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## THEORETICAL ANALYSIS

* Step 1: Input Size

The input for each analysis is an array length of n.

* Step 2: Basic Operation for (1)

### Basic operation is the comparison marked as (1)

#### Analyze B(n)

* Step 3: Count

(1) is executed exactly n times regardless of the input.

* Step 4: Closed-Form

* Step 5: Asymptotic Notation

#### Analyze W(n)

* Step 3: Count

(1) is executed exactly n times regardless of the input.

* Step 4: Closed-Form
* Step 5: Asymptotic Notation

#### Analyze A(n)

* Step 3: Count

(1) is executed exactly n times regardless of the input.

* Step 4: Closed-Form
* Step 5: Asymptotic Notation
* Step 2: Basic Operation for (2)

### Basic operations are the three assignments marked as (2)

#### Analyze B(n)

* Step 3: Count

#### Analyze W(n)

* Step 3: Count

#### Analyze A(n)

* Step 3: Count
* Step 2: Basic Operation for (3)

### Basic operation is two assignments marked as (3)

#### Analyze B(n)

When the input array is full of 0’s, assignments marked as (3) are never executed:

#### Analyze W(n)

When the input array is full of 2’s:

#### Analyze A(n)

* Step 2: Basic Operation for (4)

### Basic operations are the two loop incrementations marked as (4)

#### Analyze B(n)

#### Analyze W(n)

#### Analyze A(n)

* Step 2: Basic Operation for (5)

### Basic operation is the assignment marked as (5)

#### Analyze B(n)

* Step 3: Count

When the input array does not contain any 0, (5) is never executed.

* Step 4: Closed-Form
* Step 5: Asymptotic Notation

#### Analyze W(n)

* Step 3: Count

When the input array is full of 0’s:

* Step 4: Closed-Form
* Step 5: Asymptotic Notation

#### Analyze A(n)

* Step 3: Count
* Step 4: Closed-Form
* Step 5: Asymptotic Notation

## IDENTIFICATION OF BASIC OPERATION(S)

*Here, state clearly which operation(s) in the algorithm must be the basic operation(s). Also, you should provide a simple explanation about why you have decided on the basic operation you choose. (1-3 sentences)*

Three assignments in (2) are basic operations. Because at least one of these operations always contributes to an algorithm's total running time. Also, second assignment in (2) is typically the most time-consuming operation in the algorithm’s innermost loop by being inside of 3 for loops and 1 while loop.

## REAL EXECUTION

### Best Case

|  |  |
| --- | --- |
| N Size | Time Elapsed |
| 1 | 0.00000476837158203125 |
| 5 | 0.000010967254638671875 |
| 10 | 0.00003814697265625 |
| 25 | 0.0002429485321044922 |
| 50 | 0.0011188983917236328 |
| 75 | 0.002679109573364258 |
| 100 | 0.004364013671875 |
| 150 | 0.011707067489624023 |
| 200 | 0.02629995346069336 |
| 250 | 0.036992788314819336 |

### Worst Case

|  |  |
| --- | --- |
| N Size | Time Elapsed |
| 1 | 0.0000011920928955078125 |
| 5 | 0.000041961669921875 |
| 10 | 0.00040078163146972656 |
| 25 | 0.013779878616333008 |
| 50 | 0.18341803550720215 |
| 75 | 0.9667437076568604 |
| 100 | 2.958270788192749 |
| 150 | 15.30362319946289 |
| 200 | 48.0098979473114 |
| 250 | 121.85824203491211 |

### Average Case

|  |  |
| --- | --- |
| N Size | Time Elapsed |
| 1 | 0.000002384185791015625 |
| 5 | 0.00003377596537272135 |
| 10 | 0.00031336148579915363 |
| 25 | 0.008852005004882812 |
| 50 | 0.09887814521789551 |
| 75 | 0.4282924334208171 |
| 100 | 1.199751853942871 |
| 150 | 6.5252476533253985 |
| 200 | 19.19698127110799 |
| 250 | 41.276151180267334 |

## COMPARISON

### Best Case

#### Graph of the real execution time of the algorithm

#### Graph of the theoretical analysis when basic operation is the operation marked as (1)

#### Graph of the theoretical analysis when basic operation is the operation marked as (2)

#### Graph of the theoretical analysis when basic operation is the operation marked as (3)

#### Graph of the theoretical analysis when basic operation is the operation marked as (4)

#### Graph of the theoretical analysis when basic operation is the operation marked as (5)

#### Comments

### Worst Case

#### Graph of the real execution time of the algorithm

#### Graph of the theoretical analysis when basic operation is the operation marked as (1)

#### Graph of the theoretical analysis when basic operation is the operation marked as (2)

#### Graph of the theoretical analysis when basic operation is the operation marked as (3)

#### Graph of the theoretical analysis when basic operation is the operation marked as (4)

#### Graph of the theoretical analysis when basic operation is the operation marked as (5)

#### Comments

### Average Case

#### Graph of the real execution time of the algorithm

#### Graph of the theoretical analysis when basic operation is the operation marked as (1)

#### Graph of the theoretical analysis when basic operation is the operation marked as (2)

#### Graph of the theoretical analysis when basic operation is the operation marked as (3)

#### Graph of the theoretical analysis when basic operation is the operation marked as (4)

#### Graph of the theoretical analysis when basic operation is the operation marked as (5)

#### Comments