Fixed Point Binary

Specification content

4.5.4.4 Numbers with a fractional part

Content
Know how numbers with a fractional part can be represented in: • fixed point form in binary in a given number of bits
Be able to convert for each representation from: • decimal to binary of a given number of bits • binary to decimal of a given number of bits.

Have you found the specification on bpcompsci.com yet? Let's look now...

Place value

Decimal

10^3 10^2 10^1 10^0 10^{-1} 10^{-2}

Place value

Decimal

10^3	10^2	10^1	10^0	10^{-1}	10^{-2}
1000	100	10	1	0.1	0.01

Place value

Decimal

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What about in binary?

Place value

Decimal

10^3	10^2	10^1	10^0	10^{-1}	10^{-2}
1000	100	10	1	0.1	0.01

What about in binary?

2^3	2^2	2^1	2^0	2^{-1}	2^{-2}
8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$

Fixed point binary

- When storing a fractional number, we have two parts to store:
  - The **integer part**
  - The **fractional part**

Fixed point binary

- When storing a fractional number, we have two parts to store:
  - The **integer part**
  - The **fractional part**
- Fixed point binary means deciding in advance where the binary point goes
  - This means we don't have to store that information
  - Example: 4 bits before the binary point, and 4 after
    - 11000101 $\longrightarrow$ 1100.0101

Conversion demonstration

1. Convert 1011.1100 to decimal

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   $11\frac{3}{4}$

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2. Convert $7\frac{3}{8}$ to fixed point binary

Conversion demonstration

1. Convert 1011.1100 to decimal

   $11\frac{3}{4}$

2. Convert $7\frac{3}{8}$ to fixed point binary

   0111.0110

Practice

Convert $6\frac{3}{4}$ into binary

Practice

Convert $6\frac{3}{4}$ into binary

0110.1100

Practice

Convert 1010.1011 into decimal

Practice

Convert 1010.1011 into decimal

$$8 + 2 + \frac{1}{2} + \frac{1}{8} + \frac{1}{16} = 10\frac{11}{16}$$

Practice

Convert 5.1875 into binary

Practice

Convert 5.1875 into binary

0101.0011

Practice

Convert 0100.0110 into decimal

Practice

Convert 0100.0110 into decimal

$$4 + \frac{1}{4} + \frac{1}{8} = 4\frac{3}{8}$$

Practice

Convert 0.1 into binary

Practice

Convert 0.1 into binary

???

Compare the binary for 67 and 33.5.

Discuss: What do you notice?

Shifts

- Decimal
  - Shift left = multiply by 10
  - Shift right = divide by 10

Shifts

- Decimal
  - Shift left = multiply by 10
  - Shift right = divide by 10
- Binary
  - Shift right = multiply by 2
  - Shift right = divide by 2

Ada Computer Science Quiz

L104 – Fixed Point Binary

Switch

Selection

- **Selection** is the process by which computers determine which course of action to take based on a condition
- A **condition** is an expression that evaluates to a Boolean (`true` or `false`)

Selection

- **Selection** is the process by which computers determine which course of action to take based on a condition
- A **condition** is an expression that evaluates to a Boolean (`true` or `false`)
- So far, we have seen `if` statements as a form of selection
- `switch` is the other form of selection you need to know about

Switch statements

- When there are multiple cases for a value, and we need to deal with each differently, a `switch` statement may come in handy

```
switch (mark)
{
    case 0:
        Console.WriteLine("Rating: Poor");
        break;
    case 1:
        Console.WriteLine("Rating: Good");
        break;
    default:
        Console.WriteLine("Invalid choice!");
        break;
}
```

Worksheet

W102 - C# Switch