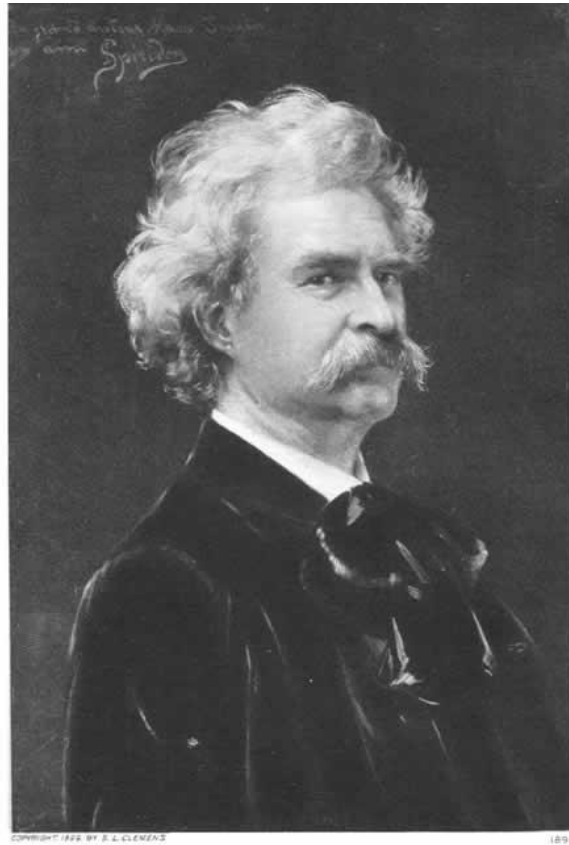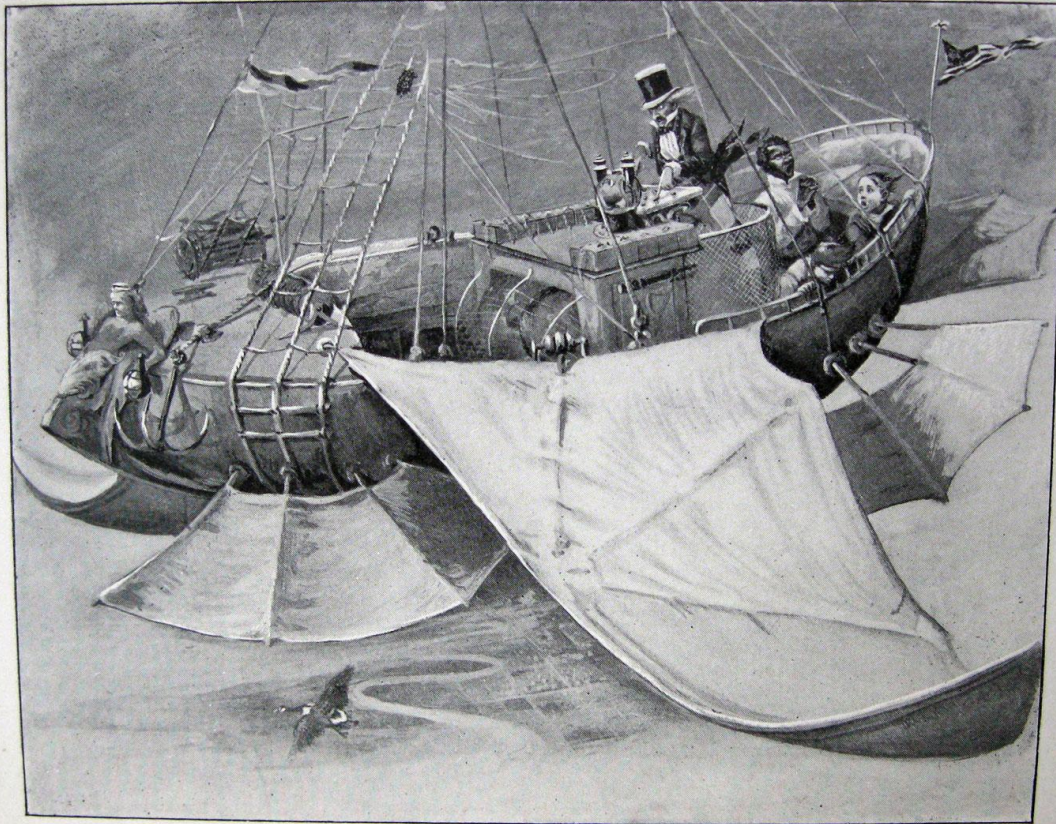# CSCE 625: Artificial Intelligence

Dr. Dylan Shell

Tom Sawyer Abroad

From Mark Twain 1894 "Tom Sawyer Abroad" — Illustrated by Dan Beard (1st edition)

2

"HE SAID HE WOULD SAIL HIS BALLOON AROUND THE WORLD."

From Mark Twain 1894 "Tom Sawyer Abroad" — Illustrated by Dan Beard (1st edition)

3

"Well, then, it's just as I reckoned.   The professor lied."

"Why?"

"Because if we was going so fast we ought to be past Illinois, oughtn't we?"

"Certainly."

"Well, we ain't."

"What's the reason we ain't?"

"I know by the color. We're right over Illinois yet. And you can see for yourself that Indiana ain't in sight."

"I wonder what's the matter with you, Huck. You know by the *color*?"

"Yes, of course I do."

"What's the color got to do with it?"

"It's got everything to do with it. Illinois is green, Indiana is pink. You show me any pink down here, if you can.   No, sir; it's green."

From Mark Twain 1894 "Tom Sawyer Abroad" — Illustrated by Dan Beard (1st edition)

4

"The map is not the territory." — Alfred Korzybski

October 23, 1852: **Augustus De Morgan writes to Sir William Rowan Hamilton**

"*A student of mine asked me to day to give him a reason for a fact which I did not know was a fact—and do not yet. He says that if a figure be any how divided and the compartments differently coloured so that figures with any portion of common boundary <u>line</u> are differently coloured—four colours may be wanted, but not more—the following is his case in which four are wanted…*"
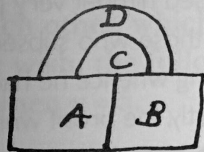
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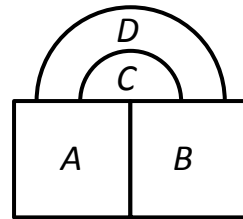
A B C D are names of colours

Query cannot a necessity for five or more be invented…"

8

Francis Guthrie

Tinting Maps.—In tinting maps, it is desirable for the sake of distinctness to use as few colours as possible, and at the same time no two conterminous divisions ought to be tinted the same. Now, I have found by experience that *four* colours are necessary and sufficient for this purpose,—but I cannot prove that this is the case, unless the whole number of divisions does not exceed five. I should like to see (or know where I can find) a general proof of this apparently simple proposition, which I am surprised never to have met with in any mathematical work.   F. G.

Figure 1: Letter in *The Athenæum* of June 10, 1854.

From Brendan D. McKay, 2012, "A note on the history of the four-colour conjecture"

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Figure 1: Letter in *The Athenæum* of June 10, 1854.

? ?

Francis Galton

From Brendan D. McKay, 2012, "A note on the history of the four-colour conjecture"

10

Most famous fallacious proof in the whole of mathematics.

Believed to be true for 11 years, and was the starting point for many subsequent proofs.

Percy John Heawood found a counterexample.

Alfred Bray Kempe

Heinrich Heesch's Box of Reducible Configurations

From Robin Wilson's "Four Colors Suffice"

Solution in 1976 by Kenneth Appel and Wolfgang Haken

The first major theorem to be proven with extensive computer assistance

Aroused considerable controversy

Hardness

It is NP-Complete to decide whether a graph admits a coloring with k colors, except for k=1 and k=2.

Also: Zuckerman, D. (2007), "Linear degree extractors and the inapproximability of Max Clique and Chromatic Number", Theory of Computing 3: 103–128.

Color Australia

http://robotics.cs.tamu.edu/dshell/cs625/csp-map.pdf

http://robotics.cs.tamu.edu/dshell/cs625/csp-forward.pdf

http://robotics.cs.tamu.edu/dshell/cs625/csp-backtracking.pdf

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

'As far as I know, Seymour Papert was the first to use the phrase "toy problem." At a 1967 AI workshop I attended in Athens, Georgia, he distinguished among tau or "toy" problems, rho or real-world problems, and theta or "theory" problems in artificial intelligence. This distinction still serves us well today.'

— Nils J. Nilsson "The Quest for Artificial Intelligence"

- **Allocating frequencies to mobile phone cells**
- **Laying out components on circuit board**
- **Fitting a protein structure to measurements**
- **Drawing up an examination timetable**

'After these early programs, work on computer chess programs continued, with off-again--on-again effort, throughout the next several decades. According to John McCarthy, Alexander Kronrod, a Russian AI researcher, said "Chess is the Drosophila of AI" — meaning that it serves, better than more open-ended intellectual tasks do, as a useful laboratory specimen for research. As Minsky said, "It is not that the games and mathematical problems are chosen because they are clear and simple; rather it is that they give us, for the smallest initial structures, the greatest complexity, so that one can engage some really formidable situations after a relatively minimal diversion into programming.'

— Nils J. Nilsson "The Quest for Artificial Intelligence"

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Sources:

Tom Sawyer Images:

http://www.bellsbooks.com/wp-content/uploads/2011/10/Tom-Sawyer-Abroad-Illustration-21.jpg

http://www.twainquotes.com/UniformEds/UniformEdsCh22.html

Francis Guthrie:

By Paul venter - http://en.wikipedia.org/wiki/Image:Francis_guthrie.jpg

Alfred Bray Kempe

http://aprender-mat.info/history/photos/Kempe_3.jpeg

Kenneth Appel and Wolfgang Haken

http://ebulten.library.atilim.edu.tr/shares//images/M3.png

Sources:

Minesweeper Image:

> http://dl.maximumpc.com/galleries/VirtWin31/Minesweeper_sm.png

Sudoku:

> https://upload.wikimedia.org/wikipedia/commons/thumb/f/ff/Sudoku-by-L2G-20050714.svg/2000px-Sudoku-by-L2G-20050714.svg.png