



Sample Solution to Assignment 1, Problem 1

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```
/*
```

```
PROG: floating
```

```
LANG: C
```

```
*/
```

```
#include <stdio.h>
```

```
#include <stdlib.h>
```

```
#include <stdint.h>
```

```
#include <math.h>
```

```
#define ABSOLUTE_WIDTH 31
```

```
#define MANTISSA_WIDTH 23
```

```
#define EXPONENT_WIDTH 8
```

```
#define EXPONENT_MASK 0xffu
```

```
#define MANTISSA_MASK 0x007fffffu
```

```
#define EXPONENT_BIAS 127
```

```
union float_bits {
```

```
    float f;
```

```
    uint32_t bits;
```

```
};
```

```
void print_float( FILE *output, float f ) {
```

```
    union float_bits t; t.f = f;
```

```
    uint32_t sign_bit = ( t.bits >> ABSOLUTE_WIDTH );
```

```
    uint32_t exponent = ( t.bits >> MANTISSA_WIDTH ) & EXPONENT_MASK;
```

```
    uint32_t mantissa = ( t.bits & MANTISSA_MASK );
```

```
    if( sign_bit != 0 ) {
```

```
        fprintf( output, "-" );
```

```
    }
```

```

if( exponent > 2 * EXPONENT_BIAS ) {
    fprintf( output, "Inf\n" ); /* Infinity */
    return;
} else if( exponent == 0 ) {
    fprintf( output, "0." ); /* Zero or Denormal */
    exponent = ( mantissa != 0 ) ? exponent + 1 : exponent;
} else {
    fprintf( output, "1." ); /* Usual */
}

for( int k = MANTISSA_WIDTH - 1; k >= 0; --k ) {
    fprintf( output, "%d", ( mantissa >> k ) & 1 );
}

if( exponent != 0 || mantissa != 0 ) {
    fprintf( output, " * 2^%d\n", (int) ( exponent - EXPONENT_BIAS ) );
}
}

int main() {
    FILE *input  = fopen( "floating.in",  "r" );
    FILE *output = fopen( "floating.out", "w" );

    size_t N; float f;
    fscanf( input, "%zu", &N );

    for( size_t i = 0; i < N; ++i ) {
        fscanf( input, "%f", &f );
        print_float( output, f );
    }

    fclose( input );
    fclose( output );
    return 0;
}

```

Below is the output using the test data:

floating:

- 1: OK [0.004 seconds] OK!
- 2: OK [0.004 seconds] OK!
- 3: OK [0.004 seconds] OK!
- 4: OK [0.004 seconds] OK!
- 5: OK [0.005 seconds] OK!

6: OK [0.004 seconds] OK!

7: OK [0.004 seconds] OK!

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