

I. Time Complexity or Computational Time

A. Complexity + 1 to determine how complex

1. For example, the complexity from 10 to 100 is 11 times
2. Capital Sigma means the sum of
 - a) Formula to see how much a list of numbers adds up to -
$$n = x(x+1)/2$$
3. You can have constant complexity
 - a) $O(n)$
 - (1) Linear Complexity
 - b) $O(n^2)$
 - (1) Quadratic time

B. Computational Time

1. Measures the rate the time an algorithm takes to complete a process relative to the complexity of the input set
 - a) Adding and multiplying by constants won't do anything to computational time

C. Factorial

1. Factorial is the product of the natural numbers less than or equal to the given numbers
2. Symbol is !

D. Should Know

1. Constant
 - a) Fastest
2. Log
3. Roots
 - a) Particularly square roots
4. Linear
5. Lin-log
6. Polynomial
 - a) Order 2 is quadratic
7. Exponential
8. Factorial
 - a) Slowest

II. Searches

A. Linear or Series Search

1. Least amount of prep-work
 - a) Examines one element at a time, one after another
 - (1) $O(n)$
 - (a) Linear Time

B. BinarySearch

1. Order the data set
2. Halve the data set and examine which half to keep
3. Halve the "keeper" set and examine which "new" half to keep.

4. Repeat till complete
 - a) $O(\log n)$
 - (1) Steps 2 through 4

C. HashTable

1. A data structure which stores data in an associative manner.
 - a) Data is stored in an array format, where each data value has its own unique index value.
 - (1) Data is stored in an indexed list with a Hashing function to associate a data point and an index data may then be called by index rather than dealing with the full data entry.
 - (a) Average time is constant
 - (b) Hashing function is a rule
 - (i) Any type of function is a rule
 - (c) Run in linear time
 - (i) $O(n)$
 - (a) % means "mod"
 - (i) Use is defined in other note sheet
 - (b) Basic function in all of these is finding a data point
 - (i) Asking a data set, "Do you contain x" and it will say yes or no - applies to all searches

III. Search Algorithm Videos

A. Search in constant time

1. What is a hash
2. How does it work
 - a) Put new piece of data in hash function
 - (1) Takes input and does mathematical operation to them, and positions them in the table
 - b) Attempting to search
 - (1) Instead of searching through the array, you tell the hash function, "Where is the position (data)"
 - (a) The hash table would show the position
 - (2) An empty slot in a hash table is just as important as an input
 - (a) An empty slot is something
 - (i) Hash Collision is when hash functions points a new item to a position that is already occupied
 - (a) You need to define a new set of logic to reposition the new item
3. What is it for

a) Empty hash table initialized to known size

Examples for Computational Time -

A pizza making robot builds the following pizzas with the stated number of steps

Cheese - 12

1 topping - 16

2 toppings - 20

3 toppings - 24

Find the time complexity.

Linear

A computer program finds the locations of the local maximums and minimums of a polynomial. The higher the order of the polynomial the greater the possibility of more local extremes.

Order 1 - 3 steps 3,5,8,9

Order 2 - 6 steps

Order 3 - 11 steps

Order 4 - 19 steps

Order 5 - 28 steps

Find the time complexity.

Quadratic.

The fair has a jelly bean jar guessing contest every year. Every year, the jar gets bigger and bigger. Below are the total number of steps Jimmy used in his winning algorithm each year.

4 steps - 1996

4 Steps - 1997

4 Steps - 1998

5 Steps - 1999

4 steps - 2000

Find incremental change.

For the first one, each thing changes positive 4. Therefore it is linear. Constant change = Linear. No change = Constant.

For the second one they change at 3,5,8, and 9. Therefore it is quadratic.

For the third one, they change at an average is zero. Therefore, it is constant.

If there is little variation, then it is constant.