

FGCS Project

Knowledge Information Processing by Highly Parallel Processing

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Technical Framework of FGCS Technology

New Computer Technology oriented to
Knowledge Information Processing (KIP)

Kernel Mechanism of S/W and H/W

→ Logical Inference using KB

→ Highly Parallel Processing

Conceptual Design of FGCS Technology

Knowledge Processing

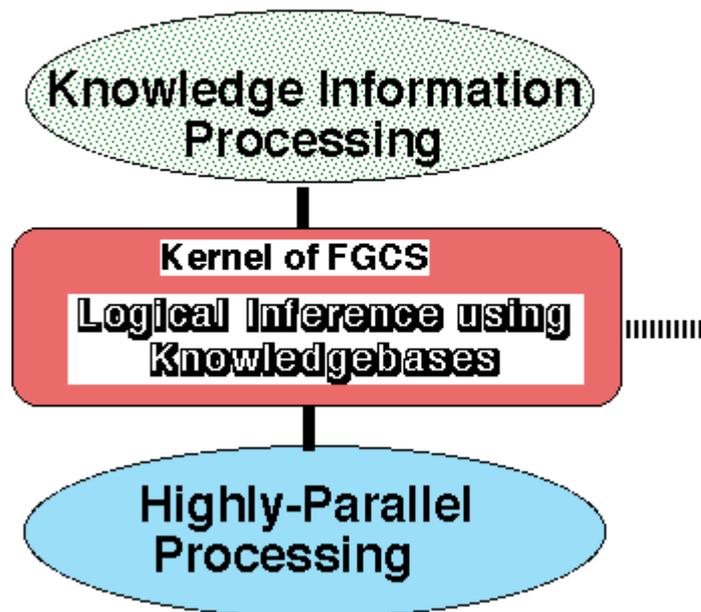
Logic Programming

Highly Parallel Processing

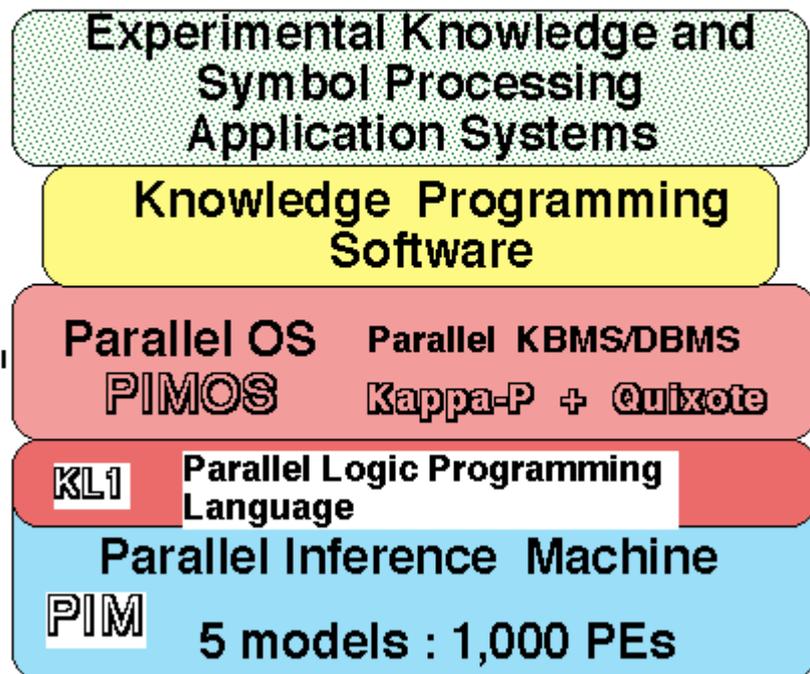
Parallel S/W Technology

Parallel H/W Technology

Technical Framework



Prototype System of FGCS



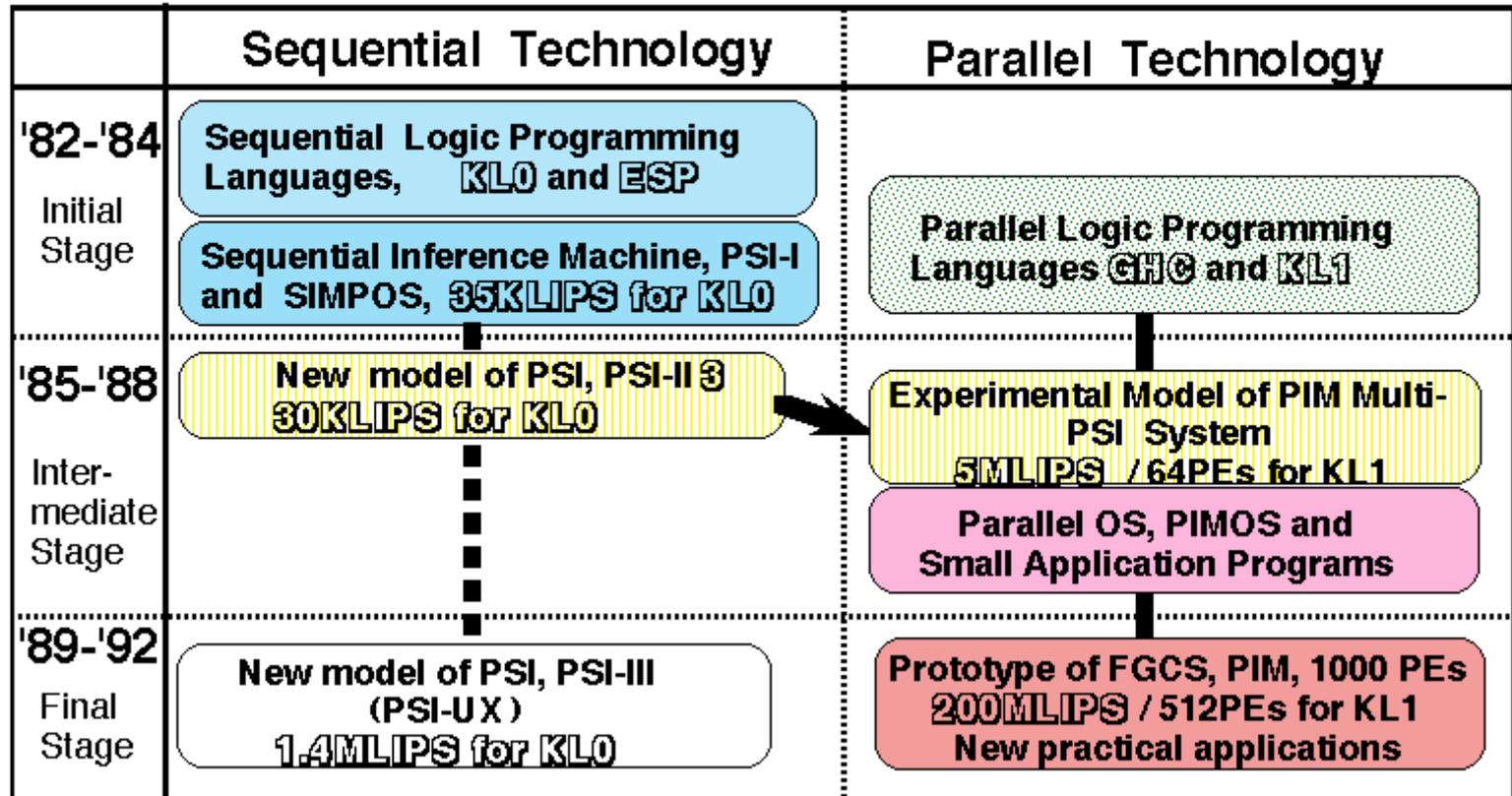
R & D Plan of FGCS Project

Fiscal Year	Goals of Stage	Budget	
'82 ~ '84 Initial Stage	Initial stage R & D of Basic Component Technology and Tools	¥8.3 B	Billion Yen ¥54.2 B
'85 ~ '88 Inter-mediate Stage	Intermediate stage R & D of Experimental Medium-scale Subsystems	¥21.6 B	
'89 ~ '92 Final Stage	Final Stage R & D of Experimental Prototype System	¥24.3 B	

FGCS Follow-on Project

'93 ~ '94	Dissemination of FGCS Technology Porting of Major Software to Unix-based Sequential and Parallel computers (ICOT Free Software, IFS)	¥2.8 B
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Developing the FGCS prototype system



FGCS Prototype System

Experimental Application Systems

Legal Reasoning System Genetic Information Processing Systems
 Parallel VLSI-CAD Systems Software Generation Support System
 Other parallel expert systems

Knowledge Programming Software

Knowledge Representations
 Quixote CLP

Natural Language
 Processing Systems

Theorem Proving
 MGTP

Parallel OS

PIMOS + KL1 Programming Env.

Parallel DBMS

Kappa-P

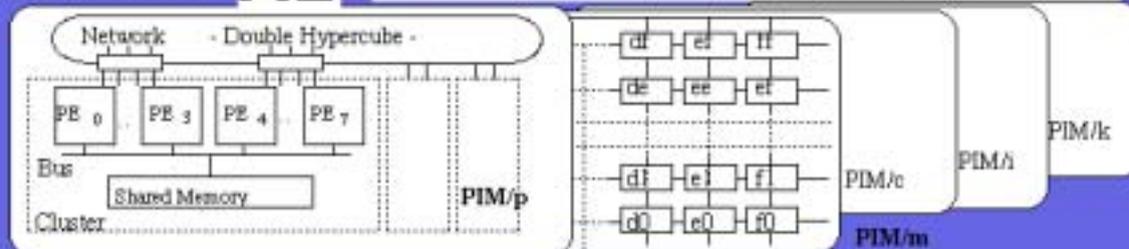
KL1

Parallel Logic Programming Language

1000PEs in total

PIM

Parallel Inference Machine (5 Modules)



Remarkable Features

of FGCS Prototype System

High Performance by Parallel Processing

Almost linear speed-up is attained.

Performance ← Proportional to No. of PEs

FGCS Prototype System

100-200 MLIPS
(256 - 512 PEs)

Mainframe System

1 - 2 MLIPS
(1 PE)

100 times faster in knowledge and symbol processing

LIPS: Logical Inference Per Second, 1 LIPS = 50 - 100 IPS

Remarkable Features

of FGCS Prototype System

High Productivity of Parallel Software

High-level parallel logic language: KL1

- Dataflow synchronization
- Automatic memory management

Efficient two phase parallel programming

- First phase: You write parallel algorithms.
- Second phase: You specify load balancing

.....▶ **10 times more productive
than conventional languages**

Typical New Applications in Symbol and Knowledge Processing

Genetic Information Processing

A Biological Sequence Analysis System

An Integrated Biological Database System

Automated Reasoning

A Parallel Theorem Prover, MGTP

Higher-level
Inference Engine

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graph LR; MGTP[A Parallel Theorem Prover, MGTP] --> HIE[Higher-level Inference Engine]; HIE --> HELICS-II[A Legal Reasoning System, HELICS-II];
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Automated Program Generation

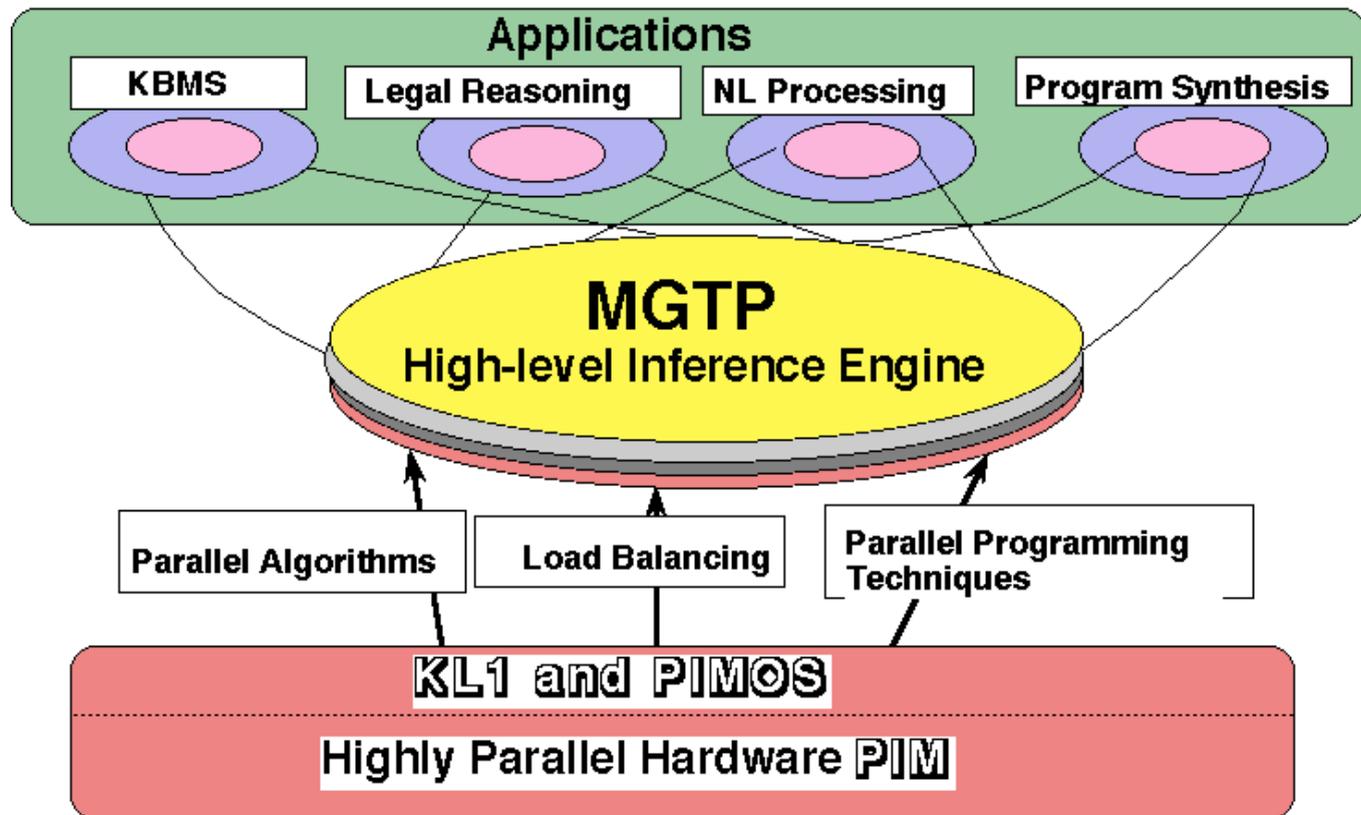
A Parallel Program Generation System,
MENDELS ZONE

Legal Reasoning

A Legal Reasoning System, HELICS-II

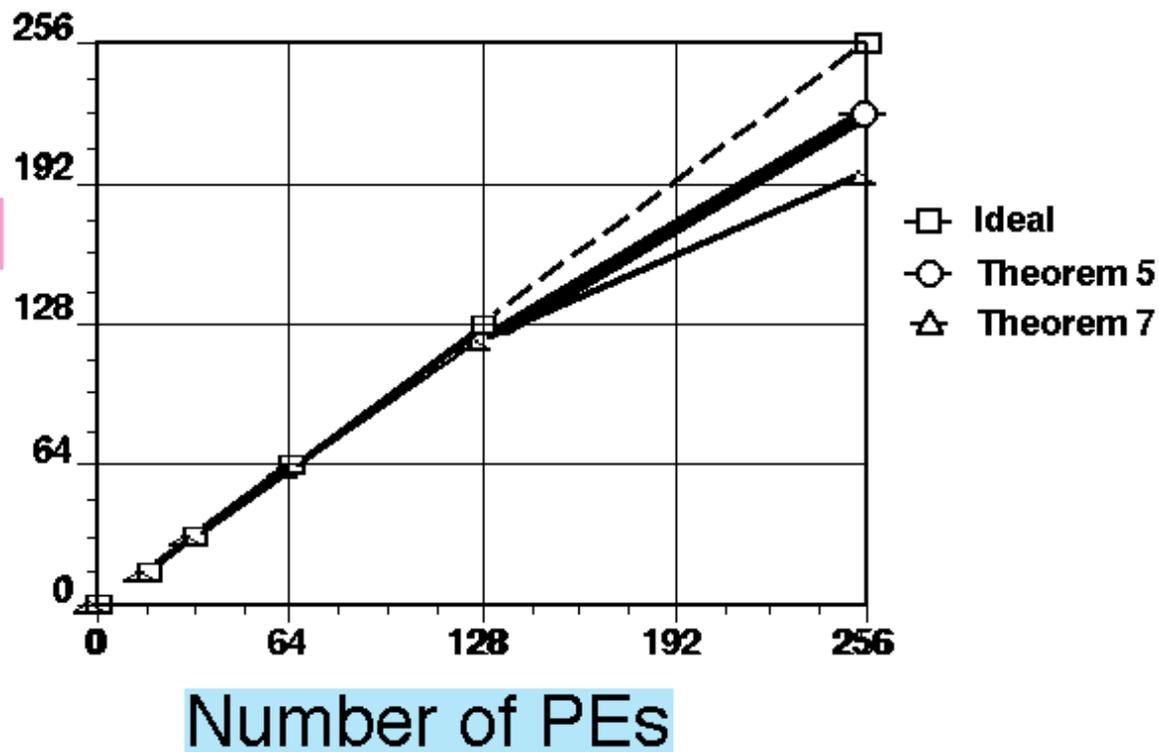
Parallel Theorem Prover: MGTP

Role of MGTP in FGCS Technology

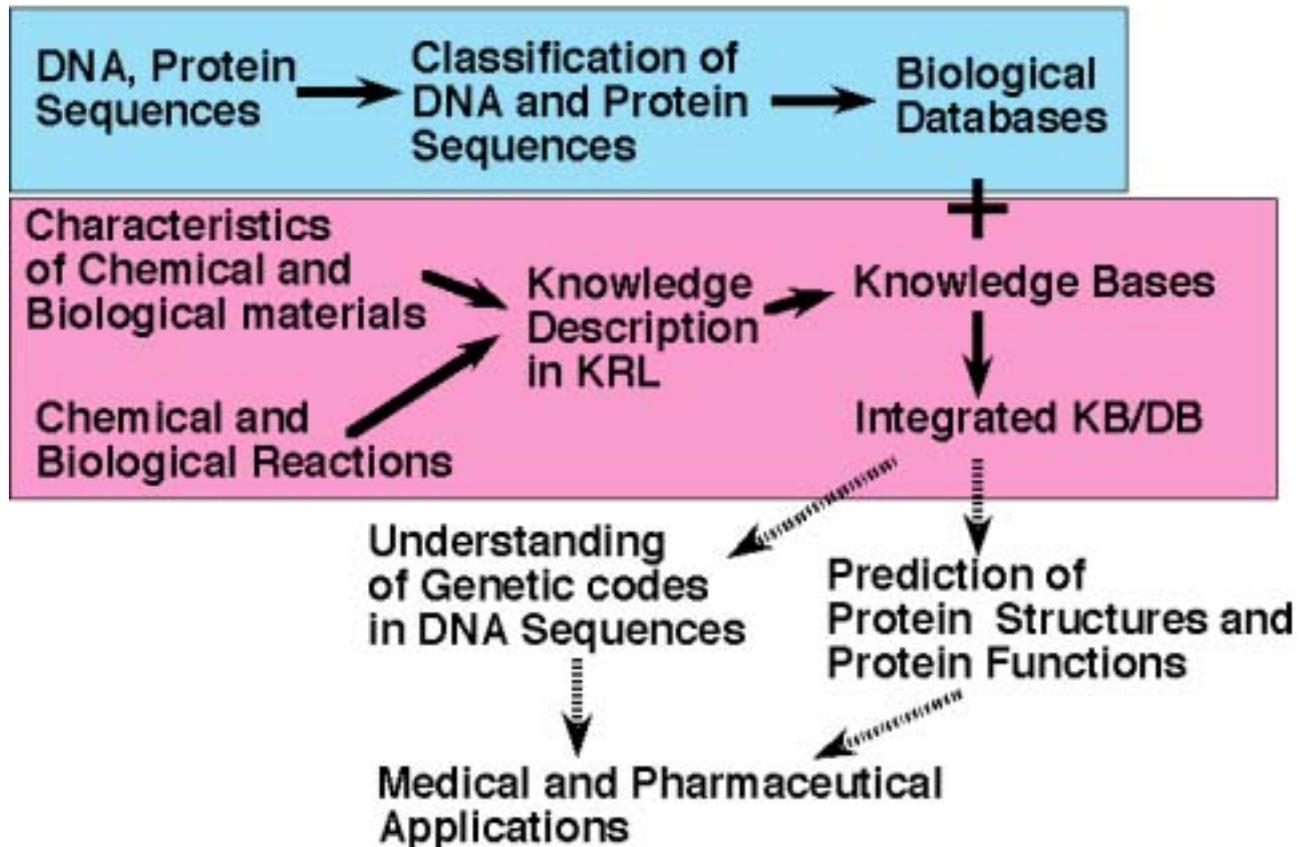


Performance Gain for MGTP/N on PIM/m

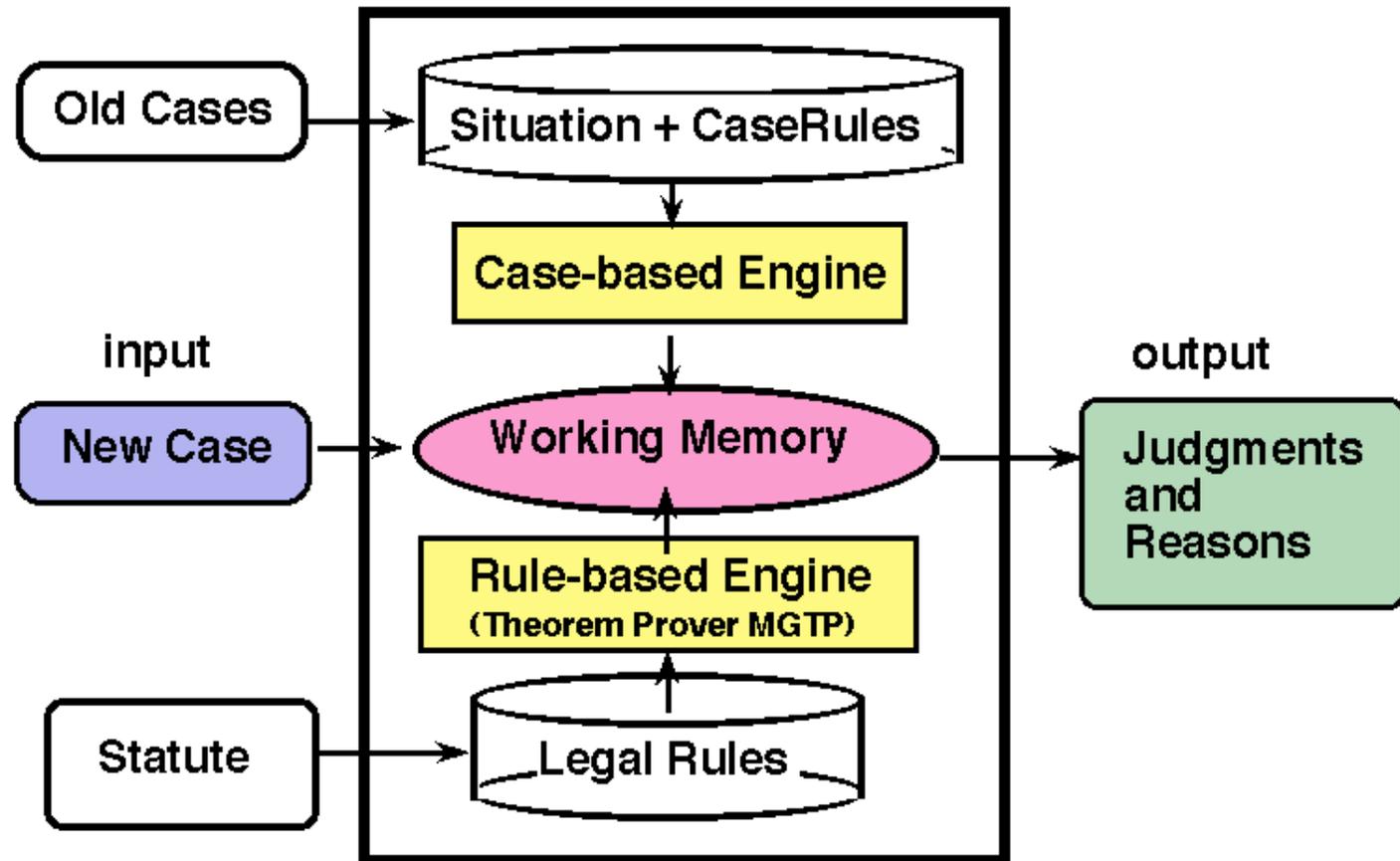
Speed-Up



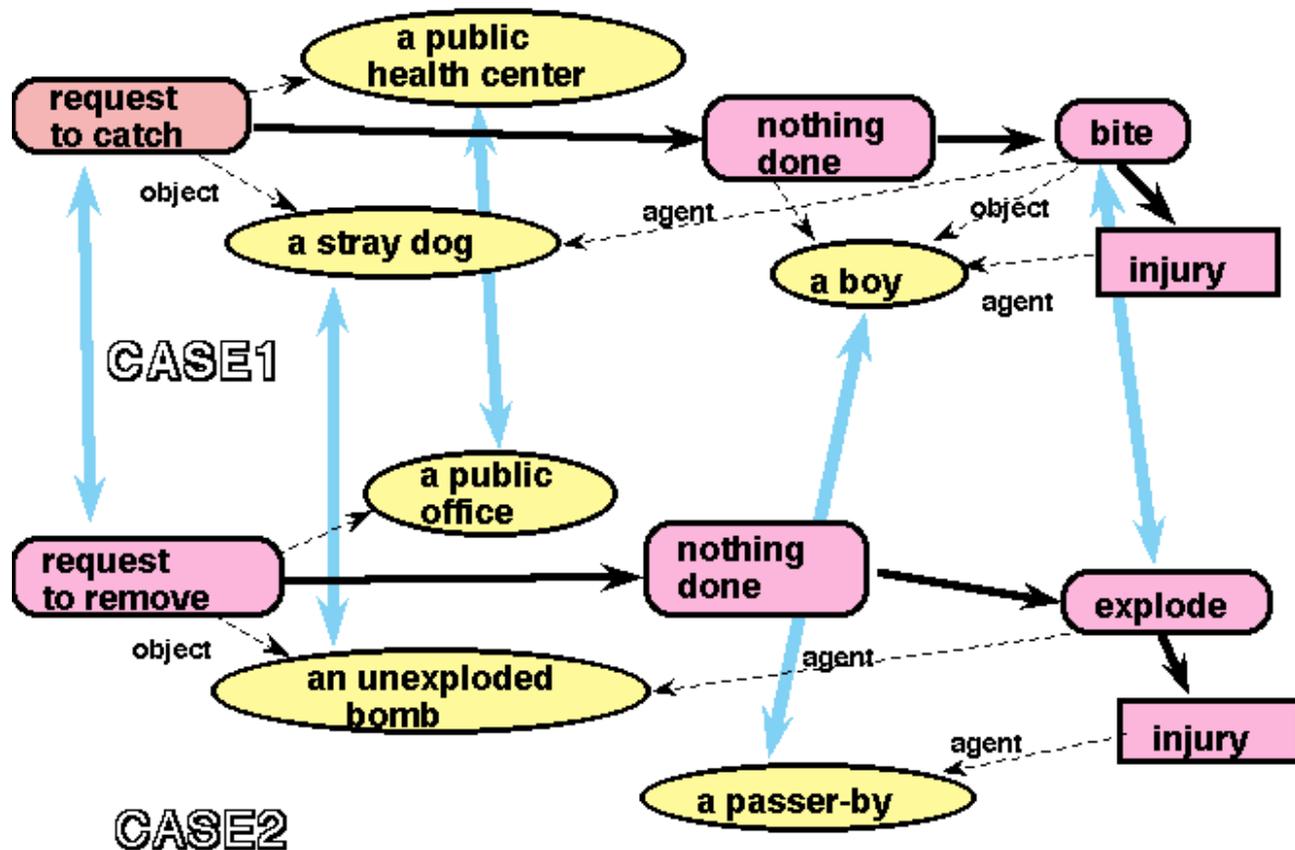
Genetic Information Processing



Structure of Legal Reasoning System: HELIC-II



Similarity Matching between Two Cases



A Two Year Follow-up Project (1993.4 - 1995.3)

Dissemination of FGCS Technology

Common Infrastructure for world's researchers

**Porting the KL1 and PIMOS environment on
Unix-based sequential and parallel computer systems**

Further development of knowledge processing software

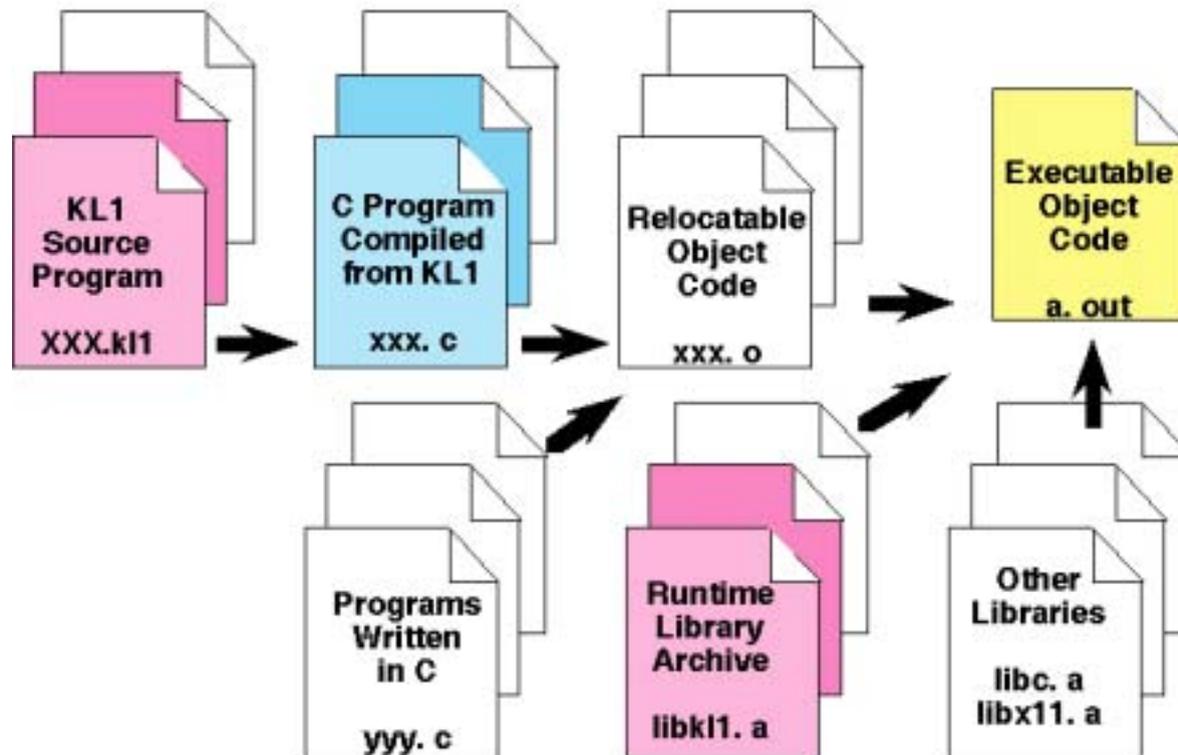
- Parallel DBMS**
- Knowledge representation languages**
- Parallel theorem proving**
- Genetic information processing**
- Legal reasoning**

ICOT Free Software (IFS)

**Free Distribution of Major Software Systems developed
in the FGCS Project and Follow-on Project**

KLIC System

Porting KL1 and PIMOS Environment
to C and Unix Environment



Future application areas for FGCS technology

