Execution Cycle Example

PC: Program Counter

IR: Instruction Register

General Purpose Registers

a0:	964
a1:	10
t0:	
t1:	
t2:	

Load

Store

PC:	0000
IR:	

Memory

0000	00A10018
0004	008E1821
0008	8C620000
0012	8CF20004
0016	ACF20000
0020	AC620004
0024	03E00008
1000	0A12170D
1004	11111111
1008	00000000
1012	0F0F0F0F
1016	FFFFFFFF
1020	FFFFFFFF

Instruction Fetch

Instruction Decode

Operand Fetch

Execute

Result Store

Next Instruction

Control Flow

Jumps – GOTO different next instruction

```
j 25                    # go to 100: PC = 25*4 (instructions are 32-bit)
jr $ra                  # go to address in $ra: PC = value of $ra
```

Branches – GOTO different next instruction if condition is true

2 register: beq (==), bne (!=)

```
beq $t0, $t1, FOO          # if $t0 == $t1 GOTO FOO: PC = FOO
```

1 register: bgez (>=0), bgtz (>0), blez (<=0), bltz (<0)

```
bgez $t0, FOO    # if $t0 >= 0 GOTO FOO: PC = FOO
```

```
if (a == b)
   a = a + 3;
else
   b = b + 7;
c = a + b;
```

```
# $a0 = a, $a1 = b, $a2 = c
     bne   $a0, $a1, ELSEIF     # branch if a!=b
     addi  $a0, $a0, 3;         # a = a + 3
     j DONE;                    # avoid else
ELSEIF:
     addi  $a1, $a1, 7;         # b = b + 7
DONE:
     add   $a2, $a0, $a1;       # c = a + b
```

Loop Example

Compute the sum of the values 1…N-1

```
int sum = 0;
for (int I = 0; I != N; I++) {
        sum += I;
}
```

```
# $t0 = N, $t1 = sum, $t2 = I
add $t1, $zero, $zero
add $t2, $zero, $zero
:Loop:
add $t1, $t1, $t2
addi $t2, $t2, 1
beq $t2, $t0, END
j Loop
:END:
```

add $t1, $zero, $zero
add $t2, $2, $2
beq $t0, $t2, END
j Loop

bne $t0, $t2, Loop

Comparison Operators

For logic, want to set a register TRUE (1) / FALSE(0) based on condition

```
slt $t0, $t1, $t2      # if ($t1 < $t2) $t0 = 1 else $t0 = 0;
```

```
if (a >= b)
    c = a + b;
a = a + c;
```

?

addi $t4, $zero, 1

a >= b

a < b

```
# $t0 = a, $t1 = b, $t2 = c
```

slt $t3, $t0, $t1 // (a<b)?

bne $t3, $zero, Foo

beq $t3, $t4, Foo

add $t2, $t0, $t1 // c=a+b

Foo: add $t0, $t0, $t2 // a=a+c