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" ),
       *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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