BINURY NUMBERS PART

Lesson Plan: Class 04 / P / 11

(Rough sketch – design phase)
Overall goal of the lesson: Children will learn more about Binary Numbers.
Prior knowledge required: Lessons learned from the introductory Binary Numbers period. Knowledge of basic mathematics: addition, multiplication, division.
MODULE 1:
Module time: 35 minutes
Goal: To learn more about Binary Numbers and how they are used in modern computing.
Description: Children will learn about binary numbers with the help of an activity.
Material required:
Physical:

1. One copy of the worksheet Binary Numbers Part 2 per child.
2. Writing material to solve the worksheet: pencil and eraser.

Electronic:
PPT Presentation for Binary Numbers Part 2
Procedure Summary:
Distribute the worksheets (Introduction to Network Protocols) to the children.
Procedure Details:

1. Begin with a quick recap of the previous lesson. The students learned that the most commonly used numbering system is the Decimal Number System where the digits have a place value of multiples of ten. For example, the number 365 has the digit 5 in the Units' place (i.e. 5 bundles of one), the digit 6 in the Tens place (i.e. 6 bundles of 10), and the digit 3 in the Hundreds place (i.e. 3 bundles of 10x10), giving us a total of 365.
2. The students also learned that the Decimal Number System is not the only numbering system used in the world. The other most widely used numbering system is the Binary Number System. The students learned that Binary Numbers are made up of combination of two symbols: 0 (OFF) and 1 (ON).
3. The digits in the Binary Number System have a place value of multiples of two. Right most digit has the units place with a value of 1. As we move leftwards, the digits have values in multiples of two. For example, the number 2 is written as 010. Binary Digits are also known as Bits.
4. The students learned that the Binary Number System is important because it is the numbering system understood by all computers and digital devices in the world. This is because computers and digital devices are made up of millions of electronic parts that send out either an OFF signal or an ON signal to communicate with each other and work together. Computers can "talk" with other computers and devices using these ON/OFF signals.
5. So, let's take our learning a little bit further… In the last lesson, we learned about three-digit Binary Numbers where the lowest number is 0 and highest number is 111 or decimal 7. But what if we wanted to count higher using the Binary Number System? In the decimal number system, if you put a zero on the right hand side of the number it gets multiplied by 10, so 4 becomes 40… 40 becomes 400 etc. What will happen if we put a zero on the right hand side of a Binary Number? The decimal number four which is represented as 100 (pronounced as One-Zero-Zero) in binary … if we add a zero to the right becomes 1000. What is its value?

3 bundles of 2 (2x2x2 = 8)	2 bundles of 2 (2x2 = 4)	1 bundle of 2 (1x2 = 2)	Units' place (Value = 1)

The value is 8.

What does this mean? It means that as we increase the digits in Binary Numbers, it gets multiplied by 2!

Now, if we put a zero next to the binary number 1000…

4 bundles of 2 (2x2x2x2 = 16)	3 bundles of 2 (2x2x2 = 8)	2 bundles of 2 (2x2 = 4)	1 bundle of 2 (1x2 = 2)	Units' place (Value = 1)
1	0	0	0	0

The value is 16!

6. So does this mean we can only count even numbers? The answer is no. We can count odd numbers too.

4 bundles of 2 (2x2x2x2 = 16)	3 bundles of 2 (2x2x2 = 8)	2 bundles of 2 (2x2 = 4)	1 bundle of 2 (1x2 = 2)	Units' place (Value = 1)
0	1	0	1	1

The value is 11

4 bundles of 2 (2x2x2x2 = 16)	3 bundles of 2 (2x2x2 = 8)	2 bundles of 2 (2x2 = 4)	1 bundle of 2 (1x2 = 2)	Units' place (Value = 1)
1	1	1	1	1

The value is 31

7. Ask the children who can tell if 100 is actually one hundred or binary four? Confusing right? Binary numbers are distinguished from decimal numbers by adding a tiny little 2 at the bottom of the number. Binary four is written as 100_2. The tiny little 2 at the bottom tells us that digits in this number have place values of 2.
8. One popular method of converting decimal numbers to binary is the Divide by 2 Method. Let's take the decimal number 24. Take the number 24 and divide it by 2. The remainder of the division is the bit value starting from the right. Keep dividing the quotients till you end up with zero quotient.

   24 ÷ 2 = 12 Remainder = 0 -- right most bit

   12 ÷ 2 = 6 Remainder = 0

   6 ÷ 2 = 3 Remainder = 0

   3 ÷ 2 = 1 Remainder = 1

   1 ÷ 2 = 0 Remainder = 1 --- left most bit

   Now read the remainders in reverse, i.e. from bottom up. This means that **decimal 24 is represented as 11000_2 in binary**.

9. Let's try that again, this time with an odd number. Example: 33

   33 ÷ 2 = 16 Remainder 1 – right most bit
   16 ÷ 2 = 8 Remainder 0
   8 ÷ 2 = 4 Remainder 0
   4 ÷ 2 = 2 Remainder 0
   2 ÷ 2 = 1 Remainder 0
   1 ÷ 2 = 0 Remainder 1 – left most bit

   This means that **decimal 33 is represented as 100001_2 in binary**.

10. Ask the children if anyone has used a computer to type letters or see photos or watch videos? When we type we can see letters appearing on the screen. We can form sentences and store them or send them. We can send pictures, music, videos. How does all this happen?
11. Computers are made up of millions of electronic parts that are capable of storing or sending either an OFF value or ON value. The reason why computer parts use only two values is because it is much easier to build devices that work with two values. Ask the children if they have seen the back portion of a CD or DVD … the shiny portion! CDs or DVDs store bits (Binary digits) using light signals… a part of the shiny surface does not reflect laser light (OFF signal) and part of the shiny surface reflects laser light (ON signal). When we play the CD, a combination of ON/OFF signals (or binary numbers) are interpreted as musical notes, which when put together makes a song or music!
12. Now imagine if we had to build a CD or CD playing device that used the decimal number system for interpreting music. This will mean that we would need to build a device that is capable of interpreting TEN signals representing symbols 0 1 2 3 4 5 6 7 8 9! This would be terribly difficult and complicated, not to mention terribly expensive!
13. How about alphabets, numbers, punctuations and other symbols that we normally see on a keyboard? In the early days of computing, some wise people decided that there must be a uniform way of interpreting all the letters we see on the keyboard. They came up with something called ASCII -- the American Standard Code for Information Interchange (pronounced AS-KEE). ASCII assigns numbers starting from 0 to 127 to all alphabets, numbers, punctuations, and other symbols seen on keyboards. For example, the capital letter A is assigned the number 65 (Binary: 01000001_2). The small letter ‘a’ is assigned the number 97 (01100001).
14. You will notice that ASCII values are grouped in eight bits. One bit on its own cannot represent anything of value, so bits are usually grouped together in groups of eight. Eight bits together is called one Byte
15. Ask the children if they have ever heard something like “My phone has 16 GB memory” or “My computer has 32-bit speed”. What does this mean?
    32-bit speed means that the computer can work with 32 bit numbers in one go i.e. it can process 32 ON/OFF signals at once. To put things in perspective 255 is an 8-bit number.
16. 16 GB memory means that the phone can store 16 Giga Bytes of information. One Giga is 1000 x 1000 x 1000 … so 16 GB memory means 16 x 1000 x 1000 x 1000 Bytes. 1 Byte is 8 bits!

Assessment :
Answer questions on the activity sheet

Information Broadcast : In Computer Science, the children learnt about Binary Numbers.