



# Computer Science Unplugged

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# Computer Science Unplugged



Created by

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Adapted for classroom use by  
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- CS Unplugged is a book of activities that illustrate computer science principles without using a computer.
- Activities are short and are designed to be easily integrated into classes and include exercises and lesson plans for teachers.

## CS UNPLUGGED

- The basic edition of Computer Science Unplugged has 12 classroom exercises for you to use with your students.
- Each exercise has a number of extensions, activities and background information.
- All activities can be done without the use of computers, but they all demonstrate fundamental principles used in computers today.

## TWENTY GUESSES

- How much information is there in a 1000-page book? Is there more information in a 1000-page telephone book, or in Tolkien's *Lord of the Rings*?
  - If we can measure this, we can estimate how much space is needed to store the information.
- This activity introduces a way of measuring information content.

## TWENTY GUESSES

- Can you read the following sentence?

Ths sntnc hs th vwls mssng.

- You probably can, because there is not much "information" in the vowels.



## TWENTY GUESSES

- I am thinking of a number between 1 and 100.
- I will start you off with 20 pieces of candy.
- You may only ask questions that have a "yes" or "no" answer.
- For each incorrect guess, you will lose one piece of candy.
- Once you guess correctly, you can keep whatever candy remains.

## TWENTY GUESSES

- To pick a number between 0 and 100, you only need 7 guesses.
  - Always shoot for the middle number of the range and eliminate half the possibilities!
  - This concept is called binary search.
- If the number was between 0 and 1000, you would only need 3 additional guesses.
- You can guess a number between 0 and 1 million in only 20 guesses!

## LIGHTEST & HEAVIEST

- Computers are often used to put lists into some sort of order (e.g. names into alphabetical order, appointments or e-mail by date, etc.)
  - If you use the wrong method, it can take a long time to sort a large list into order, even on a fast computer.
- In this activity children will discover different methods for sorting, and see how a clever method can perform the task much more quickly than a simple one.

## LIGHTEST & HEAVIEST

- Start with 8 containers with different amounts of sand or water inside. Seal tightly.
- Children are only allowed to use the scales to compare the relative weights of two containers.
- Only two containers can be compared at a time.



## LIGHTEST & HEAVIEST

- METHOD 1 is called Selection Sort.
- METHOD 2 is called Quick Sort.
- Generally, quick sort is a lot faster than selection sort is.

## BATTLESHIPS

- Computers are often required to find information in large collections of data.
- Computer scientists study quick and efficient ways of doing this.
- This activity demonstrates three different search methods so children can compare them.

## BATTLESHIPS

- Battleships are lined up at sea.
- Each battleship has a number that is hidden.
- How many guesses does it take for you to find a specific battleship?
  - The number of guesses is the child's score.
  - The lowest score wins.



# BATTLESHIPS

GAME 1: Ships are randomly ordered.

## Your Ships

### Number of Shots Used:

A decorative banner at the top of the page. It features a repeating pattern of blue and black triangles pointing to the right. Below this pattern, the letters of the alphabet are arranged in two rows: A, B, C, D, E, F, G, H, I, J, K, L, M in the top row, and N, O, P, Q, R, S, T, U, V, W, X, Y, Z in the bottom row. The letters are in a bold, black, sans-serif font.

## FIND SHIP # 717

1A

# BATTLESHIPS

## GAME 2: Ships are in increasing order.

## Your Ships

Number of Shots Used:

33	183	730	911	1927	1943	2200	2215	3451	3519	4055	5548	5655
A	B	C	D	E	F	G	H	I	J	K	L	M
5785	5897	5905	6118	6296	6625	6771	6831	7151	7806	8077	9024	9328
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

## FIND SHIP # 5897

2A

## BATTLESHIPS

GAME 3: Ships are ordered into 10 groups based on a mystery function.

### Your Ships

Number of Shots Used:

0	1	2	3	4	5	6	7	8	9
A	E	H		L		O	R	V	Y
B	F	I	K	M		P	S	W	Z
C	G	J		N		Q	T	X	
D						U			

FIND SHIP # 8417

3A

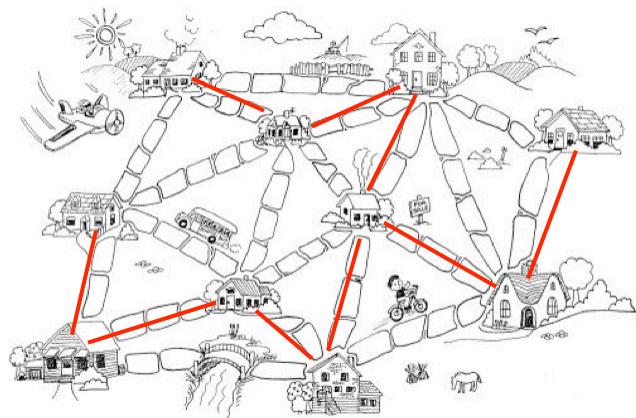
## BATTLESHIPS

- These three games illustrate
  - linear search
  - binary search
  - hashing
- What is the maximum number of guesses required for each of these search techniques
  - for 26 battleships?
  - for  $n$  battleships?

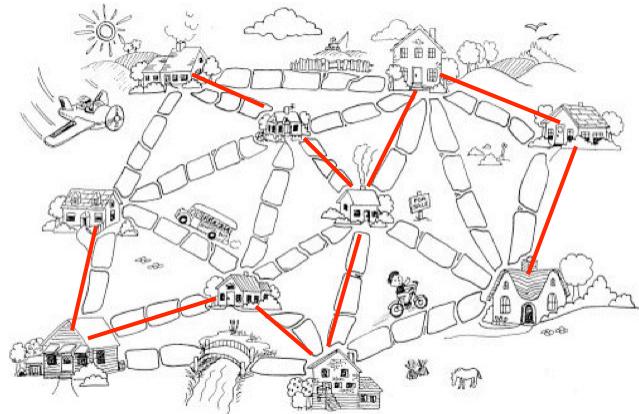
## THE MUDDY CITY

- Our society is linked by many networks: telephone, utilities, roads
- For a particular network, there is usually some choice about where the links can be placed.
- This exercise examines a complete network to determine the links necessary to connect all the components of the network at minimal cost.

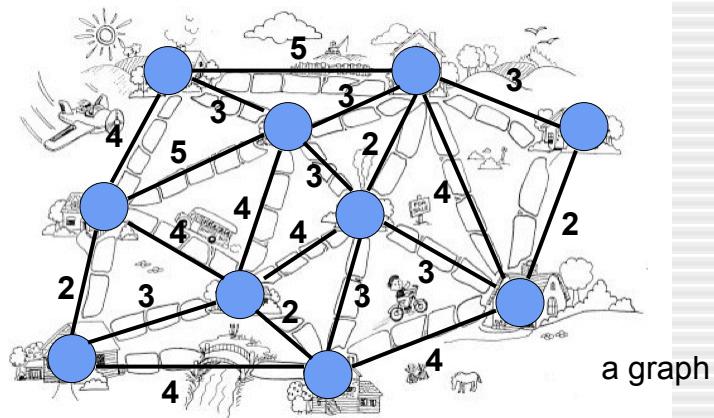
## THE MUDDY CITY



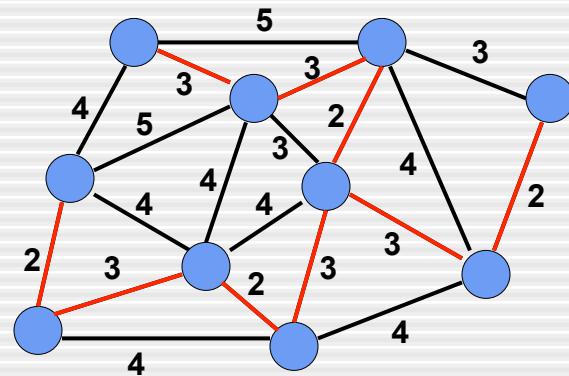
# THE MUDDY CITY



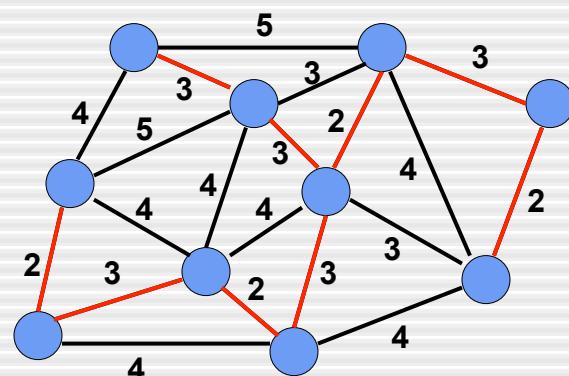
# THE MUDDY CITY



## THE MUDDY CITY



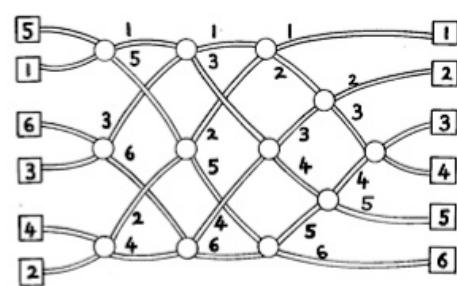
## THE MUDDY CITY



## THE MUDDY CITY

- This exercise illustrates how to build what we call the “minimal spanning tree”.
  - A tree does not have any cycles where you can get back to where you were before.
- This exercise does not give us the shortest path from one location to another.
  - But there is another algorithm for that!

## BEAT THE CLOCK



## BEAT THE CLOCK

- This activity illustrates structures used in parallel sorting networks.
- Kids sort data by walking through a sorting network laid out on the floor.
- The network simulates how a parallel network would sort data.
  - Kids find out that data can be sorted a lot faster in parallel!

## CS UNPLUGGED

- The teacher's version of Computer Science Unplugged is available online at <http://www.csunplugged.org>
  - The book is FREE to download and use!
- Additional material will be published soon to add even more activities, including video to demonstrate how to use these activities effectively in your classroom.