Shape Inference by Parsing & Enumeration

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1. Motivation

► To infer shapes of heap data structures.

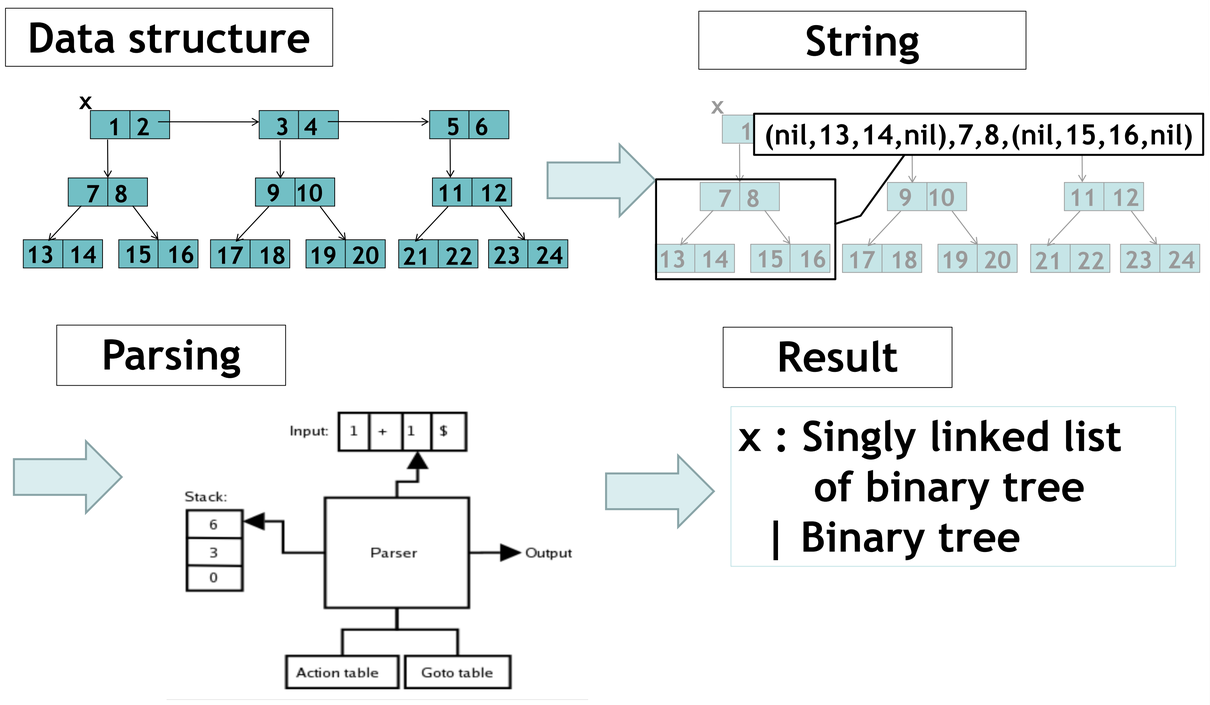
```
fun f ( x )
{
   local t;
   o = NULL;
   while (x != NULL)
   {
     t = x->tl;
     x->tl = o;
     o = x;
     x = t;
   }
}
```

x : Singly linked list.

t : Singly linked list.

o : Singly linked list.

2. How to ?



► Transform Generation of heap data structures into Generation of strings.

► Advantage : Getting good performance using advanced parsing technique.

3. Target Language & Data Structures

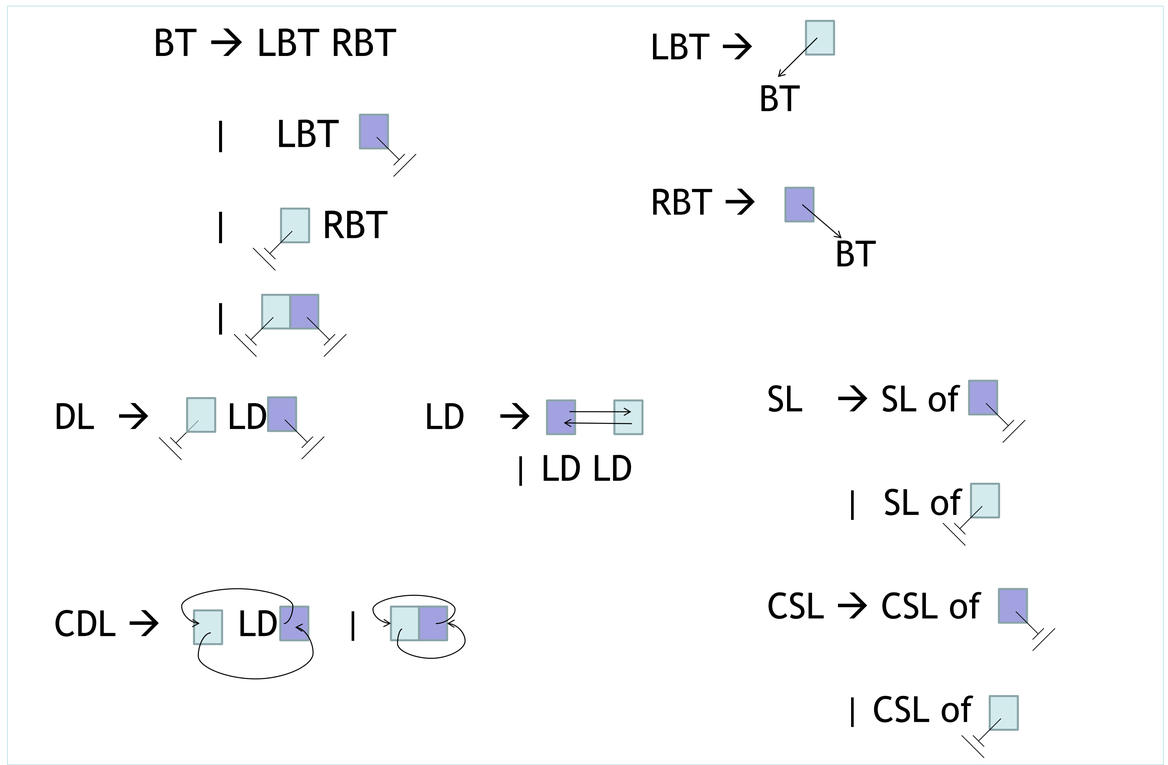
► Language : Typical 2-field language.

► Data structures :

Data structure →
| Binary tree
| Singly linked list
| Cyclic singly linked list
| Doubly linked list
| Cyclic doubly linked list
| Singly linked list of Data structure
| Cyclic singly linked list of Data structure

4. Grammar

► Primitive data structure grammar



► Composite data structure grammar

SL of □ → □ (RSL of □)
| (LSL of □) □

CSL of □ → □ (RCSL of □)
| (LCSL of □) □

L□ → □←
| L□ L□

R□ → □→
| R□ R□

RSL of □ → R□

LSL of □ → L□

RCSL of □ → R□

LCSL of □ → L□

5. Experimental Result

► Data structure grammar ∈ CFG
: Generalized LR parser needed.

► Using **Elkhound** : GLR Parser generator.

Program	Description	Cost (sec)	Analysis Result
listrev.k	List construction (length 30) followed by list reversal	4.8	Singly linked list or Binary tree
cslbt.k	Cyclic singly linked list(length 5) of binary tree (depth 3) construction	0.08	Cyclic singly linked list of binary tree
sl2dl.k	List construction followed by transformation into doubly linked list.	0.02	Doubly linked list
cslcsl.k	Cyclic singly linked list of Cyclic singly linked list construction	0.02	Cyclic singly linked list of cyclic singly linked list

6. Conclusion

► We can infer shape of data structures using parsing technique.

► We invented data structure grammar that can represent primitive and composite data structures.

► Our work is the first research to adopt parsing technique into shape analysis.

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