

Understanding the Aging Process with Artificial Intelligence

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Lawrence Berkeley National Laboratory
University of California, Berkeley

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Outline

1 About Me

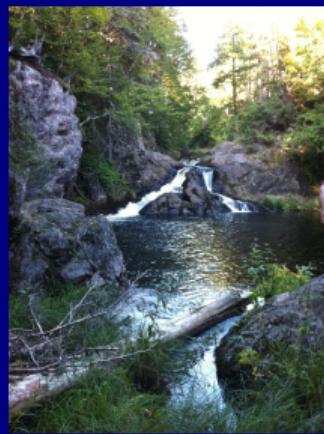
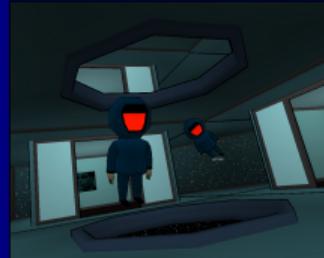
2 Understanding the Aging Process

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

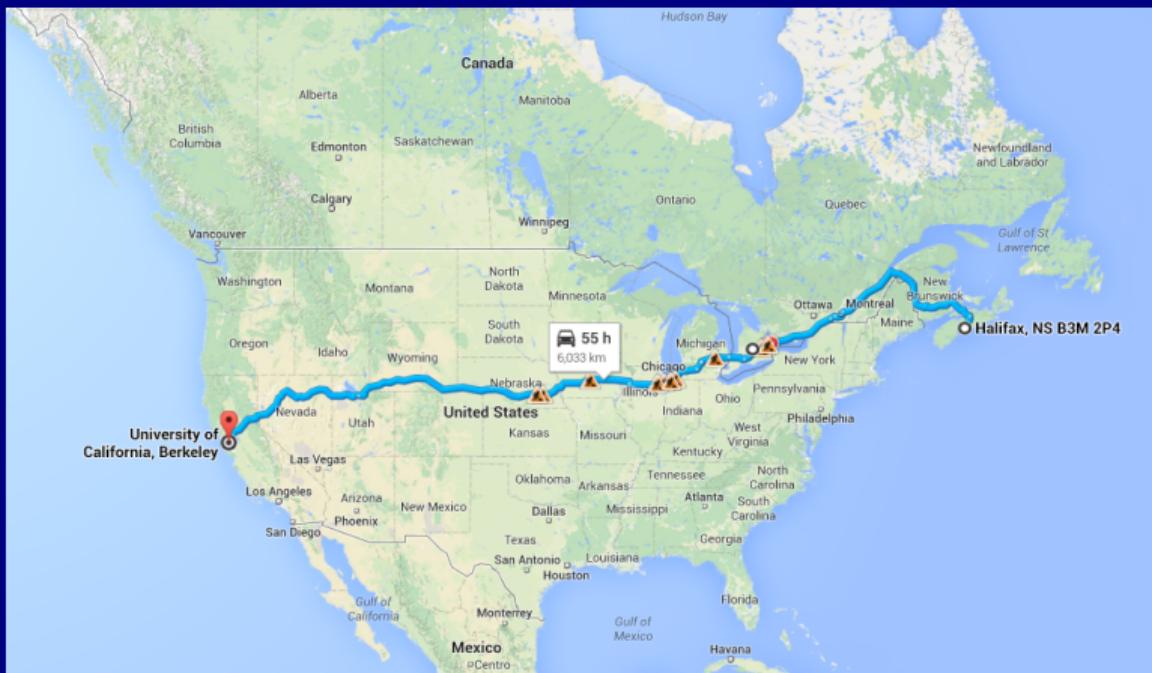
Institution University of Waterloo

Location Waterloo, Ontario, Canada



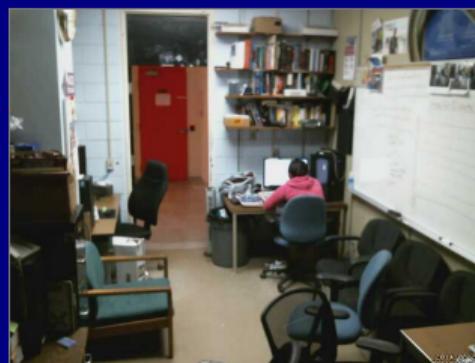
Where I'm from

Atlantic Canada



How I Became a Researcher at CREA

Prof. Garan Emailed the University of Waterloo Computer Science Club



Outline

1 About Me

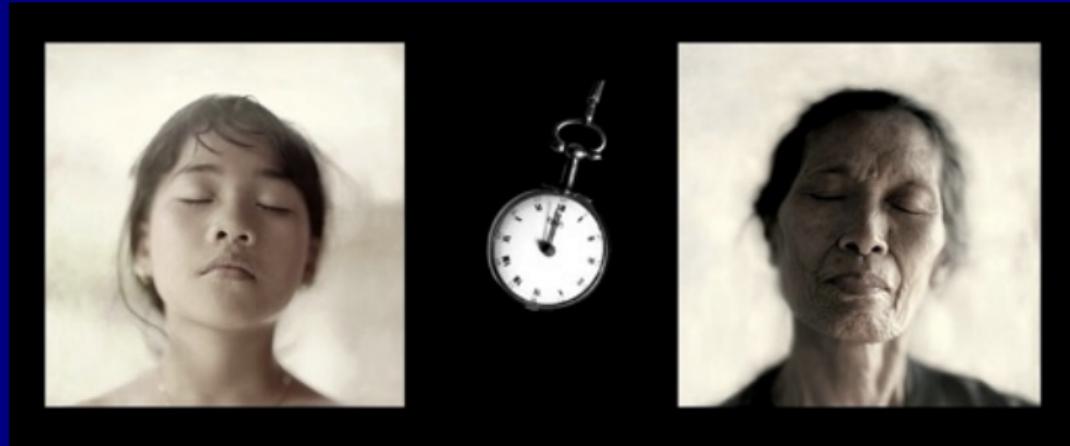
2 Understanding the Aging Process

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 a PubMed search results page for the query "aging". The search has returned 1 to 20 of 306272 results, sorted by Recently Added. The results list several articles, each with a checkbox, title, author(s), journal, date, PMID, and a "Free Article" link if available. To the right of the results, there is a "Results by year" chart showing a steady increase in the number of publications over time, with a "Download CSV" button below it. Further down, there are sections for "Related searches" (including "aging review", "brain aging", "anti aging", "aging skin", and "cells aging") and "Titles with your search terms" (listing "The social impact of aging populations: some [Soc Sci Med. 1994]" and "The hallmarks of aging [Cell. 2013]").

PubMed Search Results for "aging":

Results: 1 to 20 of 306272

- 1. Noack J, Brambilla Pisoni G, Molinari M. Swiss Med Wkly. 2014 Aug 21;144:w14001. doi: 10.4414/smw.2014.14001. eCollection 2014.
- 2. Kapiriri L, Tharao WE, Muchenje M, Masinde KO, Siegel S, Ongooiba F. World Health Popul. 2014;15(2):14-22.
- 3. Sheardova K, Laczó J, Vyhnašek M, Andel R, Mokrošová I, Vlček K, Amlerová J, Hora J. PLoS One. 2014 Aug 21;9(8):e105623. doi: 10.1371/journal.pone.0105623. eCollection 2014.
- 4. 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.

Related searches:

- aging review
- brain aging
- anti aging
- aging skin
- cells aging

Titles with your search terms:

- The social impact of aging populations: some [Soc Sci Med. 1994]
- The hallmarks of aging [Cell. 2013]
- Eating habits and appetite control in the elderly: th [Int Psychogeriatr. 2003]

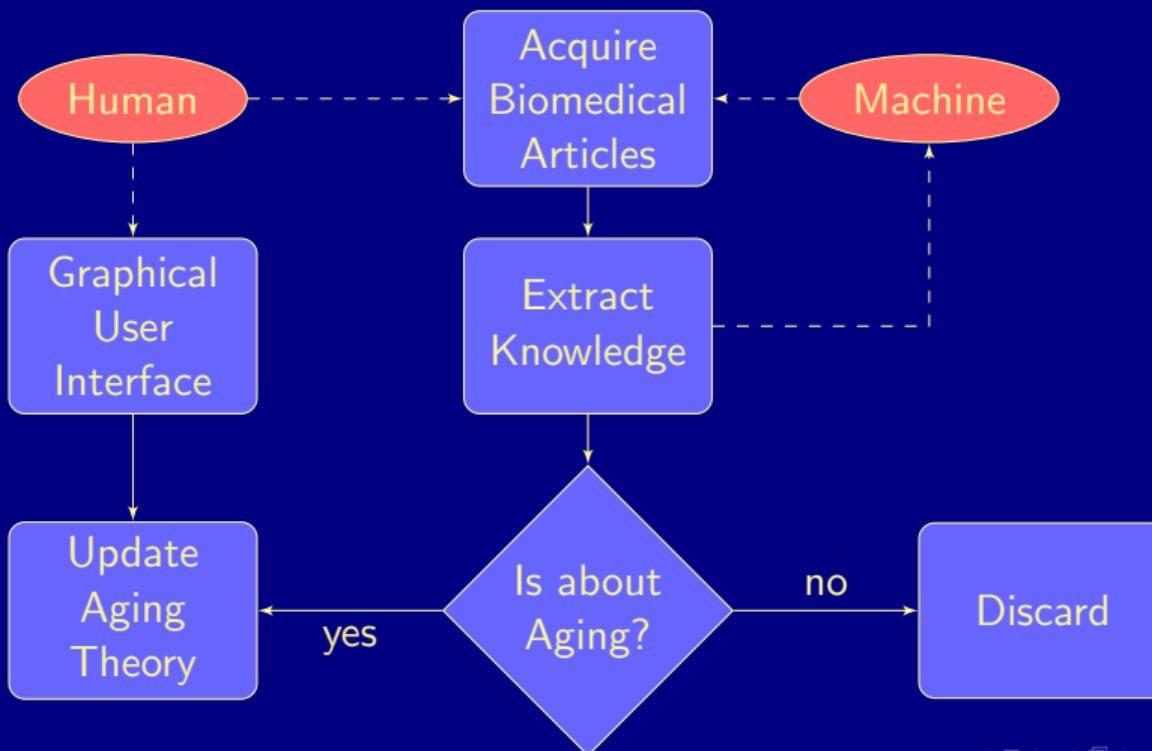
Why is it Difficult to Understand Aging?

High Number of Publications; Growing Rate of Discovery



How can CREA Understand Aging?

Build a Knowledge Base that Describes and Reasons about Aging



Outline

1 About Me

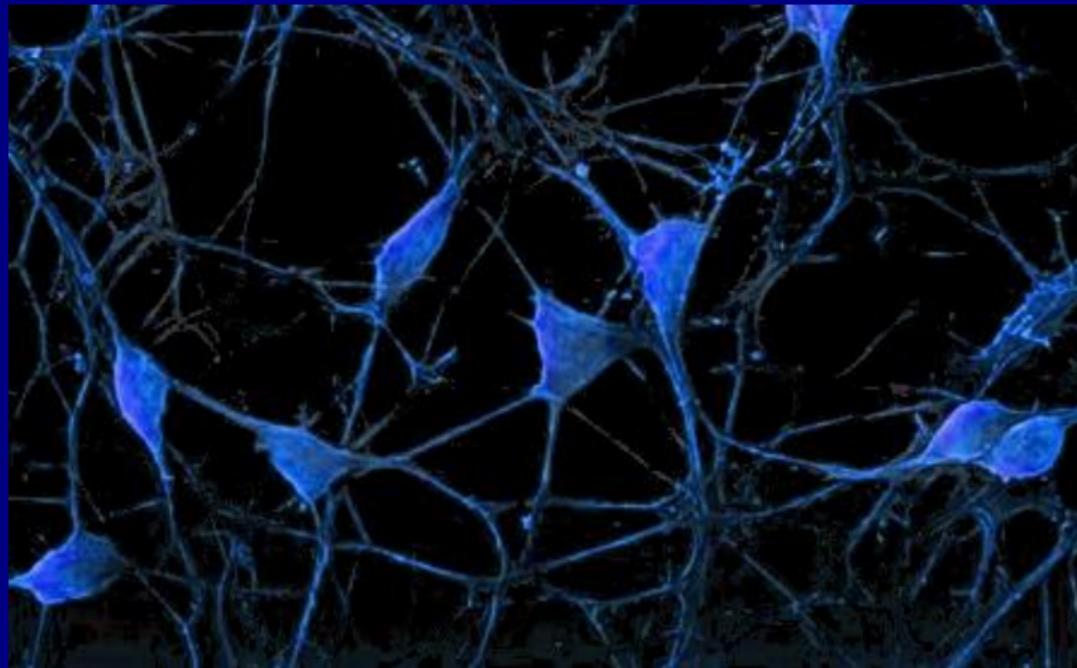
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What is Knowledge Extraction?

Knowledge Extraction is the Act of Reading and Understanding Text



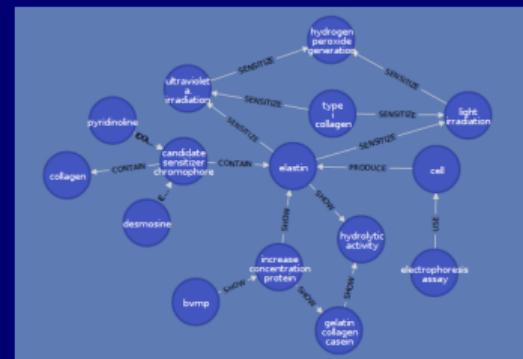
What is Knowledge Extraction?

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.

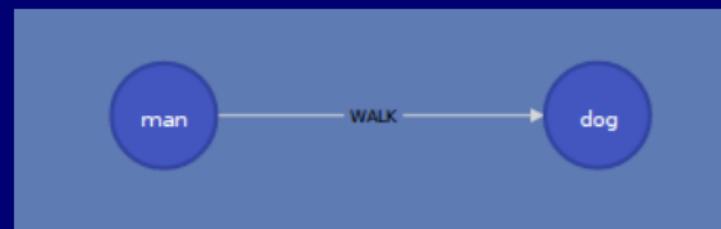
How is Knowledge Extracted from Text?

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



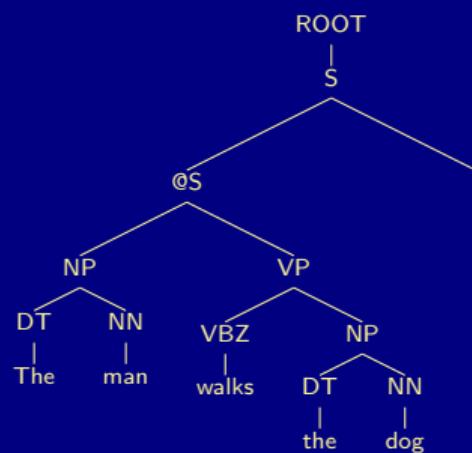
How is Knowledge Extracted from Text?

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

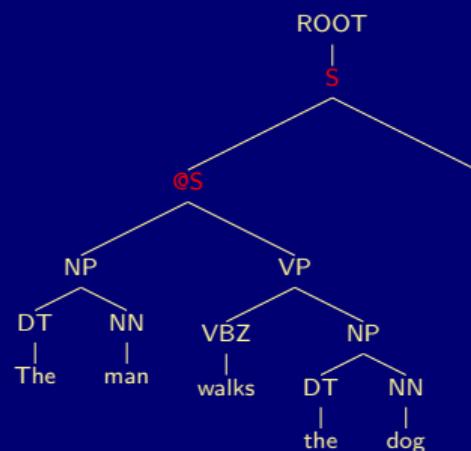
Group Phrases into Clauses - Containing Facts

| 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

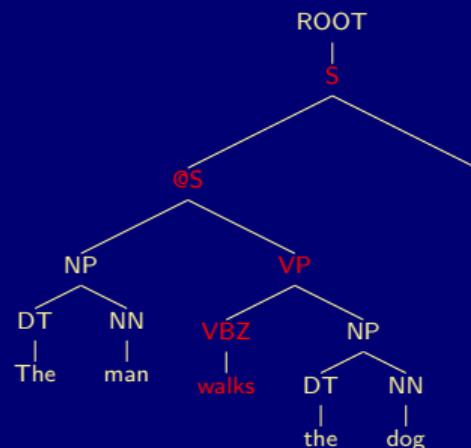
Find Clauses in the Constituent Tree



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

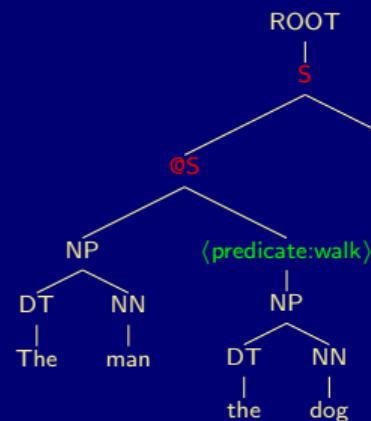
Find Predicates - Actions that Relate Literal Nouns to Form Facts



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

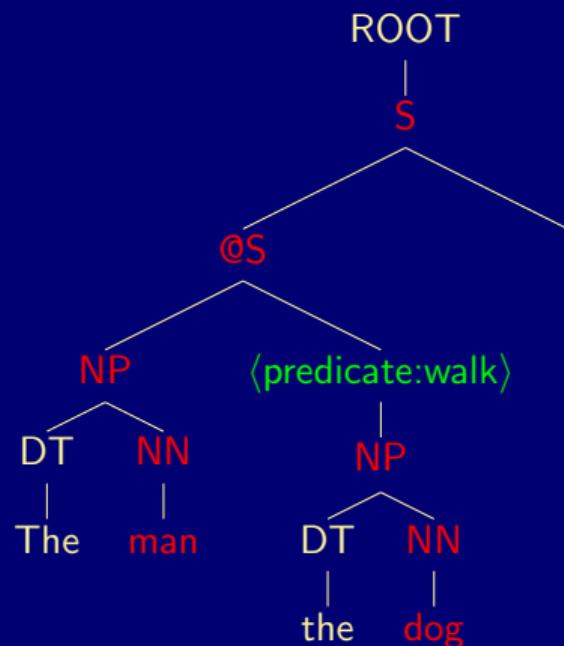
Rewrite the Constituent Tree - Include the Predicate



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

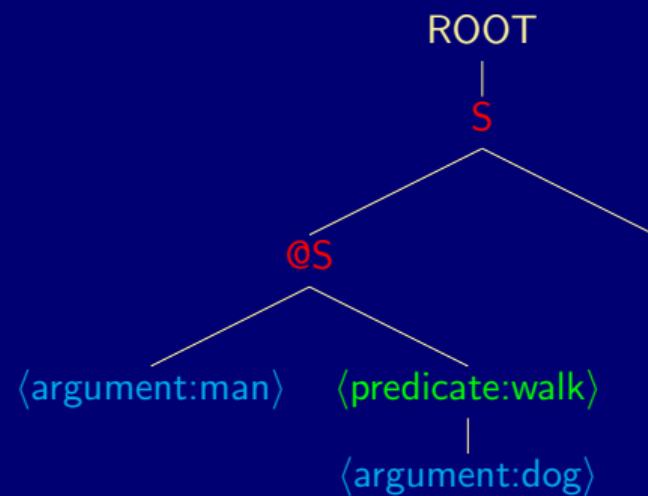
Find Literal Nouns



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

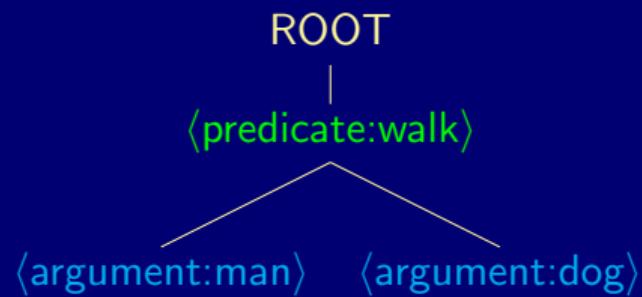
Rewrite the Constituent Tree - Include Literal Nouns



How is Knowledge Extracted from Text?

Compilation: Understand the Meaning of the Sentence

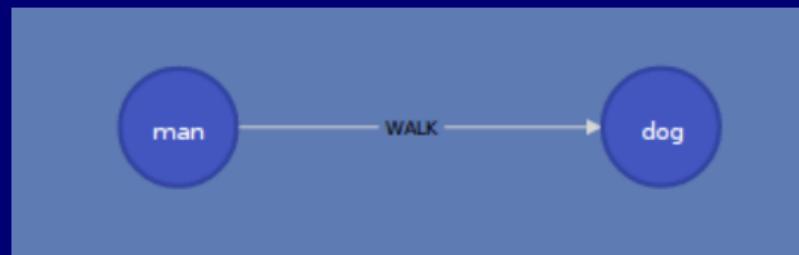
Rewrite the Constituent Tree - Apply Arguments to the Predicate to Form a Fact



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



Outline

1 About Me

2 Understanding the Aging Process

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?