

## ANALYSIS OF ALGORITHMS : Assignment 1

### INSERTION SORT

Compiled in Eclipse by giving various values for the length of the array using command line arguments.

Set the command line arguments value in eclipse by the following steps:

Run >> Run Configurations

Argument tab >> set the field program arguments

```
import java.util.Arrays;
public class InsertionSort {

    public static void main(String[] args) {
        int n=Integer.parseInt(args[0]);
        int a[] = new int[n];
        addingarrayelements(a);
        System.out.println("Before Sorting(input): ");
        printarrayelements(a);
        long startTime = System.nanoTime();
        // sort the array
        insertionSort(a);
        long endTime = System.nanoTime();
        System.out.println("\nAfter Sorting(output): ");
        printarrayelements(a);
        System.out.println("Time taken for"+" "+n+" "+"inputs "+(endTime -
startTime) + " ns");
    }

    /*
     * This method will sort the given integer array using insertion sort
    algorithm
    */
    private static void insertionSort(int[] a) {
        for (int i = 1; i < a.length; i++) {
            int key = a[i];
            int j = i;
            while (j > 0 && a[j - 1] > key) //to make it as descending change
the a[j-1] < key
            {
                a[j] = a[j - 1];
                j--;
            }
            a[j] = key;
        }
    }

    public static void printarrayelements(int[] b) {
        System.out.println(Arrays.toString(b));
    }

    public static void addingarrayelements(int[] b) {
        for (int i = 0; i < b.length; i++) {
            b[i] = (int) (Math.random() * 1000);
        }
    }
}
```

```
}  
}
```

### INPUT AND OUTPUT:

Input : 1000

Output:

Before Sorting(input):

```
[241, 13, 328, 809, 325, 935, 78, 194, 54, 994, 224, 258, 618, 164, 185, 974,  
567, 847, 711, 606, 601, 135, 813, 385, 840, 608, 185, 489, 46, 428, 709,  
623, 970, 317, 305, 992, 857, 449, 832, 22, 413, 159, 940, 736, 974, 905,  
802, 292, 397, 844, 417, 856, 254, 954, 762, 603, 228, 671, 376, 366, 214,  
596, 138, 173, 531, 953, 858, 669, 826, 123, 17, 205, 690, 757, 465, 215,  
752, 697, 109, 327, 41, 149, 688, 564, 682, 369, 523, 897, 595, 378, 743,  
346, 704, 107, 830, 822, 328, 700, 539, 895, 833, 643, 126, 739, 320, 774,  
589, 530, 145, 224, 84, 727, 284, 829, 997, 768, 150, 553, 198, 886, 265, 44,  
838, 948, 322, 522, 710, 449, 547, 819, 554, 39, 956, 523, 930, 283, 53, 899,  
197, 620, 743, 419, 930, 915, 767, 526, 622, 296, 741, 491, 823, 465, 980,  
65, 983, 53, 643, 921, 121, 109, 369, 802, 119, 301, 504, 635, 863, 952, 223,  
847, 682, 612, 336, 562, 524, 449, 326, 333, 116, 411, 233, 639, 889, 736,  
299, 361, 812, 114, 937, 117, 398, 517, 431, 377, 57, 476, 2, 992, 657, 374,  
277, 916, 615, 147, 969, 617, 113, 634, 576, 923, 38, 698, 210, 826, 90, 173,  
248, 64, 59, 607, 350, 128, 686, 782, 535, 753, 657, 975, 436, 783, 224, 977,  
545, 803, 656, 962, 250, 835, 258, 379, 749, 919, 931, 208, 435, 419, 339,  
48, 218, 451, 600, 736, 340, 897, 13, 394, 617, 125, 773, 88, 750, 651, 790,  
546, 266, 667, 719, 716, 905, 595, 35, 312, 785, 526, 546, 850, 466, 723, 23,  
105, 116, 140, 743, 384, 351, 261, 612, 456, 952, 427, 175, 503, 584, 228,  
282, 13, 864, 441, 390, 70, 581, 496, 477, 137, 663, 404, 326, 31, 526, 642,  
513, 480, 764, 524, 767, 325, 750, 170, 491, 174, 620, 326, 155, 69, 271,  
916, 955, 512, 472, 400, 589, 20, 906, 708, 270, 244, 989, 793, 124, 549,  
617, 585, 924, 877, 547, 460, 712, 668, 1, 160, 252, 591, 215, 479, 378, 819,  
77, 922, 285, 672, 704, 968, 486, 468, 791, 561, 703, 573, 837, 892, 192,  
735, 894, 624, 121, 988, 316, 208, 421, 570, 102, 69, 168, 569, 811, 34, 984,  
229, 697, 534, 92, 168, 680, 788, 668, 61, 988, 393, 862, 720, 833, 483, 398,  
843, 278, 900, 981, 168, 531, 619, 826, 183, 260, 7, 500, 30, 169, 376, 942,  
741, 997, 661, 935, 515, 305, 31, 551, 262, 895, 644, 75, 301, 489, 806, 710,  
692, 326, 282, 899, 357, 668, 574, 493, 865, 826, 580, 70, 435, 202, 132,  
652, 525, 7, 609, 737, 120, 787, 960, 45, 681, 610, 200, 613, 560, 797, 689,  
922, 557, 352, 272, 548, 252, 863, 675, 408, 626, 475, 354, 80, 524, 688,  
421, 794, 497, 164, 116, 673, 577, 414, 747, 474, 659, 241, 989, 630, 228,  
60, 918, 632, 315, 790, 166, 889, 732, 814, 177, 21, 839, 633, 578, 187, 302,  
227, 357, 438, 590, 805, 635, 302, 217, 582, 530, 734, 90, 456, 823, 363,  
639, 981, 868, 465, 829, 817, 456, 426, 529, 930, 182, 531, 193, 162, 153,  
820, 270, 458, 796, 390, 262, 912, 863, 954, 904, 62, 733, 713, 504, 292,  
498, 578, 85, 999, 378, 559, 598, 217, 492, 721, 150, 728, 76, 430, 892, 291,  
853, 757, 912, 519, 338, 797, 269, 102, 528, 359, 83, 530, 626, 956, 397,  
211, 132, 268, 428, 878, 876, 285, 639, 502, 384, 145, 53, 487, 216, 291,  
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808, 405, 764, 594, 961, 542, 752, 228, 640, 279, 166, 894, 68, 143, 872,  
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930, 420, 148, 351, 201, 87, 516, 163, 992, 415, 340, 869, 198, 243, 70, 441,  
412, 96, 194, 557, 123, 329, 686, 242, 796, 989, 414, 761, 254, 750, 758,  
199, 686, 491, 279, 616, 104, 90, 828, 496, 45, 789, 181, 174, 825, 58, 900,  
335, 741, 206, 856, 224, 178, 146, 540, 144, 701, 595, 85, 962, 872, 710,
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669, 811, 700, 605, 847, 916, 344, 457, 145, 468, 956, 941, 190, 796, 283,  
551, 541, 633, 990, 942, 318, 174, 490, 825, 737, 716, 425, 93, 649, 148,  
862, 798, 199, 201, 678, 308, 855, 417, 587, 498, 83, 16, 738, 86, 130, 405,  
860, 294, 541, 903, 457, 888, 185, 367, 678, 213, 857, 790, 59, 330, 738,  
615, 545, 469, 288, 478, 805, 42, 497, 295, 145, 178, 742, 170, 999, 287,  
884, 358, 297, 473, 682, 617, 791, 698, 9, 645, 768, 501, 861, 928, 448, 709,  
648, 247, 749, 18, 792, 328, 54, 560, 234, 540, 67, 557, 66, 393, 818, 940,  
100, 564, 452, 398, 906, 552, 433, 639, 493, 660, 420, 796, 575, 889, 188,  
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807, 623, 523, 42, 415, 491, 518, 864, 533, 742, 731, 316, 489, 582, 374,  
658, 657, 873, 501, 948, 351, 295, 316, 266, 431, 700, 450, 499, 333, 376,  
532, 446, 909, 784, 23, 519, 337, 754, 734, 850, 609, 27, 661, 182, 564, 543,  
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130, 241, 593, 799, 978, 904, 812, 189, 358, 817, 707, 400, 649, 829, 742,  
857, 10, 791, 532, 929, 894, 426, 668, 944, 240, 435, 171, 970, 862, 70, 258,  
61, 368, 726, 73, 884, 330, 325, 39, 996, 331, 154, 546]

After Sorting(output):

[1, 1, 2, 7, 7, 9, 9, 10, 13, 13, 13, 16, 17, 18, 20, 21, 22, 23, 23, 27, 30,  
31, 31, 34, 35, 38, 38, 39, 39, 41, 42, 42, 44, 45, 45, 46, 48, 53, 53, 53,  
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113, 114, 115, 116, 116, 116, 116, 117, 119, 120, 121, 121, 123, 123, 124,  
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711, 712, 713, 716, 716, 719, 720, 721, 721, 723, 726, 727, 728, 728, 731,
732, 733, 734, 734, 735, 735, 736, 736, 736, 737, 737, 737, 738, 738, 739,
741, 741, 741, 742, 742, 742, 742, 743, 743, 743, 744, 747, 749, 749, 750,
750, 750, 750, 752, 752, 753, 754, 757, 757, 757, 757, 758, 758, 761, 762,
764, 764, 767, 767, 768, 768, 773, 774, 775, 782, 783, 784, 785, 787, 788,
789, 790, 790, 790, 790, 791, 791, 791, 792, 793, 793, 794, 794, 796, 796,
796, 796, 796, 797, 797, 798, 799, 802, 802, 803, 805, 805, 806, 806, 807,
808, 809, 811, 811, 811, 812, 812, 813, 814, 817, 817, 818, 819, 819, 820,
822, 823, 823, 825, 825, 826, 826, 826, 826, 827, 828, 829, 829, 829, 830,
832, 832, 833, 833, 835, 837, 838, 839, 840, 843, 844, 847, 847, 847, 850,
850, 853, 855, 856, 856, 857, 857, 857, 858, 860, 861, 862, 862, 862, 863,
863, 863, 864, 864, 865, 868, 869, 870, 870, 872, 872, 873, 873, 876, 877,
878, 878, 884, 884, 886, 888, 889, 889, 889, 889, 892, 892, 894, 894, 894,
895, 895, 897, 897, 899, 899, 900, 900, 903, 904, 904, 905, 905, 906, 906,
909, 912, 912, 915, 916, 916, 916, 918, 918, 919, 921, 922, 922, 923, 924,
928, 929, 930, 930, 930, 930, 931, 935, 935, 935, 937, 940, 940, 941, 941,
942, 942, 943, 944, 946, 948, 948, 952, 952, 953, 954, 954, 955, 956, 956,
956, 960, 961, 962, 962, 968, 969, 970, 970, 974, 974, 975, 977, 978, 980,
981, 981, 983, 984, 987, 988, 988, 989, 989, 989, 990, 992, 992, 992, 994,
996, 997, 997, 999, 999]
```

Time taken for 1000 inputs 2594951 ns

**Input : 100**

**Output:**

Before Sorting(input):

```
[929, 341, 479, 844, 286, 822, 315, 936, 116, 244, 748, 563, 950, 350, 509,
28, 70, 464, 188, 648, 174, 276, 158, 112, 623, 726, 740, 85, 951, 979, 53,
476, 252, 197, 349, 925, 997, 741, 315, 954, 558, 421, 940, 692, 461, 689,
73, 249, 938, 938, 718, 622, 917, 667, 452, 481, 921, 876, 78, 309, 742, 920,
795, 143, 922, 17, 683, 599, 238, 740, 298, 955, 396, 122, 508, 816, 120,
465, 477, 287, 622, 519, 902, 635, 234, 488, 149, 139, 626, 239, 972, 210,
604, 141, 853, 865, 955, 211, 832, 362]
```

After Sorting(output):

```
[17, 28, 53, 70, 73, 78, 85, 112, 116, 120, 122, 139, 141, 143, 149, 158,
174, 188, 197, 210, 211, 234, 238, 239, 244, 249, 252, 276, 286, 287, 298,
309, 315, 315, 341, 349, 350, 362, 396, 421, 452, 461, 464, 465, 476, 477,
479, 481, 488, 508, 509, 519, 558, 563, 599, 604, 622, 622, 623, 626, 635,
648, 667, 683, 689, 692, 718, 726, 740, 740, 741, 742, 748, 795, 816, 822,
832, 844, 853, 865, 876, 902, 917, 920, 921, 922, 925, 929, 936, 938, 938,
940, 950, 951, 954, 955, 955, 972, 979, 997]
```

Time taken for 100 inputs 78411 ns

Input: 10

Output:

Before Sorting(input):  
[532, 385, 891, 663, 323, 900, 894, 907, 868, 70]

After Sorting(output):  
[70, 323, 385, 532, 663, 868, 891, 894, 900, 907]

Time taken for 10 inputs 4106 ns

### MERGE SORT:

```
import java.util.Arrays;

class MergeSort {
    public static void main(String[] args)
    {
        int n=Integer.parseInt(args[0]);
        int a[] = new int[n];
        addingarrayelements(a);
        System.out.println("Before Sorting(input): ");
        printarrayelements(a);
        long startTime = System.nanoTime();
        // sort the array
        MergeSort_function(a, 0, (a.length - 1));
        long endTime = System.nanoTime();
        System.out.println("\nAfter Sorting(output): ");
        printarrayelements(a);
        System.out.println("Time taken for"+" "+n+" "+"inputs
"+"(endTime - startTime)+" ns");
    }

    public static void printarrayelements(int[] b) {
        System.out.println(Arrays.toString(b));
    }

    public static void addingarrayelements(int[] b) {
        for (int i = 0; i < b.length; i++) {
            b[i] = (int) (Math.random() * 1000);
        }
    }

    static public void MergeSort_function(int [] n, int p, int r)
    {
        int q;
        if (r > p)
        {
            q = (r + p) / 2;
            MergeSort_function(n, p, q);
            MergeSort_function(n, (q + 1), r);

            Merge(n, p, (q+1), r);
        }
    }
}
```

```

    }
}

static public void Merge(int [] n, int p, int q, int r)
{
    int [] newarr = new int[n.length];
    int i, left_end, num_elements, pos;

    left_end = (q - 1);
    pos = p;
    num_elements = (r - p + 1);

    while ((p <= left_end) && (q <= r))
    {
        if (n[p] <= n[q])
            newarr[pos++] = n[p++];
        else
            newarr[pos++] = n[q++];
    }

    while (p <= left_end)
        newarr[pos++] = n[p++];

    while (q <= r)
        newarr[pos++] = n[q++];

    for (i = 0; i < num_elements; i++)
    {
        n[r] = newarr[r];
        r--;
    }
}
}

```

### **INPUT AND OUTPUT :**

Input : 1000

Output:

Before Sorting(input):

[156, 666, 469, 798, 9, 626, 395, 412, 260, 129, 727, 105, 74, 43, 186, 629, 776, 868, 545, 107, 993, 638, 78, 875, 978, 893, 641, 211, 315, 811, 948, 786, 812, 536, 613, 90, 996, 794, 918, 70, 93, 128, 70, 938, 724, 474, 919, 415, 875, 327, 731, 705, 879, 474, 601, 122, 214, 103, 568, 622, 987, 118, 273, 428, 829, 662, 280, 613, 772, 179, 802, 710, 398, 808, 646, 420, 178, 565, 627, 46, 458, 541, 577, 522, 977, 319, 349, 834, 181, 882, 889, 180, 816, 595, 527, 411, 476, 215, 127, 201, 822, 494, 654, 903, 187, 656, 970, 230, 136, 907, 448, 750, 362, 219, 25, 680, 971, 762, 913, 609, 821, 804, 63, 603, 73, 317, 825, 600, 536, 272, 996, 116, 695, 392, 580, 105, 539, 119, 141, 180, 440, 693, 586, 565, 356, 541, 585, 842, 597, 609, 602, 991, 208, 885, 680, 260, 823, 136, 724, 144, 456, 767, 993, 87, 295, 826, 932, 592, 42,

380, 247, 63, 682, 890, 372, 95, 907, 751, 51, 875, 563, 867, 808, 40, 621, 978, 489, 645, 152, 493, 908, 857, 723, 707, 842, 597, 428, 669, 301, 659, 497, 375, 16, 756, 61, 669, 573, 520, 186, 981, 468, 759, 721, 987, 633, 146, 872, 419, 675, 104, 648, 459, 117, 847, 511, 623, 463, 413, 593, 573, 768, 59, 869, 62, 723, 565, 491, 83, 953, 846, 338, 338, 346, 750, 480, 353, 762, 99, 877, 921, 391, 804, 138, 48, 340, 393, 562, 282, 822, 382, 29, 87, 399, 698, 485, 948, 342, 826, 953, 991, 80, 409, 990, 238, 128, 790, 480, 21, 581, 405, 488, 722, 529, 960, 661, 760, 241, 80, 330, 644, 18, 457, 6, 21, 996, 574, 486, 850, 945, 753, 106, 235, 388, 636, 16, 987, 904, 168, 509, 705, 552, 852, 560, 979, 759, 308, 710, 385, 849, 175, 361, 68, 625, 992, 372, 56, 85, 971, 527, 926, 362, 533, 142, 68, 484, 43, 547, 615, 379, 433, 671, 23, 833, 332, 283, 415, 797, 828, 701, 60, 491, 259, 938, 775, 282, 270, 342, 615, 176, 903, 725, 936, 82, 682, 891, 832, 711, 494, 238, 959, 85, 553, 807, 980, 153, 904, 754, 210, 938, 717, 716, 561, 976, 104, 965, 552, 532, 296, 550, 972, 247, 804, 862, 769, 403, 637, 178, 880, 955, 706, 775, 993, 853, 327, 162, 709, 932, 112, 801, 152, 837, 615, 478, 865, 32, 809, 104, 709, 918, 829, 333, 617, 500, 471, 833, 211, 838, 606, 431, 759, 704, 1, 645, 418, 521, 45, 306, 462, 652, 554, 63, 31, 532, 77, 583, 944, 987, 173, 165, 292, 319, 669, 285, 873, 357, 257, 349, 966, 771, 672, 537, 633, 360, 312, 142, 487, 906, 403, 301, 848, 483, 699, 308, 282, 724, 296, 984, 820, 706, 328, 743, 535, 543, 196, 41, 757, 701, 514, 884, 924, 356, 132, 946, 957, 797, 441, 631, 95, 18, 658, 122, 323, 150, 953, 16, 884, 308, 77, 719, 869, 775, 618, 105, 573, 167, 149, 331, 98, 380, 282, 877, 688, 670, 105, 30, 412, 171, 559, 66, 105, 524, 44, 322, 927, 59, 979, 199, 501, 148, 62, 895, 367, 934, 732, 327, 398, 629, 672, 265, 897, 952, 236, 181, 336, 122, 375, 689, 73, 981, 964, 744, 938, 468, 433, 956, 276, 668, 260, 477, 883, 106, 202, 920, 296, 766, 79, 685, 65, 567, 591, 883, 943, 679, 875, 766, 449, 99, 492, 208, 842, 374, 86, 326, 401, 230, 242, 748, 800, 107, 923, 405, 508, 324, 482, 980, 397, 626, 422, 288, 154, 412, 956, 947, 679, 780, 967, 665, 376, 874, 118, 361, 121, 710, 740, 95, 773, 750, 599, 507, 233, 55, 799, 46, 479, 745, 894, 778, 466, 829, 754, 971, 475, 227, 825, 982, 314, 921, 238, 178, 758, 760, 629, 770, 742, 369, 631, 469, 135, 988, 751, 801, 349, 856, 745, 799, 667, 899, 660, 507, 912, 85, 432, 428, 29, 797, 299, 577, 189, 968, 318, 320, 298, 510, 964, 511, 139, 810, 111, 765, 955, 642, 725, 872, 958, 895, 210, 470, 110, 926, 707, 88, 555, 179, 555, 601, 210, 975, 811, 921, 387, 982, 931, 521, 779, 971, 718, 968, 780, 881, 183, 211, 924, 112, 243, 807, 137, 220, 55, 601, 655, 858, 388, 648, 678, 914, 593, 319, 271, 265, 659, 602, 605, 464, 337, 579, 338, 988, 496, 944, 842, 380, 755, 210, 32, 721, 878, 956, 727, 411, 615, 44, 858, 142, 459, 251, 330, 285, 266, 186, 26, 669, 796, 650, 261, 856, 27, 857, 984, 560, 511, 12, 134, 863, 144, 849, 905, 173, 469, 602, 67, 707, 21, 787, 126, 426, 302, 884, 879, 923, 679, 715, 810, 777, 862, 831, 863, 284, 664, 733, 369, 239, 431, 127, 279, 705, 835, 666, 391, 274, 780, 878, 984, 373, 764, 25, 111, 582, 396, 683, 811, 773, 697, 723, 689, 103, 471, 187, 618, 558, 275, 304, 811, 785, 478, 478, 140, 408, 480, 662, 386, 899, 411, 937, 35, 324, 517, 491, 360, 983, 43, 417, 781, 34, 576, 958, 913, 683, 752, 838, 303, 420, 692, 332, 559, 69, 776, 596, 493, 160, 159, 560, 923, 203, 961, 374, 994, 0, 198, 28, 209, 37, 340, 219, 918, 338, 843, 997, 630, 911, 127, 18, 375, 35, 249, 447, 320, 227, 954, 714, 957, 647, 881, 322, 503, 90, 439, 888, 591, 484, 289, 415, 927, 960, 406, 568, 378, 189, 427, 379, 838, 629, 353, 373, 334, 746, 718, 596, 24, 65, 988, 364, 171, 112, 338, 910, 677, 930, 922, 208, 502, 875, 404, 442, 111, 808, 852, 521, 138, 645, 37, 991, 600, 473, 808, 507, 343, 66, 507, 742, 849, 708, 303, 246, 218, 662, 914, 298, 879, 519, 469, 257, 590, 912, 103, 235, 336, 753, 505, 192, 56, 254, 793, 709, 495, 458, 22, 768, 85, 927, 101]

After Sorting(output):

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978, 978, 979, 979, 980, 980, 981, 981, 982, 982, 983, 984, 984, 984, 987,
987, 987, 987, 988, 988, 988, 990, 991, 991, 991, 992, 993, 993, 993, 994,
996, 996, 996, 997]
Time taken for 1000 inputs 2608909 ns
```

**Input: 100**

**Output:**

```
Before Sorting(input):
[874, 306, 207, 97, 429, 347, 202, 840, 443, 241, 721, 132, 665, 350, 703,
442, 351, 617, 775, 96, 737, 722, 767, 791, 382, 764, 950, 831, 73, 695, 659,
740, 719, 418, 893, 879, 25, 999, 552, 82, 757, 927, 199, 145, 116, 762, 629,
207, 54, 738, 71, 654, 379, 155, 547, 237, 144, 418, 762, 478, 123, 656, 926,
312, 150, 695, 71, 115, 704, 48, 739, 951, 423, 245, 422, 881, 139, 502, 759,
676, 646, 233, 280, 112, 631, 375, 461, 307, 123, 828, 939, 232, 361, 571,
10, 619, 206, 190, 943, 971]
```

```
After Sorting(output):
[10, 25, 48, 54, 71, 71, 73, 82, 96, 97, 112, 115, 116, 123, 123, 132, 139,
144, 145, 150, 155, 190, 199, 202, 206, 207, 207, 232, 233, 237, 241, 245,
280, 306, 307, 312, 347, 350, 351, 361, 375, 379, 382, 418, 418, 422, 423,
429, 442, 443, 461, 478, 502, 547, 552, 571, 617, 619, 629, 631, 646, 654,
656, 659, 665, 676, 695, 695, 703, 704, 719, 721, 722, 737, 738, 739, 740,
757, 759, 762, 762, 764, 767, 775, 791, 828, 831, 840, 874, 879, 881, 893,
926, 927, 939, 943, 950, 951, 971, 999]
Time taken for 100 inputs 106737 ns
```

**Input: 10**

**Output:**

```
Before Sorting(input):
[210, 768, 445, 887, 391, 57, 887, 41, 74, 60]
```

```
After Sorting(output):
[41, 57, 60, 74, 210, 391, 445, 768, 887, 887]
Time taken for 10 inputs 13137 ns
```

## MAX-SUB ARRAY PROBLEM :

```
import java.util.*;

public class Maxsubarray {
    public static void main(String[] args) {
        int n=Integer.parseInt(args[0]);
        int a[] = new int[n];
        addingarrayelements(a);
        System.out.println("Max-Array Elements(input): ");
        printarrayelements(a);
        long startTime = System.nanoTime();
        // sort the array
        int b[] =maxSubarray(a);
        long endTime = System.nanoTime();
        System.out.println("\nMax Sub Array in the given Array of
elements:(output): ");
        printarrayelements(b);
        System.out.println("Time taken for"+" "+n+" "+"inputs
"+(endTime - startTime) + " ns");
    }
    public static void printarrayelements(int[] b) {
        System.out.println(Arrays.toString(b));
    }

    public static void addingarrayelements(int[] b) {
        for (int i = 0; i < b.length; i++) {
            b[i] = -1000+ (int) ( Math.random()*((2000-(-
1000))+1));
        }
    }

    static int[] maxSubarray(int[] a) {

        double max_so_far = 0;
        double max_ending = 0;
        int max_start_index = 0;
        int startIndex = 0;
        int max_end_index = -1;

        for(int i = 0; i < a.length; i++) {
            if(0 > max_ending +a[i]) {
                startIndex = i+1;
                max_ending = 0;
            }
            else {
                max_ending += a[i];
            }

            if(max_ending > max_so_far) {
                max_so_far = max_ending;
                max_start_index = startIndex;
                max_end_index = i;
            }
        }

        if(max_start_index <= max_end_index) {
```

```

        System.out.println("Array start index : "+max_start_index);
        System.out.println("Array start index : "+(max_end_index));
        return Arrays.copyOfRange(a, max_start_index, max_end_index+1);
    }

    return null;
}

}

```

## **INPUT AND OUTPUT:**

Input : 1000

Output:

Max-Array Elements(input):

```

[-804, 449, 972, 1364, 286, 652, 1974, -787, 1294, -625, -278, 1959, 1224, -
801, 975, -212, 1928, 225, 1877, -938, 672, 1398, -569, 128, 505, 459, 152,
656, 1414, -178, 285, -756, 1582, 562, -316, -765, 880, 928, 1192, -293, -
830, 1351, -761, -544, -936, -179, 1365, 1511, -604, -221, 1382, 1229, 905,
252, 1097, 487, 1447, 1889, 1725, 628, -526, -118, 1464, -8, 1520, 330, 1159,
-278, -956, -391, 480, 339, 1203, -370, 1683, -825, -156, 497, 713, 220, -
491, -887, 1241, -773, -905, 607, -886, 84, -505, 148, 684, -590, 643, 1764,
-407, 1217, 1174, 131, 759, 102, -737, 1057, -423, 988, 1162, -601, 750, 779,
-543, -372, 1580, 503, -724, -52, -837, -433, 324, -992, -461, -355, 1010, -
330, 601, -549, 1821, 1090, 1439, 230, -404, 1491, 684, 243, 1496, 1484, 462,
-247, 115, 596, -301, 1174, -484, -158, -291, 967, 1833, 663, 325, 696, 556,
411, 1223, 265, -275, -249, -415, 1883, 1877, 871, -157, -396, 886, 1290,
918, -509, -320, 1257, -849, 438, 1270, 1316, 1000, 580, 1543, -504, 1514,
1909, 969, -117, -302, -737, 517, 861, -14, -740, 1972, 1320, 1310, 969, -
780, 371, 596, 212, -902, 1734, -57, 299, 1988, -39, -749, -226, -429, 1957,
-282, 355, 1909, -81, 310, 1730, -581, 824, 1137, 127, -677, 930, -454, 1775,
1649, -529, -225, 305, -891, -270, -960, 1025, -96, 66, -809, 621, 824, 1200,
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Array start index : 1

Array start index : 998

Max Sub Array in the given Array of elements:(output):

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478, 1167, 642, 421, 1724, -413, 1533, -847, 1282, 1676, 1618, -500, 93,  
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Time taken for 1000 inputs 290244 ns

**Input:100**

**Output:**

Max-Array Elements(input):

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285, 1801, 45, -93, 268, 887, 120, 419, 553, 117, 866, 42, 542, 1156, -164,  
766, 1416, -976, 1519, 848, -542, -743, 877, -720, 861, 1085, -489, 1432,  
1777, -406, -429, 439, 522, 1910, -178, 1083, 1008, 1385, 184, 1376, -180,  
1642, 1528, 958, 760, 866, -424, 560, -863, -676, 441, 1353, 1725, 353, 1582,  
-135, 1931, 266, 822, -632, 1562, 634, 516, -784, 390, 1265, -10, 1508, 1698,  
1911, 34, 1715, -933, 274]

Array start index : 7

Array start index : 97

Max Sub Array in the given Array of elements:(output):

[103, 626, 1221, 905, 1219, -382, -326, -566, -99, 1019, 1772, -969, -378,  
1068, 400, 412, -230, -341, -271, 285, 1801, 45, -93, 268, 887, 120, 419,  
553, 117, 866, 42, 542, 1156, -164, 766, 1416, -976, 1519, 848, -542, -743,  
877, -720, 861, 1085, -489, 1432, 1777, -406, -429, 439, 522, 1910, -178,  
1083, 1008, 1385, 184, 1376, -180, 1642, 1528, 958, 760, 866, -424, 560, -  
863, -676, 441, 1353, 1725, 353, 1582, -135, 1931, 266, 822, -632, 1562, 634,  
516, -784, 390, 1265, -10, 1508, 1698, 1911, 34, 1715]

Time taken for 100 inputs 201570 ns

**Input:10**

**Output:**

Max-Array Elements(input):

[1136, -102, 1573, 1753, 1374, 1070, -784, -30, -205, 299]

Array start index : 0

Array start index : 5

Max Sub Array in the given Array of elements:(output):

[1136, -102, 1573, 1753, 1374, 1070]

Time taken for 10 inputs 183917 ns