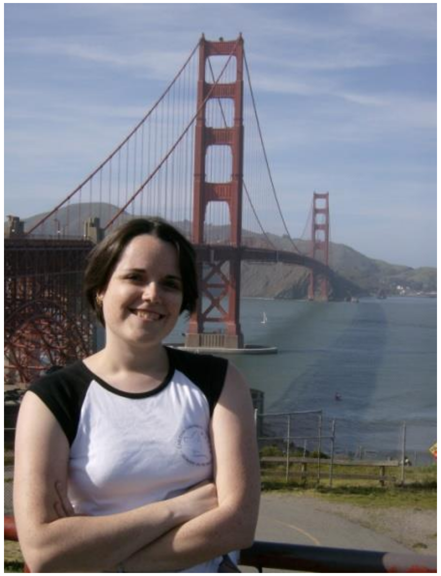
COMP 1406: Introduction

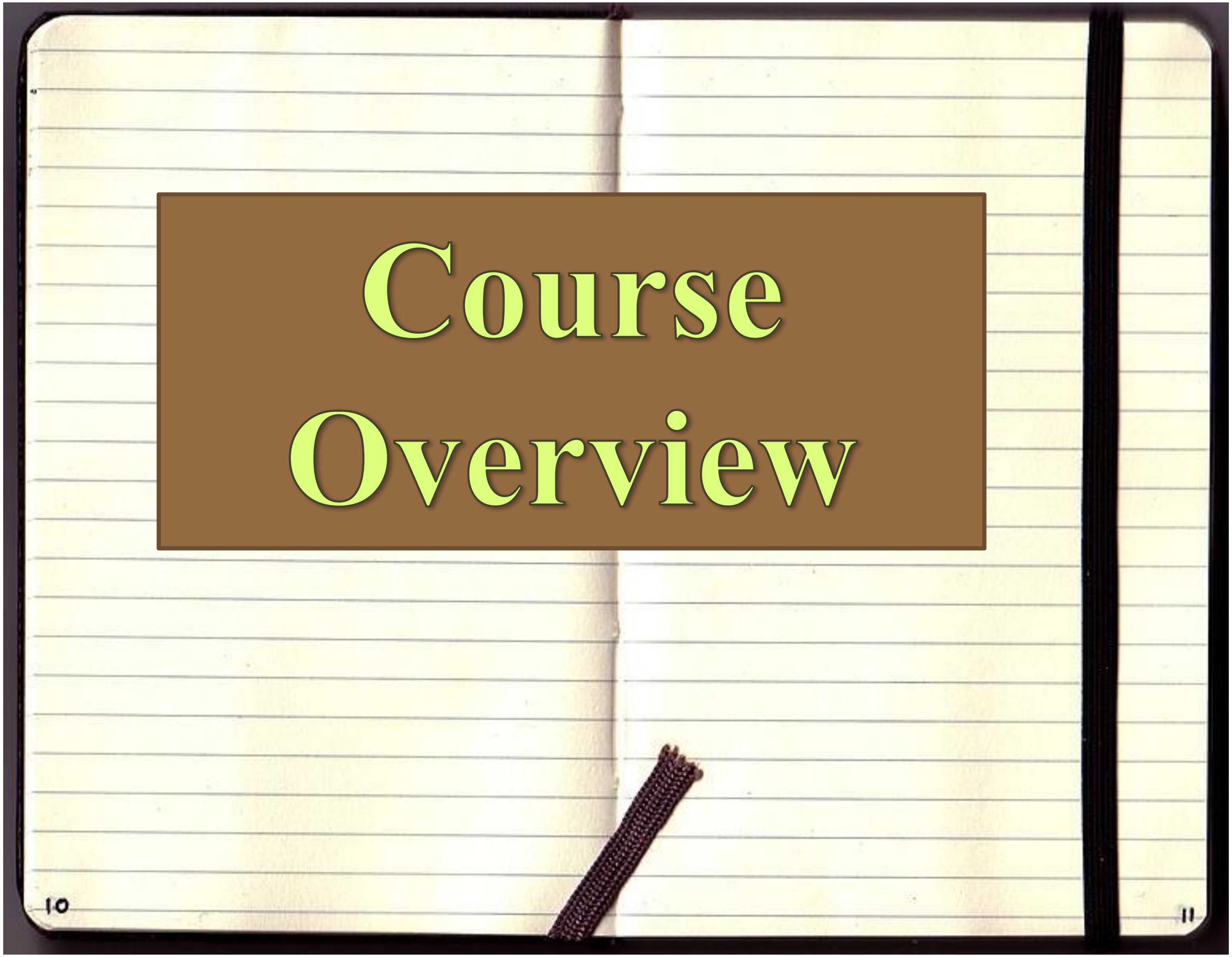
Course Overview

Introduction to Problem Solving

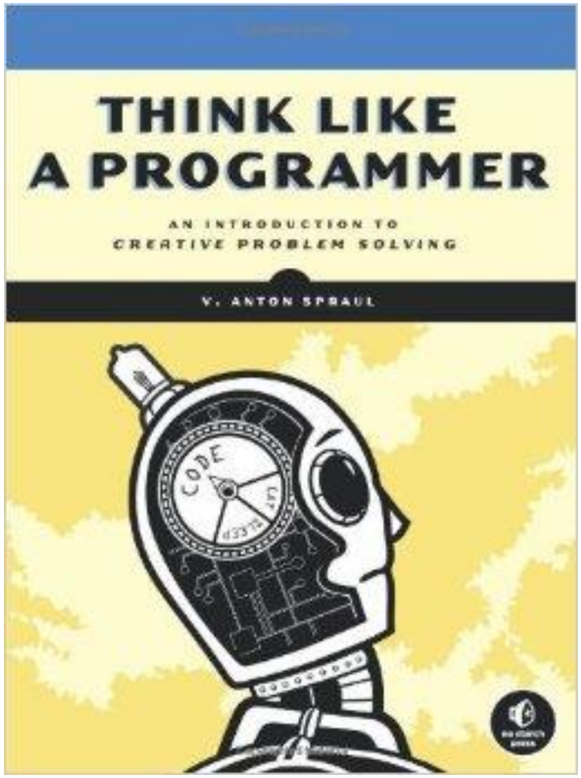
About Me



Course Overview



http://commons.wikimedia.org/wiki/File:Moleskine_ruled_notebook,_inside_view.jpg



http://www.nostarch.com/thinklikeaprogrammer

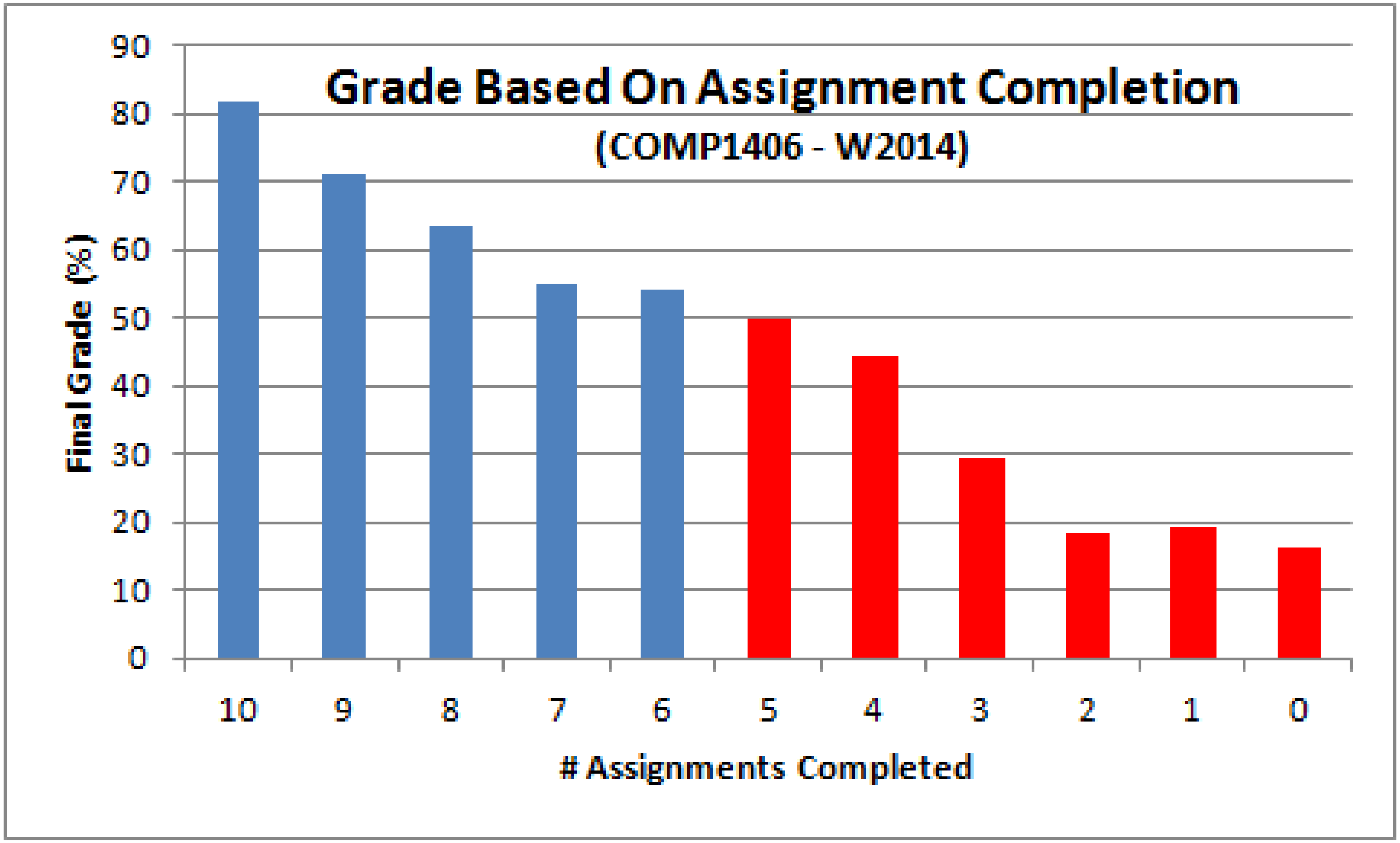
Poll Everywhere

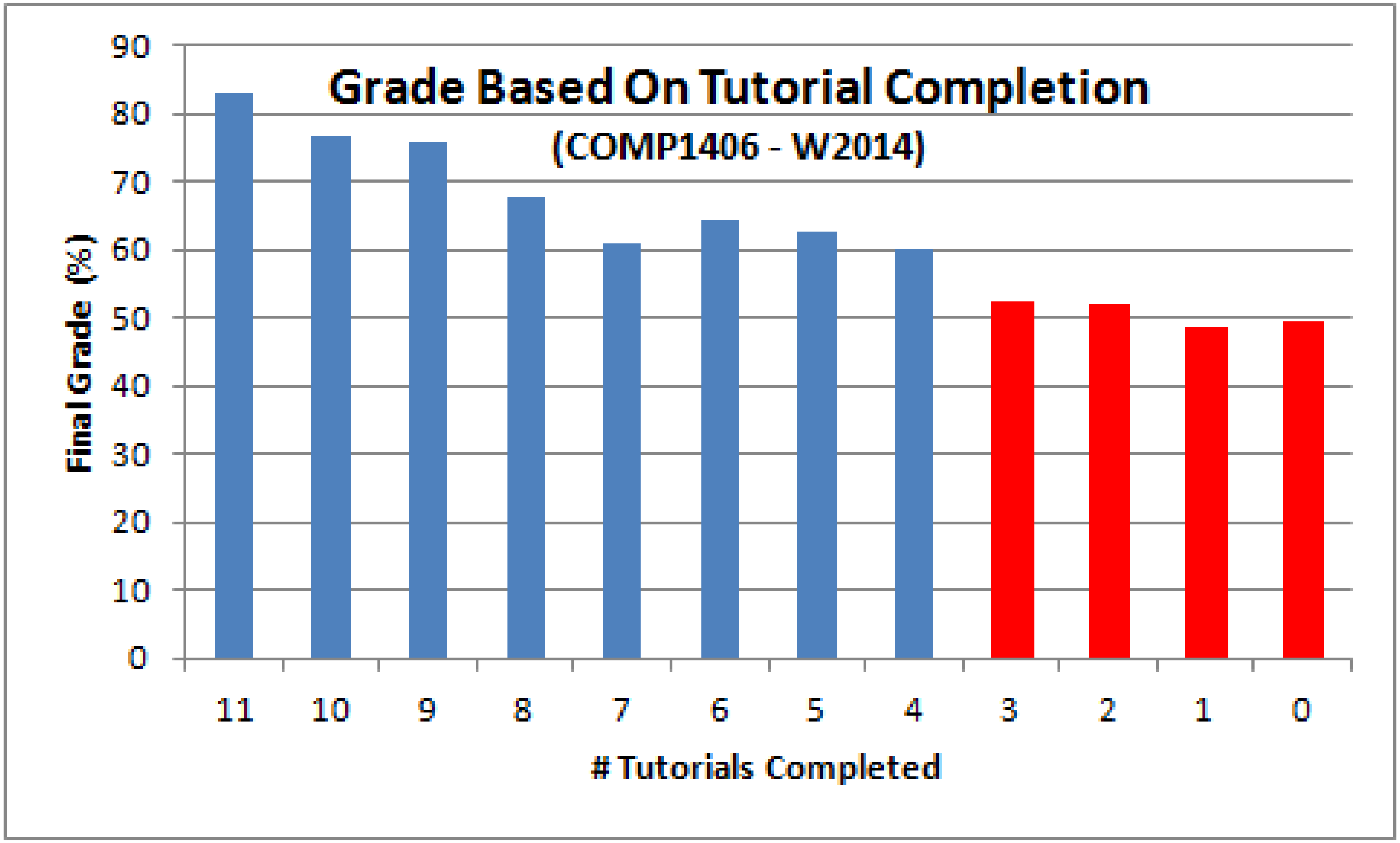
Bring your devices!
(Laptops, tablets, cell phones)

…let's try it now!

Policies

1. Come to class and tutorial.
2. Participate.
3. Do required readings.
4. Submit on time.
5. Take advantage of office hours.
6. Remember that slides are only a teaching prop.


Grade Based On Assignment Completion
(COMP1406 - W2014)
Final Grade (%)
90
80
70
60
50
40
30
20
10
0
10
9
8
7
6
5
4
3
2
1
0
# Assignments Completed


Grade Based On Tutorial Completion
(COMP1406 - W2014)
Final Grade (%)
90
80
70
60
50
40
30
20
10
0
11
10
9
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5
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3
2
1
0
# Tutorials Completed

Introduction to Problem Solving

PROBLEMS

have constraints

...language, platform, performance, memory footprint, open source (or not)…

PROBLEM SOLVING FOR PROGRAMMERS:

writing an original program that performs a particular set of tasks and meets all stated constraints

The Fox, the Goose, and the Corn

A farmer with a fox, goose, and a sack of corn needs to cross the river. The farmer has a rowboat, but there is room for only the farmer and one of his three items. Unfortunately, both the fox and the goose are hungry. The fox cannot be left alone with the goose, or the fox will eat the goose. Likewise, the goose cannot be left alone with the sack of corn, or the goose will eat the corn. How does the farmer get everything across the river?

Strategy: Re-state the Problem in Formal Terms

Constraints:

1. The farmer can take only one item at a time in the boat.
2. The fox and goose cannot be left alone on the same shore.
3. The goose and corn cannot be left alone on the same shore.

Strategy: Re-state the Problem in Formal Terms

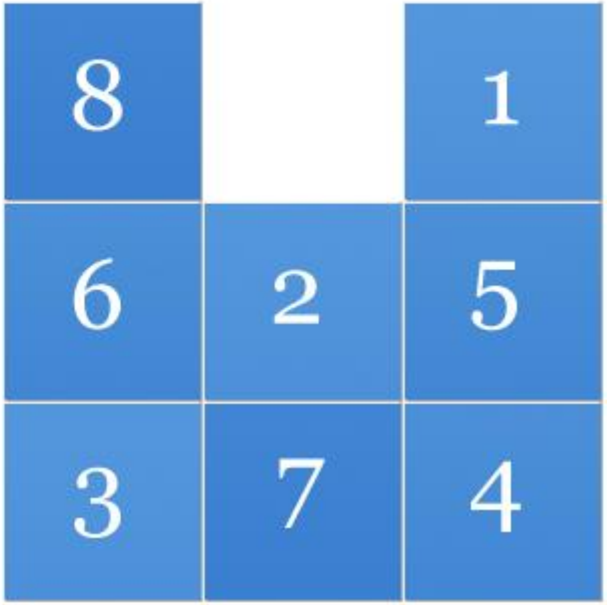
Operations:

1. Row the boat from one shore to the other.
2. If the boat is empty, load an item from the shore.
3. If the boat is not empty, unload the item to the shore.

Strategy: Re-state the Problem in Formal Terms

Get new insights into the problem!

Sliding Tile Puzzles

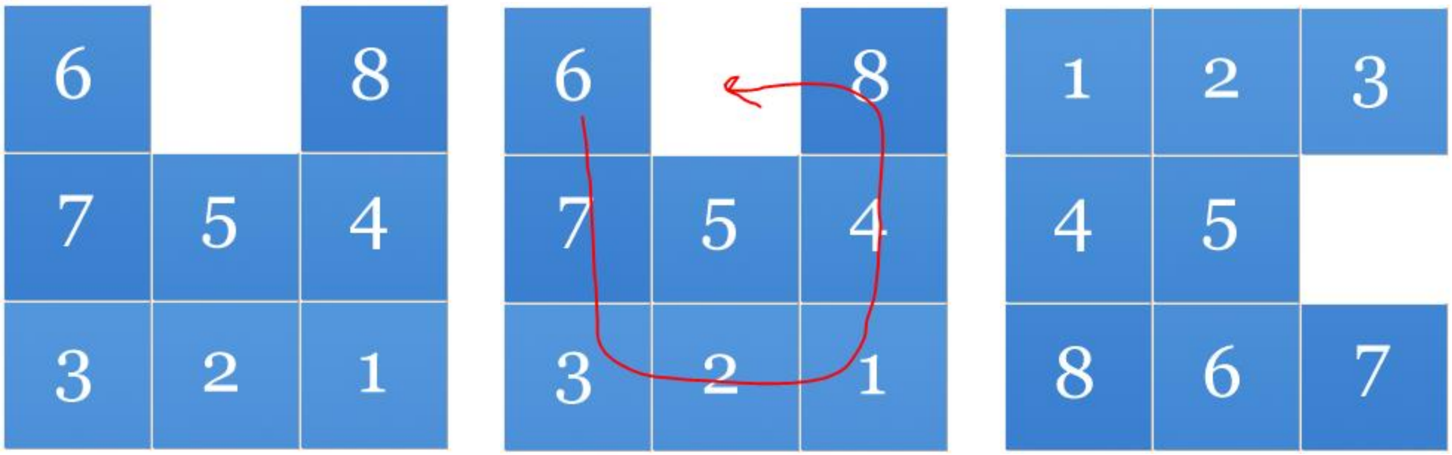


8		1
6	2	5
3	7	4

http://mypuzzle.org/sliding

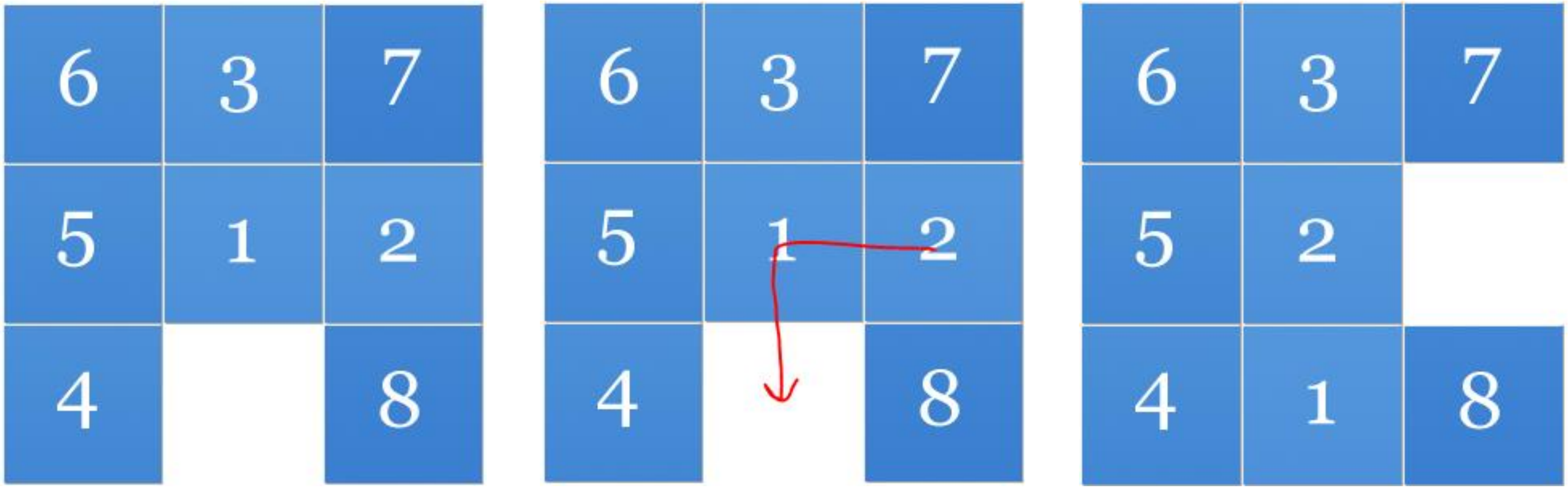
Strategy: Break the Problem Down

Observation: train of tiles can be rotated while preserving order



Strategy: Break the Problem Down

Look for numbers that will be adjacent in the solution



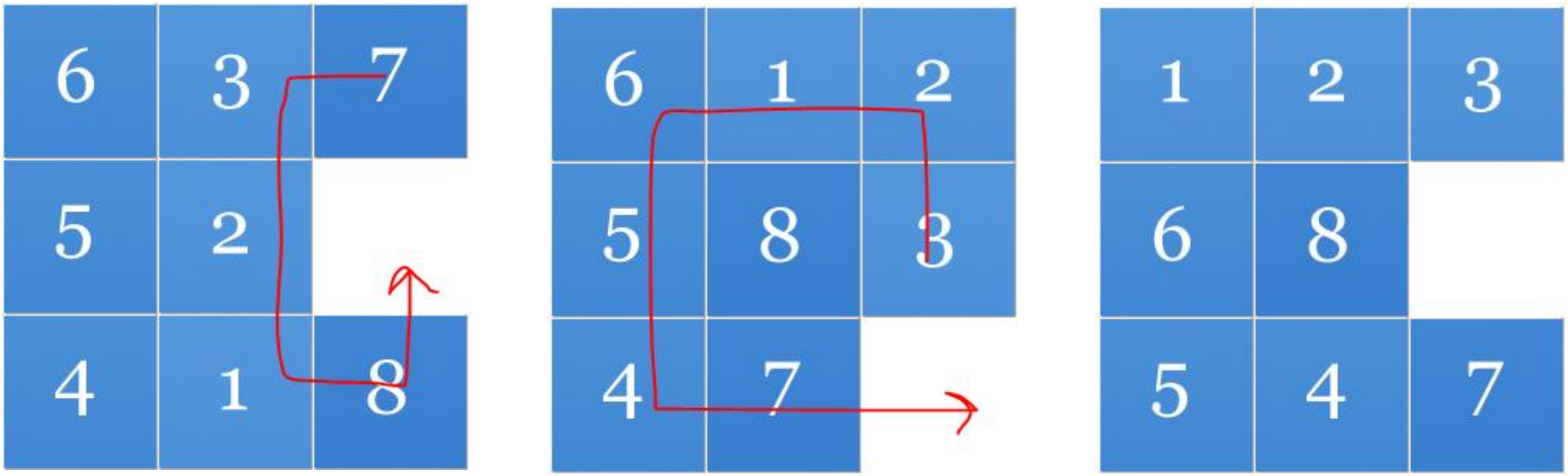
6	3	7
5	1	2
4		8

6	3	7
5	1	2
4		8

6	3	7
5	2	
4	1	8

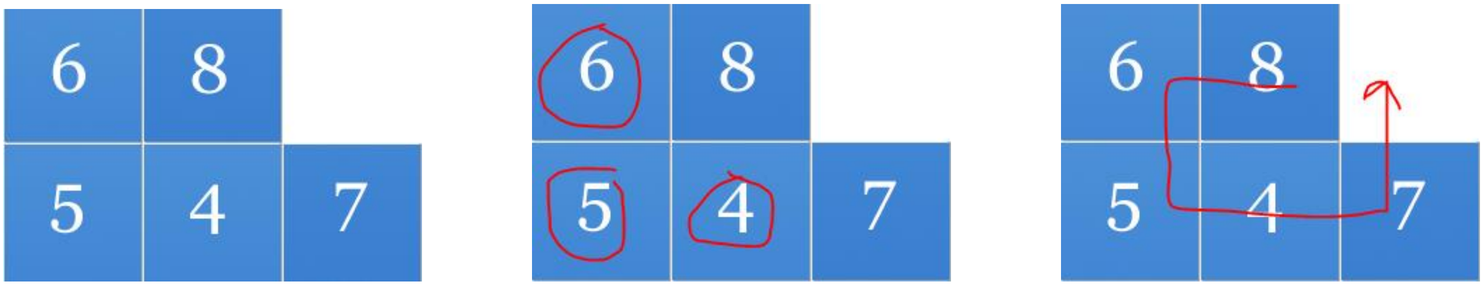
Strategy: Break the Problem Down

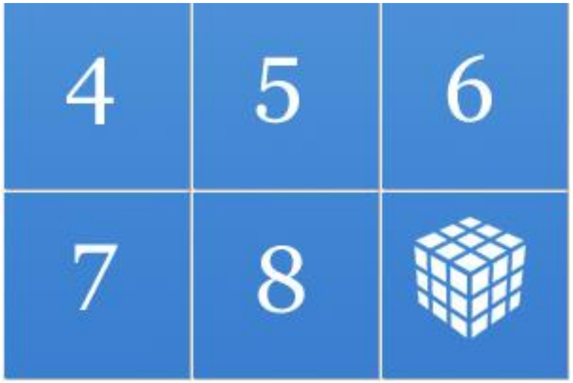
Use trains to move the adjacent tiles to the correct position



Strategy: Break the Problem Down

Now we only have a 2x3 grid to solve

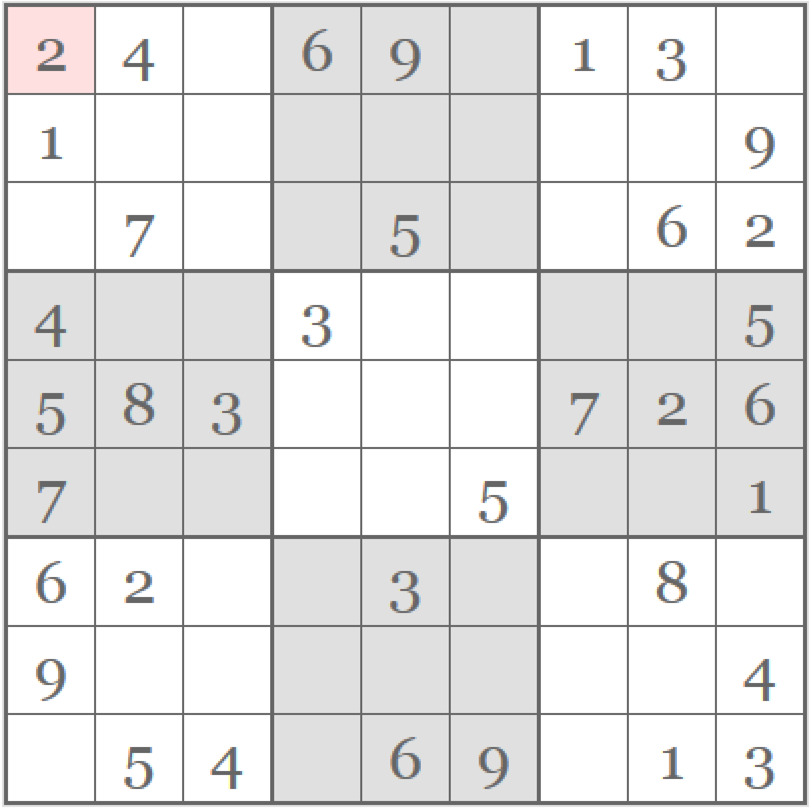




Strategy: Break the Problem Down

Impossible to plan a complete solution from the beginning, but it is possible to come up with systematic strategies!

Sudoku

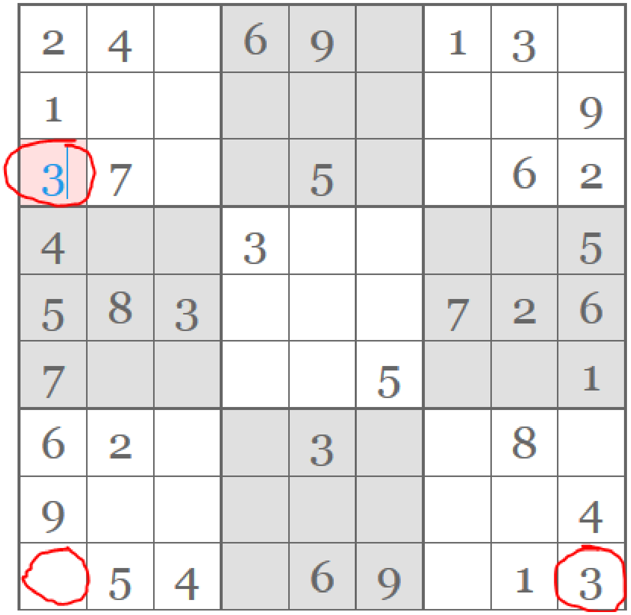


2	4		6	9		1	3	
1								9
	7			5			6	2
4			3					5
5	8	3				7	2	6
7					5			1
6	2			3			8	
9								4
	5	4		6	9		1	3

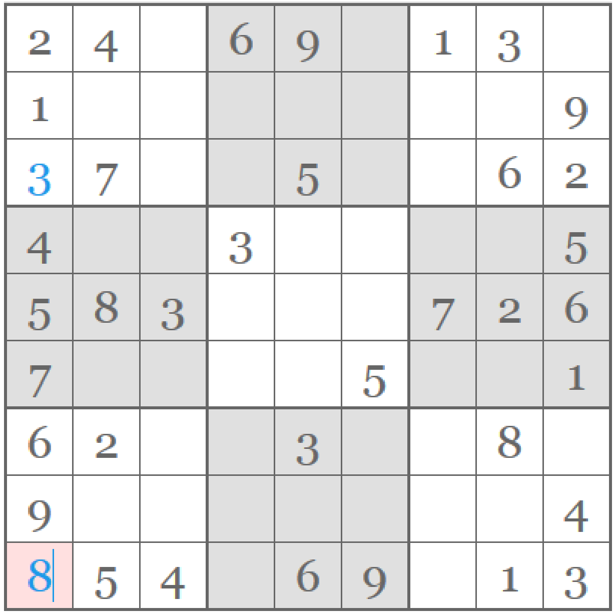
http://mypuzzle.org/sudoku

Strategy: Start with the Most Constrained Parts

Start with the rows that are most filled in, and look for constraints.



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



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

General Problem-Solving Techniques

Always Have a Plan

https://www.flickr.com/photos/ivanavasilj/8435739638/

Aimless wandering wastes time.
Without a plan, you are hoping for a lucky break.
Plans give you intermediate goals.
Plans can change.

Restate the Problem

http://en.wikipedia.org/wiki/Sawtooth_National_Forest

Check out the problem from every angle before starting.
We may find the goal is not what we thought.
Use restatement to confirm understanding.

Divide the Problem

https://www.flickr.com/photos/jecobo/7511559128/

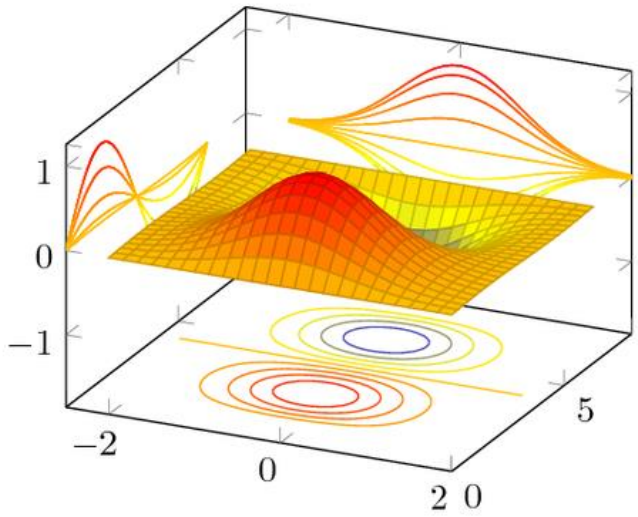
Divide the problem into steps or phases.
Difficulty for each phase can be an order of magnitude lower.
Sometimes the sub-problems are hidden.

Start with What You Know

http://www.mywritingblog.com/2014/07/guest-post-how-to-write-novel-in-just-3.html

Fully investigate a problem with the skills you have first.
Build confidence and momentum towards your goal.
You may learn more about the problem this way.

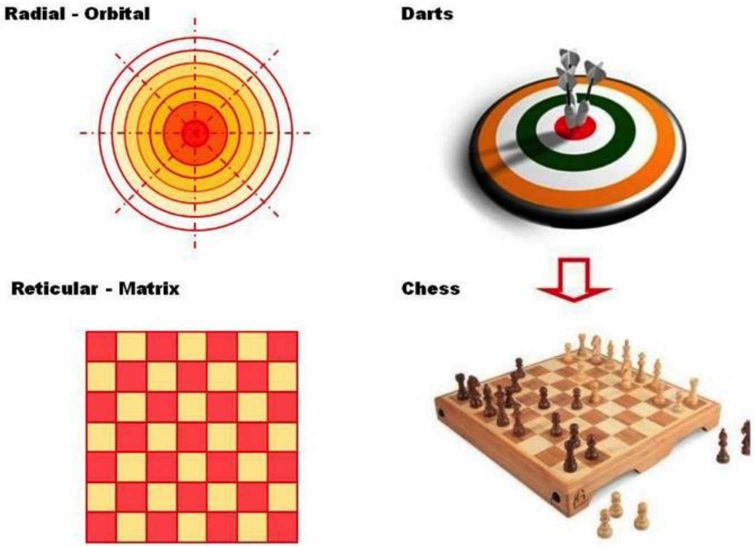
Reduce the Problem



http://pgfplots.net/tikz/examples/contour-and-surface/

Reduce scope by adding or removing constraints.
Work on a simpler problem that isn't easily divided.
Pinpoint where remaining difficulties lie.

Look for Analogies



http://commons.wikimedia.org/wiki/File:Reticular_Matrix_Chessboard_Analogy.jpg

Look for similarities to problems you've already solved.
Recognizing analogies improves speed and skill.
You need to build up a store of prior problems before you can find analogies.

Experiment

https://www.flickr.com/photos/sea-turtle/5146567573/

Try things and observe the results (this is not guessing!).
One form: make small test programs.
Other forms are similar to debugging.

Don't Get Frustrated!

http://en.wikipedia.org/wiki/Frustration

Everything will seem to take longer and be harder!
Avoiding frustration is a decision *you* make.
Go back to the plan, work on a different problem, or take a break.