Make the Largest Number from the 2-digit Primes Problem:

Make the biggest number you can out of the 2 digit primes. You may only use a prime number once. Each pair of adjacent digits must be a prime number.

For example: A possible answer might be the number 4731979. This number contains (reading from left to right) the primes 47, 73, 31, 19, 97 and 79. Notice how the 7 is the end of one number and the start of the next, like links in a chain. The actual answer is bigger than this.

A Starting Point: Here is a list of all the 2-digit primes:

11 13 17 19 23 29 31 37

41 43 47 53 59 61 67 71

73 79 83 89 97

SOLUTION: 619737131179

EXPLANATION:

Of the 21 2-digit primes, nine begin with an even number and two with a 5. No prime is even or ends with a 5, so if any of those 11 numbers is used it must be the first component of the answer and none of the others can be used.

The first component must be one of 89, 83, 67 or 61, since these are the largest ones ending with each of the 4 possible odd primes that the remainder of the answer must start with.

The remaining ten 2-digit prime numbers, containing only the digits 1, 3, 7 and 9, can be used to make a number with at most 11 digits. Do any such exist?
In any sequence made from overlapping 2-digit numbers, the first and last digits are used once and all others twice. If the first and last digits are the

same, then all digits are used an even number of times; if the first and last digits are different, then two digits are used an odd number of times and the other two an even number of times. Conversely, if a digit is used an odd number of times, one appearance must be as either the first or last digit.

The digits 1, 3, 7 and 9 occur 7, 4, 6 and 3 times respectively in the 10 available odd-odd primes. Therefore if an 11-digit answer exists, it must start with a 1 and end with a 9, or vice-versa. But the first digit cannot be 9 since that could only come from 97 and would leave no way of using 19 and 79. Therefore the only possible 11-digit solutions must start with 1 and end with 9.

Try to construct the largest possible such number. The second digit can be 9; the third digit must then be 7, the penultimate digit also has to be 7. The largest remaining possibility for the fourth digit is 3, and then for the fifth digit, 7. The third from the end must then be 1 and the sixth is also a 1. The seventh digit must then be 3 and the last space filled with a 1. This is a legal solution, since it uses all 10 odd-odd primes once and once only, and by its construction it must be the largest such number. [There are in fact other, smaller, solutions]

This 11-digit number cab be preceded by the largest even-odd or 5-odd prime with a 1 as second digit. This number is 61. Thus the final answer is the 12-digit number 619737131179.