

Plan for Today

MiniJava compiler

- source: MiniJava
- target: MIPS

MIPS basics

Stack frame the MiniJava compiler will generate

- Calling convention is an agreement amongst programmers, procedure call convention
- Need to match the Wisconsin C-- compiler to implement garbage collection

CS453 Lecture

C-- Stack Frame Layout

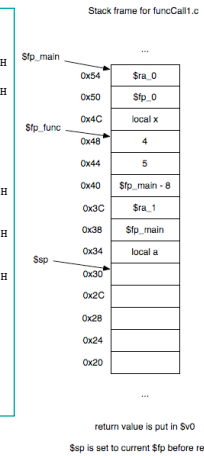
1

Mapping out the stack frame for the funcCall1 example

```
int foo(int x,int y,int *z) {
  int a;
  a = x * y - *z;
  return a;
}
void main() {
  int x;
  x = 2;
  cout << foo(4,5,&x);
  cout << "\n";
}
```

```
.text
_foo:
sw $ra, 0($sp) #PUSH
subu $sp, $sp, 4
sw $fp, 0($sp) #PUSH
subu $sp, $sp, 4
addu $fp, $sp, 20
subu $sp, $sp, 24
...
lw $t0, -20($fp)
move $v0, $t0
lw $ra, -12($fp)
move $t0, $fp
lw $fp, -16($fp)
move $sp, $t0
jr $ra
```

```
.text
.globl main
main:
sw $ra, 0($sp) #PUSH
subu $sp, $sp, 4
sw $fp, 0($sp) #PUSH
subu $sp, $sp, 4
addu $fp, $sp, 8
subu $sp, $sp, 12
li $t0, 2
sw $t0, -8($fp)
li $t0, 4
sw $t0, 0($sp) #PUSH
subu $sp, $sp, 4
li $t0, 5
sw $t0, 0($sp) #PUSH
subu $sp, $sp, 4
subu $t0, $fp, 8
sw $t0, 0($sp) #PUSH
subu $sp, $sp, 4
jal foo
move $a0, $v0
...
lw $ra, 0($fp)
move $t0, $fp
lw $fp, -4($fp)
move $sp, $t0
jr $ra
```



C-- Stack Frame Layout

Wisconsin C-- calling convention

Calling convention (contract between caller and callee)

- \$sp must be divisible by 4
- caller should pass parameters in order on the stack
- upon callee entry, the stack pointer \$sp should be pointing at the first empty slot past the last parameter
- upon callee exit, the stack pointer \$sp should be pointing at the first parameter
- upon callee exit, return value should be in \$v0

Rules to follow for PA2 (to standardize frame usage)

- \$sp should always be pointing at next empty slot on the stack
- \$ra and \$fp should be stored right after the parameters on stack, you can't use any other callee-saved registers
- \$fp should be made to point at the first parameter, so that the address for the first parameter is \$fp-0, the address for the second parameter is \$fp-4, ...
- locals should be stored in order, right after \$ra and \$fp

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3

Another example: where does each variable go?

```
class A {
  public static void main(String[] a){
    System.out.println(42);
  }
}

class B {
  int [] x;
  boolean mBool;

  public int foo(boolean p1, int p2, B b, int [] y)
  {
    boolean v1; int i; int j; return 0;
  }
  public B bar()
  {
    B b;
    b = new B;
    return b;
  }
  public boolean baz() {
    return mBool;
  }
}
```

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4