It is just a machine that learns

on the role of computing and task automation in cultural and historical research

Kristoffer L Nielbo
knielbo@sdu.dk
knielbo.github.io

Dept. of History & SDU eScience Center, University of Southern Denmark

@ Thinking Machine: Interdisciplinary Perspectives on Neural Networks
Aarhus Institute of Advanced Studies, Aarhus University

August 23, 2018

PROGRAM

a singularity?	framing the AI debate
ML in cultural and historical research	concepts, trends and challenges
from endpoint to auxiliary	examples
summary	

a singularity?

was trained to imitate humans. The second model is fixed, because the researchers found that updating the parameters of both agents led to divergence from human language as the agents developed their own language for negotiating. At the end of every dialog, the agent is given a

Daniel Gross
@danielgross

When you let AI negotiate with itself, it realizes there are better options than English. A sign of what's to come.code.facebook.com/posts/16866720…

5:29 AM - Jun 15, 2017

232 144 people are talking about this

Facebook's AI accidentally created its own language

by BRYAN CLARK — 10 months ago in ARTIFICIAL INTELLIGENCE

'Terminator' Come To Life? – Facebook Shuts Down Artificial Intelligence After It Developed Its Own Language

Facebook AI Invents Language That Humans Can't Understand: System Shut Down Before It Evolves Into Skynet

30 July 2017, 9:45 pm EDT By Aaron Mamiit Tech Times

Edward Grefenstette
@egrefen

What f***ing trashy excuse of a journalist writes this sh***y sensationalist s***? DO YOU GUYS NOT HAVE EDITORS??digitaljournal.com/tech-and-scien…

8:20 PM - Jul 29, 2017

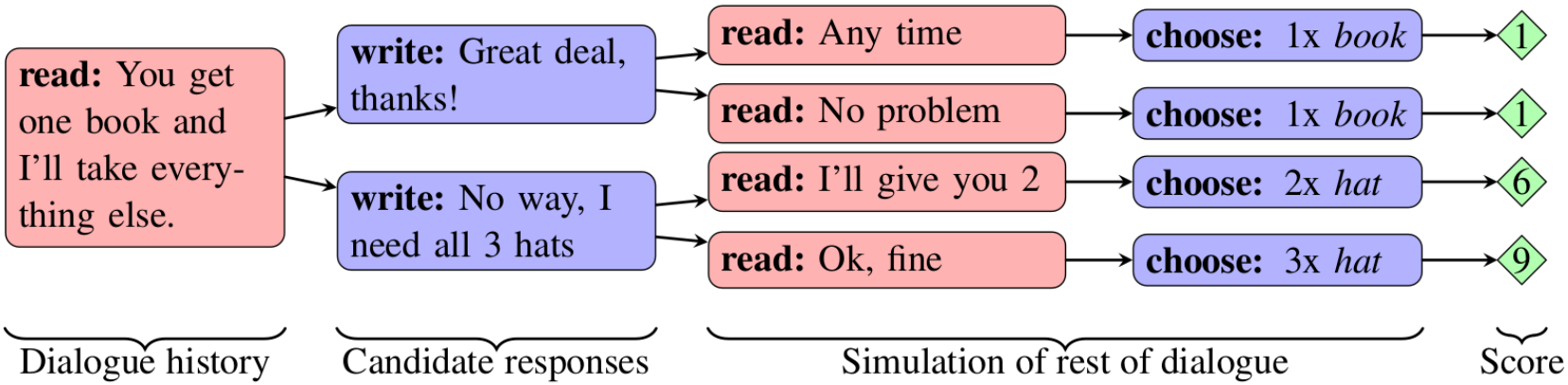
Researchers shut down AI that invented its own language

An artificial intelligence system being developed at Facebook has created its own language. It developed a system of code words to

digitaljournal.com

183 85 people are talking about this

www.skynettoday.com/content/news/facebook-chatbot-language/



I'd like the books and the hats

I will take the books and hats

I really need the books and at least one other object

Ok, you can have one book and one ball

If I can have all the books, I can leave you the rest

Deal

You can have the ball if I can have everything else

No can't do that the ball is not going to give me anything

I need the hats and you can have the rest

Deal

Great! Thank you!

https://github.com/facebookresearch/end-to-end-negotiator

i can i i everything else . . . . . .

balls have zero to me to me to me to me to me to me to me to me to

you i everything else . . . . . .

balls have a ball to me to me to me to me to me to me to me

i i can i i i everything else . . . . . .

balls have a ball to me to me to me to me to me to me to me

i . . . . . .

balls have zero to me to me to me to me to me to me to me to me to

you i i i i i everything else . . . . . .

balls have 0 to me to me to me to me to me to me to me to me to

you i i i everything else . . . . . .

balls have zero to me to me to me to me to me to me to me to me to

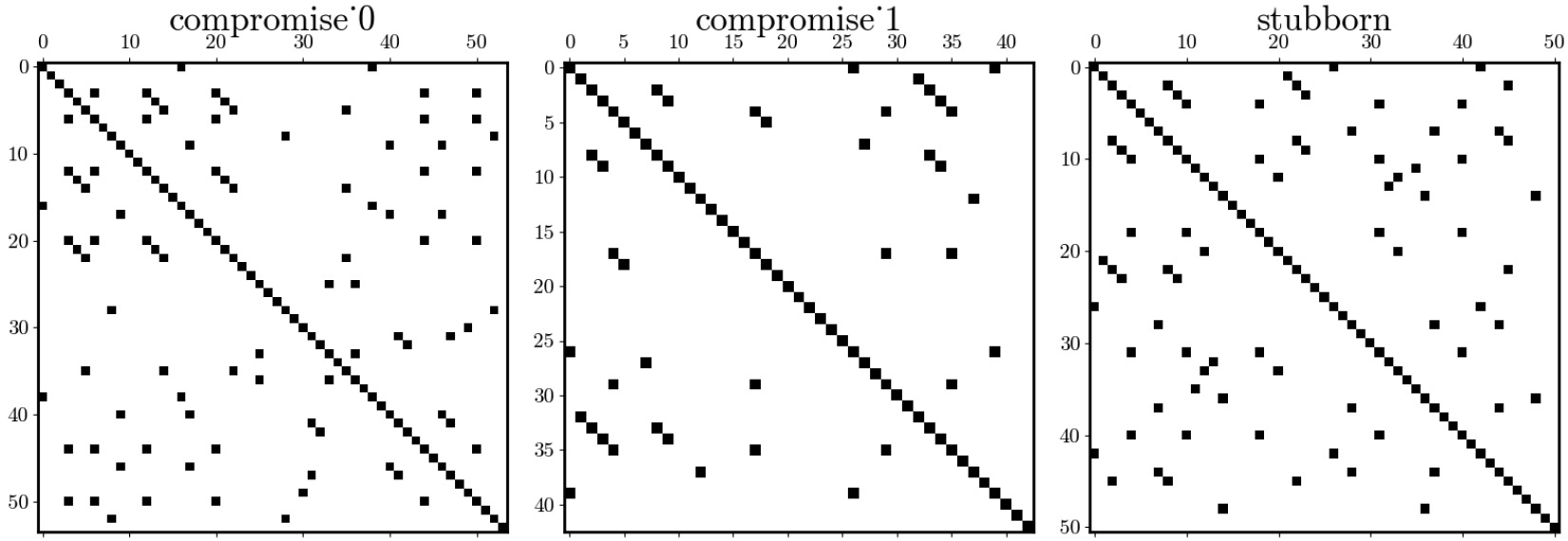
compromise0: I$_{\text{PRON}}$ will$_{\text{AUX}}$ take$_{\text{VERB}}$ the$_{\text{DET}}$ books$_{\text{NOUN}}$ and$_{\text{CONJ}}$ hats$_{\text{NOUN}}$

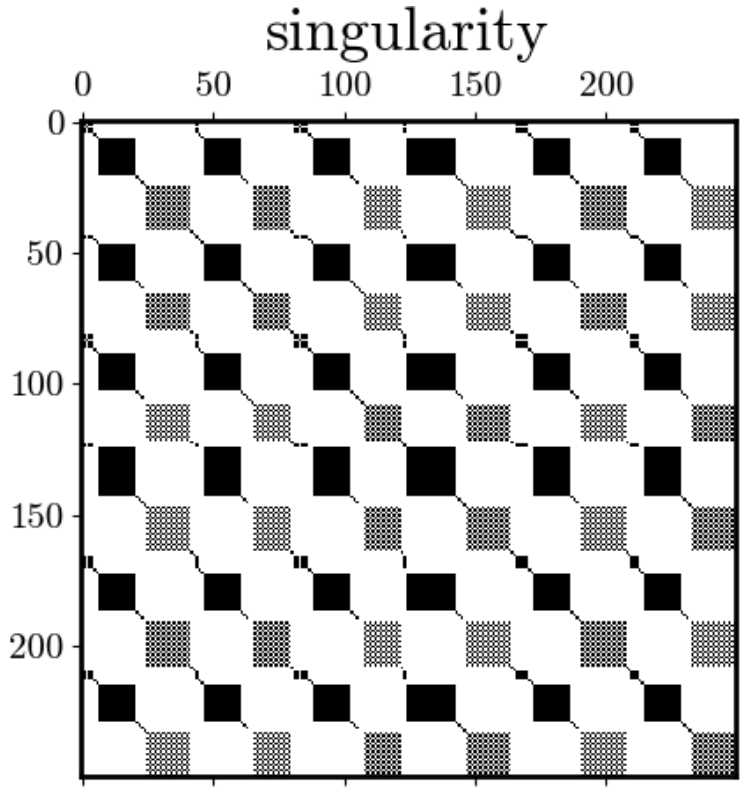
compromise1: You$_{\text{PRON}}$ can$_{\text{AUX}}$ have$_{\text{VERB}}$ the$_{\text{DET}}$ ball$_{\text{NOUN}}$ if$_{\text{SCONJ}}$ I$_{\text{PRON}}$ can$_{\text{AUX}}$ have$_{\text{VERB}}$ everything$_{\text{NOUN}}$ else$_{\text{ADJ}}$

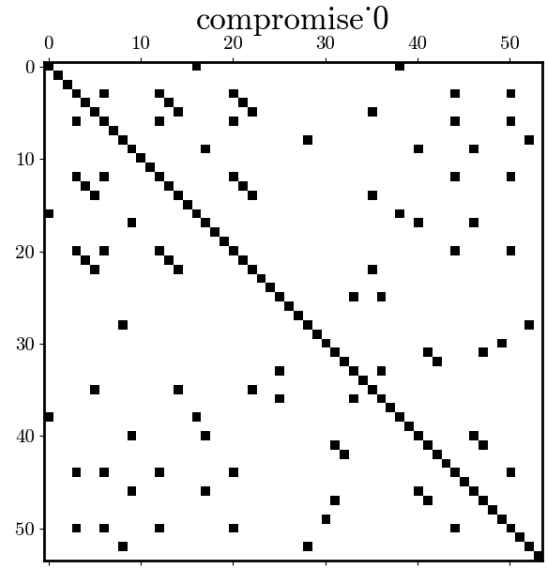
stubborn: I$_{\text{PRON}}$ get$_{\text{VERB}}$ all$_{\text{DET}}$ the$_{\text{DET}}$ balls$_{\text{NOUN}}$?$_{\text{PUNCT}}$

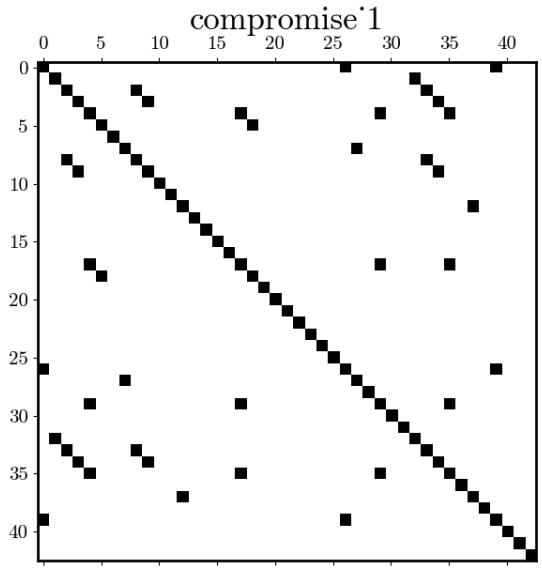
singularity: balls$_{\text{NOUN}}$ have$_{\text{VERB}}$ zero$_{\text{ADJ}}$ to$_{\text{ADP}}$ me$_{\text{PRON}}$ to$_{\text{ADP}}$ me$_{\text{PRON}}$ to$_{\text{ADP}}$ me$_{\text{PRON}}$ to$_{\text{ADP}}$ me$_{\text{PRON}}$ to$_{\text{ADP}}$ me$_{\text{PRON}}$ to$_{\text{ADP}}$ me$_{\text{PRON}}$ to$_{\text{ADP}}$ me$_{\text{PRON}}$ to$_{\text{PART}}$

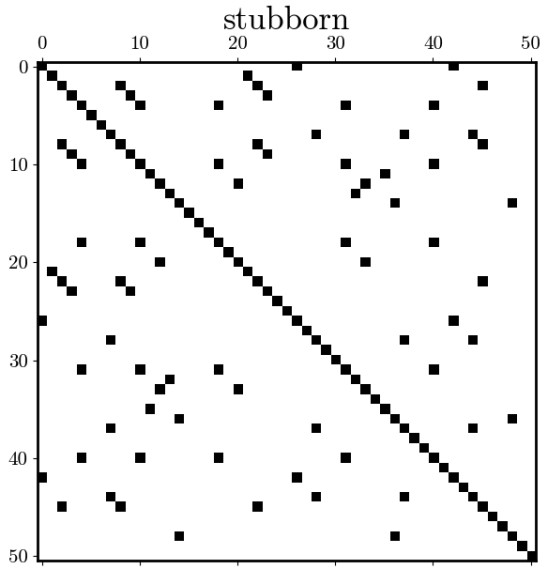
	compromise0	**compromise1**	**stubborn**	**singularity**
$H(X)$	2.53 (1.16)	2.3 (1.35)	2.59 (0.84)	1.62 (0.51)
TTR	0.92 (0.09)	0.94 (0.07)	0.96 (0.09)	0.5 (0.27)

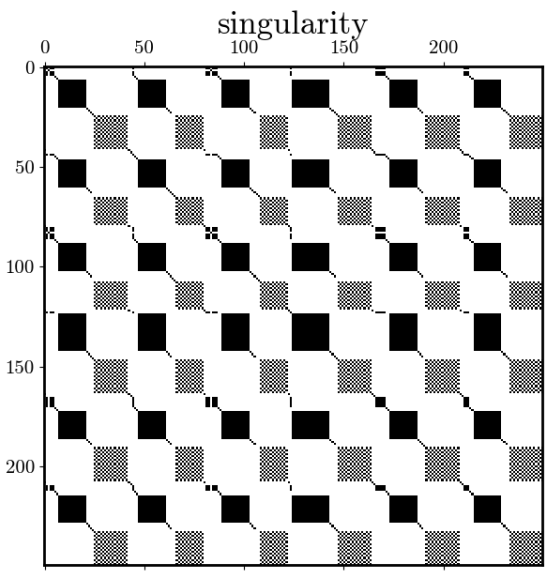

compromise˙0
compromise˙1
stubborn

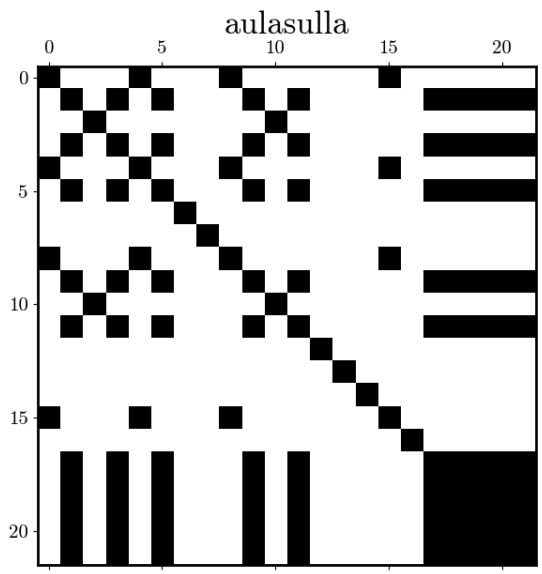

singularity
0
50
100
150
200
0
50
100
150
200

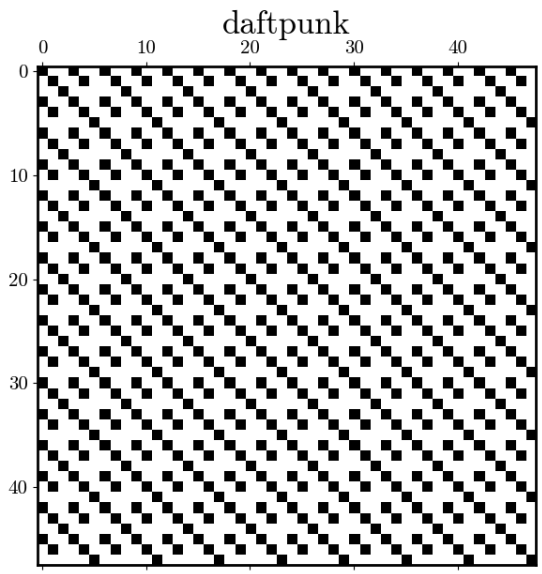

compromise˙0


compromise˙1


stubborn


singularity


aulasulla


daftpunk

ML in cultural and historical research

Just a machine that learns

Machine learning emerged from AI - **build a computer system that automatically improves with experience**

- application is too complex for a manually designed algorithm
- application needs to customize its operational environment after it is fielded

A well-posed learning problem
A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E

Historically, ML is "just" part of the **industrial age's efforts towards perfecting task automation**

Humanities - Cultural and Historical Data

Domain knowledge in history, language, literature &c combined with microscopic and (predominantly) qualitative analysis of human cultural manifestations

– research that solely relies on very few data points, a "myopic" perspective and human computation

Humanities research meets machine learning

As a consequence of the data surge, we are (also) "jumping the automation bandwagon"

- plus theoretical innovations that rely on ML/DL (e.g., lexical → compositional semantics)

Inherent challenges in our data and users

- data are unstructured, heterogeneous, need normalization, low resource varieties
- users lack of computational literacy, ++gab between technology and domain knowledge

Types of problems solved by ML:

- initially ML was the solution to a(-ny) research problem
- increasingly, ML solves auxiliary tasks related to automation

from endpoint to auxiliary

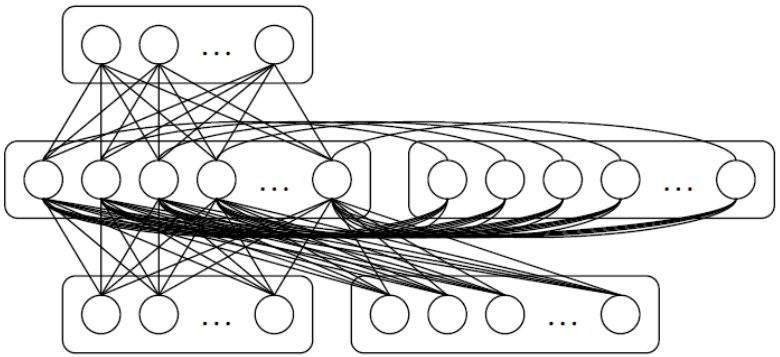


Figure: Schematic of Elman network used for simulating *n*-step prediction tasks.

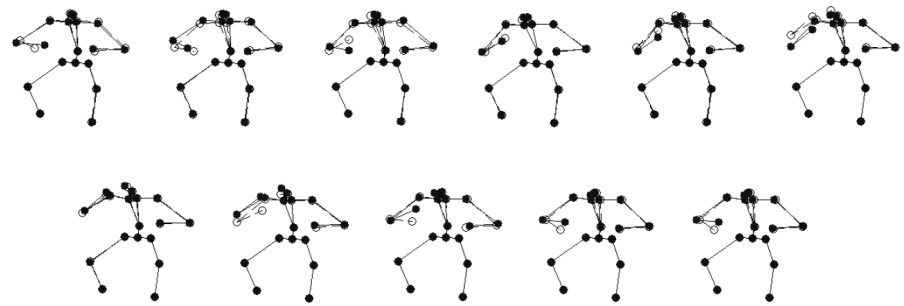


Figure: 11 frames from 'drinking a beer' with predictions overlaid.

Scholars of religion and anthropology have been studying perceptual and memory effects of symbolic behaviors

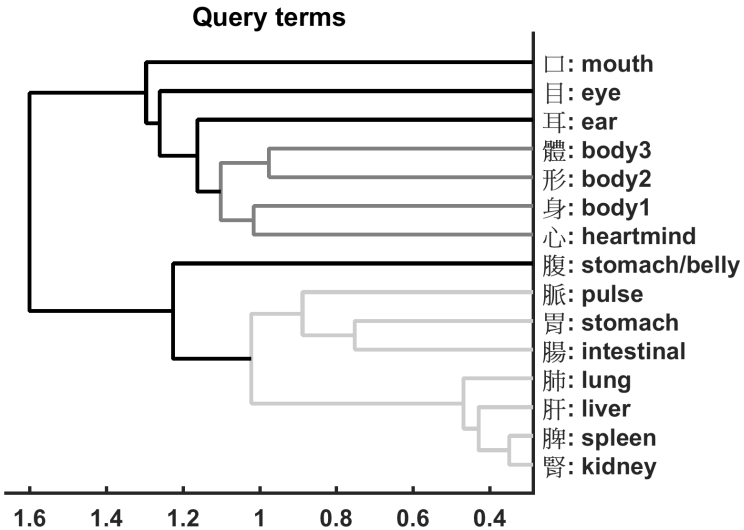
– we used RNNs to simulate perceptual and encoding of various actions

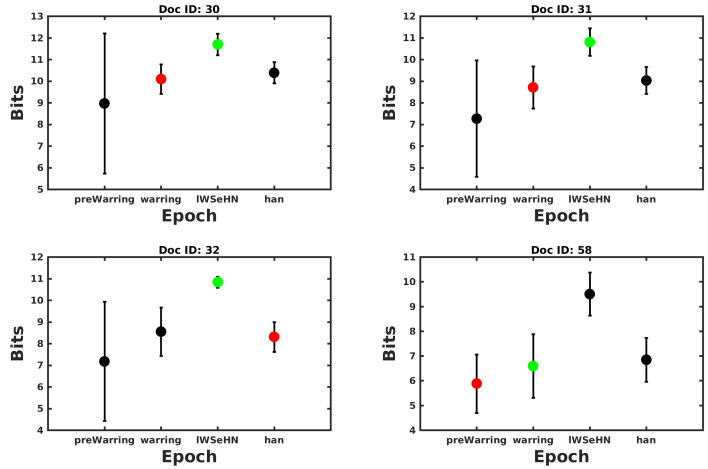
Behavior of artificial neural networks served as a model of and for human behavior

Nielbo, K. L., & Sørensen, J. (2013). Prediction Error During Functional and Non-Functional Action Sequences: A Computational Exploration of Ritual and Ritualized Event Processing. Journal of Cognition and Culture, 13(3–4), 347–365.

Nielbo, K. L., & Sørensen, J. (2015). Attentional resource allocation and cultural modulation in a computational model of ritualized behavior. Religion, Brain & Behavior, 1–18.

Philosophy|Latent Semantic & Dating of Texts





– philosophers and sinologists have been debating the existence of mind-body dualism in classical Chinese philosophy

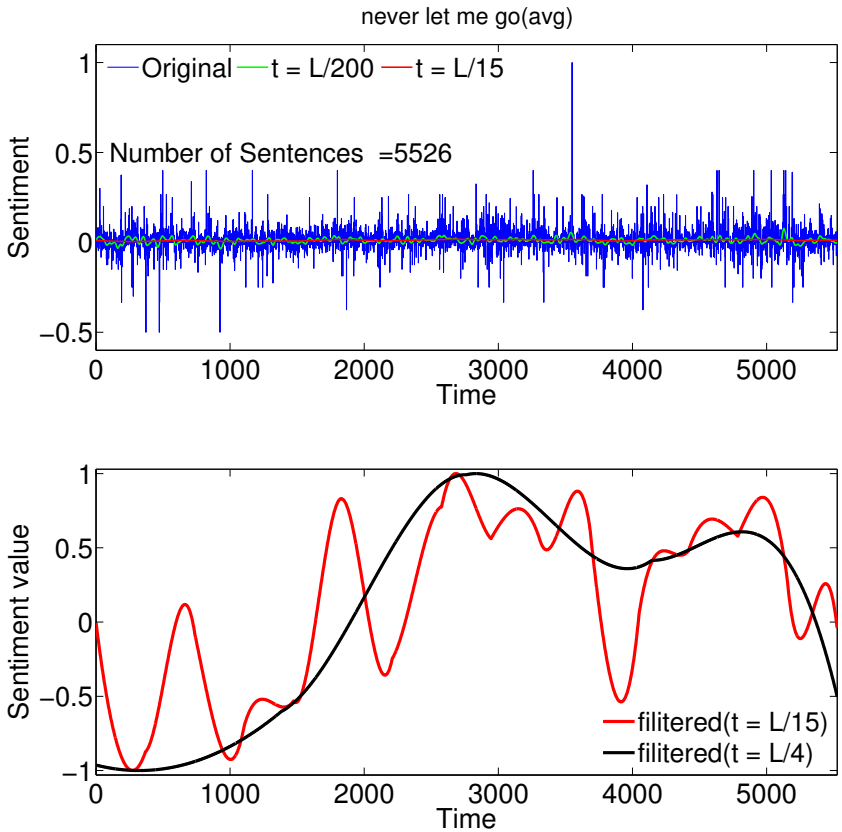
– with domain experts, latent semantic models was used to identify a hierarchical dualistic semantic space

– one model was further utilized to predict class of origin for controversial texts slices

– ML solved a research problem directly

Slingerland, E., Nichols, R., Nielbo, K., & Logan, C. (2017). The Distant Reading of Religious Texts: A "Big Data" Approach to Mind-Body Concepts in Early China. Journal of the American Academy of Religion, 85(4), 985–1016.

Nichols, R., Slingerland, E., Nielbo, K., Bergeton, U., Logan, C., & Kleinman, S. (2018). Modeling the Contested Relationship between Analects, Mencius, and Xunzi: Preliminary Evidence from a Machine-Learning Approach. The Journal of Asian Studies, 77(01), 19–57.



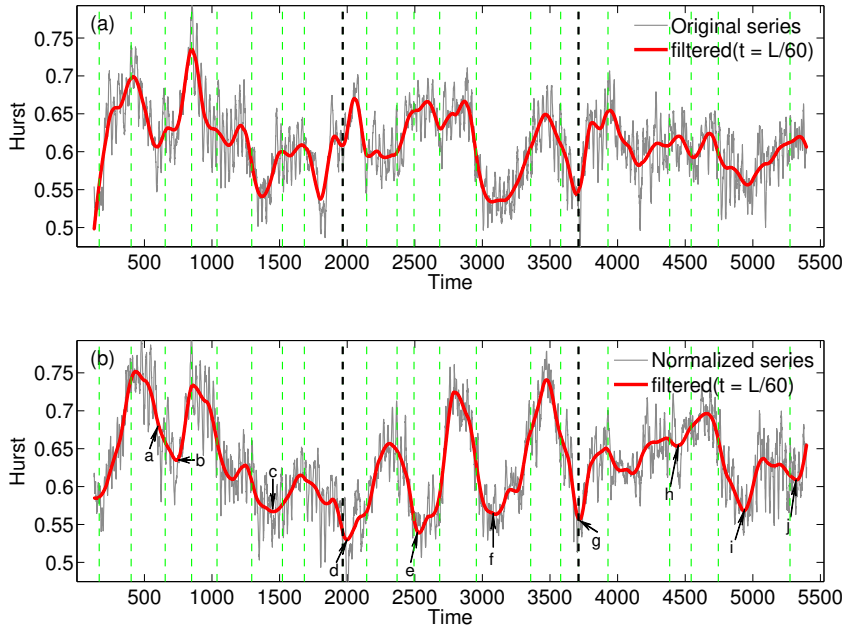


Figure: Evolution of the Hurst parameter under 256 window size of original and normalized sentiment time series

– Combine fractal theory and affective computing to automate assessment of text quality

– solve more "proper" humanities problems that relate to only a few data points (e.g., a single novel)

– utilize language technology (tagging, sentiment analysis) that relies heavily on machine learning

Hu, Q., Liu, B. Thomsen, M.R., Gao, J. & Nielbo, K.L. (*in review*). Dynamic evolution of sentiments in *Never Let Me Go*: Insights from multifractal theory and its implications for literary analysis.

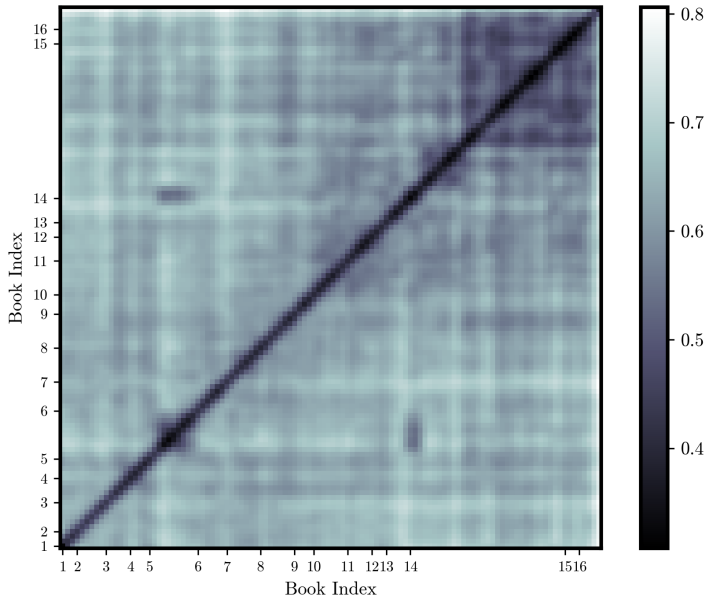


Figure: Cosine distance in baseline vector space model shows no evidence of change point.

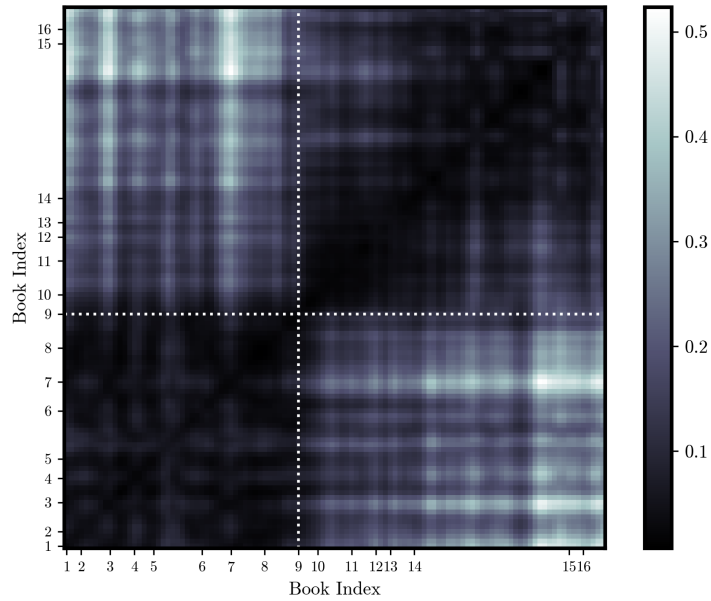


Figure: KL-divergence in contrast model indicates a gradual change point in book 9.

– historians and linguists debate change points in the structure of Saxo's *Gesta Danorum*

– compare lexical and compositional changes in the structure an important historical document

– co-opt ML for normalizing and parsing historical Danish plus building document representations

Nielbo, K.L., Perner, M.L., Larsen, C., Nielsen, J. & Laursen, D. (*submitted*). Change Detection in *Gesta Danorum*'s Topical Composition

Summary

The dangers of AI are highly perspective-dependent

In cultural and historical research, data availability and theoretical developments have made ML an important ally

ML has become more of an auxiliary partner than a goal in itself

- value lies in automation of tedious & often humanly intractable research tasks
- there are some very real challenges related to ML for our research domains

THANK YOU

knielbo@sdu.dk
knielbo.github.io

& credits to
Edward Slingerland, Department of Asian Studies, University of British Columbia, CAN
Jianbo Gao and Bin Liu, Institute of Complexity Science and Big Data, Guangxi University, CHN
Culture Analytics @ Institute of Pure and Applied Mathematics, UCLA, US