15-410

"Don't make me stop the car..."

#define

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Outline

What's wrong with this picture?

Example 1

```
int scanbuf[64];

int getchar(void)
{
   ...
   if (++bufindex == 64)
      bufindex = 0;
   ...
}
```

Example 1 – Change Requirement

```
From: Dave Eckhardt
Subject: keyboard buffer size

Keyboard buffers must handle
somebody placing a cat on the
keyboard (the 101-key keyboard).
```

Example 1 – Cat On Keyboard

Photo credit: Ivan Jager, 2006-10-22

Option 1

```
int scanbuf[256];

int getchar(void)
{
   ...
   if (++bufindex == 64)
      bufindex = 0;
   ...
}
```

Option 2

```
int scanbuf[64];

int getchar(void)
{
   ...
   if (++bufindex == 256)
      bufindex = 0;
   ...
}
```

Option 3 – *Try This At Home!!!*

```
#define KSB_SIZE 256
int scanbuf[KSB_SIZE];

int getchar(void)
{
   ...
   if (++bufindex == KSB_SIZE)
     bufindex = 0;
   ...
}
```

Example 2 – Beyond Equality!

```
int scanbuf[64];

int getchar(void)
{
   ...
   if (bufindex == 63)
      bufindex = 0;
   ...
}
```

Example 2 – Truly Pernicious

How to fix *half* of the problem

```
% grep 64 *.c
```

Wrong *two* ways

- Won't find 63
- Will find random unrelated 64's

Example 3

```
#define CENTER_X 40
#define CENTER_Y 12

  ...
  set_cursor_pos(CENTER_Y, CENTER_X);
  ...
```

Example 3 – Change Requirement

```
From: Dave Eckhardt
Subject: new screen size

We have updated the VGA hardware
initialization sequence.  The
new screen size will be:

#define CONSOLE_WIDTH 120
#define CONSOLE_HEIGHT 30
```

Example 4

```
...
p->regsave[-18] |= 0x402;
...
```

Don't make me stop the car.....

Multiplicity

```
#define INC_TWICE(x) ++x; ++x
// Note: only one ';'
```

Multiplicity

```
#define INC_TWICE(x) ++x; ++x

INC_TWICE(ac);
```

Multiplicity

```
#define INC_TWICE(x) ++x; ++x

INC_TWICE(ac);
        ⇒ ++ac; ++ac;
```

Multiplicity

```
#define INC_TWICE(x) ++x; ++x

INC_TWICE(ac);
        ⇒ ++ac; ++ac;

if (ac) INC_TWICE(ac);
```

Multiplicity

```
#define INC_TWICE(x) ++x; ++x

INC_TWICE(ac);
        ⇒ ++ac; ++ac;

if (ac) INC_TWICE(ac);
        ⇒ if (ac) ++ac; ++ac;
```

Multiplicity

```
#define INC_TWICE(x) ++x; ++x
```

What to do?

- See “multi-line macro”

Precedence and Parentheses

```
#define TWICE(x) 2*x

TWICE(3)        /* 2*3 ⇒ 6 */
```

Precedence and Parentheses

```
#define TWICE(x) 2*x

TWICE(3)        /* 2*3 ⇒ 6 */
TWICE(1+q)      /* 2*1+q ⇒ oops! */
```

Precedence and Parentheses

```
#define TWICE(x) 2*x

TWICE(3)        /* 2*3 ⇒ 6 */
TWICE(1+q)      /* 2*1+q ⇒ oops! */
```

What to do?

```
#define TWICE(x) (2*(x))
TWICE(1+q)      /* (2*(1+q)) */
```

Beware...

```
#define MAX(x,y) ((x>y)?(x):(y))
```

Beware...

```
#define MAX(x,y) (((x)>(y))?(x):(y))

MAX(x++,y++)    /* ⇒ ??? */
```

Beware...

```
#define MAX(x,y) (((x)>(y))?(x):(y))

MAX(x++,y++)   /* ⇒ you lose */
```