UNSL at eRisk 2021: A Comparison of Three Early Alert Policies for Early Risk Detection

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Outline

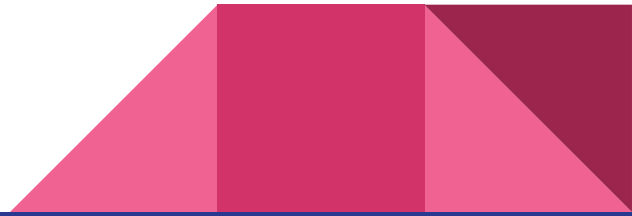
- Early text classification framework
- Proposed models
- Runs and results:
  - Task 1
  - Task 2

https://jmloyola.github.io/files/talks/2021_erisk.pdf

Early Text Classification Framework

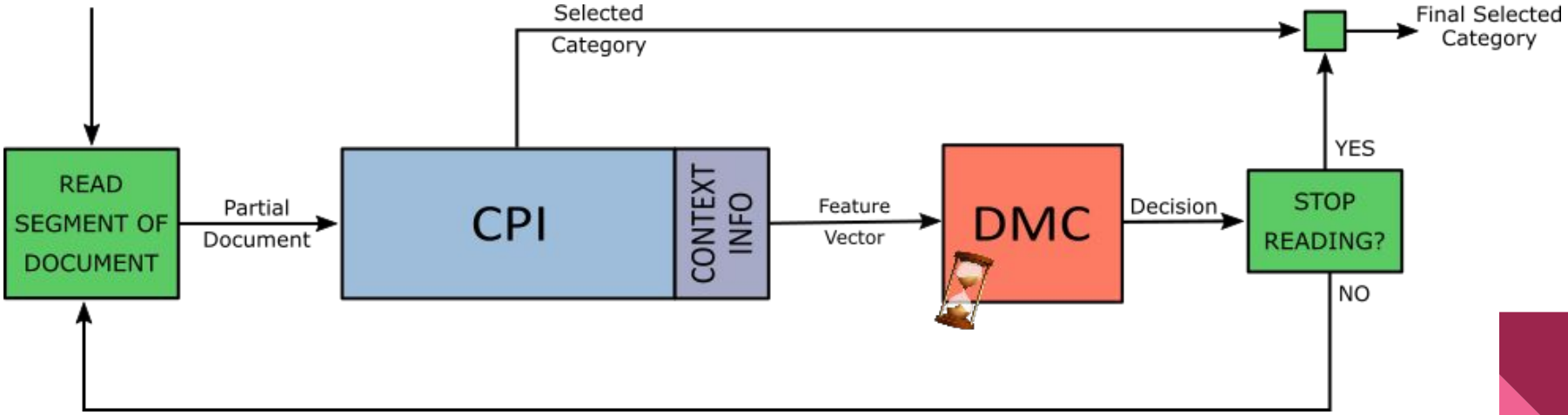
Early Text Classification Framework

- Development of predictive models that can determine the category of a document as soon as possible.
- Find an adequate balance between:
  - precision of the classification
  - minimum time for a prediction to be reliable.
- It can be conceptualized in two parts:
  - Classification with Partial Information (CPI).
  - Decision of the Moment of Classification (DMC).



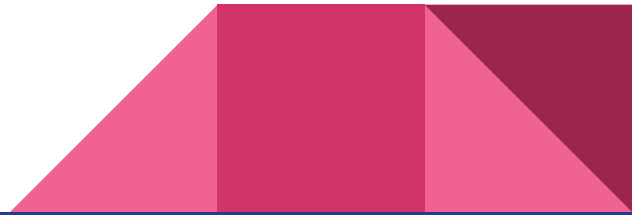
Early Text Classification Framework

- CPI → Classification with Partial Information
- DMC → Decision of the Moment of Classification



Early risk detection

- Special case of early text classification.
- We are only concerned with predicting the risk category as early as possible.
- If the current partial input is classified as non-risky, the model continues to accumulate information in case, in the future, the user begins to show risky patterns.
- It is essential to recover as many users at risk as possible as their lives could be in danger.



Proposed Models

Proposed models

- EarlyModel
- SS3
- EARLIEST

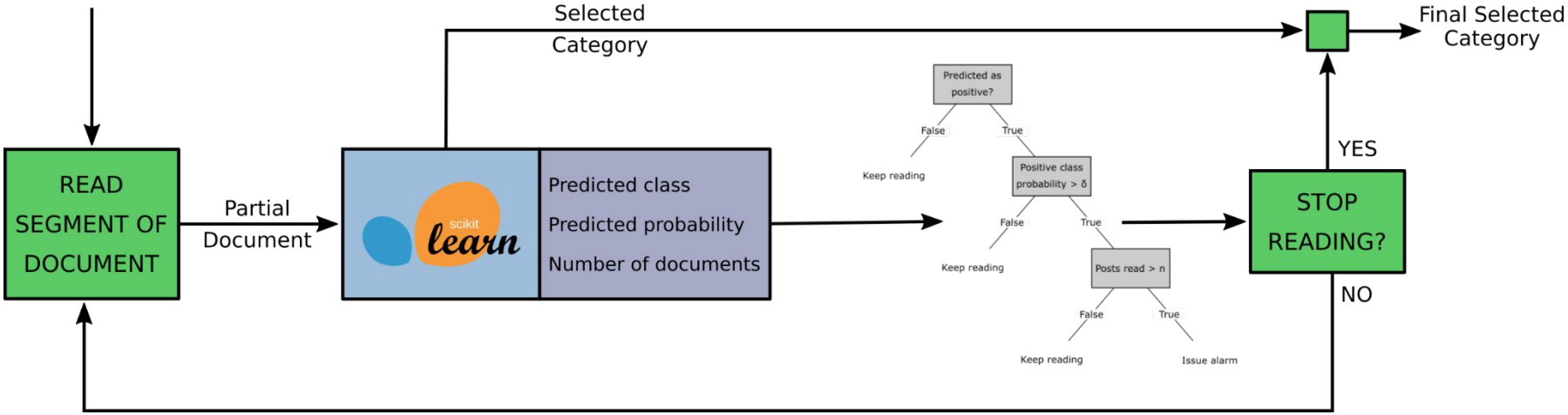
Proposed models

We can identify each model with:

- Input representation
- Model used for classification with partial information (CPI)
- Early alert policy (DMC)

EarlyModel

EarlyModel


READ SEGMENT OF DOCUMENT
Partial Document
scikit learn
Predicted class
Predicted probability
Number of documents
Selected Category
Predicted as positive?
False
True
Keep reading
Positive class probability > δ
False
True
Keep reading
Posts read > n
False
True
Keep reading
Issue alarm
STOP READING?
YES
NO
Final Selected Category

EarlyModel

Input representation:

- Bag of words
- Linguistic Inquiry and Word Count (LIWC)
- Latent Dirichlet Allocation (LDA)
- Latent Semantic Analysis (LSA)
- Doc2vec

EarlyModel

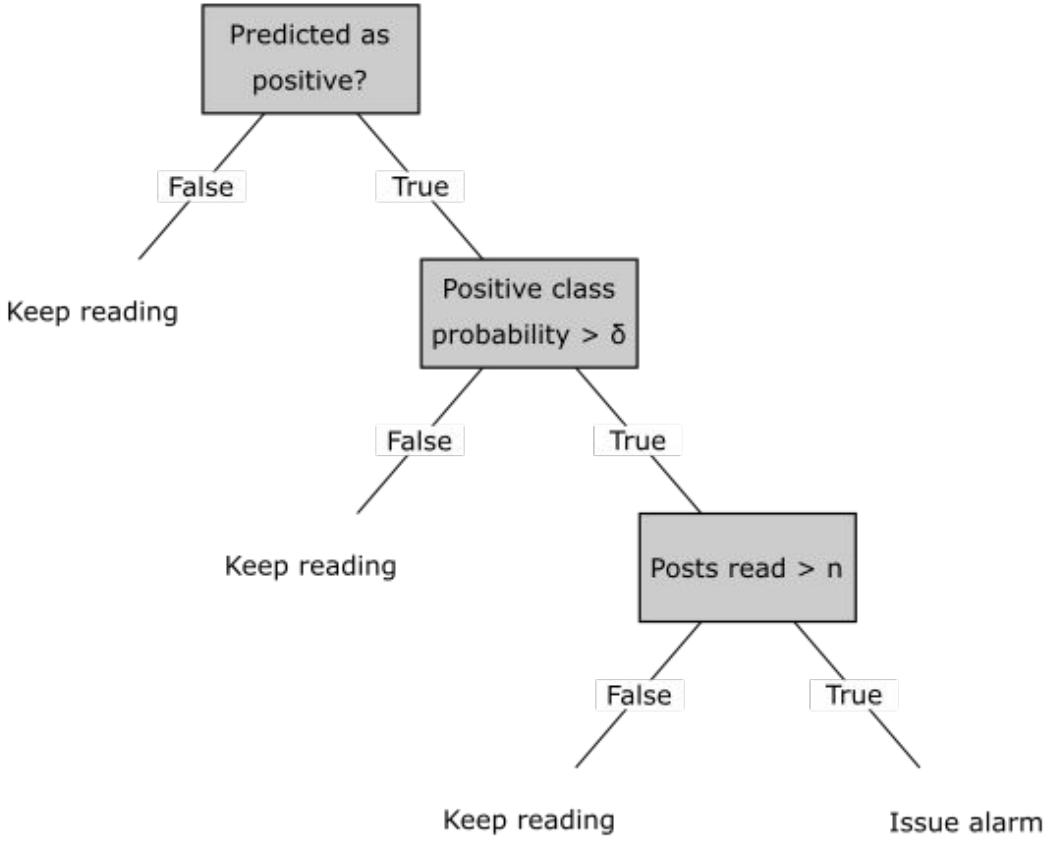
Models used for classification with partial information:

- Decision trees
- K-nearest neighbors
- Support vector machine (SVM)
- Logistic regression
- Multi-layer perceptron (MLP)
- Random forests

- LSTM
- BERT

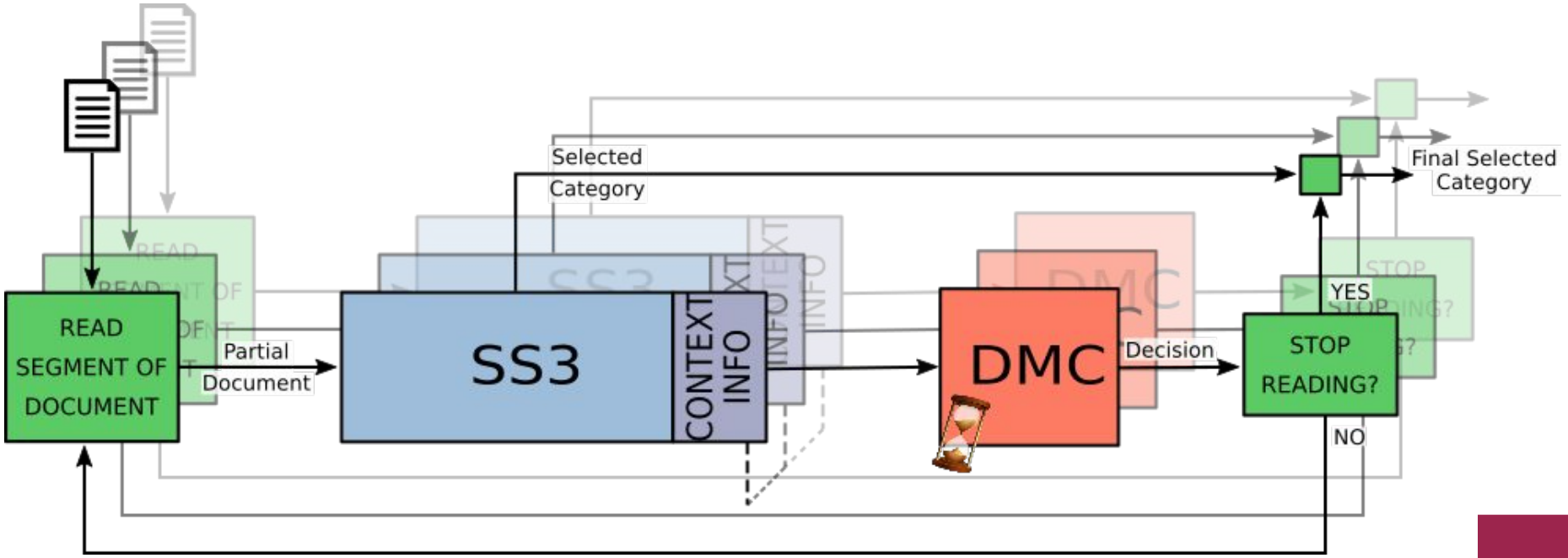
EarlyModel

Early alert policy:

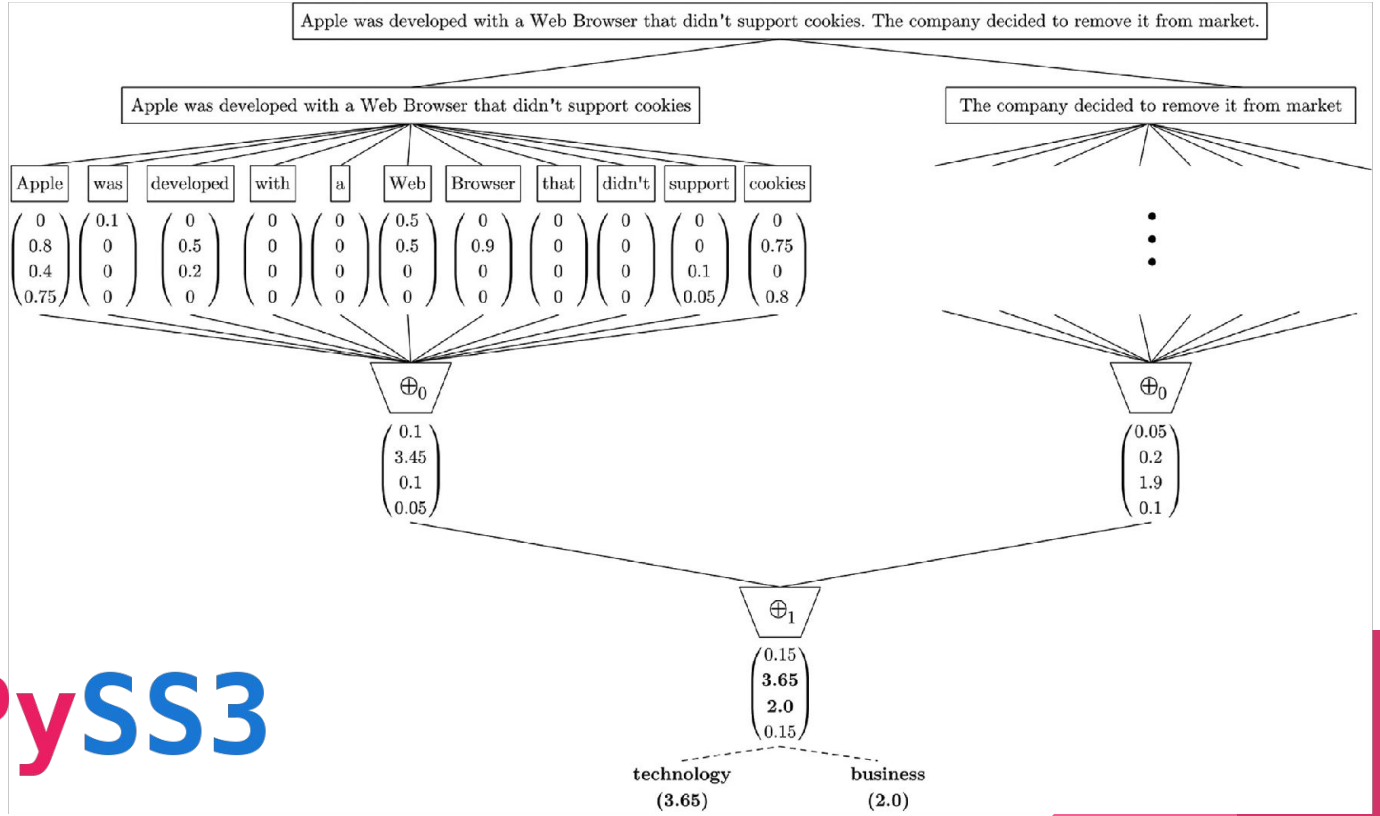


SS3

SS3


READ
SEGMENT OF
DOCUMENT
Partial
Document
SS3
CONTEXT
INFO
DMC
Decision
STOP
READING?
YES
NO
Selected
Category
Final Selected
Category

SS3


Apple was developed with a Web Browser that didn't support cookies. The company decided to remove it from market.
Apple was developed with a Web Browser that didn't support cookies
The company decided to remove it from market
Apple
was
developed
with
a
Web
Browser
that
didn't
support
cookies
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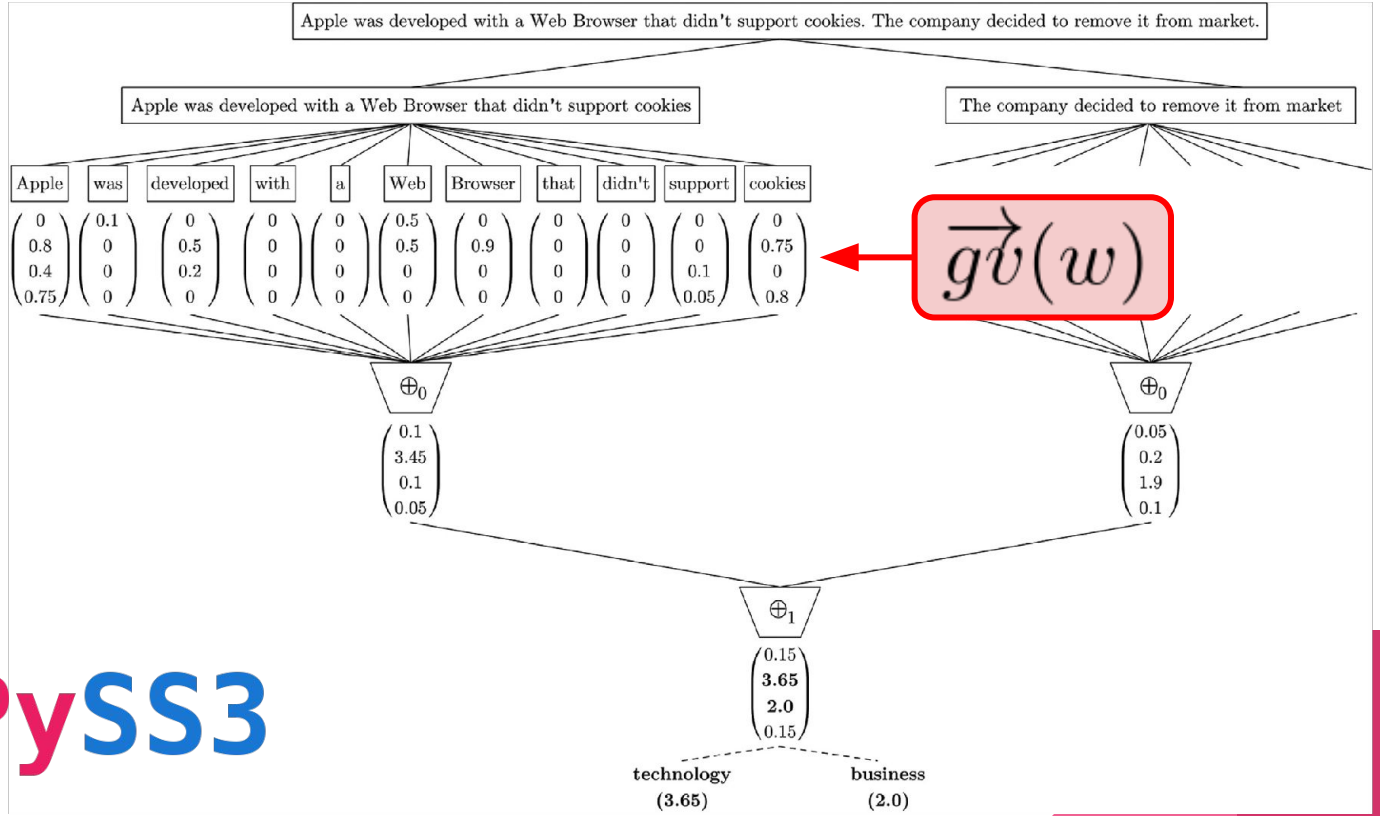
technology
(3.65)
business
(2.0)

PySS3

SS3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Apple
was
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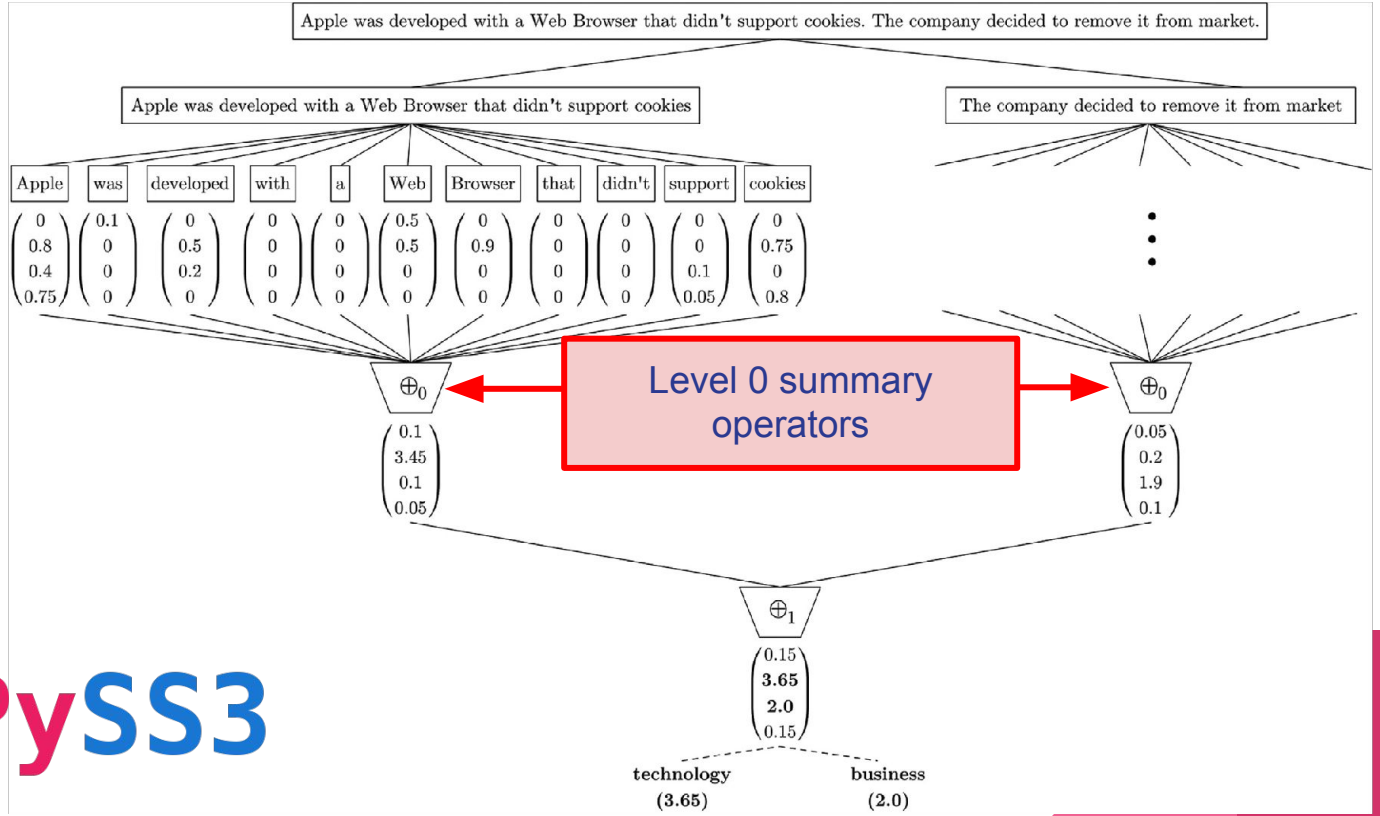
technology
(3.65)
business
(2.0)

PySS3

SS3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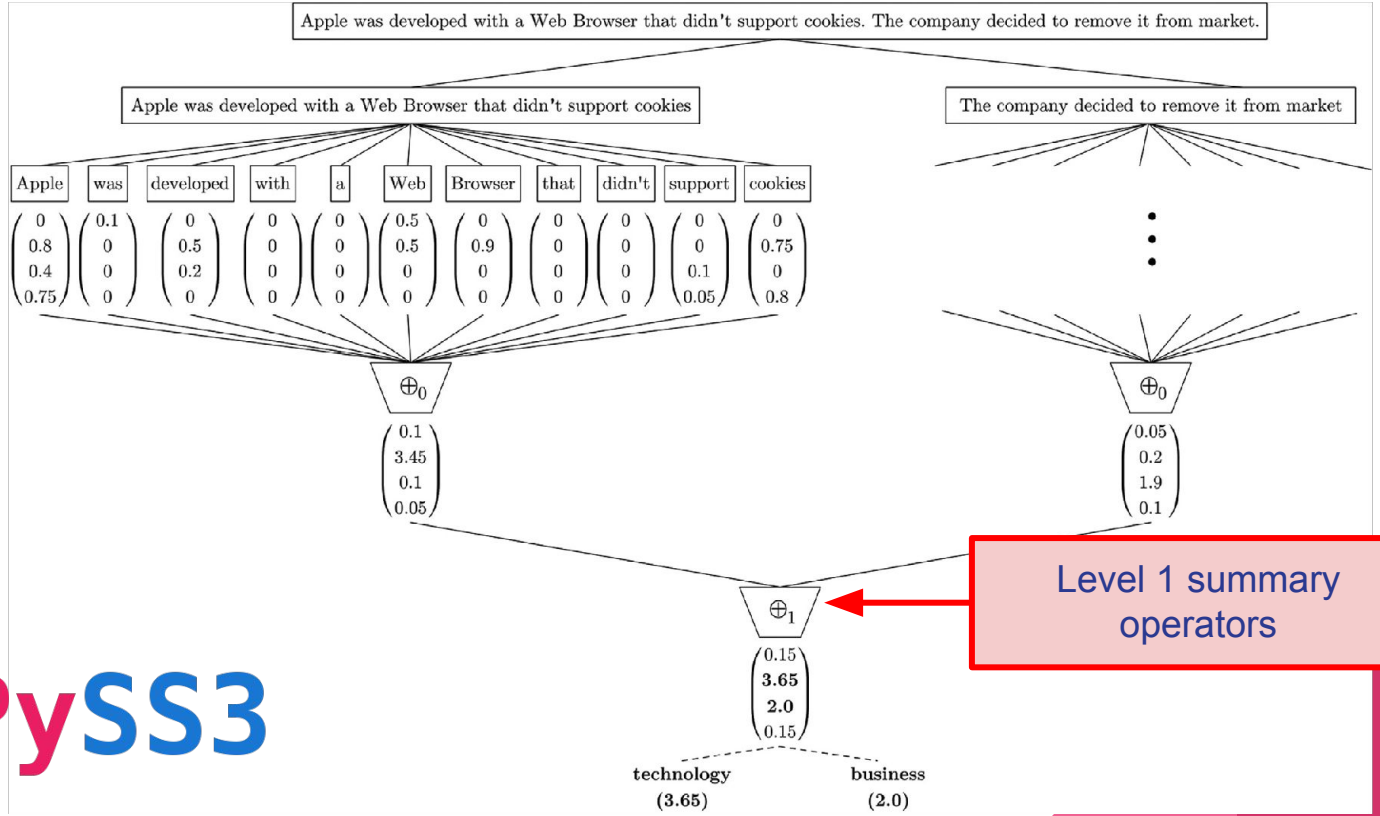
cookies
Level 0 summary operators
technology
(3.65)
business
(2.0)

PySS3

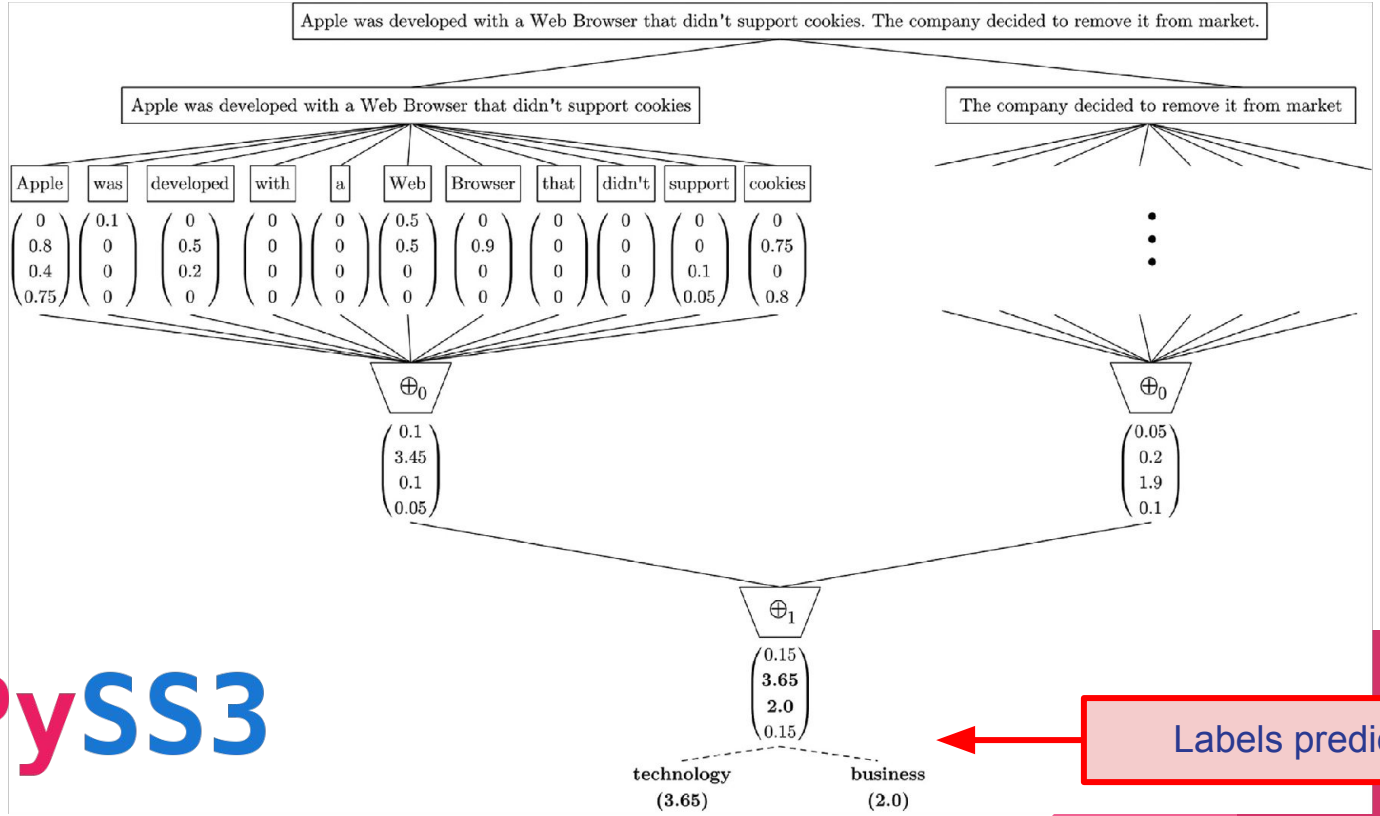
SS3



Level 1 summary operators

PySS3

SS3



PySS3

Labels predicted

SS3

Early alert policy:

$$decision_u = \begin{cases} 1, & \text{if } score_u > \text{median}(scores) + \gamma \cdot \text{MAD}(scores) \\ 0, & \text{otherwise.} \end{cases}$$

SS3

Early alert policy:

$$decision_u = \begin{cases} 1, & \text{if } score_u > \text{median}(scores) + \gamma \cdot \text{MAD}(scores) \\ 0, & \text{otherwise.} \end{cases}$$

Risk class score
-
Non-risk class score

SS3

Early alert policy:

$$decision_u = \begin{cases} 1, & \text{if } score_u > \text{median}(scores) + \gamma \cdot \text{MAD}(scores) \\ 0, & \text{otherwise.} \end{cases}$$

$$scores = \{score_u | u \in \text{Users}\}$$

SS3

Early alert policy:

$$decision_u = \begin{cases} 1, & \text{if } score_u > \text{median}(scores) + \gamma \cdot \underline{\text{MAD}}(scores) \\ 0, & \text{otherwise.} \end{cases}$$

Median Absolute Deviation

SS3

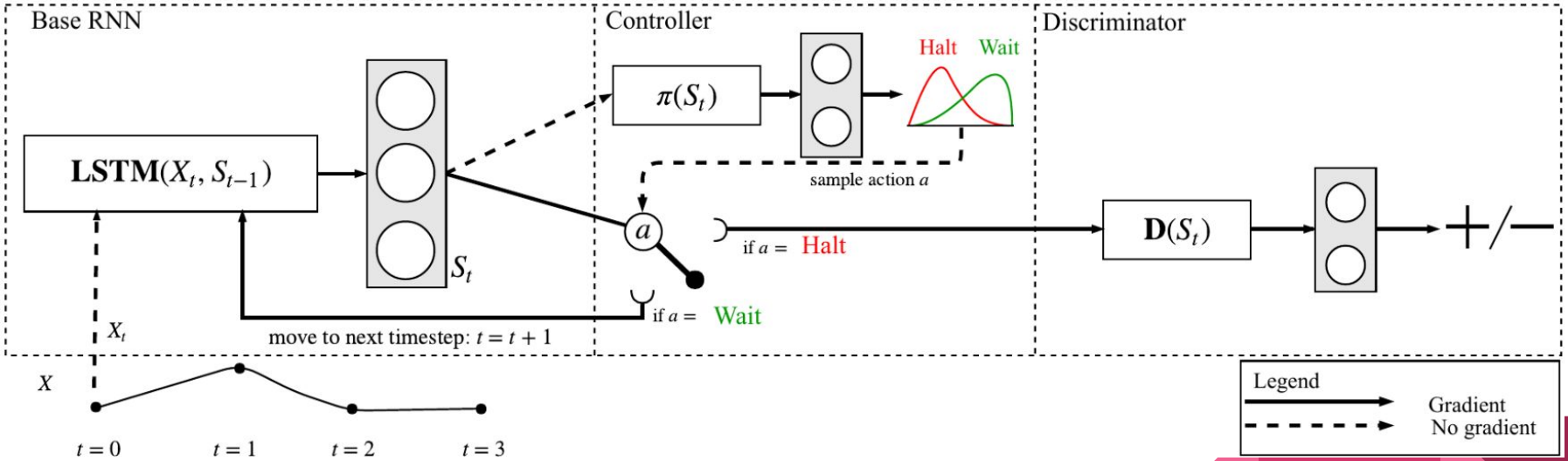
Early alert policy:

$$decision_u = \begin{cases} 1, & \text{if } score_u > \text{median}(scores) + \gamma \cdot \text{MAD}(scores) \\ 0, & \text{otherwise.} \end{cases}$$

Early alert policy hyper-parameter

EARLIEST

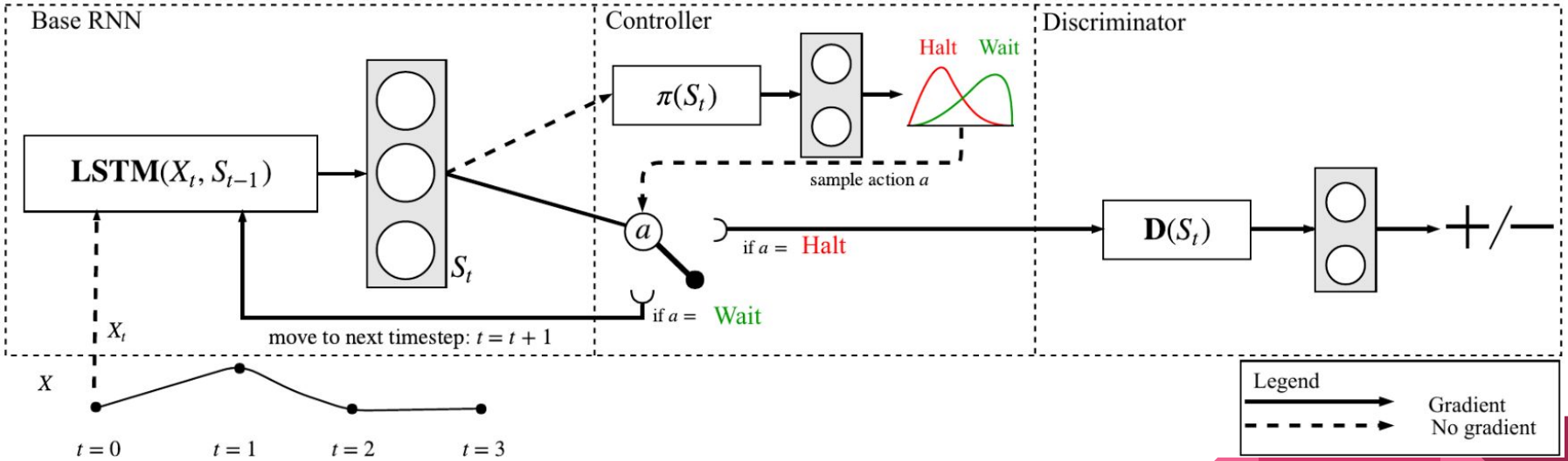
EARLIEST



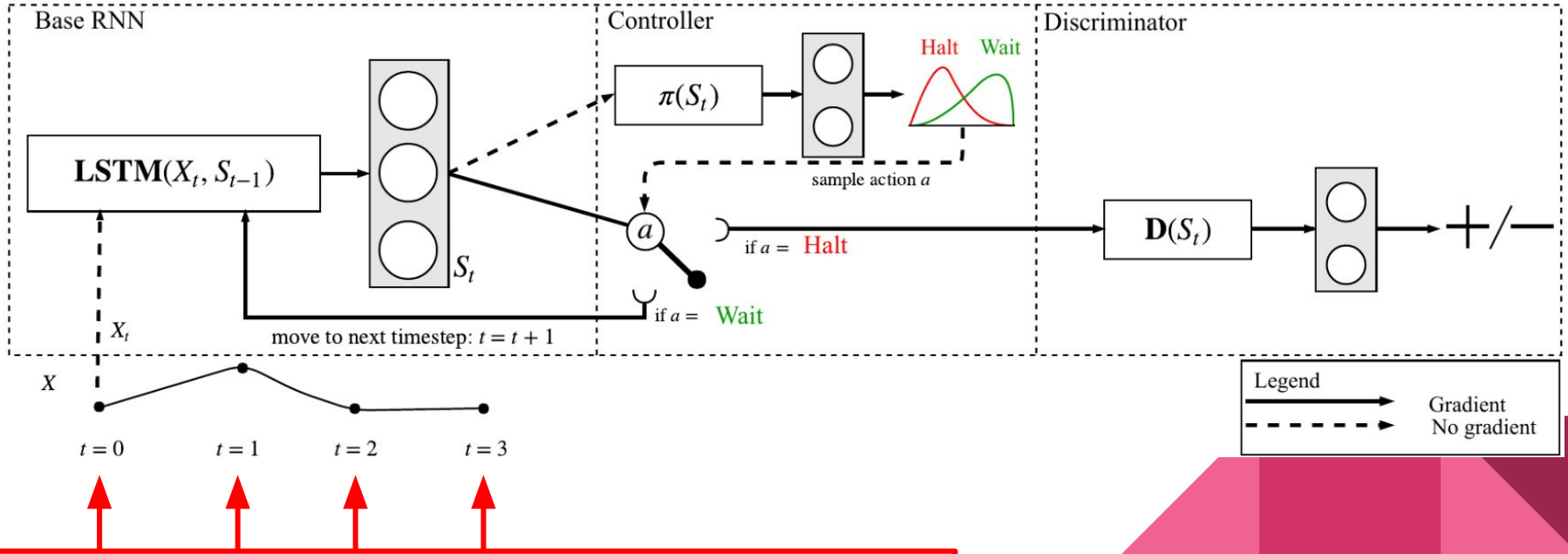
Hartvigsen et al. 2019

EARLIEST

Early and Adaptive Recurrent Label ESTimator



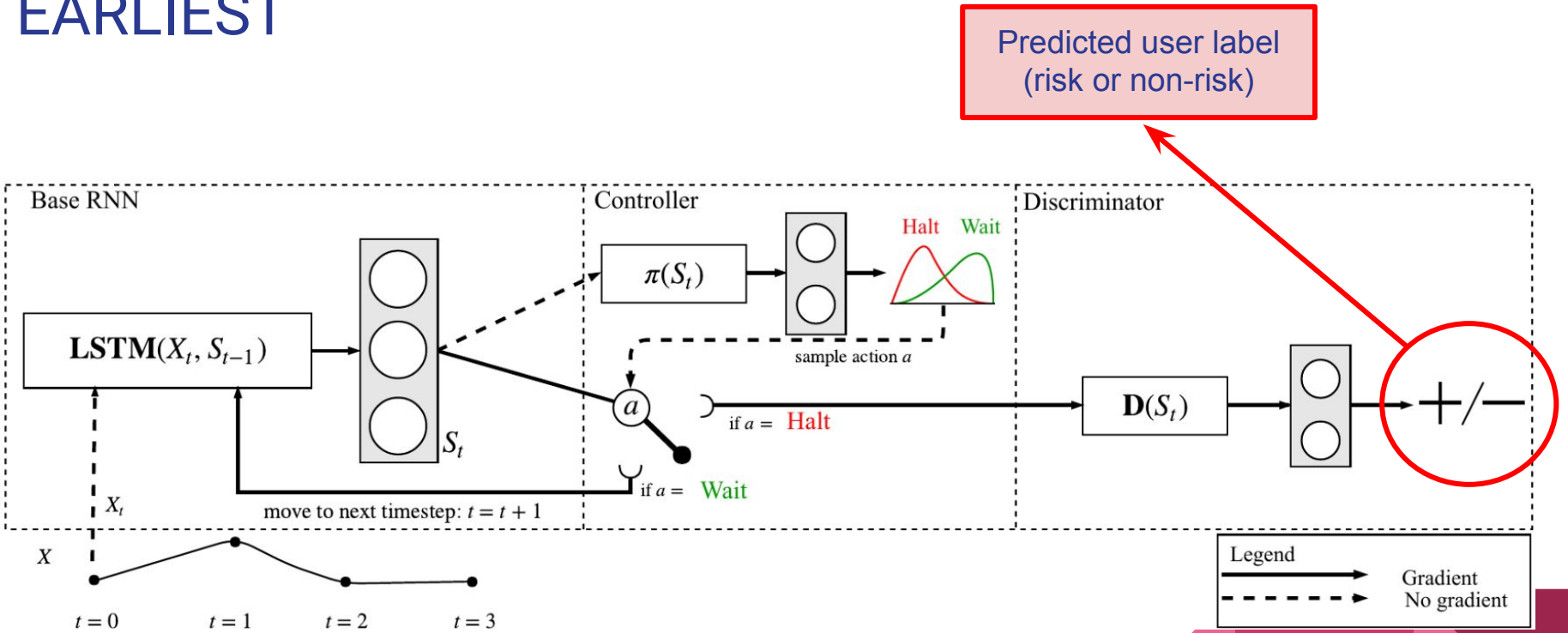
EARLIEST



Sequence of input documents for a user (doc2vec)

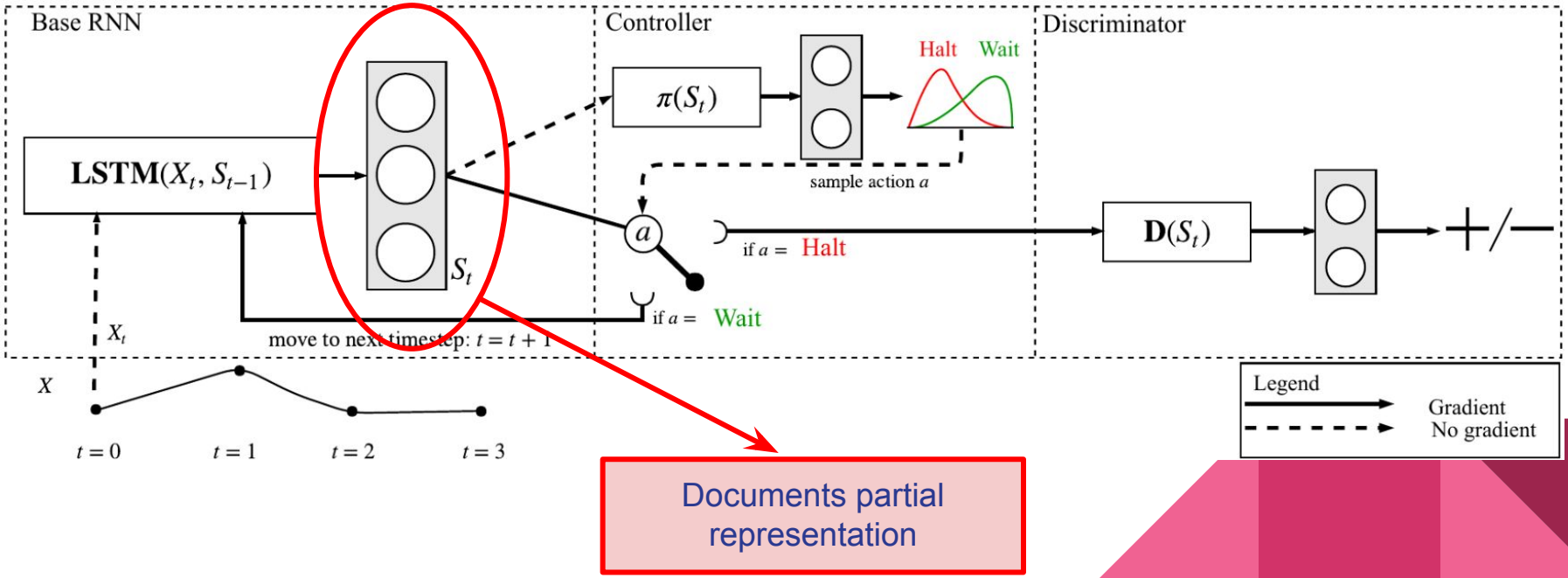
Hartvigsen et al. 2019

EARLIEST



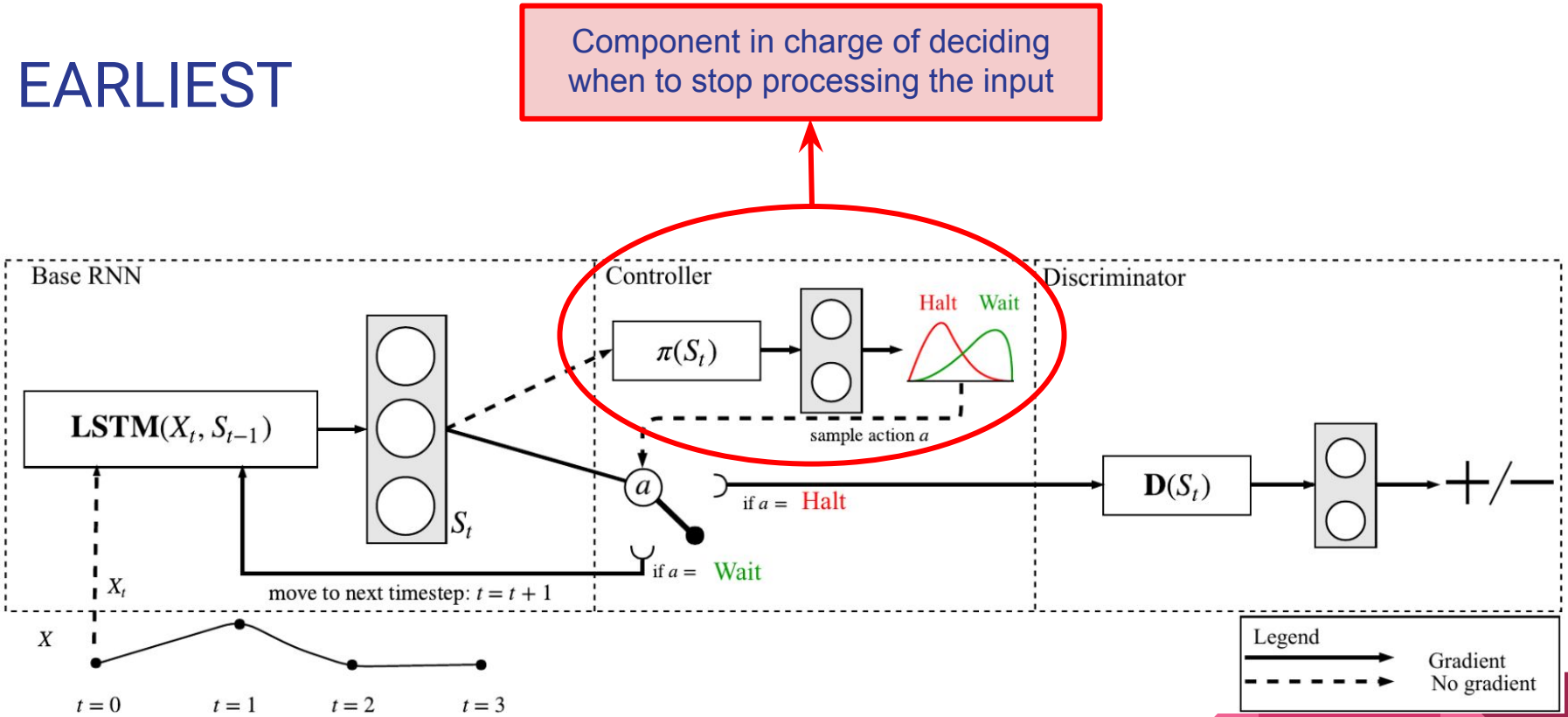
Hartvigsen et al. 2019

EARLIEST



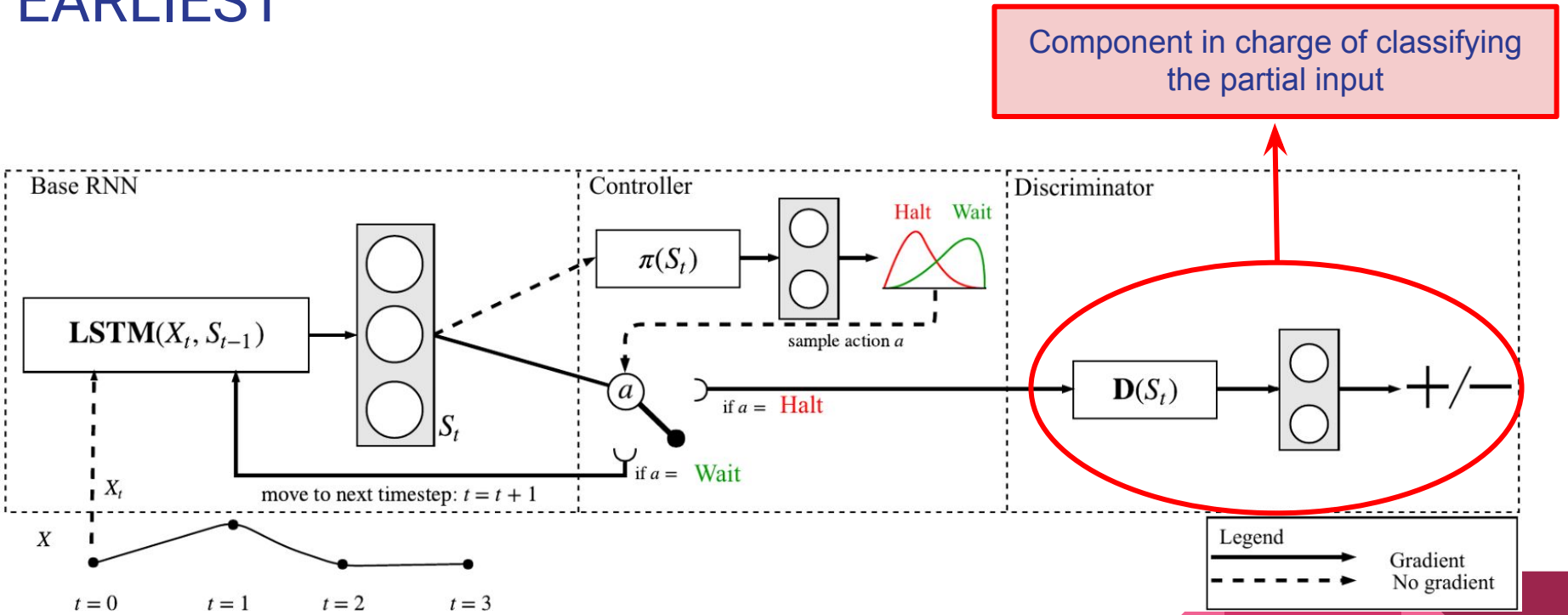
Hartvigsen et al. 2019

EARLIEST



Hartvigsen et al. 2019

EARLIEST



Hartvigsen et al. 2019

EARLIEST

The hyper-parameter λ penalizes the delay in the classification while training.

Runs and Results

Task 1: Early Detection of Pathological Gambling

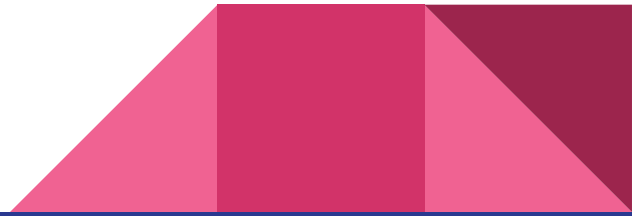
Task 2: Early Detection of Self-Harm

T1 - Early Detection of Pathological Gambling - Runs

- UNSL#0 (EarlyModel):
  - Representation ⟶ bag of words (unigrams of words with tf-idf)
  - Model ⟶ logistic regression
  - Decision policy ⟶ threshold = 0.7 and minimum number of post = 10
- UNSL#1 (EarlyModel):
  - Representation ⟶ doc2vec
  - Model ⟶ logistic regression
  - Decision policy ⟶ threshold = 0.85 and minimum number of post = 3
- UNSL#2 (EarlyModel):
  - Representation ⟶ bag of words (4-grams of characters with tf-idf)
  - Model ⟶ SVM
  - Decision policy ⟶ threshold = 0.75 and minimum number of post = 10

T1 - Early Detection of Pathological Gambling - Runs

- UNSL#3 (EARLIEST):
  - Representation ⟶ doc2vec
  - Model ⟶ LSTM
  - Decision policy ⟶ λ = 0.000001
- UNSL#4 (EARLIEST):
  - Representation ⟶ doc2vec
  - Model ⟶ LSTM
  - Decision policy ⟶ λ = 0.00001



T1 - Early Detection of Pathological Gambling - Results

team name	run id	P	R	$F1$	$ERDE_5$	$ERDE_{50}$	$latency_{TP}$	$speed$	$latency\text{-}weighted\ F1$
UNSL (EarlyModel)	0	.326	.957	.487	.079	.023	11	.961	.468
UNSL (EarlyModel)	1	.137	.982	.241	.060	.035	4	.988	.238
UNSL (EarlyModel)	2	**.586**	.939	**.721**	.073	**.020**	11	.961	**.693**
UNSL (EARLIEST)	3	.084	.963	.155	.066	.060	1	**1**	.155
UNSL (EARLIEST)	4	.086	.933	.157	.067	.060	1	**1**	.157
RELAI	0	.138	.988	.243	**.048**	.036	1	**1**	.243
BLUE	1	.157	.988	.271	.054	.036	2	.996	.270
UPV-Symanto	0	.042	.415	.077	.088	.087	1	**1**	.077
CeDRI	0	.076	**1**	.142	.079	.060	2	.996	.141
EFE	2	.233	.750	.356	.082	.033	11	.961	.342

Table 2. Decision-based evaluation

T1 - Early Detection of Pathological Gambling - Results

team name	run id	P	R	$F1$	$ERDE_5$	$ERDE_{50}$	$latency_{TP}$	$speed$	$latency\text{-}weighted\ F1$
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EFE	2	.233	.750	.356	.082	.033	11	.961	.342

Table 2. Decision-based evaluation

T2 - Early Detection of Self-Harm - Runs

- UNSL#0 (EarlyModel):
  - Representation ⟶ doc2vec
  - Model ⟶ MLP
  - Decision policy ⟶ threshold = 0.7 and minimum number of post = 10
- UNSL#1 (EARLIEST):
  - Representation ⟶ doc2vec
  - Model ⟶ LSTM
  - Decision policy ⟶ λ = 0.000001
- UNSL#2 (EARLIEST):
  - Representation ⟶ doc2vec
  - Model ⟶ LSTM
  - Decision policy ⟶ λ = 0.00001

T2 - Early Detection of Self-Harm - Runs

- UNSL#3 (SS3):
  - Representation → raw text
  - Model → SS3
  - Decision policy → γ = 2
- UNSL#4 (SS3):
  - Representation → raw text
  - Model → SS3
  - Decision policy → γ = 2.5

T2 - Early Detection of Self-Harm - Results

team name	run id	P	R	$F1$	$ERDE_5$	$ERDE_{50}$	$latency_{TP}$	$speed$	$latency\text{-}weighted\ F1$
UNSL (EarlyModel)	0	.336	.914	.491	.125	**.034**	11	.961	.472
UNSL (EARLIEST)	1	.11	.987	.198	.093	.092	**1**	**1.0**	.198
UNSL (EARLIEST)	2	.129	.934	.226	.098	.085	**1**	**1.0**	.226
UNSL (SS3)	3	.464	.803	.588	.064	.038	3	.992	.583
UNSL (SS3)	4	.532	.763	**.627**	.064	.038	3	.992	**.622**
NLP-UNED	4	.453	.816	.582	.088	.04	9	.969	.564
Birmingham	0	.584	.526	.554	.068	.054	2	.996	.551
Birmingham	2	**.757**	.349	.477	.085	.07	4	.988	.472
EFE	2	.366	.796	.501	.12	.043	12	.957	.48
BLUE	2	.454	.849	.592	.079	.037	7	.977	.578
UPV-Symanto	1	.276	.638	.385	**.059**	.056	1	1.0	.385

Table 5. Decision-based evaluation

T2 - Early Detection of Self-Harm - Results

team name	run id	P	R	$F1$	$ERDE_5$	$ERDE_{50}$	$latency_{TP}$	$speed$	$latency\text{-}weighted\ F1$
UNSL (EarlyModel)	0	.336	.914	.491	.125	**.034**	11	.961	.472
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Table 5. Decision-based evaluation

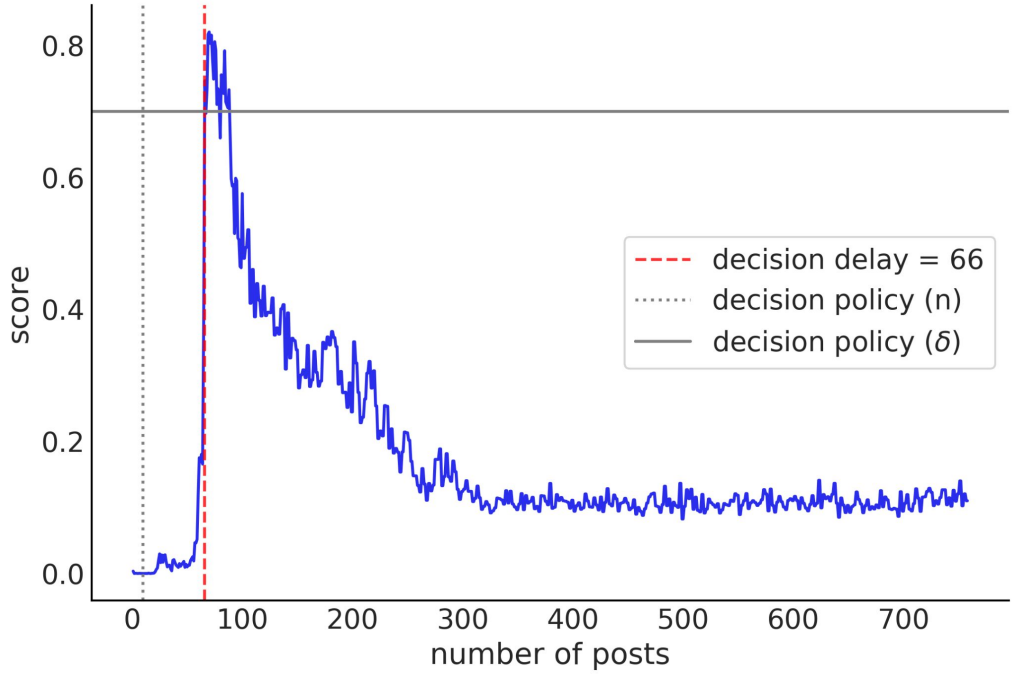
Thank you for your attention.
Any questions?

jmloyola@unsl.edu.ar

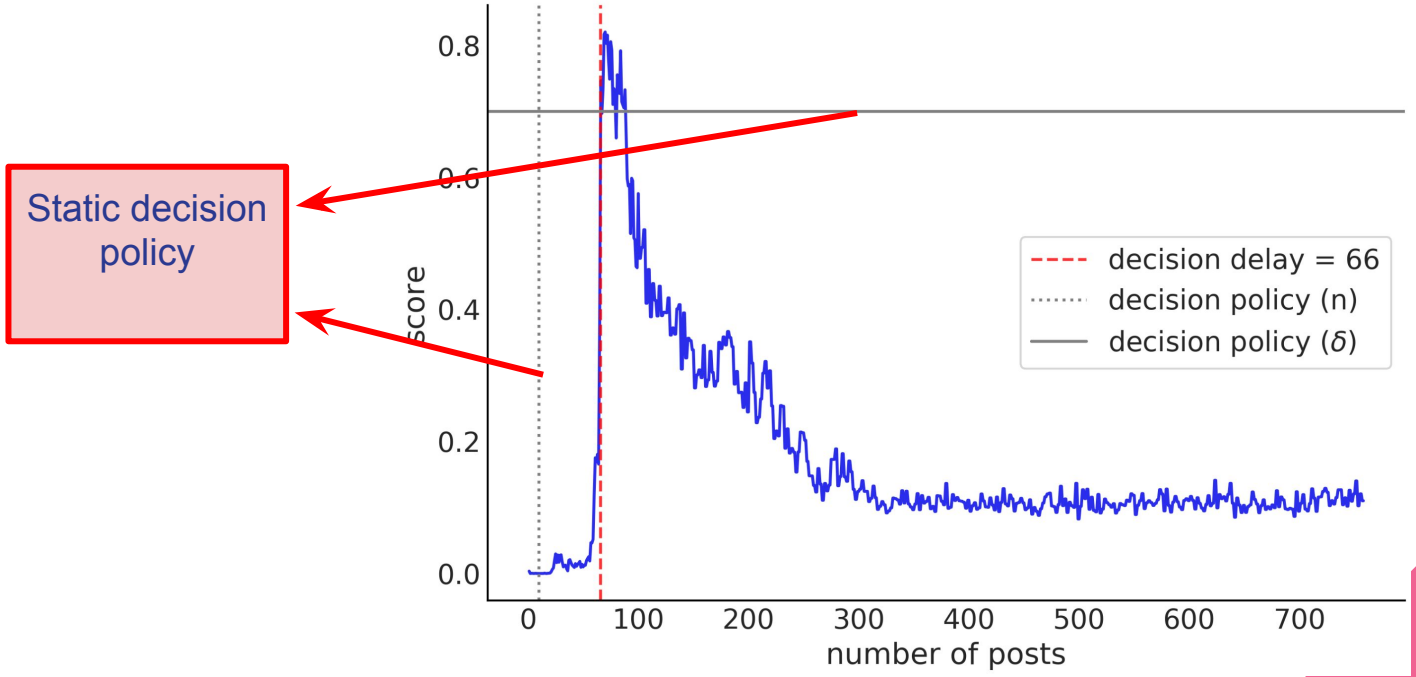
References

- Loyola, J. M., Errecalde, M. L., Escalante, H. J., & y Gomez, M. M. (2017, October). Learning when to classify for early text classification. In Argentine Congress of Computer Science (pp. 24-34). Springer, Cham.
- Burdisso, S. G., Errecalde, M., & Montes-y-Gómez, M. (2019). A text classification framework for simple and effective early depression detection over social media streams. Expert Systems with Applications, 133, 182-197.
- Hartvigsen, T., Sen, C., Kong, X., & Rundensteiner, E. (2019, July). Adaptive-halting policy network for early classification. In Proceedings of the 25th ACM SIGKDD International Conference on Knowledge Discovery & Data Mining (pp. 101-110).

Score and decision policy visualization (EarlyModel)

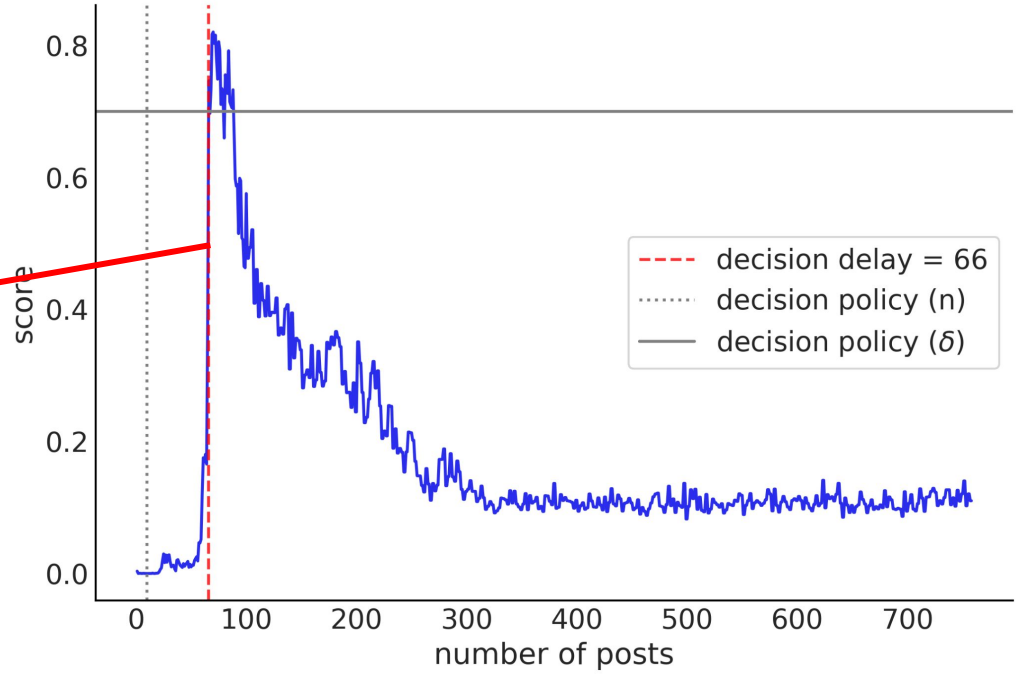


Score and decision policy visualization (EarlyModel)

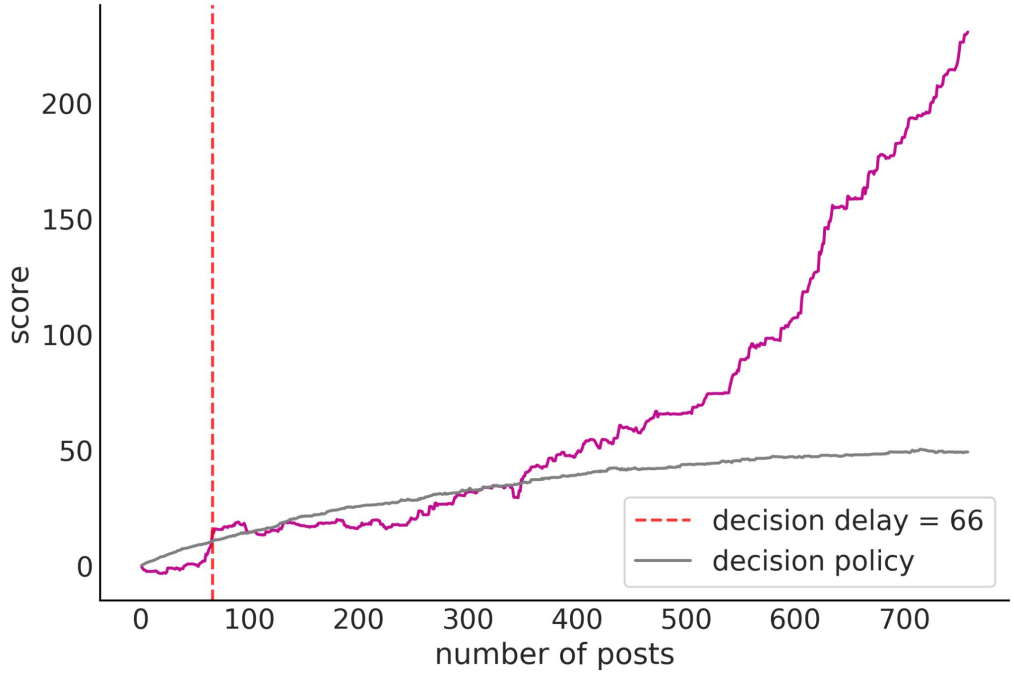


Score and decision policy visualization (EarlyModel)

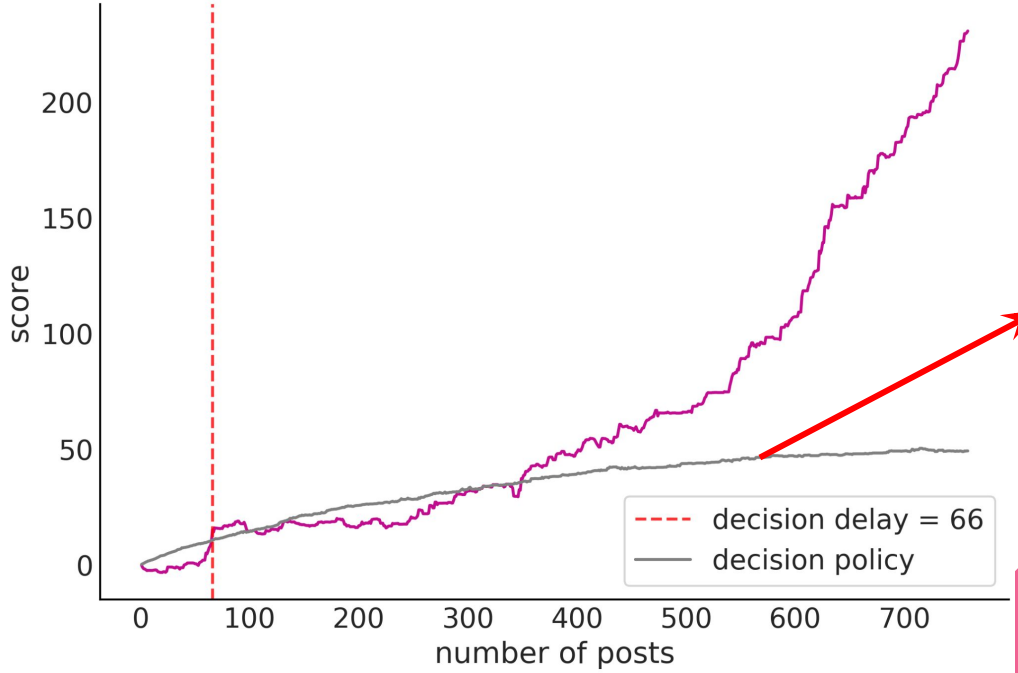
Time when an alarm is issued



Score and decision policy visualization (SS3)



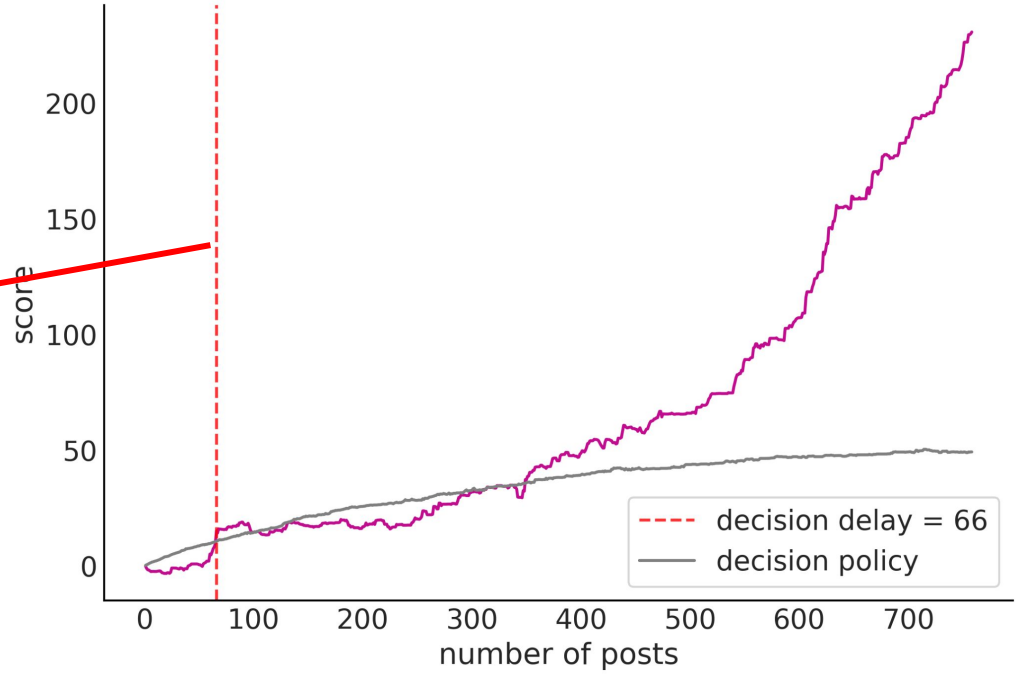
Score and decision policy visualization (SS3)



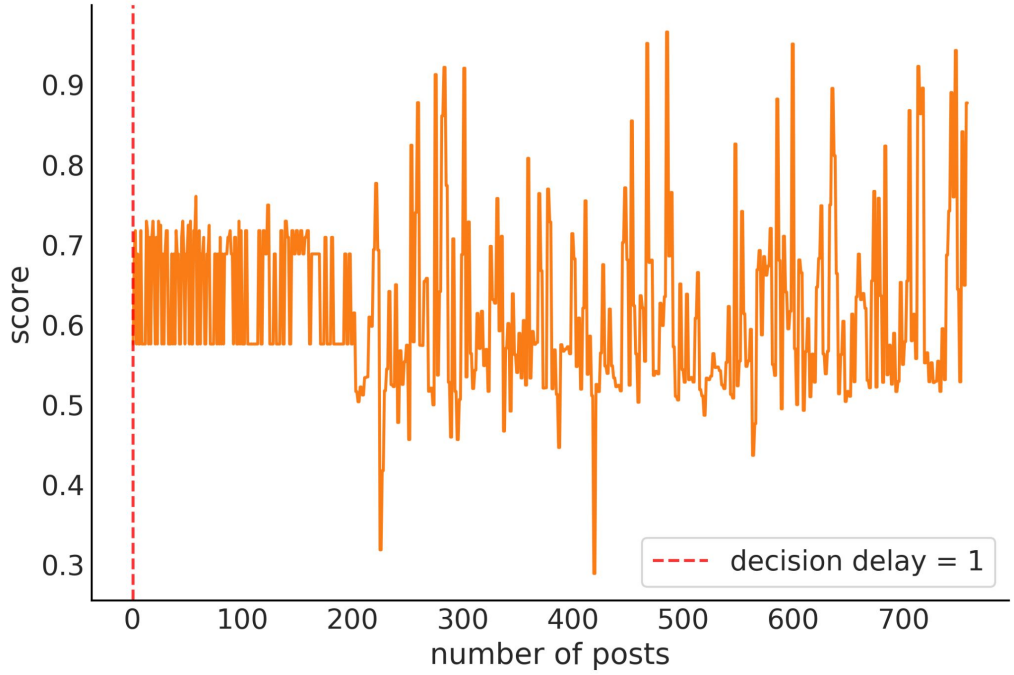
Dynamic decision policy (depends on the scores of all users)

Score and decision policy visualization (SS3)

Time when an alarm is issued

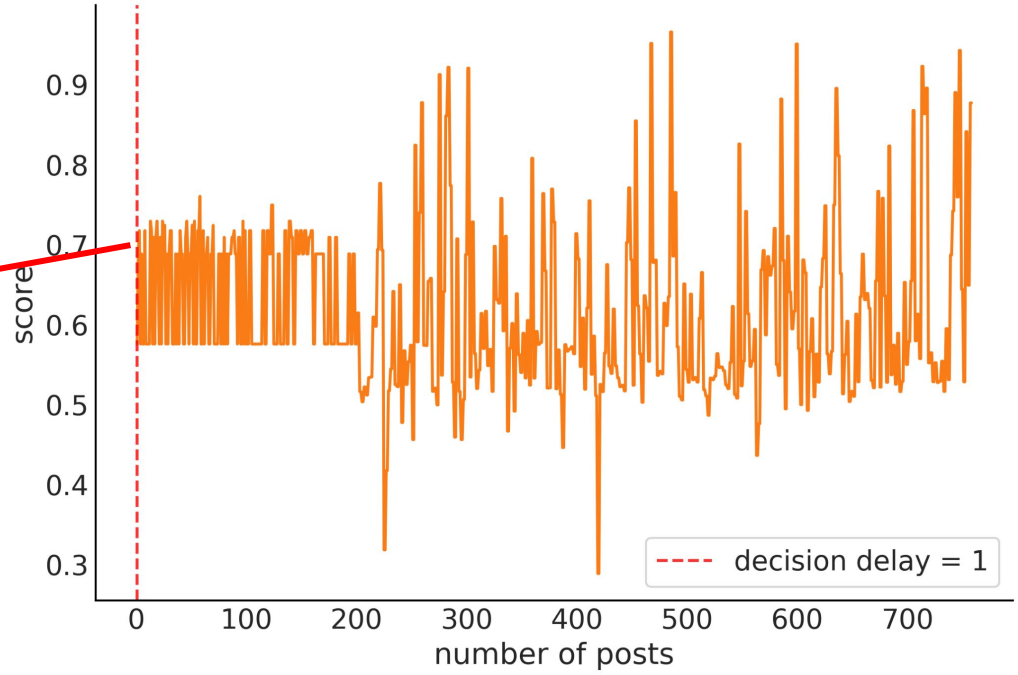


Score and decision policy visualization (EARLIEST)



Score and decision policy visualization (EARLIEST)

Time when an alarm is issued



Corpus generation procedure

- Based on posts and comments from Reddit (https://www.reddit.com/).
- Positive cases were obtained from particular subreddits
  - T1: https://www.reddit.com/r/problemgambling/
  - T2: https://www.reddit.com/r/selfharm/
- Negative cases were obtained from general subreddits: sports, jokes, gaming, politics, news, y LifeProTips.
- All users with less than 31 posts or comments, or with an average number of words per post less than 15, were discarded.

T1 - eRisk corpus

- Based on posts and comments from Reddit (https://www.reddit.com/).
- No corpus was supplied for training.

Corpus	#users			#posts	#posts per user			#words per post		
	Total	Pos	Neg		Med	Min	Max	Med	Min	Max
T1_test	2,348	164	2184	1,130,792	244	10	2,001	12	0	10,175
T1_train	726	176	550	71,187	54	31	740	20	1	4,516
T1_valid	726	176	550	74,507	55	31	1,234	19	1	7,479

T2 - eRisk corpus

- Based on posts and comments from Reddit (https://www.reddit.com/).
- A training and validation corpus were provided.

Corpus	#users			#posts	#posts per user			#words per post		
	Total	Pos	Neg		Med	Min	Max	Med	Min	Max
T2_test	1,448	152	1296	746,098	275.5	10	1,999	12	0	18,064
T2_train	340	41	299	170,698	282.0	8	1,992	10	1	6,700
T2_valid	423	104	319	103,837	95.0	9	1,990	7	1	2,663
redd_train	1,051	494	557	118,452	61.0	31	1,466	18	1	5,971
redd_valid	1,051	494	557	119,651	59.0	31	1,781	18	1	4,382
comb_train	1,391	535	856	289,150	73.0	8	1,992	13	1	6,700
comb_valid	1,474	598	876	223,488	63.0	9	1,990	11	1	4,382
ilab_train	26,256	10319	15937	259,297	5.0	1	1,825	19	1	11,933

Pre-processing of the input

1. Convert text to lower case.
2. Convert HTML and Unicode codes into their respective symbols.
3. Replace links to the web with a token.
4. Replace internal reddit links with the name of the subreddit they lead to.
5. Delete any character that is not a number or letter.
6. Replace numbers with a token.
7. Delete new lines, tab, and multiple consecutive white spaces.

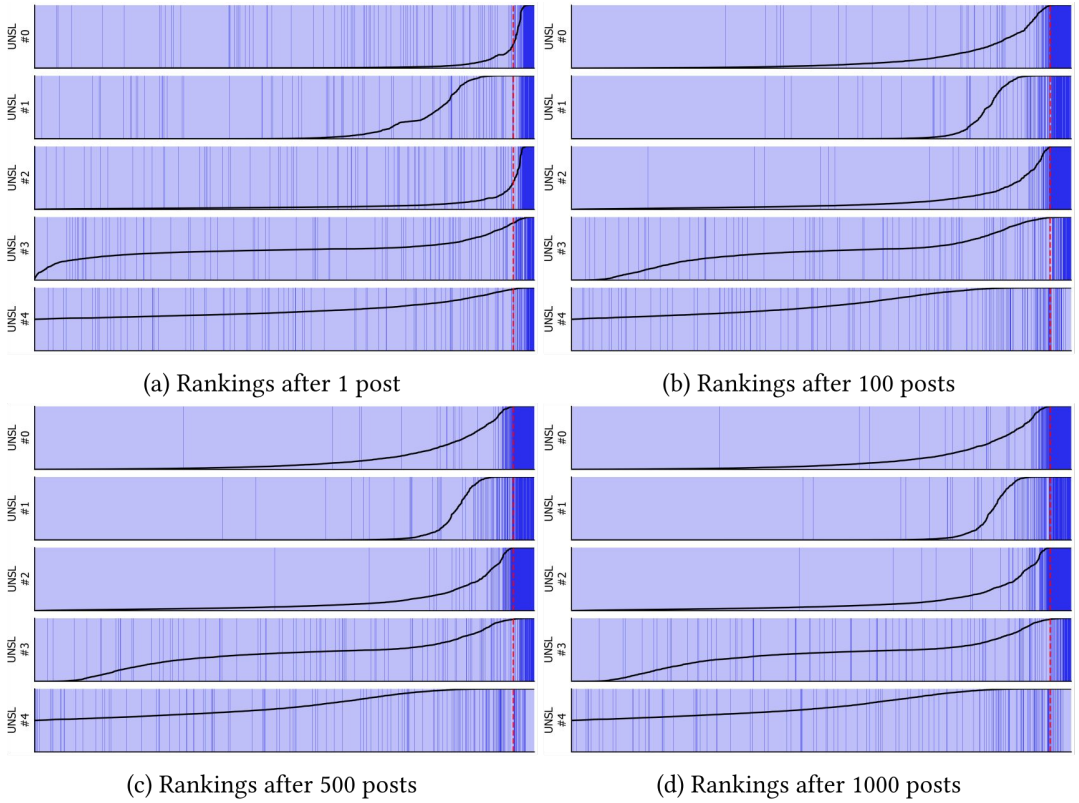
T1 - Overlap between competition corpus and the corpus generated

	# users	# users with >25% overlap	# users with >50% overlap	# users with >75% overlap
positives	164	24	10	2
negatives	2184	2	0	0

T2 - Overlap between competition corpus and the corpus generated

	# users	# users with >25% overlap	# users with >50% overlap	# users with >75% overlap
positives	152	6	3	0
negatives	1296	0	0	0

T1 - Separation plot



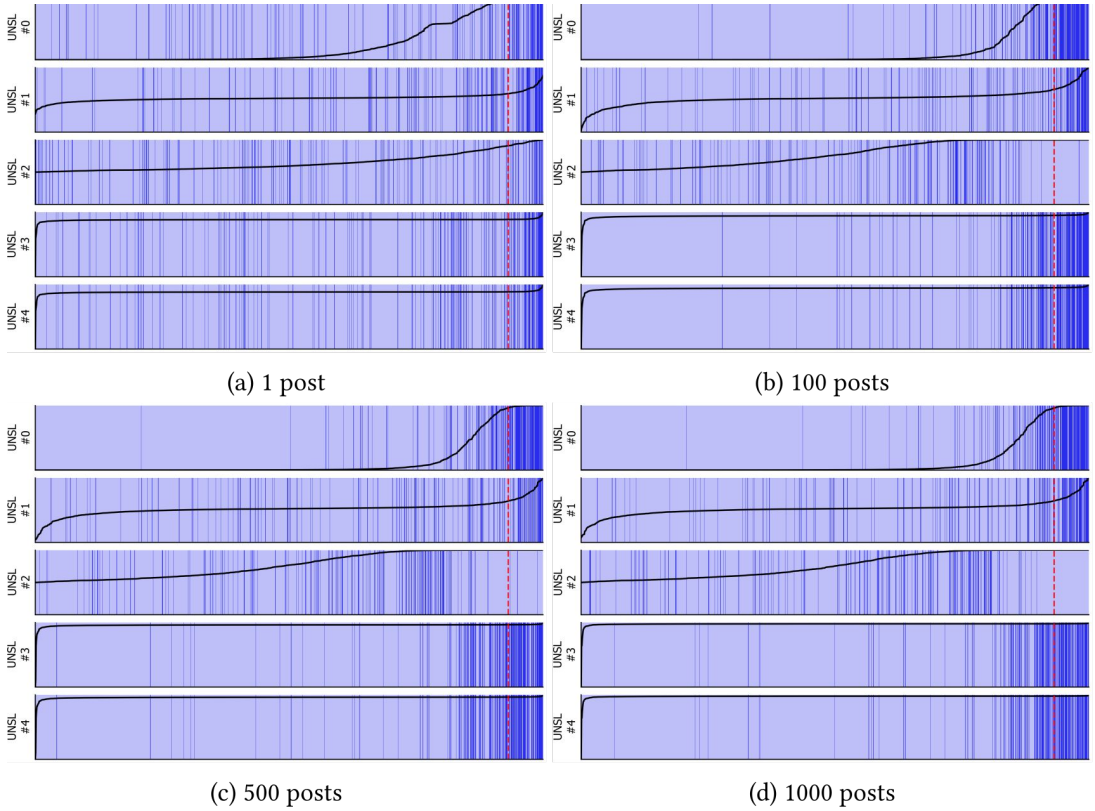
(a) Rankings after 1 post

(b) Rankings after 100 posts

(c) Rankings after 500 posts

(d) Rankings after 1000 posts

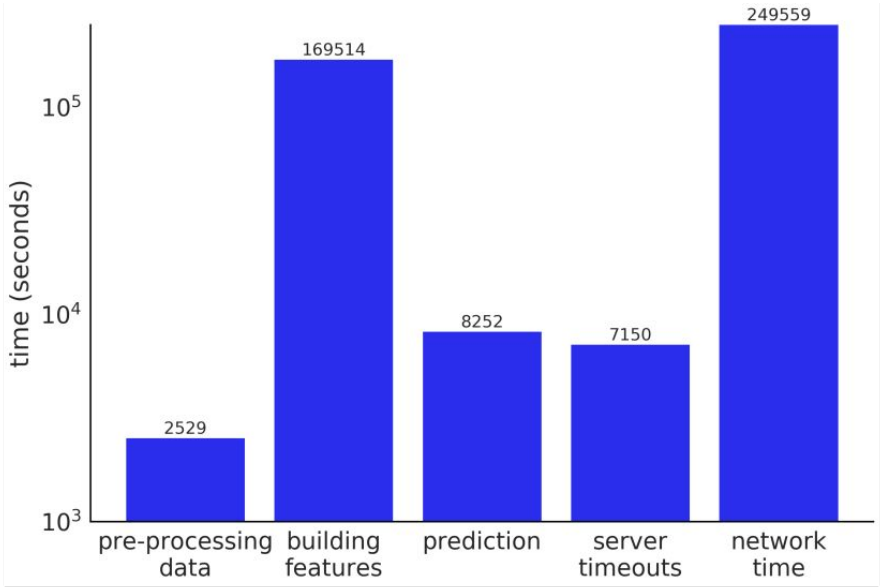
T2 - Separation plot



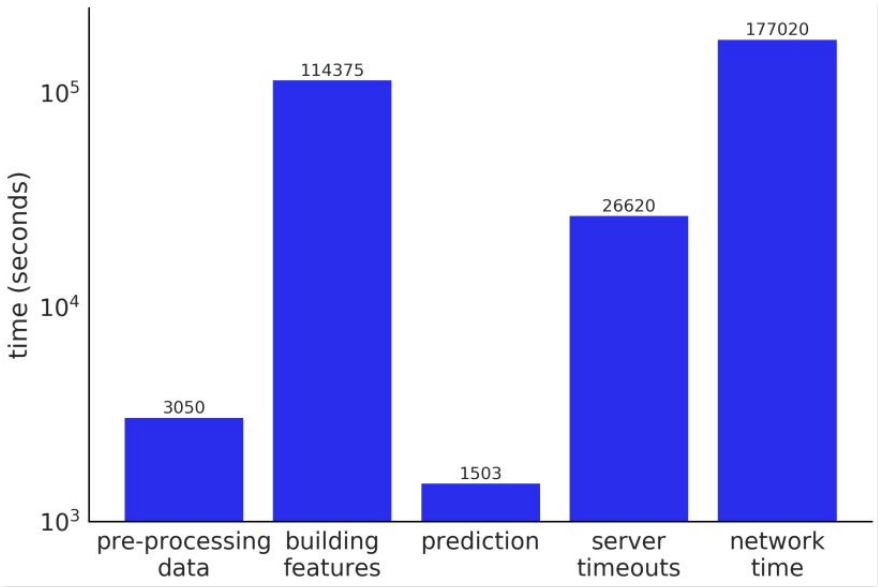
(a) 1 post (b) 100 posts

(c) 500 posts (d) 1000 posts

Elapsed time

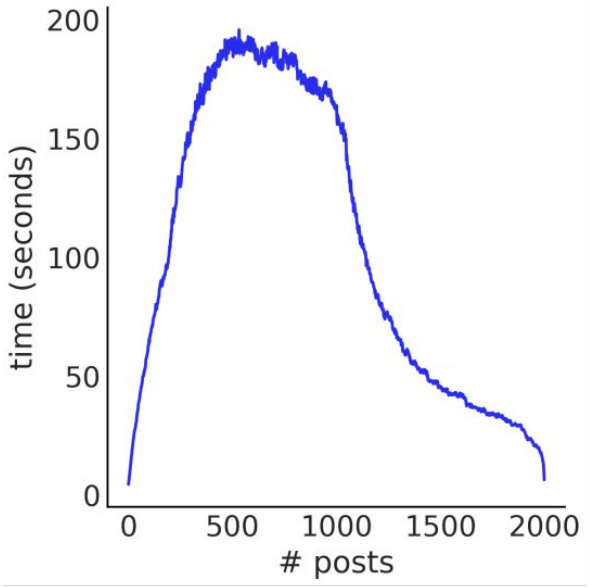


(a) Task T1

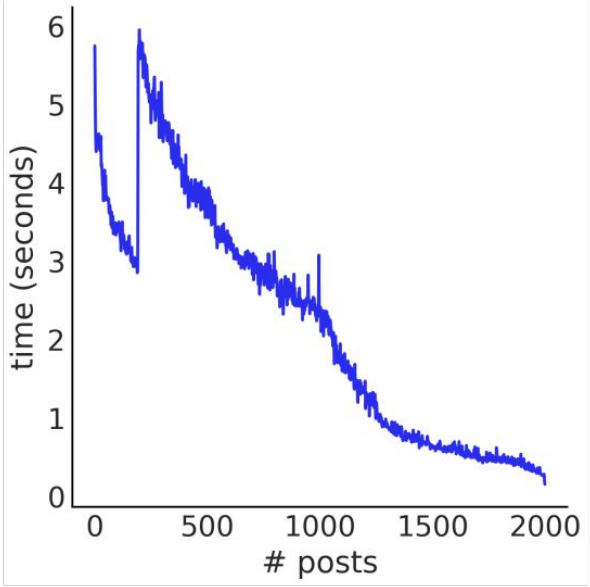


(b) Task T2

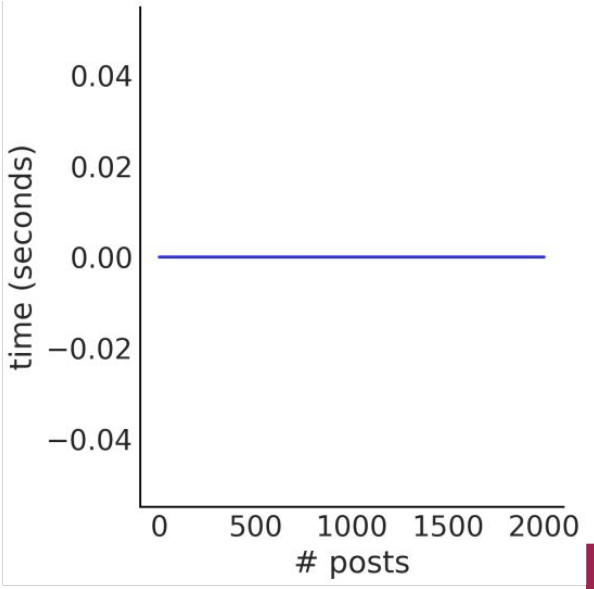
Time spent during the feature building stage



(a) EarlyModel



(b) EARLIEST



(c) SS3