(http://csmatters.org/pd-new)   C - 01a

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Bits, Binary and Hex (online version)

Unit Concept Lessons

Revision Date: Sep 10, 2019
Duration: 120 50-minute sessions

Lesson Summary

Summary: Teachers will master Lesson 1-4: Bits, Binary, and Hex. They will understand binary and its relation to computers. They will understand converting decimal to binary. They will also understand different types of memory.

Outcomes:

Teachers will

- Understand binary and its relation to computers/computing
- Evaluate different ways to engage and reinforce an understanding of binary and conversion for students.
- Be introduced to the concept of abstraction
- Understand different types of memory
- Be introduced to logic gates
- Understand how to convert decimal to binary and vice versa

Overview: (Total: 120 min)

1. Binary: Importance, Conversions
2. Logic and Gates
3. StartUp and Practice Activities
4. Flippy Do Worksheet
5. Extending to octal and hex

Learning Objectives

CSP Objectives

Big Idea - Professional development provides ongoing opportunities for teachers to examine a variety of classroom assessments, practice using them in their classrooms, and analyze the results to (1) understand and report on student mastery of Maryland content standards.

- ○ LO 1c - Professional development provides ongoing opportunities for teachers to examine a variety of classroom assessments, practice using them in their classrooms, and analyze the results to (1) understand and report on student mastery of Maryland content standards.

Big Idea - Professional development combines a variety of learning experiences, including, but not limited to, individual study, demonstrations, observation, practice, feedback, and reflection as well as opportunities for collaboration and problem solving among colleagues.

- ○ LO 9b - Professional development combines a variety of learning experiences, including, but not limited to, individual study, demonstrations, observation, practice, feedback, and reflection as well as opportunities for collaboration and problem solving among colleagues.

Big Idea - Professional development recognizes and draws on the knowledge, skills, and dispositions of successful teachers by including them as leaders, facilitators, and resources in professional learning opportunities.

- ○ LO 9e - Professional development recognizes and draws on the knowledge, skills, and dispositions of successful teachers by including them as leaders, facilitators, and resources in professional learning opportunities.

Key Concepts

1. Concept of different number systems - how they are the same and different

2. How place valued number systems work - exponents on the base indicates the value given to that place

3. How to do conversions binary to/from decimal

4. How to compare values of different bases

Teacher Resources

Student computer usage for this lesson is: **required**

CL01_Bits and Binary Folder (https://drive.google.com/open?id=0B5vAY-fhOT-ieWhaSmtKcmtmbUU)

Binary Outline (https://drive.google.com/open?id=18iWW-BoUJrc3odKVsbL_TxaUtf9SVGM6lwAtV79EH-k)

Lesson Plan

TOTAL: 120 minutes

Binary: Importance, Conversions

Watch the Khan Academy video on "How Computers Work, Binary & Data (https://www.khanacademy.org/computing/computer-science/how-computers-work2/v/khan-academy-and-codeorg-binary-data)". Would you choose to show this to your class? If so, would you show all of it or just part of it? If not, be prepared to share your favority activity for introducing binary in the discussion group.

Watch the Khan Academy videos (https://www.khanacademy.org/math/algebra-home/alg-intro-to-algebra/algebra-alternate-number-bases/v/number-systems-introduction) about converting binary/decimal and decimal/binary. (students will NOT need to know how to do math in other base systems, but you might want to offer this as an enrichment activity)

Key point: Everything inside of a computer is represented by a series of binary digits. 1 bit is equivalent to 1 binary digit. This causes challenges since not all fractions can convert perfectly from decimal to binary.

It is important to talk about bits in the context of physical things - hardware. Abstraction is introduced by demonstrating that bits can be represented in many different forms.

Specific things that are very important to represent with bits:

- numbers
- real numbers
- fractions
- songs
- images
- characters (ASCII)

Abstraction is a key concept here - crucial for modern computing.

Logic & Logic Gates

Circuits and logic: Watch the Khan Academy video on Circuits & Logic. (https://www.khanacademy.org/computing/computer-science/how-computers-work2/v/khan-academy-and-codeorg-circuits-logic) or the Code.org video on Circuits and Logic (https://www.youtube.com/watch?v=ZoqMiFKspAA)

Flip Flops are a basic circuit in digital electronics. Flip Flops are circuits that remember the value of a specific bit by refreshing it constantly. Search for a video on how flip flops work (there are different kinds, pick one) and add a post to the discussion group:

1. How do you plan to introduce binary and flip flops in your classroom? Describe an activity or video, cite the source and give a short summary.
2. If you found the video on flip flops confusing, post a question to the discussion group
3. If you understand flip flops well, answer a post in the discussion group

Watch the Khan Academy video on CPU, memory, input and output.
(https://www.khanacademy.org/computing/computer-science/how-computers-work2/v/khan-academy-and-codeorg-cpu-memory-input-output)

Learn how to construct a truth table to evaluate an expression at Wisc Online: how to create a truth table (https://www.wisc-online.com/learn/career-clusters/manufacturing/dig802/the-4-input-truth-table)

Discussion of digits and significance - in particular, differences between decimal counting and binary counting making sure to tie it to what they already know - they know place values in decimal.

StartUp and Practice Activities

Read about how the Birthday Card Trick (https://drive.google.com/open?id=0B_LG6mwDBugnaHpvYVdUWlpFQW8) works. Print out a set of cards to use in your classroom if you would like to do this as a warmup or class activity.

Decimal to Binary Activity (Toe Touches): Split the class up into 6 groups, each group lines up. Need to represent a decimal number as a group in binary by standing tall and raising hands if they are a 1, crouch down as a 0. Note: This doesn't always work, sometimes kids spend their time arguing

Alternative game (quieter): Cisco Binary Game available at https://studio.code.org/projects/applab/iukLbcDnzqgoxuu810unLw (https://studio.code.org/projects/applab/iukLbcDnzqgoxuu810unLw)

Choose one question to answer on the Discussion board:

1. Why wouldn't the birthday trick work for decimal?
2. Practice the birthday trick on a couple of people, comment on the experience. How quickly can you determine a birthday? How much class time do you think this would take for students to do in pairs once they know the trick?
3. Describe an activity that you would want to try in your classroom to engage students in doing conversions.

Flippy Do Worksheet

The Flippy Do is a paper tool for quickly doing binary/decimal conversions. Follow the directions to create one of these worksheets for yourself. Consider using 5X7 index cards for students to create their own that they can use throughout the year for a quick warmup or quiz question.

Flippy Do available at https://curriculum.code.org/csp/unit1/5/ (https://curriculum.code.org/csp/unit1/5/) and Flippydo (https://drive.google.com/open?id=0B_LG6mwDBugnQV9VVGtGTWgzSlU)

Flipping Cards (https://drive.google.com/open?id=0B_LG6mwDBugnSGwya2lSem5ld00)

Extending to Octal and Hexadecimal

Watch the videos in the conversion folder (https://drive.google.com/drive/folders/0B00cKGscEL1YZkxvNXllc2RCTjA). Practice at least one of each type of conversion without looking at the video until you are sure you know what you are doing.

Why we use octal and hexadecimal - give a long string of binary digits and explain how hard it would be to take that number to decimal but also how hard it is for people to read in binary

Since Octal is 2^3 and Hexadecimal is 2^4 - these are easier conversions to/from binary

Show examples of where these other bases are used - IPB6 and colors (RGB)

Evaluate additional resources at

- Decimal/Binary and Binary/Decimal converters available at

http://www.binaryhexconverter.com/decimal-to-binary-converter (http://www.binaryhexconverter.com/decimal-to-binary-converter)

- Binary/Octal/Hexadecimal converter at

https://www.mathsisfun.com/binary-decimal-hexadecimal-converter.html (https://www.mathsisfun.com/binary-decimal-hexadecimal-converter.html)

- Online quiz at

http://www.free-test-online.com/binary/binary2decimal.htm (http://www.free-test-online.com/binary/binary2decimal.htm)

- Worksheet/Quiz Generator at

https://www.worksheetworks.com/math/numbers/systems.html (https://www.worksheetworks.com/math/numbers/systems.html)

- Nice online quiz at

http://networking.ringofsaturn.com/IP/binquiz.php (http://networking.ringofsaturn.com/IP/binquiz.php)

Evidence of Learning

Formative Assessment

Playing the on-line binary conversion games

Summative Assessment

A short quiz to use in class with at least 2 variations posted to piazza.

(http://www.umbc.edu/) (http://www.umd.edu/)

(http://www.nsf.gov/)

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