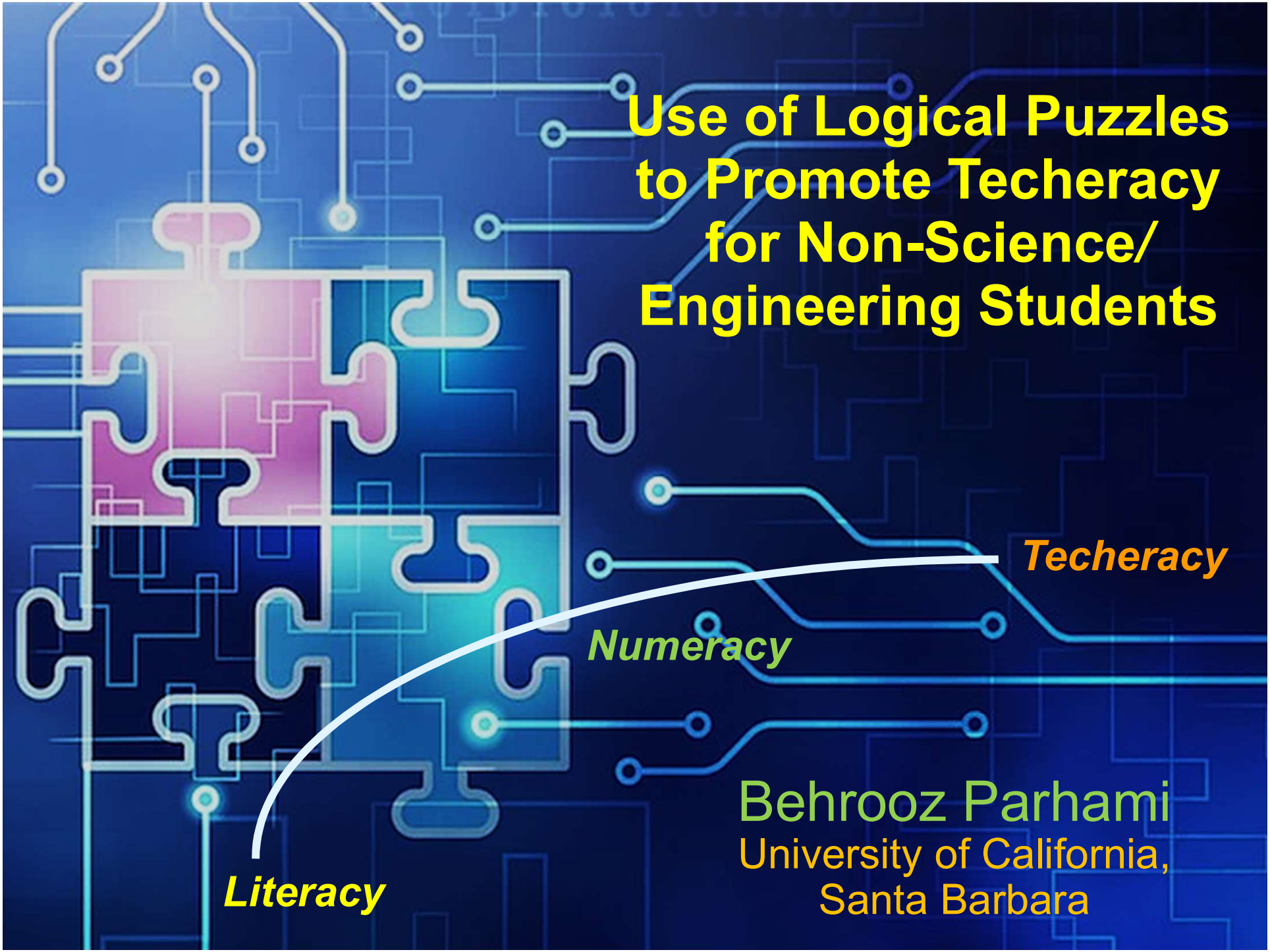
Use of Logical Puzzles to Promote Techeracy for Non-Science/ Engineering Students
Techeracy
Numeracy
Literacy
Behrooz Parhami
University of California, Santa Barbara

About This Presentation

This slide show was first developed in winter of 2018 for a seminar presented to Razi University, Kermanshah, Iran. The talk was delivered in Persian via Skype, on Monday, 3/05, 9:30 AM, at the Central Library's Dr. Shamsipour Hall. A revised form of the talk was given in November 2018 at IEEE IEMCON, U. British Columbia, Vancouver, Canada.
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Edition	Released	Revised	Revised	Revised
First	Winter 2018	Fall 2018		

Literacy, Numeracy, Techeracy

Literacy: Deemed necessary since the Middle Ages
Reading & writing skills (taught by telling stories) → **Literate**
Prose literacy
Document literacy
And now … **Digital-media literacy**

Numeracy: Quantitative literacy
Arithmetic skills (taught via real-life problems) → **Numerate**
Expanded to include problem-solving and reasoning

Techeracy: Technical (engineering) literacy
Appreciation of technology (taught via … ?) → **Techerate**
Thesis: ***Techeracy should be taught via puzzles***

A Brief History of Techeracy

Earliest discussion: 18th-century Industrial Revolution

In modern times: Before World War II

Became urgent: In our lifetime, that is, the age of

Digital computing

Quantitative finance

AI: Smart everything **…**

My background in promoting techeracy:

1984 computer appreciation book (in Persian)

2003 "Math + Fun" extracurricular program

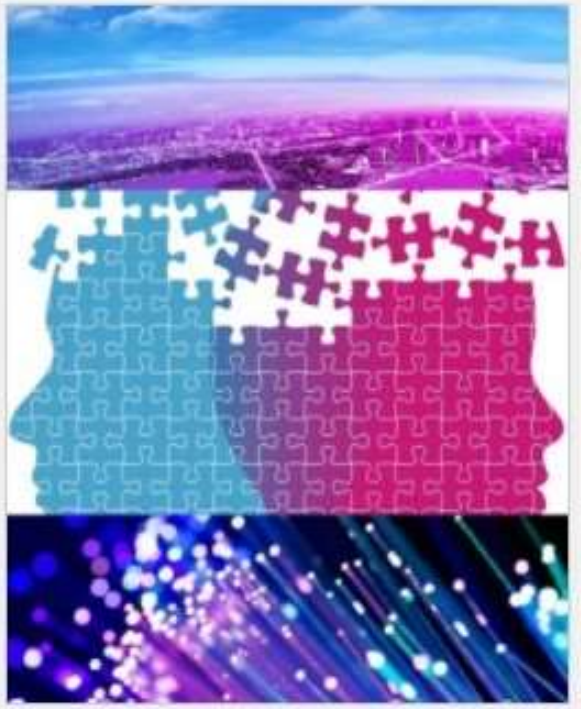
2007 CE puzzling problems seminar

2016 sci/tech puzzling problems

- Home & Contact
- Curriculum Vitae
- Research
  - Computer arithmetic
  - Parallel processing
  - Fault tolerance
  - Broader research
  - Research history
  - Research collab
  - List of publications
- Teaching
  - ECE1B Freshman sem
  - INT94TN Frosh sem
  - ECE154 Comp arch
  - ECE252B Comp arith
  - ECE252C Adv dig des
  - ECE254B Par proc
  - ECE257A Fault toler

Behrooz Parhami's INT 94TN Course Page for Fall 2016

Puzzling Problems in Science and Technology



Page last updated on 2016 December 02

Note: This is a new freshman seminar, first offered in fall 2016
Enrollment code: 58446
Prerequisite: Open to freshmen only
Class meetings: W 3:30-4:20, Buchanan 1934
Instructor: Professor Behrooz Parhami
Open office hours: M 12:00-2:00, W 4:30-5:30, HFH 5155
Course announcements: Listed in reverse chronological order
Grading scheme: Pass/Fail grade assigned based on attendance
Course calendar: Schedule of lectures and links to lecture slides
The ten lectures: Lecture summaries and references
Additional topics: Possible replacements for current lectures
Attendance record: Please check regularly for possible errors
Miscellaneous information: Motivation, catalog entry, history
[The design and goals of this seminar resemble those of **ECE 1B**, "Ten Puzzling Problems in Copmuter Engineering."]

Course Announcements

2016/12/02: The fall 2016 offering of the freshman seninar INT 94TN is officially over and course grades have been reported to the Registrar. I enjoyed preparing new material for this seminar, teaching it, and getting to interact with students from several majors not normally taking my ECE Department courses. Have a great holiday break and hope to see some of you in future courses or around the campus!

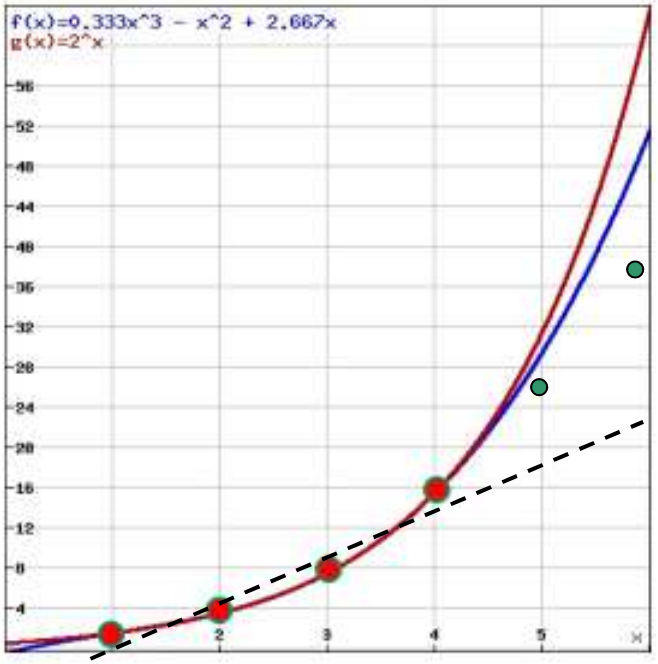
Example Topic: Predicting the Future

Find the Next Term in a Sequence

	$n = 1$	2	3	4	5	6	7
$u(n) = n$	1	2	3	4	5	___	
	1	2	3	4	5	___	___
	1	2	3	___	5	6	
___ ___	3	4	5	6			$c(n) = n + 2$
___ ___	2	4	6	8	___		$d(n) = 2n$
	2	4	8	16	___		$f(n) = 2^n$
___ ___	2	4	8	16			

Sequence Puzzles: Let's Dig Deeper

n = 1	2	3	4	5	
2	4	8	16	**32**	$f(n) = 2^n$
2	4	8	16	**30**	$g(n) = n(n^2 - 3n + 8)/3$
2	4	8	16	**26**	$h(n) = n^2$ (± 1 for odd n)

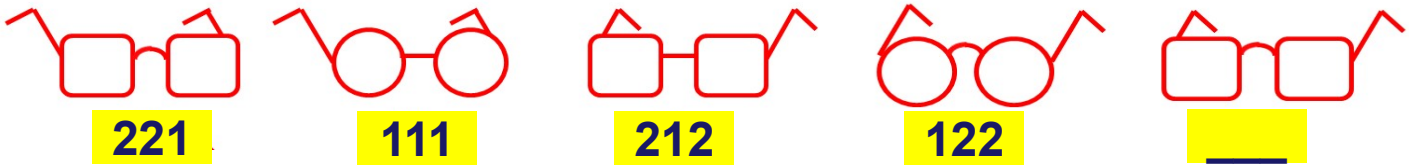


What about the 30th term?

n = 1	2	…	30
2	4	…	**1,073,741,824**
2	4	…	**8180**
2	4	…	**900**

Sequences Do Not Have to Be Numeric

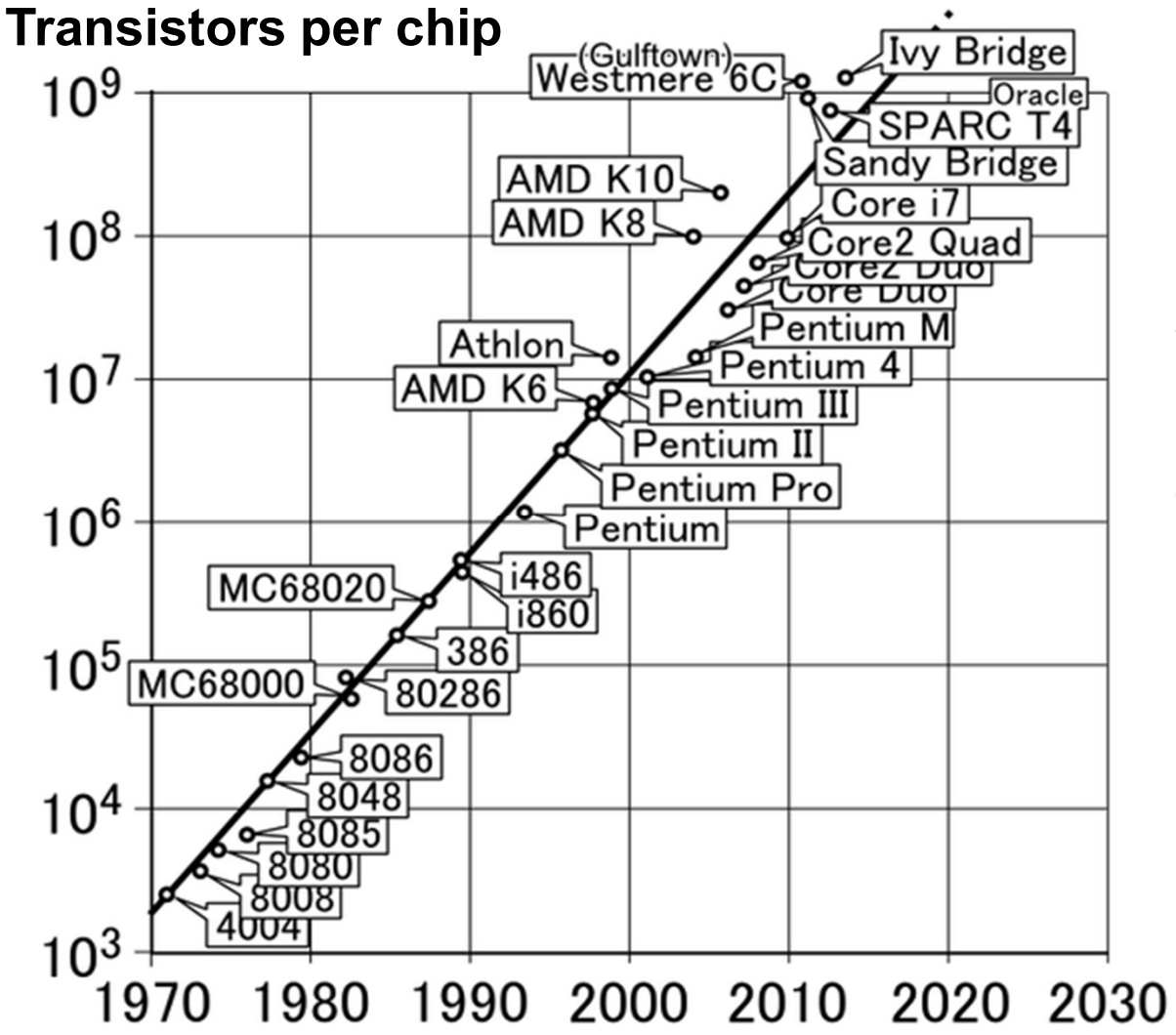
Z	O	T	T	F	F	__		
J	F	M	__	M	J	J		
31	__	31	30	31	30	31	31	30
A	E	F	H	I	__			
3	3	5	4	4	3	5	__	
3	4	6	9	__	18	24		
1	3/2	__	7/8	9/16				
1	11	21	1211	111221		312211		__



Economic Forecasting: Stock Market

Long-term variations: **Uses logarithmic scale on the value axis**

Technology Forecasting: Moore's Law

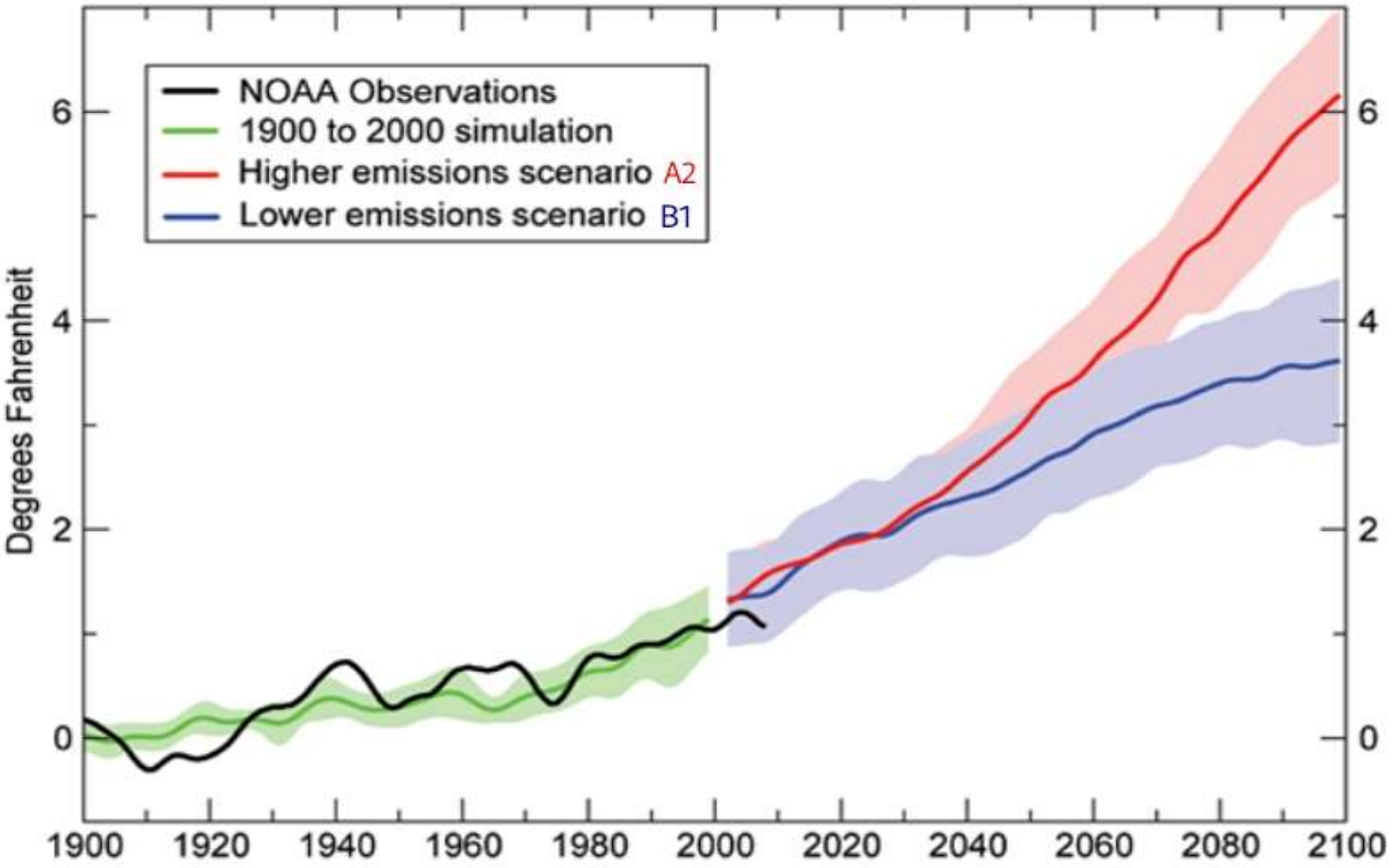


In 1965, Gordon Moore, an Intel co-founder predicted that the number of components per integrated circuits will double every year.

In 1975, he revised his forecast to doubling every 2 years (the original forecast had a small set of data points).

Exponential growth is a hallmark of computing and communications.

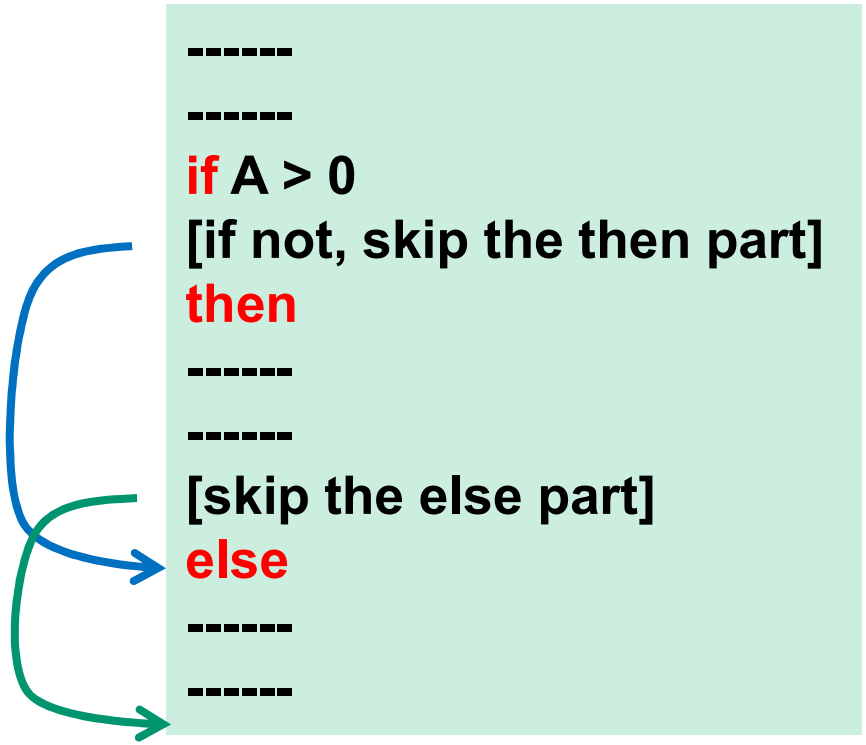
Climate Forecasting: Global Warming

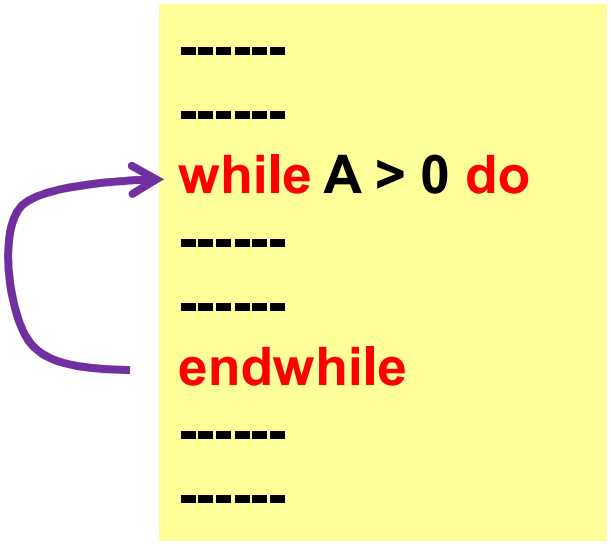


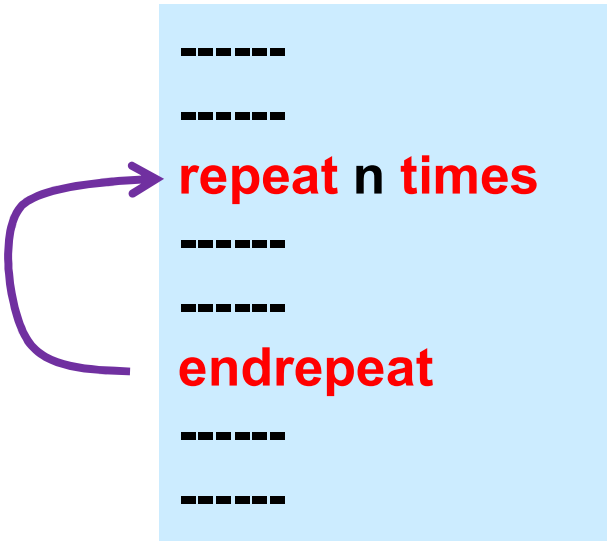
Program Forecasting: Branch Prediction

Modern computers look ahead and process future work to increase speed:

When there is a conditional branch, future work to be done is uncertain





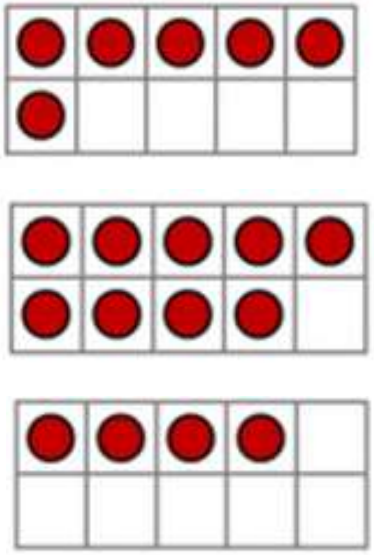


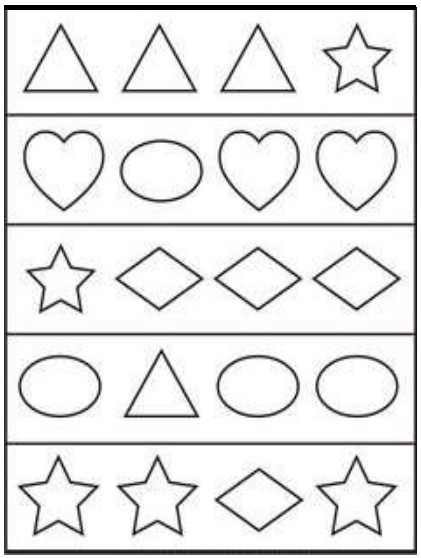
Example Topic: Recommender Systems

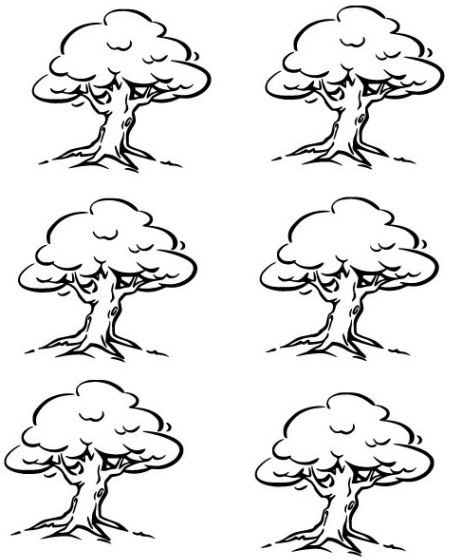
Which of These Is Not Like the Others?

A	H	I	M	N	O	V	W	X
0	3	6	7	8	9			
3	4	7	13	20	33	53	86	139

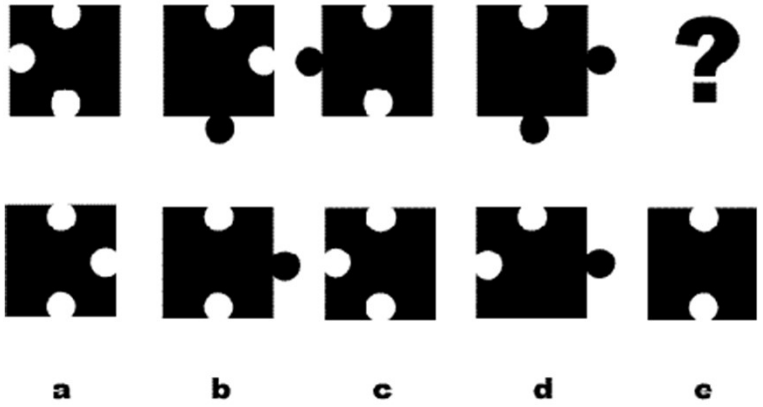
Big Fast Green Warm

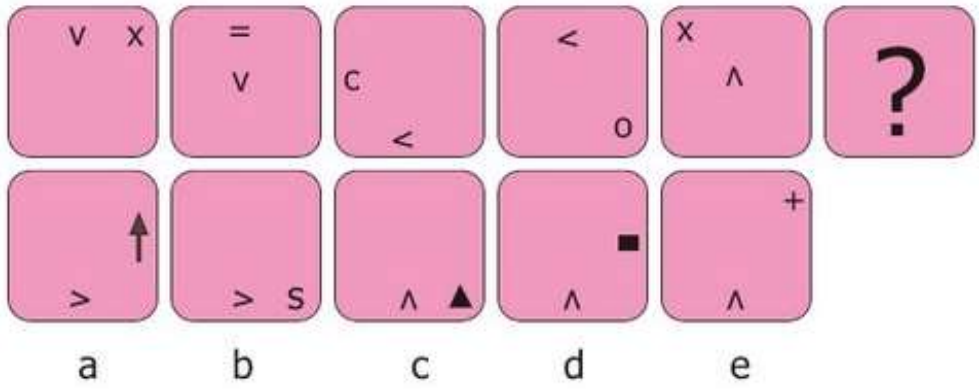


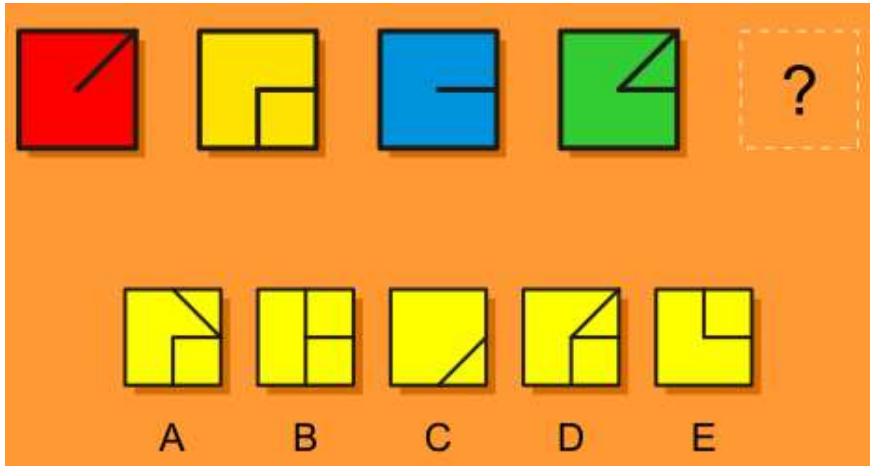


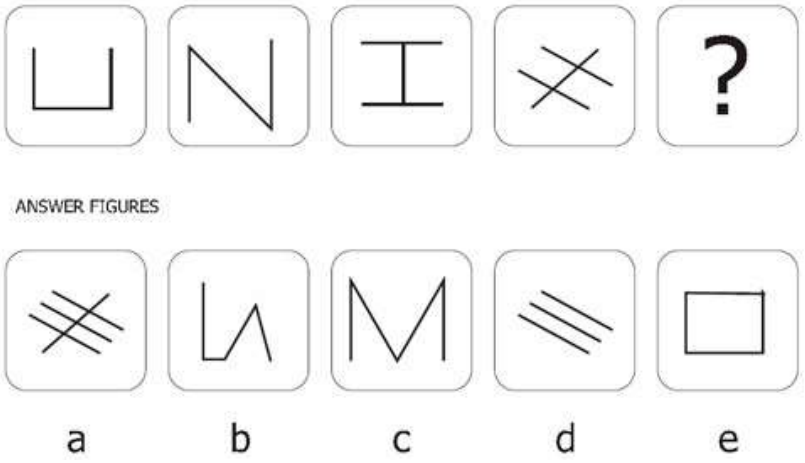


Which of These Is Like the Others (1)?

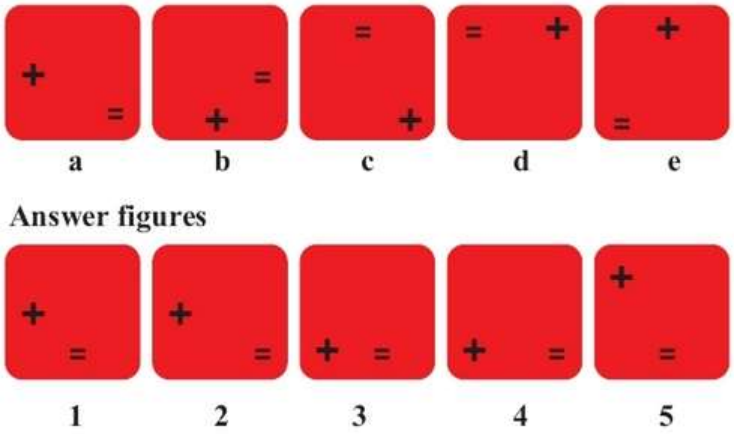


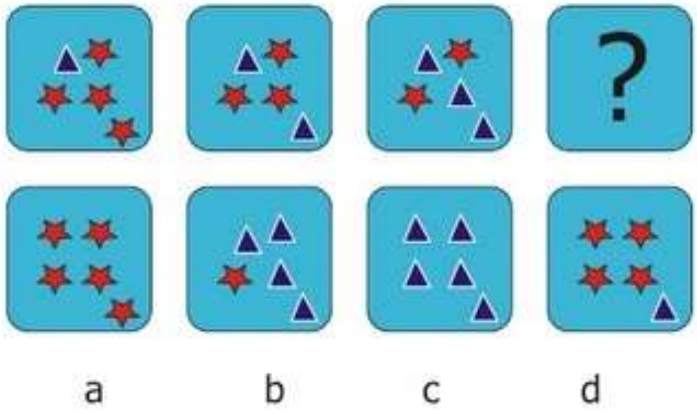


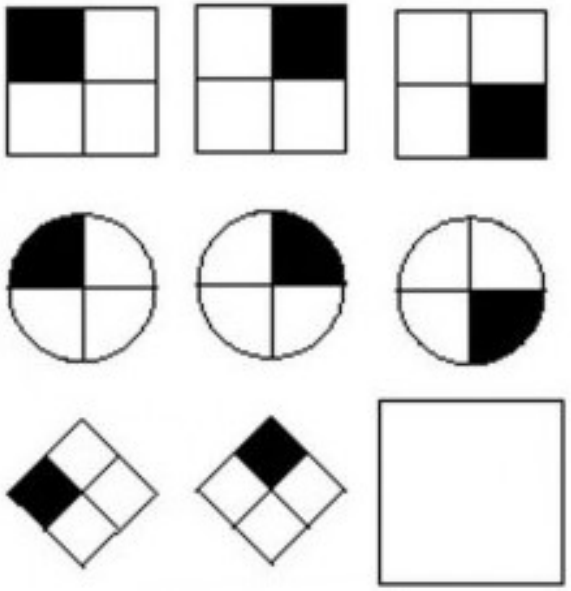


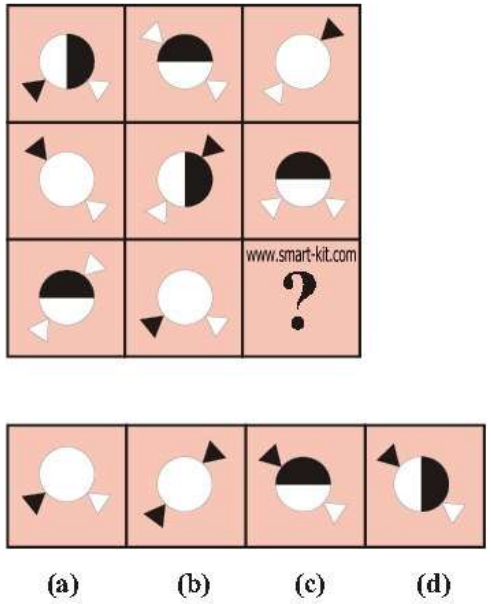


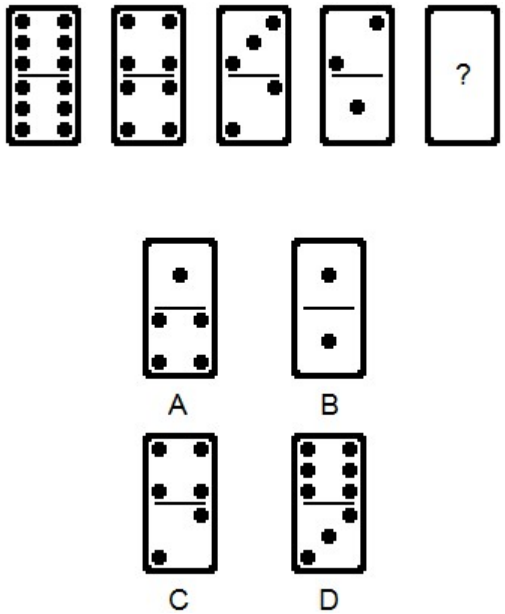
Which of These Is Like the Others (2)?











Similarity Puzzles with Words

What do the following sets of words have in common?

assess; banana; dresser; grammar; potato; revive; uneven
(besides all having at least two repeating letters)

bulb; orange; angel; silver; month; revive; uneven

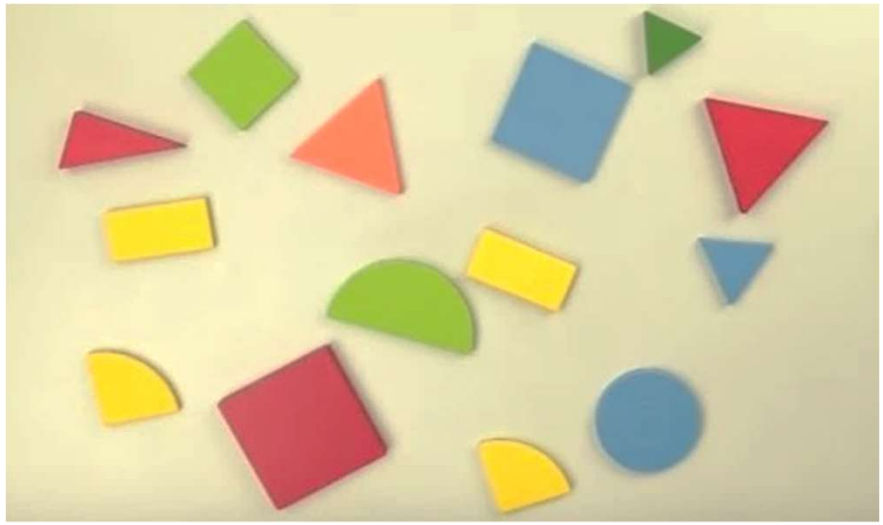
baobab; youngberry; hopscotch; yieldability; dachshund; dumbfounded

aquamarine; beloved; discrepancy; frangipani; freedom; gallipot; overflowing; pagoda; scrounger

Classifying by Color, Shape, and So on

Very young kids are taught about classification by features
(2-minute video: http://www.youtube.com/watch?v=5bip0bcFlgo)

Possible features in the shapes shown in the video:
Color: Blue, Green, Orange, Yellow
Geometric shape: Square, Rectangle, Triangle, Circle, …
Curvature: Straight sides only, at least one curved side
Size: Large, Small (area)
Number of sides: 2, 3, 4
Triangleness: Yes, No
Thickness?
Material?
Weight?
Floats on water?



Example: Recognizing Five Letters

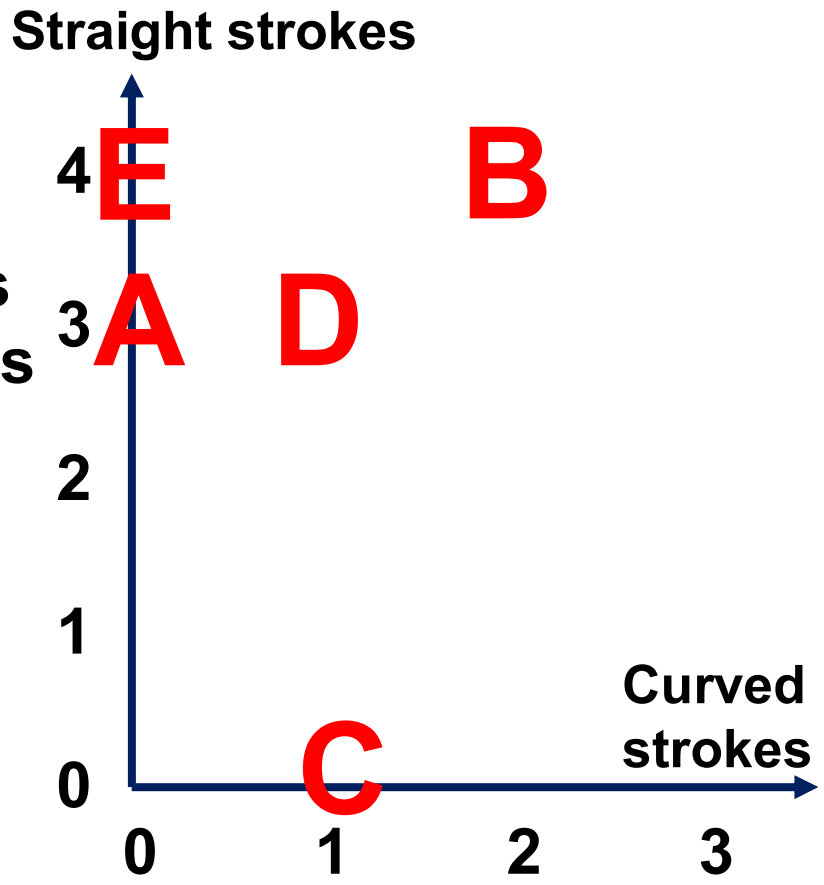
A, B, C, D, E

Example features:

***x*: Number of curved segments**
***y*: Number of straight segments**

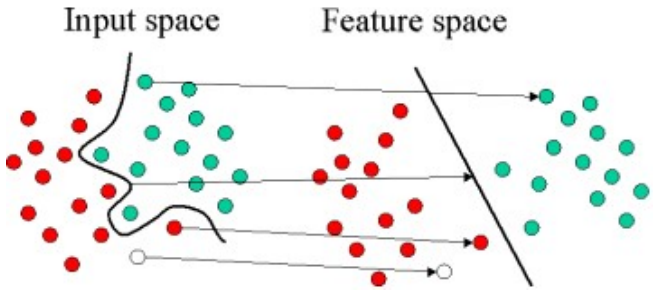
Where would "F" fall?

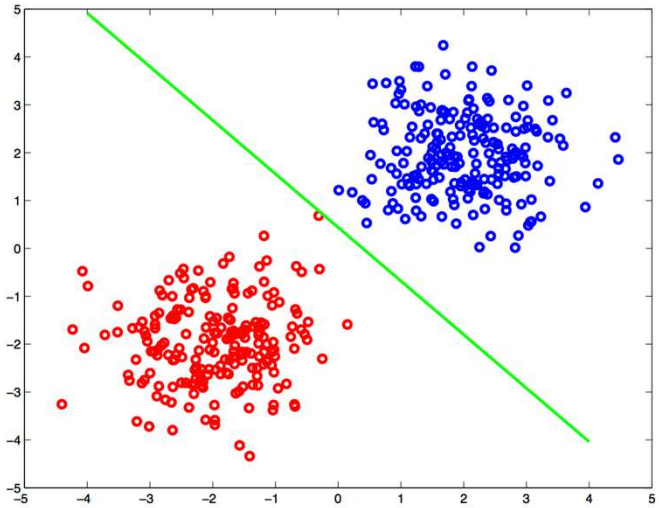
Suggest an additional feature

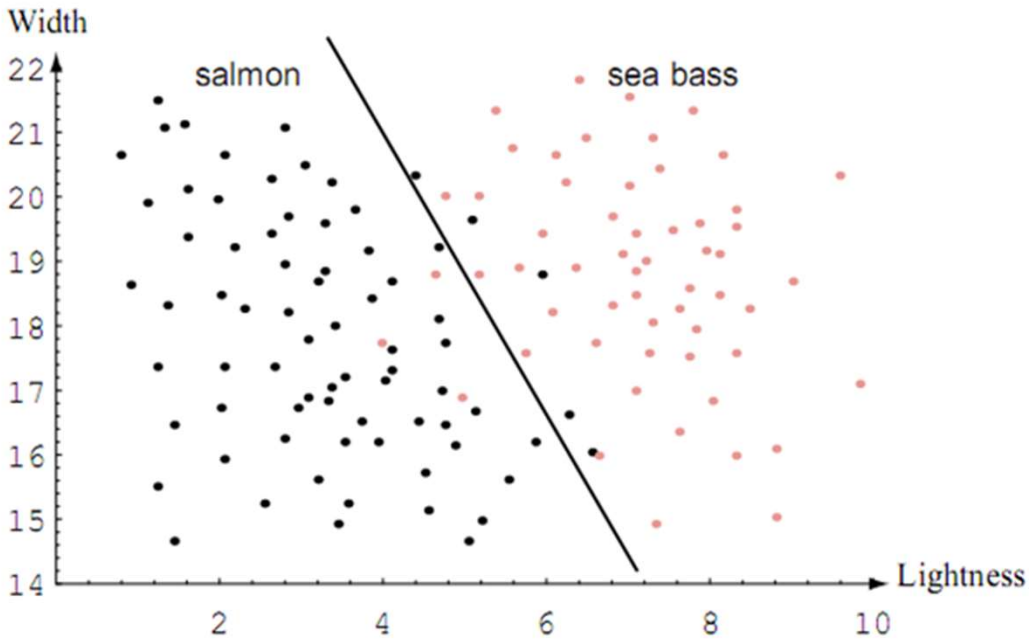


Pattern Classification Example

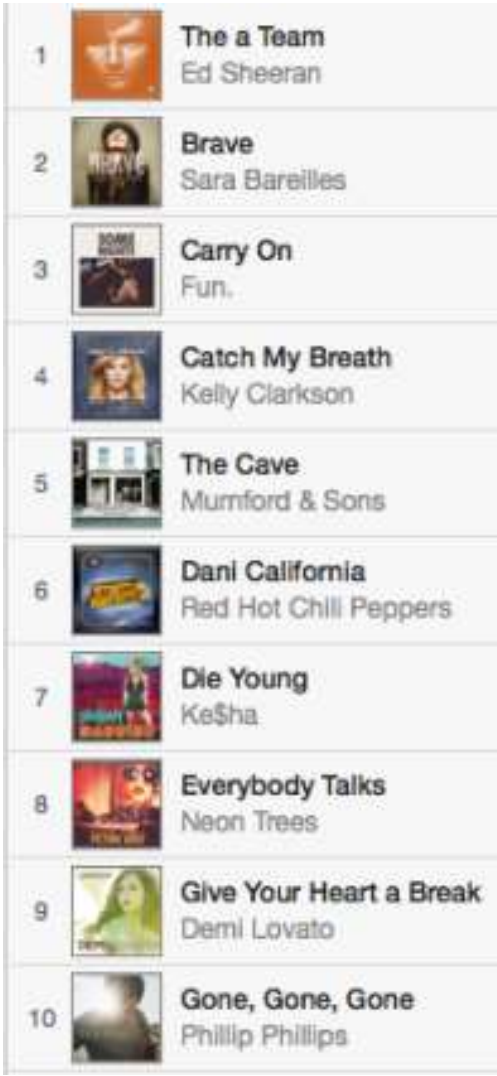
Extracting features from given inputs allows us to separate and classify the inputs according to desired categories







Your Next Book, Movie, or Song



Google Search Results Presentation

razi university kermanshah

All Maps News Images Videos More Settings Tools

About 81,800 results (1.00 seconds)

Scholarly articles for razi university kermanshah

... and research forest of **Razi University**, **Kermanshah** ... - Heidari - Cited by 12
Antimicrobial activity of the leaves of Pistacia khinjuk - Taran - Cited by 28
In vitro Propagation and Agrobacterium-mediated ... - Motamedi - Cited by 16

Razi University - Wikipedia
https://en.wikipedia.org/wiki/Razi_University
Razi University (Persian: دانشگاه رازی) is a public university based in **Kermanshah**, Iran. It is a center of research in many STEM fields such as CFD (Computational Fluid Dynamics), membrane research, nano-science, and nanotechnology. The school's Science and Engineering Departments attract many Iranian high ...

دانشگاه رازی: صفحه نخست
razi.ac.ir/ Translate this page
Razi University دانشگاه رازی **RAZI UNIVERSITY**. کرمانشاه، طاق بستان، خیابان دانشگاه، دانشگاه رازی-کدپستی: ۶۷۱۴۴۱۴۹۷۱. تلفن مرکزی: ۶-۰۸۳-۳۴۲۷۷۶۰۵ .info@razi.ac.ir. کلیه حقوق این وب سایت متعلق به دانشگاه رازی می باشد. | هرگونه برداشت مطالب با ذکر منبع بلامانع است. طراحی و پیاده سازی توسط سپهر افزار ایرانیان.
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Razi University of Kermanshah, Iran - Academia.edu
razi.academia.edu/
Academia.edu is a place to share and follow research.

Razi University - Classbase
https://www.classbase.com/countries/Iran/Universities/Razi-University-20642
Razi University (RU). 5 4 3 2 1 .دانشگاه رازی. Write a Review. Overview; Reviews. Iran web rank: 42. Asia web rank: 806. Global web rank: 2619. General Information. Type: Public. Year of Establishment: 1972.

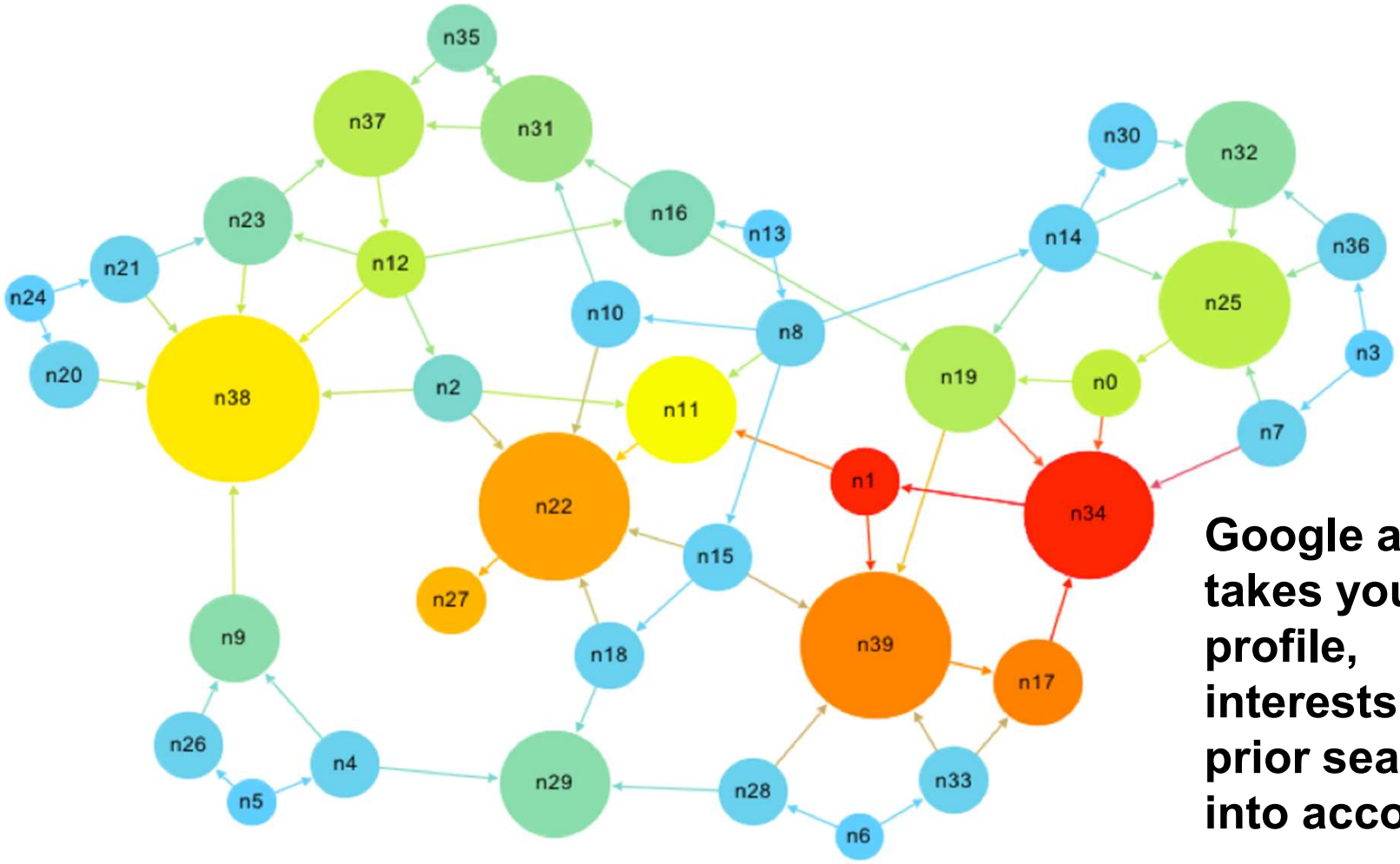
Razi University
Public university in Kermanshah, Iran
Website Directions

Razi University is a public university based in Kermanshah, Iran. It is a center of research in many STEM fields such as CFD, membrane research, nano-science, and nanotechnology. Wikipedia

Address: Kermanshah Province, Kermanshah, Sayyad-e-Shirazi Blvd, Iran
President: Mohammad Ebrahim Aalami Aleagha
Phone: +98 83 3427 7603
Total enrollment: 8,902 (2010)
Founded: 1972

Google's 'Pagerank' Algorithm

Algorithm to rank the hits so that the most useful ones come first



Google also takes your profile, interests, and prior searches into account

Neural-Network Pattern Recognition

Train the system using known patterns, then use it on others
(4-minute video: http://www.youtube.com/watch?v=kGv-1it8Sac)

Facial-Recognition Technology

Train the system using known patterns, then use it on others
(1-minute video: http://www.youtube.com/watch?v=tZzIH4Qf5Y8)

Conclusions and Future Work

Done so far: Formulated problems from computing and other engineering/tech disciplines in terms of puzzles

Forecasting and recommender systems discussed

3D models from 2D images

Computational geometry

Maps and graphs

Other problems: The world of puzzles is quite rich and extensive and we can find a puzzle for virtually any problem

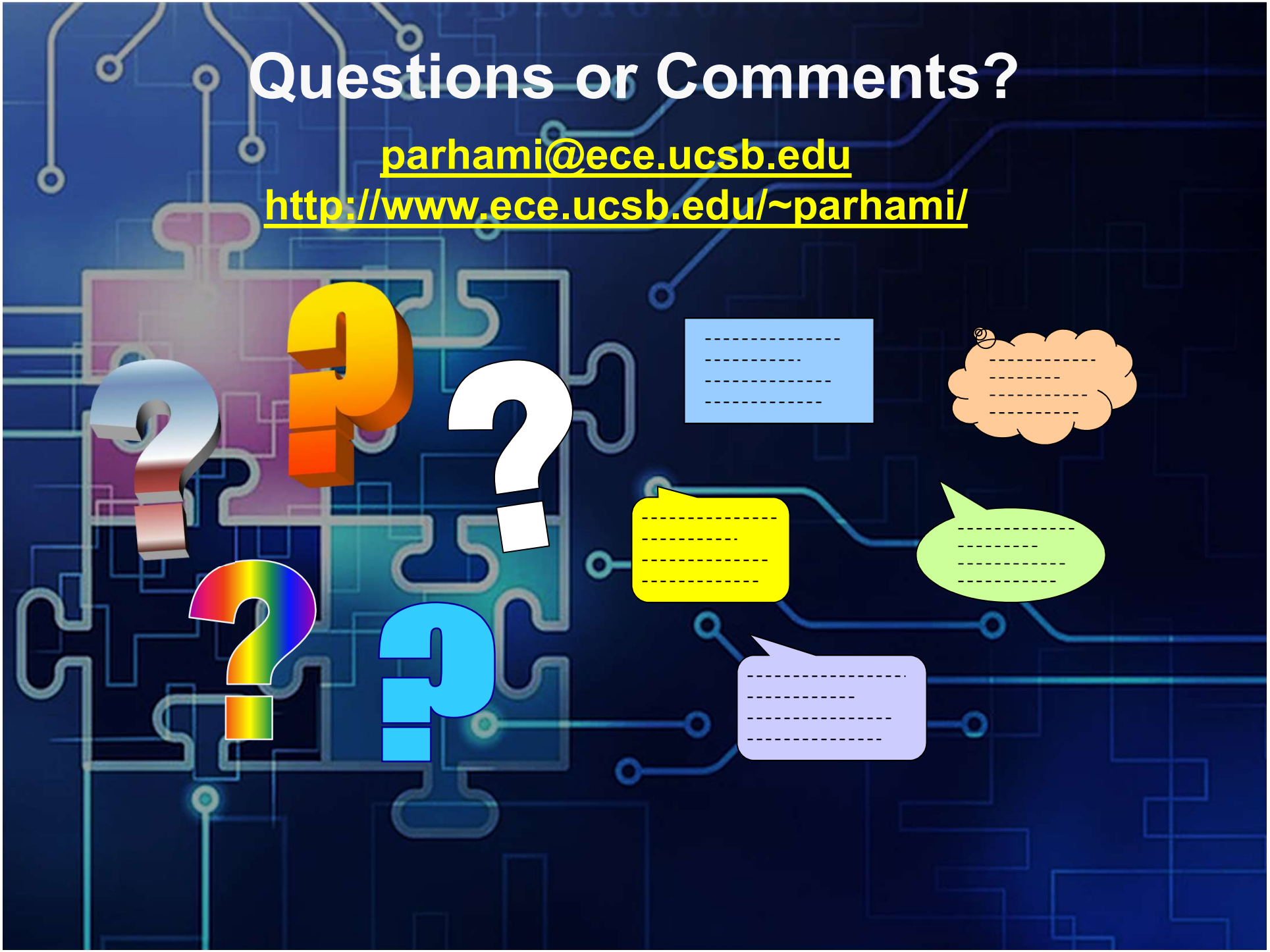
People in various disciplines should pitch in

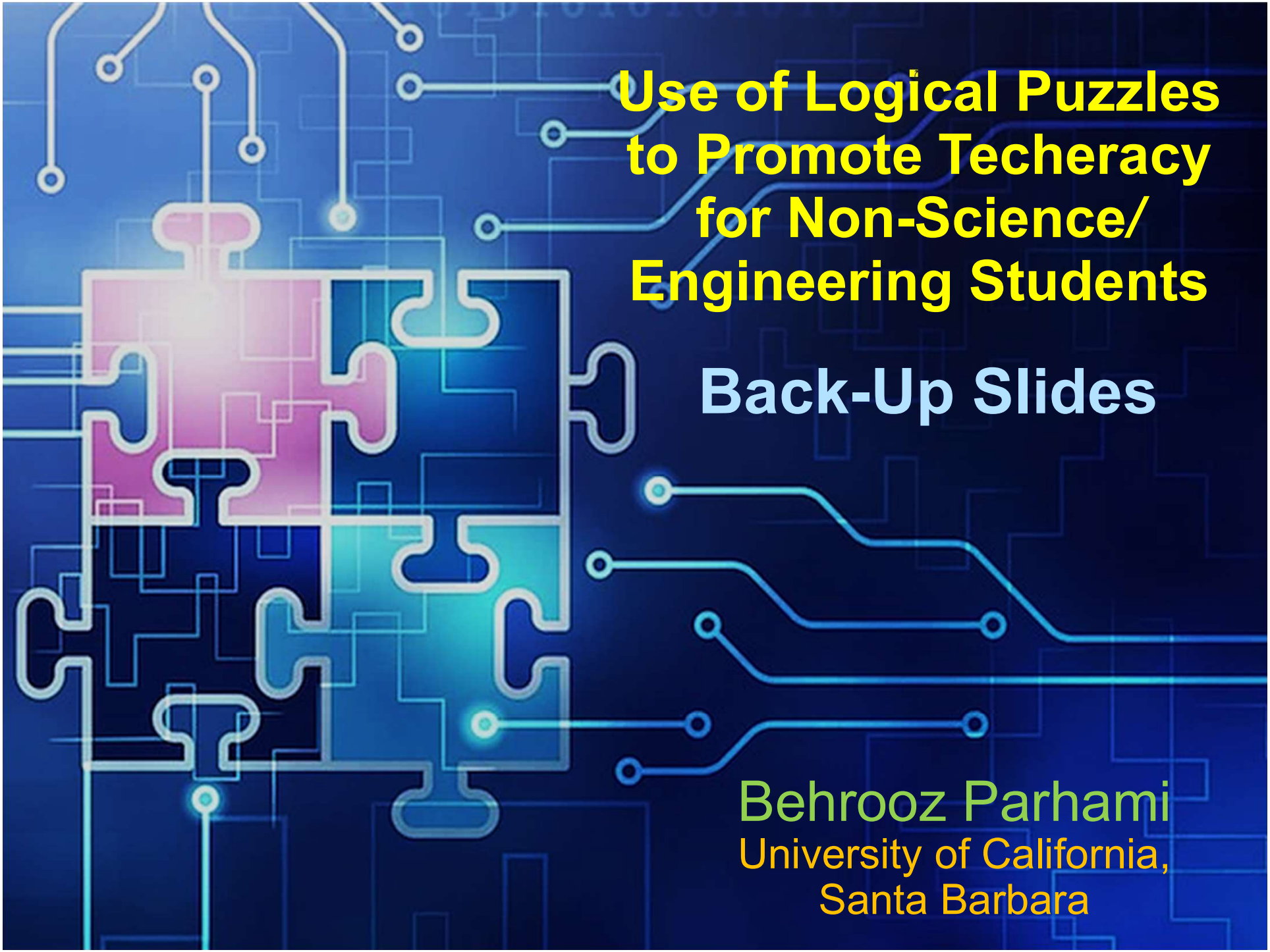
Book project: I am compiling the problems for my two seminars (ECE 1B and INT 94TN) into book form

Hope to spread the message further via the book

Questions or Comments?

parhami@ece.ucsb.edu
http://www.ece.ucsb.edu/~parhami/

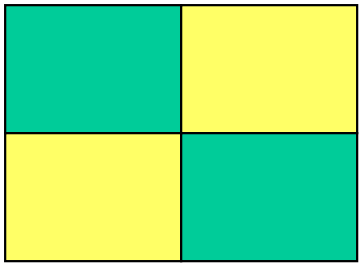



Use of Logical Puzzles to Promote Techeracy for Non-Science/ Engineering Students
Back-Up Slides
Behrooz Parhami
University of California, Santa Barbara

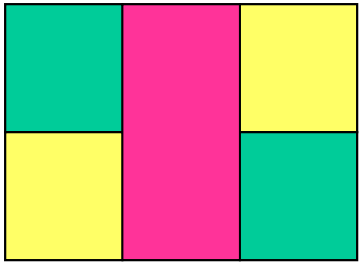
Example Topic:
Maps and Graphs

The Map Coloring Problem: USA

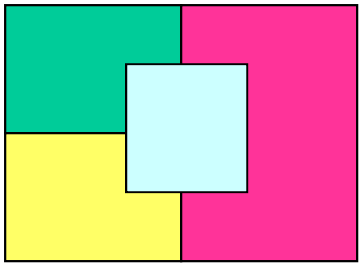
We want to color countries, oceans, lakes, and islands on a map so that no two adjacent areas have the same color.



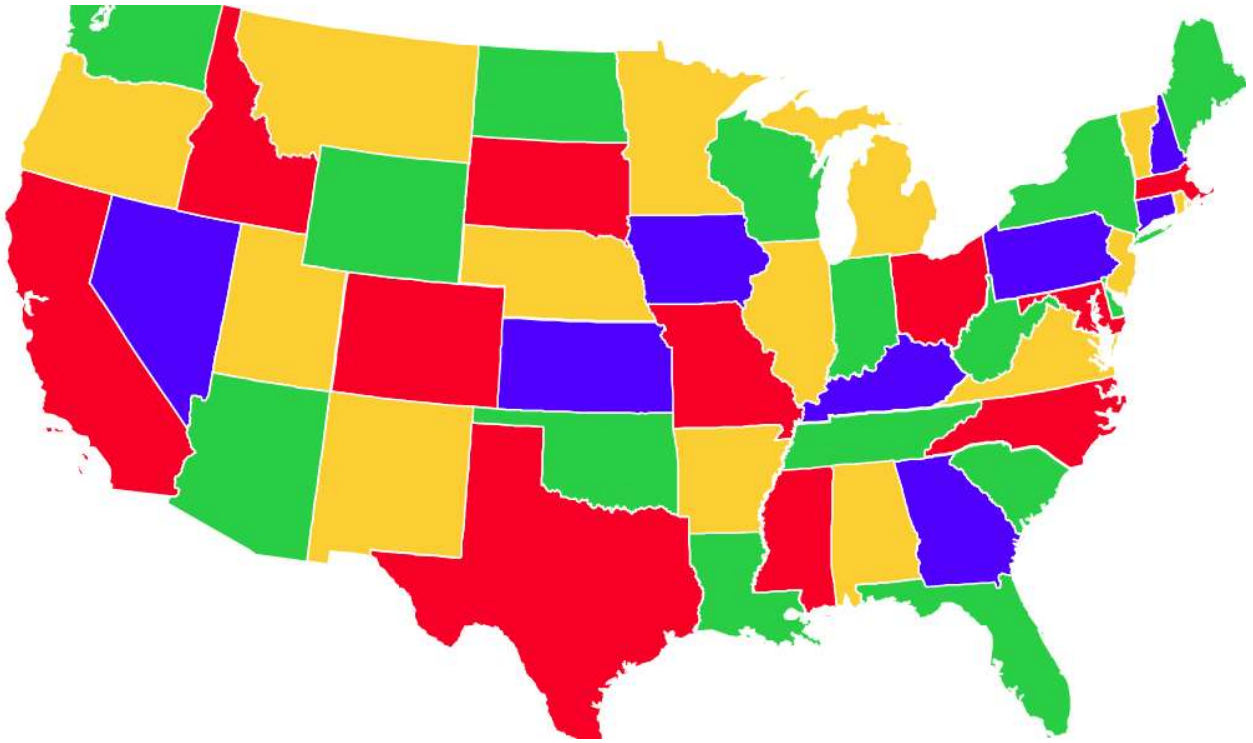
Two colors



Three colors



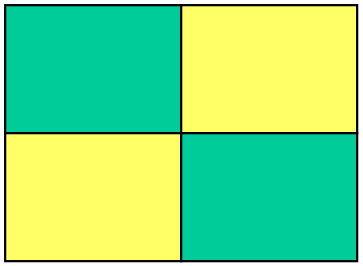
Four colors



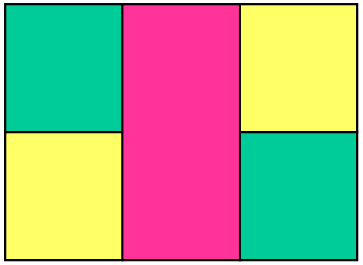
We know that four colors always suffice

The Map Coloring Problem: Iran

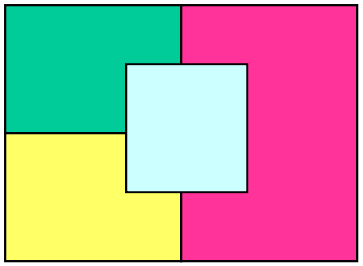
We want to color countries, oceans, lakes, and islands on a map so that no two adjacent areas have the same color.



Two colors

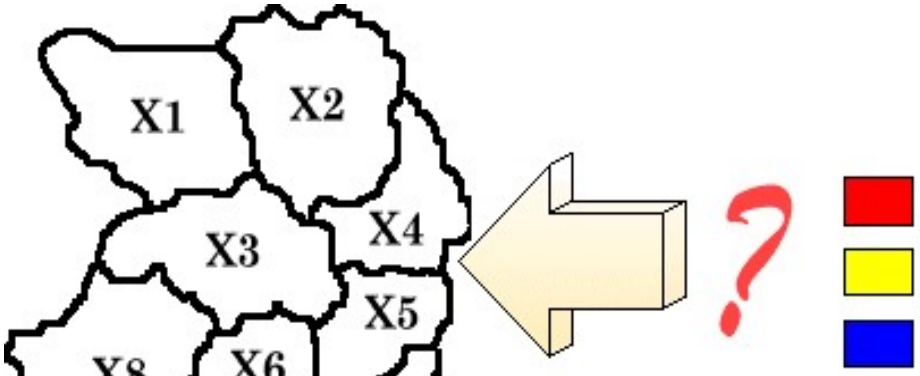


Three colors

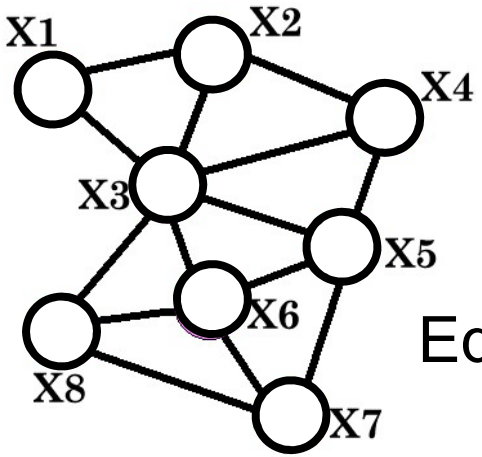


Four colors

Map and Graph Coloring

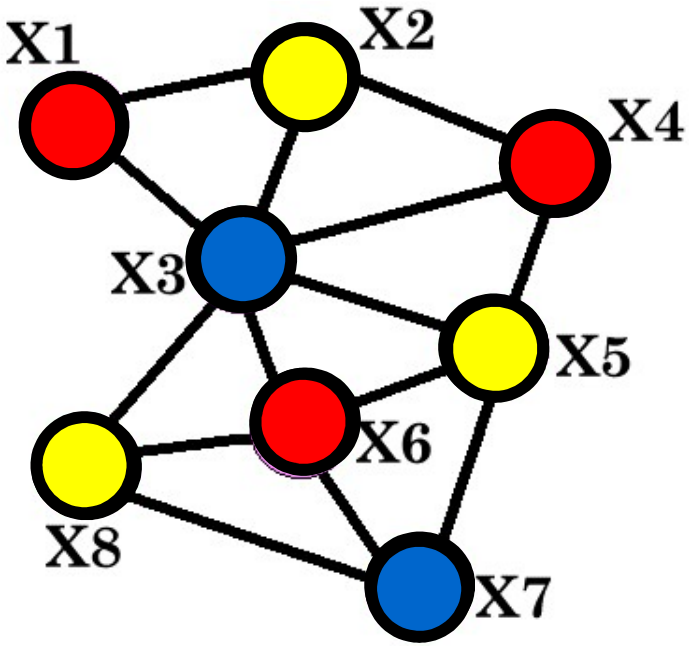


Map to be colored



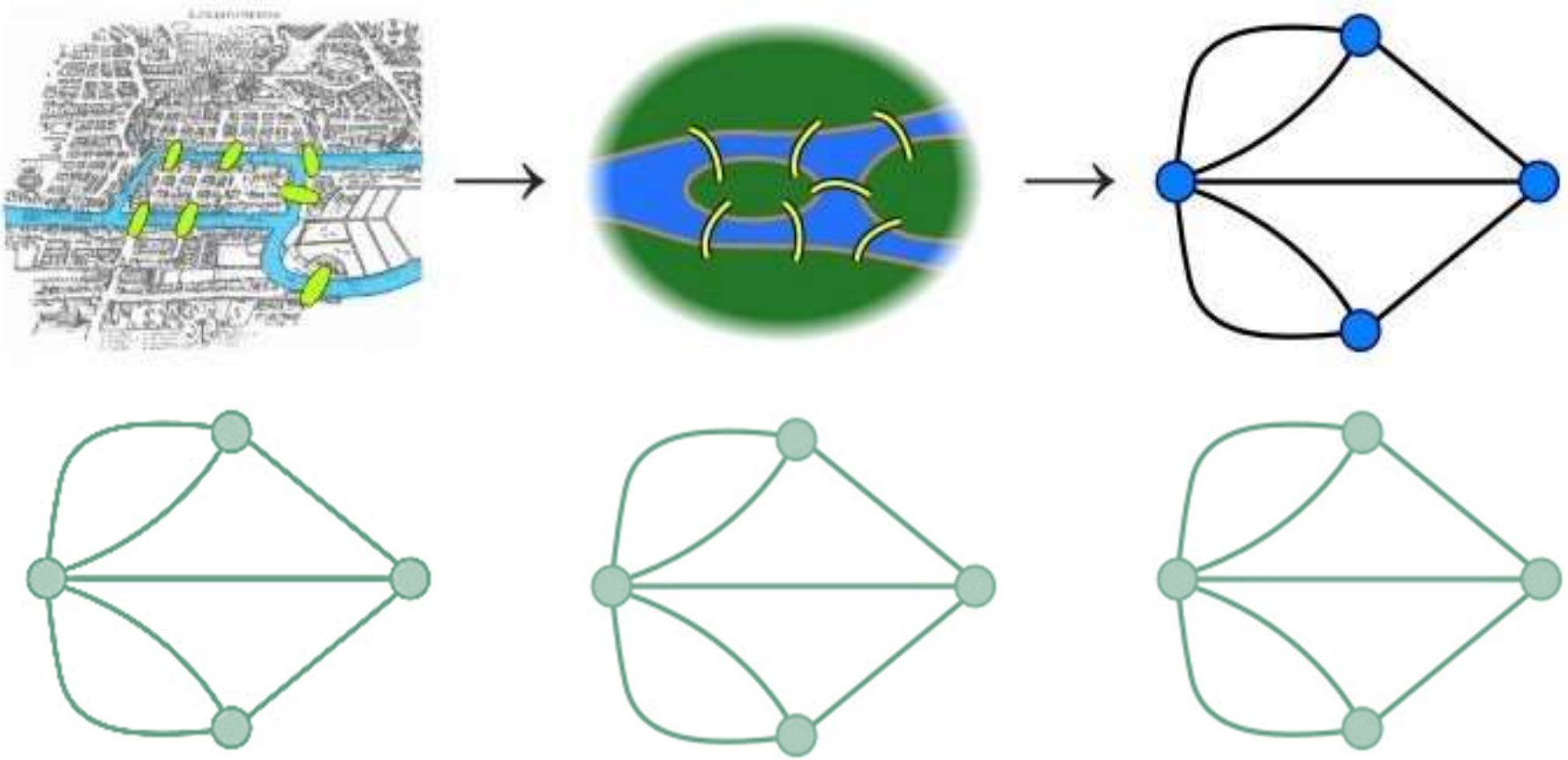
Equivalent graph

A map can be converted to a planar graph that can be drawn with no edges crossing

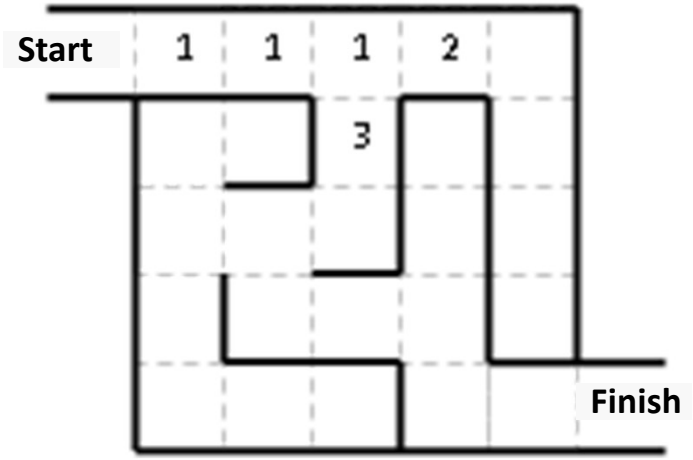


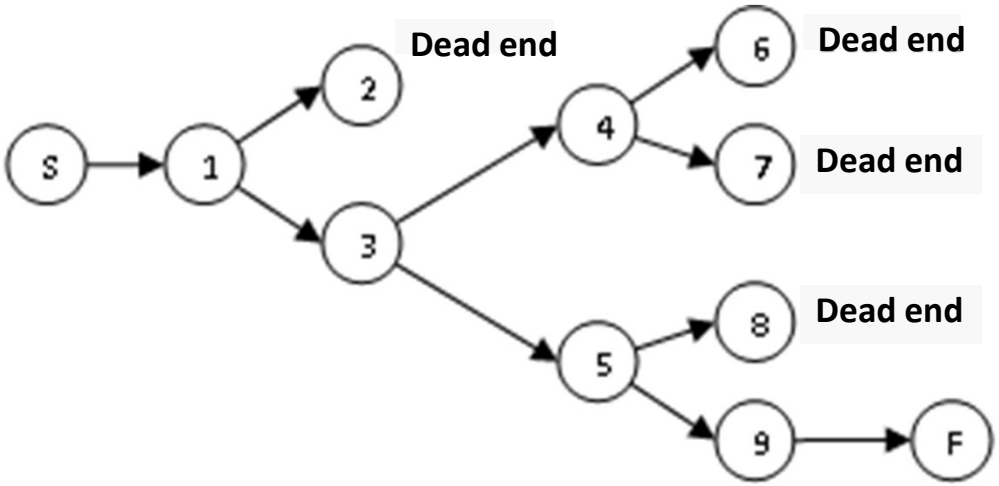
The Bridges of Konigsberg Puzzle

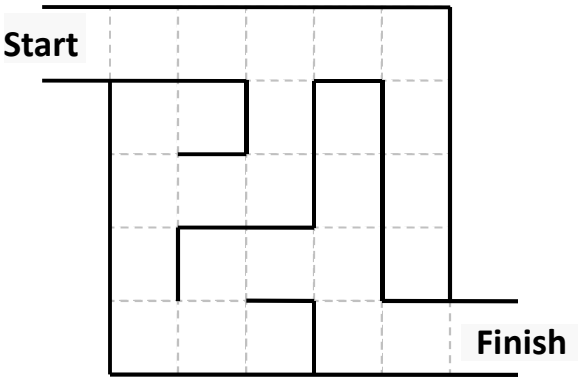
Can you walk in the city of Konigsberg in such a way that you cross each bridge once and only once (in either direction)?

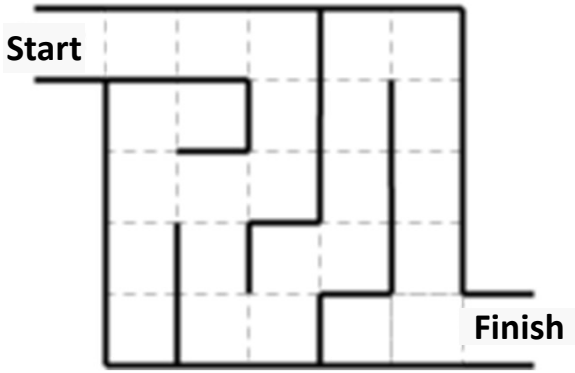


Mazes Represented as Graphs









Maze-Solving Robots

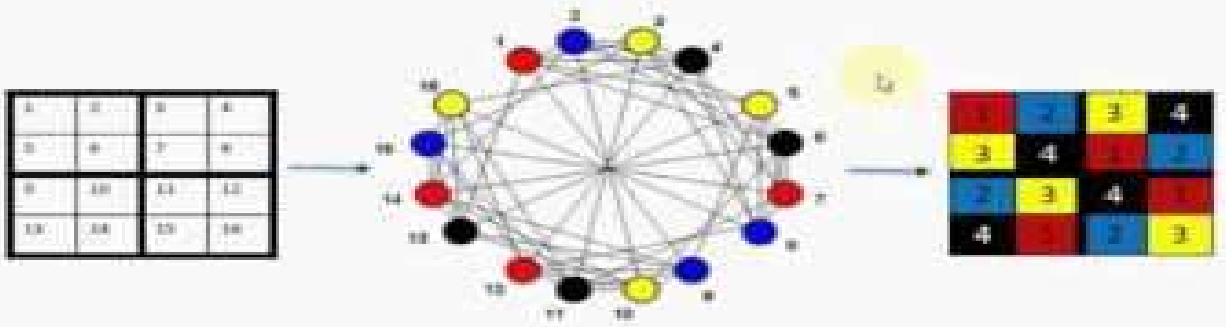
4-minute video: http://www.youtube.com/watch?v=MLHeUEPLSAY

Applications of Graph Coloring

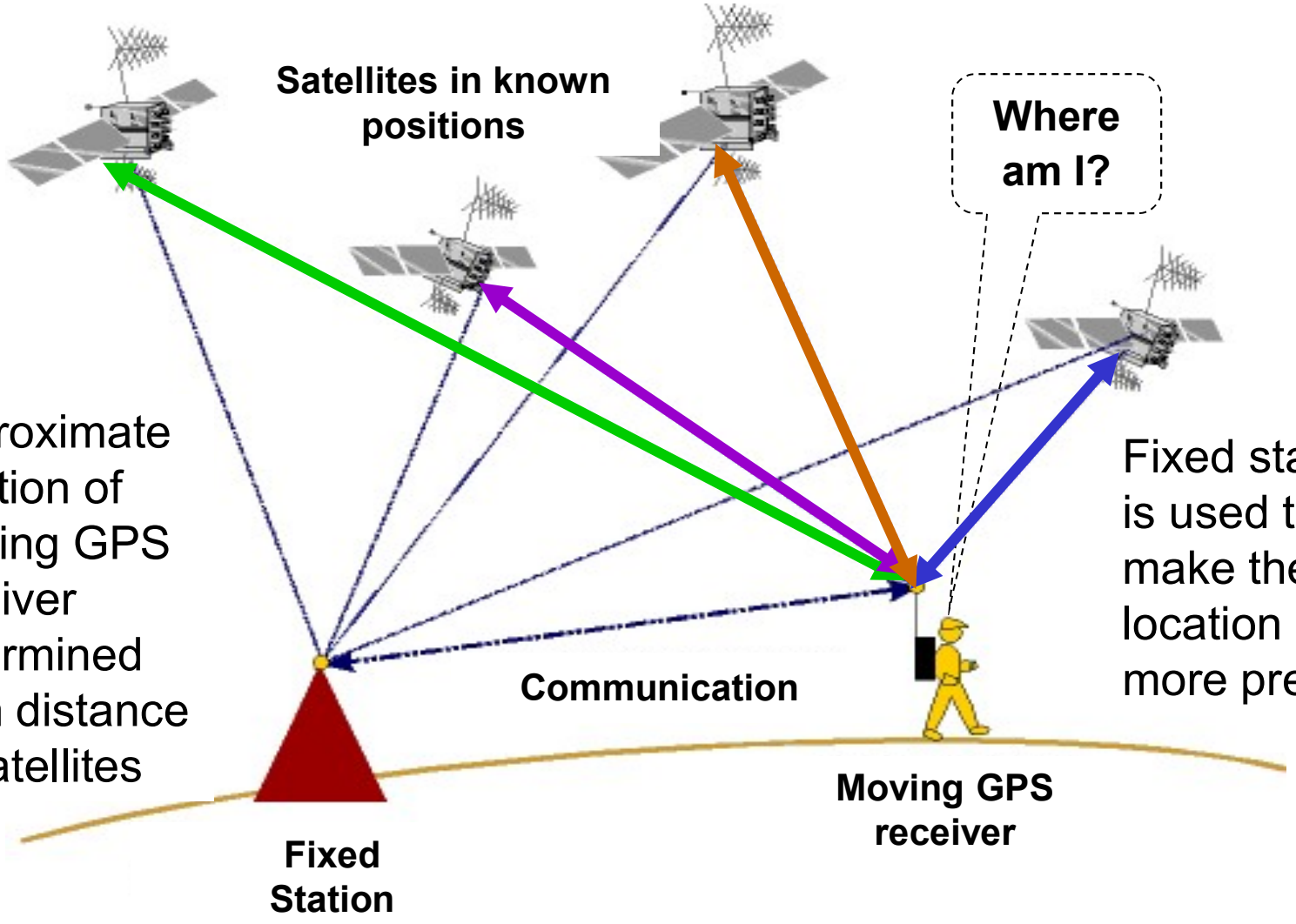
9-minute video: http://www.youtube.com/watch?v=y4RAYQjKb5Y

Solving Sudoku Puzzles

- Fill in the blank cells so that each row, column and 2x2 box has the characters 1 to 4 exactly once.



How GPS Works: The Measurements



GPS-Guided Navigation

You know where you are (GPS) and where you want to go (address)
Roads form a known maze, stored on Google's servers
When there are multiple paths, you want the shortest/fastest path
To determine which path is faster, dynamic congestion data may be used