

かけ算とわり算を見てみよう

…というわけで、ここまで見てきたシフト演算を使ってコンピュータはかけ算やわり算をするわけですが、



そうなんですね。単純に考えるとシフト演算では、「2、4、8、16…」のような 2^n にあたる数字でしか、かけ算もわり算もできません。「3」とか「7」とかの、半端な数字で行う計算はどうすりやいいの?という壁にぶち当たります。

The diagram shows a computer character and a mushroom character. The computer says, "そこで、かけ算なら 2^n 同士の足し算に置きかえて計算を行います" (So, for multiplication, we replace it with the addition of 2^n numbers). The mushroom says, "あ! 確かに!" (Ah! That's right!). In the center, there is a box titled "かけ算の場合" (Multiplication case) with the equation $? \times 7 = ? \times (4 + 2 + 1)$. A lightbulb icon says, "2^n であらわせる数にばらす!" (Break down the number into 2^n). Below it, the equation is shown as $= ? \times (2^2 + 2^1 + 2^0)$, then $= (? \times 2^2) + (? \times 2^1) + ?$. Arrows point from the terms to labels: "左に2ビットシフトしたもの" (Shifted left by 2 bits), "左に1ビットシフトしたもの" (Shifted left by 1 bit), and "元の数値" (Original value).

一方のわり算。わり算も基本は同じなのですが、こちらはまず「わり算って何?」というところから整理する必要があります。

The diagram shows a computer character and a mushroom character. The computer asks, "「なに?」って「分割できる数」の計算をします?" (What is it called when you calculate the division of a number?). The mushroom says, "20 ÷ 5 は ちがう? どう? つまりはこんな引き算だと見なすことができる!" (20 ÷ 5 is different? How? It's like this subtraction calculation). The computer says, "5ずつ4つに分けられる...の意味" (It means it can be divided into groups of 5 four times).

The diagram shows a computer character and a mushroom character. The computer says, "そこで、わり算なら 2^n の引き算を用いて計算を行なうわけです" (So, for division, we use 2^n subtractions to calculate it). The mushroom says, "こんな感じの計算をしてるのと同じこと" (It's like doing this kind of calculation). In the center, there is a box titled "わり算の場合" (Division case) with the equation $15 \div 3 \rightarrow 1111_{\text{15}} \div 11_3$. A speech bubble says, "たとえば15を3でわるとする場合..." (For example, if we divide 15 by 3...). To the right, it says, "2進数に直すと..." (Convert to binary) and "二の元の数字を11で超えない範囲で" (Within the range where the original digit is 11 or less). Below, it shows the steps of binary long division: $1100 \rightarrow \begin{array}{r} 1111 \\ -1100 \\ \hline 11 \end{array}$ (2-bit shift), $11 \rightarrow \begin{array}{r} 11 \\ -11 \\ \hline 0 \end{array}$ (0-bit shift). A note says, "引き算の結果を超えない範囲で" (Within the range where the result of subtraction is not exceeded). At the bottom, it says, "...ということは 元の数値から引くことができた回数を求めるには、この2つを足してやれば良い" (That means, to find the number of times you can subtract from the original value, add these two together). This leads to the equation $2^2 + 2^0 = 4 + 1 = 5$, with a note at the bottom right saying, "引くことのできた回数" (Number of times you can subtract).