

Binary Search -- A Fundamental Algorithm

FIT 100

Binary search is a clever though common sense way to search an ordered set of items. Queries 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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FIT 100 Reminder ... Algorithm vs Program

- ❖ The process just described on the title slide -- suitably embellished -- 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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FIT 100 Algorithm Analysis

- ❖ Understanding the problem ...
 - + Inputs: The end points, (lo, hi) , of an ordered sequence
 - Answers to a series of questions
 - + Outputs: A selected item
 - + How the inputs are transformed to the outputs: A series of questions is posed of the form "Is the desired item after item x ?" so that the x^{th} item is chosen to be midway in the interval
 - If the reply is *yes*, the new interval (*next after* x, hi)
 - If the reply is *no*, the new interval is (lo, x)
 - The output is the item when the interval contains only a single item

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FIT 100 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?

```

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 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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FIT 100 Guessing Days In A Sign

- ❖ A complication in searching for a birthday in a given sign is that the signs span parts of two months
- ❖ Not to worry ... logically extend the starting month

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

The interval to be searched is 21 through 52

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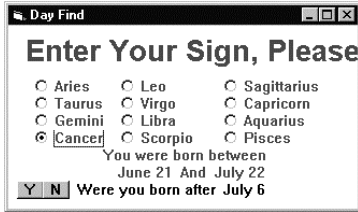
FIT 100 Transforming Probe To A Date

- ❖ 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?

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FIT 100**Guess? What?**

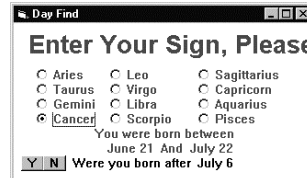
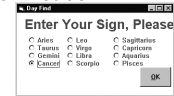
- ❖ What information is needed by the guess procedure?



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FIT 100**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?



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FIT 100**Overall Data Flow ...**

- ❖ Where do the initial values come from?
 - After the Zodiac computation, loEnd and hiEnd can be set
- ❖ When are these values used?
 - In the guess procedure to compute the midPt for the guess
- ❖ How are these values updated?
 - In the yes and no button event handlers
 - In the case of "yes," which end moves?
 - + loEnd = midPt + 1
 - In the case of "no", which end moves?
 - + hiEnd = midPt
 - Why are the two setting not "opposite" one another?
- ❖ When the does the questioning terminate?
 - When the end points are equal

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FIT 100**Structure Of Solution**

```

Declarations
Private Sub optAri
Private Sub optTau
Private Sub optGem
Private Sub optCan
Private Sub optLeo
Private Sub optVir
Private Sub optLib
Private Sub optSco
Private Sub optSag
Private Sub optCap
Private Sub optAqu
Private Sub optPis
Private Sub cmdOK
Private Sub cmd Yes
Private Sub cmd No
Private Sub guess

```

-- additional variable declarations

↑ Inherit from Zodiac

-- initialize, make first guess
-- revise interval, make guess
-- revise interval, make guess
-- formulate guess

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