IEEE Floating Point Representation

<table>
<thead>
<tr>
<th>Sign</th>
<th>Exponent</th>
<th>Mantissa</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12</td>
<td>23</td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>123</td>
</tr>
</tbody>
</table>

A positive number, where the exponent is 0. The mantissa is a number that represents the value of the number.

Two's Complement

- \( \text{Two's Complement} \)
- \( \text{Number} = \text{Two's Complement} + 1 \)
- \( \text{Example:} \) \( 1011 = -1 \)

Endianness

- Little Endian: Least significant digit comes first.
- Big Endian: Most significant digit comes last.

Bit Shifting

- **Logical Shift**: Moves the bits to the left or right without changing the sign.
- **Arithmetic Shift**: Preserves the sign bit by shifting the least significant bit.

Multiplication by Bitwise Shifting Left

- \( (a \times b)_{2} = (a \times 2^{n})_2 \)
- \( (a \times b)_{2} = (a \times 2^{n})_2 + (a \times 2^{n-1})_2 \)

Division by Powers of Two Using Bitwise Shifting Right

- \( (a / 2^n)_{2} = (a \ll n)_2 \)
- \( (a / 2^n)_{2} = (a \ll n)_2 + (a \ll (n-1))_2 \)

Amdahl's Law

- \( S = \frac{P}{P + (1 - P) \times E} \)
- \( P = \text{Fraction of time program is running} \)
- \( E = \text{Fraction of time program is executing} \)

General Organization

- A cache is an array of small sets.
- Each set contains one or more lines.
- Each line contains a valid tag, some tag bits, and a block of data.
- The cache organization includes a portion of the address bits into the tag bits, set index bits, and bit offset bits.

Fundamental parameters

- \( S \): \# of sets
- \( E \): \# of elements per set
- \( B \): \# of blocks
- \( a \): \# of addresses
- \( n \): \# of blocks
- \( C \): \# of cache sets

Derived quantities

- \( S \times E \times B \): \# of elements in cache
- \( S \times E \times B \times n \): \# of cache blocks

Summary of cache parameters