電子情報通信学会コンピュテーション研究会
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グラフ文法による図と表の処理の定式化

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土田賢省(東洋大学)
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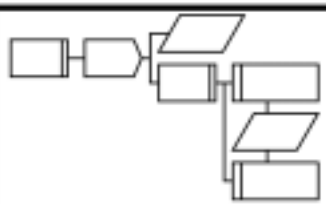
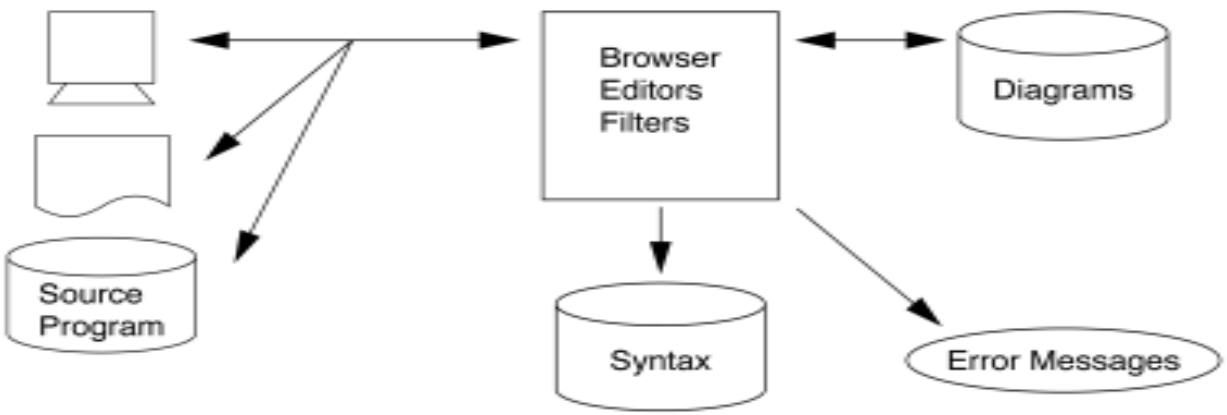
本発表: IFIP ICSE2000での発表とその後の我々の研究のまとめ

概要

- TARGET: ソフトウェア仕様書に使用する図表

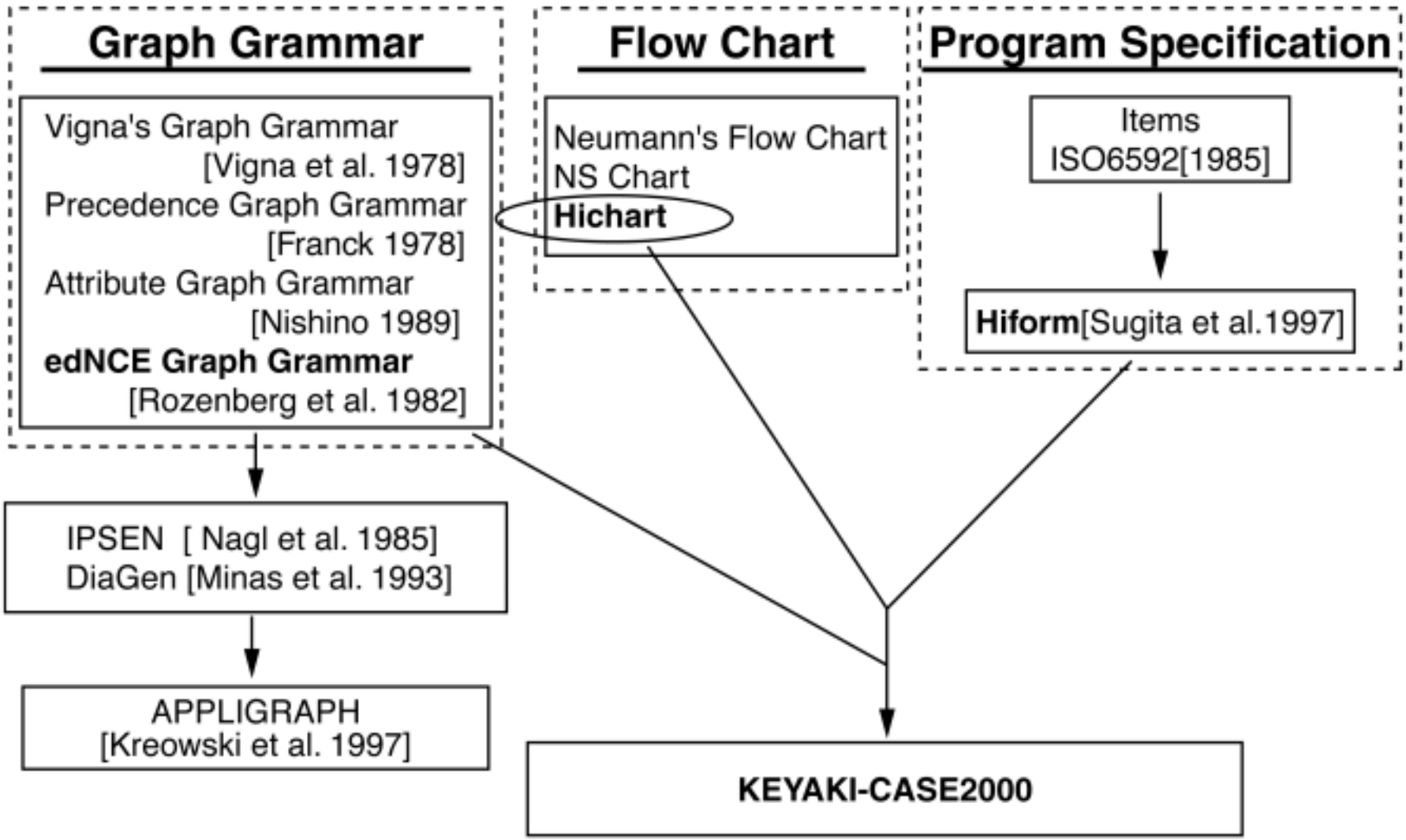
Diagrams		Corresponding Graphs	Universal Models
Hierarchical Diagram		Attribute Tree	Attribute NCE CFGG
Nested Diagram	Program Code: / Program Name: / Library Code: / **Program Specification** / Version:	Attribute Marked Tree	Attribute NCE CFGG
Tessellation Diagram	Name: x, y; Type: int, float; Size: 2, 4; G/L: G, L	Attribute Marked Tessellation Graph	Attribute NCE CSGG

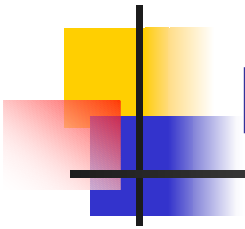
- GOAL: 図表の構文的処理システムの構築



1 はじめに

背景

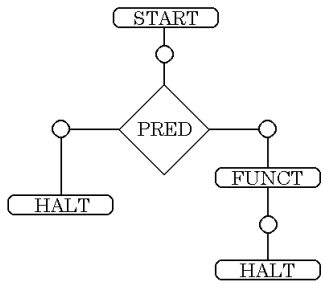
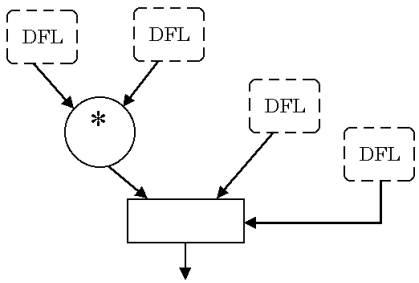
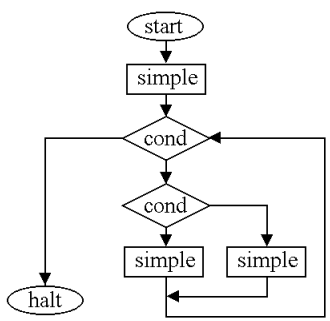

Graph Grammar
Vigna's Graph Grammar
[Vigna et al. 1978]
Precedence Graph Grammar
[Franck 1978]
Attribute Graph Grammar
[Nishino 1989]
edNCE Graph Grammar
[Rozenberg et al. 1982]
Flow Chart
Neumann's Flow Chart
NS Chart
Hichart
Program Specification
Items
ISO6592[1985]
Hiform[Sugita et al.1997]
IPSEN [Nagl et al. 1985]
DiaGen [Minas et al. 1993]
APPLIGRAPH
[Kreowski et al. 1997]
KEYAKI-CASE2000

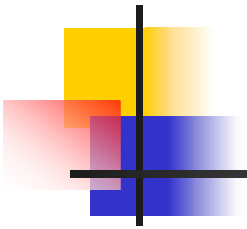


Related Works

Project Name	Program Semantics by GG	Drawing by Combinatorial Algorithm	Drawing by AGG	Syntax by Graph Grammar
IPSEN	○	—	—	○
DiaGen	—	○	○	○
KEYAKI-CASE2000	—	○	○	○

Related Works (continued)

Diagrams		Known Models	
Flowchart		CF PLEX Grammar	K.S.Fu (1982)
		Relational Grammar	K.Wittenburg Et al.(1991)
Data Flow Chart		Positional Grammar	G. Costagliola et al. (1990)
Structured Flow Chart		Symbol Relation Grammar	F.Ferruci et al. (1996)

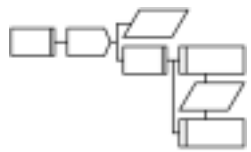
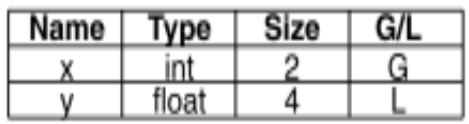


目的

- 図表の構造の構文的定義
- 図表のレイアウトに関する構文的定義
- 図表の構文を用いた処理方法(解析･編集等)
- 図表の構文的処理システム

結果

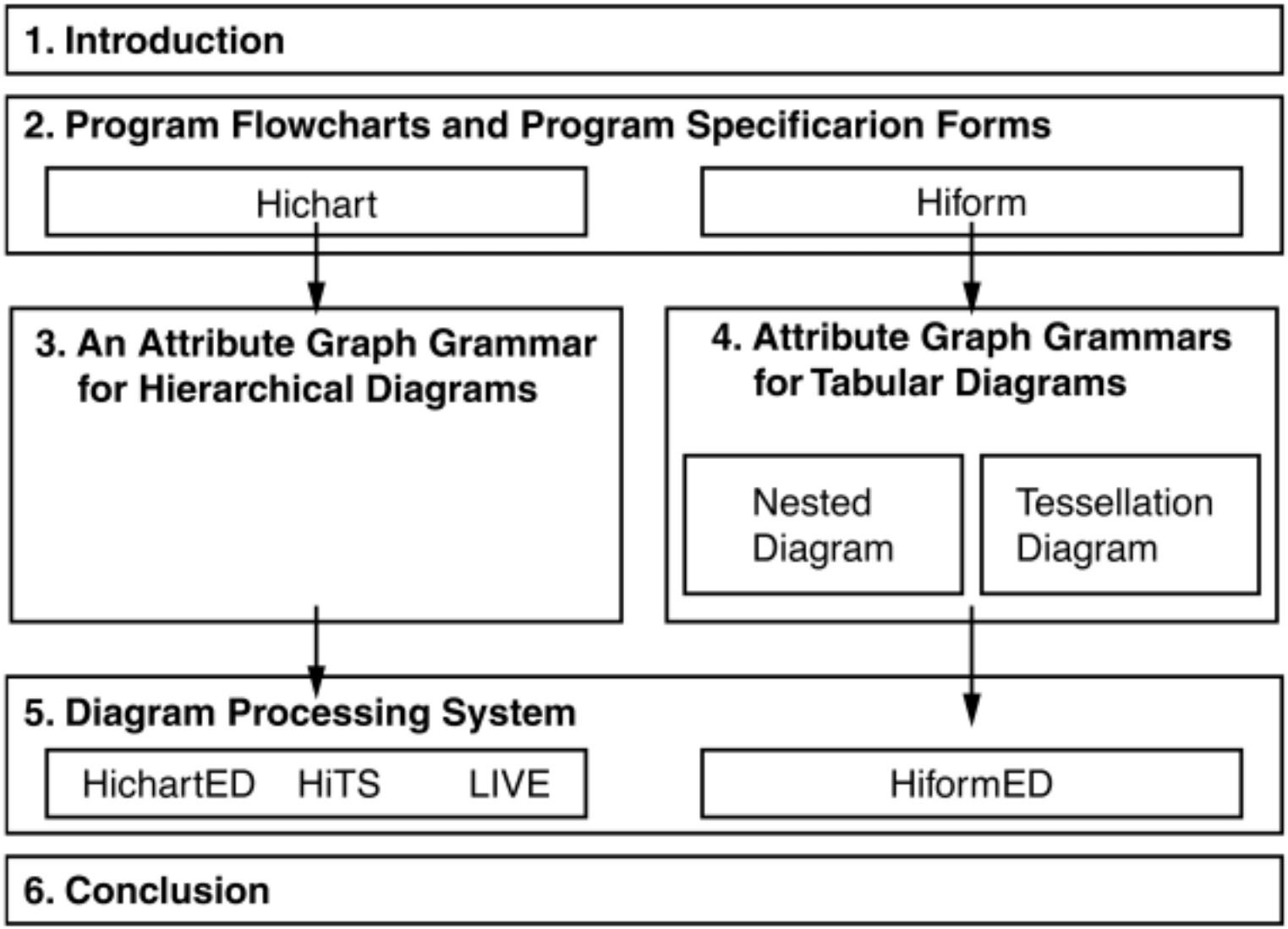
- 文法による定式化（図表の構造とレイアウト）

Graph Grammar	Grammar's type (Rewriting rule, Attribute rule)	Diagram
HCGG	*Context-free, precedence* (67, 723)	
HNGG	*Context-free, precedence* (280, 1252+280)	
HTGG	*Context-sensitive* (69, 308)	

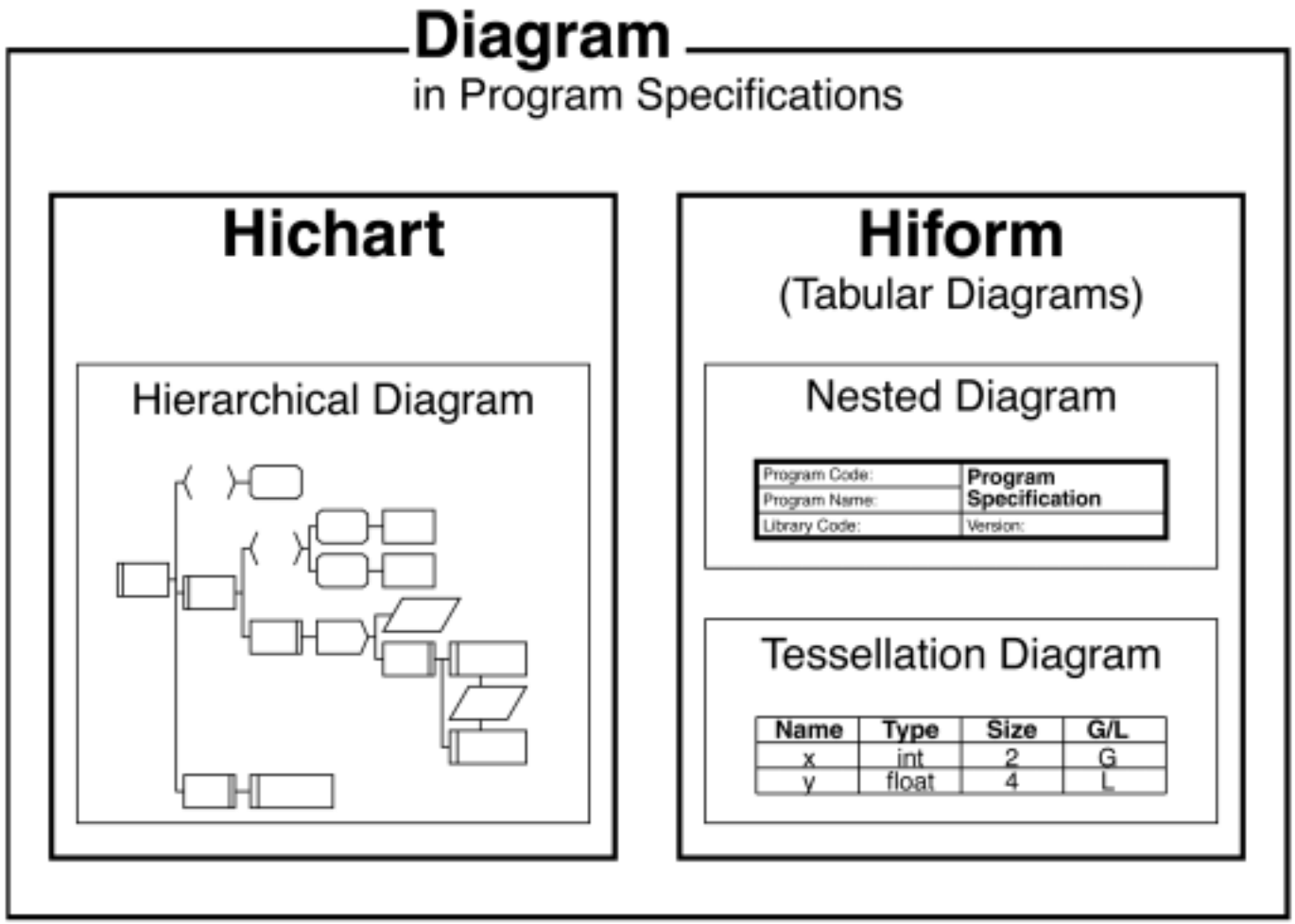
- 図表の統一的処理方法

  図表処理システム KEYAKI-CASE2000

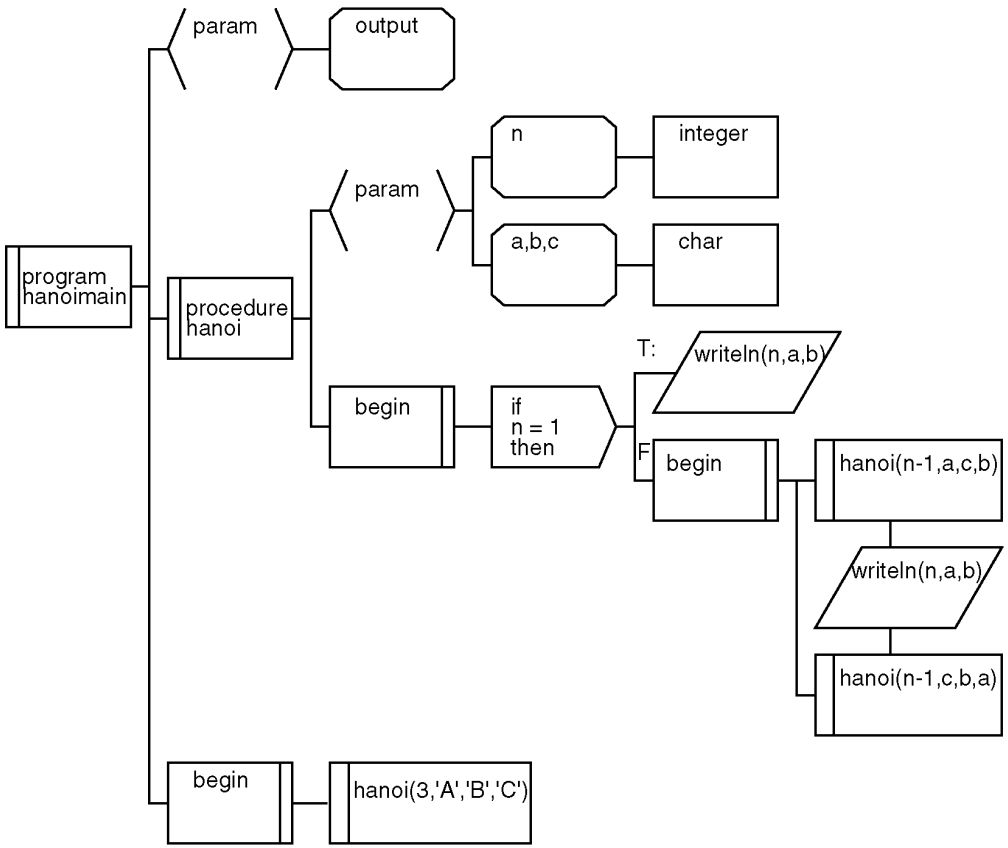
Contents


1. Introduction
2. Program Flowcharts and Program Specificarion Forms
Hichart
Hiform
3. An Attribute Graph Grammar for Hierarchical Diagrams
4. Attribute Graph Grammars for Tabular Diagrams
Nested Diagram
Tessellation Diagram
5. Diagram Processing System
HichartED HiTS LIVE
HiformED
6. Conclusion

2. プログラム流れ図とソフトウェア仕様書



2.1 階層型プログラム流れ図



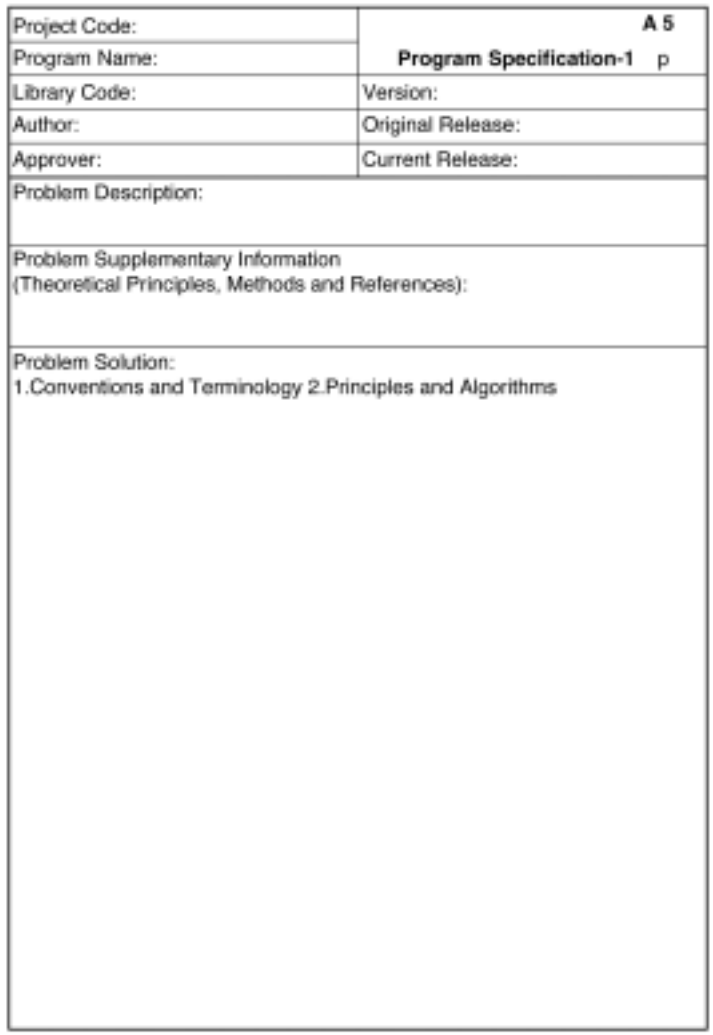
Hichart プログラム流れ図 (ハノイの塔).

2.2表形式のプログラム仕様書

Hiform

(a program specification language)

- ISO6592**の項目を含む**17**種類の様式**
- **表形式の仕様書**



Project Code:	A 5
Program Name:	**Program Specification-1** p
Library Code:	Version:
Author:	Original Release:
Approver:	Current Release:
Problem Description:	
Problem Supplementary Information (Theoretical Principles, Methods and References):	
Problem Solution: 1.Conventions and Terminology 2.Principles and Algorithms	

Project Code: hanoi_main	A 5
Program Name: procedure hanoi	**Program Specification-1** p
Library Code: cs-2000-01	Version: 2.1
Author: Tomokazu Arita	Original Release: 1999/12/25
Approver:	Current Release: 2000/1/31

Problem Description:

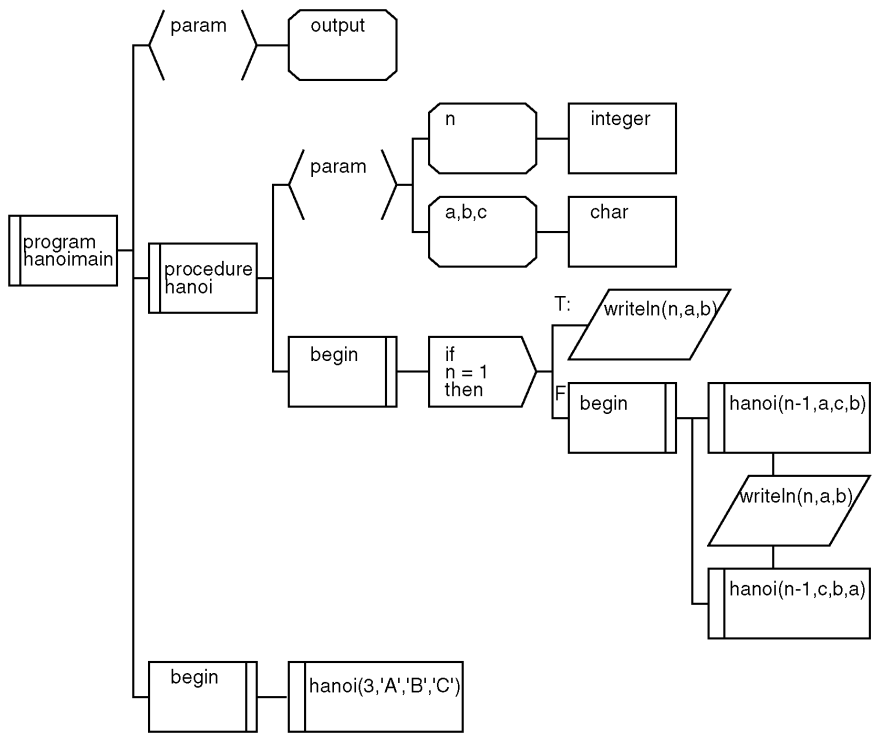
How to discribe the structure of this program.

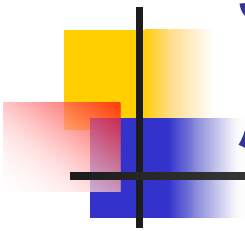
Problem Supplementary Information
(Theoretical Principles, Methods and References):

Theoretical Principles: Hichart Diagram

Problem Solution:
1.Conventions and Terminology 2.Principles and Algorithms

1. Convention : Hichart Diagram



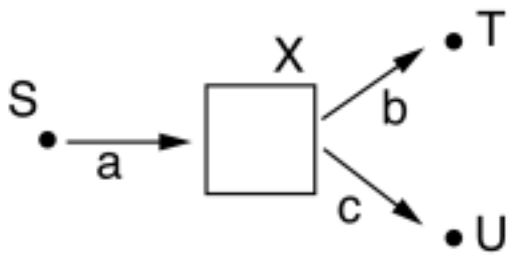


3. 階層型プログラム図を定式化する属性グラフ文法

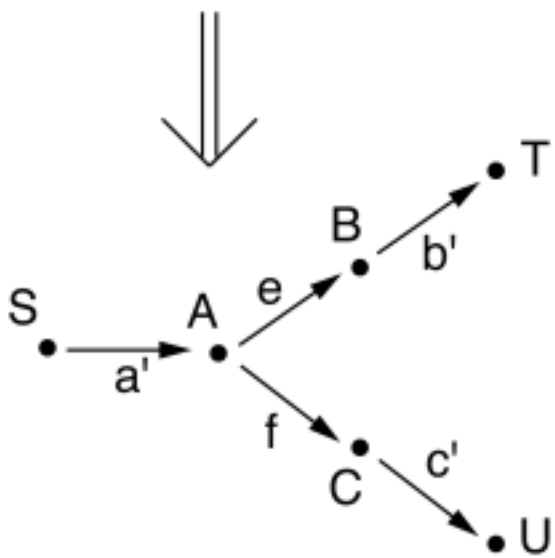
NCE (Neighborhood Controlled Embedding) Graph Grammar [Rozenberg et al. 1982]

導出例

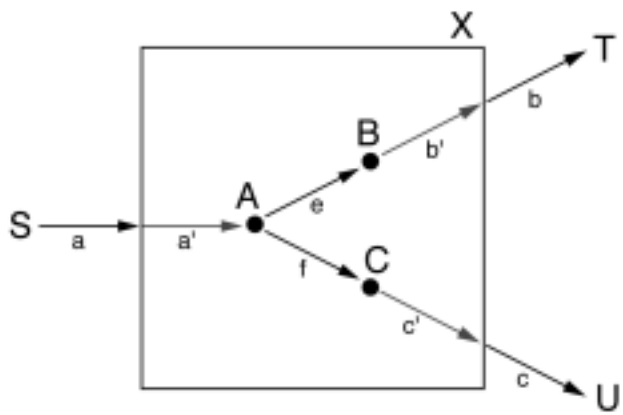
G_1:



G_2:

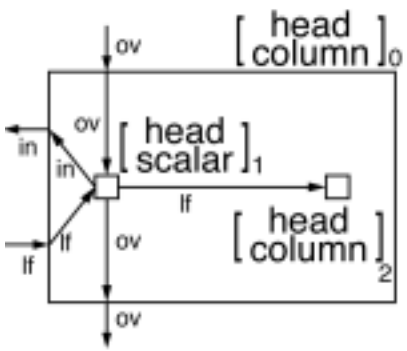


生成規則:



Attribute Context-free NCE Graph Grammar

生成規則と属性規則

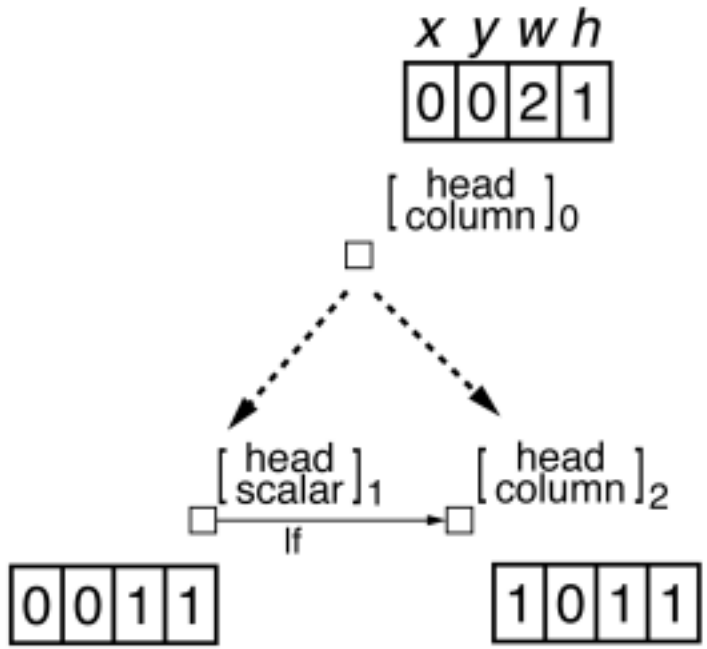


Semantic Rule

x(1) = x(0)
x(2) = x(0)+width(1)
y(1) = y(0)
y(2) = y(0)

width(0) = width(1)+width(2)
height(0) = max(height(1), height(2))

属性評価:



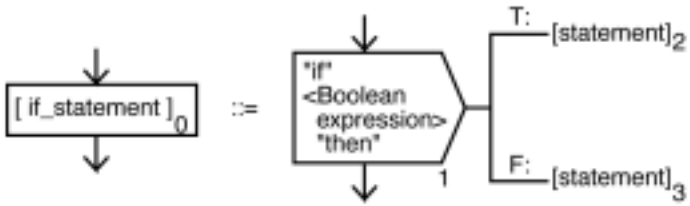
■文法 3.1 HCGG

HCGG (HiChart Graph Grammar):

Hichart**プログラム流れ図に対する**

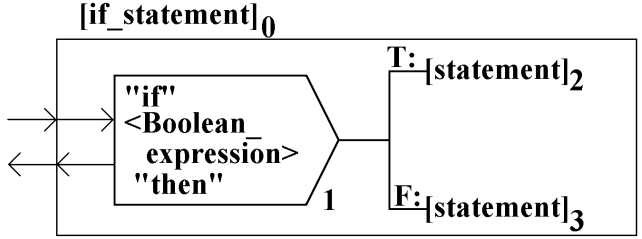
属性文脈自由NCE**グラフ文法**

Production Example of HCGG



if_statement(1)

Production



Semantic Rules

top(2)=top(0)	cl(2)="T:"
top(3)=bottom(2)+GapY	cl(3)="F:"
x(1)=x(0)	id(1)=id(0)
x(2)=x(0)+w(1)+GapX	id(2)=id(1)+1
x(3)=x(0)+w(1)+GapX	id(3)=id(2)+nc(2)
y(0)=(y(2)+y(3))/2	nc(0)=1+nc(2)+nc(3)

bottom(0)=max(bottom(1),bottom(3))

w(1)=MinW

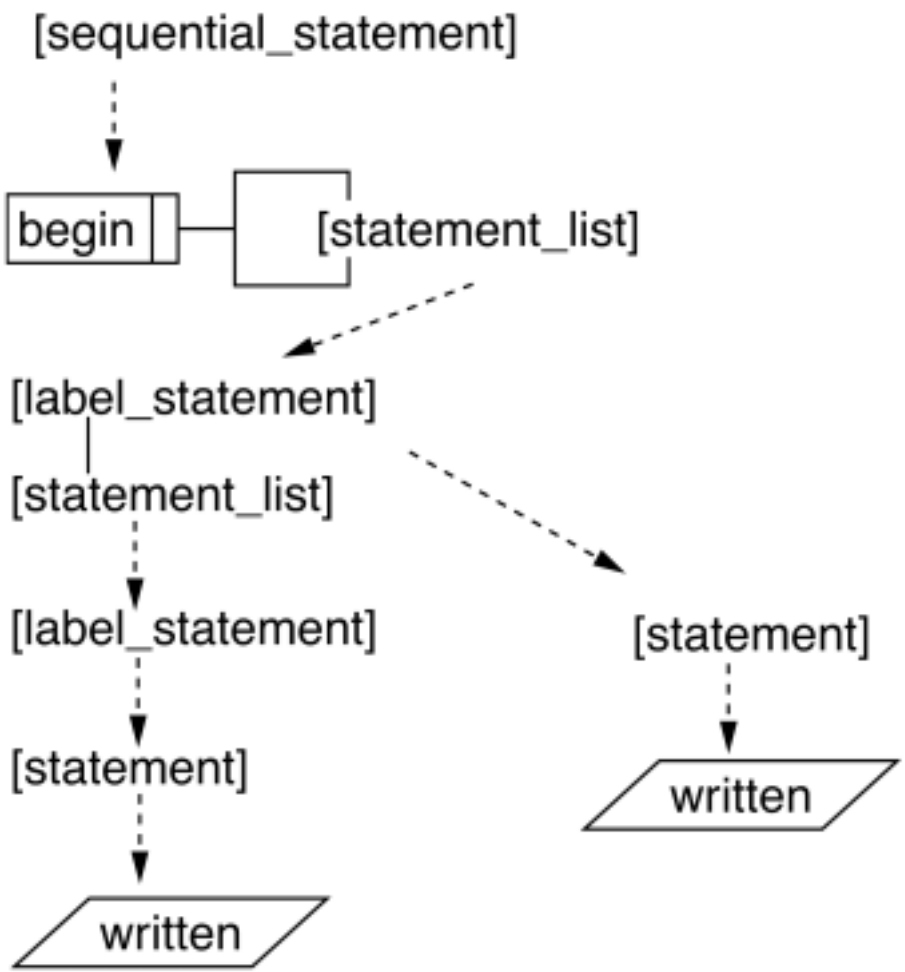
h(1)=get_height(["if",<Boolean_expression>,"then"])

cell(1)="exclusive_selection"

string(1)=get_str(["if",<Boolean_expression>,"then"])

lines(1)=get_line(1,[2,3])

HCGGの導出木


[sequential_statement]
begin
[statement_list]
[label_statement]
[statement_list]
[label_statement]
[statement]
written
[statement]
written

HCGGの特徴

GG	Type	Rewriting Rule	Attribute Rule
HCGG	**文脈自由**	67	723

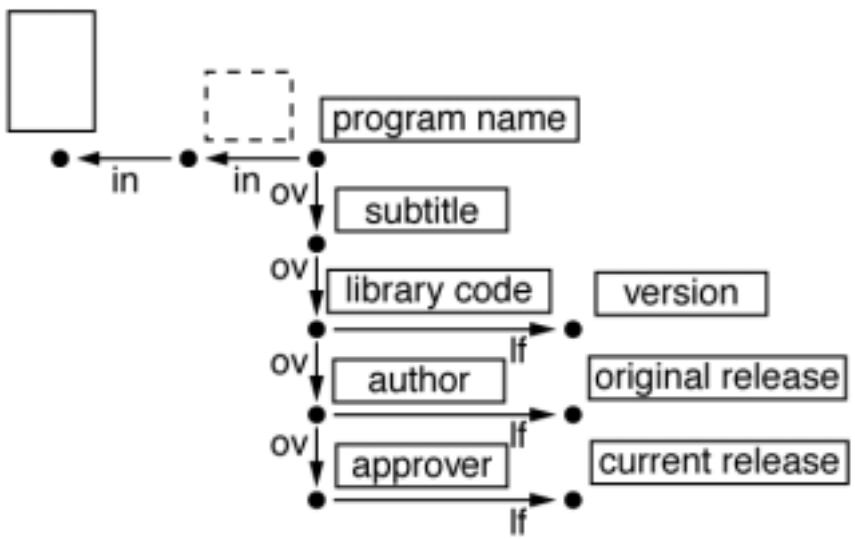
- **命題 3.2**
  ＨＣＧＧは順位グラフ文法である．

3.2 表に対する属性ＮＣＥグラフ文法

- 表とそれに対応するマーク付きグラフ

program name :	
subtitle :	
library code :	version :
author :	original release :
approver :	current release :

program name :	
subtitle :	
library code :	version :
author :	original release :
approver:	current release :



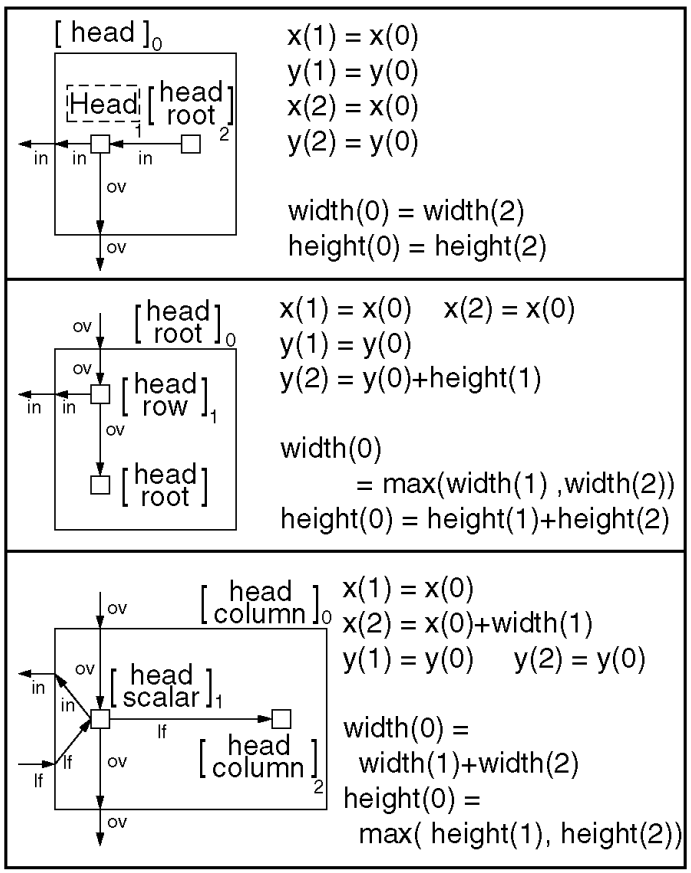
文法 4.1 HNGG

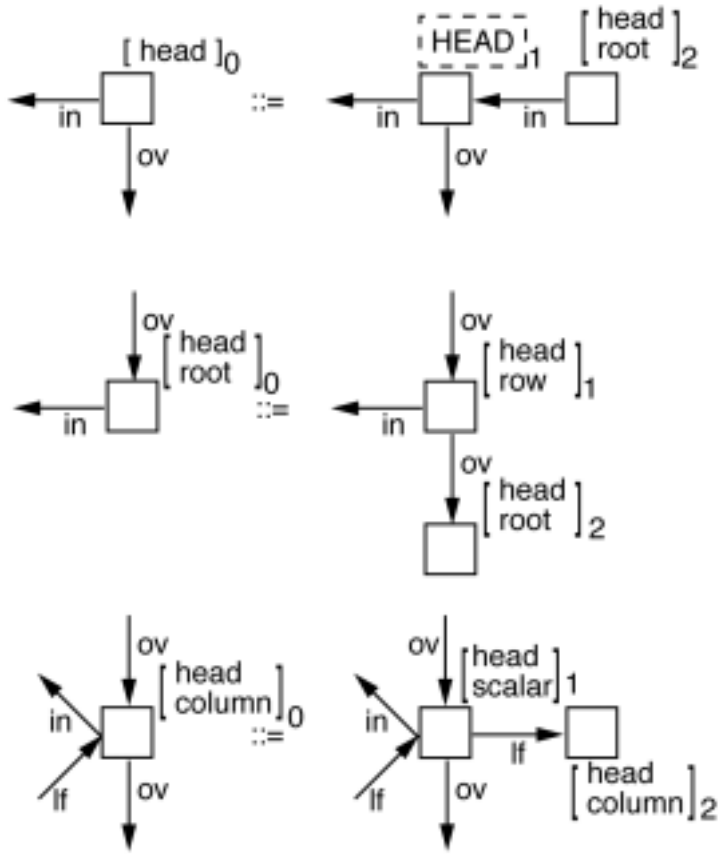
HNGG (Hiform Nested Graph Grammar) :

表形式の仕様書Hiformを定式化する

属性NCEグラフ文法

Production Examples of HNGG

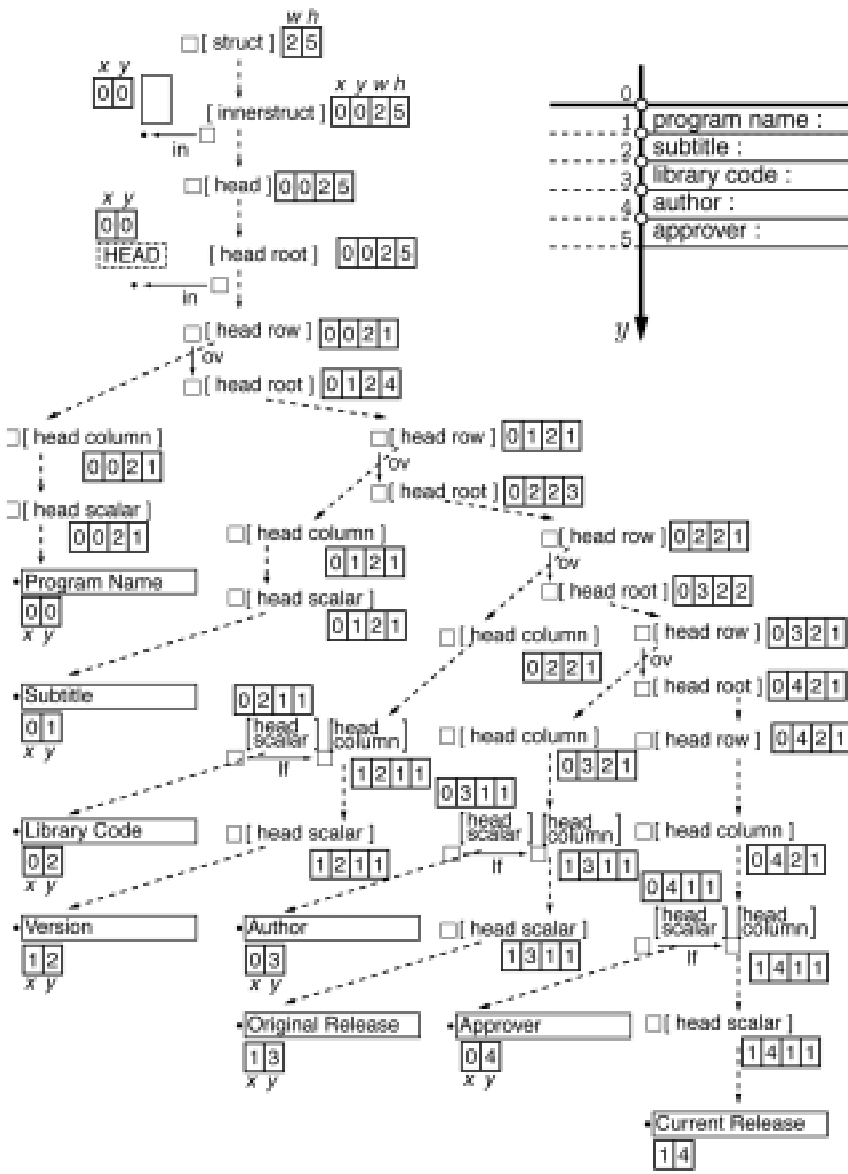


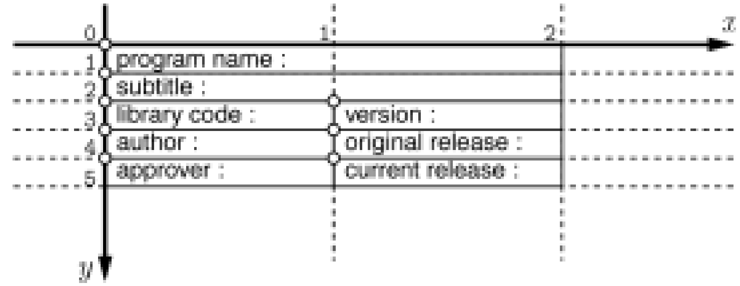


HNGGの特徴

GG	Type	Rewriting Rule	Attribute Rule
HNGG	**文脈自由**	280	1252+280

■HNGGの導出木

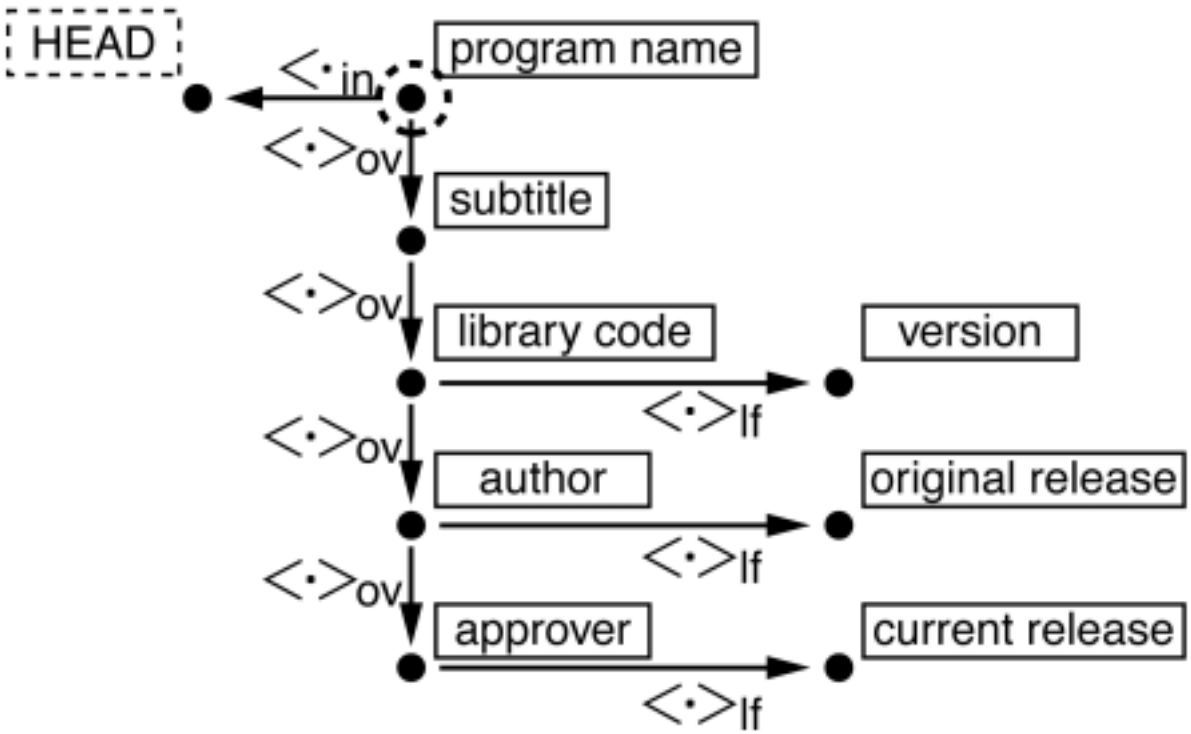

[struct]
[innerstruct]
in
[head]
HEAD
[head root]
[head row]
ov
[head column]
[head scalar]
Program Name
Subtitle
Library Code
Version
Author
Original Release
Approver
Current Release
lf
x y w h


program name :
subtitle :
library code :
version :
author :
original release :
approver :
current release :
x
y

■ 命題 **4.2**

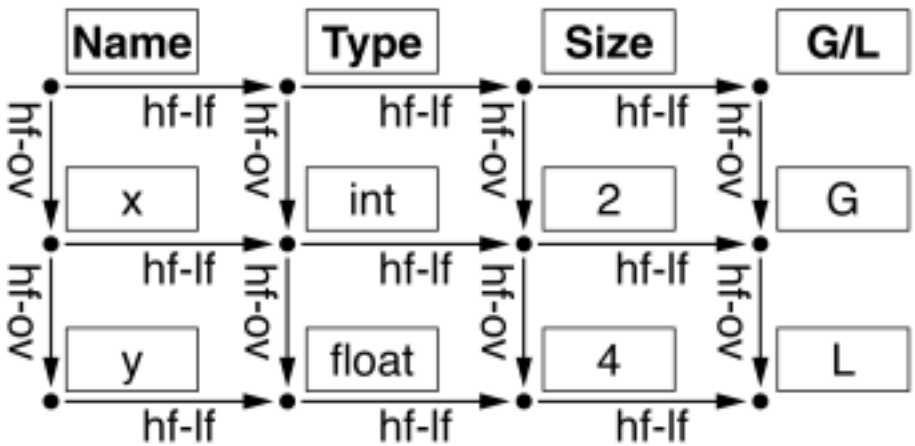
HNGG **は順位グラフ文法である.**

How to use precedence rule



- **格子状の表とそれに対応するグラフ**

Name	Type	Size	G/L
x	int	2	G
y	float	4	L

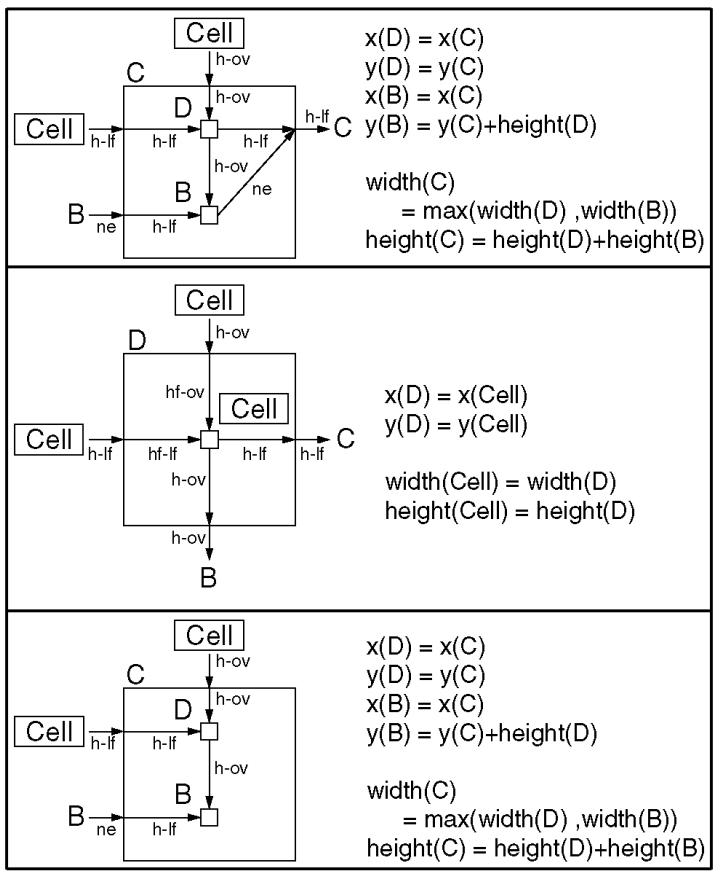


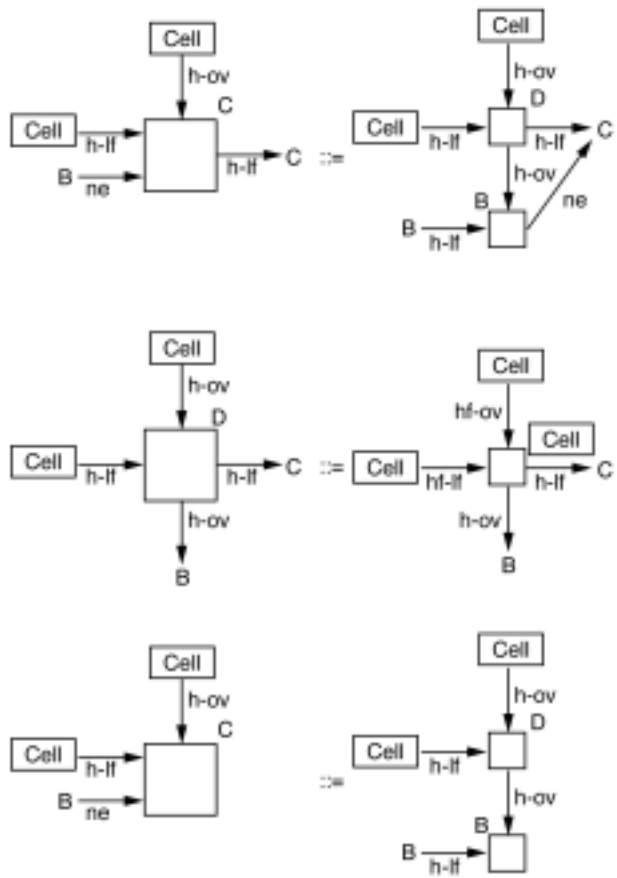
Grammar 4.3 HTGG

HTGG (Hiform Tessellation Graph Grammar):

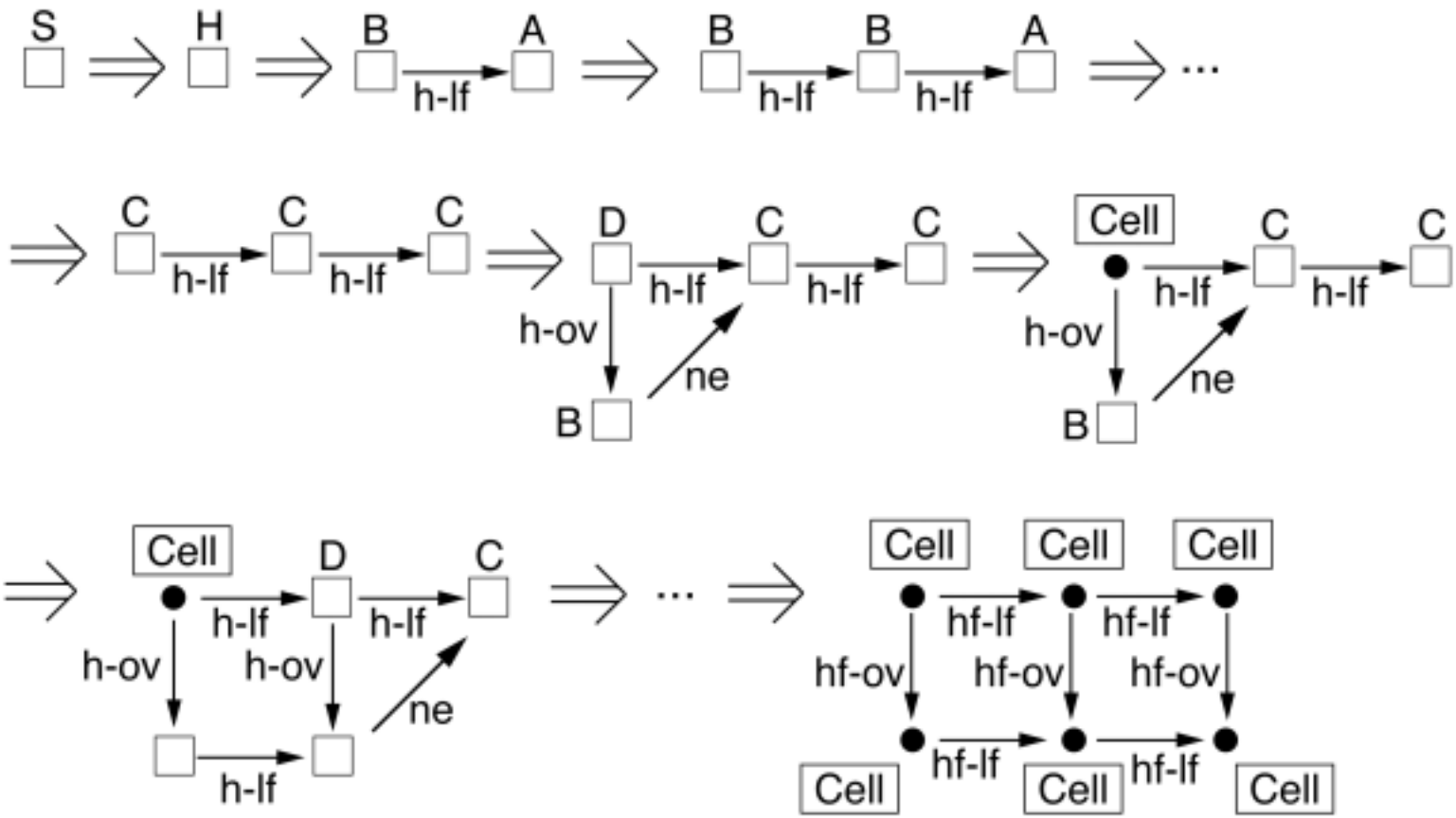
格子状の表を定式化する属性NCEグラフ文法

Production Example of HTGG





HTGGの導出


S
H
B
A
h-lf
B
B
A
h-lf
h-lf
C
C
C
h-lf
h-lf
D
C
C
h-lf
h-lf
h-ov
ne
B
Cell
C
C
h-lf
h-lf
h-ov
ne
B
Cell
D
C
h-lf
h-lf
h-ov
h-ov
ne
h-lf
Cell
Cell
Cell
hf-lf
hf-lf
hf-ov
hf-ov
hf-ov
hf-lf
hf-lf
Cell
Cell
Cell

HTGGの特徴

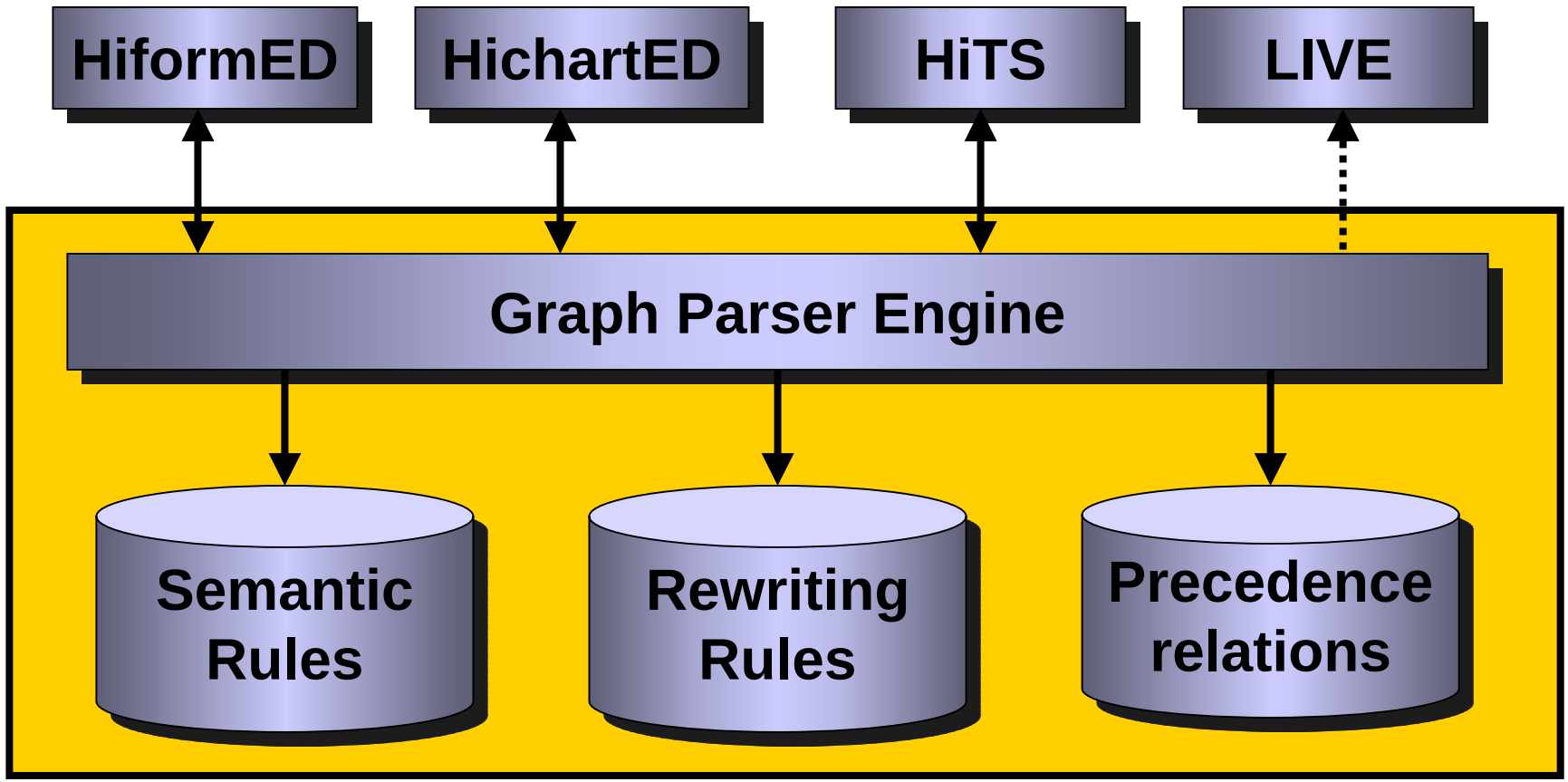
GG	Type	Rewriting Rule	Attribute Rule
HTGG	**文脈依存**	69	308

5. 図表処理システム

KEYAKI – CASE2000 Concept

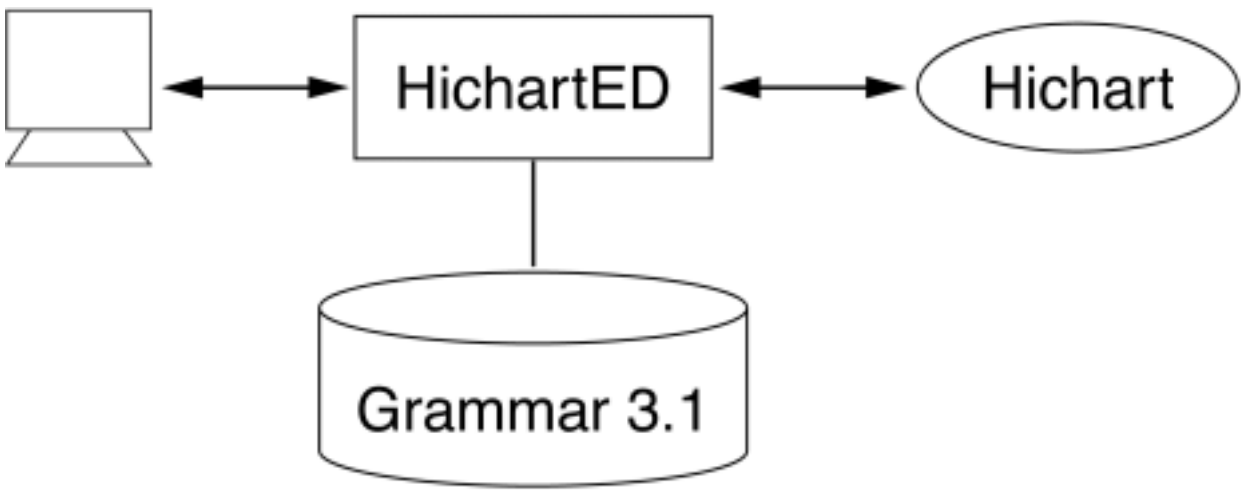
1. **HichartED**
   Hichart**プログラム図編集コンポーネント**
2. **HiTS**
   Hichart **プログラム図フィルタリングコンポーネント**
3. **LIVE**
   プログラム変数解析コンポーネント
4. **HiformED**
   Hiform **プログラム仕様書編集コンポーネント**

Keyaki-case 2000

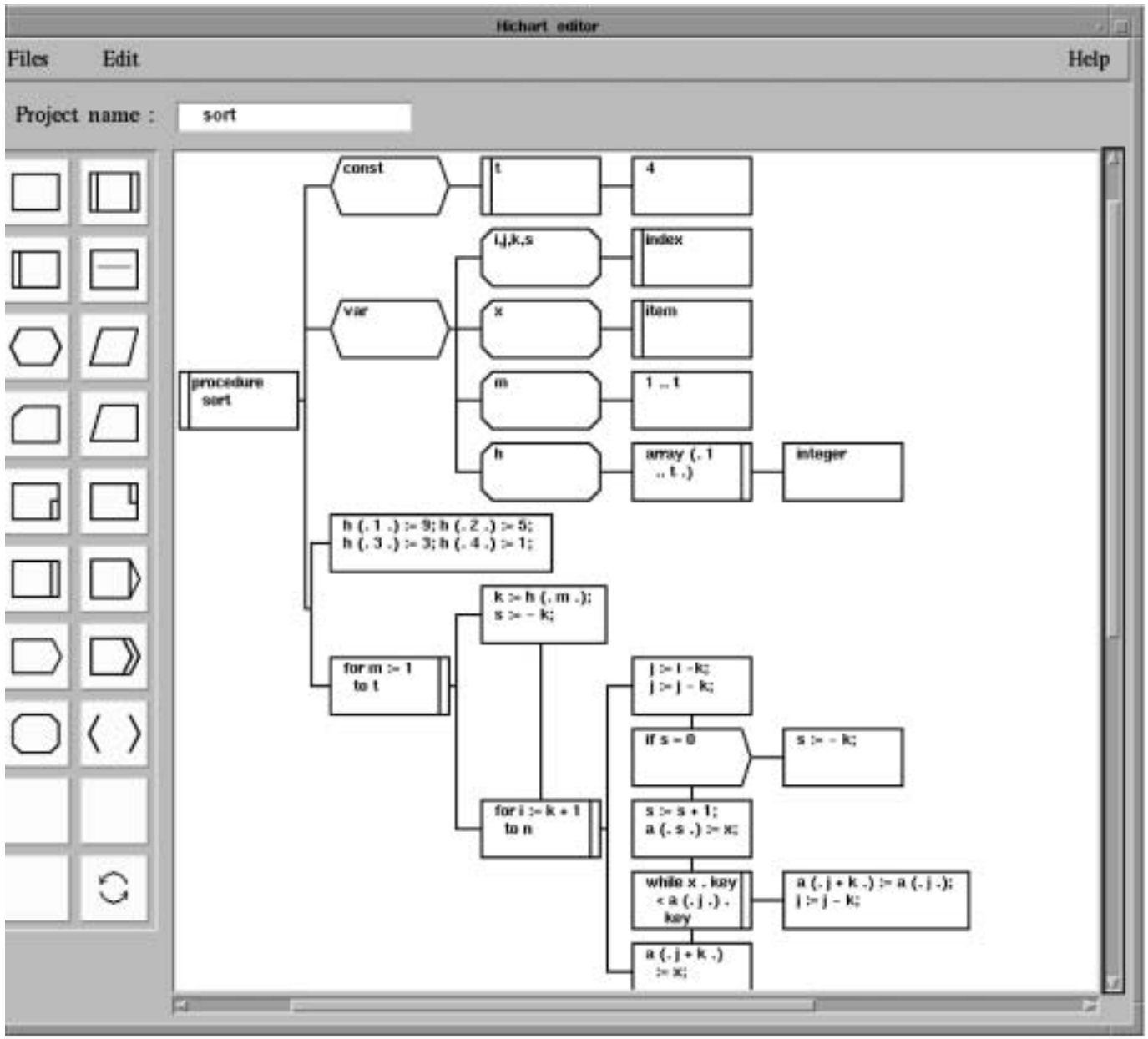


5.1 HichartED

- Hichart**流れ図作成･編集コンポーネント**
- **構文指向型エディタ**
- **編集方法は構文に基づいて定式化**



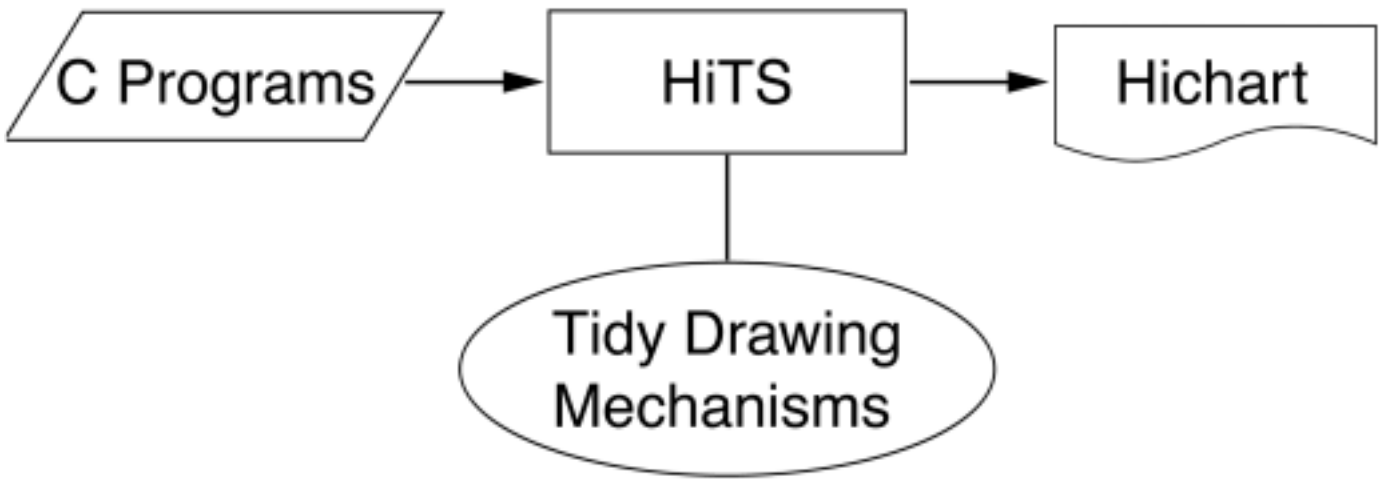
Screen Concept of HichartED



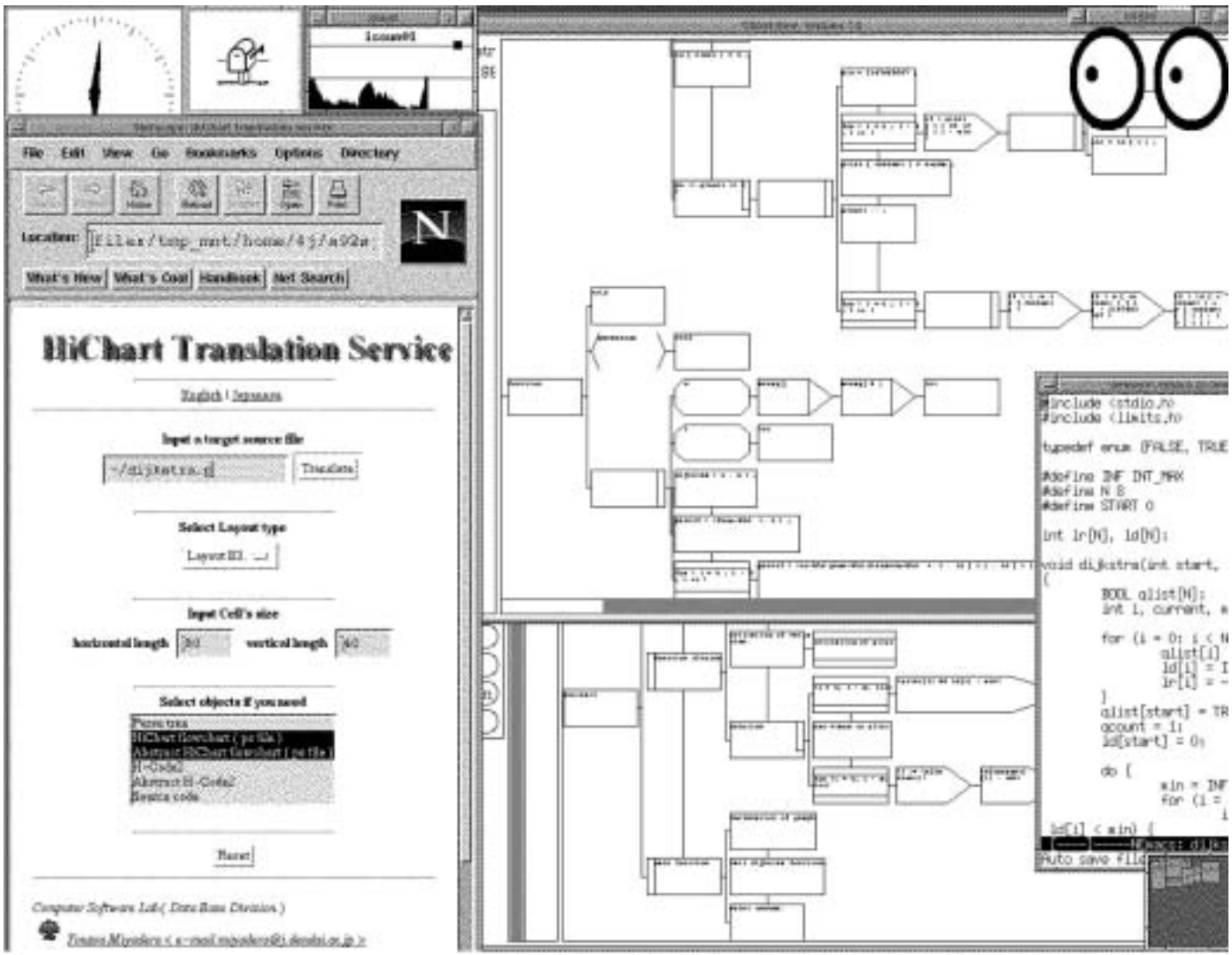
5.2 HiTS

Miyadera et.al [7,9]

- プログラム流れ図フィルタリングコンポーネント
- ソースからプログラム図を生成する.
- 木構造図の美的描画処理による描画
- データ構造や処理の流れの視覚化支援



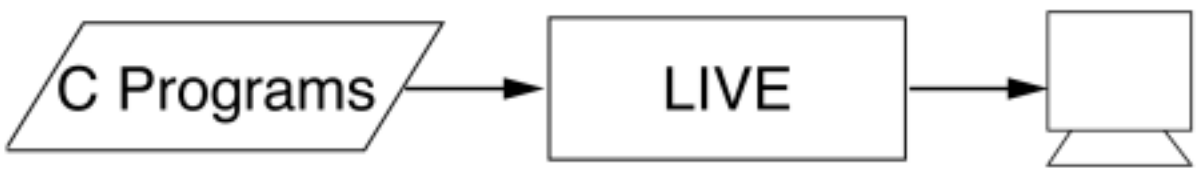
Execution Screen in HiTS



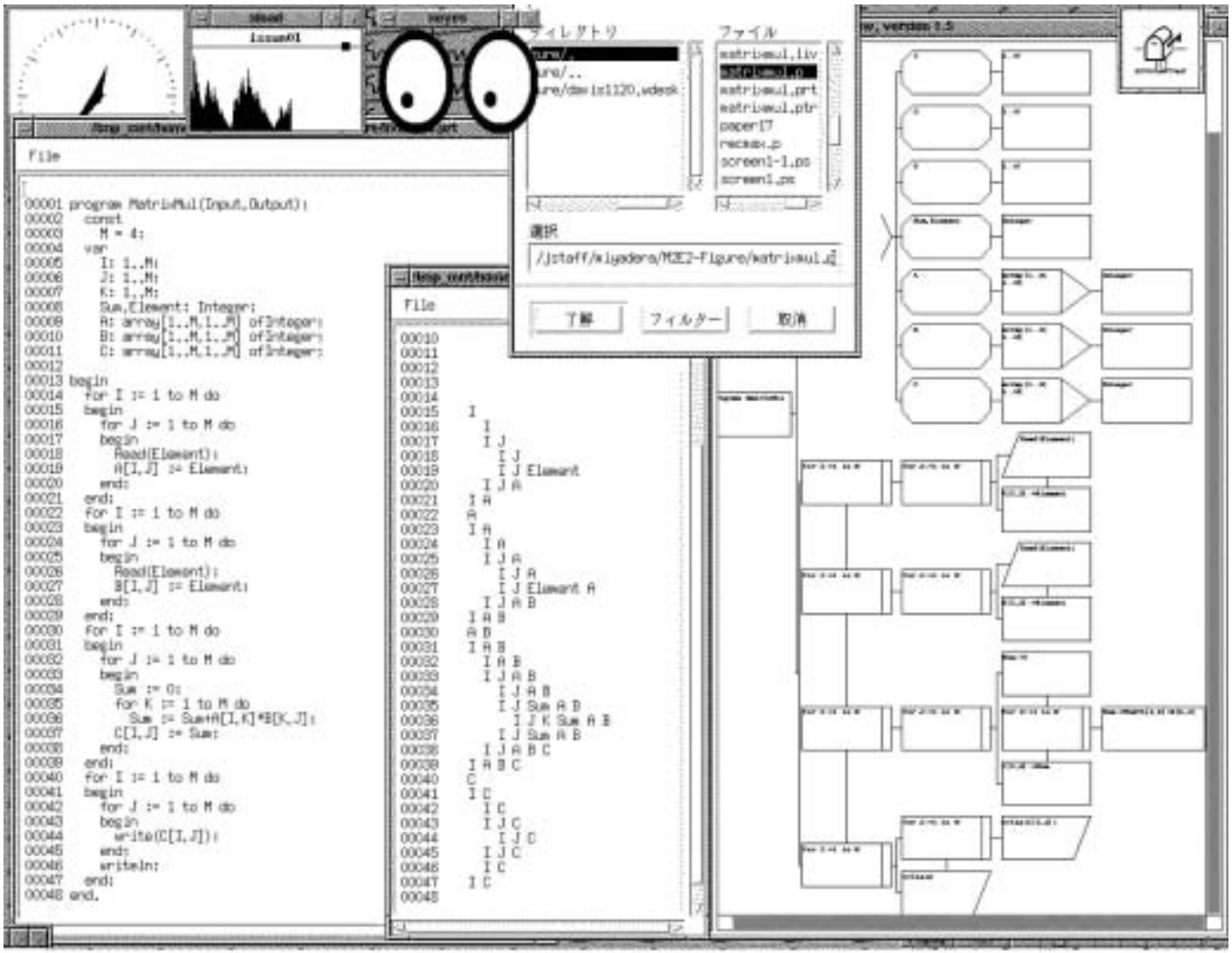
5.3 LIVE

Miyadera et.al. [9]

- プログラム変数解析コンポーネント
- プログラムモジュール化を支援

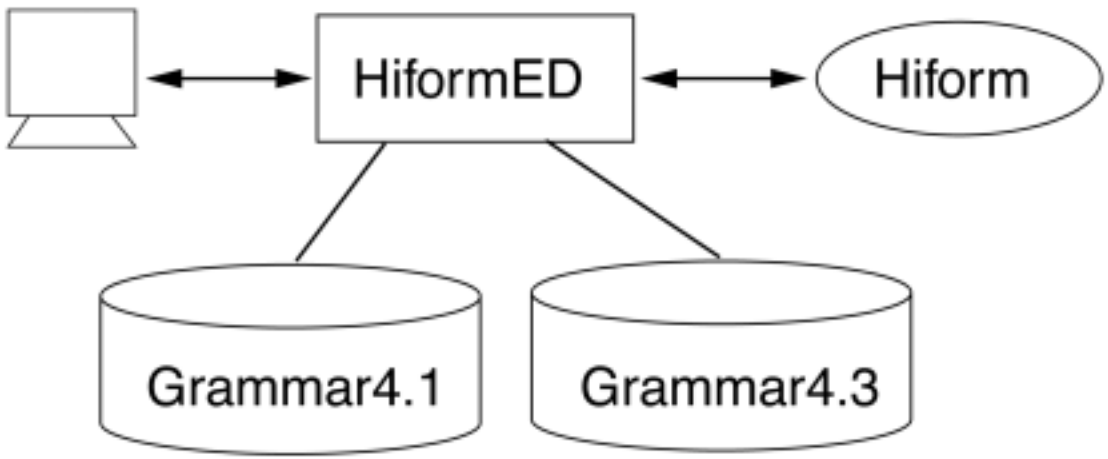


Execution Screen in LIVE

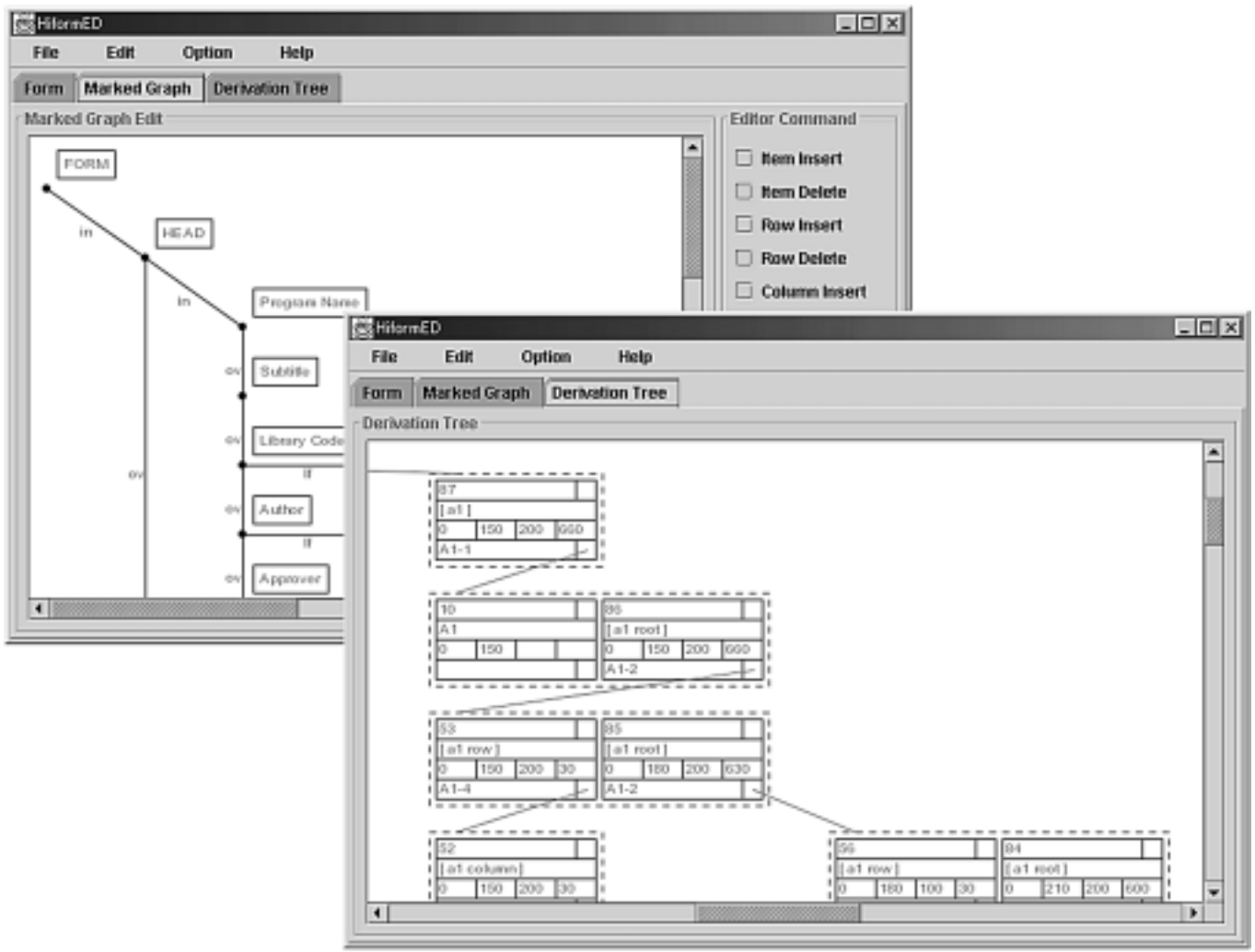


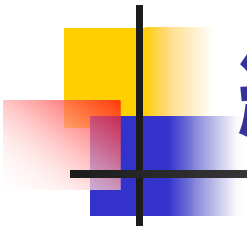
5.4 HiformED

- **プログラム仕様書**Hiform**編集システム**
- **文法**4.1**に基づくパーサーは開発済み**
- **文法**4.1**に基づいた編集方法は一部定式化** [**有田**, GT-VMT02]
- **属性評価による**XML**ソースの出力可能**
  XML Viewer**による閲覧可能** [**井上等**, IASTED AI2002]



Screen Concept of HiformED





結論

- 図表の構造を属性グラフ文法により定式化した.
- 図表のレイアウトを属性グラフ文法により定式化した.
- 図表の統一的処理方法を提案した.

- 統一的処理システムは現在開発中

6. 結論 (つづき)

System	NCE GG	System with NCE GG	System without NCE GG
HichartED	△	△	○
HiTS	○	Not yet	○
LIVE	Not yet	Not yet	○
HiformED	△	△	△

Our Project Web Site :

Including detailed description of Graph Grammars

- **URL:**

  http://www.hichart.org/