CS Simplified

GBEA Conference 2016

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Mrs. Pintu Thaker - Meadowcreek High School
Cipher Activity

Java Life video

Cipher Video

Can you decode this secret message?

Tbizljb ql

ZP Pfjmficfba
Cipher Activity

Can you decode this secret message?

Tbizljb ql

ZP Pfjmifcfba

Welcome to CS Simplified

Make your own cipher decoder

Khan Academy - Great unit on Cryptography!
Cipher Activity

CS Symbol Encryption
Algorithms

Sheldon’s Friendship Algorithm

Amelia Bedelia - to teach programming as following instructions exactly

Ask students to write down the steps to fold a paper airplane, draw a house etc. - then have a partner try to follow the directions.

LightBot

Flowchart Symbols Explained

Khan Academy - Intro to Algorithms Unit
Algorithm

noun

Word used by programmers when they do not want to explain what they did.
Debugging Code

Neat Story

Debugging Wiki
Binary

Binary Lights Demonstration - use tap lights to teach students Binary!

Harvard CS50 - Binary Lesson

Cisco Binary Game

Binary CS Unplugged Activities

There are 10 types of people in this world...

Those who know binary and those who don’t!

8 BITS MAKE A BYTE - WHAT WOULD 9 BITS MAKE? AN OVERBYTE!
Number System

• Decimal Number System
  – Base 10 – 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
  – 4783 and we can look at it like this. We have 4 x 1000 + 7 x 100 + 8 x 10 + 3 x 1, giving us the 4783 value.

• In computing we should understand
  – Binary Number System
    • Base 2 – 0 and 1
  – Octal Number System
    • Base 8 – 0 to 7
  – Hexadecimal Number System
    • Base 16. Digits used : 0 to 9, Letters used : A- F
Number System

• Binary to Decimal

\[ 1110_2 \]

\[
\begin{array}{cccc}
1 & 1 & 1 & 0 \\
(1*2^3) & (1*2^2) & (1*2^1) & (0*2^0) \\
1 * 8 & 1 * 4 & 1 * 2 & 0 * 1 \\
8 & 4 & 2 & 0 \\
8 + 4 + 2 + 0 = 14_{10}
\end{array}
\]

\[ 1110_2 = 14_{10} \]
Number System

• Decimal to Binary

\[-14_{10}\]

<table>
<thead>
<tr>
<th>2</th>
<th>14</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

\[1110_2\]
### Number System

#### Binary to Hex

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Hex</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
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<tr>
<td>3</td>
<td>3</td>
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<td>8</td>
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<td>9</td>
<td>9</td>
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<tr>
<td>10</td>
<td>A</td>
</tr>
<tr>
<td>11</td>
<td>B</td>
</tr>
<tr>
<td>12</td>
<td>C</td>
</tr>
<tr>
<td>13</td>
<td>D</td>
</tr>
<tr>
<td>14</td>
<td>E</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>1</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1*2^3)</td>
<td>(1*2^2)</td>
<td>(1*2^1)</td>
<td>(0*2^0)</td>
</tr>
<tr>
<td>1 * 8</td>
<td>1 * 4</td>
<td>1 * 2</td>
<td>0 * 1</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>2</td>
<td>0</td>
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</tbody>
</table>

\[ 8 + 4 + 2 + 0 = 14_{10} \]

\[ 14_{10} = E_{hex} \]
Number System

Binary to Hex

$111110_2$

<table>
<thead>
<tr>
<th>1</th>
<th>1</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(1 \cdot 2^3)$</td>
<td>$(1 \cdot 2^2)$</td>
<td>$(1 \cdot 2^1)$</td>
<td>$(0 \cdot 2^0)$</td>
</tr>
<tr>
<td>1 * 8</td>
<td>1 * 4</td>
<td>1 * 2</td>
<td>0 * 1</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

$8 + 4 + 2 + 0 = 14_{10}$

$14_{10} = \text{E}_{\text{hex}}$

<table>
<thead>
<tr>
<th>0</th>
<th>0</th>
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<th>1</th>
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<tr>
<td>$(0 \cdot 2^3)$</td>
<td>$(0 \cdot 2^2)$</td>
<td>$(1 \cdot 2^1)$</td>
<td>$(1 \cdot 2^0)$</td>
</tr>
<tr>
<td>3_{10}</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

$111110 = 3\text{E}_{\text{hex}}$
Number System

- **Hex to Decimal**

  A23

  \[
  A23_{\text{hex}} = 2595_{\text{dec}}
  \]

<table>
<thead>
<tr>
<th>A</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( (10 \times 16^2 ) )</td>
<td>( (2 \times 16^1 ) )</td>
<td>( (3 \times 16^0 ) )</td>
</tr>
<tr>
<td>10 \times 256</td>
<td>2 \times 16</td>
<td>3 \times 1</td>
</tr>
<tr>
<td>2560</td>
<td>32</td>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Hex</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
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<tr>
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<td>14</td>
<td>E</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
</tr>
</tbody>
</table>
Octal to Decimal System

Octal to Decimal

36238<sub>8</sub>

<table>
<thead>
<tr>
<th>3</th>
<th>6</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>(3*8&lt;sup&gt;3&lt;/sup&gt;)</td>
<td>(6*8&lt;sup&gt;2&lt;/sup&gt;)</td>
<td>(2*8&lt;sup&gt;1&lt;/sup&gt;)</td>
<td>(3*8&lt;sup&gt;0&lt;/sup&gt;)</td>
</tr>
<tr>
<td>3 * 512</td>
<td>6 * 64</td>
<td>2 * 8</td>
<td>3 * 1</td>
</tr>
</tbody>
</table>

1536 + 384 + 16 + 3 = 1939<sub>10</sub>

3623<sub>8</sub> = 1939<sub>10</sub>

Decimal to Octal

1939<sub>10</sub>

<table>
<thead>
<tr>
<th>8</th>
<th>1939</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>242</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>30</td>
<td>6</td>
</tr>
</tbody>
</table>

1939<sub>10</sub> = 3623<sub>8</sub>
Variables

Use cups to demonstrate that variables are containers that hold something.

If you try to put an int into a double you can but are wasting space!

If you try to put a double into an int you will spill over & lose data.
Conditionals

if statement Red Light/Green Light

The caller chooses a condition and asks everyone who meets that condition to stand up/sit down.

- If you are wearing blue, stand up.
- If you are wearing sandals, sit down.

Try switching it up by saying things like "If you are not blonde, stand up."

Video teaching demo - if else activity (lesson: Conditionals with Cards)

CS Words Drag & Drop Activity
Conditionals Unplugged

Create a course on the classroom floor where students use decisions and methods.
Just for fun….if Statements

**Being a Programmer**

My mom said: “Honey please go to the store and buy 1 bottle of milk.
If they have eggs, bring 6.”
I came back with 6 bottles of milk.

ONE DOES NOT SIMPLY MISS AN ELSE

AFTER SUCH A POWERFUL IF STATEMENT
Boolean Logic

Viva la if Statement Song

Boolean Logic with Dwight Schrute

Have students create truth tables

*When you use and both sides have to be true to evaluate to true

* When you use or only one side has to be true to evaluate to true.

Do you want to go to prom with someone who is good looking AND funny? Good looking or funny?
Boolean Logic

If that is the question...the answer to $2b \lor \neg 2b$ is TRUE
Loops

Clap your hands 3 times - how did you know to stop?

Take the 3 different parts of a for loop (start - stop - inc/dec) and let the students piece them as a puzzle.

How many lines of writing did the student save by writing this loop?
Endless Loop

How did the programmer die in the shower?

His shampoo bottle said to......

Show that if you do not have a stop your loop will continue on.
Muffin Tin or Egg Carton Arrays

Using Muffin Tin or Egg Cartons, arrays can be demonstrated in a visual, hands-on manner.

Directions:

· Using Muffin Tin or Egg Cartons, arrays can be demonstrated in a visual, hands-on manner.
· Have students bring in egg cartons or collect use muffin tins.

· Use clothes pins, sticky notes, sticky dots etc. to let students label rows and columns.

· Use the cards attached and make more to allow the students to put objects in the corresponding row and column.

Note: Students may be acquainted with math matrices. If so, you will need to explain that computer science counts from 0 rather than 1.

Hint: If you wish a single row array, cut the egg carton in half-length wise and then use the number of egg slots needed by cutting more or a portion off for an individual problem demonstration.

Cards on subsequent pages could be place in slide show based on the numbers needed or those wanted that day.
Arrays Continued

Do you have the Headbandz game?

Use index cards with 0 - 9 to teach Array indexes.

Have students wearing the headbands to hold numbers or words. You can use this to teach how to store values in an array, `indexOf()`, `charAt()`, `substring` etc. This is also good to use when sorting arrays or lists.
Arrays

Too Many Daves by Dr. Seuss - The need to index in an array/arraylist

Song - You use Arrays

Computational Fairy Tales - Arrays

Why did the programmer quit his job?
Because he didn’t get arrays
Strings

Characters in a String work very similarly as objects in an Array.

Index starts at 0

I use a magnet & make it fall off my board if it tries to access out of bounds

When you pull a substring - draw a line BEFORE each number

myArray.substring(2,4) put a line before the 2nd index & another before the 4th index.

Why is (3, 7) not out of bounds?
Arraylist

Arraylists can add and remove elements.

Use ABC blocks to teach Arraylist methods
Searching

Linear Search - go through your classroom & ask “Is your name John?” until you get to John (use a student name that is near the end of the row)

Binary Search - You can also split a phone book!

Khan Academy - Binary Search Unit

CS Unplugged - Searching
Sorting

Insertion Sort with playing cards
Harvard CS50 Insertion Sort Explained

Selection Sort with playing cards
Harvard CS50 Selection Sort Explained

Merge Sort with playing cards
Harvard CS50 Merge Sort Explained

A website that shows the different sorts in action

CS Unplugged - Sorting

*Don’t sort by shape or height - give them numbers, use birthdays etc.

Khan Academy has units on all sorts & asymptotic notation
Recursion

Recursion: See Recursion

Recursion - The Cat in the Hat Comes Back

Sing About Recursion

Lightbot 2.0

Khan Academy - Recursion Unit

Khan Academy - Teaching Recursion with Towers of Hanoi

Teaching recursion using Russian Dolls (Demo)

- Note: The smallest doll is the base case it has the answer
- It tells the doll next to it the answer & stacks back in - continue until all dolls are nested again.
The movie Inception is a good example of Recursion
* do not show this movie in class but your kids have most likely seen it & you can mention
Limbo is an infinite loop
The code they seek is the base case
The kick back up through the dreams is solving the recursion
Constructor

Wear a hard hat & show a house plan (or pretend)

Let students know constructors are the blueprint that tells what an object will look like!

This video is great to show the difference between the constructor and an actual object.

Mad PhD makes Objects

Another analogy - the recipe is the constructor code - the cookie it makes is the object. You can eat the recipe card - it is just the plan.
Creating Objects (Java Programming)

Have students make a **poplet**

**Remember: a class describes what an object knows and what an object does**

A class is the blueprint for an object. When you write a class, you’re describing how the JVM should make an object of that type. You already know that every object of that type can have different *instance variable* values. But what about the methods?

<table>
<thead>
<tr>
<th>instance variables (state)</th>
<th>knows</th>
</tr>
</thead>
<tbody>
<tr>
<td>title</td>
<td></td>
</tr>
<tr>
<td>artist</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>methods (behavior)</th>
<th>does</th>
</tr>
</thead>
<tbody>
<tr>
<td>setTitle()</td>
<td></td>
</tr>
<tr>
<td>setArtist()</td>
<td></td>
</tr>
<tr>
<td>play()</td>
<td></td>
</tr>
</tbody>
</table>
More CS Teaching Resources!

- Khan Academy - Computer Science Units & Programming Units
- Code.org AP CS Principles Curriculum (it’s FREE make a code studio teacher account)
- Code.org CS Videos
- Hour of Code
- Codecademy - it’s FREE - you can create a teacher account
- Earsketch - learn programming by making music!
- Edhesive - students can create free logins for free courses for Intro, CS Principles, APCS A
- Codingbat (for APCS A)
- Georgia Tech’s APCS A Interactive Review Book & CS Principles Interactive Review Book
- Mr. Horn’s APCS A Exam Review (for APCS A - goes over the AP Questions)
- A+ Computer Science Curriculum for APCS A
- My Programming Lab (not free but grades Java labs)
- Sphero Robots - Lightning Lab Resources
- Makey Makey
- Finch Robots
- Adafruit Circuit Playground
- Georgia Virtual Curriculum - IDT, CS Principles, APCS A
- 101 Tech Tools you can use in your classroom
- Gcflearnfree.org - various videos and lessons for all levels
- Scratch - beginning programming using animation
- Alice.org - learn programming and create videos of what you program the code to do!
- Practicelt (for AP CS A)
- codehs.com