



Sebastian Hack
Christoph Weidenbach

January 13, 2009

Tutorials for “Advanced C”
Exercise sheet 9

Happy new year to every one!

Exercise 9.1: (*Masks, 1 P*)

Give a C statement that

1. sets bits 5, . . . , 13 in an int.
2. clears bits 2, . . . , 6 and bit 18 in an int.

Assume that the least significant bit has the index 0.

Exercise 9.2: (*Bit Operations, 2 P*)

1. What is the effect of

```
int x, y, m;  
...  
x = x ^ y;  
y = y ^ (x & m);  
x = x ^ y;
```

2. Implement a multiplication by 112 by only using the operators $+$, $-$, \gg^u , \gg^s , \ll , $|$, $\&$, \oplus

Exercise 9.3: (*Two's complement arithmetic, 2 P*)

1. Derive the equation $\overline{x - y} = \bar{x} + y$ from $x + \bar{x} = -1$.
2. For which parameter does this method return 1:

```
int foo(int x) {  
    assert(x != 0);  
    return x == -x;  
}
```

Exercise 9.4: (*Number of Trailing Zeroes, 2 P*)

1. Can you use every de Bruijn number in the number-of-trailing-zeroes algorithm?
2. Implement the hash-table algorithm to compute the number of trailing zeroes of an int. Also provide a function to initialize the hash table.

Exercise 9.5: (*Population Code, 3 P*)

Sets of integers in $[0, n[$ are often and efficiently implemented as bit sets for reasonably small n . To this end one keeps an array of $k = n/\text{wordsize}$ integers and treats it as an array of bits. An integer i is contained in the set if the corresponding bit is 1. Obviously, set union, difference, intersection, membership test can be implemented efficiently with bit operations. To query the number of elements in the bit set, one computes the sum of the population counts of all the integers that constitute the set.

Implement a function `bitset_size(int *set, int k)` that computes the number of 1 bits in the array `set` of length `k`. Devise a method that is more efficient than just applying the population count algorithm presented in the lecture to each integer.

Submit your solution until the lecture on January, 13.

Note: Joint solutions are not permitted.