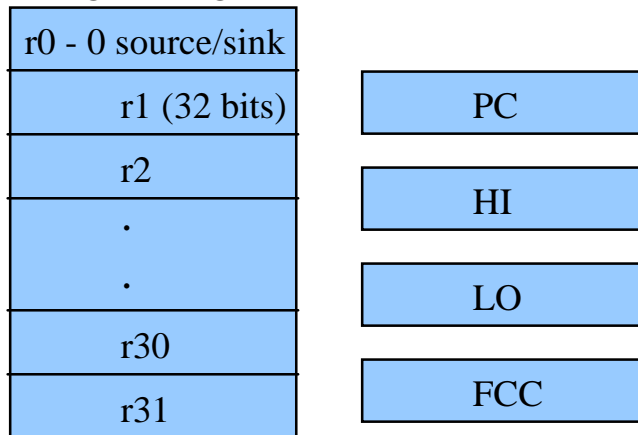# The SimpleScalar Instruction Set

- clean and simple instruction set architecture:
  - ❑ MIPS/DLX + more addressing modes - delay slots
- bi-endian instruction set definition
  - ❑ facilitates portability, build to match host endian
- 64-bit inst encoding facilitates instruction set research
  - ❑ 16-bit space for hints, new insts, and annotations
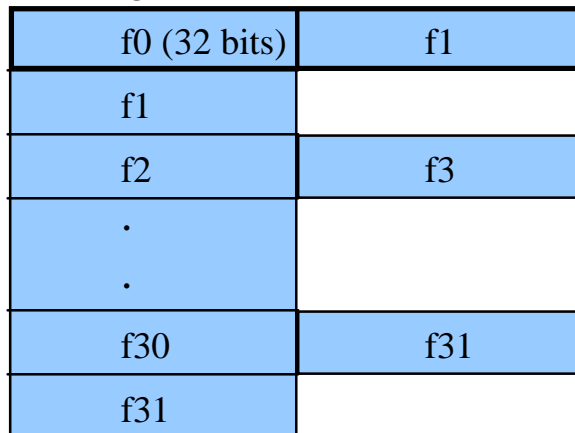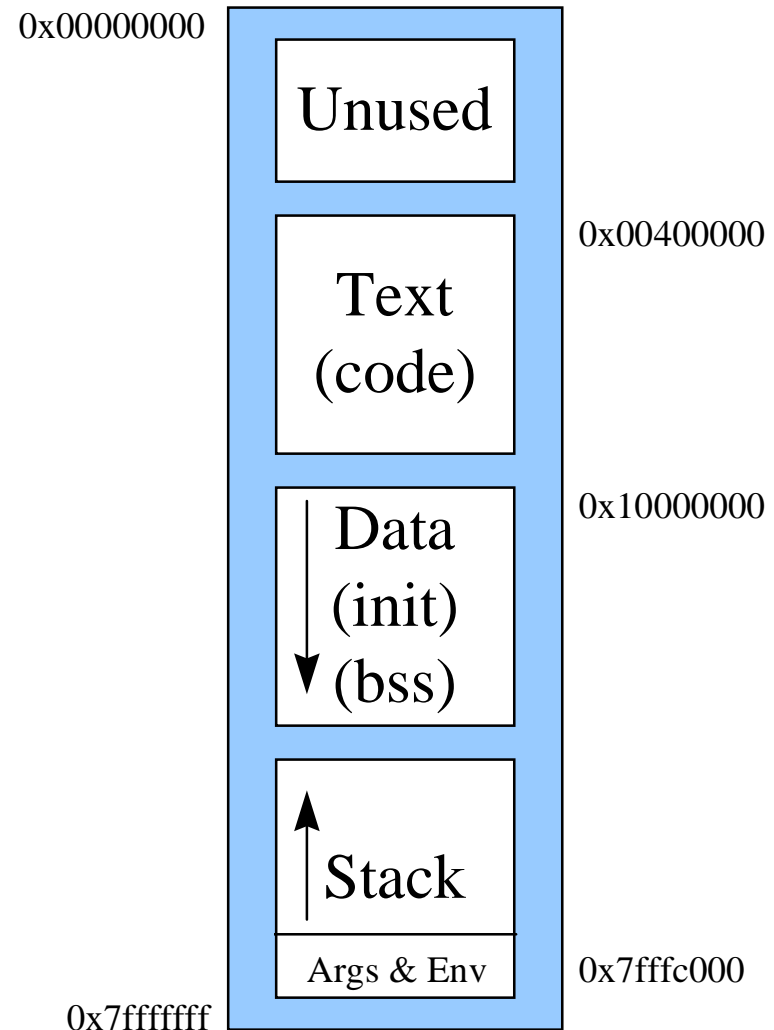  - ❑ four operand instruction format, up to 256 registers

| | | | | 16-imm | |
|---|---|---|---|---|---|
| 16-annote | 16-opcode | 8-ru | 8-rt | 8-rs | 8-rd |
| | | | | | |

63          48          32    24    16    8    0

# SimpleScalar Architected State

Integer Reg File

| |
|---|
| r0 - 0 source/sink |
| r1 (32 bits) |
| r2 |
| . |
| . |
| r30 |
| r31 |

| |
|---|
| PC |
| HI |
| LO |
| FCC |

FP Reg File (SP and DP views)

| | |
|---|---|
| f0 (32 bits) | f1 |
| f1 | |
| f2 | f3 |
| . | |
| . | |
| f30 | f31 |
| f31 | |

Virtual Memory

0x00000000

Unused

0x00400000

Text
(code)

0x10000000

Data
(init)
(bss)

Stack

Args & Env

0x7fffc000

0x7fffffff

# SimpleScalar Instructions

## Control:

j - jump
jal - jump and link
jr - jump register
jalr - jump and link register
beq - branch == 0
bne - branch != 0
blez - branch <= 0
bgtz - branch > 0
bltz - branch < 0
bgez - branch >= 0
bct - branch FCC TRUE
bcf - branch FCC FALSE

## Load/Store:

lb - load byte
lbu - load byte unsigned
lh - load half (short)
lhu - load half (short) unsigned
lw - load word
dlw - load double word
l.s - load single-precision FP
l.d - load double-precision FP
sb - store byte
sbu - store byte unsigned
sh - store half (short)
shu - store half (short) unsigned
sw - store word
dsw - store double word
s.s - store single-precision FP
s.d - store double-precision FP

addressing modes:
  (C)
  (reg + C)   (w/ pre/post inc/dec)
  (reg + reg)  (w/ pre/post inc/dec)

## Integer Arithmetic:

add - integer add
addu - integer add unsigned
sub - integer subtract
subu - integer subtract unsigned
mult - integer multiply
multu - integer multiply unsigned
div - integer divide
divu - integer divide unsigned
and - logical AND
or - logical OR
xor - logical XOR
nor - logical NOR
sll - shift left logical
srl - shift right logical
sra - shift right arithmetic
slt - set less than
sltu - set less than unsigned

# SimpleScalar Instructions

## Floating Point Arithmetic:

add.s - single-precision add
add.d - double-precision add
sub.s - single-precision subtract
sub.d - double-precision subtract
mult.s - single-precision multiply
mult.d - double-precision multiply
div.s - single-precision divide
div.d - double-precision divide
abs.s - single-precision absolute value
abs.d - double-precision absolute value
neg.s - single-precision negation
neg.d - double-precision negation
sqrt.s - single-precision square root
sqrt.d - double-precision square root
cvt - integer, single, double conversion
c.s - single-precision compare
c.d - double-precision compare

## Miscellaneous:

nop - no operation
syscall - system call
break - declare program error