

Discussion 4: Algorithmic Complexity + Programming Paradigms

Algorithmic Complexity: Definitions

1. What is runtime? How do we measure it?

2. If a function runs in $O(n)$ time, that means it runs...

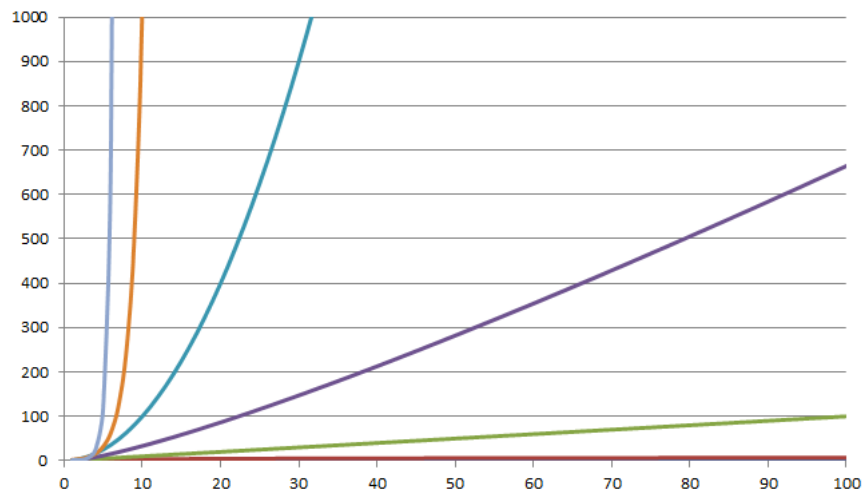
O in linear time at worst O in linear time on average O in linear time at best

Understanding Runtimes

1. Fill in the following chart:

| Runtime | Notation | As input size increases by... | The number of steps change by... |
|----------------------|----------|-------------------------------|----------------------------------|
| Constant | | +1 | |
| Logarithmic | | x2 | |
| Linear | | +1 | |
| Quadratic | | x2 | |
| Exponential (base B) | | +1 | |

2. In the following diagram, label each of lines. Which is the best runtime? The worst?



Runtime: Practice

1. Find the runtime of the following blocks or descriptions of blocks:

a.

```

+ add + x + and + y +
report x + y
    
```

b.

```

+ average + list +
script variables sum
for each item of list
change sum by item
report sum / length of list
    
```

c.

```

+sort+ list : +
script variables sorted list min min_index <<
set sorted list to list
repeat until length of list = 0
  set min_index to 1
  set min to item 1 of list
  for i = 1 to length of list
    if item i of list < min
      set min to item i of list
      set min_index to i
  add item min_index of list to sorted list
  delete min_index of list
report sorted list
  
```

d. This block takes in a value and a list and searches through every item in the list one by one to see if it can find that value.

e. This block takes in a value and a sorted list and searches for the value in the sorted list. Every iteration of the algorithm, it figures out which half of the list the value would be in, and then only searches in that half of the list.

Programming Paradigms

1. Write down the programming paradigm that **best** fits the following descriptions:

- One sprite tells a second sprite to run some code. The second sprite does it.
- You input a global list into a block. It reports a new list with different values, without modifying the input list.
- You give a program a condition as an input and it uses this condition to remove numbers from a list. You input a list and it removes items.
- You have a global variable set to a secret word. You change the secret word every time you ask a player for a new secret word.

2. Match each of the following scripts to a programming paradigm:

| | | |
|---|--|--|
| | <p><i>Assume sum is a global variable in the second script</i></p> | |
| <pre> +Scaled+Sum+of+ List : + script variables sum set sum to 0 for i = 1 to length of List for j = 1 to length of List change sum by item j of List report sum </pre> | <pre> +Scaled+Sum+of+ List : + set sum to 0 for i = 1 to length of List for j = 1 to length of List change sum by item j of List report sum </pre> | <pre> when clicked create a clone of myself when I start as a clone script variables sum set sum to 0 for i = 1 to length of List for j = 1 to length of List change sum by item j of List report sum </pre> |

Challenge

1. What does the following block do? What is its runtime?



2. If myList is a list of n words, each of length n, what is the runtime of the following block?

