Plan for Today

Symbol Table Implementation
- how type information is represented with SymTable and Type data structures

Stackframes
- gcc stackframe
- next time: MiniJava stackframe

Type implementation in the MiniJava compiler

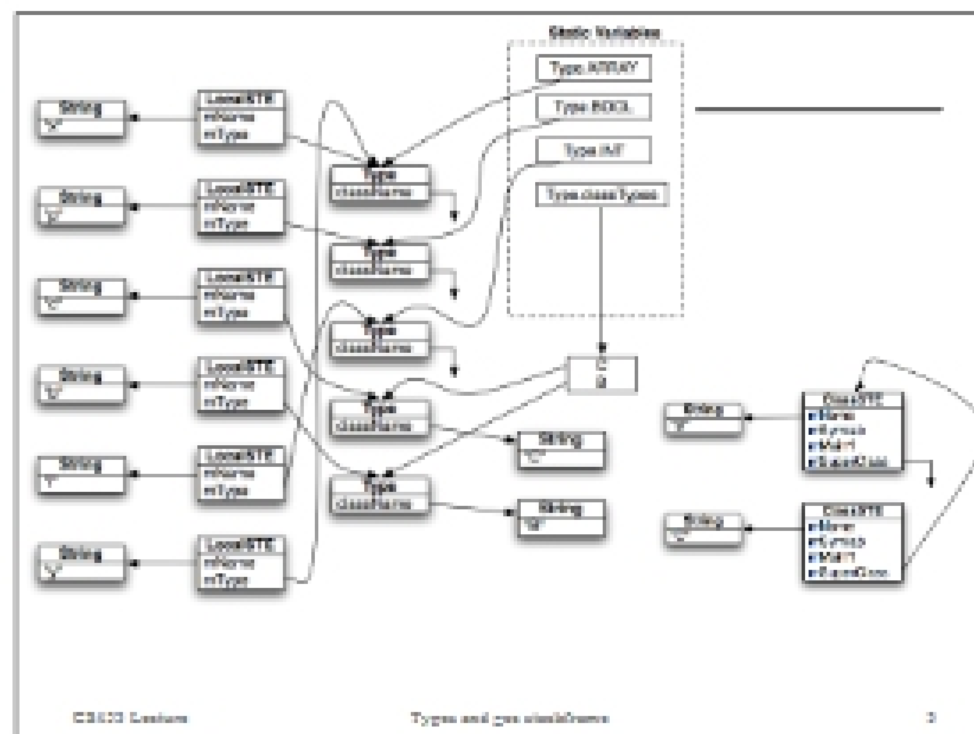
```
public class Type {
  public static final Type ARRAY = new Type();

  public static final Type BOOL = new Type();

  public static final Type INT = new Type();

  // class type map (key: class name, value: type)
  private static final HashMap<String, Type> classTypes
    = new HashMap<String, Type>();
```

Only one instance of the type object per atomic type and class type
- to determine if types are equal just compare references
- Type class does not know about inheritance



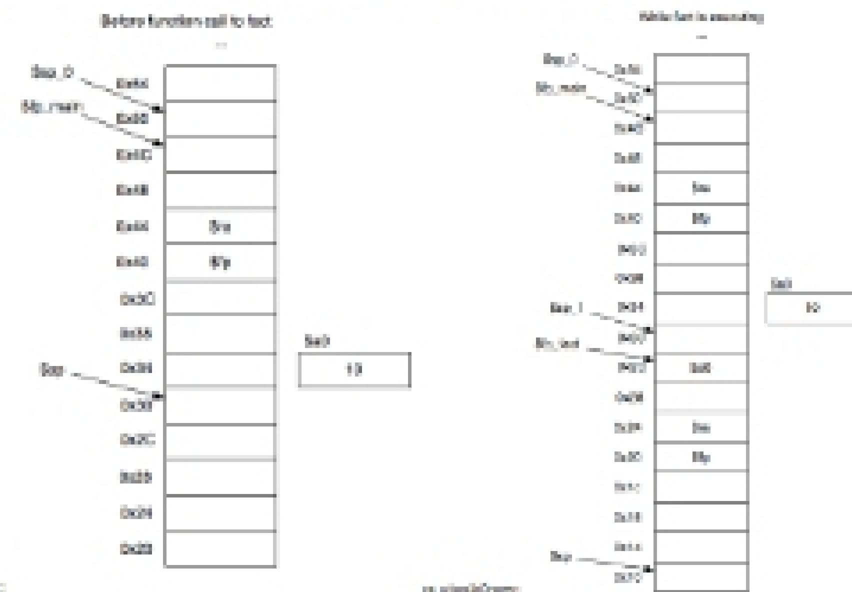
Plan for Learning about Stack Frames

Typical C stack frame
- gcc calling convention described in A.5 and A.6 in appendix on assembly code and MIPS

Stack frame the MiniJava compiler will generate
- Need to match the Wisconsin C-- compiler to implement garbage collection

General stack frame concept
- agreement amongst programmers, procedure call convention
- each agreement has to answer a set of questions
- handling nested procedures
- handling first class functions

Mapping out the stack frame for the fact example



gcc calling convention

Various rules

- $sp must stay at 8 byte boundaries
- $sp could be pointing to useful data
- minimum frame size is 24 bytes
  - four argument registers, $ra, pad to double word boundary
- first four arguments passed in $a0-$a3
- arguments after first four passed on stack, pushed in reverse order
- before a call the caller must save any caller-saved registers that it is using
- at beginning of function, callee must save any callee-saved registers that it will be using
- return value should be in $v0

A possible implementation of the gcc convention

Caller

1. Put first four arguments in $a0-$a3
2. Push later arguments in reverse order (how do we maintain 8 byte boundary?)
3. Save caller-saved registers that are in use
4. Execute a jal

Callee

1. Allocate memory for the frame: 24 + pad[(# params passed over four)*4 + (space for callee-saved regs and caller-saved registers) + (space for locals and temps)]
2. Save callee-saved registers at highest addresses in the frame
3. Set up frame pointer to point to highest address in the frame
4. Compute ...
5. Put return value in $v0
6. Restore all callee-saved registers
7. Pop stack frame by adding size of frame
8. Return by using the return address register, $ra