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ELE 408
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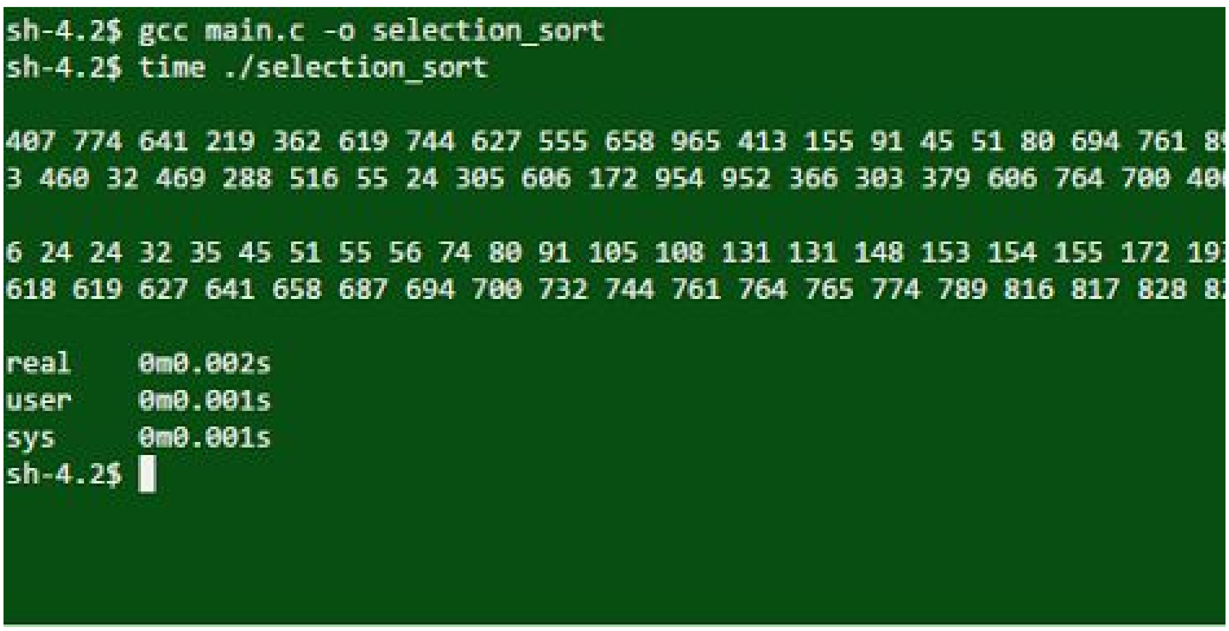
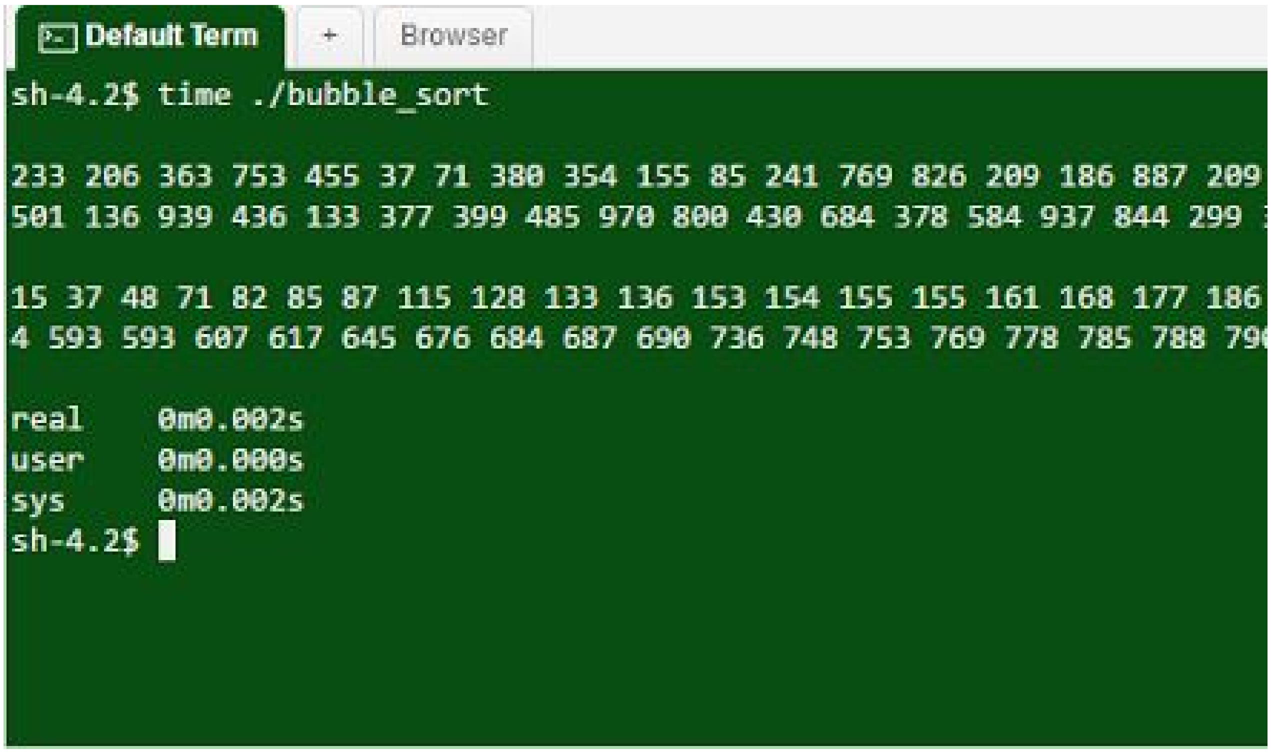
Homework #2

Selection Sort: For the selection sort program I followed the algorithm explained in the ELE 408 slides. This means that to sort the array, I started with the first unsorted number and then went through the rest of the array to find a smallest number. If a smallest number is smaller than the unsorted number, we switch the unsorted number and found smallest number. Then we repeat this process for the next unsorted number, all the way up to the end of the array, n-1 times. I generated the random numbers by looping through the array and generating a random modulo 1000 because we only want numbers 1 - 1000. I seeded the random number generator with the time so that it was a more effectively random. Then I printed the results to the console.

(The images were hard to display here without cropping, the full images are in the zip file)



Bubble Sort: For the bubble sort program, everything is the same except the sorting algorithm. This time we just go through each value in the array, and if it is smaller than the one before it, we switch the two, then continue to the end. We repeat this process n-1 times so that the array is completely sorted.



Merge Sort: For merge sort, everything is the same again except for the sorting algorithm. This time we recursively split the array in half and sort the numbers, then merge them back together. This is done recursively until there is only one number, which obviously cannot be split in half.

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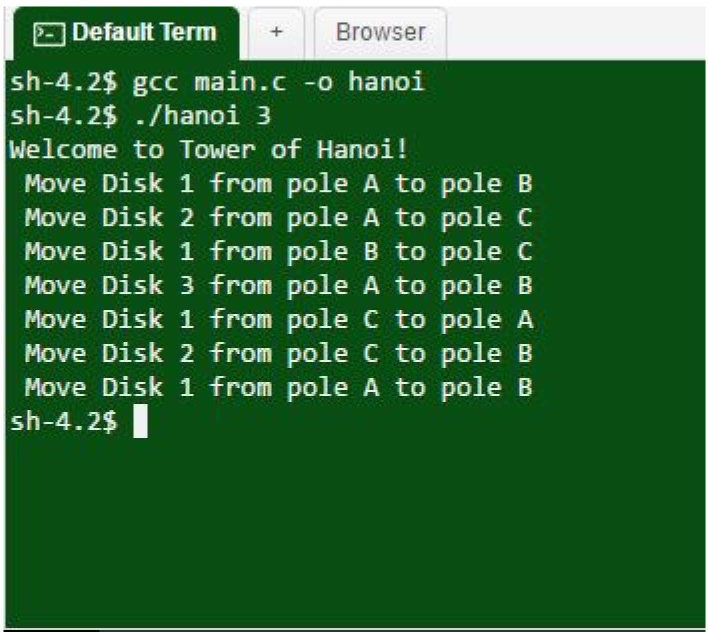
Default Term   +   Browser
sh-4.2$ gcc main.c -o mergesort
sh-4.2$ time ./mergesort
Original Array:
383 886 777 915 793 335 386 492 649 421 362 27 690 59 763 926 540 426 172 736 2
36 505 846 729 313 857 124 895 582 545 814 367 434 364 43 750 87 808 276 178 78

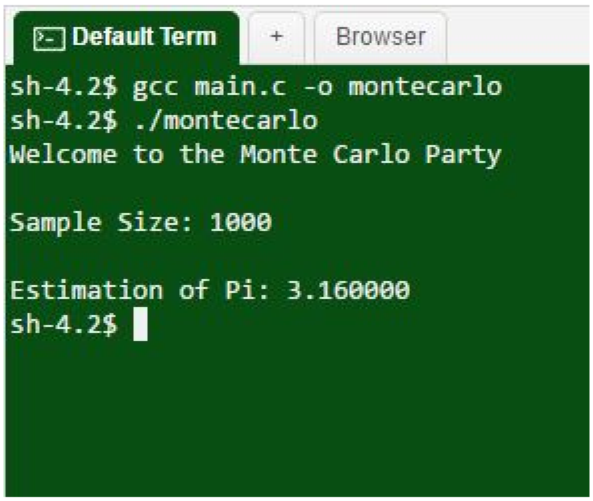
Results:
0 11 12 22 27 42 43 58 59 60 67 69 84 87 91 94 123 124 135 167 170 172 178 198
586 649 651 676 690 729 736 739 750 754 763 777 782 784 788 793 802 808 814 846

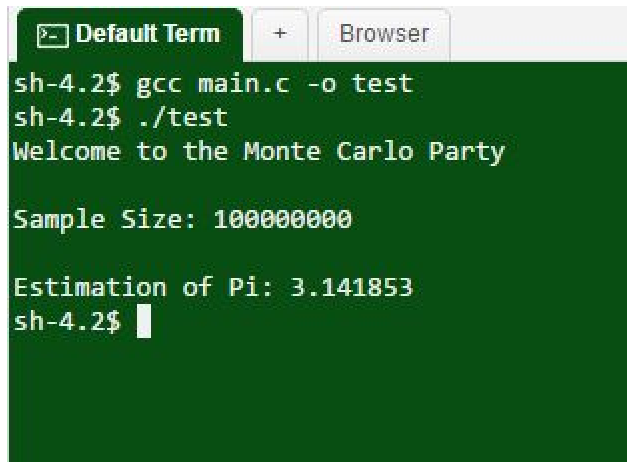

real    0m0.002s
user    0m0.001s
sys     0m0.000s
sh-4.2$
```

Tower of Hanoi: For this program we also use recursion. The user can input a number of disks to play the game with. This is taken as a command line argument and passed as the value for number of disks. Then the program recursively uses the hanoi function which basically takes breaks the process down into several "chunks" of the way that 2 disks are handled. The algorithm for two disks is repeated as many times as necessary for the actual number of disks until the game is completed. The results are printed to the console throughout the process.



Monte Carlo: For the monte carlo program, we estimate the value of Pi by randomly generating a large number of values within a 1x1 square. For every x,y coordinate generated, we check if the point is inside of a circle with radius 1. If the point is in the circle, we increment a counter. After we generate all the samples, we divide the number of points in the circle by the total number of points in the sample size. This should give us Pi/4. We multiply that value by 4 and it gives us an approximation of Pi. We notice that the higher the sample size, the closer the approximation to Pi becomes. I tried to create the best graph I could that shows this relationship.





Queue Problem: For the queue problem, we use the queue length formula to simulate average queue length. The average queue length is the last queue length, plus arrival rate, minus service rate. So we simulate the this by generating a random value by deciding on a large sample size, and then generating random values between 0 and the max for arrival time (and service time for some parts). For each sample we calculate the average queue length, and if it goes negative we just reset it to zero because we do not want a negative waiting time. And then after we run all the samples, we report that average waiting time and print it to a text file. For the second and third part, we change the distribution of the arrival time and service time to the Bernoulli distribution and M distribution and compare the times.