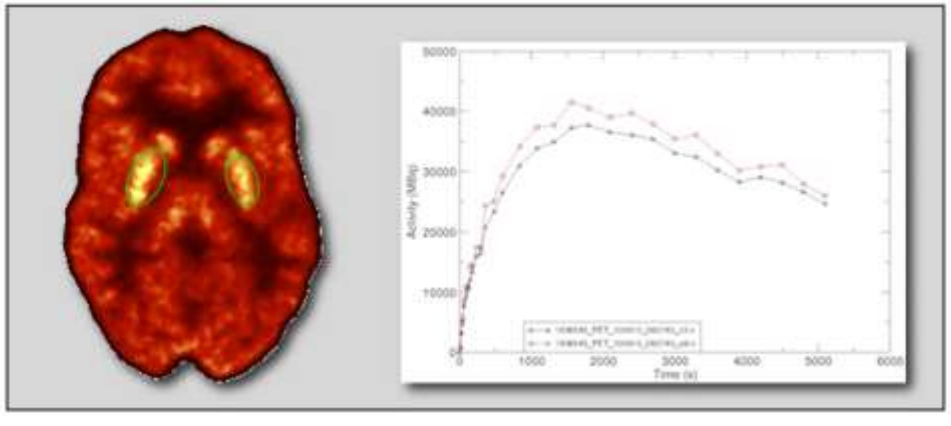
Overview

- We are a Radiology lab running multiple studies, all different
- Five-year research neuro PET pharmaceutical imaging study
- Four US academic medical centres
- 600 subjects, 2 scans each
- Images uploaded by scanner techs or Radiology admins
- Research subjects: No Protected Health Information entered
- High variability: Subject codes, sites, scanners, staff
- Some scanners could not have a DICOM node configured
- Some sites insist on encrypted transport

Neuro PET


B




50000
40000
30000
20000
10000
Activity (MBq)
0
1000
2000
3000
4000
5000
6000
Time (s)

Requirements

- A small, flexible solution with quick deployment
- Stability – no memory leaks, restart on crash/reboot
- Scalable to ~ TB scale
- Client upload via DICOM transport and Web interface
  - Not every DICOM modality can be configured for our node
- Security – Encrypted transport
  - Potential to achieve HIPAA compliance
- Client multi language/environment support
- Hierarchical development environment

Orthanc

- Small
- Flexible
- Quick deployment
- Stable
- Scalable
- Upload via DICOM & Web
- Multi language

Runs easily in 2 GB, 1 core instance

Plain text config files

DICOM nodes in separate config

Compiles and installs easily on AWS Linux

Configuration synchronised by Git

Simple directory/symlink config files

orthanc and nginx daemons are stable

```
#installin/opt/orthanc
#orthanc/nodes.json
```

Auto restart with supervisord

Orthanc easily handles our scale

Images stored in external DB

Has web interface including drag/drop

Language-independent with REST

```
{
  "DicomModalities" : {
    "sitethree" : ["SITETHREE", "172.3.4.4", 104 ],
    "sitetwo" : ["SITETWO", "172.3.4.5", 104 ]
  }
}
```

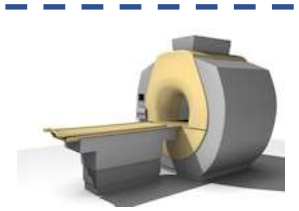
We develop & test with curl & Postman

Clients in Python and Matlab

Why a Cloud Solution?

- Problems with DICOM transport:
  - Not (easily) encrypted over public internet
  - Ports (104 or custom) usually blocked
  - C-MOVE not possible behind NAT
- Cloud location is available from anywhere
  - Can allow only certain IP ranges
- Many features are easily deployed
  - Encryption of storage and transport
  - Backups of database instances
  - Logging of users and actions

Implementation

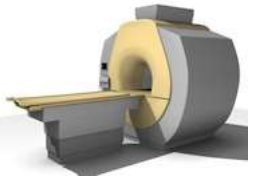


Site 1

DICOM

11112

amazon web services



Site 2

https://

443

ORTHANC

PostgreSQL

NGINX

Let's Encrypt

EC2

RDS

MATLAB

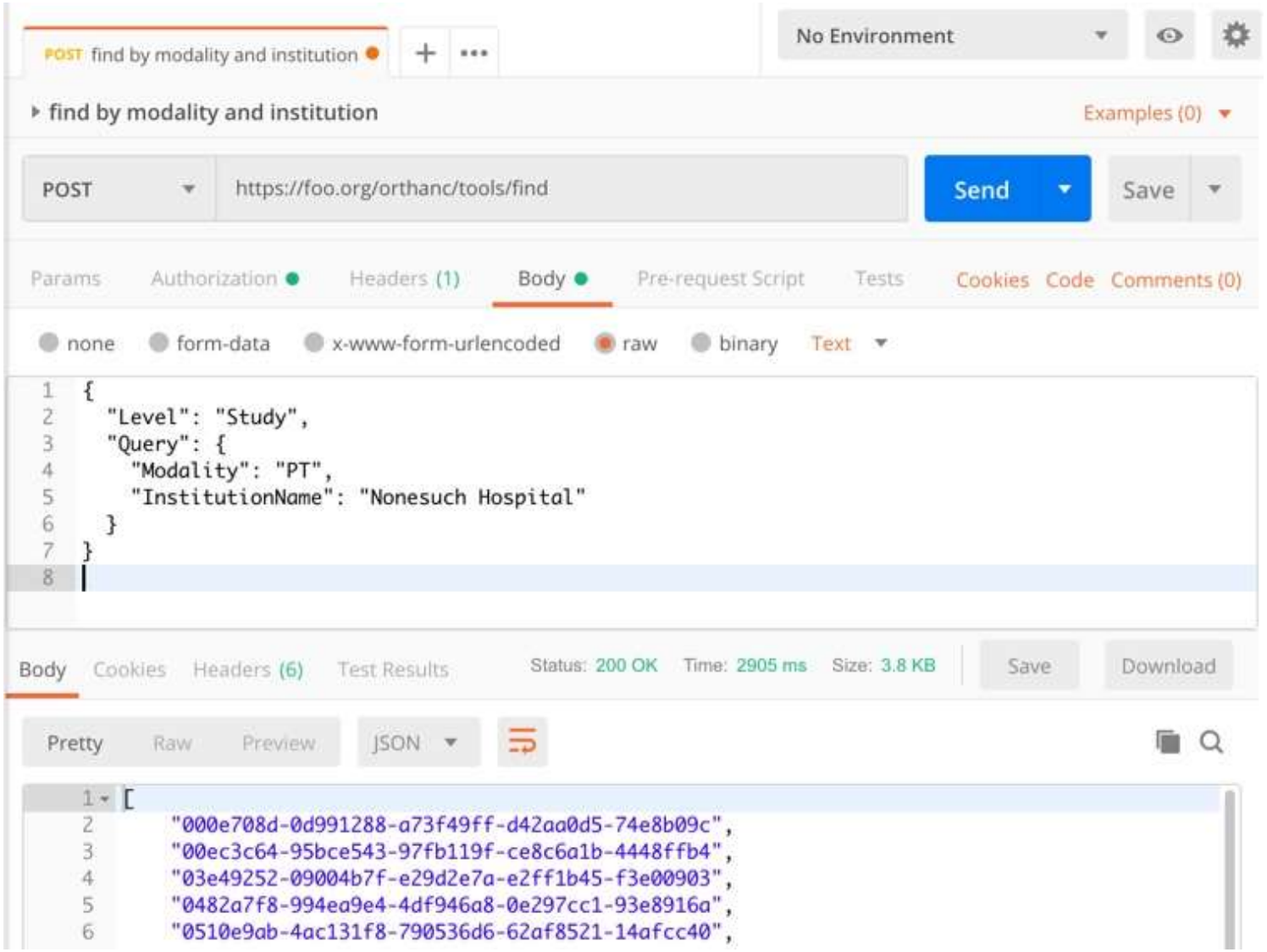
python

POSTMAN

Study Manager

Rapid Prototyping: Postman

POSTMAN

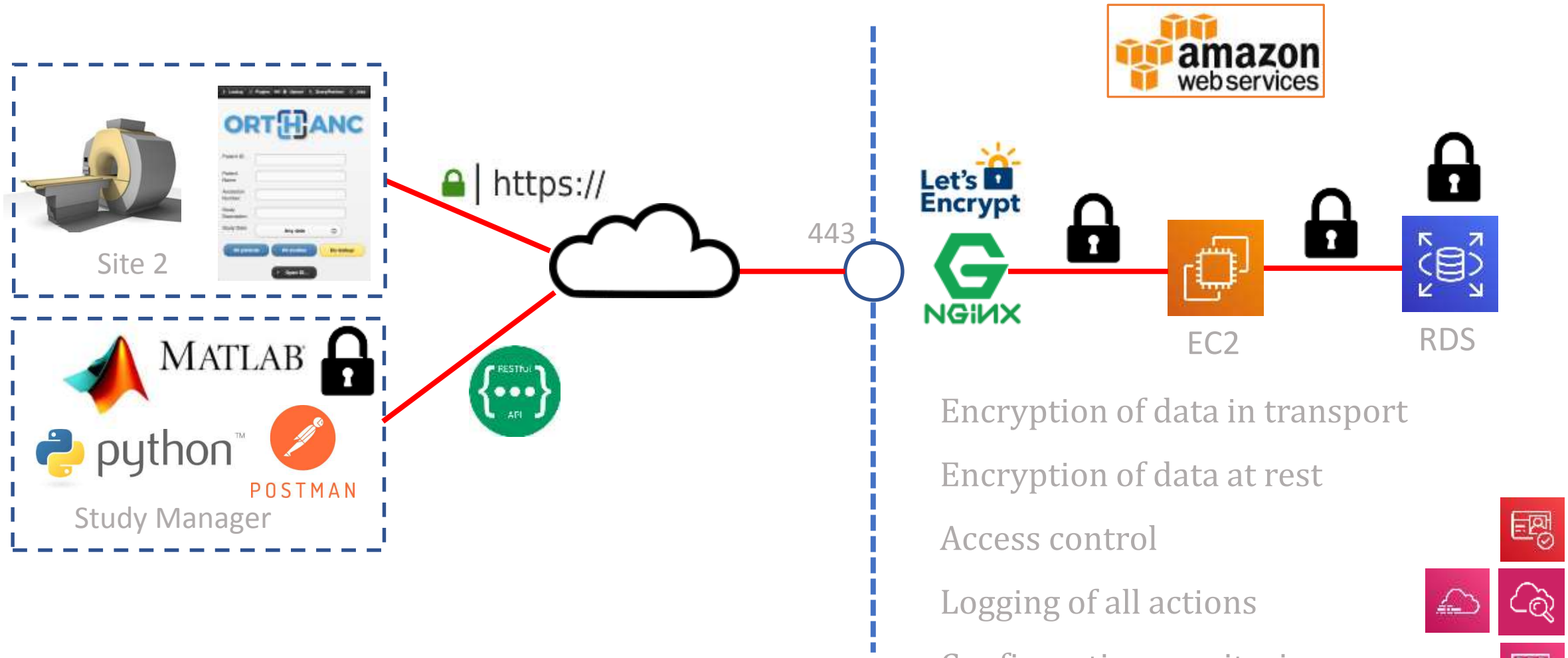


HIPAA Compliance

Requires (amongst others):

- Encryption of data in transport
- Encryption of data at rest
- Access control
- Logging of all actions
- Configuration monitoring
- Verified backup/archive procedure

Possible HIPAA-Compliant Implementation



Clinical Medicine vs. Medical Research

Clinical	Research
Read individually, now	Processed in batch, later
Read by humans	Processed automatically
Immediate reading	Delayed processing

=	William / Will	≠	Nicknames
=	William / Wiliam	≠	Misspelling
=	Sarah / Sara	≠	Alternate spellings
=	A010 / AO10	≠	Spoken digits

Accommodating Error

Every human process includes random error

Medicine has a strong culture of *reducing* and *correcting* error

Automation achieves *zero* ambiguity by *accommodating* error

Why not just fix the errors?

- **Difficult**
- ersed backups immedia
  ated
- PACS systems have limited access
- Slow, heavyweight process
- No history (provenance) of edits
- Only conforms to one view of correctness

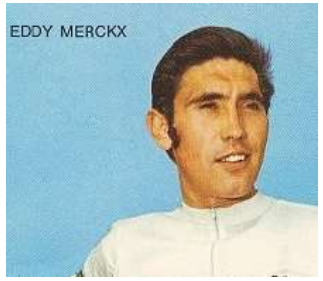
'Fixing' is an attempt to say that something did not happen, that did happen

The 'fixing' process itself will contain error

Identity

What is the correct identity of this subject?
It depends on who you ask.

Patient



“Eddy Merckx”

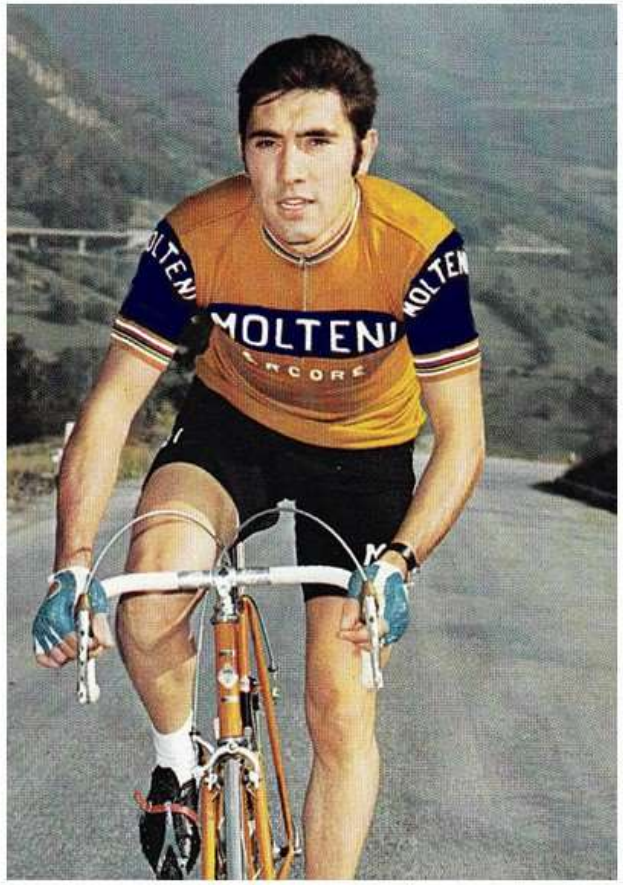
Developer

M	E	R	C	K	X

É	D	O	U	A	R	D

Investigator

SUBJ1001

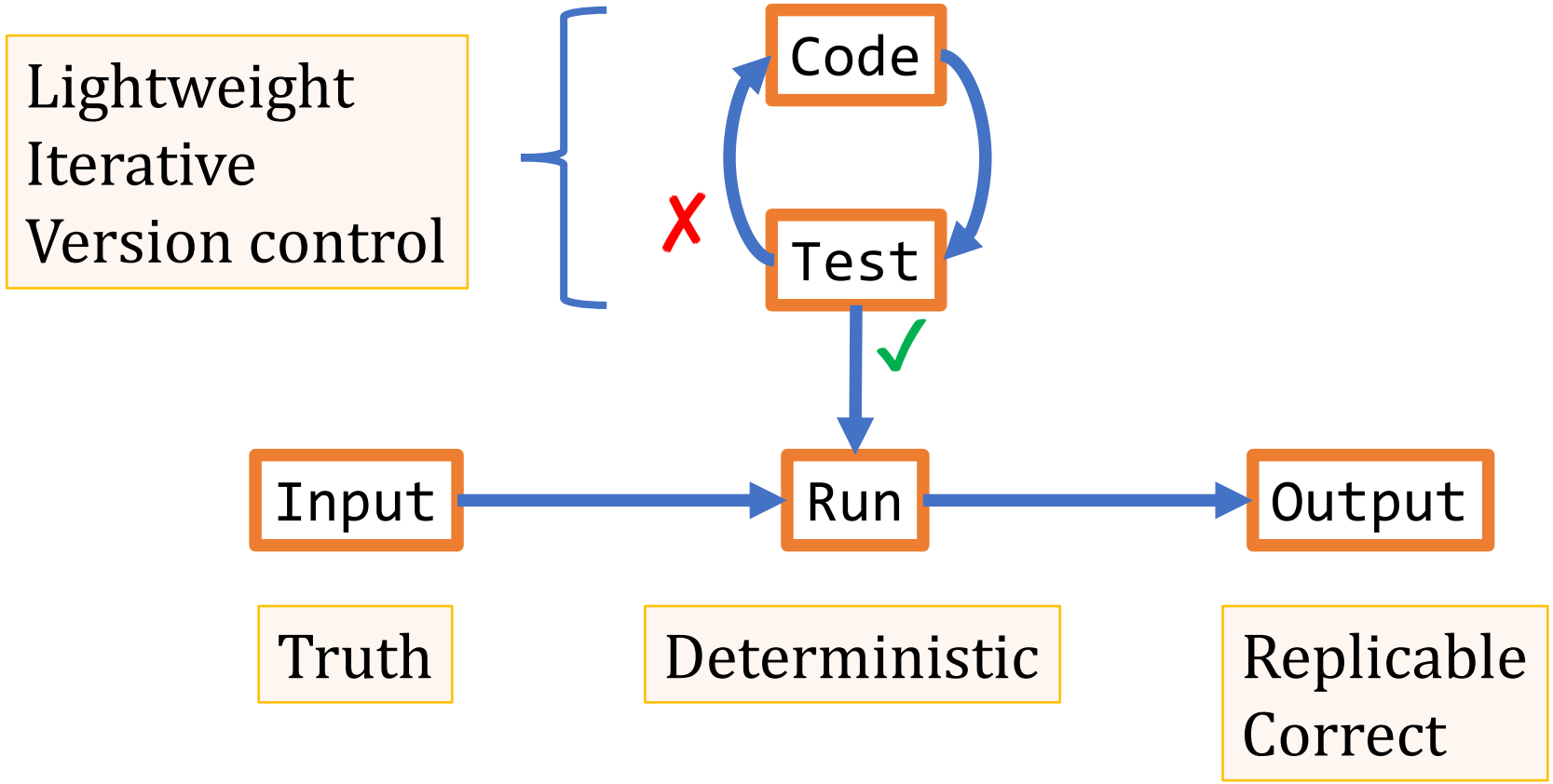


Multiple Identities

A *person* enrolled in a *study* and who receives a *scan* has three identities:

Personal Identity	• Name, birthdate, hospital history number
Study Identity	• Name or code wished to be used at scan time
Scan Identity	• Name and history actually used at scan time

Eliminating Error in Software Development



Accommodating Error in Identity