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
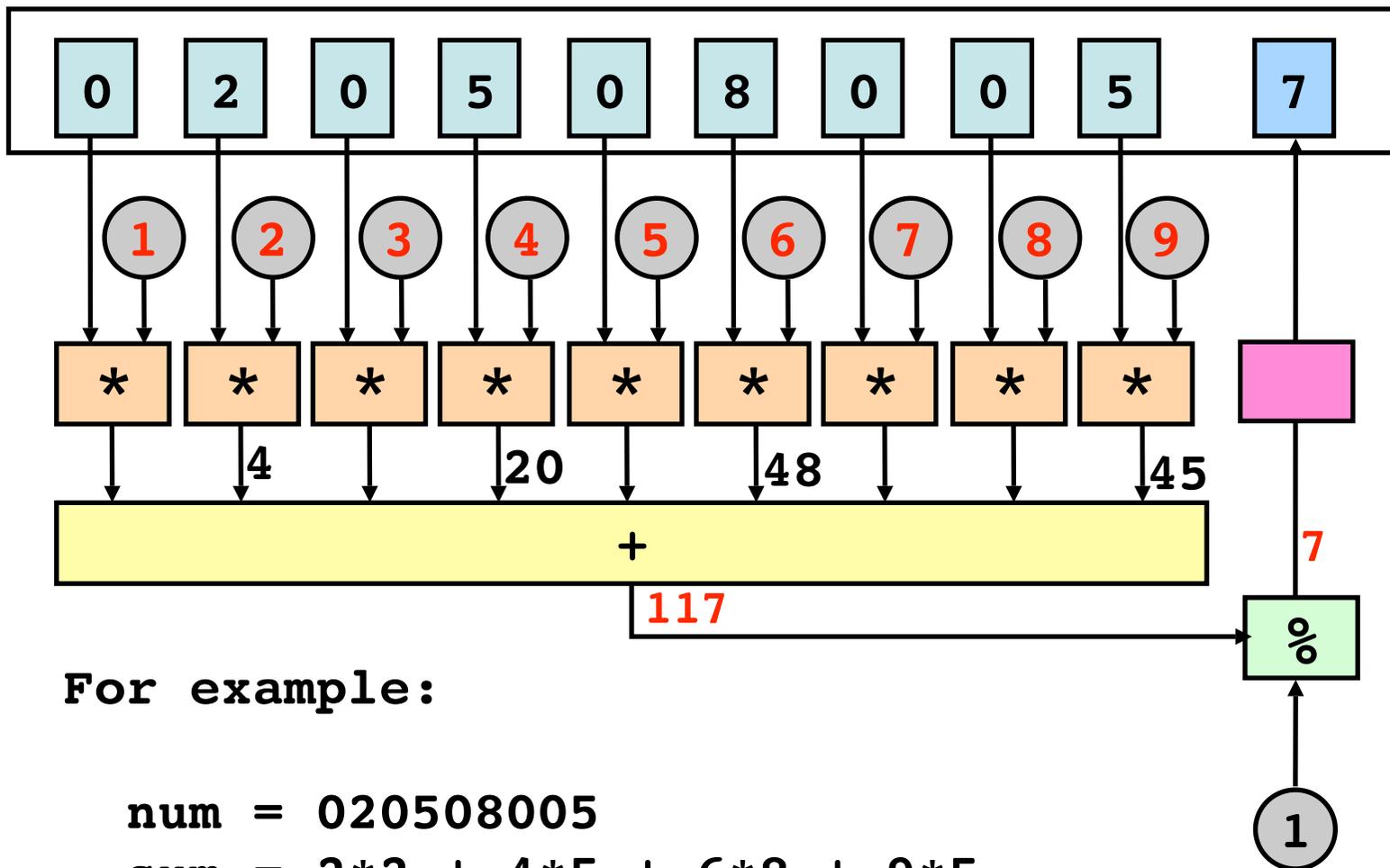recursion
stacks
queues
trees
more!

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.

Data Flow Diagram of the bookNumber Algorithm

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

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

$$\text{check} = (\text{sum mod } 11)$$

Another: 10 down to 2

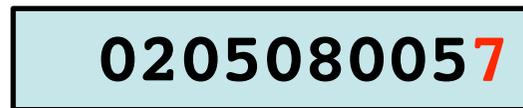$$\text{total} = 10*d_1 + 9*d_2 + 8*d_3 + 7*d_4 + 6*d_5 + 5*d_6 + 4*d_7 + 3*d_8 + 2*d_9$$

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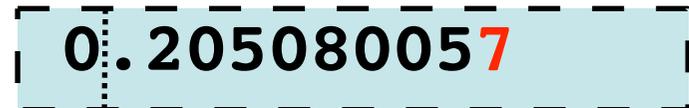
Representation of ISBN data: many ways

1. Many digits (and a character)

0	2	0	5	0	8	0	0	5	7

2. Integer

020508005**7**

3. Real number ?

0.205080057

4. String of Characters

0 – 2 0 5 – 0 8 0 0 5 – **7**
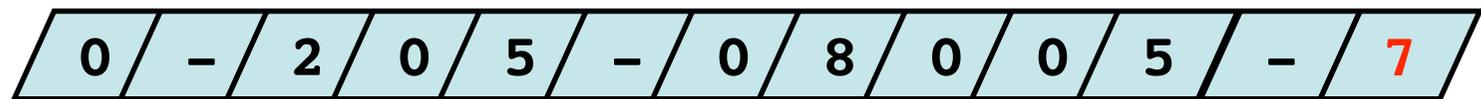
5. Array of digits or characters

$d[] = $

0	2	0	5	0	8	0	0	5	7

BookNumber as an Array: Code another way

d =	0	2	0	5	0	8	0	0	5
	1	2	3	.	.	i	.	.	9
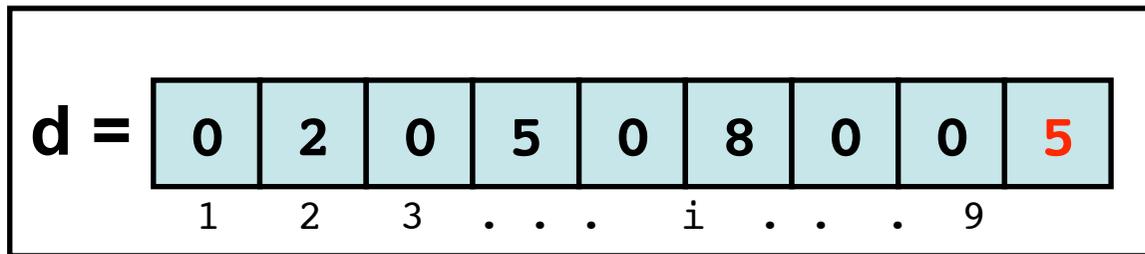
Pass 1: Increment each position

```
Loop i = 9 to 1

    Inc digit[i-1] by digit[i]

EndLoop i
```

d =	2	2	1	1	1	1	5	5	5
	1	2	3	.	.	i	.	.	9
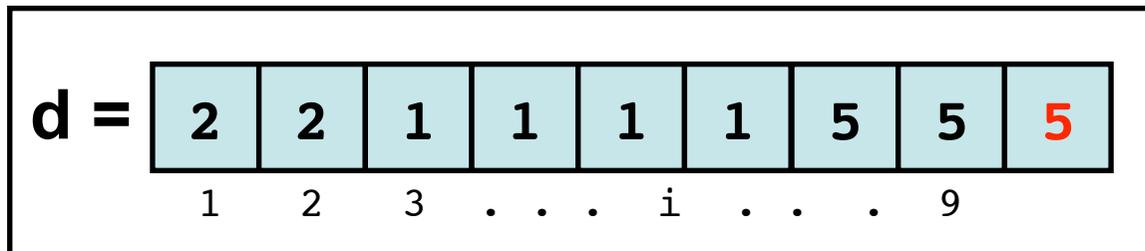
Pass 2: Accumulate all values;   **117**

Avoids all multiplication

Tree of BookNumber

0	2	0	5	0	8	0	0	5

5

5

5

5

13

13

18

18

20

20

5

5

5

13

13

18

18

20

20

\---

Sum of internal nodes = 117
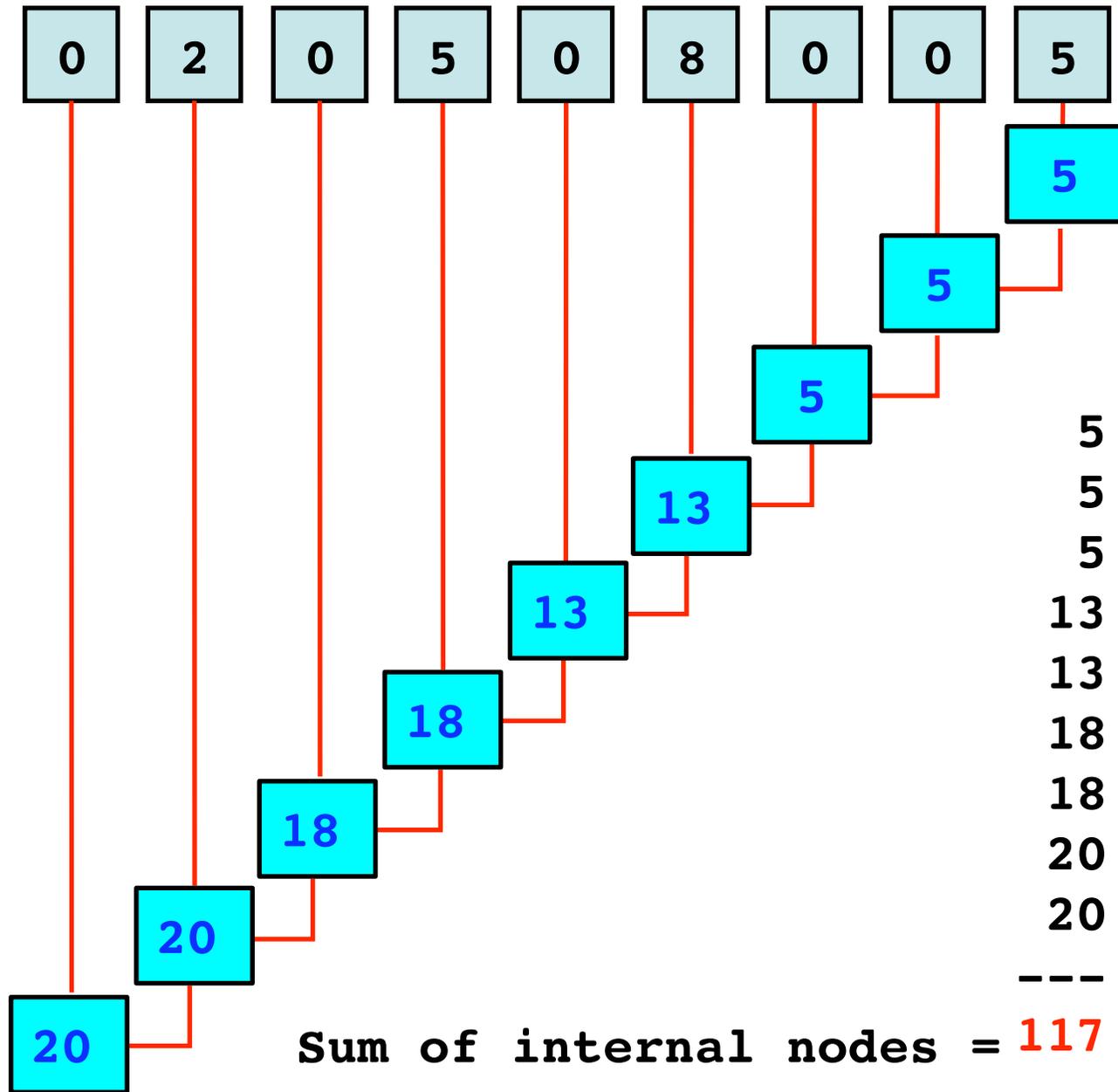
Class Diagram of BookNumber:

BookNumber

CONSTRUCT
```
BookNumber (d1,d2,...,d9)
BookNumber (integer)
BookNumber (string)
BookNumber (array)
```

TRANSFORM

setPublisher(s)

setPubNumber(i)

Attributes: data, state

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

OBSERVE

getCountry()

checkSymbol

void methods

boolean methods

typed methods

isValid() ?

isEnglish ?

COMPARE
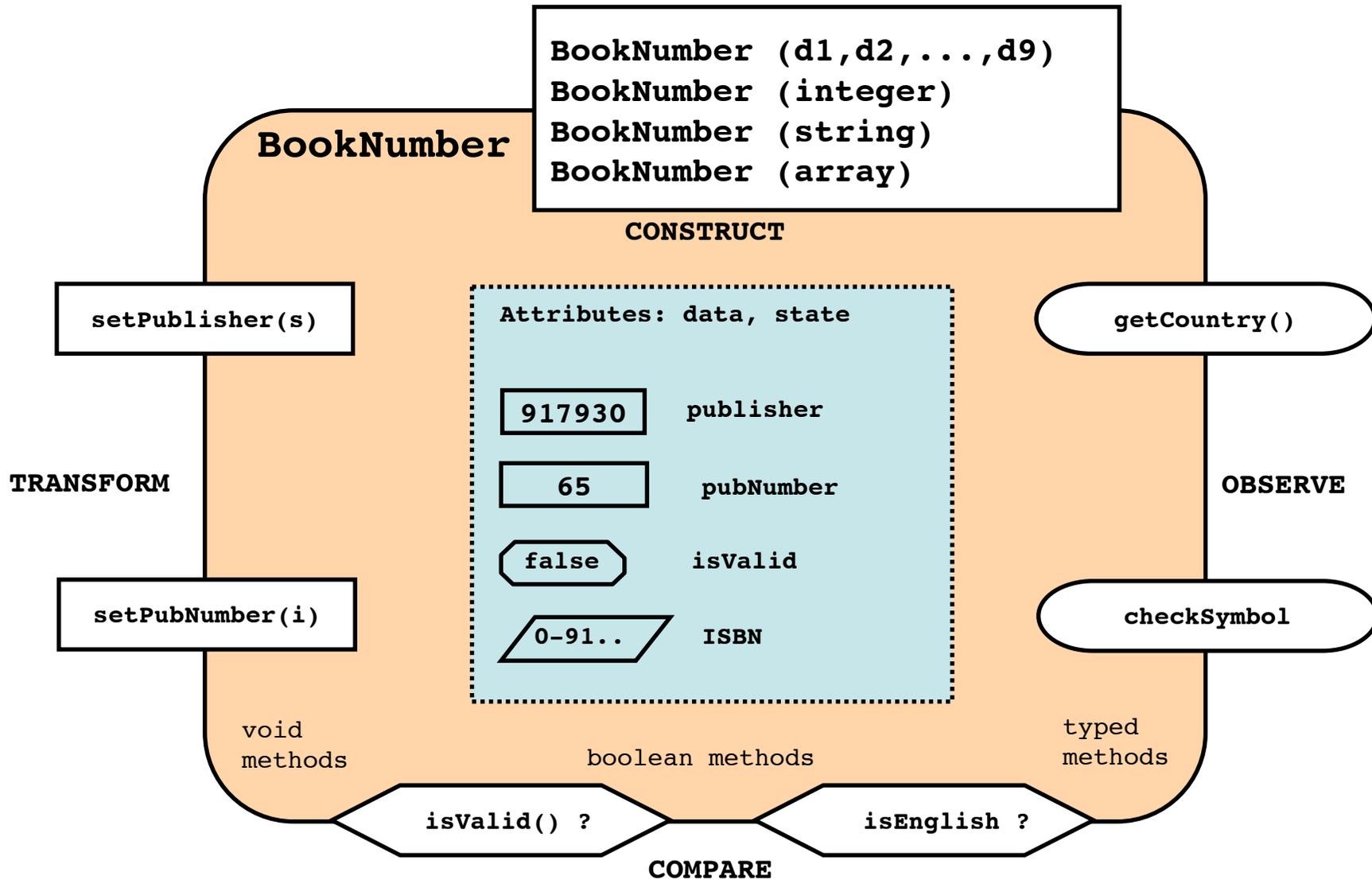
MANY

Algorithms:

1. Up vs Down (10 to 2)
2. Series (2) of div & mult
3. Loop & nest of div & mod
4. Two-Pass Incr & Sum
5. Recursion
6. Weird
7, Weirder: Primitive
8. Weirdest: Search!

. . .

M. More

Data Structures

1. Many, 10, digits
2. One integer
3. Two Arrays
4. A string
5. Stacks
6. Queue
7. List
8. Tree

. . .

N. More

An assignment for all seasons (after all concepts)

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