Binary Numbers Teachers' Notes

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Overview: One 50-minute session. Suitable for third through tenth grades. (I've presented this in as little as 35 minutes.)

Prerequisite: Familiarity with the concepts of positional number systems and place values.

Presentation

- Lecture with slides and handout covering the following (15 minutes) Slides are part of the kit. Alternatively, there is a video that presents this material.
    - We can represent any number
    - Binary numbers are "times two" instead of "times ten."
    - Why binary numbers are used in computers.
    - Examples with "counting cards."
- Questions and exercises (30 minutes)

Students who complete this session successfully will be able to:

- Explain briefly why binary numbers are used in computers
- Determine the decimal value of small binary numbers
- Convert small decimal numbers to binary using counting cards.

About the exercises:

- The algorithm for converting decimal to binary with the counting cards is: working from the left, turn over any card that will make the total number of dots on that card, plus all dots on cards to the left, more than the number being converted. There is an example in the video, beginning at slide 9, 10:40 into the video.
- If we added a sixth card, it would be 32s place, and the next would be 64; each place is twice its predecessor..
- Patterns and relationships:
    - Rightmost three cards up gives 7 dots (4 + 2 + 1)
    - The next card is eight.
    - The difference is one (8 – 7 = 1)
    - The number of dots on any card will be one more than the total of dots to its right.

Things to watch for:

- Students may have trouble with the idea that the cards must be in place order, with the ones place on the right, then twos place, fours place, and so on..
- Students should work from the left when converting decimal to binary.
- The handout says, "One stands alone and starts every system of numbers." This is true only for positional number systems, and you may need to explain, for example, that Roman numbers do not have a ones place because they're not positional, *i.e.* do not have places at all.

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