

Tapestry Workshop
The University of Virginia
July 15, 2009

COMPUTER SCIENCE
Unplugged

And kinesthetic computer science activities



Lynn Lambert
Christopher Newport University
Newport News, Virginia

COMPUTER SCIENCE *Unplugged*



Author: Tim Bell (not pictured: Ian Witten and Mike Fellows)

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Global project

New Zealand
Sweden
United Kingdom
Korea
Japan
China
Haiti

Even USA (CSTA, Peter Denning, Carnegie-Mellon, SIGCSE, AP Reading, NECC)



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What is Unplugged

**How to teach important
computer topics without using
computers at all!**

🔌 Have Fun!

🔌 www.csunplugged.org

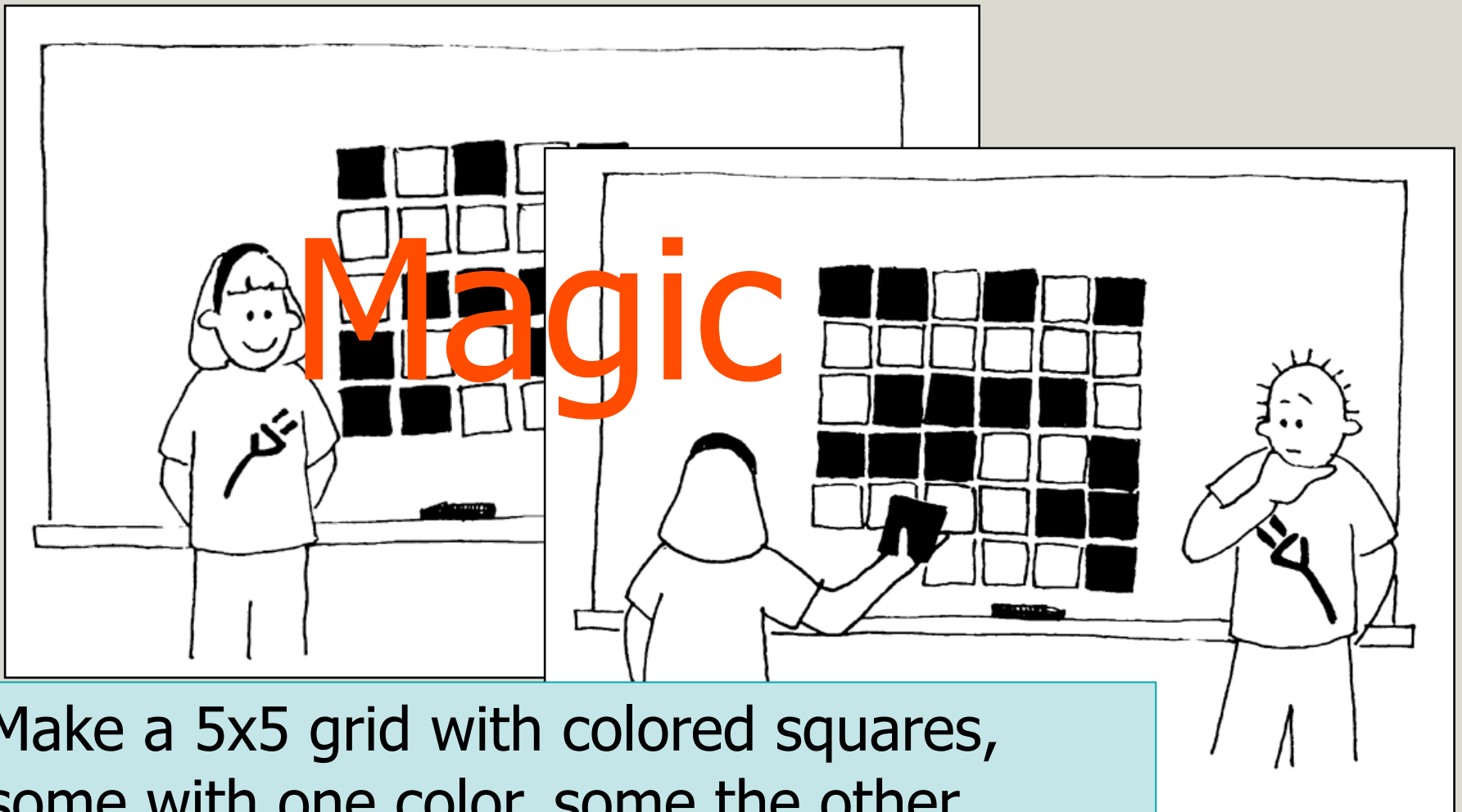


Like?

- ✂ **Binary Numbers**
- ✂ **Image Representation**
- ✂ **Text Compression**
- ✂ **Error Detection and Correction**
- ✂ **Searching Algorithms**
- ✂ **Sorting Algorithms**
- ✂ **Sorting Networks**
- ✂ **Minimal Spanning Trees**
- ✂ **Routing and Deadlock**
- ✂ **Finite-state Automata**
- ✂ **Programming Languages**
- ✂ **Information Theory**




Magic Trick



Make a 5x5 grid with colored squares, some with one color, some the other.

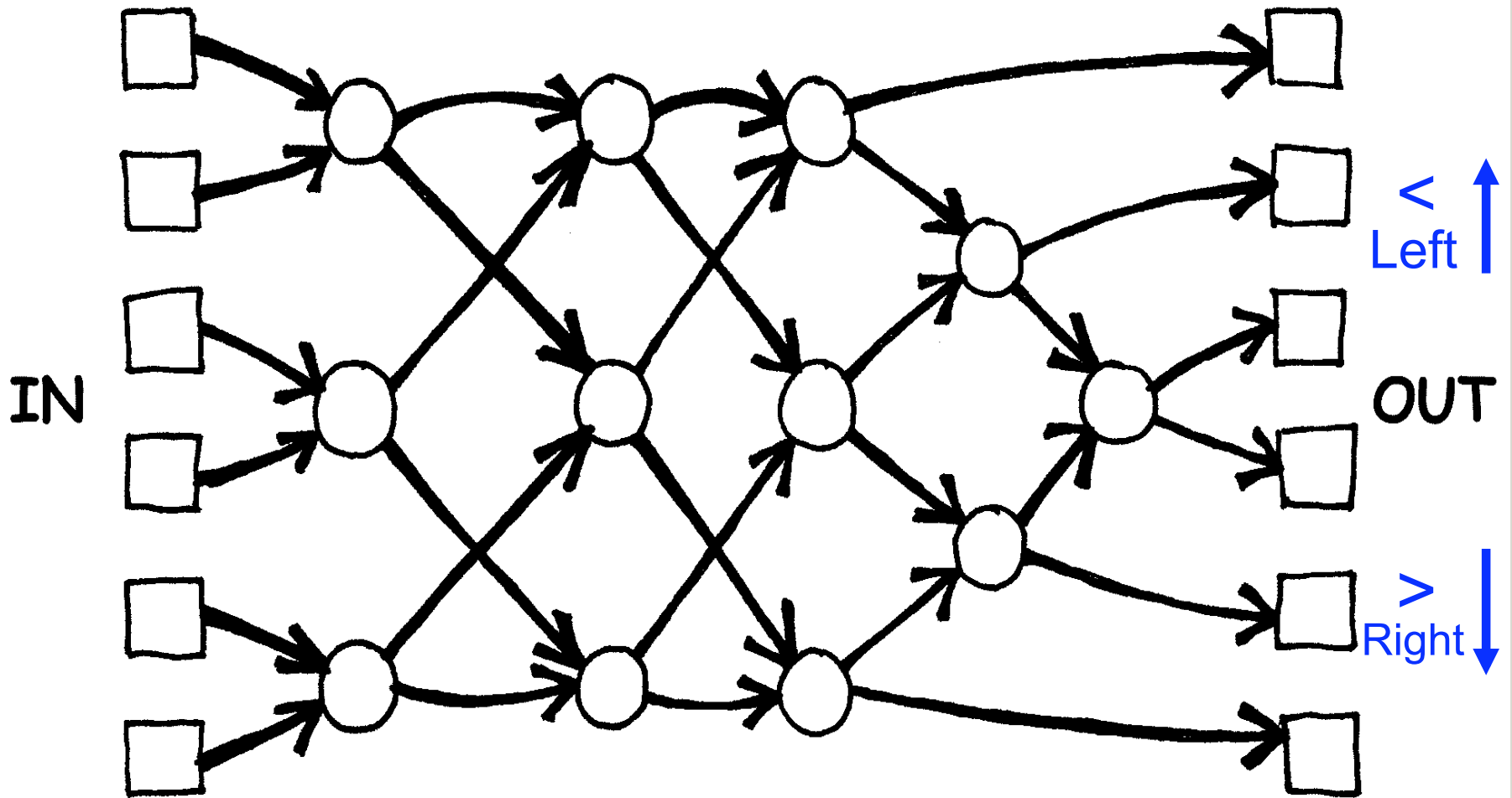


Parity Checking

- ✚ Even parity
- ✚ Can detect a bit that was corrupt
- ✚ ISBN detects adjacent swapped digits or a single incorrect digit 
- ✚ $X_{10} = (1x_1 + 2x_2 + 3x_3 + 4x_4 + 5x_5 + 6x_6 + 7x_7 + 8x_8 + 9x_9) \bmod 11$
- ✚ *Harry Potter and The Deathly Hallows*: 0-545-01022-5
- ✚ $(0*1 + 5*2 + 4*3 + 5*4 + 0*5 + 1*6 + 0*7 + 2*8 + 2*9)$
- ✚ $(0 + 10 + 12 + 20 + 0 + 6 + 0 + 16 + 18) = 82$
- ✚ $82 \bmod 11 = 5$



Sorting network



Have you used Unplugged? How?

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Binary Digits



Characters in Binary

01000 H
00101 E
01100 L
01100 L
01111 O

1	2	3	4	5	
A	B	C	D	E	
6	7	8	9	10	
F	G	H	I	J	
11	12	13	14	15	
K	L	M	N	O	
16	17	18	19	20	
P	Q	R	S	T	
21	22	23	24	25	26
U	V	W	X	Y	Z



Characters and Sound Represented in Binary

1	2	3	4	5	6	7	8	9	10	11	12	13
A	B	C	D	E	F	G	H	I	J	K	L	M
14	15	16	17	18	19	20	21	22	23	24	25	26
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

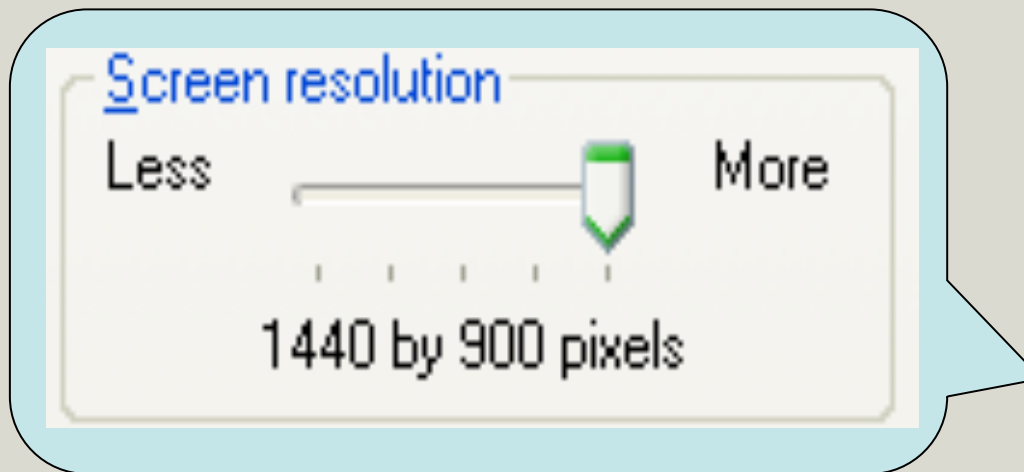
🔑 "ASCII"

🔑 Modem



Image Representation (black and white)

✂ Each pixel is a bit



$$1440 * 900 = 1,296,000 \text{ pixels/bits}$$

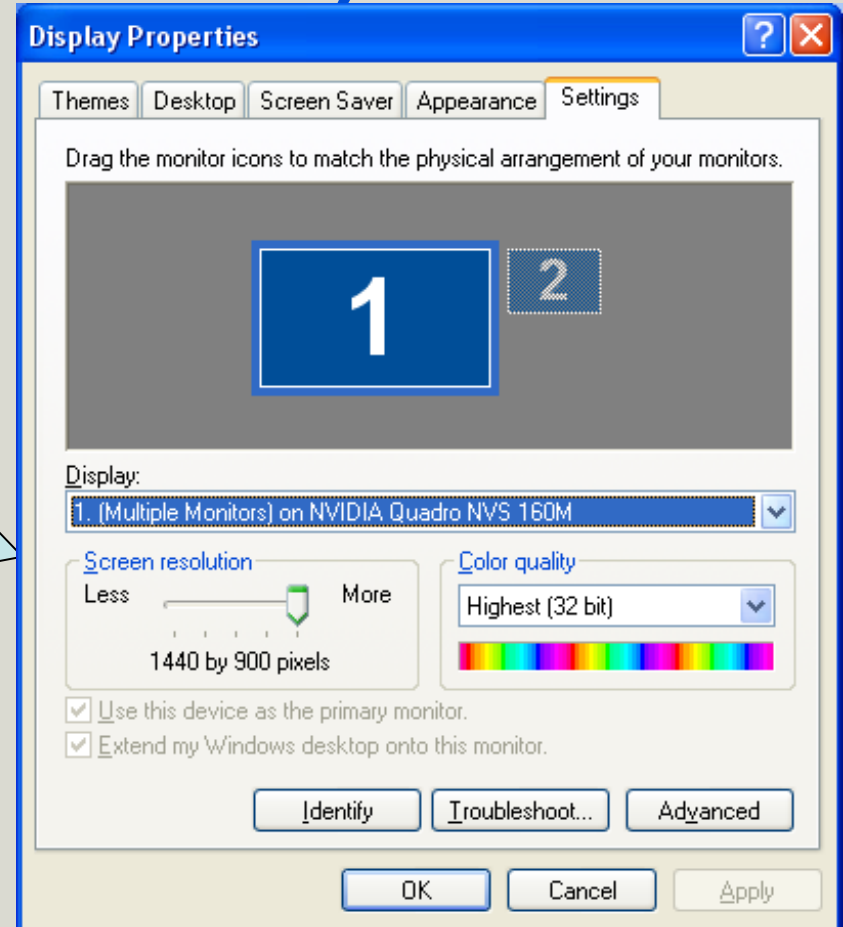


Image Representation (black and white)

✚ Each pixel is a bit

✚ 00001111111111100 for first row

✚ etc.

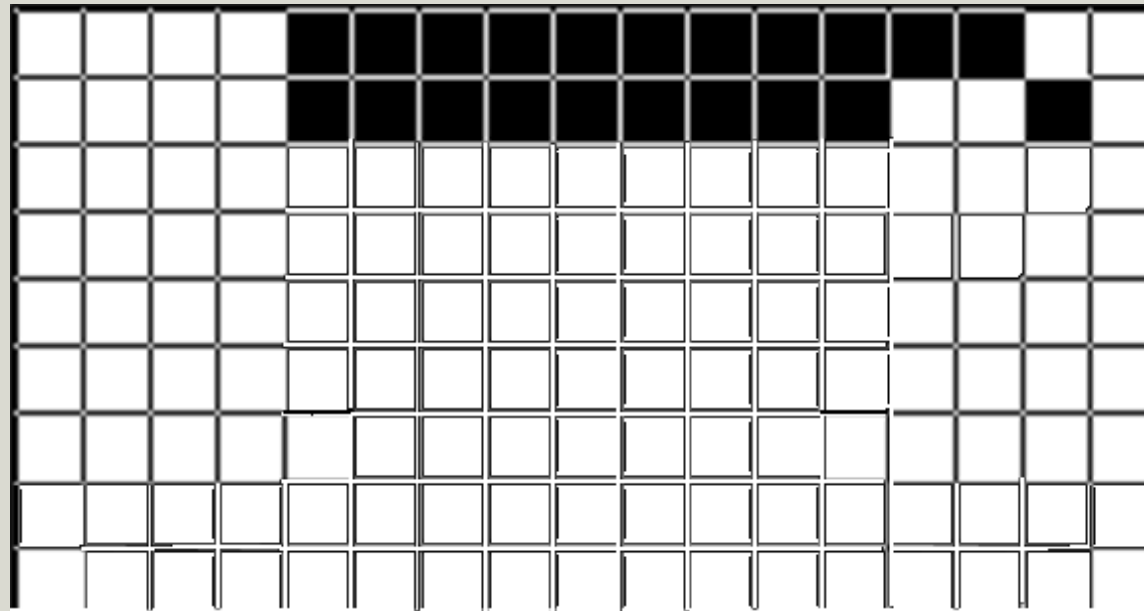
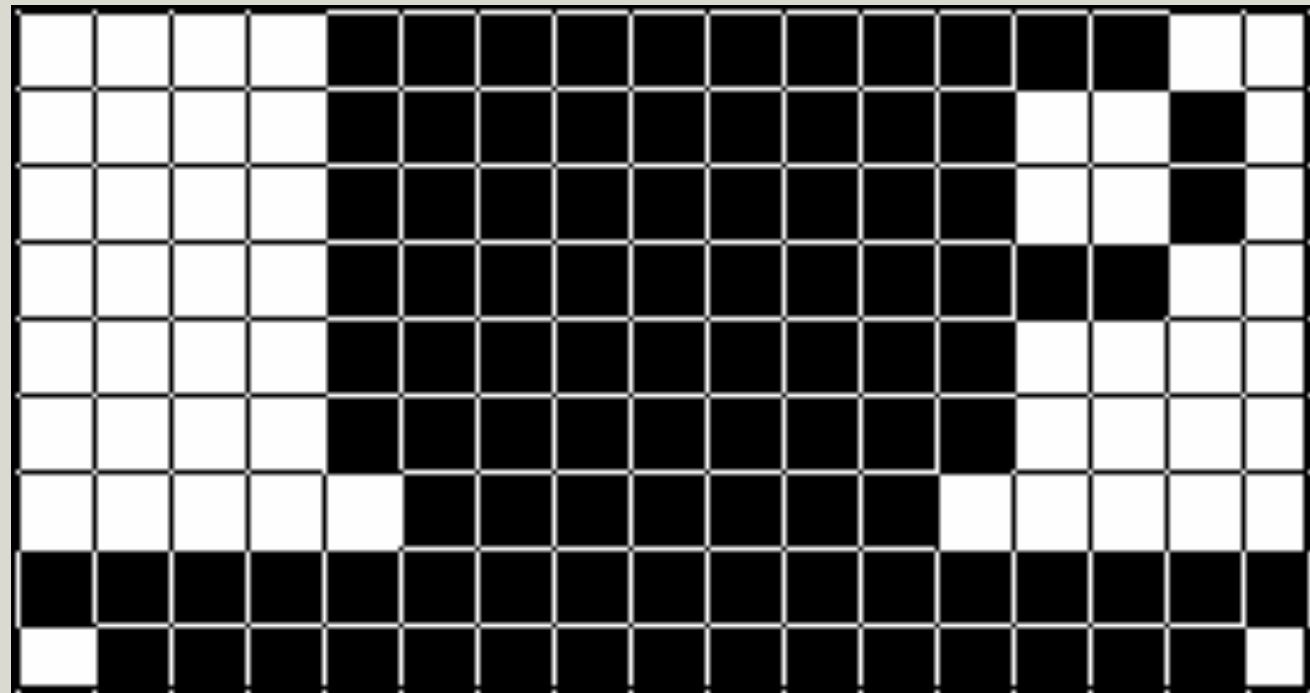


Image Compression Run Length Encoding

4, 11, 2
4, 9, 2, 1, 1
4, 9, 2, 1, 1
4, 11, 2
4, 9, 4
4, 9, 4
5, 7, 5
0, 17
1, 15, 1





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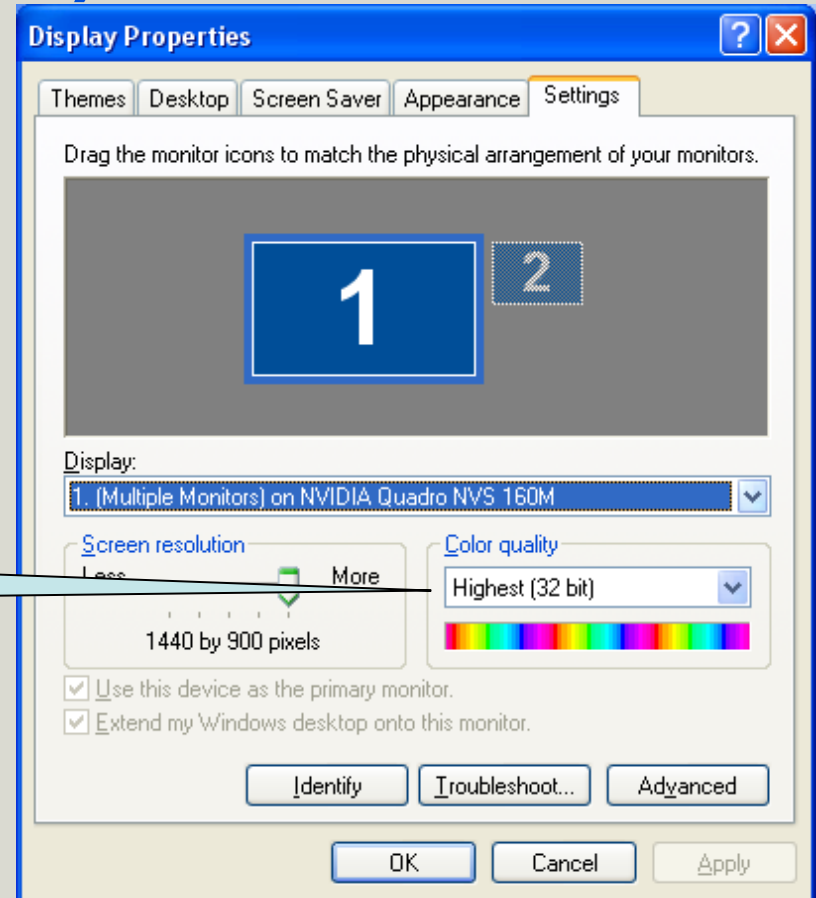
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Image Representation (Color)

- ✚ Each pixel is a bit
- ✚ Still 1,296,000 pixels
- ✚ Now, each pixel is

32 bits



Color Images

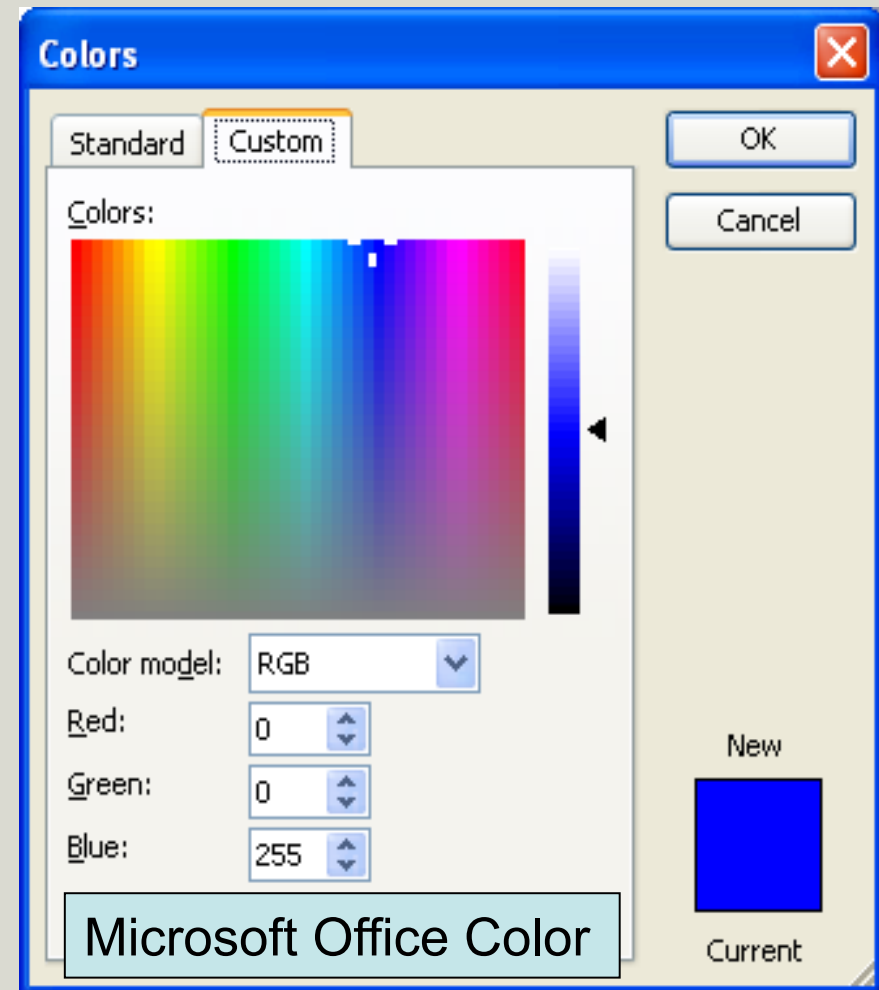
🔧 RGB color

0 0 255 for blue

00000000

00000000

11111111



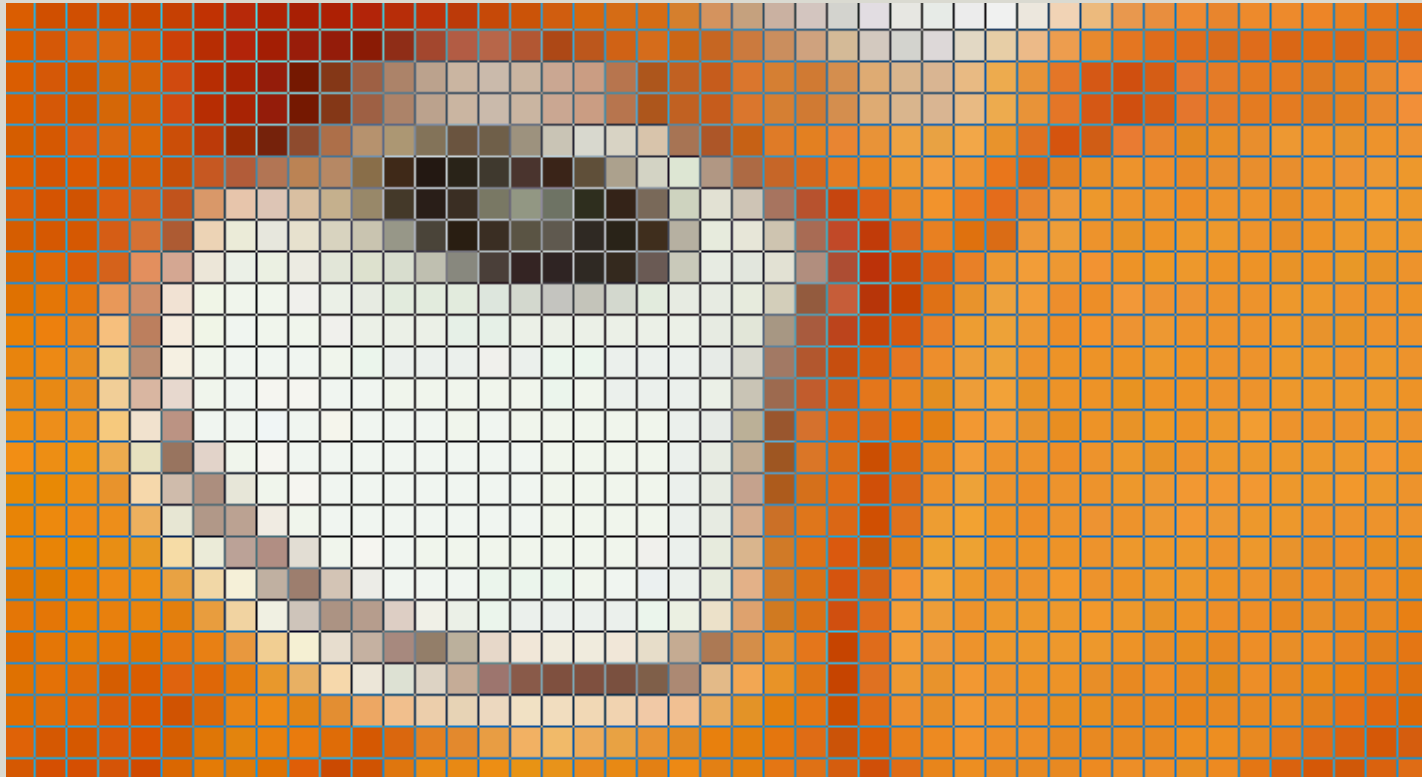


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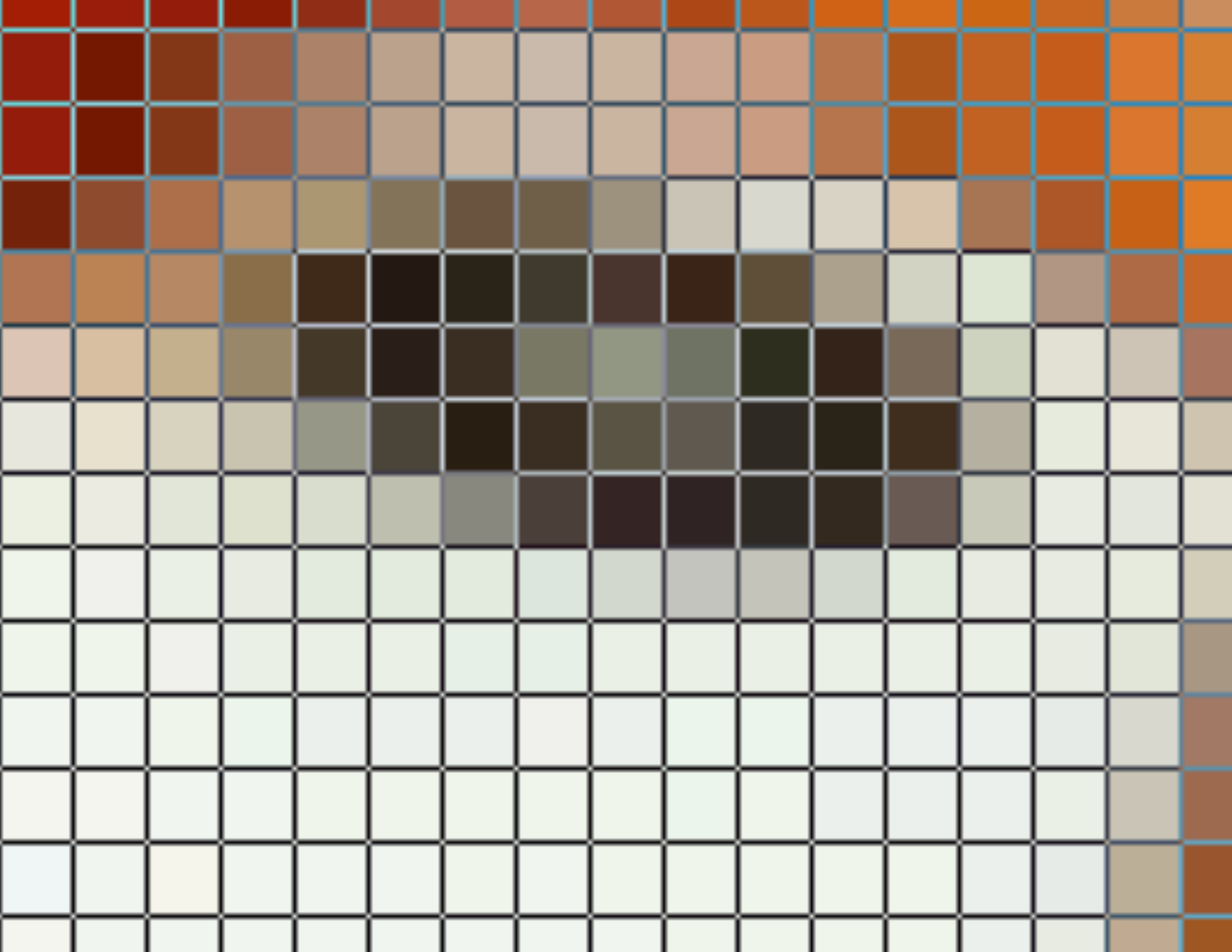


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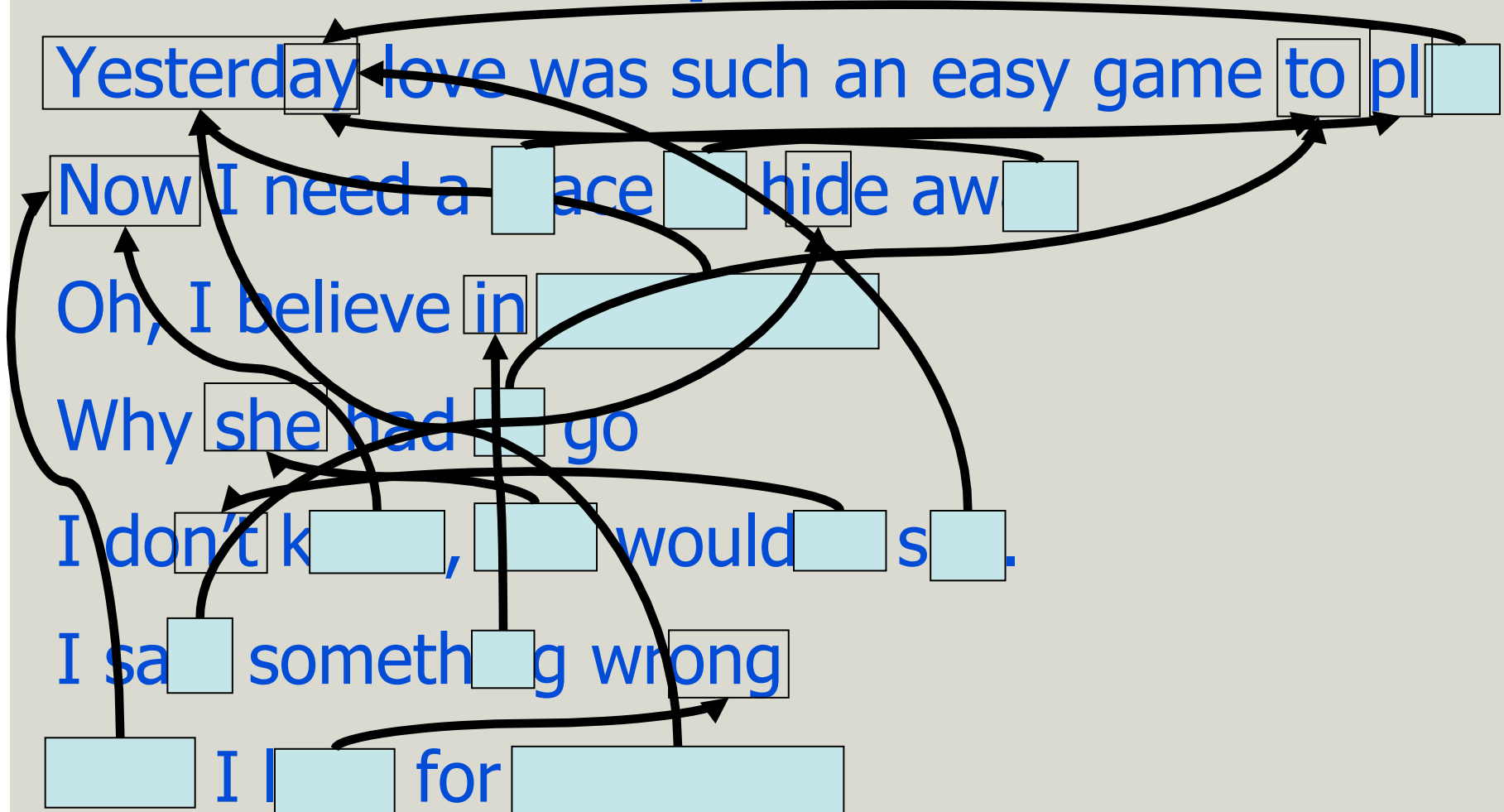
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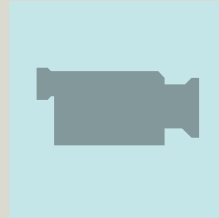
204/102/0	196/198/0	226/113/0	226/113/0	
141/105/101	180/90/0	204/102/0	226/113/0	
240/240/255	230/206/158	179/102/38	204/102/0	
218/218/200	232/238/228	217/187/63	141/105/101	

“Yesterday” by The Beatles, L-Z Compression



Routing and Deadlock

 Orange Game



TREASURE HUNT: Finite State Automata (FSA)

- ✚ FSA are theoretical state models
- ✚ Unplugged uses a treasure hunt.
Others:
 - ✚ letters to accept particular words
 - ✚ a metro map for getting to a particular location



TREASURE HUNT

- 🚢 Goal: **Find Treasure Island**
- 🚢 Start: from **Pirates' Island**
- 🚢 Friendly pirate ships sail along fixed routes between islands offering rides to travelers.
- 🚢 Each island has two departing ships, A and B.
- 🚢 Determine all possible sequences of ships that a traveler can take to arrive at Treasure Island.
- 🚢 Use your map to record all the ship routes.



TREASURE HUNT

Pirate's Island



Pirates' Island

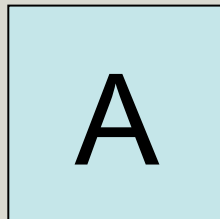
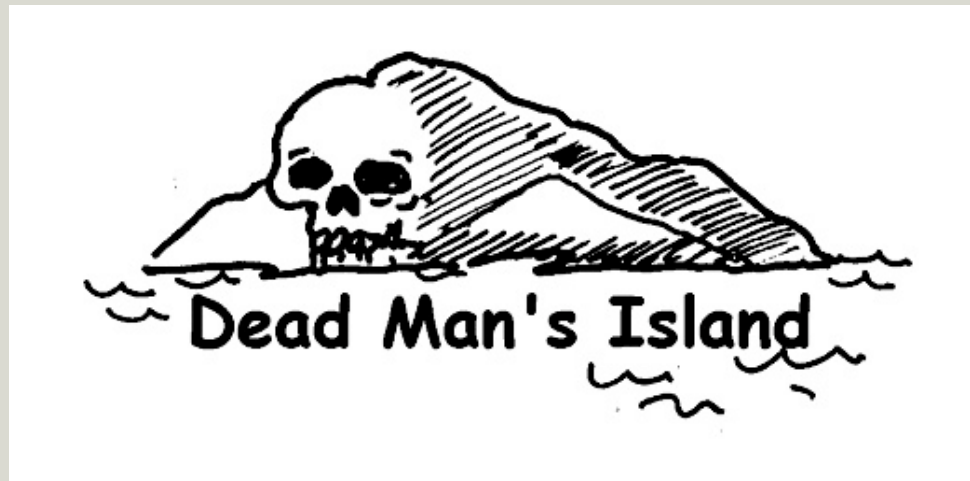
A

B



TREASURE HUNT

Dead Man's Island



TREASURE HUNT

Shipwreck Bay



Shipwreck Bay

A

B



TREASURE HUNT

Mutineers' Island



Mutineers' Island

A

B



TREASURE HUNT: Smugglers' Cove



A

B



TREASURE HUNT: Musket Hill



Musket Hill

A

B



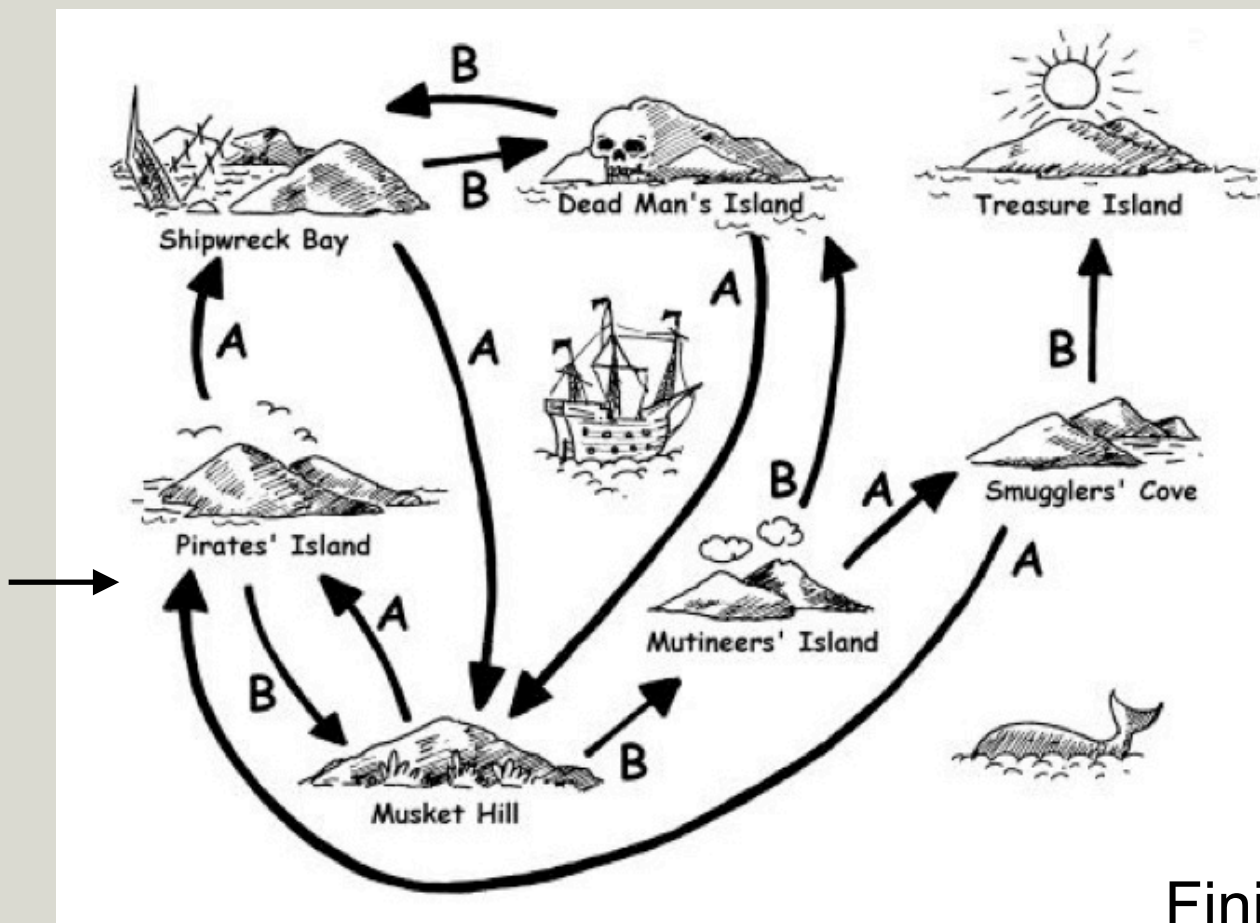
TREASURE HUNT: Treasure Island



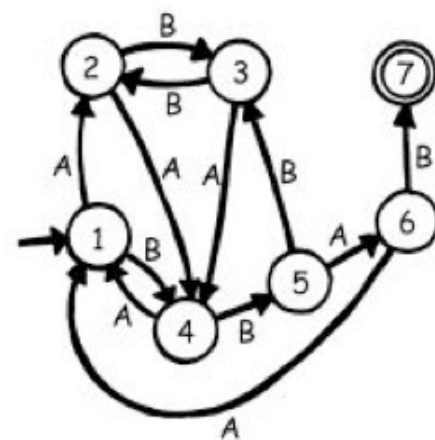
PLAY AGAIN



TREASURE HUNT



What is the
quickest
route?



Finite State Automata



Non CSUnplugged Activities

✂ Andy Begel, Steve Wolfman, Dan Garcia
KLA (Kinesthetic Learning Activities),
<http://ws.cs.ubc.ca/~kla/>,

✂ Binary Tree

✂ Recursion

✂ cons, car, cdr

✂ AP Reading Toy Night with Robert Duvall

✂ AP list, CSTA



Your Turn

Break up into groups, and answer at least one of the following:

1. What unplugged or unplugged-like activities have you done in your classroom? What worked/didn't work?
2. Based on the ideas that we've talked about, how would you expand/modify these in your classroom?
3. What topics do you think would benefit from a kinesthetic learning activity?



Your Turn Reporting

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Non CSUnplugged Activities

🔑 Andy Begel, Steve Wolfman, Dan Garcia KLA (Kinesthetic Learning Activities), <http://ws.cs.ubc.ca/~kla/>,

🔑 Binary Tree

🔑 Recursion

🔑 cons, car, cdr

🔑 AP Reading Toy Night with Robert Duvall

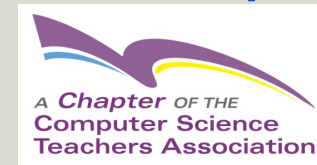
🔑 AP list, CSTA

🔑 Internet, Sorting, Searching



CSTA Membership

✚ The Southeastern Virginia Chapter of Computer Science Teachers Association



✚ Web Page for SEV-CSTA:
<http://www.cs.nsu.edu/csta/>

✚ Web Page for CSTA:
<http://www.csta.acm.org/>

✚ Membership to both is FREE!!!



Peruvian coin toss

✂ Fair coin toss over the phone



One way function

- ✂ Both have the same telephone book
- ✂ Pick a function
 - ✂ Odd/even length of name
 - ✂ Name begins with H/T

..... 389 5391	McHardie K J Wainui St Riccn.....348 9207	Mcllory L S
.....942 2514	McHardy D J & J M	Mcllory R R
Rd Wnoni.....389 2410	172 Halswell Junction Rd Hlswl.....322 9093	20 Gilbert
St Sprey.....332 8062	McHardy M A & J A	MacIlquhan
St NthNB.....383 6526	10 Brenchley Rd Lytn.....LYT-328 7537	43 Eastw
.....342 6343	Lytn Cellular phone.....0-25-294 5495	Mcliquham
.....LYT-328 8687	McHardy M J 5 Flockton St StAlb.....385 5392	4/93 Sou
	McHardy R & Hanson J M	Mclraith A
	154 Burwood Rd Burwd.....383 9876	Lakeside
	McHarg A K	Mclraith B
	48 Marriner St Sumnr.....SUM-326 4330	Mclraith C
	McHarg G D 3 Sunhaven Pl Htsby Phone/	66 McEv
	Fax.....332 5856	Mclraith D
CLINIC &	McHarg J L 23 Forest Park Pl Prkld.....383 3715	Mclraith E
	McHarg M 22 The Brae StAH.....384 1667	Mclraith F
	McHarg Rodger L & Heather A	Mclraith G
1.....342 6343	38 Rembrandt Pl Brynd.....358 8599	Mclraith H
.....0800 661 234	Facsimile.....358 8390	Mclraith I
.....348 8823	McHarg S 2 Crichton Tce Cashm.....332 6308	Mclraith J
	McHarg Samuel F	Mclraith K
	129 Colombo St Smfld.....332 9417	Mclraith L
	MCHARG SI LTD 173 St Asaph St.....366 5367	Mclraith M
	MacHarper B J & S I	Mclraith N
	5 Hope St Shrly.....385 7034	Lakeside
	Facsimile.....385 7012	Mclraith P
	MacHarper C M 6B Howe St NewBn.....388 1843	Edwards
	MacHarper M G	Facsimile
	232 Bower Ave NthNB.....382 1961	Mclraith R
	MacHill P S	16 Duns
	2/44 Prestons Rd Redwd.....352 4746	Mclraith S
	McHenry D J & Y L	24 Orlan
	54 Englefield Rd Blfst.....BEL-323 7217	Mclraith V
	McHenry I R 14 Grosvenor St Redwd.....352 8572	4987 Cr
	McHenry M A Charles St Pbitn.....349 3238	Hiltp.....
	McHenry M R & T M	Mclroy A
	103A Prestons Rd Redwd.....354 2070	Cellular p
		Mclroy Ca
		25 Glen
		Mclroy C
		64 McBr



Select name

te	389 5391	McHardie S I 16 Bucknell St SCKDN.....348 5548	Mcllroy L S
	942 2514	McHardie K J Wainui St Riccn.....348 9207	Mcllroy R R
Rd Wnoni.....	389 2410	McHardy D J & J M	20 Gilbert
St Sprey.....	332 8062	172 Halswell Junction Rd Hlswl.....322 9093	Macllquhan
St NthNB.....	383 6526	McHardy M A & J A	43 Eastw
	342 6343	10 Brenchley Rd Lytn.....LYT-328 7537	Mcllquham
	LYT-328 8687	Lytn Cellular phone.....0-25-294 5495	4/93 Sou
		McHardy M J 5 Flockton St StAlb.....385 5392	Mcllraith A
		McHardy R & Hanson J M	Lakeside
		154 Burwood Rd Burwd.....383 9876	Mcllraith B
		McHarg A K	Mcllraith C
		48 Marriner St Sumnr.....SUM-326 4330	66 McEv
		McHarg G D 3 Sunhaven Pl Htsby Phone/	Mcllraith D
		Fax.....332 5856	Mcllraith G
		McHarg J L 23 Forest Park Pl Prkld.....383 3715	Mcllraith I
		McHarg M 22 The Brae StAH.....384 1667	Mcllraith J
		McHarg Rodger L & Heather A	Mcllraith J
		38 Rembrandt Pl Brynd.....358 8599	Mcllraith L
		Facsimile.....358 8390	Mcllraith M
		McHarg S 2 Crichton Tce Cashm.....332 6308	Mcllraith M
		McHarg Samuel F	Mcllraith N
		129 Colombo St Smfld.....332 9417	Lakeside
		MCHARG SI LTD 173 St Asaph St...366 5367	Mcllraith P
		MacHarper B J & S I	Edwards
		5 Hope St Shrly.....385 7034	Facsimile
		Facsimile.....385 7012	Mcllraith R
		Macharper C M 6B Howe St NewBn.....388 1843	16 Duns
		Macharper M G	Mcllraith S
		232 Bower Ave NthNB.....382 1961	24 Orlan
		Machell P S	Mcllraith V
		2/44 Prestons Rd Redwd.....352 4746	4987 Ch
		McHenry D J & Y L	Hiltp.....
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		McHenry M R & T M	25 Glenc
		103A Prestons Rd Redwd.....354 2070	Mcllroy C
			64 McBr

CLINIC &



Record phone number

te	389 5391	McHardie K J Wainui St Riccn.....	348 9207	McIlroy L S	
	942 2514	McHardy D J & J M	172 Halswell Junction Rd Hlswl.....	322 9093	McIlroy R R
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					24 Orlan
					McIlraith V
					4987 Ch
					Hiltp.....
					McIlroy A
					Cellular p
					McIlroy C

332-6308



Presenter guesses: H or T?

332-6308



Presenter tries to find name

332-6308



CS Unplugged wants your ideas: Designing an activity

- ✂ What are the key elements?
 - ✂ e.g. bits, states, compare, relationships
- ✂ What games/puzzles/toys use similar elements?
- ✂ Turn it into a challenge
 - ✂ To find (best) solution
 - ✂ Compare speed (of groups or methods)
 - ✂ Team?
 - ✂ Impediments?
- ✂ Evaluate
 - ✂ Simplicity, engagement, cost, novelty
- ✂ Refine
 - ✂ Show to lots of kids/teachers/profs
 - ✂ Publish



Questions?

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