Semantic Search for Quantity Expressions

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110392 Guided Research Applied and Computational Mathematics & Thesis

Overview

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- Motivation: Problem and State Of The Art

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- Our Approach: Structure Of The Search Engine

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- Our Approach: Structure Of The Search Engine
  - The Unit System

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  - The Search Algorithm

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- The Implementation

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  - The Unit System
  - The Search Algorithm
  - The Frontend
- The Implementation
- Time for Questions

Motivation (1)

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- everything is quantified

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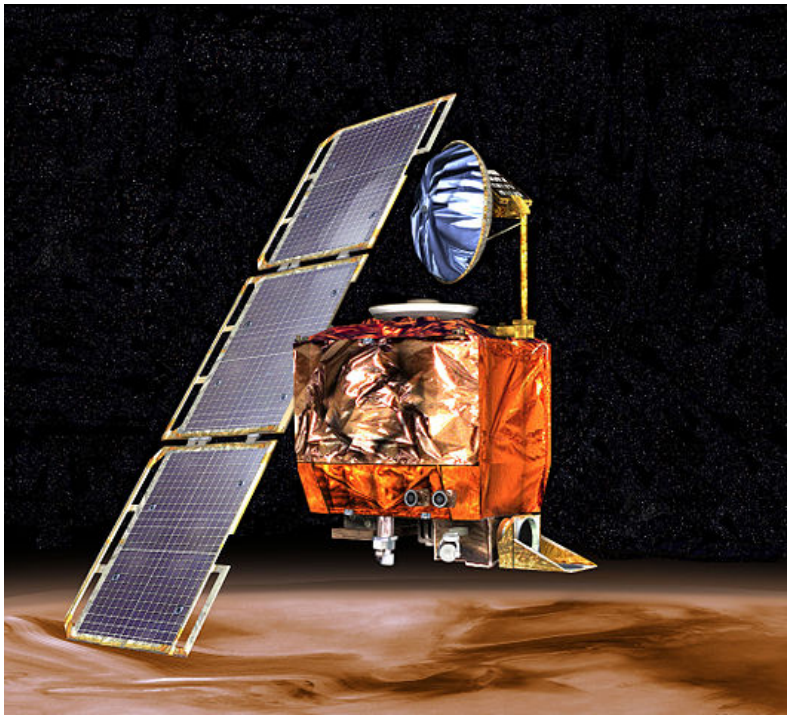

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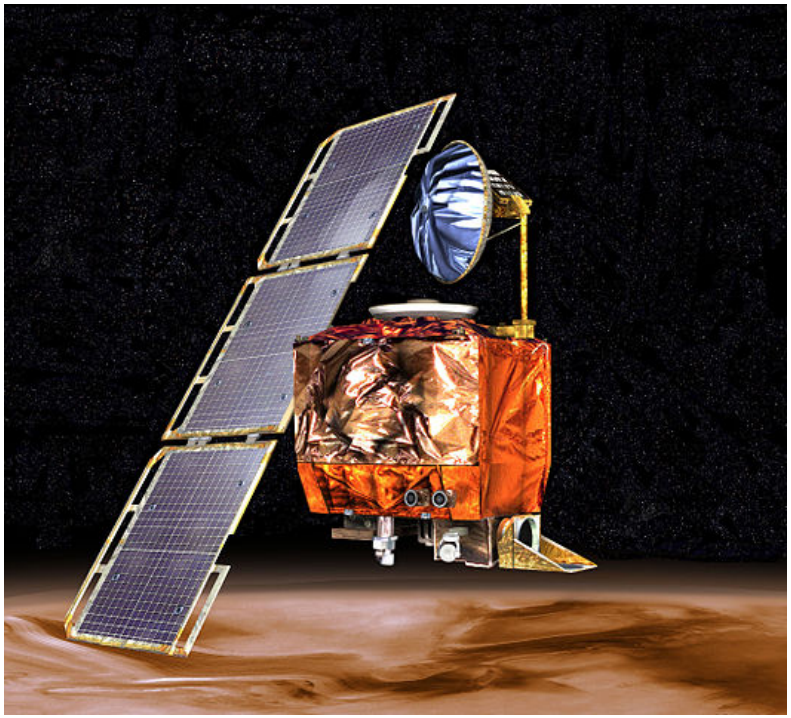

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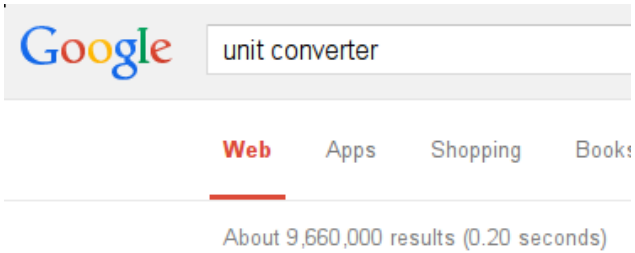

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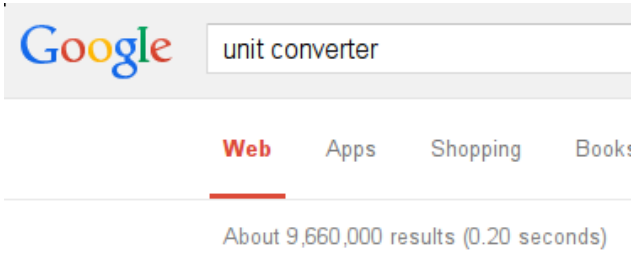
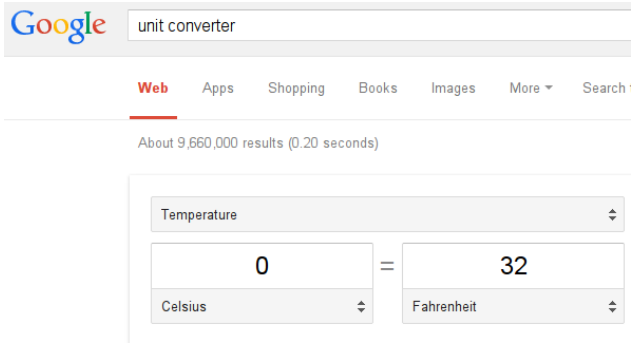


  - Google itself has one integrated



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- This is the kind of search engine we have built

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- For the first two points, we use a meta-mathematical approach

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- *MMT* is a software that allows us to make use of these concepts
- It is easy to write down your own theories and related them with views

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- such as velovity $= \frac{\text{length}}{\text{time}}$
- We can use this to get a *Theory of Dimensions*:

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Dimension		
dim	:	type
none	:	dim
count	:	dim
length	:	dim
mass	:	dim
time	:	dim
current	:	dim
temperature	:	dim
luminous	:	dim
amount	:	dim
$\cdot$	:	$\text{dim} \to \text{dim} \to \text{dim}$
$/$	:	$\text{dim} \to \text{dim} \to \text{dim}$

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  6. The *quotient* of two existing QEs such as 1 $\frac{\text{Meter}}{\text{Second}}$
- this results in the following *Theory of Quantity Expressions*:

Our Approach: The Unit System (5)

Quantity Expression		
import Dimension		
QE	:	$\mathsf{dim} \rightarrow \mathsf{type}$
QENMul	:	$\forall x : \mathsf{dim}.\mathbb{R} \rightarrow \mathsf{QE}\,(x) \rightarrow \mathsf{QE}\,(x)$
QENDiv	:	$\forall x : \mathsf{dim}.\mathsf{QE}\,(x) \rightarrow \mathbb{R} \rightarrow \mathsf{QE}\,(x)$
QEAdd	:	$\forall x : \mathsf{dim}.\mathsf{QE}\,(x) \rightarrow \mathsf{QE}\,(x) \rightarrow \mathsf{QE}\,(x)$
QEMul	:	$\forall x, y : \mathsf{dim}.\mathsf{QE}\,(x) \rightarrow \mathsf{QE}\,(y) \rightarrow \mathsf{QE}\,(x \cdot y)$
QEDiv	:	$\forall x, y : \mathsf{dim}.\mathsf{QE}\,(x) \rightarrow \mathsf{QE}\,(y) \rightarrow \mathsf{QE}\left(\frac{x}{y}\right)$

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Non SI Lengths
import Quantity Expression
Thou : QE (length) Foot = QENMul (1000, Thou) Yard = QENMul (3, Foot) Chain = QENMul (22, Yard) Furlong = QENMul (10, Chain) Mile = QENMul (8, Furlong)

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- Here is a small part of it

Our Approach: The Unit System (6)