FIT 100

Topics In Programming

Why Algorithms Matter
Procedures
Collections

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Searching A List: Review

- If there's no order to the list (or the Yellow Pages)...
  - best you can do is start at the beginning: linear search
- Binary search is a simple, common sense way to search through an *ordered* set of items.
  - Questions, often referred to as queries or probes, are asked to *find if the desired item is smaller or larger.*
  - If the question, hereafter called probe, is chosen from the middle of the sequence, ½ the possibilities are eliminated with each answer.
  - It's a bit like 20 questions, but MUCH more specific.

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Binary Search at Work

- Use binary search to locate L in the alphabet

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?

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Another Example of the Algathm at Work

- Use binary search to locate a letter in the alphabet

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? No

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?

FIT 100 Another Example of the Algorithm at Work

- Use binary search to locate a letter in the alphabet

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? No

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? Yes

~~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?

FIT 100 Another Example of the Algorithm at Work

- Use binary search to locate a letter in the alphabet

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? No

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? Yes

~~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? Yes

~~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?

FIT 100 Another Example of the Algorithm at Work

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? No

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? Yes

~~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? Yes

~~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? No

~~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?

FIT 100 Another Example of the Algorithm at Work

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? No

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? Yes

~~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? Yes

~~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? No

~~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? Yes

The Letter is L

How Good is a Particular Algorithm?

- You might think we can't answer this question without programming a computer and trying it.
- Amazingly, it is possible to make very good comparisons between algorithms without programming them!
- Basic idea: estimate the number of "steps" each algorithm needs to solve the problems.
- Computers run at different speeds, but..
  - they are all alike enough that the number of steps they need for a particular algorithm doesn't vary by as much as you might think.
- This gives us an abstract, mathematical way to compare the speed of different algorithms

Algorithm vs. Program

- Remember that an algorithm is an abstraction.
- We can apply it, at least mentally, to a variety of situations, even without a computer
- A program incorporates all the details needed for a computer to perform the algorithm
- A program for binary search will encode the algorithm for a specific situation, in a specific language, with specific assumptions

Battle of the Algorithms

- Binary Search: Each question allows you to throw out half of the unexamined items (throw half of the phone book away each time)
- Linear Search: Each question lets you tear out only one page.

Do The Math for Searching 200 Items

	linear	binary
step 0	200 remaining	200
step 1	199	100
step 2	198	50
step 3 see where it's going?	197	25

FIT 100 Bottom Line

- It can be shown mathematically when a sorted list of N items is to be searched:
- Linear sort needs on average about N/2 steps
- Binary sort needs on average about Log_2N steps
- The bigger N is, the bigger the improvement.
- Project for someone: Calculate and present some numbers based on these formulas (see me).

FIT 100 Trade-Offs

- If we know algorithm A has a better formula than algorithm B:

Would we ever still want to use algorithm B??

FIT 100 Procedures: Review

- Procedures (also known as ___, ___, ___ etc.) are sets of statements that accomplish some purpose.
- Procedures "encapsulate functionality" (package together useful operations, algorithms) so that they can be used anytime needed.
- For example, you only write the cmdOK-Click function once, but it executes many times – each time there is a click on that button.

FIT 100 Procedure Terminology

```
Private Sub txtScoops_KeyPress (KeyAscii as Integer)
    lblScoops.Caption = txtScoops.text & " scoops, please."
    tstScoops.text = ""
End Sub
```

Procedures have the following features:

- Name: term used to refer to the task the procedure performs,
- Definition: The steps that will accomplish the task. Also known as the *procedure body*
- Parameters: the names of the data sent to or from the procedure
- Declaration: the entire package of the name, definition and parameters

FIT 100 Calling A Procedure

- The procedure declaration only specifies how the procedure works and only needs to be given once
- A procedure call causes the procedure to execute.
- A procedure call can be used anywhere that the task to be performed is needed

Example: The system "calls" cmdOK_Click automatically

Surprise: you could call that event handler yourself if you wanted to

Why might you want to?

How would you do it?

FIT 100 Procedural Abstraction

- Whenever the same operations are performed in different places in a program, there is an opportunity for "procedural abstraction": wrapping the operations into a procedure.

```
Private Sub anynamelchoose( )
    ' any statements I want
    ' as many as I want
End Sub
```

- You can then call the function from different parts of the program.

FIT 100 Mini-Exercise #1

- What is the value of x after the form has been loaded?

```
Option Explicit
Dim x As Integer

Private Sub squid()
   x=x+2
End Sub

Private Sub Form_Load
   x=0
   Call squid
End Sub
```


FIT 100 Mini-Exercise #2

- What is the value of y after the form has been loaded?

```
Option Explicit
Dim y As Integer

Private Sub squid()
   y=y+2
End Sub

Private Sub clam()
   call squid
   call squid
End Sub

Private Sub Form_Load
   y=0
   Call squid
   Call clam
End Sub
```

Collections: Review

- Let's make an appointment book.
- Declare it.
- Give it some initial dates.
- Display all the dates.
- Display a particular date.
- Add a date and display again

Creating and Showing The Collection

Showing One Date on Request

Displaying the Dates: Problem One

- I want to display in more than one place on the form

Displaying the Dates: Problem two

- If you add or delete a date while the program runs – how do you display the whole, changed, collection??

Mid: A String Function

- From VB textbook, p. 81:
- *Mid(x, s, n)* Returns the middle *n* characters of string *x* starting at character number *s*

Make a Prediction

What is returned by this?
Mid("Gong Xi Fa Cai", 2, 4)

Test your prediction on the computer!

Getting Each Character From A String

```
Dim count as Integer
Dim i as Integer
For i = 0 to count
   Msgbox (Mid("Gong Xi Fa Cai", 2, 4))
next i
```