01-0: Syllabus

- Office Hours
- Course Text
- Prerequisites
- Test Dates & Testing Policies
  - Check dates now!
- Grading Policies

01-1: How to Succeed

- Come to class. Pay attention. Ask questions.

01-2: How to Succeed

- Come to class. Pay attention. Ask questions.
  - A question as vague as “I don’t get it” is perfectly acceptable.
  - If you’re confused, there’s a good chance someone else is confused as well.

01-3: How to Succeed

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- Come by my office
  - I am very available to students.

01-4: How to Succeed

- Come to class. Pay attention. Ask questions.
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  - If you’re confused, there’s a good chance someone else is confused as well.
- Come by my office
  - I am very available to students.
- Start the homework assignments and projects early
  - Projects in this class are significantly harder than CS112

01-5: How to Succeed

- Come to class. Pay attention. Ask questions.
  - A question as vague as “I don’t get it” is perfectly acceptable.
  - If you’re confused, there’s a good chance someone else is confused as well.
- Come by my office
• I am very available to students.
• Start the homework assignments and projects early
  • Projects in this class are significantly harder than CS112
• Read the notes.
  • Ask Questions!

01-6: **Brief Commercial**
• Most interview questions will be based on material for this class
• If you go into software development, you will use this material *Every Day!*

01-7: **What is an algorithm?**
• An algorithm is a step-by-step method for solving a problem.
• Each step must be well defined.
• Algorithm ≠ Computer Program.
• A program is an *implementation* of an algorithm.
• Can have different implementations of the same algorithm
  • Different Languages
  • Different Coding Styles

01-8: **Example: Selection Sort** Algorithm:
• Examine all $n$ elements of a list, and find the smallest element
• Move this element to the front of the list
• Examine the remaining $(n - 1)$ elements, and find the smallest one
• Move this element into the second position in the list
• Examine the remaining $(n - 2)$ elements, and find the smallest one
• Move this element into the third position in the list
• Repeat until the list is sorted

01-9: **Example: Selection Sort** Java Code:
```
for (int i=0; i<A.length - 1; i++) {
    smallest = i;
    for (j=i+1; j<A.length; j++) {
        if (A[j] < A[smallest])
            smallest = j;
    
    tmp = A[i];
    A[i] = A[smallest];
    A[smallest] = tmp;
}
```
01-10: **Problem I: Bridge**
Four people want to cross a bridge

- The bridge can only hold two people at the same time
- Each person requires a different amount of time to cross the bridge (1, 2, 5, and 8 minutes)
- It is pitch black, and they have only 1 flashlight which they need to shuttle back and forth across the bridge

01-11: **Purpose of the Problem**

- Obvious solution is not always optimal
  - “Obviously” want fastest person to shuttle flashlight
- Optimal solution is often not obvious
  - Second-fastest person needs to do some of the shuttling

01-12: **Problem II: 8 Queens**

- Standard 8x8 Chessboard
- Place 8 Queens on this board, so that no Queen attacks another Queen.

- Queens can move horizontally or diagonally any number of squares

01-13: **8-Queens Data Structures**

- Two-dimensional array of characters.
- List of x-y coordinates of each queen.
- Array of integers:
  - Each element in this array represents a column
  - Value stored in element $i$ represents the row in which the queen at column $i$ is located.

01-14: **8-Queens Data Structures**

- Choice of data structure can influence how we solve the problem
  - Two dimensional array of characters: $\binom{64}{8}$ potential solutions (around $10^{14}$)
  - List of 8 x-y coordinates: $64^8$ potential solutions (also around $10^{14}$)
  - Array of rows: $8^8$ potential solutions (around $10^{7}$)
01-15: **9 Coins**

- There are 9 coins. 8 are good, but one is counterfeit. The counterfeit coin is lighter than the other coins.
- You have a balance scale, that can compare the weights of two sets of coins
- Can you determine which coin is counterfeit, using the scale only 2 times?
- If there are 27 coins, one lighter and counterfeit, can you find it using the scale 3 times?

01-16: **9 Coins**

- First, let’s ensure that it’s possible
- There are 9 possible cases: Coin 1 is bad, coin 2 is bad, coin 3 is bad, etc.
- Can we distinguish between 9 different cases using two weighings?

01-17: **9 Coins**

- First, let’s ensure that it’s possible
- There are 9 possible cases: Coin 1 is bad, coin 2 is bad, coin 3 is bad, etc.
- Can we distinguish between 9 different cases using two weighings?

<table>
<thead>
<tr>
<th>First Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>left light</td>
</tr>
<tr>
<td>equal</td>
</tr>
<tr>
<td>right light</td>
</tr>
</tbody>
</table>

9 Different Outcomes

01-18: **9 Coins**

- Weigh Coins 1,2,3 against 4,5,6
- What are the possible outcomes?
- What will they tell us?

01-19: **9 Coins**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>123</td>
<td>456</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bad coin is in**

- \{4, 5, 6\}
- \{7, 8, 9\}
- \{1, 2, 3\}

01-20: **9 Coins**

- We now have a set of 3 coins, we know one of them is bad
• Call these coins A, B, C
• Weigh A against B.
• What are the outcomes?
• What will they tell us?

01-21: 9 Coins

01-22: 9 Coins

• Things to think about
  • How would we extend this to 27 coins?
  • We decided which coins to weigh second, after we had the results of the first weighing. Could we decide which coins to weigh before getting any results, and still solve the problem in 2 weighings?
  • The “classic” version of this problem is 12 coins, 3 weighings, and the counterfeit coin could be either heavy or light. Can you solve that problem? (The classic problem is a little harder ...