

Understanding the Aging Process

An Automated Approach that Uses Artificial Intelligence

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University of California, Berkeley

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Outline

1 About Me

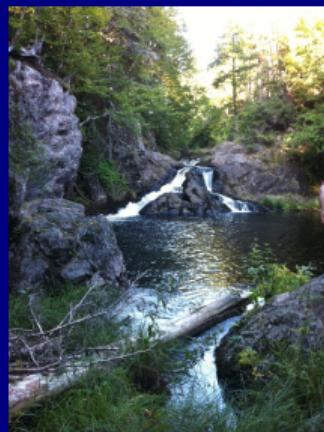
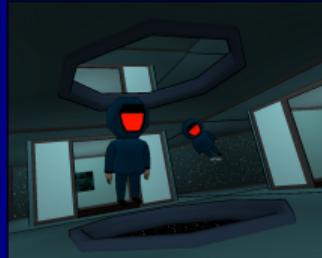
2 Understanding the Aging Process

3 Knowledge Extraction

4 What Next?

Who I am

Mark Farrell



What I'm Studying

Computer Science

Year 2

Program Bachelor of Computer Science

Faculty Mathematics

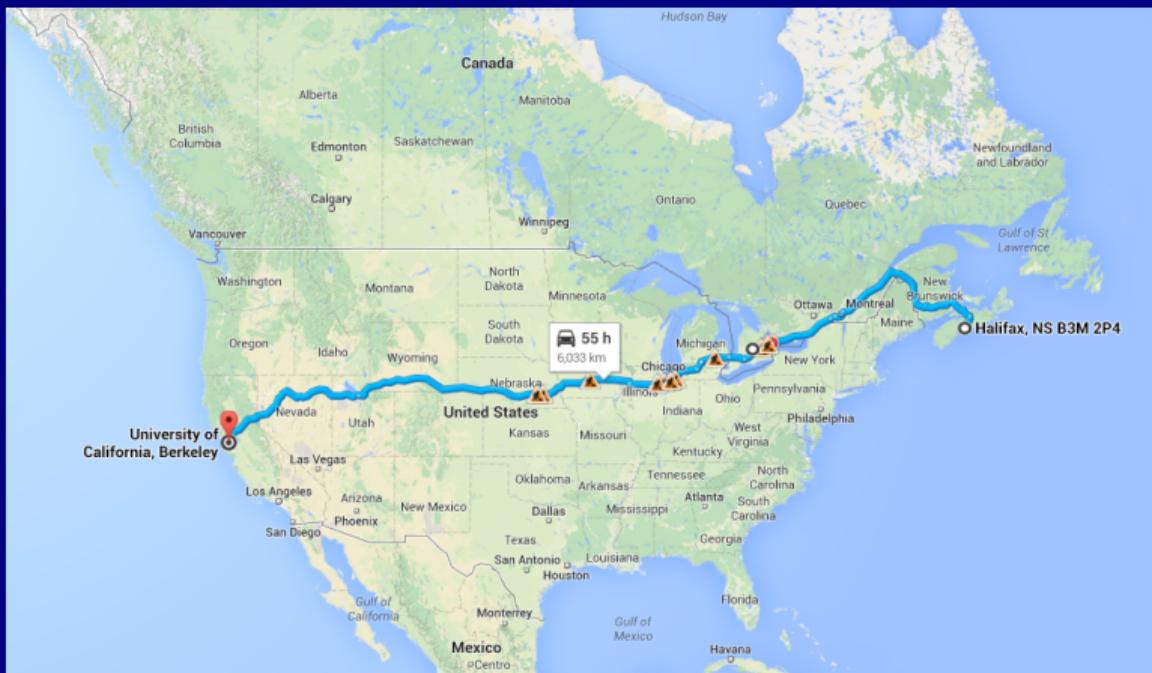
Institution University of Waterloo

Location Waterloo, Ontario, Canada



Where I'm from

Atlantic Canada



How I Became a Researcher at CREA

Prof. Garan Emailed the University of Waterloo Computer Science Club



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1 About Me

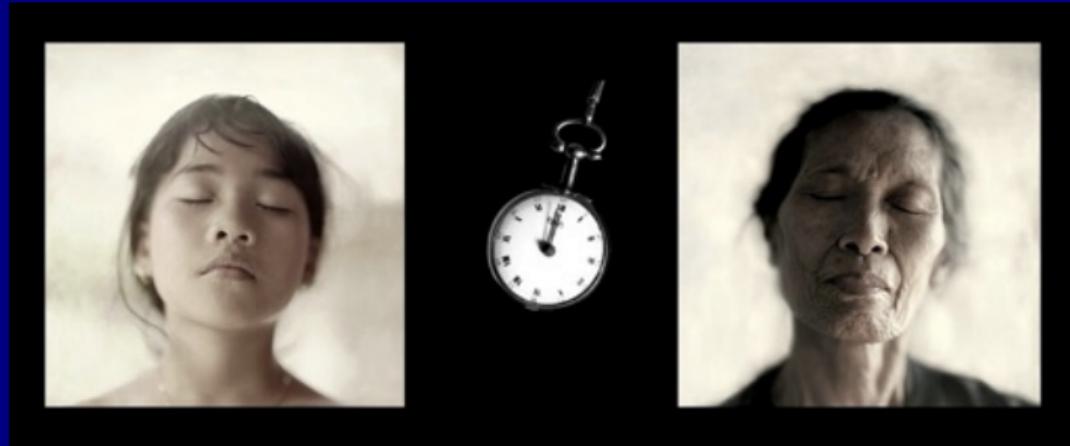
2 Understanding the Aging Process

3 Knowledge Extraction

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?

High Number of Publications; Growing Rate of Discovery

The screenshot shows the PubMed search interface with the query 'aging'. The results page displays 1 to 20 of 306272 articles. A sidebar on the left provides filtering options for article types, text availability, and publication dates. The main content area shows a list of articles with titles like 'Proteostasis: Bad news and good news from the endoplasmic reticulum.', 'The Experiences of Making Infant Feeding Choices by African, Caribbean and Black HIV-Positive Mothers in Ontario, Canada.', and 'Amyloid- β induces NLPP1-dependent neuronal pyroptosis in models of Alzheimer's disease.' To the right, there is a 'Results by year' chart showing a steady increase in the number of publications over time, and a 'Related searches' sidebar with terms such as 'aging review', 'brain aging', 'anti aging', 'aging skin', and 'cells aging'.



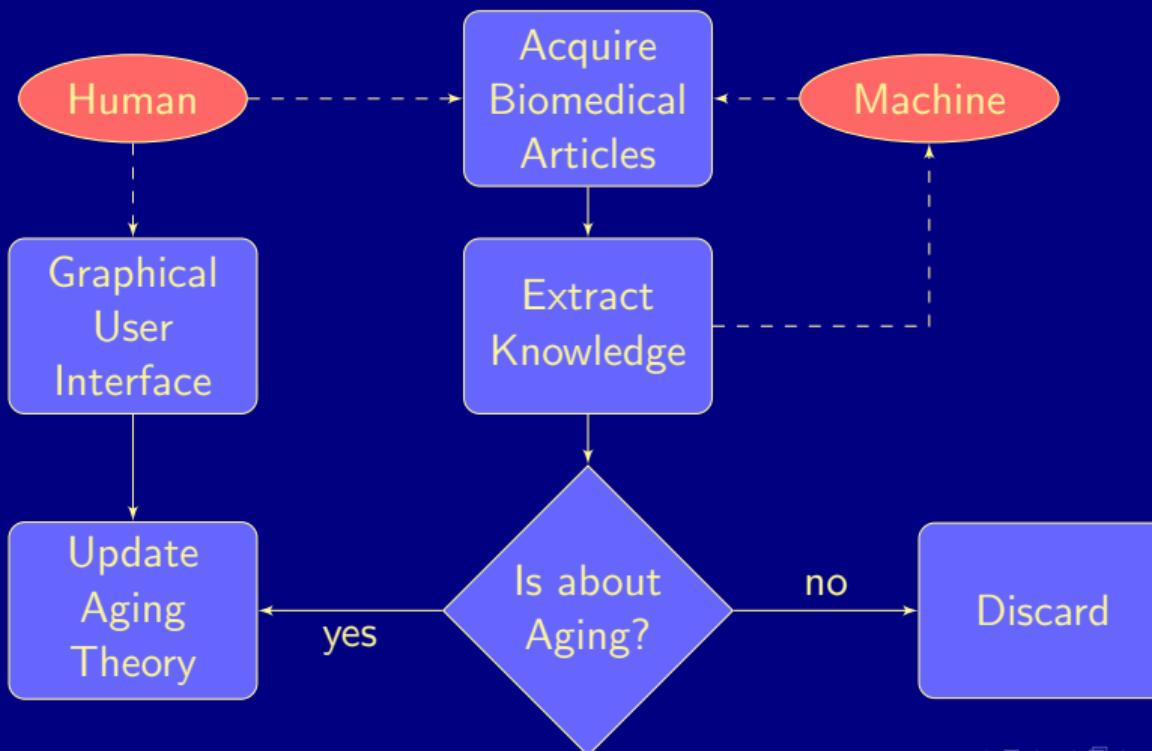
Why is it Difficult to Understand Aging?

High Number of Publications; Growing Rate of Discovery



How can CREA Understand Aging?

Build a Knowledge Base that Describes and Reasons about Aging



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1 About Me

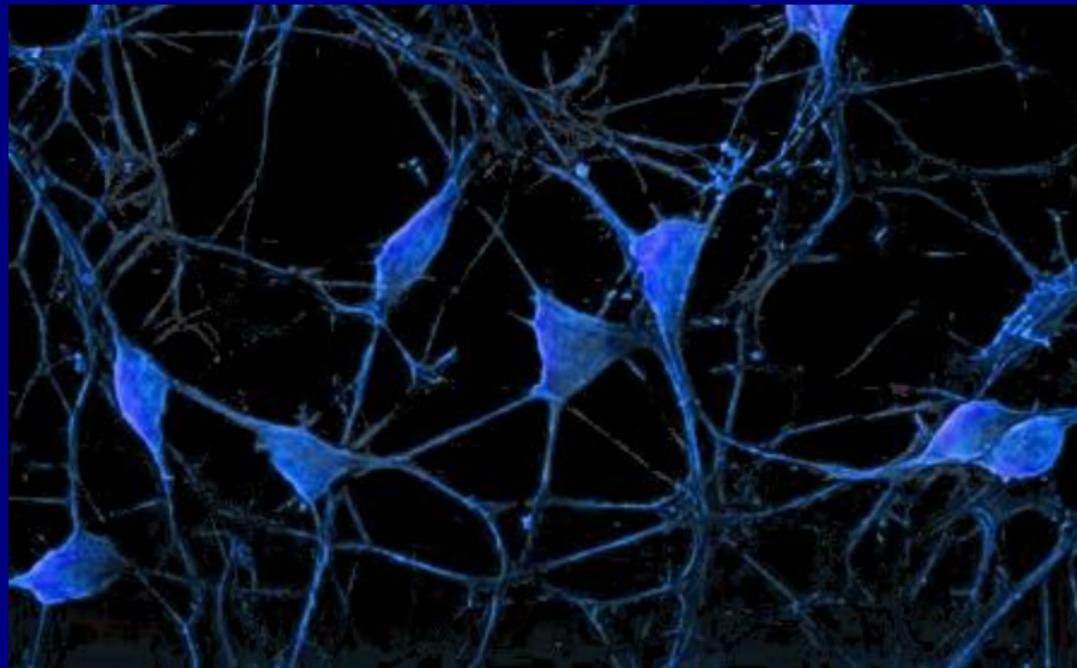
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What is Knowledge Extraction?

Knowledge Extraction is the Act of Reading and Understanding Text



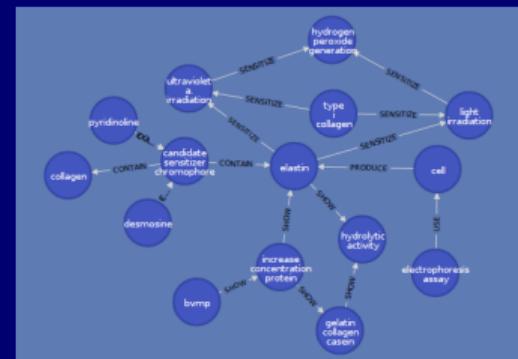
What is Knowledge Extraction?

An Example of Knowledge Extraction

Input

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

Output



How is Knowledge Extracted from Text?

An Overview of Knowledge Extraction

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.

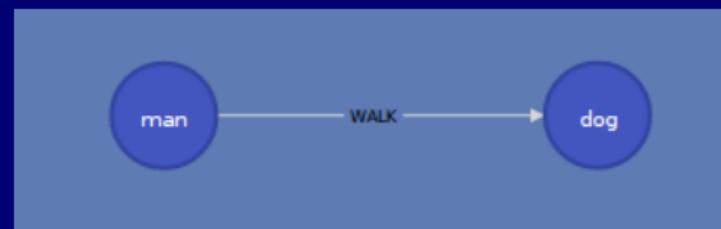
How is Knowledge Extracted from Text?

An Example of How Knowledge is Extracted From Text

Input Token - A Sentence

The man walks the dog.

Output Fact - An Understanding of the Sentence



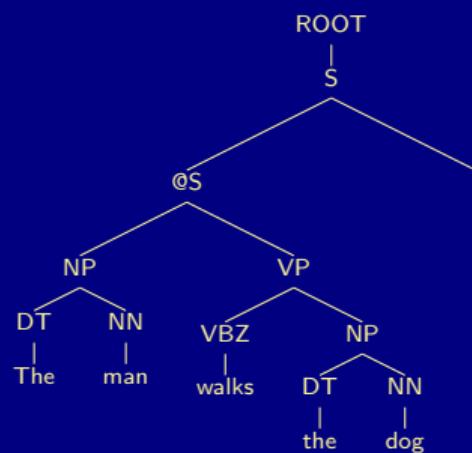
How is Knowledge Extracted from Text?

Tokenization: Begin by Reading a Sentence

The man walks the dog.

How is Knowledge Extracted from Text?

Parsing: Generate a Constituent Tree for the Sentence



How is Knowledge Extracted from Text?

A Brief Lesson on Parsing Sentences

Assign each Word a Part-of-Speech Tag

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
VBD	Singular Present Verb	falls
VBN	Past Tense Verb	fell
VBN	Past Participle Verb	fallen
VBG	Gerund Verb	falling
...

How is Knowledge Extracted from Text?

A Brief Lesson on Parsing Sentences

Group Words into Phrases

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
...

How is Knowledge Extracted from Text?

A Brief Lesson on Parsing Sentences

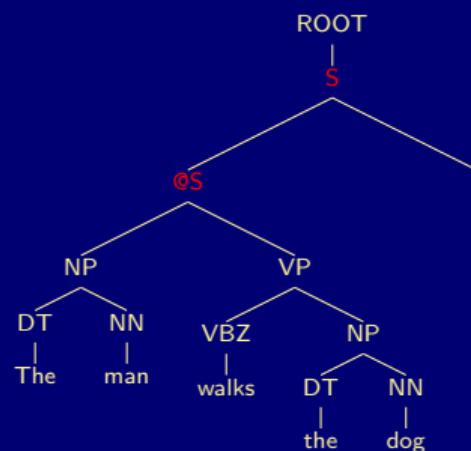
Group Phrases into Clauses - Containing Facts

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

How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

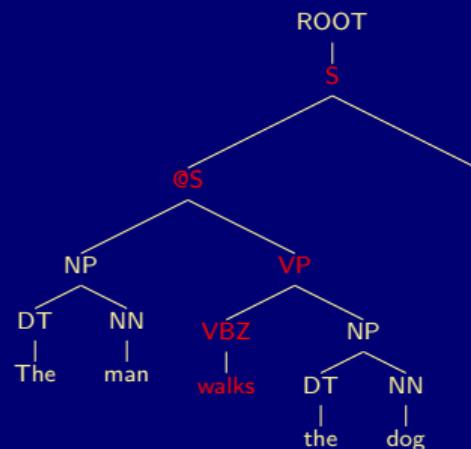
Find Clauses in the Constituent Tree



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

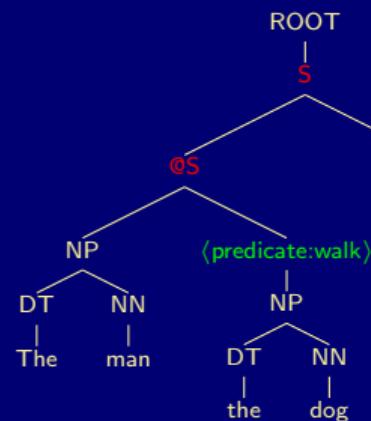
Find Predicates - Actions that Relate Literal Nouns to Form Facts



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

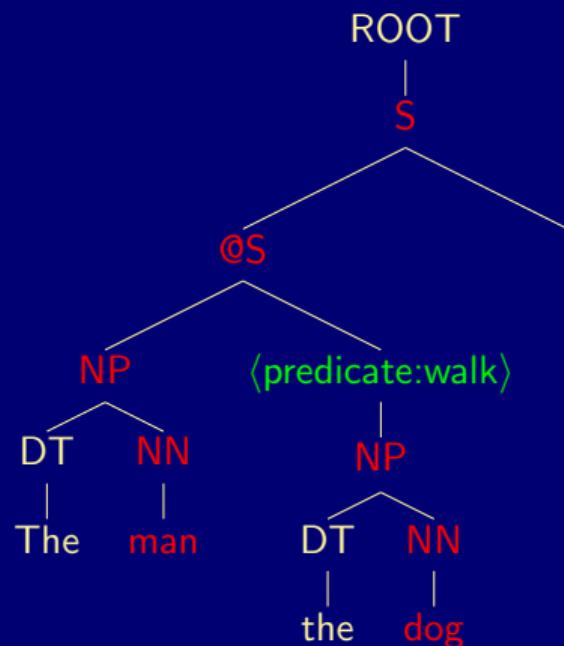
Rewrite the Constituent Tree - Include the Predicate



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

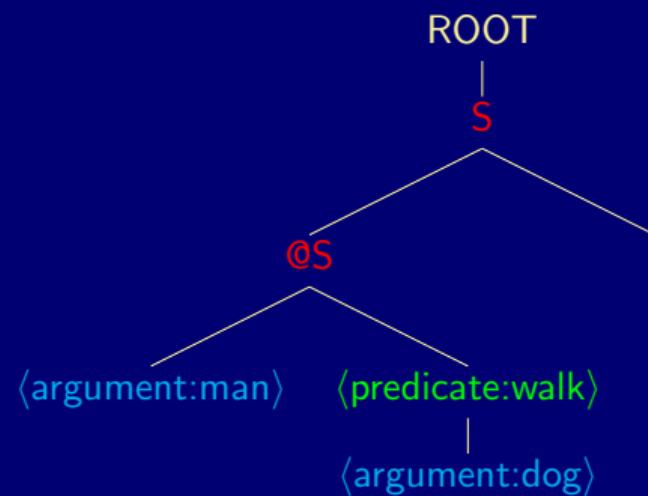
Find Literal Nouns



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

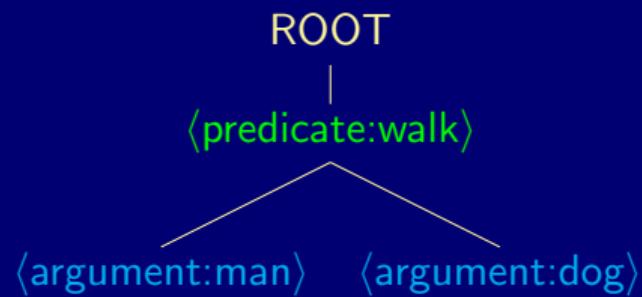
Rewrite the Constituent Tree - Include Literal Nouns



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

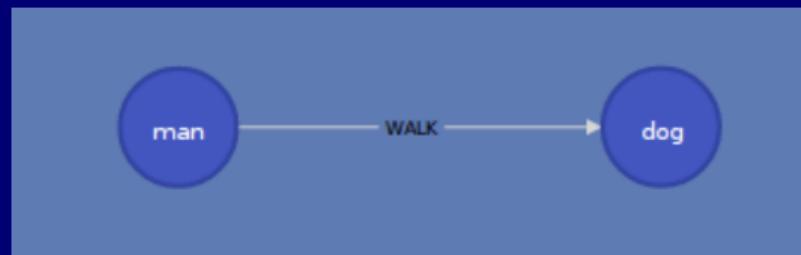
Rewrite the Constituent Tree - Apply Arguments to the Predicate to Form a Fact



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

Output Fact



Why is Knowledge Extraction Useful for Understanding the Aging Process?

Let's Examine a Visualization of Knowledge Extracted from PubMed Abstracts to Find Out



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1 About Me

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3 Knowledge Extraction

4 What Next?

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

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Website markfarrell.ca

Questions?