



US005966686A

United States Patent [19]

[11] Patent Number: **5,966,686**

Heidorn et al.

[45] Date of Patent: ***Oct. 12, 1999**

[54] **METHOD AND SYSTEM FOR COMPUTING SEMANTIC LOGICAL FORMS FROM SYNTAX TREES**

[75] Inventors: **George Heidorn; Karen Jensen**, both of Bellevue, Wash.

[73] Assignee: **Microsoft Corporation**, Redmond, Wash.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/674,610**

[22] Filed: **Jun. 28, 1996**

[51] Int. Cl.⁶ **G06F 17/27**

[52] U.S. Cl. **704/9; 707/104**

[58] Field of Search 704/9, 8, 1, 10; 395/12; 707/100, 101, 102, 104

[56] References Cited

U.S. PATENT DOCUMENTS

5,111,398	5/1992	Nunberg et al.	704/9
5,146,406	9/1992	Jensen	704/9
5,386,556	1/1995	Hedin et al.	707/4
5,406,480	4/1995	Kanno	704/10
5,424,947	6/1995	Nagao et al.	704/9

FOREIGN PATENT DOCUMENTS

0413132A2	7/1990	European Pat. Off. .
0413132A3	7/1990	European Pat. Off. .

OTHER PUBLICATIONS

Geetha, T. V. and Subramanian, R.K., "Natural Language Representation—a Connectionist Approach", Computer and Communication, New Delhi, Aug. 28, 1991, vol. 3, pp. 294–298.

Isahara, Hitoshi and Ishizaki, Shun, "Context Analysis System for Japanese Text", 11th International Conference on Computational Linguistics. Proceedings of Coling '86, Bonn, West Germany, Aug. 25–29, 1986, pp. 244–246.

Winograd, Terry, "Computer Software for Working with Language", *Scientific American*, Sep. 1984, New York, U.S.A., vol. 251, No. 3, pp. 90–101.

Jensen, Karen et al., *Natural Language Processing: The PLNLP Approach*, Kluwer Academic Publishers, Boston, 1993.

Garside, Roger et al., *The Computational Analysis of English: A Corpus-Based Approach*, Longman, pp. 97–109, 1987.

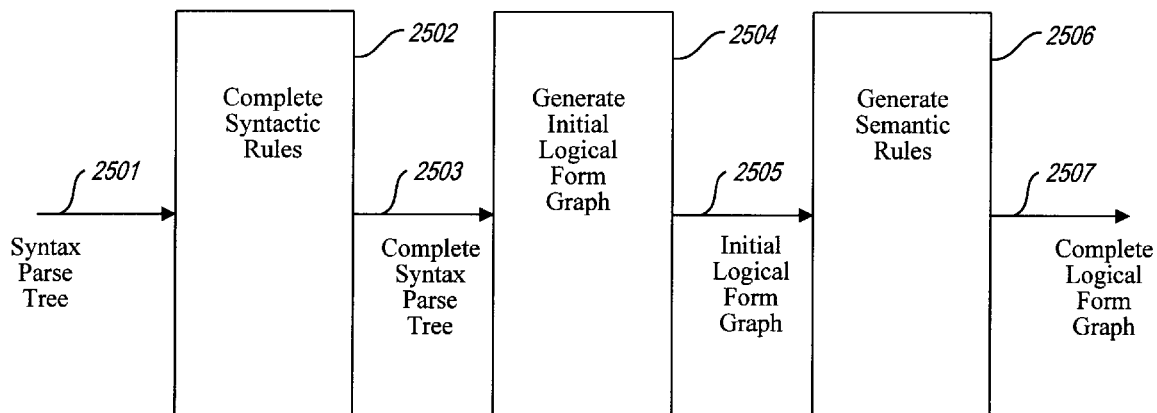
Primary Examiner—Joseph Thomas
Attorney, Agent, or Firm—Seed and Berry LLP

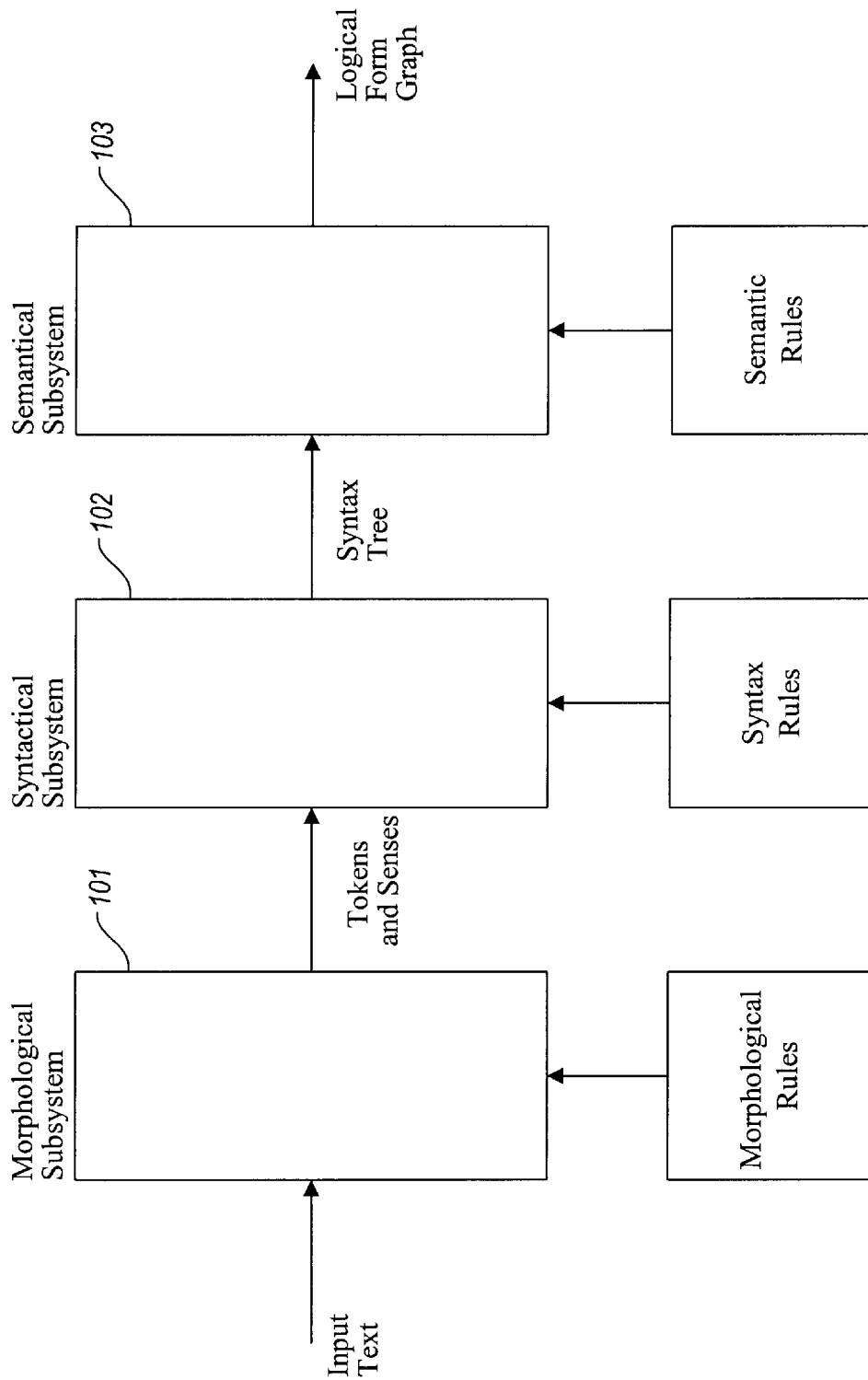
[57] ABSTRACT

Methods and computer systems for semantically analyzing natural language sentences. The natural language processing subsystems for morphological and syntactic analysis transform an input sentence into a syntax parse tree. Semantic analysis applies three sets of semantic rules to create a skeletal logical form graph from a syntax parse tree. Semantic analysis then applies two additional sets of semantic rules to provide semantically meaningful labels for the links of the logical form graph, to create additional logical form graph nodes for missing elements, and to unify redundant elements. The final logical form graph represents the complete semantic analysis of an input sentence.

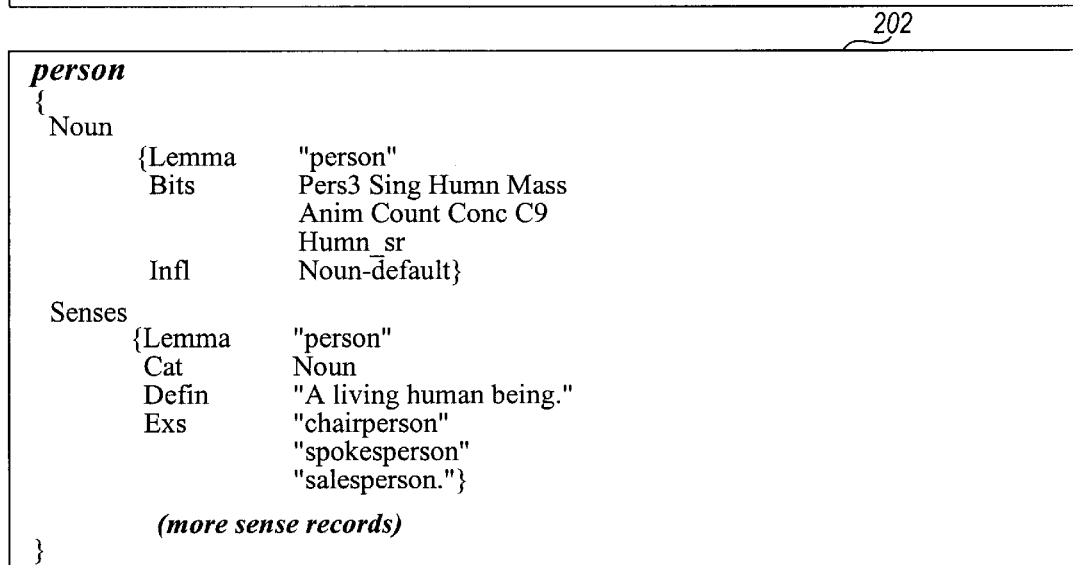
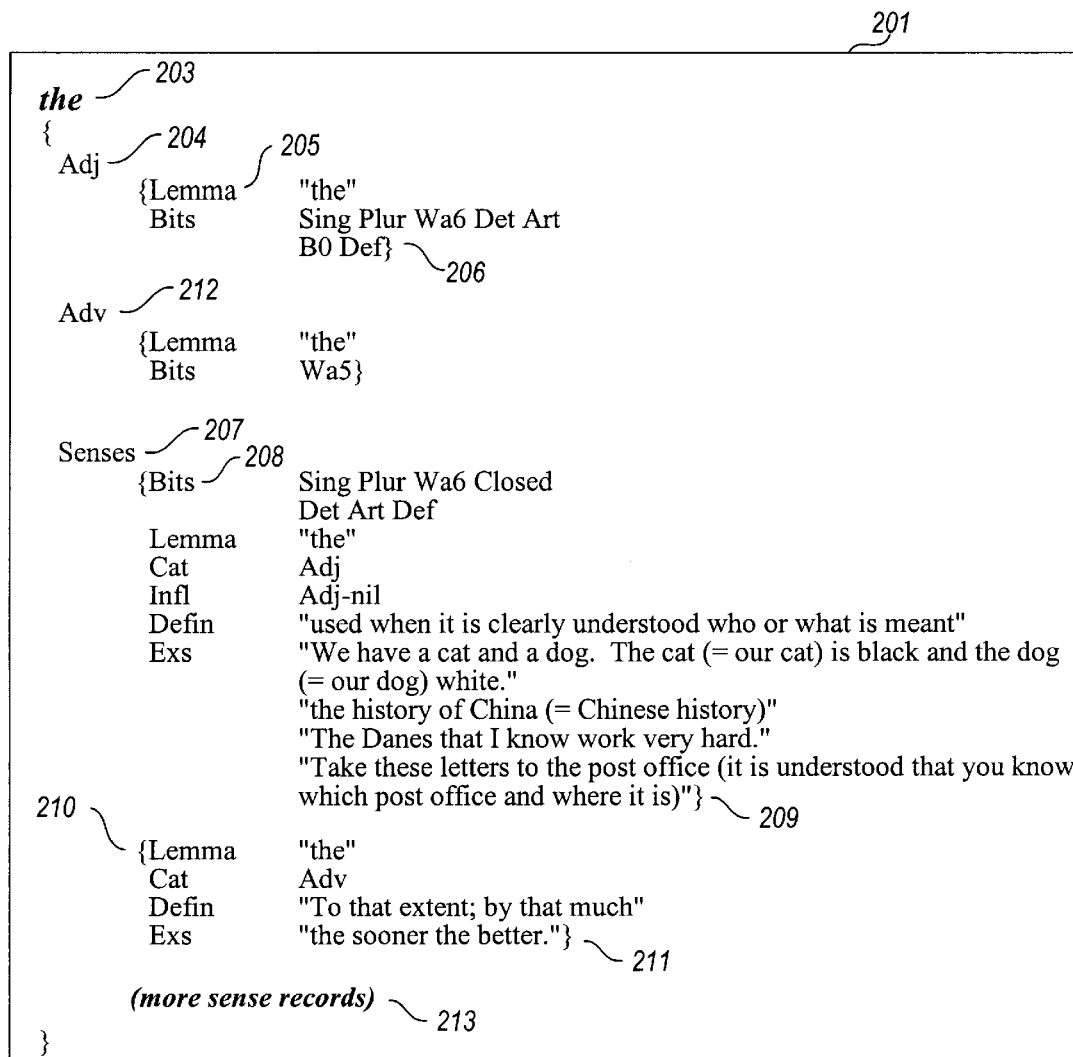
9 Claims, 69 Drawing Sheets

The New Semantic Subsystem





(PRIOR ART)
Fig. 1



(PRIOR ART) Fig. 2

whom	
{	
Pron	
	{Lemma "who"
	Bits Pers3 Sing Plur Rel Wh
	Humn Obj Anim}
Senses	
	{Lemma "who"
	Bits Pers3 Sing Plur Rel Wh
	Closed Humn Obj Anim
	Cat Pron
	Defin "(the object form of who, used esp. in writing and careful speech)"
	Exs "With whom?"
	"The man with whom he talked."
	"You saw whom?"
	"Whom did they see?"
	"the man (whom) they saw arriving"
	"a man (whom) you may know of"} (more sense records)
}	

i	
{	
Noun	
	{Lemma "i"
	Bits Pers3 Sing TakesAn
	Infl Noun-irreg}
Pron	
	{Lemma "I"
	Bits Sing Nom TakesAn Persl
	Humn Anim LexCap}
Senses	
	{Lemma "i"
	Cat Noun
	Infl Noun-irreg
	Defin "The ninth letter of the modern English alphabet."}
	{Lemma "I"
	Cat Pron
	Defin "Used to refer to oneself as speaker or writer."}
	(more sense records)
}	

met	
{	
Verb	
	{Lemma "meet"
	Bits Sing Plur Past
	Pastpart
	Infl Verb-meet}
Senses	
	{Lemma "meet"
	Bits Past Pastpart
	Cat Verb}
}	

(PRIOR ART) Fig. 3

```

was
{
  Verb
    {Lemma  "be"
     Bits   Pers3 Sing Past Pers1
     Infl   Verb-be } }

  Senses
    {Lemma  "be"
     Bits   Past Pastpart
     Cat    Verb}

  (more sense records)
}

```

```

my
{
  Adj
    {Lemma  "I"
     Bits   Wa5 Det Poss Pers1 Def
           Gen A0
     Infl   Adj-none }

  Ij
    {Lemma  "my } }

  Senses
    {Lemma  "I"
     Bits   Wa5 Closed Det Poss
           Pers1 Def Gen A0
     Cat    Adj
     Infl   Adj-none
     Defin  "belonging to me"
     Exs    "my car"
           "my mother"}

    {Cat    Ij
     Defin  "Used as an exclamation of surprise, pleasure, or dismay"
     Exs    "Oh, my! What a tiring day!"}

  (more sense records)
}

```

(PRIOR ART)
Fig. 4

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.