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CMS.608 / CMS.864 Game Design
Spring 2008

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Puzzle Design

CMS.608 Game Design

See also Kim, Scott. "How to Invent Puzzles."
June 4, 2006.

What is a puzzle?

- It's a problem with one single solution
 - ... but ideally more than one path to that solution
- The opponent is the object puzzle itself, not another player
 - “Mental” Challenge (Rollings & Adams)

The Importance of Insight

- Puzzles provide new ways of thinking about the world
- The solution is logical but also
 - witty
 - surprising
 - different from everyday life

Parts of a Puzzle

- Rules: Problem Description
 - Must be precise, give all necessary information (not too much, not too little)
 - It's a mystery!
- Goal: Solution

Types of Insight

Image removed due to copyright restrictions.

Please see slide 17 in Kim, Scott. "Teaching Students to Invent Puzzles."
Math Fair Workshop, April 21, 2007.

<http://www.scottkim.com/thinkinggames/mathfair/invent-puzzles.ppt>

According to Scott Kim

Types of Puzzles

- Language
- Visual
- Logic
- Numbers
- Puzzle Games

Based on Marcel Danesi's *The Puzzle Instinct*

Language Puzzles

- Play with meaning and with words as objects

- Riddles

Image removed due to copyright restrictions.

Please see any example of a rebus puzzle, such as

<http://www.blog.beachpackagingdesign.com/2008/08/rebus-bottle-ca.html>

- Anagrams

- Cryptograms

- Rebuses

- Crosswords

Language Puzzles

- Riddles

Dreaming of apples on a wall,

And dreaming often, dear,

I dreamed that, if I counted all,

--How many would appear?

-- Lewis Carroll

Language Puzzles

- Doublet Puzzle / Word Ladder

Turn the word HEAD into TAIL, by changing one letter at a time, forming a new word each time to do so

Change IRON into LEAD by introducing a new letter or by rearranging the letters of the word, at any step, instead of introducing a new letter. But you may not do both in the same step.

Lewis Carroll

Language Puzzles

- Doublet Puzzle / Word Ladder

Turn the word HEAD into TAIL, by changing one letter at a time, forming a new word each time to do so

HEAD

HEAL

TEAL

TELL

TALL

TAIL

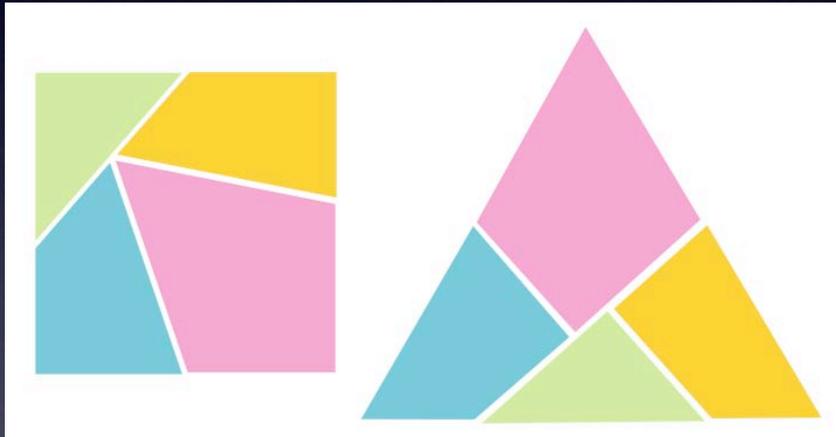
Visual Puzzles

- Play with visual shapes and space
 - Dissection and Arrangement
 - Mazes
 - Hidden Images
 - Spot the Difference
 - Geometrical Challenges

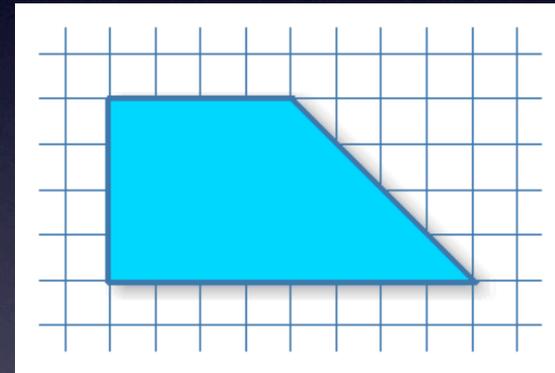


Visual Puzzles

- Dissection Puzzles



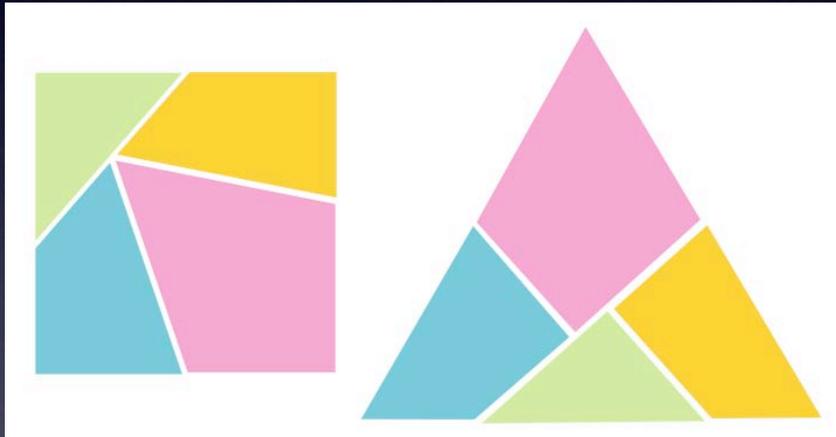
*Haberdasher's Problem:
Dissect a square into pieces to
form a triangle, with only four cuts.
(Henry Dudeney)*



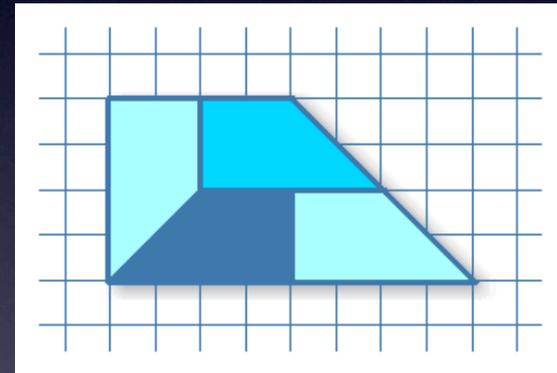
*Divide this figure into four pieces,
which must be identical in their
shape and size. Some pieces can be
mirror reflections of others.*

Visual Puzzles

- Dissection Puzzles



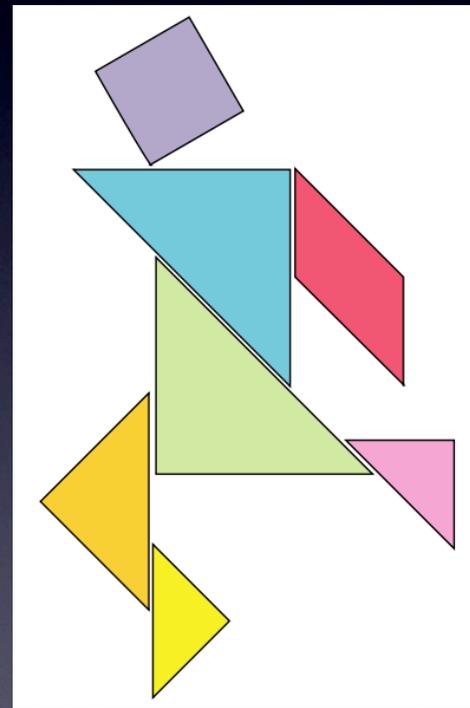
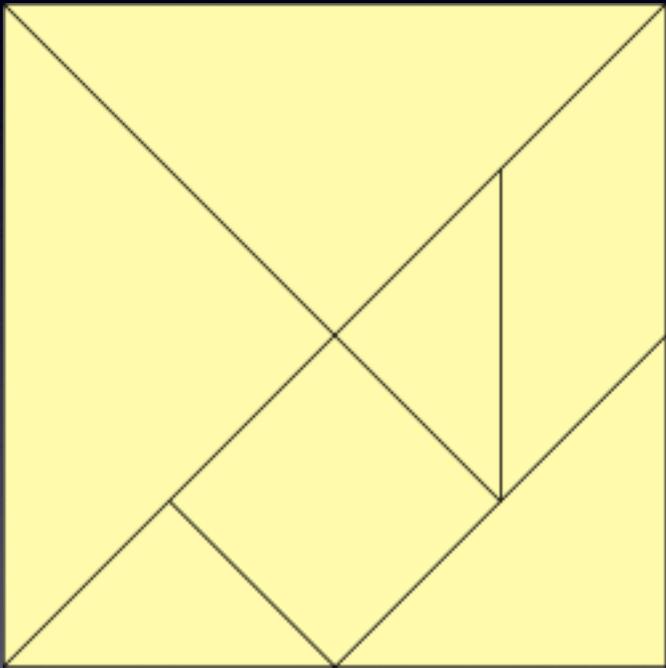
*Haberdasher's Problem:
Dissect a square into pieces to
form a triangle, with only four cuts.
(Henry Dudeney)*



*Divide this figure into four pieces,
which must be identical in their
shape and size. Some pieces can be
mirror reflections of others.*

Visual Puzzles

- Rearrangement



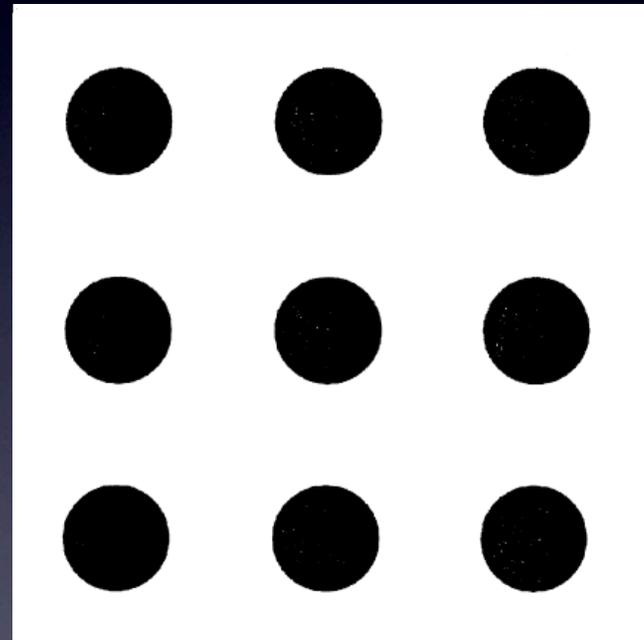
Images from Wikimedia Commons, <http://commons.wikimedia.org>.

Tangram

Visual Puzzles

- Geometrical Challenge

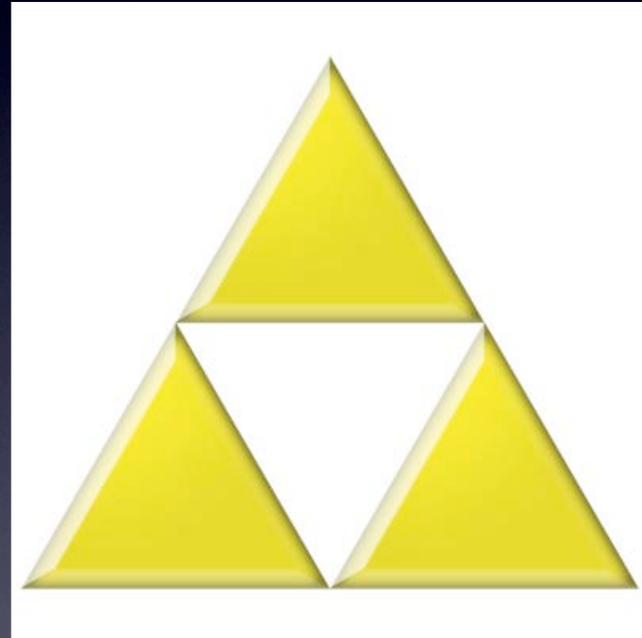
Without the pencil leaving the paper, can four straight lines be drawn along the nine dots?



Visual Puzzles

- Geometrical Challenge

*Can you draw the
Triforce in one stroke?*



Logic Puzzles

- Play with ideas
 - Deduction
 - Truth
 - Deception

Logic Puzzles

- Deduction Puzzles

In a certain company, Bob, Janet and Shirley hold the positions of director, engineer and accountant, but not necessarily in that order.

The accountant, who is an only child, earns the least.

Shirley, who is married to Bob's brother, earns more than the engineer.

What position does each person fill?

Logic Puzzles

- Truth Puzzles: “knights or knaves”

The Dodo says that the Hatter tells lies

The Hatter says that the March Hare tells lies

The March Hare says that the Dodo and the Hatter tell lies

Who is telling the truth?

– Lewis Carroll

Logic Puzzles

- Logic puzzles based on deception

How many cubic inches of dirt are there in a hole that is one foot deep, two feet wide, and six feet long?

How many times can you subtract the number one from the number twenty-five?

If 3 cats kill 3 rats in 3 minutes, how long will it take 100 cats to kill 100 rats?

Number Puzzles

- Play with mathematical operations, patterns and combinatorics
 - Magic Squares
 - River-Crossing Puzzles
 - Containers and Weights
 - Cryptarithms

Number Puzzles

- Magic squares

2	7	6	→	15
9	5	1	→	15
4	3	8	→	15
↙	↓	↓	↓	↘
15	15	15	15	15

Image from Wikimedia Commons, <http://commons.wikimedia.org>.

Number Puzzles

- River-crossing puzzles

A farmer is returning from market, where he bought a goat, a wolf and cabbage. On the way home he must cross a river. His boat is little, allowing him to take only one of the three things. He can't keep the goat and the cabbage together (because the goat would eat it), nor the goat with the wolf (because the goat would be eaten).

How shall the farmer get everything on the other side (without any harm)?

What is the minimum number of trips across the river?

Number Puzzles

- Cryptarithms

$$\begin{array}{r} \text{FORTY} \\ + \text{TEN} \\ \hline \text{TEN} \\ \hline \text{SIXTY} \end{array}$$

– *Martin Gardner*

Puzzle Games

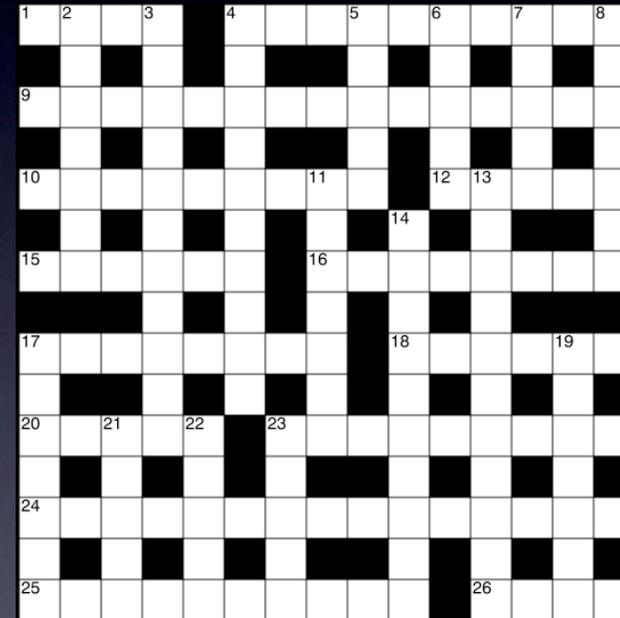
- Use a template, and allow different levels of difficulty.
 - Sudoku
 - Chess Problems
 - Movement and Arrangement
 - Mechanical Puzzles
 - Computer Puzzle Games

How to design puzzles?

- Fill in the template

			1	1	5	1	1
		1					
		3					
1	1	1					
		1					
		1					

Nonogram



Crossword

How to design puzzles?

- Make a sequence: easy to hard

Image removed due to copyright restrictions.

Please see any photo of Mastermind, such as

<http://upload.wikimedia.org/wikipedia/commons/2/2d/Mastermind.jpg>

After Scott Kim, "How to Invent Puzzles." <http://scottkim.com/thinkinggames/exploratorium06/how-to-invent-puzzles.html>

How to design puzzles?

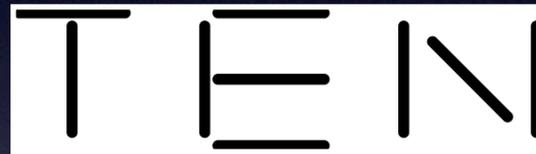
- Change the rules of an existing game (basically what we've been doing all term)
- Change the skin
- Vary parameters: scale, size
- Extend the rules

Image removed due to copyright restrictions.
Please see <http://www.addedbytes.com/blog/colour-sudoku/>

Colour Sudoku: instead of filling in the numbers 1 to 9 in each of the 3 by 3 blocks, you must enter 1 to 9 in the 9 boxes of each colour - i.e. there are nine yellow boxes, and the yellow boxes must contain the digits 1 to 9.

How do we design **new** puzzles?

- Notice the unusual

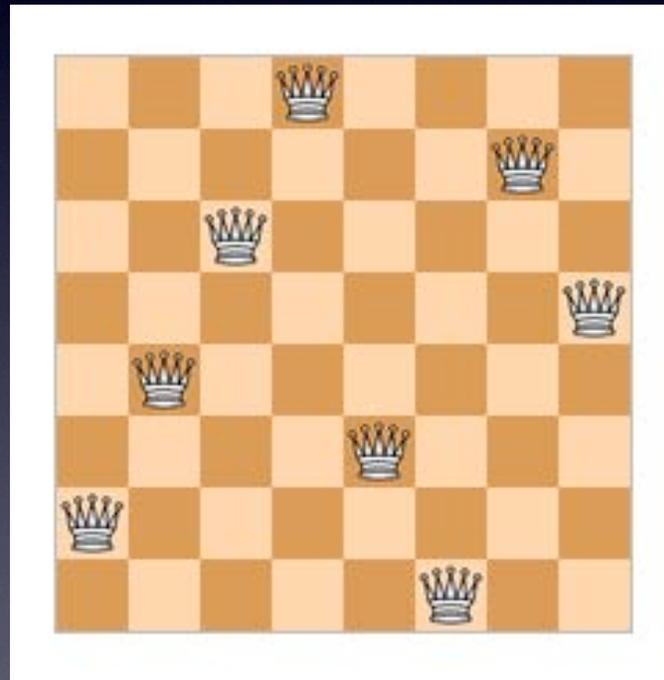


Remove six matches and leave ten:



How do we design **new** puzzles?

- Ask a new question



How do we design **new** puzzles?

- Choose a topic / context

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Please see http://www.math.nus.edu.sg/aslaksen/gem-projects/maa/Interview_with_the_Minotaur/imprint.gif

The 'Imprint of Man' is a hedge maze design in the shape of a foot in Gloucestershire. Built in 1975, it is based on the Minotaur design and portrays the footprint of a Colossus (300m tall).

After Scott Kim, "How to Invent Puzzles." <http://scottkim.com/thinkinggames/exploratorium06/how-to-invent-puzzles.html>

How do we design **new** puzzles?

- Choose a topic / context

Images removed due to copyright restrictions.

Please see -

<http://schmid.dk/gamelog/images/monkey.gif>

<http://www.mystjourney.com/img/main-myst.jpg>

Exercise: Mini-Mystery Hunt

- Phase I: Design a puzzle using MIT as your fictional framework (1 hour)
 - Groups of 2
 - Pick up one index card and design a variant on that type of puzzle.
 - If you finish your puzzle and there's time, you can make another of that type or a different one
 - At the end of the hour, please hand in a piece of paper with the puzzle problem (*but not the solution!*). Include your names on top of the page.

Exercise: Mini-Mystery Hunt

- Phase II: Solve the puzzles! (30 min)
 - Everybody will get a copy of all the puzzles
 - You can solve them in pairs or individually
 - Don't ask the designers for the solution yet!

Exercise: Mini-Mystery Hunt

- Phase III (30 min): Solving the puzzles together
 - If we cannot solve the puzzle, its designers will have to explain the solution
 - Puzzle critique:
 - Was it easy / difficult?
 - Why couldn't you solve it (if that's the case)?
 - Is it fun? How / why?