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Data Structures

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Data From *assignment1*

**Algorithm 2 vs. Algorithm 3 Chart**

**Algorithm 3 vs. Algorithm 4**

**Raw Table Data (Highlighted cells are the worst case for each algorithm, for each run)**

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| --- | --- | --- | --- |
| Input size (8000) | **Algorithm 2(ns)** | **Algorithm 3(ns)** | **Algorithm 4(ns)** |
| Test 1 | 49979823 | 3493930 | 349821 |
| Test 2 | 43103537 | 3831686 | 334397 |
| Test 3 | 39151839 | 3031341 | 343436 |
| Test 4 | 41891174 | 4386526 | 333098 |
| Test 5 | 36799853 | 2788062 | 531921 |
| Test 6 | 37615120 | 3041810 | 414819 |
| Test 7 | 37117284 | 3143155 | 426690 |
| Test 8 | 40123943 | 3901231 | 409123 |
| Test 9 | 45680912 | 3061293 | 345878 |
| Test 10 | 50192343 | 2996532 | 320238 |
| **Average** | 42165582.8 | 3367556.6 | 380942.1 |

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| Input size (16000) | **Algorithm 2(ns)** | **Algorithm 3(ns)** | **Algorithm 4(ns)** |
| Test 1 | 131301330 | 7803460 | 694227 |
| Test 2 | 72405190 | 4899512 | 622700 |
| Test 3 | 133155825 | 4706361 | 611232 |
| Test 4 | 133597332 | 4377516 | 617807 |
| Test 5 | 138662752 | 5064131 | 654722 |
| Test 6 | 137011214 | 5822490 | 1405731 |
| Test 7 | 135612467 | 4788253 | 687259 |
| Test 8 | 133530191 | 5185930 | 654910 |
| Test 9 | 85578379 | 5257320 | 678493 |
| Test 10 | 136174433 | 5657892 | 628652 |
| **Average** | 123702911.3 | 5356286.5 | 725573.3 |

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| Input size (32000) | **Algorithm 2(ns)** | **Algorithm 3(ns)** | **Algorithm 4(ns)** |
| Test 1 | 657536636 | 7532897 | 1161932 |
| Test 2 | 507443190 | 7604411 | 1213029 |
| Test 3 | 669583338 | 7810656 | 1230386 |
| Test 4 | 514856040 | 7901520 | 1208294 |
| Test 5 | 512967627 | 8357856 | 1223600 |
| Test 6 | 511478157 | 7535434 | 1172125 |
| Test 7 | 660597734 | 7579282 | 1163935 |
| Test 8 | 671070403 | 7940302 | 1184153 |
| Test 9 | 511197561 | 7720668 | 1251021 |
| Test 10 | 503186726 | 7740286 | 1183488 |
| **Average** | 571991741.2 | 7772331.2 | 1199196.3 |

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| Input size (64000) | **Algorithm 2(ns)** | **Algorithm 3(ns)** | **Algorithm 4(ns)** |
| Test 1 | 3794990547 | 14608096 | 2660242 |
| Test 2 | 2022733577 | 13803284 | 2536249 |
| Test 3 | 2067325700 | 13796985 | 26964049 |
| Test 4 | 3760762377 | 14391111 | 4641123 |
| Test 5 | 2026057689 | 13972658 | 2530227 |
| Test 6 | 3764899174 | 16031875 | 3007687 |
| Test 7 | 3781699960 | 14033706 | 2542110 |
| Test 8 | 2684438192 | 13879442 | 2552423 |
| Test 9 | 1940990965 | 14221379 | 5851298 |
| Test 10 | 2009640332 | 21828062 | 2558715 |
| **Average** | 2785353851 | 15056659.8 | 5584412.3 |

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| Input size (128000) | **Algorithm 2(ns)** | **Algorithm 3(ns)** | **Algorithm 4(ns)** |
| Test 1 | 10456290237 | 26521015 | 4937814 |
| Test 2 | 10436990827 | 26343243 | 4982167 |
| Test 3 | 10431966847 | 26480418 | 4973901 |
| Test 4 | 10435216029 | 26508951 | 4998012 |
| Test 5 | 10435378564 | 26407612 | 4927634 |
| Test 6 | 10489736348 | 26578347 | 5023845 |
| Test 7 | 10434758974 | 26389504 | 5034123 |
| Test 8 | 10437097035 | 26377642 | 4945032 |
| Test 9 | 10447800923 | 26445288 | 4948810 |
| Test 10 | 10458790959 | 26573894 | 5019803 |
| **Average** | 10446402674 | 26462591.4 | 4979114.1 |

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| Input size (256000) | **Algorithm 2(ns) O()** | **Algorithm 3(ns)O()** | **Algorithm 4(ns)O()** |
| Test 1 | 41862239483 | 41946706 | 5065374 |
| Test 2 | 41660183569 | 42027774 | 5531736 |
| Test 3 | 41699263166 | 40263752 | 5694920 |
| Test 4 | 41812113796 | 40459944 | 5778007 |
| Test 5 | 41814315968 | 41149111 | 9051722 |
| Test 6 | 41681960591 | 40938510 | 5763894 |
| Test 7 | 41780426550 | 40129698 | 5640127 |
| Test 8 | 41799637851 | 41620181 | 5980301 |
| Test 9 | 41799863759 | 37708529 | 5008954 |
| Test 10 | 41737778549 | 40085370 | 4990269 |
| **Average** | 41764778328 | 40632957.5 | 5850530.4 |

**Worst Case Analysis**

Data collected from running Algorithm 2, 3 & 4 fit the idea of Big-Oh analysis for. From the gathered data, it is clearly visible that Algorithm 2 increases exponentially quicker than Algorithm 3 or 4 given an expanding input size (N). Likewise, Algorithm 3 increases at a much higher rate than Algorithm 4 did for an expanding input size (N).

Interestingly enough, for the last two input sizes (128000 & 256000), Algorithm 4’s computation time stagnated at around the same average. The run time in nanoseconds only slightly increased from N = 128000 to 256000. Observing this, we can hypothesize that if input sizes continued to increase, the computation time in nanoseconds would approach the input size N, as that is its Big-Oh boundary.

Regarding each individual algorithm, it seemed that as input size increased, relative variation in the data points decreased. Stabilization of run-time variation means that these algorithms are capable of being modeled for large input values.