

Binary Search -- A Fundamental Algorithm

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Binary search is a clever, though common sense way to search an ordered set of items. Tests are made, called *probes*, asking whether the desired item is smaller or larger. If the probe is chosen in the middle of the sequence, 1/2 of the possibilities must be eliminated with any answer. Now the details...

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Reminder ... Algorithm vs Program

- ❖ The process just described on the title slide is the binary search algorithm ... the idea given abstractly
- ❖ A program for binary search -- your goal -- will encode the algorithm for a specific situation, in a specific language, with specific assumptions

Today's Topics: Analyze the binary search algorithm
Review the Day Finder application
Reason through the logic of using
binary search in the Day Finder
context

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Algorithm Analysis

- ❖ Understanding the problem ...
 - + Inputs:
 - + Outputs:
 - + How the inputs are transformed to the outputs:

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Analyzing Properties Of Solution

- ❖ End points ... inclusive
- ❖ Before/after questions ... stay with one form
- ❖ Probing odd-length and even-length intervals (\)
- ❖ New interval's endpoints ... one is kept, one changes
- ❖ Termination ... when is it over?

```
After M? N
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
After G? Y
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
After J? Y
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
After L? N
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
After K? Y
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
The letter is L
```

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Guessing Days In A Sign

- ❖ The “complicating” problem with searching for a birthday in a sign, is that the signs span parts of two months
- ❖ Not to worry ... logically extend the starting month

Day Find

Enter Your Sign, Please

Aries Leo Sagittarius
 Taurus Virgo Capricorn
 Gemini Libra Aquarius
 Cancer Scorpio Pisces

You were born between
June 21 And July 22

Were you born after July 6

Days in June 30
Day in July + 22
Day in exJune 52

June 52

The interval to be searched is 21 through 52

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Transforming Probe To A Date

- ❖ The size of the interval is: $(52 - 21) = 31$
- ❖ The midpoint of the interval is: $31 \div 2 = 15$
- ❖ The probe, low end + midpoint: $21 + 15 = 36$
- ❖ What day is June 36?

Day Find

Enter Your Sign, Please

Aries Leo Sagittarius
 Taurus Virgo Capricorn
 Gemini Libra Aquarius
 Cancer Scorpio Pisces

You were born between
June 21 And July 22

Were you born after July 6

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Guess? What?

- ❖ What information is needed by the Guess procedure?

Day Find

Enter Your Sign, Please

Aries Leo Sagittarius
 Taurus Virgo Capricorn
 Gemini Libra Aquarius
 Cancer Scorpio Pisces

You were born between
June 21 And July 22

Y **N** Were you born after July 6

Guess(_____, _____, _____, _____, _____, _____, _____)

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Using Binary Search In Day Finder

- ❖ Inherit the initial configuration from Zodiac
- ❖ The Guess Procedure asks one probe at a time ...
- ❖ When is Guess called?

Day Find

Enter Your Sign, Please

Aries Leo Sagittarius
 Taurus Virgo Capricorn
 Gemini Libra Aquarius
 Cancer Scorpio Pisces

You were born between
June 21 And July 22

Y **N** Were you born after July 6

OK

Day Find

Enter Your Sign, Please

Aries Leo Sagittarius
 Taurus Virgo Capricorn
 Gemini Libra Aquarius
 Cancer Scorpio Pisces

You were born between
June 21 And July 22

Y **N** Were you born after July 6

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Overall Data Flow ...

- ❖ Where do the initial values come from?
- ❖ How are these values updated?

Guess(_____, _____, _____, _____, _____, _____)