Tackling healthcare workflows with behavioural models and natural language processing: a proposal

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- workflows (in healthcare)
- what are behavioral models
- naturel language processing
- our proposal

... problems, rathez than solutions; Looking for feedback

A ubiquitous concept



the way that a particular type of work is organized, or the order of the stages in a particular work process:

Essentially a workflow is a description of some procedural Knowledge used to

- · design, organise, coordinate
- · communicate
- · mouitoz
- · meaure effectiveness of some procedures, policies, protocols...

Outline of the talk
- workflows (in healthcare)

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Just a (bunch of) diagrams?

SYNLAB

COVID-19. Back to the workplace. Guidance.

BASIC RT-PCR is the laboratory test of choice to detect infected workers. It is the most sensitive test for this purpose. If Back to work not available we recommend: CONFIRMED DIAGNOSIS Several possible Back to work Health Authority protocol Blue boxes mea Until PCR becomes negative and/or PCR or Aq **HEALTHY** Contact · Consider retesting in some specific situations . Clinical basic follow up (fever, cough...) to initiate the check up will classify employees Back to work Company HS service decide if to send to Back to work SYMPTOMATIC Back to work Ab 7 days later

- many workflow users
 - · stakeholders
 - · policy makers, experts ...
 - · actors
 - · homons, institutions, sw. __
- resource monagement
- distributed choices
- no standard precision
 - · ampignity
 - · no madine processble stefet

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https://www.synlab.com/new-publications/sars-cov-2/save-return

Workflows in 107/05 (aka business processes)

Industry standard practices

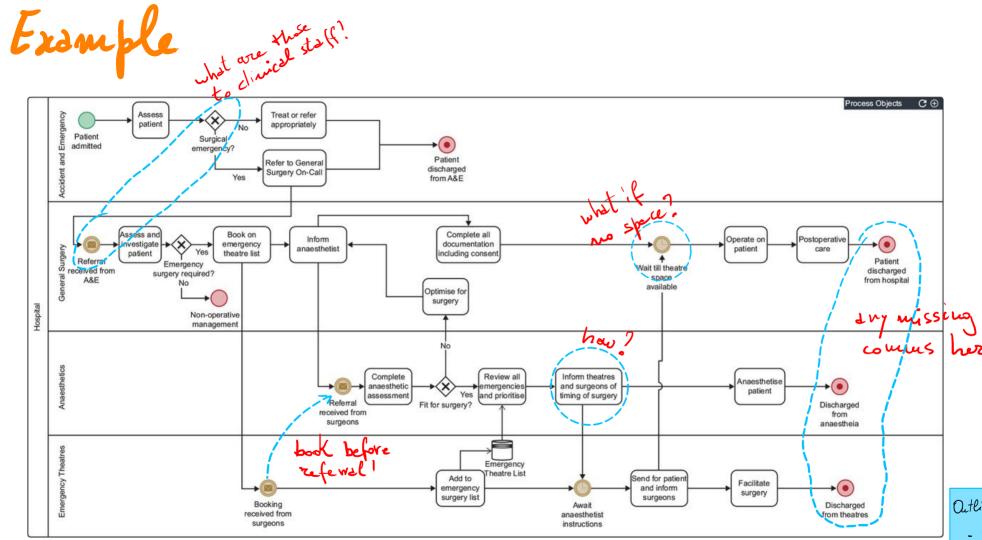
Vtools

* Lack of frecision
* minimal support to resource management

behavioural models.

prototype Looks Pack of intellepibility x

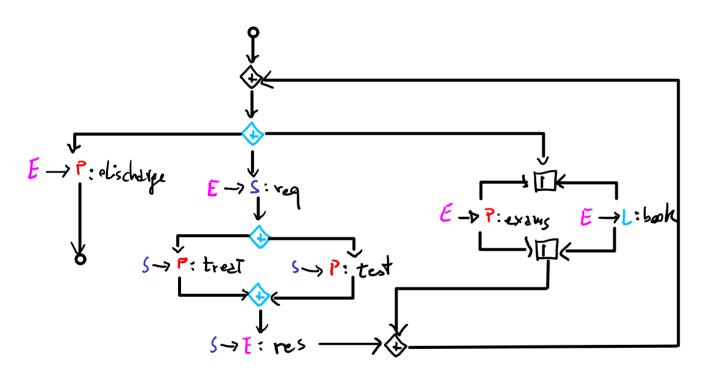
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Chandrabalan, Shanmugham: Automating clinical pathways using executable business process model and notation Int. J. of Innovation in Health Informatics. 24(3), 2017

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Beheviours models as type

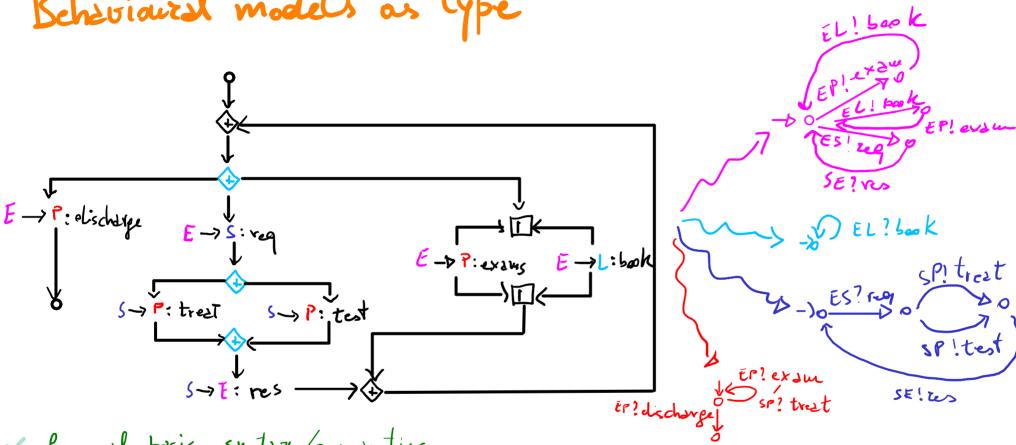


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Behevioural models as type EL! Saok E→L:bok 5-> P: treet S > P: test 5-> I: res SE! res

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Beheviours models as type

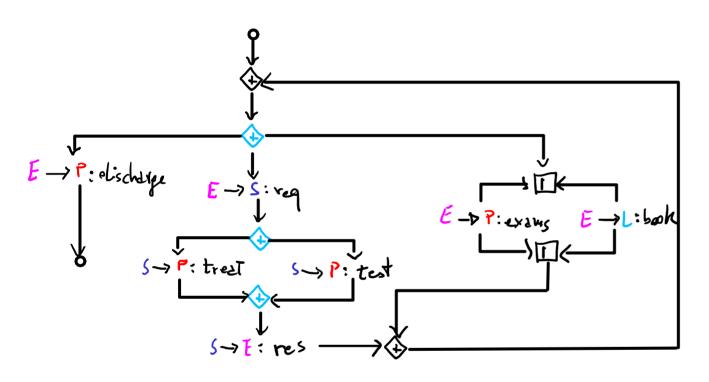


- I formal basic syntax/semantics
- v several decidable properties tools for
- x tradeoff between control-resources
- Vx operational & denotational communics

realisability Soundness / Civenery

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Natural language



An audit penel may want to check

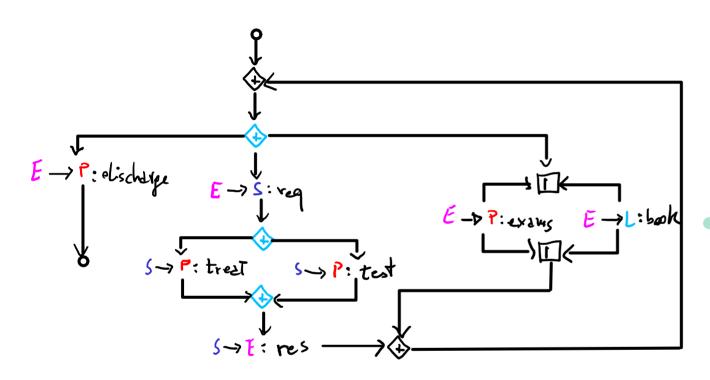
- e) [] Polischarged
- but they would phrase them as

 a') they petient will be discharged
 - b') the results of a specialist's examinations are sent to the emergency department

(au we "translate" (d) and (b) into (d) and (b)... and vice versa?

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Natural language



the emergency department

 a. discharges patients immediately (if their conditions are good), or until the conditions of the patient are good,

- b. requests for a specialist, or else
- c. informs the patient about the exams to do and books the lab

the results of a specialist's examinations are sent to the emergency department

exterpretation

varses as U s requested -> \$ E gets results

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A proposal

We advocate a model-driven approach combining

formal behavioural model & natural language processing

to foster

tool-supported static analysis of resource-aware workflows

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40265

Accessibility

WUs must understand workflows
WUs do not share a common buguage
most WUs do not understand formal buguages



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Goals

Accessibility

WUs must understand workflows
WUs do not share a common language
most WUs do not understand formal languages

Realisability

often the execution context is implicit lack of internal consistency Composition may break properties





f Ƴ Through testing the app has been found to have flaws detecting iPhones. Apple's iOS pushed the app to the background and as a result it could only detec<mark>t four per cent of</mark> iPhones it came into contact with, compared with 75 per cent of Androids. In contrast, iPhones running the Apple-Google system spotted 99 per cent of handsets.

The development of the app has taken months and consumed NHS resources as well as the work of private companies contracted to help build the system. The approval first mosted in mid. March, the week

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The Impact of Poor Communication on Medical Errors

By Michelle Swift, IN. JD. CPHANT | Published 12/2/2017. © 2

Realisability

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6 mpliance

Regulatory spaces was impose proutitetive requirements
Simulations/mointoring are not enough

COVID-19RESPONSE RECOMMENDATIONS

PROTECT CIVIL RIGHTS
MAKE VOLUNTARY COMPLIANCE
POSSIBLE

ACLU²(S MA

our proposal

Harnessing workflows

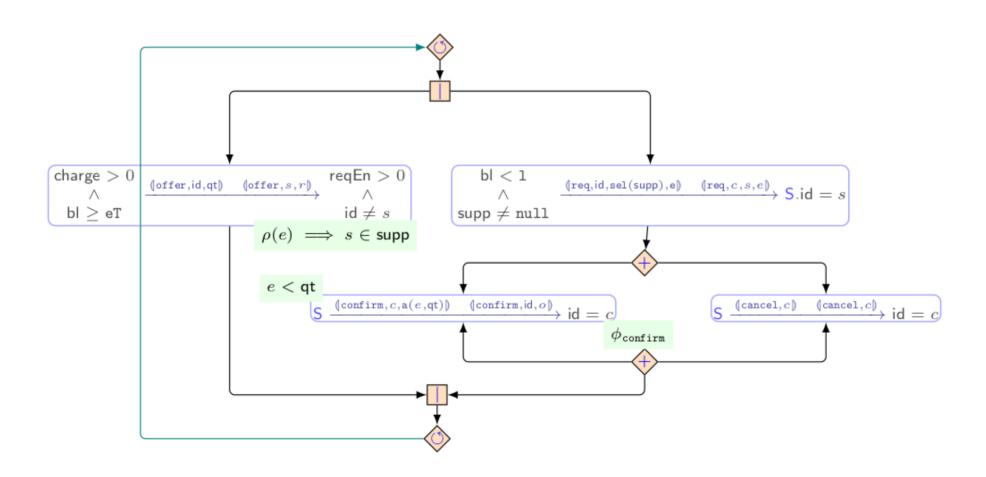
- Developing & theory of resource aware workflows
- Defining BSL, algorithms, and tools to
 - · specify workfaus and their properties
 - · refine vorkpous
 - · statically analise workfows

Our gualua principle:

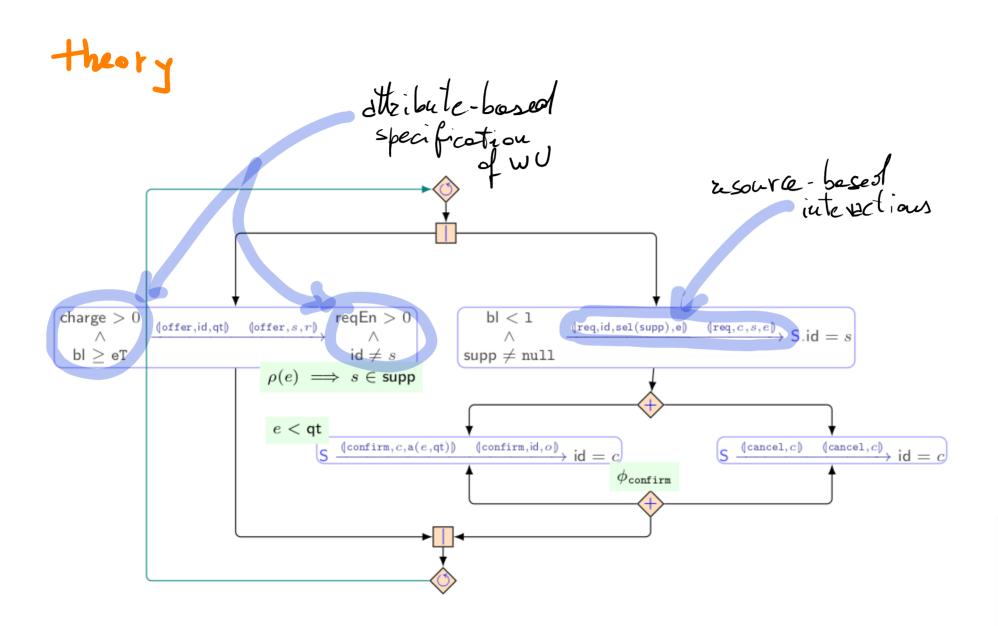
to deliver intellijible statically checked workflows

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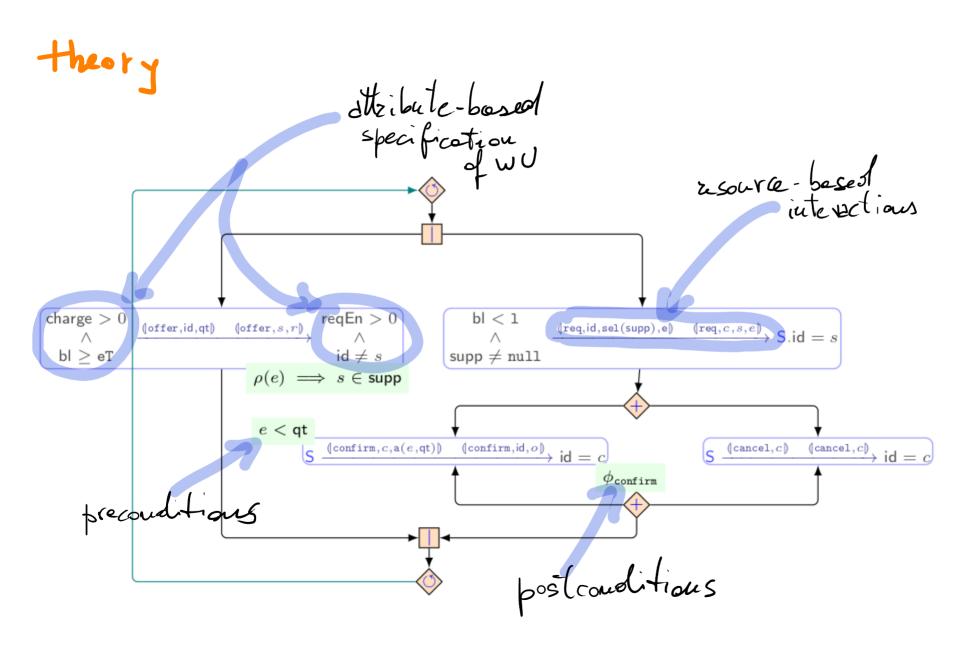
theory



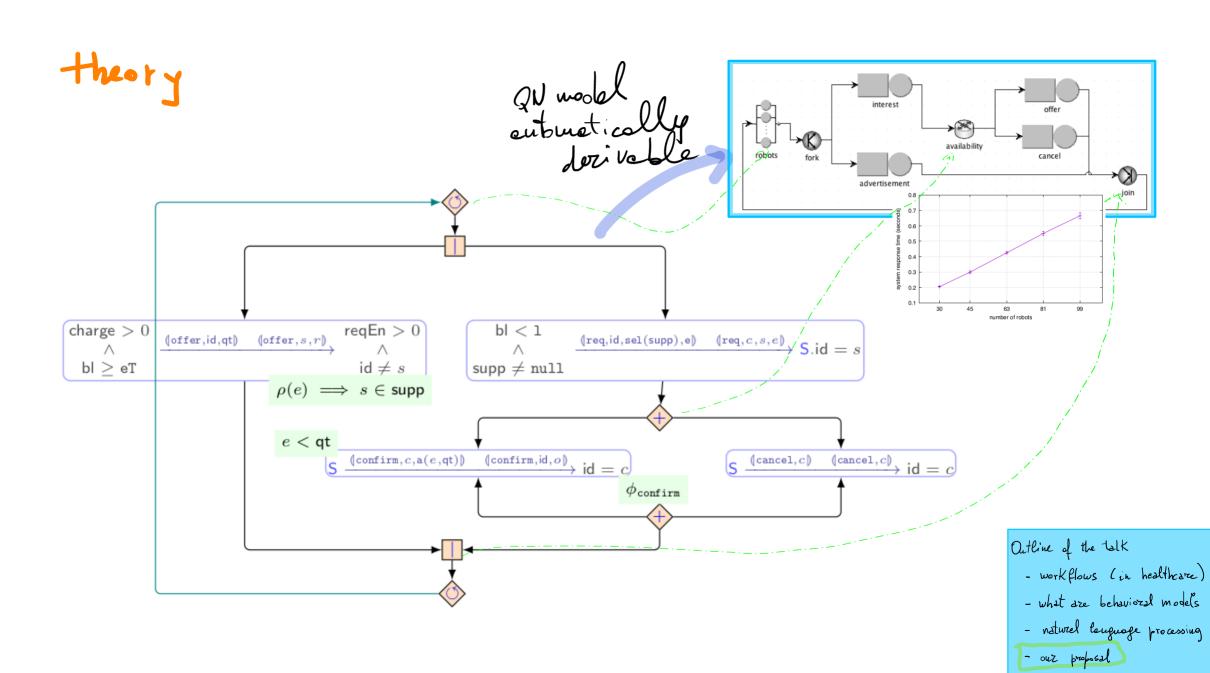
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- Languages, algorithms, and tools

 Behavioral typing to statically enforce properties
 - WU-friendly DSL to capture | causel- & concrete defendencies | relevant (non-) functional properties
 - "interfaces" with industrial standards | natural language DCR solutions, MAPS
 - Tools: besides the industrial platforms

```
(Ris)QFLan # DSLs for quantitative analysis
           # tool-chain for multiparty session types
ChorGram
AIOCJ
           # choreographic programming language
OKGraph
           # unsupervised language understanding
. . .
```

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Thank you!