How can computation... find what you are looking for?

How to Make List with 100 Random Numbers?
Script: Create Valuable Numbers
- Puts result in List: Valuable Numbers
  - Contains 100 elements
  - Each element: Integer between 1 and 1000

How to plot contents of List?
Same approach as drawing function for y
Just grab next value of y from list instead
How many items can you put in a list? How do you find the number of items in a list? What is the difference:

What is the difference: 

For the given list, what would this code do?

"Search" has many meanings

- Look up "name" in phonebook (get number)
- Find "credit-worthy" consumers in database
- Find web pages relevant to "computer music"
- Identify suspicious cell phone conversations originating in Country X
- Find the meaning of life

- Today: Very straight-forward
  - Find specified KEY in a LIST
  - Find maximum element in a LIST

Search Demo

Search Demo

How can you find value in list?

What does it mean to "find" value? (e.g. 93?)

Know "index" (or location) of value in list
(index = 9)

What algorithm would you use?

- Look at each item of list
  - Is this value looking for? Yes?
  - Danal No?
  - Look at next element
- Repeat for all elements of list
- If reach end and don’t find?
  - Item not in list

Robust to length of List

- Should work for list of any length
- Not just 100 elements
How to implement search?

- Look at each item of list
  - Is this value looking for?
    - Yes, done!
    - No, look at next element
- Repeat for all in list
- If reach end and don’t find?
  - Item not in list
- Robust to any length

Variables?

- List of Valuable Numbers (input)
- Key: Value searching for (input)
- Key Index: Answer (output)
- Index: Loop through List; tracks current location

- Look at each item of list
- Is this value looking for?
  - Yes, done!
  - No, look at next element
- Repeat for all in list
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  - Item not in list
- Robust to any length

How to display matching Name?

Have corresponding Names list

Use Key Index to “index” into Name list

Take care to use broadcast and wait
  - (and not just broadcast)
  - Find Key script must finish to guarantee it has set value of “Key Index” variable

How do we know if Key not found?
  - Key index is 0!

How can you find Max value in list?

How is this different than finding specified key?
  - Don’t know max value before start

How do you know found maximum?
  - Greater than (or equal to) all others in list

Approach to finding maximum?
  - Remember the largest seen so far
  - If current key > current max, remember current key as new max
Similar Code Structure

Find Key
Loop through List using “index” which starts at 1, increments by 1, thru length
Key Index or Max Index set to index where element is located

Differences?
Find Max: Uses Max to record current max (initialize to 0…)
Find Max: Must look through every element of list (don’t stop early)

Find Max

Similarities?

Demo “Find Max”

The winning name is qlyf!

Linear Search
Summary: Examine all of the elements of list looking for a match; examine elements in order

Inefficient algorithm; why?

Efficiency (performance) really matters when millions or billions of elements!

How efficient is an algorithm?
Option 1: Could run and measure how it takes
• Disadvantage: Depends on hardware
• Disadvantage: Don’t know efficiency on different lists

Option 2: Can analyze code
• Count number of operations performed
• Advantage: Understand how behavior depends upon size of input
• Use N for number of elements in input (List)
How many operations to find max?

- Count number of Scratch blocks
  - Which blocks to count?
  - Exclude reading variables

- How many blocks?
  - How many before loop?
    - 3 blocks to start up
  - How many in loop?
    - Assume worst-case (take if = true)
      - Approx 6...
  - How many times is loop executed????
    - $N$

Total: $3 + 7 \times N$ blocks
- $O(N)$ blocks
- # times loop executed, not # blocks in loop

Linear Search

Check-Up

- What assumption does script make?
  - Values in list > 0

- How to implement "Find Min"?
  - What to set Min to?
  - Item 1 of Valuable Numbers

Challenge Check-Up

- What does this script do?

  - Output:
    - List: Valuable Numbers (100 elements)
    - List: Names
      - 100 elements, each element is a 5 letter random string

Announcements

- Today’s Topic: How to search (find value in List)
  - Basic approach: Loop thru list using index variable, inc index by 1 til end
  - How many ops to find element in List: $O(N)$ with Linear Search

- Announcements
  - Exam 1 returned (Ave 90)
  - Homework 5: Due Friday at 5pm
    - Compose Random Music (Save values to replay song in list!)
    - Visualization