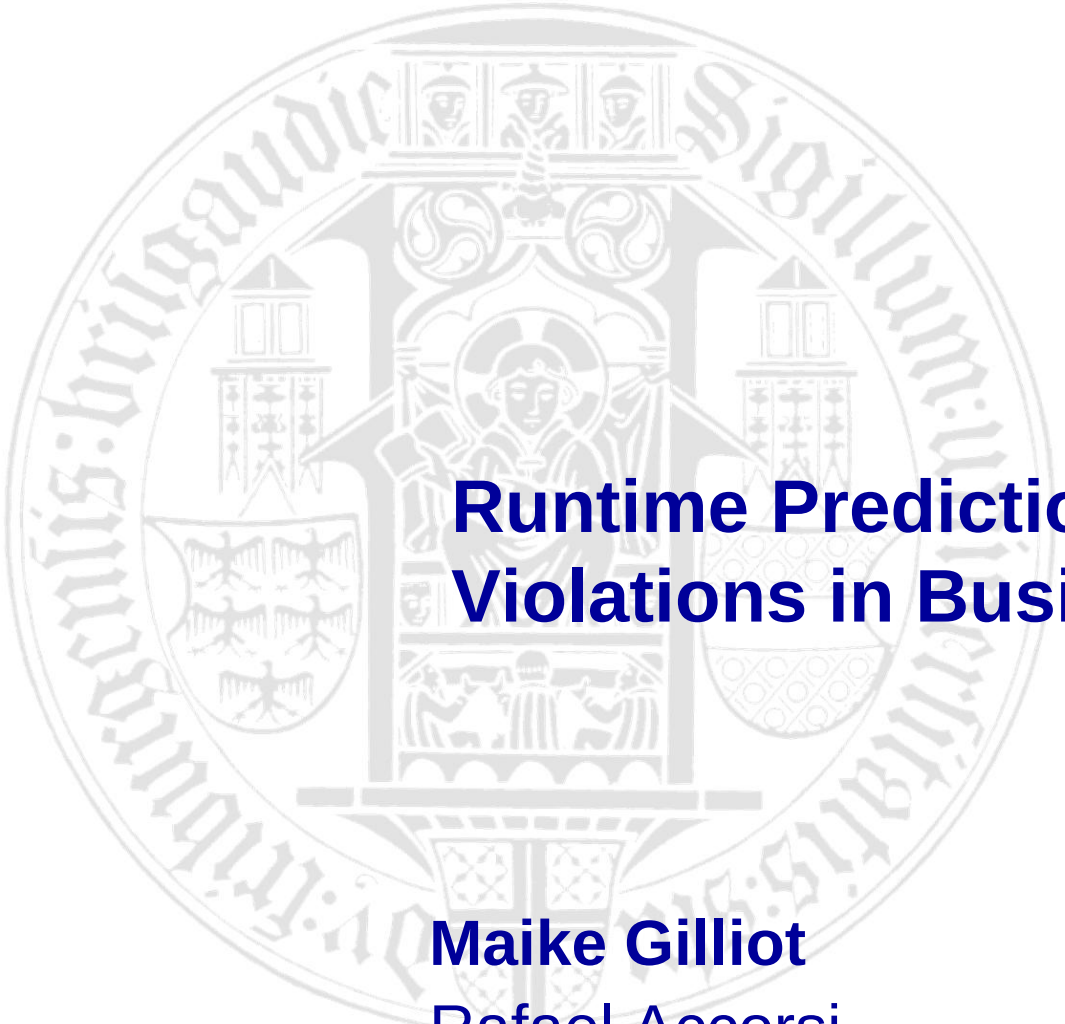

Runtime Prediction of Privacy Violations in Business Processes

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PRIMELife Summer School
Nice, 09th of September 2009

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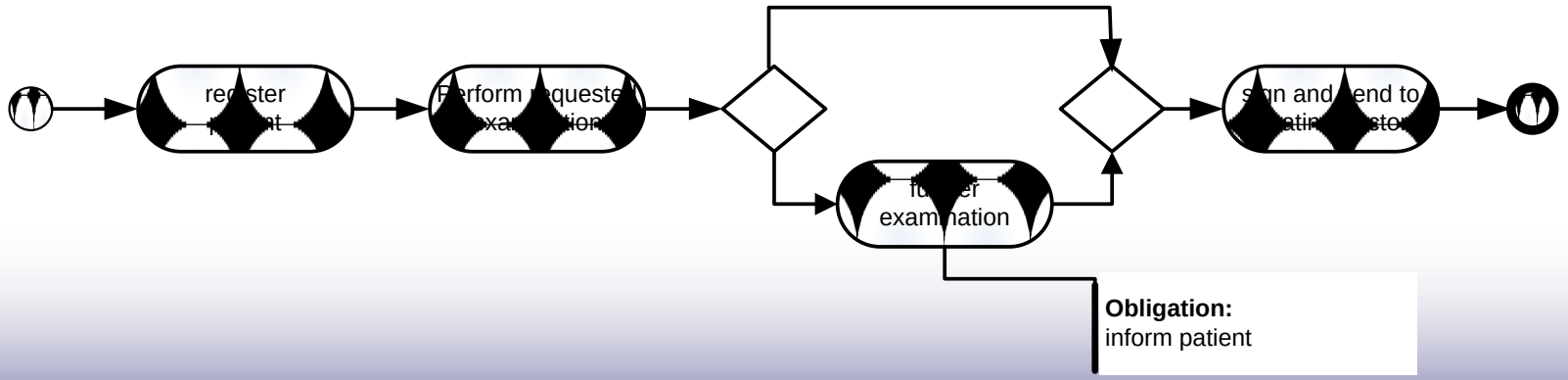
Obligations for Privacy

- **Data usage rules**
  - Prescribe usage of data **after** release
  - Examples
    - „delete data after 30 days“
    - „inform data owner about data usage“

Obligations:
actions a subject must perform

- **Obligations**
  - common in legal frameworks (up to 70%)
  - enforcement „by design“



Need for adaptive Processes

- **Need for adaptive processes**
  - Changes at runtime *to a single instance* to changed situations
  - Ability to insert or to delete steps in the workflow at runtime *to a single instance*

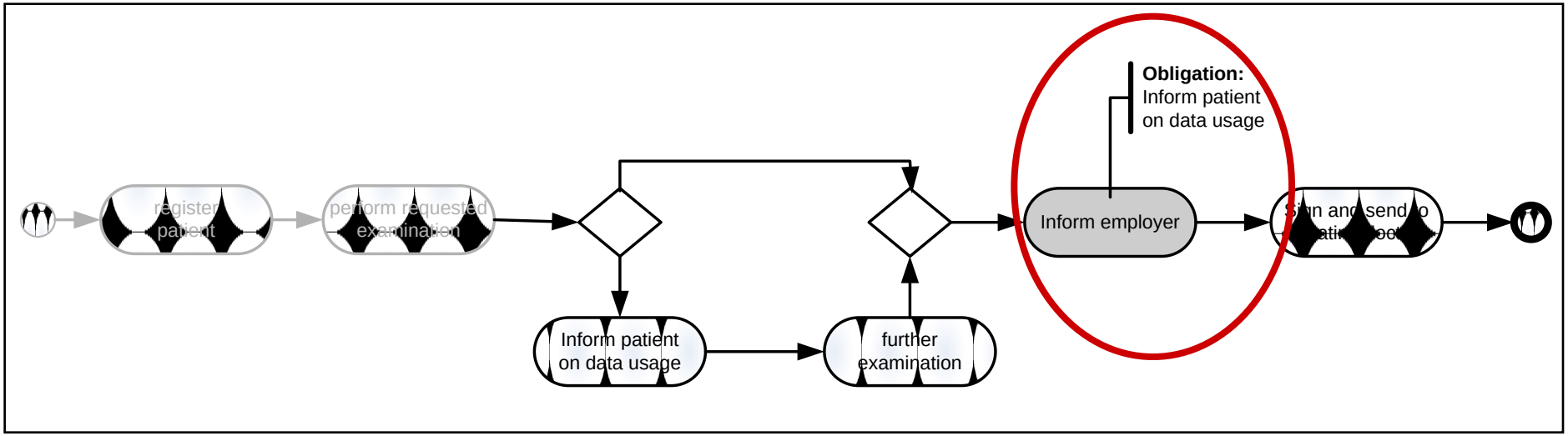
- **Assumption:**
  - Set of allowed changes for every workflow available

- **Consequence:**
  - Changed workflow may not be anymore compliant

- **Example**
  - Deletion of activity „inform patient“
  - Include activity „inform employer“

Non-compliance due to changes

In case change is accepted:



Situation:

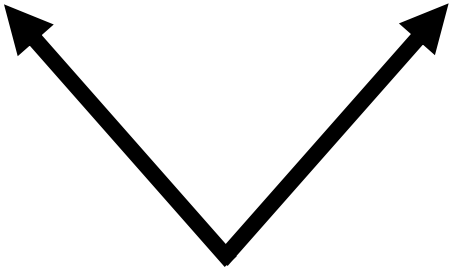
- **1 compliant continuation** {(informP),(furtherEx),(informE), (sign&send)}
- **1 non-compliant continuation** {(informE),(sign&send)}

Remedy:

- include activity „inform patient“ in upper branch
- move activity „inform patient“

Compliance in adapted processes

Problem: **Compliance** ⟷ **Adaptive processes**



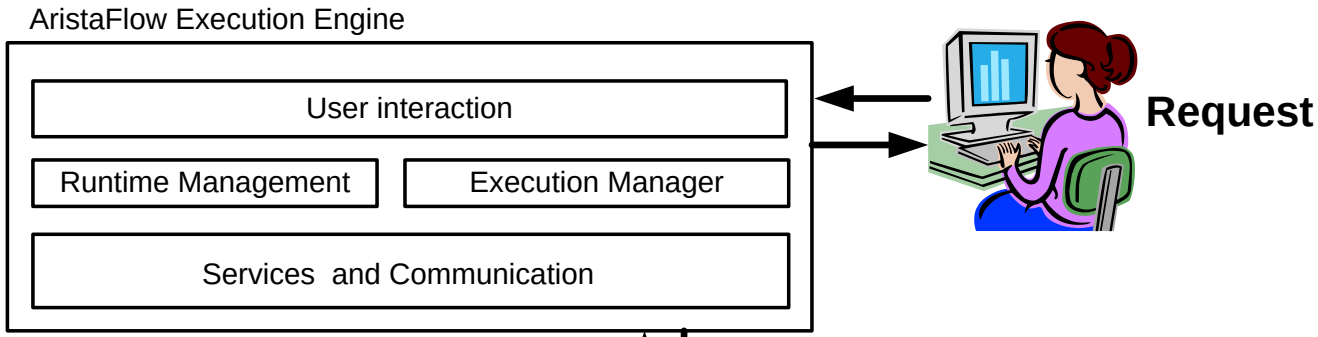
Approach: **Violation Anticipation Monitor (VAM)**

1. Evaluates change request wrt obligations
   - Detect the existence of non-compliant execution continuations
   - computes if remedy is possible
   - experience based evaluation of the continuations

2. Denies/ grants change request
   - automatically
   - delegates decision to the user

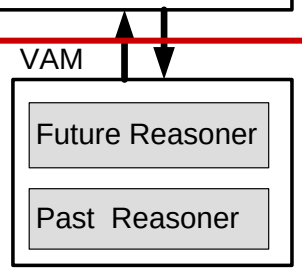
Runtime Monitoring of Change Requests

syntactic checks



evaluation wrt obligations

- **FALSE** — **deny**
- **PRESUMABLY FALSE** — **delegate to user**
- **PRESUMABLY TRUE** — **accept**
- **TRUE** — **accept**



Components of the VAM

Future Reasoner

Predicting violations based on the process continuations

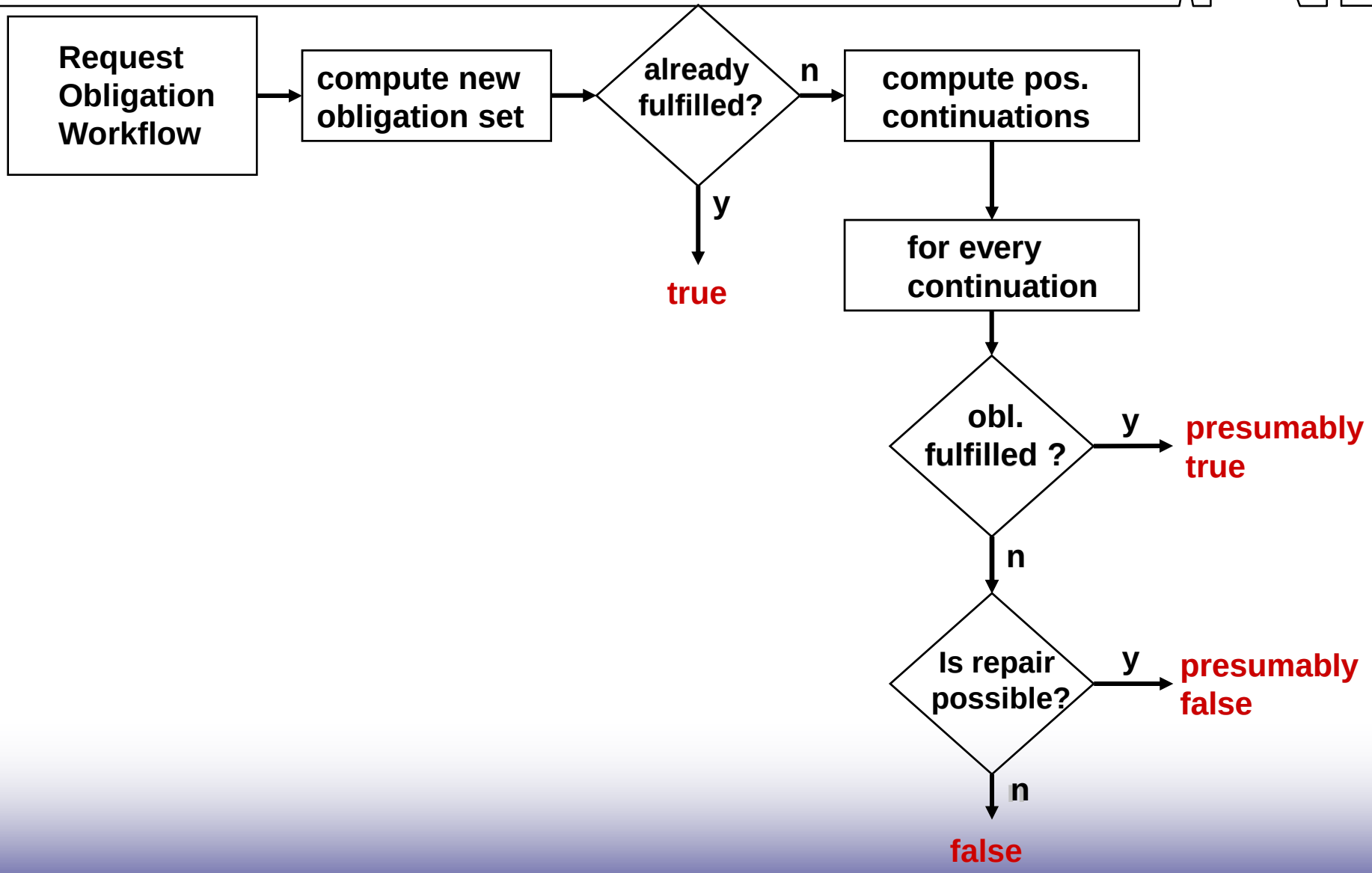
- evaltuates the possible process continuations regarding the obligation
- computes remedies

Past Reasoner

Predicting the continuation based on past executions of the workflow

- based on a log data base
- computes the probablity for each continuation

Future Reasoner



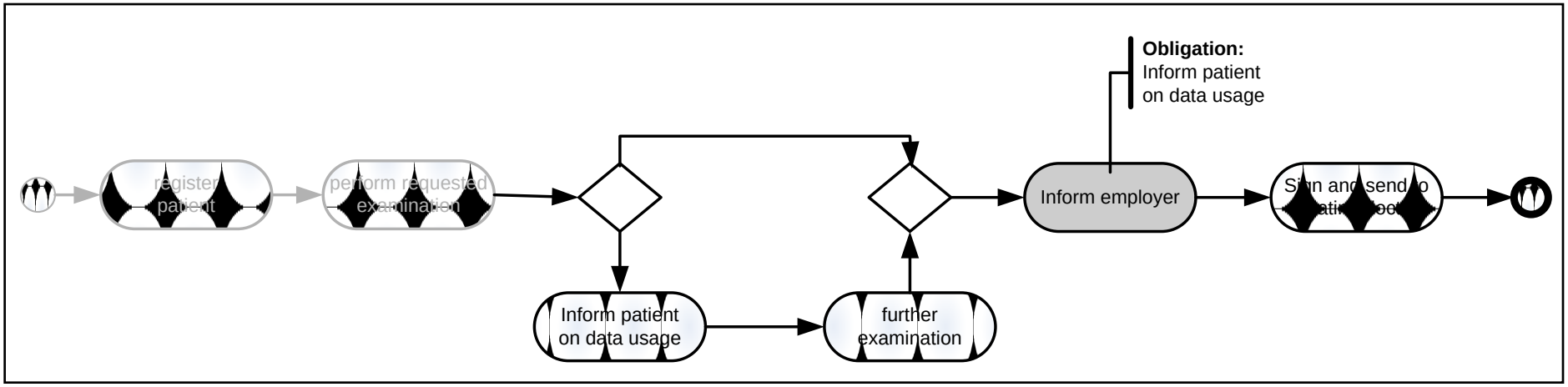
Future Reasoner - Output

Status of obligation for a single continuation

Values:

- **false:**
  the continuation violates the obligation, and no repair is possible
- **presumably false:**
  the continuation violates the obligation, but repair to the continuation is possible
- **presmuably true:**
  the continuation fulfills the obligation, if execute as it is
- **true:**
  the obligation is already fulfilled (or there is none)

Future Reasoner - Output



Situation:

- **1 compliant continuation** {(informP),(furtherEx),(informE), (sign&send)} **pt**

- **1 non-compliant continuation but repair is possible** {(informE),(sign&send)} **pf**

Output:

Continuation	$Verdict_{FR}$
(informP), (furtherEx), (informE), (sign&send)	pt
(informE), (sign&send)	pf

Past Reasoner

Log data base of former executions of the workflow

Partial trace	Continuation
…	…
(register, requestedEx)	(informP, furtherEx, informE, sign&send)
(register, requestedEx)	(sign&send)
(register, requestedEx)	(sign&send)
(register, requestedEx)	(informP, furtherEx, informE, sign&send)
(register, requestedEx)	(inform, furtherEx, informE, sign&send)
(register, requestedEx)	(inform, furtherEx, informE, sign&send)
(register, requestedEx)	(inform, furtherEx, informE, sign&send)
(register, requestedEx)	(inform, furtherEx, informE, sign&send)
…	…

Current implementation:
Number of executions per continuation

Components of the VAM

Future Reasoner

Predicting violations based on the process continuations

- evaltuates the possible process continuations regarding the obligation
- computes remedies
- **Output:**
  preliminary verdict for each continuation

Continuation	$Verdict_{FR}$
(informP), (furtherEx), (informE), (sign&send)	pt
(informE), (sign&send)	pf

Past Reasoner

Predicting the continuation based on past executions of the workflow

- based on a log data base
- computes the probablity for each continuation
- **Output:**
  probabality of each continuation

Continuation	$Prob_{PR}$
(informP), (furtherEx), (informE), (sign&send)	0.75
(informE), (sign&send)	0.25

$Verdict_{VAM}$

Future Reasoner

Continuation	$Verdict_{FR}$
(informP), (furtherEx), (informE), (sign&send)	pt
(informE), (sign&send)	pf

Past Reasoner

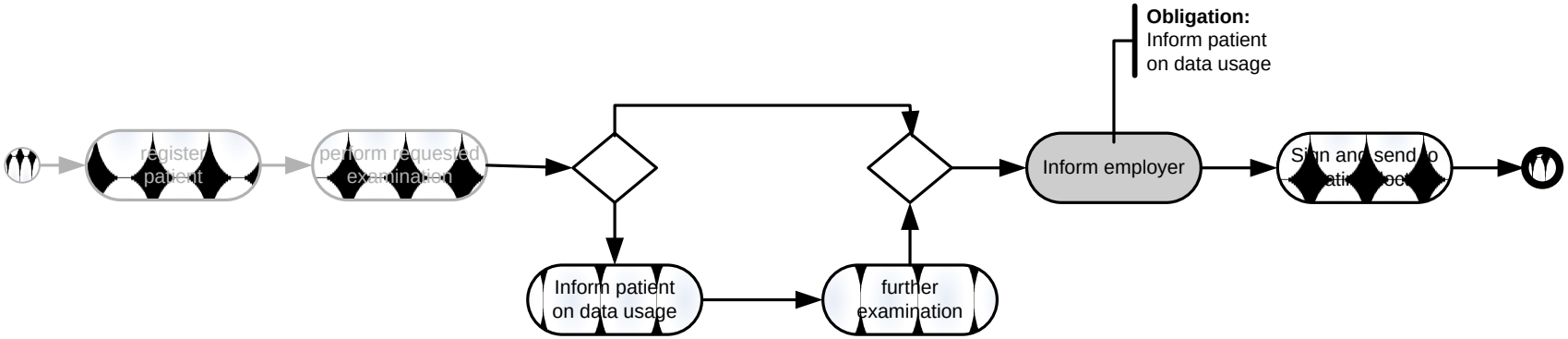
Continuation	$Prob_{PR}$
(informP), (furtherEx), (informE), (sign&send)	0.75
(informE), (sign&send)	0.25

$Verdict_{FR}$	$Prob_{PR}$
pt	0.75
pf	0.25

PRESUMABLY TRUE

Surveillance *after* change

Status of obligation may change during execution



Status:

Presumably true

Presumably false

False

Summary and Next Steps

Summary

- **Need for apdative processes *and* compliance**
- **Approach:**
  Monitoring change requests to anticipate possible violations → **VAM**
- **Result of the VAM:**

  – FALSE → reject request
  – PRESUMABLY FALSE → inform user
  – PRESUMABLY TRUE → accept request
  – TRUE → accept request

Next steps

- Implementation of the VAM
- Proof of concept evaluation
- Base Past Reasoner on Bays Nets
- Include surveillance after changes

Thank you for your attention

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