```
0000000000010158 <main>:
   10158:       1101                    addi    sp,sp,-32
   1015a:       ec06                    sd      ra,24(sp)
   1015c:       e822                    sd      s0,16(sp)
   1015e:       1000                    addi    s0,sp,32
   10160:       000227b7                lui     a5,0x22
   10164:       12078513                addi    a0,a5,288 # 22120 <__clzdi2+0x30>
   10168:       2b6000ef                jal     ra,1041e <puts>
   1016c:       fe840793                addi    a5,s0,-24
   10170:       85be                    mv      a1,a5
   10172:       000227b7                lui     a5,0x22
   10176:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
   1017a:       2ae000ef                jal     ra,10428 <scanf>
   1017e:       000227b7                lui     a5,0x22
   10182:       14078513                addi    a0,a5,320 # 22140 <__clzdi2+0x50>
   10186:       298000ef                jal     ra,1041e <puts>
   1018a:       fe440793                addi    a5,s0,-28
   1018e:       85be                    mv      a1,a5
   10190:       000227b7                lui     a5,0x22
   10194:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
   10198:       290000ef                jal     ra,10428 <scanf>
   1019c:       fe842707                flw     fa4,-24(s0)
   101a0:       fe442787                flw     fa5,-28(s0)
   101a4:       10f777d3                fmul.s  fa5,fa4,fa5
   101a8:       fef42627                fsw     fa5,-20(s0)
   101ac:       fec42787                flw     fa5,-20(s0)
   101b0:       420787d3                fcvt.d.s        fa5,fa5
   101b4:       e20785d3                fmv.x.d a1,fa5
   101b8:       000227b7                lui     a5,0x22
   101bc:       15878513                addi    a0,a5,344 # 22158 <__clzdi2+0x68>
   101c0:       1ac000ef                jal     ra,1036c <printf>
   101c4:       4781                    li      a5,0
   101c6:       853e                    mv      a0,a5
   101c8:       60e2                    ld      ra,24(sp)
   101ca:       6442                    ld      s0,16(sp)
   101cc:       6105                    addi    sp,sp,32
   101ce:       8082                    ret

00000000000101d0 <atexit>:
   101d0:       85aa                    mv      a1,a0
   101d2:       4681                    li      a3,0
   101d4:       4601                    li      a2,0
   101d6:       4501                    li      a0,0
   101d8:       0980406f                j       14270 <__register_exitproc>
```

```
Instruction: addi (Add Immediate)
 addi sp, sp, -32
 Type: I-Type
 Opcode: 0010011
 funct3: 000
 rs1: sp (x2) → 00010
 rd: sp (x2) → 00010
 Immediate: -32 (12-bit signed: 1111111110000)
 Encoding: 111111111000 00010 000 00010 0010011
 Result: 0xFFF12013


Instruction: sd (Store Doubleword)
 sd ra, 16(sp)
 Type: S-Type
 Opcode: 0100011
 funct3: 011
 rs1: sp (x2) → 00010
 rs2: ra (x1) → 00001
 Immediate: 16 (imm[11:5]=0000000, imm[4:0]=10000)
 Encoding: 0000000 00001 00010 011 10000 0100011
 Result: 0x00812023


Instruction: lui (Load Upper Immediate)
 lui x5, 0x22
 Type: U-Type
 Opcode: 0110111
 rd: x5 → 00101
 Immediate: 0x22 → 0000 0000 0010 0010
 Encoding: 0000000000100010 00101 0110111
 Result: 0x00228537

Instruction: jal (Jump and Link)
 jal x1, 104
 Type: J-Type
 Opcode: 1101111
 rd: x1 → 00001
 Immediate: 104 (000000110100, J-Type encoding rearranges this):
 imm[20]=0, imm[10:1]=0001101000, imm[11]=1, imm[19:12]=00000000
 Encoding: 00000000000011010001 00001 1101111
 Result: 0x068000EF
```

```
0000000010158 <main>:
10158:       1101                    addi    sp,sp,-32
1015a:       ec06                    sd      ra,24(sp)
1015c:       e822                    sd      s0,16(sp)
1015e:       1000                    addi    s0,sp,32
10160:       000227b7                lui     a5,0x22
10164:       12078513                addi    a0,a5,288 # 22120 <__clzdi2+0x30>
10168:       2b6000ef                jal     ra,1041e <puts>
1016c:       fe840793                addi    a5,s0,-24
10170:       85be                    mv      a1,a5
10172:       000227b7                lui     a5,0x22
10176:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
1017a:       2ae000ef                jal     ra,10428 <scanf>
1017e:       000227b7                lui     a5,0x22
10182:       14078513                addi    a0,a5,320 # 22140 <__clzdi2+0x50>
10186:       298000ef                jal     ra,1041e <puts>
1018a:       fe440793                addi    a5,s0,-28
1018e:       85be                    mv      a1,a5
10190:       000227b7                lui     a5,0x22
10194:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
10198:       290000ef                jal     ra,10428 <scanf>
1019c:       fe842707                flw     fa4,-24(s0)
101a0:       fe442787                flw     fa5,-28(s0)
101a4:       10f777d3                fmul.s  fa5,fa4,fa5
101a8:       fef42627                fsw     fa5,-20(s0)
101ac:       fec42787                flw     fa5,-20(s0)
101b0:       420787d3                fcvt.d.s        fa5,fa5
101b4:       e20785d3                fmv.x.d a1,fa5
101b8:       000227b7                lui     a5,0x22
101bc:       15878513                addi    a0,a5,344 # 22158 <__clzdi2+0x68>
101c0:       1ac000ef                jal     ra,1036c <printf>
101c4:       4781                    li      a5,0
101c6:       853e                    mv      a0,a5
101c8:       60e2                    ld      ra,24(sp)
101ca:       6442                    ld      s0,16(sp)
101cc:       6105                    addi    sp,sp,32
101ce:       8082                    ret

00000000101d0 <atexit>:
101d0:       85aa                    mv      a1,a0
101d2:       4681                    li      a3,0
101d4:       4601                    li      a2,0
101d6:       4501                    li      a0,0
101d8:       0980406f                j       14270 <__register_exitproc>

00000000101dc <exit>:
ew Applications 141                  addi    sp,sp,-16
```

```
Instruction: mv (Move, pseudo-instruction)
 mv x11, x10 (translated as addi x11, x10, 0)
 Type: I-Type
 Opcode: 0010011
 funct3: 000
 rs1: x10 → 01010
 rd: x11 → 01011
 Immediate: 0 → 000000000000
 Encoding: 000000000000 01010 000 01011 0010011
 Result: 0x00A58013

Instruction: flw (Floating-Point Load Word)
 flw f4, -24(s0)
 Type: I-Type
 Opcode: 0000111
 funct3: 010
 rs1: s0 (x8) → 01000
 rd: f4 → 00100
 Immediate: -24 (12-bit signed: 111110100100)
 Encoding: 111110100100 01000 010 00100 0000111
    Result: 0xF8412407


Instruction: fmul.s (Floating Multiply, Single)
 fmul.s fa5, fa5, fa4
 Type: R-Type
 Opcode: 1010011
 funct7: 0000001
 funct3: 000
 rs1: fa5 → 01010
 rs2: fa4 → 00100
 rd: fa5 → 01010
 Encoding: 0000001 00100 01010 000 01010 1010011
 Result: 0x20A52453



Instruction: fsw (Floating-Point Store Word)
 fsw fa5, -20(s0)
 Type: S-Type
 Opcode: 0100111
 funct3: 010
 rs1: s0 (x8) → 01000
 rs2: fa5 → 01010
```

```
0000000000010158 <main>:
  10158:       1101                    addi    sp,sp,-32
  1015a:       ec06                    sd      ra,24(sp)
  1015c:       e822                    sd      s0,16(sp)
  1015e:       1000                    addi    s0,sp,32
  10160:       000227b7                lui     a5,0x22
  10164:       12078513                addi    a0,a5,288 # 22120 <__clzdi2+0x30>
  10168:       2b6000ef                jal     ra,1041e <puts>
  1016c:       fe840793                addi    a5,s0,-24
  10170:       85be                    mv      a1,a5
  10172:       000227b7                lui     a5,0x22
  10176:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
  1017a:       2ae000ef                jal     ra,10428 <scanf>
  1017e:       000227b7                lui     a5,0x22
  10182:       14078513                addi    a0,a5,320 # 22140 <__clzdi2+0x50>
  10186:       298000ef                jal     ra,1041e <puts>
  1018a:       fe440793                addi    a5,s0,-28
  1018e:       85be                    mv      a1,a5
  10190:       000227b7                lui     a5,0x22
  10194:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
  10198:       290000ef                jal     ra,10428 <scanf>
  1019c:       fe842707                flw     fa4,-24(s0)
  101a0:       fe442787                flw     fa5,-28(s0)
  101a4:       10f777d3                fmul.s  fa5,fa4,fa5
  101a8:       fef42627                fsw     fa5,-20(s0)
  101ac:       fec42787                flw     fa5,-20(s0)
  101b0:       420787d3                fcvt.d.s        fa5,fa5
  101b4:       e20785d3                fmv.x.d a1,fa5
  101b8:       000227b7                lui     a5,0x22
  101bc:       15878513                addi    a0,a5,344 # 22158 <__clzdi2+0x68>
  101c0:       1ac000ef                jal     ra,1036c <printf>
  101c4:       4781                    li      a5,0
  101c6:       853e                    mv      a0,a5
  101c8:       60e2                    ld      ra,24(sp)
  101ca:       6442                    ld      s0,16(sp)
  101cc:       6105                    addi    sp,sp,32
  101ce:       8082                    ret

00000000101d0 <atexit>:
  101d0:       85aa                    mv      a1,a0
  101d2:       4681                    li      a3,0
  101d4:       4601                    li      a2,0
  101d6:       4501                    li      a0,0
  101d8:       0980406f                j       14270 <__register_exitproc>

00000000101dc <exit>:
  101dc:       1141                    addi    sp,sp,-16
```

```
 Result: 0x20A52453


Instruction: fsw (Floating-Point Store Word)
 fsw fa5, -20(s0)
 Type: S-Type
 Opcode: 0100111
 funct3: 010
 rs1: s0 (x8) → 01000
 rs2: fa5 → 01010
 Immediate: -20 (imm[11:5]=1111111, imm[4:0]=0100)
 Encoding: 1111111 01010 01000 010 00100 0100111
 Result: 0xFAA2027


Instruction: fcvt.d.s
 fcvt.d.s fa5, fa5
 Type: R-Type
 Opcode: 1010011
 funct7: 0100000
 rs1: fa5 → 01010
 rd: fa5 → 01010
 funct3: 000
 Encoding: 0100000 00000 01010 000 01010 1010011
 Result: 0x420A0053


Instruction: fnmadd.s
 fnmadd.s fa5, fa5, fa4, fa5
 Type: R4-Type
 Opcode: 1000011
 funct2: 11
 rs1: fa5 → 01010
 rs2: fa4 → 00100
 rd: fa5 → 01010
 rm: Rounding mode → 000
 Encoding: 01010 01010 00100 000 01010 1000011
 Result: 0x22A5423


Instruction: li (Load Immediate)
 li x10, 0x0 → addi x10, x0, 0
```

```
0000000010158 <main>:
 10158:       1101                    addi    sp,sp,-32
 1015a:       ec06                    sd      ra,24(sp)
 1015c:       e822                    sd      s0,16(sp)
 1015e:       1000                    addi    s0,sp,32
 10160:       000227b7                lui     a5,0x22
 10164:       12078513                addi    a0,a5,288 # 22120 <__clzdi2+0x30>
 10168:       2b6000ef                jal     ra,1041e <puts>
 1016c:       fe840793                addi    a5,s0,-24
 10170:       85be                    mv      a1,a5
 10172:       000227b7                lui     a5,0x22
 10176:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
 1017a:       2ae000ef                jal     ra,10428 <scanf>
 1017e:       000227b7                lui     a5,0x22
 10182:       14078513                addi    a0,a5,320 # 22140 <__clzdi2+0x50>
 10186:       298000ef                jal     ra,1041e <puts>
 1018a:       fe440793                addi    a5,s0,-28
 1018e:       85be                    mv      a1,a5
 10190:       000227b7                lui     a5,0x22
 10194:       13878513                addi    a0,a5,312 # 22138 <__clzdi2+0x48>
 10198:       290000ef                jal     ra,10428 <scanf>
 1019c:       fe842707                flw     fa4,-24(s0)
 101a0:       fe442787                flw     fa5,-28(s0)
 101a4:       10f777d3                fmul.s  fa5,fa4,fa5
 101a8:       fef42627                fsw     fa5,-20(s0)
 101ac:       fec42787                flw     fa5,-20(s0)
 101b0:       420787d3                fcvt.d.s        fa5,fa5
 101b4:       e20785d3                fmv.x.d a1,fa5
 101b8:       000227b7                lui     a5,0x22
 101bc:       15878513                addi    a0,a5,344 # 22158 <__clzdi2+0x68>
 101c0:       1ac000ef                jal     ra,1036c <printf>
 101c4:       4781                    li      a5,0
 101c6:       853e                    mv      a0,a5
 101c8:       60e2                    ld      ra,24(sp)
 101ca:       6442                    ld      s0,16(sp)
 101cc:       6105                    addi    sp,sp,32
 101ce:       8082                    ret

0000000101d0 <atexit>:
 101d0:       85aa                    mv      a1,a0
 101d2:       4681                    li      a3,0
 101d4:       4601                    li      a2,0
 101d6:       4501                    li      a0,0
 101d8:       0980406f                j       14270 <__register_exitproc>

0000000101dc <exit>:
```

```
 Opcode: 1000011
 funct2: 11
 rs1: fa5 → 01010
 rs2: fa4 → 00100
 rd: fa5 → 01010
 rm: Rounding mode → 000
 Encoding: 01010 01010 00100 000 01010 1000011
 Result: 0x22A5423


Instruction: li (Load Immediate)
 li x10, 0x0 → addi x10, x0, 0
 Type: I type
 Opcode: 0010011
 funct3: 000
 rs1: 00000
 rd : 01010
 Encoding: 000000000000 00000 000 01010 0010011
 Result: 0x00005013


Instruction: ld (Load Doubleword)
 ld ra, 24(sp)
 Type: I-Type
 Opcode: 0000011
 funct3: 011
 rs1: sp (x2) → 00010
 rd: ra (x1) → 00001
 Immediate: 24 → 000000001100
 Encoding: 000000001100 00010 011 00001 0000011
 Result: 0x01812083


Instruction: ret
 ret → jalr x0, x1, 0
 Type: I-Type
 Opcode: 1100111
 funct3: 000
 rs1: x1 (ra) → 00001
 rd: x0 → 00000
 Immediate: 0 → 000000000000
 Encoding: 000000000000 00001 000 00000 1100111
```