

# 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 */
```