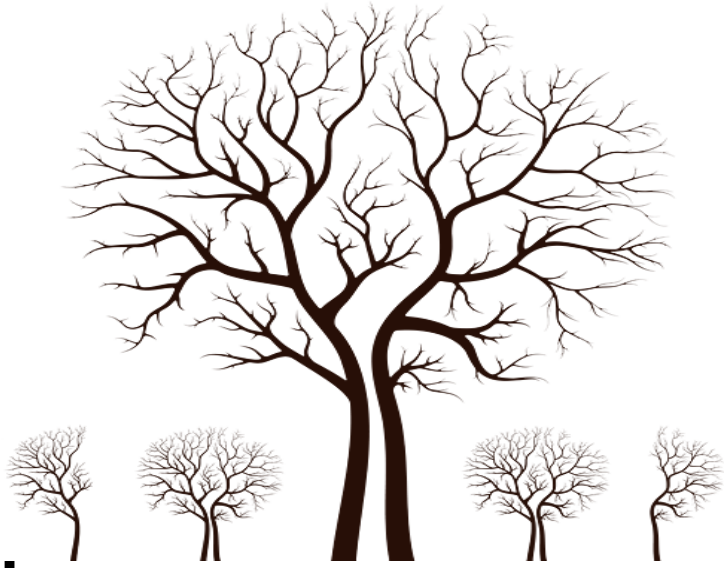


Tree Manipulation Language

(TML)

Motivation

- Designing a language that simplifies programming trees
- Focuses more on tree operation rather than underlying data structures
- Provide simple operators for frequently used operations
- Precisely simple for programmers

Comparison

Insert into BST using C

```
/* insert a tnode into the binary tree */
struct tnode *tnode_insert(struct tnode *p, int value) {
 struct tnode *tmp_one = NULL;
 struct tnode *tmp_two = NULL;

 if(p == NULL) {
  /* insert [new] tnode as root node */
  p = (struct tnode *)malloc(sizeof(struct tnode));
  p->data = value;
  p->left = p->right = NULL;
 } else {
  tmp_one = p;
  /* Traverse the tree to get a pointer to the specific tnode */
  /* The child of this tnode will be the [new] tnode */
  while(tmp_one != NULL) {
   tmp_two = tmp_one;
   if(tmp_one ->data > value)
    tmp_one = tmp_one->left;
   else
    tmp_one = tmp_one->right;
  }
```

TML Style

As simple as

alloc(a, b);

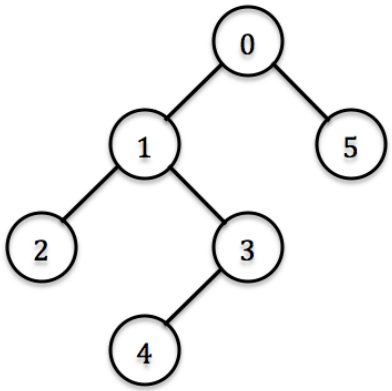
a->(b:~) or a->(~:b) depending on which child b is of a.

Language takes care of checking at compile time errors that you are thinking about

(Smart…huh.?)

Tutorial to TML

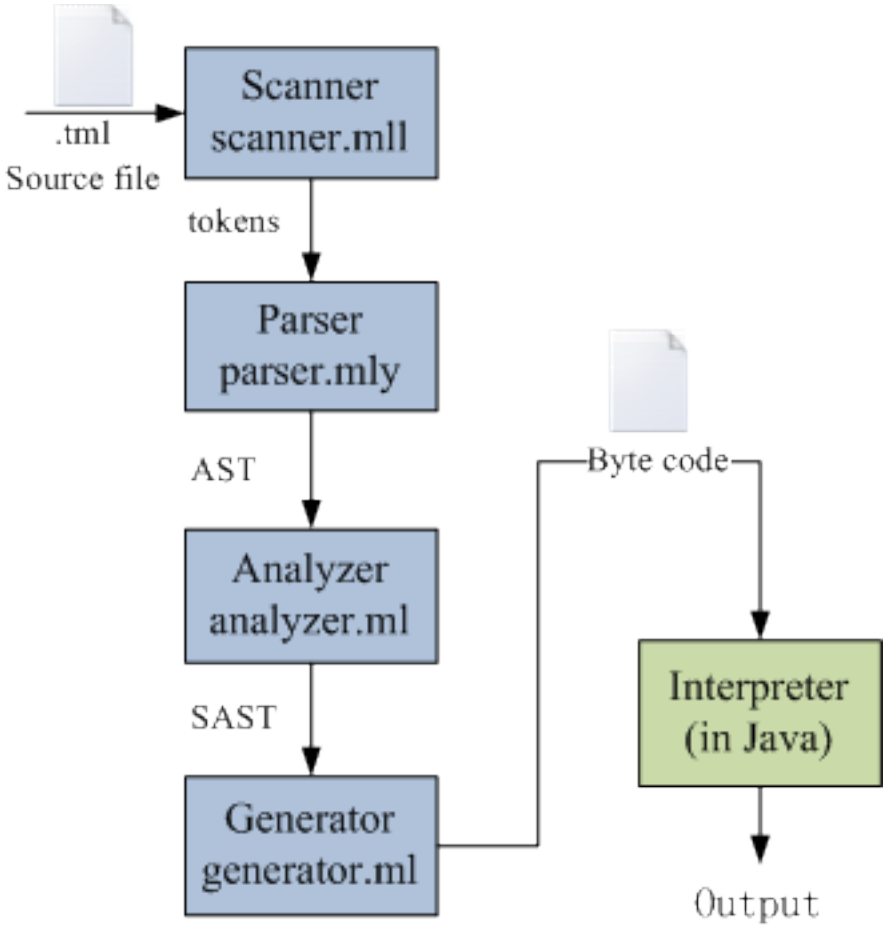
```
treetype <2> MyTree_t
{
        int val = 0;
}
void main ()
{
        int i = 0;
        MyTree_t a, b, c, d, e, f;
        alloc(a, b, c, d, e, f);

        a -> (b -> (d : e -> (f : ~)): c);

        foreach node in a by preorder
        {
                node.val = i;
                i = i + 1;
        }

        foreach node in a by inorder
        {
                print (node.val);
                print (" ");
        }
}
```



Inorder: 2 1 4 3 0 5

```
// other tree operators
#ta;       // order among siblings
ta[left]; // get child
ta.val;   // get field
&ta;      // get degree
^ta;      // get parent
tb = @ta;  // copy the node only
tc = $ta;    // copy the whole tree
```

Implementation



Implementation

```
treetype <2, [left, right]> binary_tree
{
        int a;
        float b;
}
```

```
162     Ent 0
163     Lfp -2
164     Alc 2
165     Fld i
166     Fld f
167     Pop 1
```

- Symbol table
  - parent
  - variables
  - functions
  - treetypes
    - type name
    - degree
    - aliases
    - members

Lessons learnt

- SVN was a necessary to keep all member with a working version.
- Compromising when team had different opinions. Sometimes, vote to get it finalized.
- Designing was hard. But once it made sense, it benefits implementation.
- Testing suite kept record of what had done and what to do.
- Ask immediately via email if puzzled, rather than wait until meeting.

Conclusion

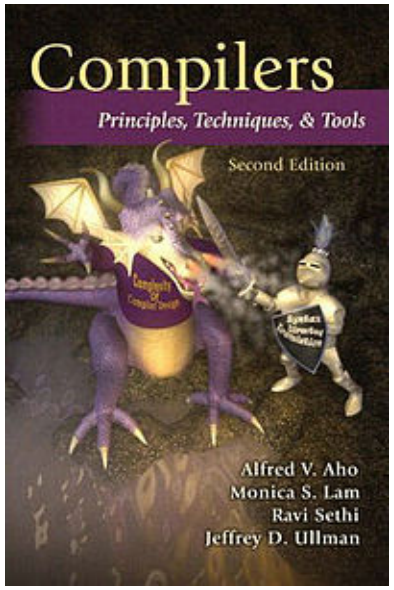
- Compiler
  - 586 ./analyzer.ml
  - 167 ./analyzer_test.ml
  - 56 ./ast.mli
  - 31 ./bytecode.mli
  - 427 ./generator.ml
  - 216 ./parser.mly
  - 50 ./sast.mli
  - 149 ./scanner.mll
  - 84 ./scanner_test.ml
  - 27 ./tml.ml
  - 45 ./type.mli
- 1838 subtotal

- Interpreter
  - 43 ./InorderIterator.java
  - 55 ./Instruction.java
  - 39 ./LevelorderIterator.java
  - 134 ./Main.java
  - 39 ./PostorderIterator.java
  - 39 ./PreorderIterator.java
  - 425 ./Program.java
  - 135 ./TMLTree.java
  - 10 ./TreeIterator.java
- 919 subtotal

- Total: 2757 lines of code

Conclusion

- Learning
- Contributing
- Enthusiastic
- More Learning
- More Contributing
- More Enthusiastic
- ….
- ….
- Enjoying



Edo period of Minamoto Yoshitsune, 18" high, circa 1820