

Semester Project Proposals

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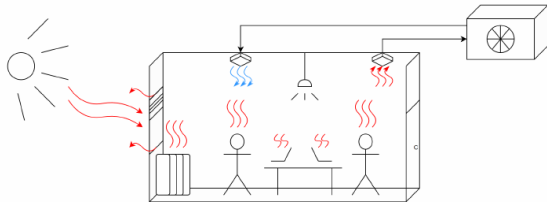


AALBORG UNIVERSITY

September 1, 2025

Project Proposal 1

Proposal 1: Smart buildings - BUILD Thomas Manns Vej 25

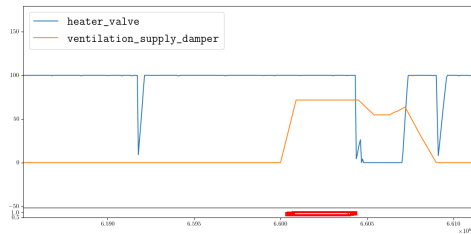


Group cs-25-sw-6-16 Bachelor

API with possibility to control:

- Ventilation
- Heating
- Blinds

Proposal 1: Smart buildings - BUILD Thomas Manns Vej 25



Heating and Ventilation

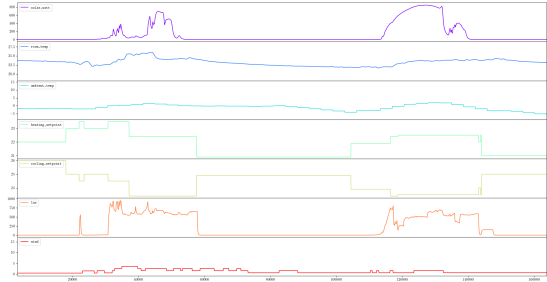
API with possibility to control:

- Ventilation
- Heating
- Blinds

Currently

- Traditional simple controllers (bang-bang controllers)
- No collaboration on controllers
- No energy optimization
- Summer some rooms get too hot

Thomas Manns Vej 25 (This Project)



This Project

- Create adequate model for the thermodynamics of TMV 23?
- Control heating, ventilation, blinds optimize: energy, user comfort?
- Test controllers in real building

Project Proposal 2

Extended Timed Regular Expressions (ETRE)

RegEx are useful for validation, pattern matching, etc. Widely used in industry.

Salve, amice!

Si vis mihi scribere, mitte litteras electronicas ad hunc locum: marcus.tullius@romamail.roma. Magister meus, Gaius Iulius Caesar, etiam vult audire novas; scribe ei ad caesar.dictator@imperium.roma.

Discipulus meus, Brutus, quaestiones habet de philosophia. Si ei respondere potes, mitte responsum ad brutus.stoicus@athenae.edu. Sed cave! Saepe tardus est in legendo.

Si errorem invenis in his litteris, nuntia servo meo, Ciceroni, ad servus.cicero@dominus.roma. Gratias tibi ago!

Vale, Seneca.Minor@stoa.roma

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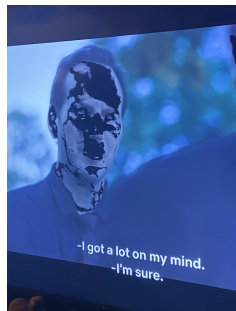
RegEx for emails: $\text{^\text{[}\backslash\text{w-}\backslash\text{.}\text{]}+@\text{([}\backslash\text{w-}\text{]}+\backslash\text{.})+[\backslash\text{w-}]\{2,4\}\text{\$}}$

RegEx expression translated to NFA to perform *pattern matching*

Extended Timed Regular Expressions (ETRE)

Finding timed patterns in time series data e.g. log files for video streaming

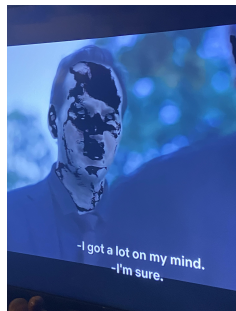
```
[08:00:01] INFO TX_START - StreamID: 8945A3, Source: server01, Destination: client192.168.10.24
[08:00:03] INFO RX_START - StreamID: 8945A3, Receiver: client192.168.10.24, BufferSize: 12MB
[08:05:12] INFO TX_HEARTBEAT - StreamID: 8945A3, CurrentBitrate: 4520kbps, DroppedFrames: 0
[08:05:12] INFO RX_HEARTBEAT - StreamID: 8945A3, BufferLevel: 10.5MB, Jitter: 12ms, Lag: 120ms
[08:15:45] WARNING RX_BUFFER_UNDERRUN - StreamID: 8945A3, Receiver: client192.168.10.24
[08:16:10] INFO RX_RECOVERY - StreamID: 8945A3, BufferLevel: 8.1MB
[08:30:00] INFO TX_STOP - StreamID: 8945A3, Duration: 1800s, AvgBitrate: 4490kbps
[08:30:01] INFO RX_STOP - StreamID: 8945A3, TotalFrames: 54000, DroppedFrames: 23
[09:00:00] INFO TX_START - StreamID: C774B1, Source: server02, Destination: edge_node05
[09:00:02] INFO RX_START - StreamID: C774B1, Receiver: edge_node05, BufferSize: 16MB
[09:15:00] ERROR TX_FAILURE - StreamID: C774B1, Reason: Encoder crash
[09:15:01] INFO RX_STOP - StreamID: C774B1, Reason: TX failure
:
```



Extended Timed Regular Expressions (ETRE)

Finding timed patterns in time series data e.g. log files for video streaming

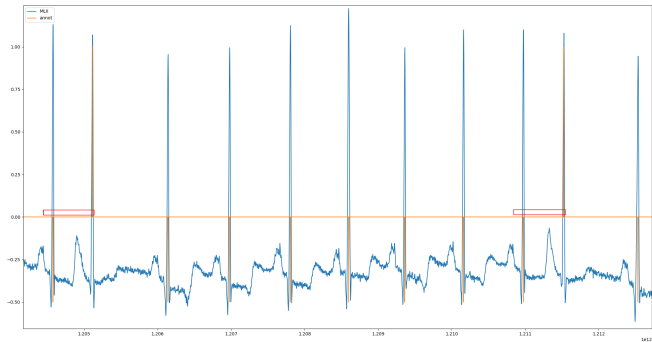
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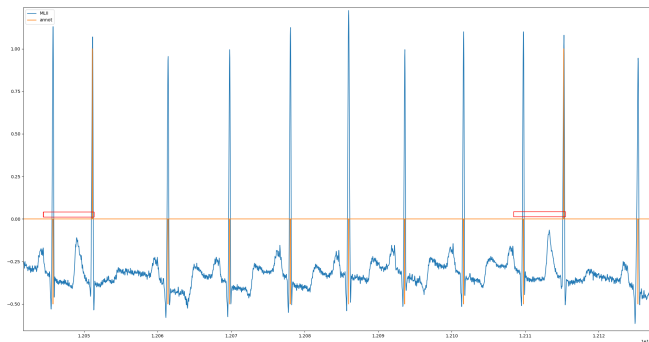
Timed RegEx for delayed frames: $(TX \cdot \Sigma^* \cdot RX)_{\geq 30ms}$

Timed RegEx expression translated to Timed Automata to perform *time pattern matching*

Extended Timed Regular Expressions (Detecting arrhythmia)



Extended Timed Regular Expressions (Detecting arrhythmia)



$$f_1(t) = -0.18 - 1.06e^{-8}t + 2.17e^{-16}t^2 \dots$$

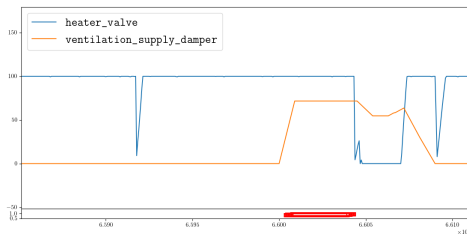
$$f_2(t) = -0.95 - 1.19e^{-7}t - 2.23e^{-15}t^2 \dots$$

Timed RegEx for two close heart beats (QRS): $(f_1 \cdot f_2 \cdot \Sigma_{[0.04s, 0.65s]}^* \cdot f_1 \cdot f_2)$

This thesis: How to infer/learn Extended Timed Regular Expressions? Applications in health, communications networks, etc.

Project Proposal 3

Parametric Extended Timed Regular Expressions

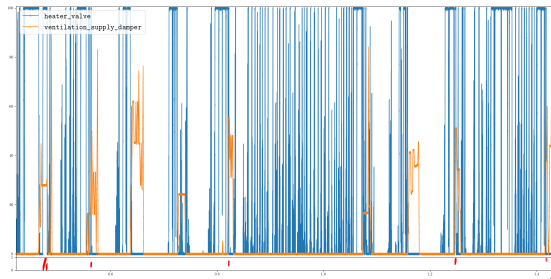


heating and ventilation ON for 1 to 2 hours
$$\text{tmv-energy}_J \equiv \langle (80_{20}^{\text{heat}})^* \rangle_{[3600s, 7200s]} \cap \langle (60_{40}^{\text{vent}})^* \rangle_{[3600s, 7200s]}$$

Parametric Extended Timed Regular Expressions

J in s.	ETRE	Match	Time
[1800, 3600]	tmv-energy _{J}	172	2.7
[3600, 5400]		81	2.7
[5400, 7200]		43	2.7
[7200, 9000]		13	2.7

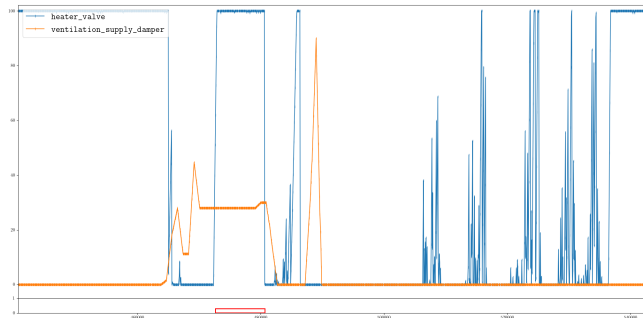
3 months of data



heating and ventilation ON for J time units

$$\text{tmv-energy}_J \equiv \langle (80_{20}^{\text{heat}})^* \rangle_J \cap \langle (60_{40}^{\text{vent}})^* \rangle_J$$

Parametric Extended Timed Regular Expressions (this project)



$$\text{tmv-energy}_J \equiv \langle (80_{20}^{\text{heat}})^* \rangle_{[3600s, \theta]} \cap \langle (60_{40}^{\text{vent}})^* \rangle_{[3600s, \theta]}$$

Detect **maximal** duration θ where both heating and ventilation ON

This project: How to find the maximal/minimal values? Can one use e.g. Parametric Timed Automata?