

Understanding the Aging Process

An Automated Approach that Uses Artificial Intelligence

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Outline

1 About Me

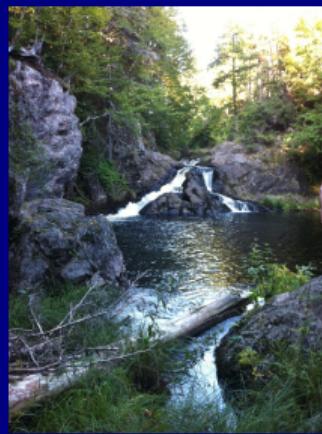
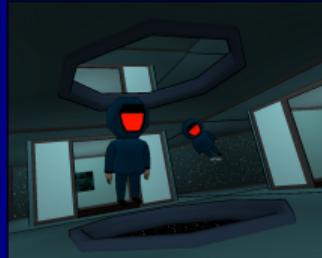
2 Understanding the Aging Process

3 Knowledge Extraction

4 What Next?

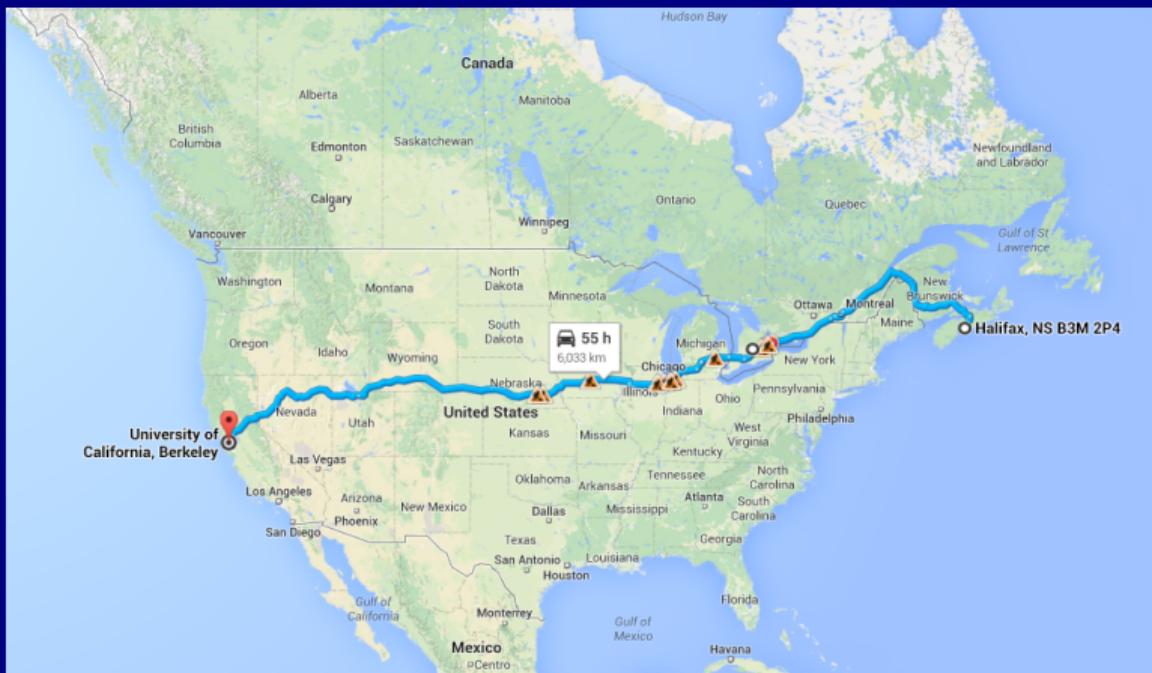
Who I am

Mark Farrell



Where I'm from

Atlantic Canada



What I'm Studying

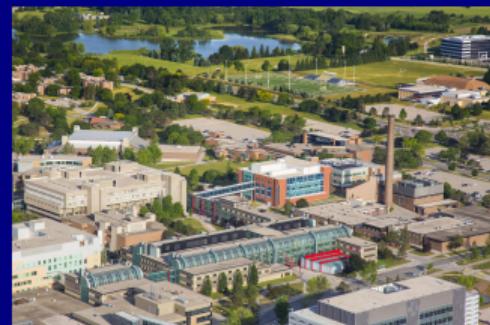
Year 2

Program Bachelor of Computer Science

Faculty Mathematics

Institution University of Waterloo

Location Waterloo, Ontario, Canada



How I Became a Researcher at CREA

Prof. Garan Emailed the University of Waterloo Computer Science Club



Why was I Interested in Research at CREA?

Hobby	CREA Research
Reverse Engineering	Natural Language Processing
Game Development	Artificial Intelligence
Health	Bioinformatics

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1 About Me

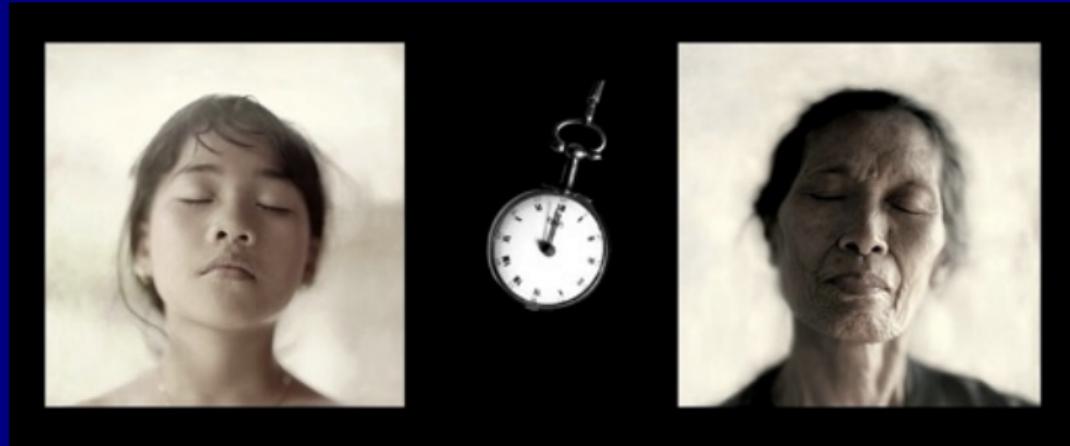
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4 What Next?

What does CREA want to do?

CREA Wants to Understand Aging and Increase Human Lifespan



Why is it Difficult to Understand Aging?

The screenshot shows the PubMed search interface with the query 'aging'. The results page displays 1 to 20 of 306272 articles, sorted by Recently Added. The results are as follows:

- Proteostasis: Bad news and good news from the endoplasmic reticulum.**
Noack J, Brambilla Pisoni G, Molinari M. Swiss Med Wkly. 2014 Aug 21;144:w14001. doi: 10.4414/smwm.2014.14001. eCollection 2014.
PMID: 25144910 [PubMed - as supplied by publisher] [Free Article](#)
[Related citations](#)
- The Experiences of Making Infant Feeding Choices by African, Caribbean and Black HIV-Positive Mothers in Ontario, Canada.**
Kapiriri L, Tharaop WE, Muchenje M, Masinde KJ, Siegel S, Ongoba F. World Health Popul. 2014;15(2):14-22.
PMID: 25144766 [PubMed - as supplied by publisher] [Related citations](#)
- Famous Landmark Identification in Amnestic Mild Cognitive Impairment and Alzheimer's Disease.**
Sheardova K, Laczó J, Výhnálek M, Andel R, Mokrisová I, Vlček K, Amerlova J, Horčík J. PLoS One. 2014 Aug 21;9(8):e105623. doi: 10.1371/journal.pone.0105623. eCollection 2014.
PMID: 25144755 [PubMed - as supplied by publisher] [Free Article](#)
[Related citations](#)
- Amyloid-β induces NLRP1-dependent neuronal pyroptosis in models of Alzheimer's disease.**
Tan MS, Tan L, Jiang T, Zhu XC, Wang HF, Jia CD, Yu JT. Cell Death Dis. 2014 Aug 21;5:e1382. doi: 10.1038/cddis.2014.348.
PMID: 25144717 [PubMed - as supplied by publisher] [Related citations](#)

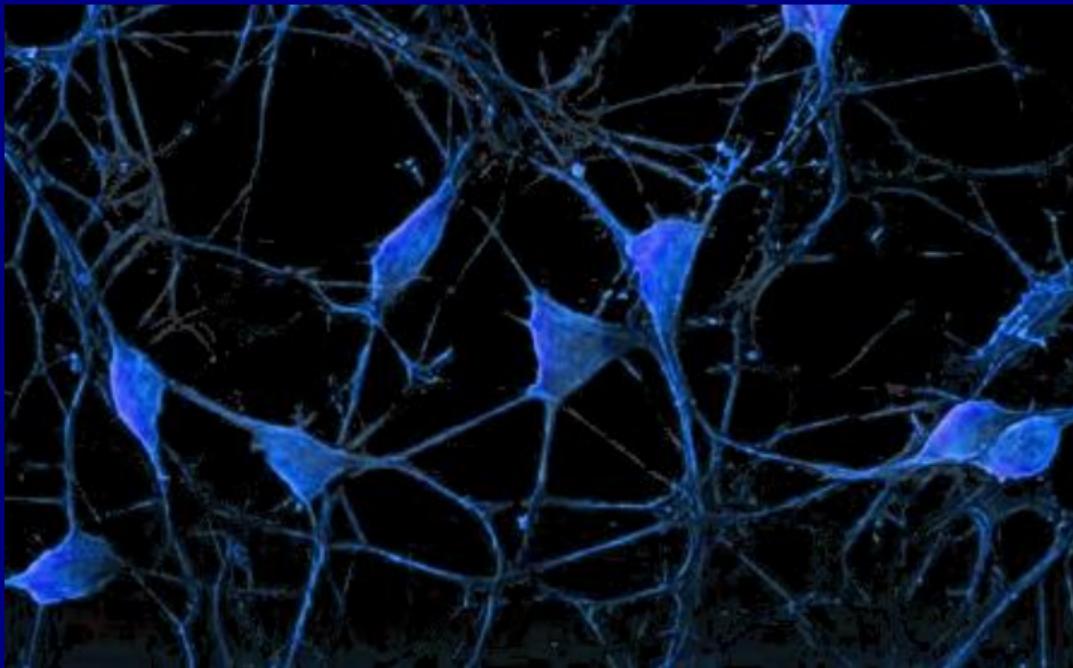
On the right side of the results page, there are sections for 'New feature', 'Results by year', 'Related searches', and 'Titles with your search terms'. The 'Results by year' section shows a bar chart of publication counts from 2000 to 2014. The 'Related searches' section includes terms like 'aging review', 'brain aging', 'anti aging', 'aging skin', and 'cells aging'. The 'Titles with your search terms' section lists titles such as 'The social impact of aging populations: some [Soc Sci Med. 1994]' and 'The hallmarks of aging [Cell. 2013]'.

Why is it Difficult to Understand Aging?



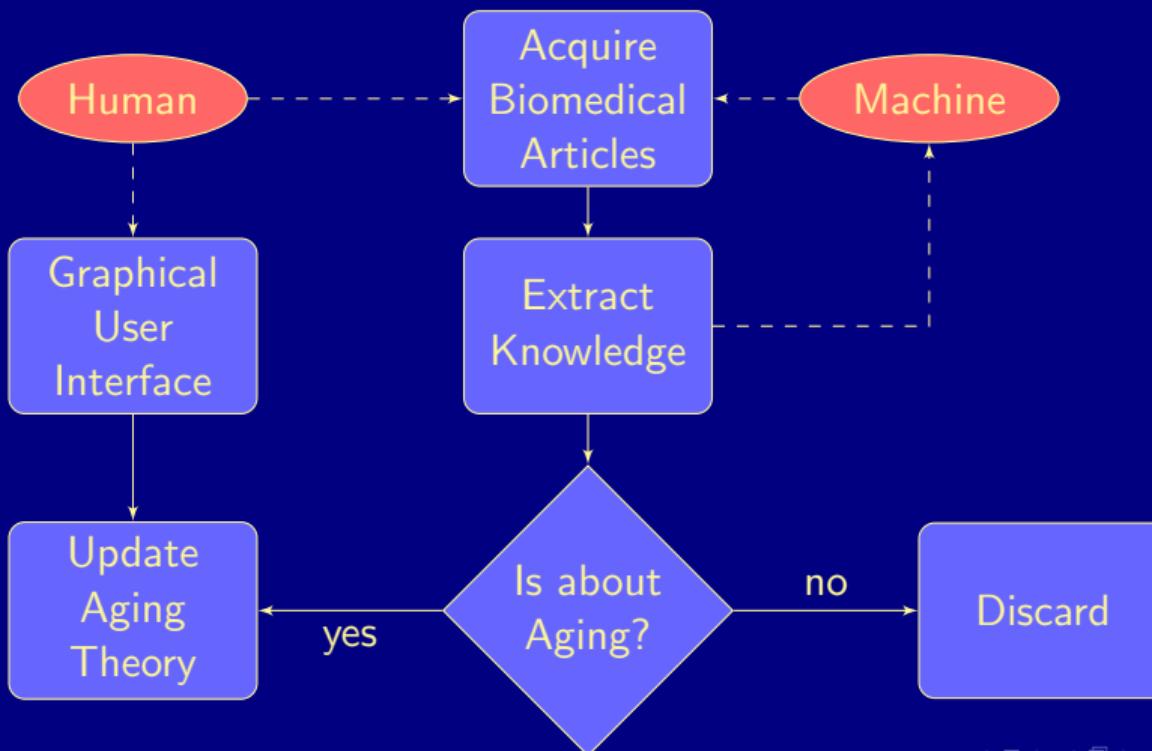
How can CREA Understand Aging?

Build a Knowledge Base that Describes and Reasons about Aging



How can CREA Understand Aging?

Build a Knowledge Base that Describes and Reasons about Aging



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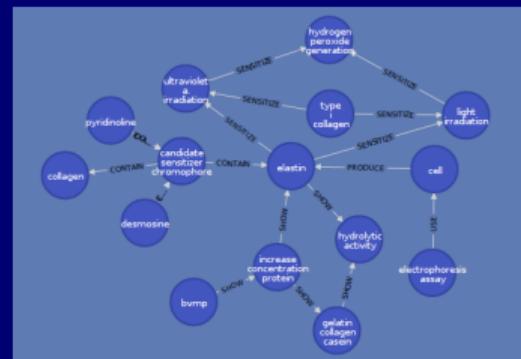
Knowledge Extraction

Overview of Progress

Input

... The pyridinoline and desmosine were examined as candidate sensitizer chromophores contained in collagen and elastin, respectively. ...

Output



Knowledge Extraction

Method

Tokenization Input a text document and read it, one sentence at a time.

Parsing For each sentence, generate a constituent tree that describes its phrase structure.

Compilation Extract facts by pattern matching on each constituent tree.

Constituent Tree Tags

Word Level

Tag	Meaning	Example
DT	Determiner	the
IN	Preposition	of
JJ	Adjective	blue
RB	Adverb	quickly
CC	Coordinating Conjunction	and
NN	Singular Noun	monkey
NNS	Plural Noun	monkeys
VB	Base Verb	fall
VBZ	Singular Present Verb	falls
VBD	Past Tense Verb	fell
VBN	Past Participle Verb	fallen
VBG	Gerund Verb	falling
...

Constituent Tree Tags

Phrase Level

Tag	Meaning	Example
NP	Noun Phrase	the woman
VP	Verb Phrase	calls the man
PP	Prepositional Phrase	from the store
ADVP	Adverb Phrase	quickly and quietly
ADJP	Adjective Phrase	blue and red
CONJP	Conjunctive Phrase	as well as
...

Constituent Tree Tags

Clause Level

Tag	Meaning	Example
S	Declarative Clause	the dog walks
SBAR	Conjunction + Clause	that the dog walks
...

Knowledge Extraction

Example

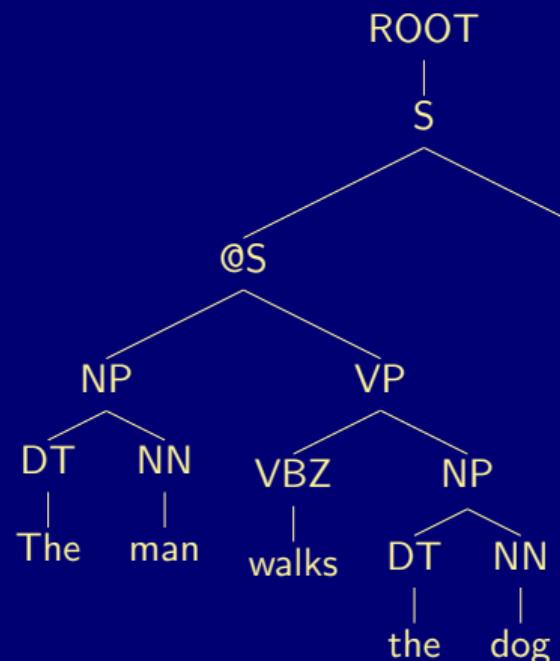
Input Token

The man walks the dog.

Knowledge Extraction

Example

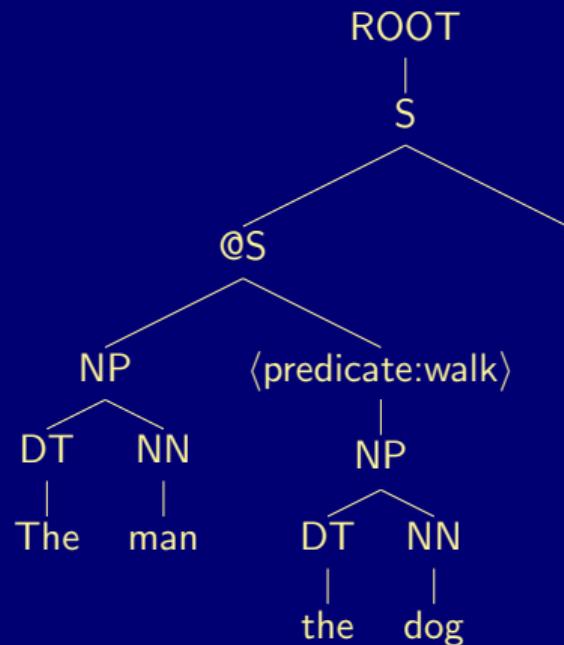
Parse Token



Knowledge Extraction

Example

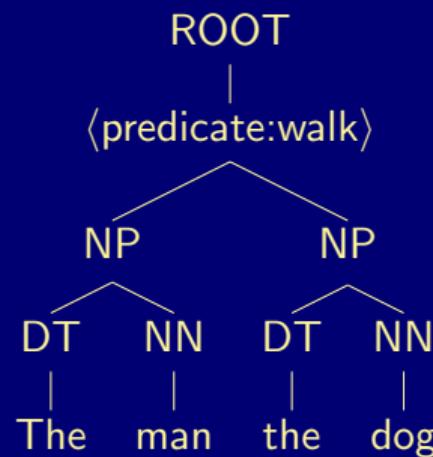
Compile Token



Knowledge Extraction

Example

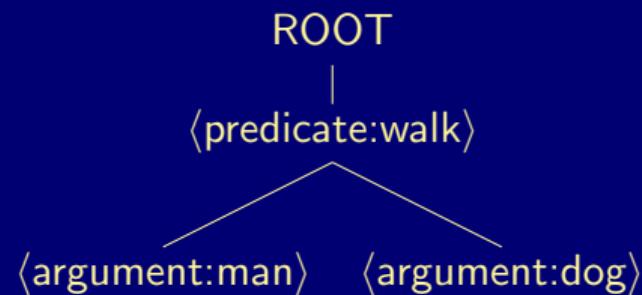
Compile Token



Knowledge Extraction

Example

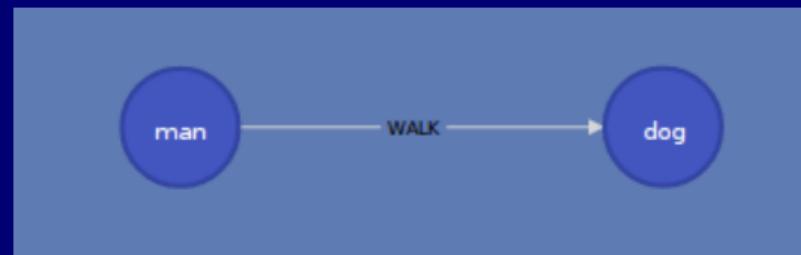
Compile Token



Knowledge Extraction

Example

Output Fact

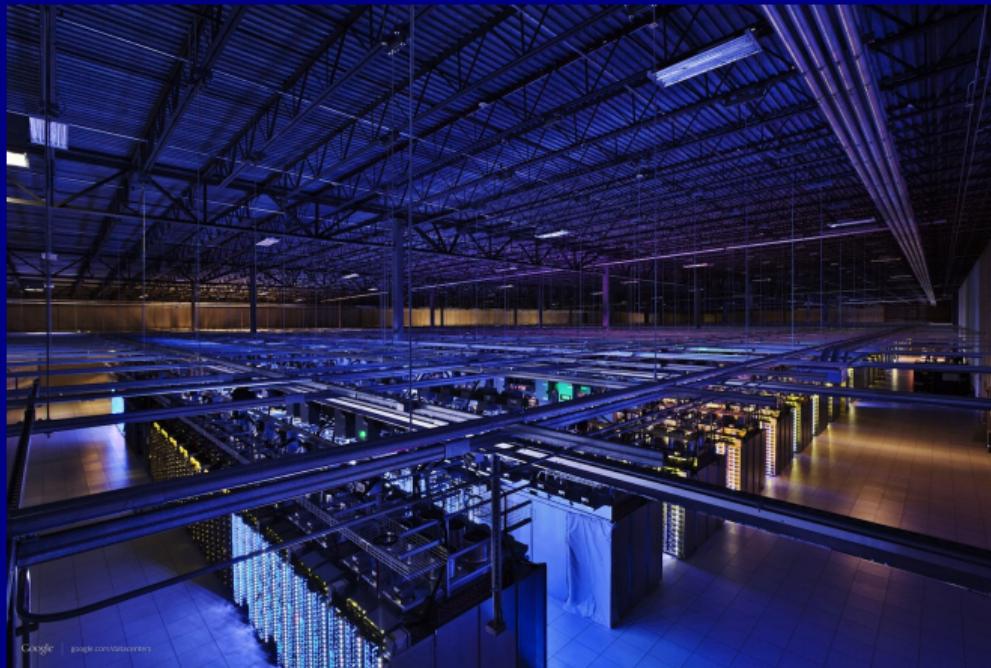


Software Demonstration

A preview of CREA's knowledge base, compiled from PubMed abstracts.

High Performance

Knowledge can be extracted from many sentences at the same time.



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What Next?

Task	Assignees
Research Direction	Steve Garan
Knowledge Extraction	Mark Farrell
Text Article Retrieval	Grace Park, Jeremy Wan
Knowledge Visualization	Mark Farrell
Graphical User Interface	Mark Farrell
Biomedical Spam Filtering	—
Automated Reasoning	—

Get Involved

Contact Me for More Information

Email m4farrel@csclub.uwaterloo.ca

Website markfarrell.ca

Questions?