Healthcare process management in Python: a use case
CRS4@Polaris Park, Sardinia
Agenda

- what field do we work in?
- what's the project?
- why (and how) Python?
- did it work?
- whither?
what field do we work in?
Healthcare Flows
distributed medicine
semantic and computational management of biomedical and heterogeneous data
clinical systems
integration and traceability
in health processes
To Err is Human
Building a Safer Health System
(Institute of Medicine, 2000)
44 to 98 thousands
people die each year in US as a result of preventable medical errors

Institute Of Medicine, *To Err Is Human: Building a Safer Health System*, 2000
Death causes in the U.S.

Motorcycle accidents: 3,600
Homicide: 17,000
AIDS/HIV: 20,000
Breast cancer: 41,000
Medical errors: 44,000

Institute Of Medicine, *To Err Is Human: Building a Safer Health System*, 2000
hospitals with automated clinical information systems had

15% less mortality

16% less post-operative complications

R. Amarsingham, M.D et al. *Clinical Information Technologies and Inpatient Outcomes - A multiple hospital study; Archives*
healthcare ICT yearly budget in Italy is about 1 billion €

What do physicians use computers for?

- Billing
- Scheduling
- Laboratory
- Communication with hospitals
- Claims status

Modern Physician / PricewaterhouseCoopers survey of executive options on key information systems issues; Modern
Bad Health Informatics Can Kill

ICT can have positive impact on health care, but there are also examples on negative impact of ICT on efficiency and even outcome quality of patient care. Medical informaticians should feel responsible for the effects of ICT on patients and public. Systematic analysis of ICT errors and failures is the precondition to be able to learn from negative examples and to design better health information systems.

This document contains summaries of a number of reported incidents in healthcare where ICT was the cause or a significant factor. For each incident or problem at least one link to a source will be provided. With the following list, we want to raise awareness on this important issue, and provide information for further reading.

This summary was inspired by a citation of Prof. Chris Taylor found in the report "Pathways to Professionalism in Health Informatics" of the UK Council for Health Informatics Professions: "Bad Health Informatics can kill". We would like to acknowledge the contribution of Dr. G.M. Hayes (President, UK Council for Health Informatics Professions; Chairman, Health Informatics Committee of the British Computer Society; President, Primary Health Care Group of the BCS) in collecting those examples.

Further reading and links: See bottom of page!

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<tr>
<th>Year</th>
<th>Name</th>
<th>Description</th>
<th>References</th>
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<tbody>
<tr>
<td>April 2011</td>
<td>Review of Reported Clinical Information System</td>
<td>Background: The US FDA has been collecting information on medical devices involved in significant adverse events since 1984. These reports have been used by researchers to advise clinicians on potential risks and complications of using these devices. Objective: Research adverse events related to the use of Clinical Information Systems (CIS) as re-ported in FDA databases.</td>
<td>Myers DB, Jones SL, Sittig DF. Review of reported clinical information system adverse events in U.S. food and drug administration databases. Appl Clin Inf 2011; 2: 63–74. doi: 10.4338/ACI-2010-11-RA-0064</td>
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<td></td>
<td>Clinical Adverse Events in US Food and Drug Administration Databases</td>
<td>Methods: Three large, national, adverse event medical device databases were examined for reports pertaining to CIS. Results: One hundred and twenty unique reports (from over 1.4 million reports) were found, representing 32 manufacturers. The manifestations of these adverse events included: missing or incorrect data, data displayed for the wrong patient, chaos during system downtime and system unavailable for use. Analysis of these reports illustrated events associated with system design, implementation, use, and support.</td>
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<td>Conclusion: The identified causes can be used by manufacturers to improve their products and by clinical facilities and providers to adjust their workflow and training of staff.</td>
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HL7

- global authority
- interoperability
- HL7 v2 / v3
- documents, and more
IHE

Abbott

AGFA

Stanford

CRS4

IBM

Harvard

Inpeco TIH

Carl Zeiss

US Social Security adm

Siemens

...and 438 more
what's the project?
laboratory services leverage

60% - 70%

of critical decision making

ToybertME, Chevret S, Cassinat B, Schlageter, Forsman; *Why is the laboratory an afterthought for managed care*
Errors in laboratory medicine

- Pre-Analytical: 60%
- Analytical: 10%
- Post-analytical: 30%

Laboratory test

- exam insertion
- ?
- Results

giovedì 14 luglio 2011
Laboratory test

exam insertion ➔ ? ➔ Results

phlebotomy

giovedì 14 luglio 2011
What can go wrong

• typing errors
• patient misidentification (and swapping)
• wrong test order entry
• wrong tube type / number
• problems in associating samples with patients
• ...

giovedì 14 luglio 2011
tubes and labels
Our scenarios

• new patient and exam insertion
• query mode in phlebotomy room
• query mode in ward room
• request mode at GP's office
why (and how) Python?
why?
1. readability

not everyone involved is a developer;
code audits should be easy to do
2. agility

lots of ever-changing standards, laws and requirements
3. portability

must support different operating systems and environments
4. completeness

lots of different ICT needs in a project of this scope
5. ease of deployment

as self-consistent as possible;
as few external packages as possible
Our requirements

• 1. readability
• 2. agility
• 3. portability
• 4. completeness
• 5. ease of deployment
Python's best features

- 1. readability
- 2. agility
- 3. portability
- 4. completeness
- 5. ease of deployment
how?
"it's not Java"
First Law of Python advocacy

shut up and show them the prototype
Zeroth Law of Python advocacy

you are probably already using Python
did it work?
1. hardware drivers
Managing hardware with Python

- PySerial, python-usb, ctypes...
- use struct!
  - see lightning talk @ 18:30 :-)
- hardware CLI
- fast scripting for hardware testing
- build second/third level APIs
2. asynchronous messages and networking
One word: Twisted

- one of Python's killer apps
- write new protocols in minutes
  - once you finally *get it* :-) 
- non blocking, asynchronous
- look, ma: no Apache!
- very robust and quite scalable
- XMLRPC, SOAP, SSL come for free
3. applications
Why web apps

- no deployment or client maintenance
- support several usage and business models
- modern interfaces: RIA, AJAX, etc.
- Django of course!
- MVC, reusable components
- very useful even outside the web
  - loose coupling always a good idea
admin's application
phlebotomist's
IHE certification

- our system was certified as IHE-compliant during Connectathon Europe 2011
- LB, LIP, PDQ-S, PDQ-C
whither?
Python in Healthcare SIG

- established on march 2011
- last edit of wiki on 2011-03-17
- mailing list
  - 18 messages in 4 months
- last message in April
No Country for Old Snakes...

- HL7 implementations
  - we only have v2...
  - ...and it's quite limited

- everyone uses Java

- Mirth
  - made in Java
  - scriptable in Javascript
...or is it?

- we must work together
- Healthcare ICT is important
  - philosophically
  - and economically - in fact we're hiring ;-)  
- show them prototypes; use Trojan horses
- have a good list of use cases
questions, thoughts, suggestions

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