Book Number

is one assignment which can be solved
in many ways, with:

- multiply and divide operations
- divide and mod operations
- loops & nests of loops
- strings in many ways
- arrays in more ways
- methods & objects
- recursion
- stacks
- queues
- trees
- more!

A Universal Assignment
Algorithm for the check symbol

**Sum** the first digit and 2 times the second digit, plus 3 times the third digit, to 9 times the ninth digit.

**Divide** this sum by 11, and the remainder is the checkSum.

**Fix** the check symbol to an ‘X’ if the checkSum is 10.
For example:

```
num = 020508005
sum = 2*2 + 4*5 + 6*8 + 9*5
     =  4  + 20  + 48  + 45
     = 117
check = 117 % 11
       = 7
```
Many algorithms for the check symbol

\[
\text{sum} = 1 \cdot d_1 + 2 \cdot d_2 + 3 \cdot d_3 + 4 \cdot d_4 + 5 \cdot d_5 + \\
6 \cdot d_6 + 7 \cdot d_7 + 8 \cdot d_8 + 9 \cdot d_9
\]

\[
\text{check} = (\text{sum mod 11})
\]

Another: 10 down to 2

\[
\text{total} = 10 \cdot d_1 + 9 \cdot d_2 + 8 \cdot d_3 + 7 \cdot d_4 + 6 \cdot d_5 + \\
5 \cdot d_6 + 4 \cdot d_7 + 3 \cdot d_8 + 2 \cdot d_9
\]

\[
\text{check} = (11 - (\text{total mod 11})) \text{ mod 11}
\]
Representation of ISBN data: many ways

1. Many digits (and a character)
   \[0 \ 2 \ 0 \ 5 \ 0 \ 8 \ 0 \ 0 \ 5 \ \boxed{7}\]

2. Integer
   \[0205080057\]

3. Real number?
   \[0.205080057\]

4. String of Characters
   \[0 \ - \ 2 \ 0 \ 5 \ - \ 0 \ 8 \ 0 \ 0 \ 5 \ - \ 7\]

5. Array of digits or characters
   \[d[ ] = \begin{array}{cccccccc}
   0 & 2 & 0 & 5 & 0 & 8 & 0 & 0 & 5 & 7
   \end{array}\]
BookNumber as an Array: Code another way

\[
d = \begin{array}{ccccccccc}
0 & 2 & 0 & 5 & 0 & 8 & 0 & 0 & 5 \\
1 & 2 & 3 & \ldots & i & \ldots & 9
\end{array}
\]

Pass 1: Increment each position

Loop \( i = 9 \) to 1

Inc digit\([i-1]\) by digit\([i]\)

EndLoop \( i \)

\[
d = \begin{array}{ccccccccc}
2 & 2 & 1 & 1 & 1 & 1 & 1 & 5 & 5 \\
1 & 2 & 3 & \ldots & i & \ldots & 9
\end{array}
\]

Pass 2: Accumulate all values; \( 117 \)

Avoids all multiplication
Tree of BookNumber

Sum of internal nodes = 117
Class Diagram of BookNumber:

- **BookNumber**
  - (d1,d2,...,d9)
  - (integer)
  - (string)
  - (array)

Attributes: data, state

- 917930 - publisher
- 65 -.pubNumber
- false - isValid
- 0-91.. - ISBN

Methods:
- void methods
- boolean methods
- typed methods
- setPublisher(s)
- setPubNumber(i)
- getCountry()
- checkSymbol
- isValid()?
- isEnglish?
<table>
<thead>
<tr>
<th>Algorithms:</th>
<th>MANY Data Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Up vs Down (10 to 2)</td>
<td>1. Many, 10, digits</td>
</tr>
<tr>
<td>2. Series (2) of div &amp; mult</td>
<td>2. One integer</td>
</tr>
<tr>
<td>3. Loop &amp; nest of div &amp; mod</td>
<td>3. Two Arrays</td>
</tr>
<tr>
<td>4. Two-Pass Incr &amp; Sum</td>
<td>4. A string</td>
</tr>
<tr>
<td>5. Recursion</td>
<td>5. Stacks</td>
</tr>
<tr>
<td>6. Weird</td>
<td>6. Queue</td>
</tr>
<tr>
<td>7. Weirder: Primitive</td>
<td>7. List</td>
</tr>
<tr>
<td>8. Weirdest: Search!</td>
<td>8. Tree</td>
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<td>...</td>
<td>...</td>
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<tr>
<td>M. More</td>
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<tr>
<td>N. More</td>
<td></td>
</tr>
</tbody>
</table>

An assignment for all seasons (after all concepts)

More slides are at: www.csun.edu/~jmotil/NiftyBookNumber