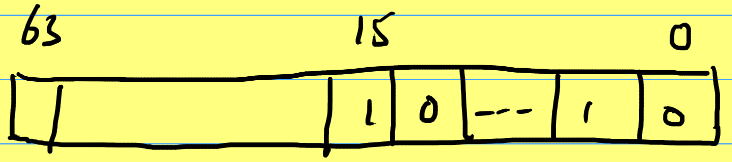
Lecture 8 CS3514 5/10/17

Consider a program to record 16 y/n answers to 16 questions.

Use an unsigned integer : Answer

Answer :

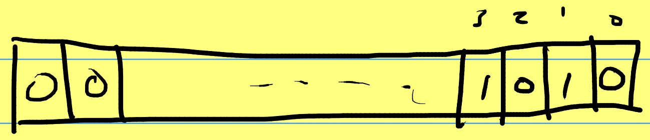


1 → y , 0 → n

__Note__ : 1 << j Is a number with 1 in the j^{th} bit and zeros everywhere else

Initialize Answer to 0
If the first 4 bits have been set in Answer, it might look like this

Answer :



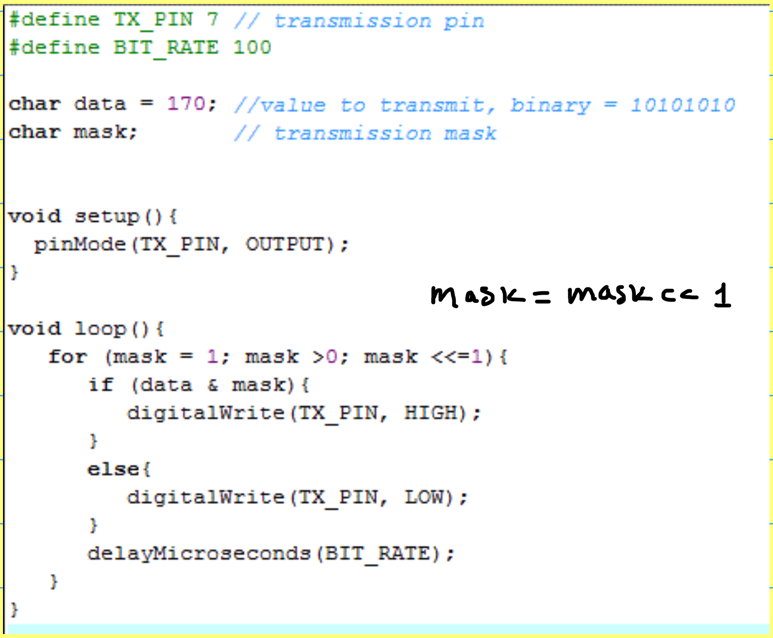
an 'n' input will just increment the value of j and leave the corresponding bit in Answer unchanged at '0'

if the next 'y' input occurs when j=6, the Answer will be OR'd with 000----1000000

```
Answer |= 1<<j ; // here j==6
(≡ Answer = Answer | 1<<j; )
```

This will put a 1 in the 6th bit posn and will leave the rest of the bits in the Answer unchanger

Bit manipulation Continued.



```
#define TX_PIN 7 // transmission pin
#define BIT_RATE 100

char data = 170; //value to transmit, binary = 10101010
char mask;        // transmission mask


void setup(){
  pinMode(TX_PIN, OUTPUT);
}

void loop(){
   for (mask = 1; mask >0; mask <<=1){
      if (data & mask){
         digitalWrite(TX_PIN, HIGH);
      }
      else{
         digitalWrite(TX_PIN, LOW);
      }
      delayMicroseconds(BIT_RATE);
   }
}
```

mask = mask << 1

Example : Transmit a byte Serrally on a pin.

The mask values will go from

00000001
To 00000010
To 00000100
⋮
To 10000000
To 00000000

<u>data & mask</u>

data : 10101010
mask : 00000001 &
00000000 → FALSE

data : 10101010
mask : 00000010 &
00000010 → TRUE

etc

So far we have seen that

$b \,\&\, 0 = 0$

$b \,\&\, 1 = b$ - use & to Select b from byte

XOR

$b \wedge 1 = \bar{b}$ - use ^ to toggle b in a byte

$b \mid 0 = b$

$b \mid 1 = 1$ use | to Set b to 1

To Set bit 2 high in PORTD, while leaving all other bits as they are:

```
PORTD |= B00000100

≡ PORTD |= 1 << 2        (PORTD = PORTD | 1<<2)
```

To Set bit 2 Low in PORTD, while leaving all other bits unchanged

```
PORTD &= B11111011       (PORTD & 0xFB)
```

not as obvious which bit is changing

```
≡ PORTD &= ~(1<<2)
```

Example : Blink on Pin 5

```
Void    setup () {
          DDRD |= B00100000;
          PORTD  =  B00000000;
  }

Void    loop () {
          PORTD  ^=  B00100000;
          delay (100);
  }
```