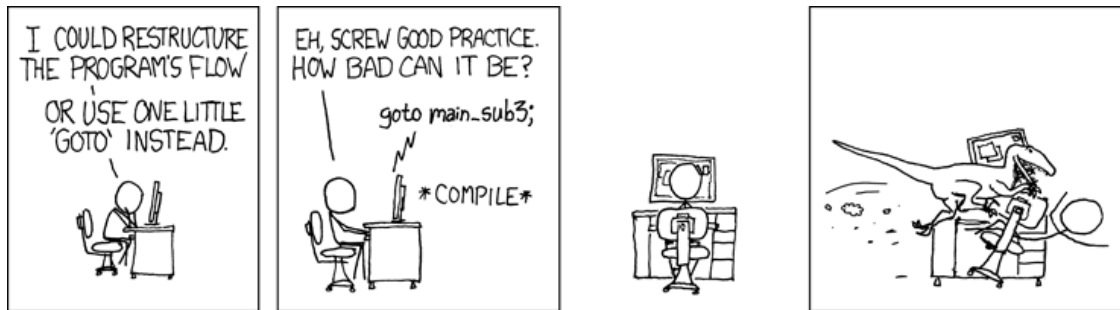
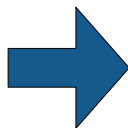


Goto



Conditional to Goto

```
if (test-expr)
  then-cmd
else
  else-cmd
...
```

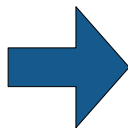


```
t = test-expr
if (!t) goto false;
then-cmd
goto done;

false:
  else-cmd

done:
  ...
```

```
long absdiff
(long x, long y)
{
  long result;
  if (x > y)
    result = x-y;
  else
    result = y-x;
  return result;
}
```



```
absdiff:
  cmpq   %rsi, %rdi # x:y
  jle   .L4
  movq   %rdi, %rax
  subq   %rsi, %rax
  ret
.L4:    # x <= y
  movq   %rsi, %rax
  subq   %rdi, %rax
  ret
```

Do-While Loops

C Code

```
long pcount_do
(unsigned long x) {
    long result = 0;
    do {
        result += x & 0x1;
        x >>= 1;
    } while (x);
    return result;
}
```

Goto Version

```
long pcount_goto
(unsigned long x) {
    long result = 0;
loop:
    result += x & 0x1;
    x >>= 1;
    if(x) goto loop;
    return result;
}
```

Do-While Loop Compilation

Goto Version

```
long pcount_goto
(unsigned long x) {
    long result = 0;
loop:
    result += x & 0x1;
    x >>= 1;
    if(x) goto loop;
    return result;
}
```

Register	Use(s)
%rdi	Argument <i>x</i>
%rax	result

```
        movl    $0, %eax    # result = 0
.L2:                                # loop:
        movq    %rdi, %rdx
        andl   $1, %edx    # t = x & 0x1
        addq   %rdx, %rax  # result += t
        shrq   %rdi        # x >>= 1
        jne    .L2         # if (x) goto loop
        rep; ret
```

While Loops: Jump-to-Middle

While version

```
while (Test)  
  Body
```



Goto Version

```
goto test;  
loop:  
  Body  
test:  
  if (Test)  
    goto loop;  
done:
```

Jump-to-Middle Example

C Code

```
long pcount_while  
(unsigned long x) {  
  long result = 0;  
  while (x) {  
    result += x & 0x1;  
    x >>= 1;  
  }  
  return result;  
}
```

Jump to Middle

```
long pcount_goto_jtm  
(unsigned long x) {  
  long result = 0;  
  goto test;  
loop:  
  result += x & 0x1;  
  x >>= 1;  
test:  
  if(x) goto loop;  
  return result;  
}
```

While Loops: Guarded Do

While version

```
while (Test)
  Body
```



Do-While Version

```
if (!Test)
  goto done;
do
  Body
  while (Test);
done:
```



Goto Version

```
if (!Test)
  goto done;
loop:
  Body
  if (Test)
    goto loop;
done:
```

Guarded Do Example

C Code

```
long pcount_while
(unsigned long x) {
  long result = 0;
  while (x) {
    result += x & 0x1;
    x >>= 1;
  }
  return result;
}
```

Do-While Version

```
long pcount_goto_dw
(unsigned long x) {
  long result = 0;
  if (!x) goto done;
loop:
  result += x & 0x1;
  x >>= 1;
  if(x) goto loop;
done:
  return result;
}
```

Switch Statements

```
void print_feedback(char letter_grade) {
    switch (letter_grade) {
        case 'A':
            printf("Excellent!\n");
            break;
        case 'B':
            printf("Well done!\n");
            break;
        case 'C':
            printf("You passed!\n");
            break;
        case 'D':
            printf("Better try again\n");
            break;
        case 'F':
            printf("Uh oh\n");
            break;
        default:
            printf("Invalid grade\n");
            break;
    }
}
```

Switch Fall Through

```
long switch_eg
(long x, long y, long z)
{
    long w = 1;
    switch(x) {
        case 1:
            w = y*z;
            break;
        case 2:
            w = y/z;
            /* Fall Through */
        case 3:
            w += z;
            break;
        case 5:
        case 6:
            w -= z;
            break;
        default:
            w = 2;
    }
    return w;
}
```

Jump Tables

Switch Form

```
switch(x) {
  case val_0:
    Block 0
  case val_1:
    Block 1
    . . .
  case val_n-1:
    Block n-1
}
```

Jump Table

```
jtab:
  Targ0
  Targ1
  Targ2
  .
  .
  .
  Targn-1
```

Targ0: Code Block 0

Targ1: Code Block 1

Targ2: Code Block 2

.
.
 .

Targn-1: Code Block n-1

Translation (Extended C)

```
goto *jtab[x];
```

Switch Example

```
long switch_eg
(long x, long y, long z)
{
  long w = 1;
  switch(x) {
  case 1:
    w = y*z;
    break;
  case 2:
    w = y/z;
    /* Fall Through */
  case 3:
    w += z;
    break;
  case 5:
  case 6:
    w -= z;
    break;
  default:
    w = 2;
  }
  return w;
}
```

Jump table

```
.section .rodata
.align 8
.L4:
.quad .L8 # x = 0
.quad .L3 # x = 1
.quad .L5 # x = 2
.quad .L9 # x = 3
.quad .L8 # x = 4
.quad .L7 # x = 5
.quad .L7 # x = 6
```

Register	Use(s)
%rdi	Argument x
%rsi	Argument y
%rdx	Argument z
%rax	Return value

```
switch_eg:
  movq %rdx, %rcx
  cmpq $6, %rdi # x:6
  ja .L8 # Use default
  jmp *.L4(,%rdi,8) # goto *JTab[x]
```

Example Jump Table

Jump table

```
.section .rodata
.align 8
.L4:
.quad .L8 # x = 0
.quad .L3 # x = 1
.quad .L5 # x = 2
.quad .L9 # x = 3
.quad .L8 # x = 4
.quad .L7 # x = 5
.quad .L7 # x = 6
```

```
switch(x) {
case 1: // .L3
    w = y*z;
    break;
case 2: // .L5
    w = y/z;
    /* Fall Through */
case 3: // .L9
    w += z;
    break;
case 5:
case 6: // .L7
    w -= z;
    break;
default: // .L8
    w = 2;
}
```

Code Blocks

```
long w = 1;
switch(x) {
case 1: // .L3
    w = y*z;
    break;
case 2: // .L5
    w = y/z;
    /* Fall Through */
case 3: // .L9
    w += z;
    break;
case 5:
case 6: // .L7
    w -= z;
    break;
default: // .L8
    w = 2;
}
return w;
```

Register	Use(s)
%rdi	Argument x
%rsi	Argument y
%rdx	Argument z
%rax	Return value

```
switch_eg:
movq %rdx, %rcx
cmpq $6, %rdi # x:6
ja .L8 # Use default
jmp *.L4(,%rdi,8) # goto *JTab[x]
```

```
.L3: # Case 1
movq %rsi, %rax # y
imulq %rdx, %rax # y*z
ret

.L5: # Case 2
movq %rsi, %rax
cqto
idivq %rcx # y/z
jmp .L6 # goto merge

.L9: # Case 3
movl $1, %eax # w = 1

.L6: # merge:
addq %rcx, %rax # w += z
ret

.L7: # Case 5,6
movl $1, %eax # w = 1
subq %rdx, %rax # w -= z
ret

.L8: # Default:
movl $2, %eax # 2
ret
```