Algorithm Discovery

Topics:

Iterative Operations
Algorithmic Problem Solving

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22.11.2007

Warm-Up

Multiplication of two integers N and M via addition

- **Example 1:** `N=3` and `M=4`

N	M	result
3	4	0
3	3	3
3	2	6
3	1	9
3	0	12

- **Algorithm:**

```
get N, M
set result to 0
while (M>0) {
   set result to result + N
   set M to M - 1
}
print result
```

Lists: Sequential Search

Problem: Find the phone number of a given Name in an (unsorted) list of names and their phone numbers

Names	**Phone numbers**
N1	T1
N2	T2
...	...
N1000	T1000

Sequential Search: First Attempt

Problem: Find the phone number of a given Name in an (unsorted) list of names and their phone numbers

```
get values for Name, N1, ...,N1000, T1, ...,T1000
if Name = N1 then print the value of T1
endif
if Name = N2 then print the value of T2
endif
...
if Name = N999 then print the value of T999
endif
if Name = N1000 then print the value of T1000
endif
```

Sequential Search: Using a Loop

Problem: Find the phone number of a given Name in an (unsorted) list of names and their phone numbers

```
get values for Name, N1, ...,N1000, T1, ...,T1000
set i to 1
set Found to NO
while (found = No or i<=1000)
{
    if (Name = Ni) then
       print the value of Ti
       set Found to YES
    else
       set i to i+1
    endif
}
if Found = NO then
 print ‘‘sorry, name is not in directory’’
endif
```

Lists: Find The Largest Number

- **Problem:** Given a list of values A1, . . . , An, find the largest value and its (first) location
- **Example:**

	A1	A2	A3	A4	A5	A6	A7
Value	5	2	8	4	8	6	4

  The largest is 8 at location 3
- **Idea:** Go through the entire list, at each iteration find the largest-so-far and record its location

Lists: Find The Largest Number

		i					
		↓					
	A1	A2	A3	A4	A5	A6	A7
Value	5	2	8	4	8	6	4

To begin with,

set largest-so-far to the value of A1

set location to 1

set i to 2

Lists: Find The Largest Number

			i ↓				
	A1	A2	A3	A4	A5	A6	A7
Value	5	2	8	4	8	6	4

Compare A1 and A2

largest-so-far still holds the value A1

set i to i+1

Lists: Find The Largest Number

				i ↓			
	A1	A2	A3	A4	A5	A6	A7
Value	5	2	8	4	8	6	4

Compare A1 and A3

largest-so-far now holds the value A3

location is 3

set i to i+1

Lists: Find The Largest Number

i

↓

	A1	A2	A3	A4	A5	A6	A7
Value	5	2	8	4	8	6	4

Continue the similar process until i=8

Lists: Find The Largest Number

```
get n
get A1, A2, ..., An
set largest-so-far to A1
set location to 1
set i to 2
while (i =< n)
{
      if Ai > largest-so-far then
         set largest-so-far to Ai
         set location to i
      endif
      set i to i + 1
}
print largest-so-far
print location
```