

Faster Prime Finding

Write a function that returns a list of all primes up to a given number.

For each number, in order to determine if it is prime, take the following steps:

1. Find the square root of the number
2. Find all the primes up to that square root
3. Test to see if any of those primes are divisors

If a number has no prime divisors, it is prime!

```
In [1]: def allPrimesUpTo(num):  
    primes = [2]  
    for number in range(3, num):  
        sqrtNum = number**0.5  
        for factor in primes:  
            if number % factor == 0:  
                # Not prime  
                break  
            if factor > sqrtNum:  
                # It's prime!  
                primes.append(number)  
                break  
    return primes
```

```
In [2]: print(allPrimesUpTo(100))
```

```
[2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71,  
73, 79, 83, 89, 97]
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```
In [3]: print(allPrimesUpTo(1000))
```

```
[2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71,  
73, 79, 83, 89, 97, 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, 151, 157,  
163, 167, 173, 179, 181, 191, 193, 197, 199, 211, 223, 227, 229, 233, 239,  
241, 251, 257, 263, 269, 271, 277, 281, 283, 293, 307, 311, 313, 317, 331, 337,  
347, 349, 353, 359, 367, 373, 379, 383, 389, 397, 401, 409, 419, 421, 431, 433,  
439, 443, 449, 457, 461, 463, 467, 479, 487, 491, 499, 503, 509, 521, 523,  
541, 547, 557, 563, 569, 571, 577, 587, 593, 599, 601, 607, 613, 617, 619, 631,  
641, 643, 647, 653, 659, 661, 673, 677, 683, 691, 701, 709, 719, 727, 733, 739,  
743, 751, 757, 761, 769, 773, 787, 797, 809, 811, 821, 823, 827, 829, 839, 853,  
857, 859, 863, 877, 881, 883, 887, 907, 911, 919, 929, 937, 941, 947, 953, 967,  
971, 977, 983, 991, 997]
```

In [4]: `print(allPrimesUpTo(100000))`

[2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, 151, 157, 163, 167, 173, 179, 181, 191, 193, 197, 199, 211, 223, 227, 229, 233, 239, 241, 251, 257, 263, 269, 271, 277, 281, 283, 293, 307, 311, 313, 317, 331, 337, 347, 349, 353, 359, 367, 373, 379, 383, 389, 397, 401, 409, 419, 421, 431, 433, 439, 443, 449, 457, 461, 463, 467, 479, 487, 491, 499, 503, 509, 521, 523, 541, 547, 557, 563, 569, 571, 577, 587, 593, 599, 601, 607, 613, 617, 619, 631, 641, 643, 647, 653, 659, 661, 673, 677, 683, 691, 701, 709, 719, 727, 733, 739, 743, 751, 757, 761, 769, 773, 787, 797, 809, 811, 821, 823, 827, 829, 839, 853, 857, 859, 863, 877, 881, 883, 887, 907, 911, 919, 929, 937, 941, 947, 953, 967, 971, 977, 983, 991, 997, 1009, 1013, 1019, 1021, 1031, 1033, 1039, 1049, 1051, 1061, 1063, 1069, 1087, 1091, 1093, 1097, 1103, 1109, 1117, 1123, 1129, 1151, 1153, 1163, 1171, 1181, 1187, 1193, 1201, 1213, 1217, 1223, 1229, 1231, 1237, 1249, 1259, 1277, 1279, 1283, 1289, 1291, 1297, 1301, 1303, 1307, 1319, 1321, 1327, 1361, 1367, 1373, 1381, 1399, 1409, 1423, 1427, 1429, 1433, 1439, 1447, 1451, 1453, 1459, 1471, 1481, 1483, 1487, 1489, 1493, 1499, 1511, 1523, 1531, 1543, 1549, 1553, 1559, 1567, 1571, 1579, 1583, 1597, 1601, 1607, 1609, 1613, 1619, 1621, 1627, 1637, 1657, 1663, 1667, 1669, 1693, 1697, 1699, 1709, 1721, 1723, 1733, 1741, 1747, 1753, 1759, 1777, 1783, 1787, 1793, 1801, 1811, 1823, 1831, 1847, 1861, 1871, 1889, 1901, 1913, 1931, 1949, 1951, 1963, 1973, 1987, 1993, 1999, 2003, 2011, 2017, 2027, 2029, 2039, 2053, 2063, 2081, 2083, 2089, 2099, 2111, 2113, 2129, 2131, 2147, 2161, 2179, 2197, 2203, 2207, 2213, 2239, 2243, 2251, 2267, 2281, 2287, 2293, 2309, 2311, 2333, 2339, 2351, 2357, 2369, 2381, 2383, 2399, 2411, 2423, 2447, 2449, 2467, 2473, 2479, 2503, 2511, 2521, 2531, 2539, 2543, 2549, 2557, 2561, 2567, 2579, 2581, 2591, 2593, 2609, 2617, 2621, 2633, 2647, 2657, 2663, 2671, 2683, 2687, 2699, 2707, 2711, 2713, 2719, 2729, 2731, 2749, 2753, 2767, 2771, 2777, 2789, 2791, 2801, 2803, 2819, 2833, 2837, 2839, 2843, 2857, 2859, 2861, 2867, 2879, 2881, 2891, 2893, 2909, 2911, 2917, 2927, 2931, 2939, 2947, 2953, 2957, 2963, 2969, 2971, 2981, 2983, 2999, 3001, 3011, 3019, 3023, 3031, 3037, 3041, 3049, 3061, 3067, 3079, 3083, 3089, 3091, 3101, 3103, 3109, 3113, 3121, 3127, 3137, 3139, 3143, 3147, 3151, 3157, 3167, 3169, 3173, 3181, 3187, 3191, 3193, 3197, 3203, 3207, 3211, 3217, 3221, 3227, 3229, 3233, 3237, 3241, 3247, 3251, 3257, 3259, 3263, 3267, 3271, 3277, 3281, 3283, 3287, 3293, 3297, 3301, 3307, 3311, 3317, 3323, 3327, 3331, 3337, 3341, 3347, 3349, 3353, 3359, 3367, 3371, 3373, 3379, 3381, 3383, 3389, 3391, 3397, 3401, 3407, 3409, 3413, 3417, 3421, 3427, 3431, 3433, 3437, 3439, 3443, 3447, 3449, 3453, 3457, 3461, 3463, 3467, 3469, 3473, 3479, 3481, 3483, 3487, 3491, 3493, 3497, 3501, 3503, 3509, 3511, 3517, 3521, 3523, 3527, 3529, 3533, 3537, 3541, 3543, 3547, 3549, 3553, 3557, 3559, 3563, 3567, 3569, 3571, 3577, 3581, 3583, 3587, 3589, 3593, 3597, 3601, 3607, 3609, 3613, 3617, 3619, 3623, 3627, 3629, 3631, 3637, 3639, 3643, 3647, 3649, 3653, 3657, 3659, 3661, 3667, 3669, 3671, 3673, 3677, 3679, 3683, 3687, 3689, 3691, 3697, 3701, 3703, 3707, 3709, 3713, 3717, 3719, 3721, 3727, 3729, 3731, 3733, 3737, 3739, 3743, 3747, 3749, 3753, 3757, 3759, 3761, 3767, 3769, 3771, 3773, 3777, 3779, 3781, 3783, 3787, 3789, 3791, 3793, 3797, 3799, 3801, 3803, 3807, 3809, 3811, 3813, 3817, 3821, 3823, 3827, 3829, 3833, 3837, 3839, 3841, 3843, 3847, 3849, 3853, 3857, 3859, 3861, 3863, 3867, 3869, 3871, 3873, 3877, 3879, 3881, 3883, 3887, 3889, 3891, 3893, 3897, 3899, 3901, 3903, 3907, 3909, 3911, 3913, 3917, 3919, 3921, 3923, 3927, 3929, 3931, 3933, 3937, 3939, 3941, 3943, 3947, 3949, 3953, 3957, 3959, 3961, 3963, 3967, 3969, 3971, 3973, 3977, 3979, 3981, 3983, 3987, 3989, 3991, 3993, 3997, 3999, 4001, 4003, 4007, 4009, 4011, 4013, 4017, 4019, 4021, 4023, 4027, 4029, 4031, 4033, 4037, 4039, 4041, 4043, 4047, 4049, 4051, 4053, 4057, 4059, 4061, 4063, 4067, 4069, 4071, 4073, 4077, 4079, 4081, 4083, 4087, 4089, 4091, 4093, 4097, 4099, 4101, 4103, 4107, 4109, 4111, 4113, 4117, 4119, 4121, 4123, 4127, 4129, 4131, 4133, 4137, 4139, 4141, 4143, 4147, 4149, 4151, 4153, 4157, 4159, 4161, 4163, 4167, 4169, 4171, 4173, 4177, 4179, 4181, 4183, 4187, 4189, 4191, 4193, 4197, 4199, 4201, 4203, 4207, 4209, 4211, 4213, 4217, 4219, 4221, 4223, 4227, 4229, 4231, 4233, 4237, 4239, 4241, 4243, 4247, 4249, 4251, 4253, 4257, 4259, 4261, 4263, 4267, 4269, 4271, 4273, 4277, 4279, 4281, 4283, 4287, 4289, 4291, 4293, 4297, 4299, 4301, 4303, 4307, 4309, 4311, 4313, 4317, 4319, 4321, 4323, 4327, 4329, 4331, 4333, 4337, 4339, 4341, 4343, 4347, 4349, 4351, 4353, 4357, 4359, 4361, 4363, 4367, 4369, 4371, 4373, 4377, 4379, 4381, 4383, 4387, 4389, 4391, 4393, 4397, 4399, 4401, 4403, 4407, 4409, 4411, 4413, 4417, 4419, 4421, 4423, 4427, 4429, 4431, 4433, 4437, 4439, 4441, 4443, 4447, 4449, 4451, 4453, 4457, 4459, 4461, 4463, 4467, 4469, 4471, 4473, 4477, 4479, 4481, 4483, 4487, 4489, 4491, 4493, 4497, 4499, 4501, 4503, 4507, 4509, 4511, 4513, 4517, 4519, 4521, 4523, 4527, 4529, 4531, 4533, 4537, 4539, 4541, 4543, 4547, 4549, 4551, 4553, 4557, 4559, 4561, 4563, 4567, 4569, 4571, 4573, 4577, 4579, 4581, 4583, 4587, 4589, 4591, 4593, 4597, 4599, 4601, 4603, 4607, 4609, 4611, 4613, 4617, 4619, 4621, 4623, 4627, 4629, 4631, 4633, 4637, 4639, 4641, 4643, 4647, 4649, 4651, 4653, 4657, 4659, 4661, 4663, 4667, 4669, 4671, 4673, 4677, 4679, 4681, 4683, 4687, 4689, 4691, 4693, 4697, 4699, 4701, 4703, 4707, 4709, 4711, 4713, 4717, 4719, 4721, 4723, 4727, 4729, 4731, 4733, 4737, 4739, 4741, 4743, 4747, 4749, 4751, 4753, 4757, 4759, 4761, 4763, 4767, 4769, 4771, 4773, 4777, 4779, 4781, 4783, 4787, 4789, 4791, 4793, 4797, 4799, 4801, 4803, 4807, 4809, 4811, 4813, 4817, 4819, 4821, 4823, 4827, 4829, 4831, 4833, 4837, 4839, 4841, 4843, 4847, 4849, 4851, 4853, 4857, 4859, 4861, 4863, 4867, 4869, 4871, 4873, 4877, 4879, 4881, 4883, 4887, 4889, 4891, 4893, 4897, 4899, 4901, 4903, 4907, 4909, 4911, 4913, 4917, 4919, 4921, 4923, 4927, 4929, 4931, 4933, 4937, 4939, 4941, 4943, 4947, 4949, 4951, 4953, 4957, 4959, 4961, 4963, 4967, 4969, 4971, 4973, 4977, 4979, 4981, 4983, 4987, 4989, 4991, 4993, 4997, 4999, 5001, 5003, 5007, 5009, 5011, 5013, 5017, 5019, 5021, 5023, 5027, 5029, 5031, 5033, 5037, 5039, 5041, 5043, 5047, 5049, 5051, 5053, 5057, 5059, 5061, 5063, 5067, 5069, 5071, 5073, 5077, 5079, 5081, 5083, 5087, 5089, 5091, 5093, 5097, 5099, 5101, 5103, 5107, 5109, 5111, 5113, 5117, 5119, 5121, 5123, 5127, 5129, 5131, 5133, 5137, 5139, 5141, 5143, 5147, 5149, 5151, 5153, 5157, 5159, 5161, 5163, 5167, 5169, 5171, 5173, 5177, 5179, 5181, 5183, 5187, 5189, 5191, 5193, 5197, 5199, 5201, 5203, 5207, 5209, 5211, 5213, 5217, 5219, 5221, 5223, 5227, 5229, 5231, 5233, 5237, 5239, 5241, 5243, 5247, 5249, 5251, 5253, 5257, 5259, 5261, 5263, 5267, 5269, 5271, 5273, 5277, 5279, 5281, 5283, 5287, 5289, 5291, 5293, 5297, 5299, 5301, 5303, 5307, 5309, 5311, 5313, 5317, 5319, 5321, 5323, 5327, 5329, 5331, 5333, 5337, 5339, 5341, 5343, 5347, 5349, 5351, 5353, 5357, 5359, 5361, 5363, 5367, 5369, 5371, 5373, 5377, 5379, 5381, 5383, 5387, 5389, 5391, 5393, 5397, 5399, 5401, 5403, 5407, 5409, 5411, 5413, 5417, 5419, 5421, 5423, 5427, 5429, 5431, 5433, 5437, 5439, 5441, 5443, 5447, 5449, 5451, 5453, 5457, 5459, 5461, 5463, 5467, 5469, 5471, 5473, 5477, 5479, 5481, 5483, 5487, 5489, 5491, 5493, 5497, 5499, 5501, 5503, 5507, 5509, 5511, 5513, 5517, 5519, 5521, 5523, 5527, 5529, 5531, 5533, 5537, 5539, 5541, 5543, 5547, 5549, 5551, 5553, 5557, 5559, 5561, 5563, 5567, 5569, 5571, 5573, 5577, 5579, 5581, 5583, 5587, 5589, 5591, 5593, 5597, 5599, 5601, 5603, 5607, 5609, 5611, 5613, 5617, 5619, 5621, 5623, 5627, 5629, 5631, 5633, 5637, 5639, 5641, 5643, 5647, 5649, 5651, 5653, 5657, 5659, 5661, 5663, 5667, 5669, 5671, 5673, 5677, 5679, 5681, 5683, 5687, 5689, 5691, 5693, 5697, 5699, 5701, 5703, 5707, 5709, 5711, 5713, 5717, 5719, 5721, 5723, 5727, 5729, 5731, 5733, 5737, 5739, 5741, 5743, 5747, 5749, 5751, 5753, 5757, 5759, 5761, 5763, 5767, 5769, 5771, 5773, 5777, 5779, 5781, 5783, 5787, 5789, 5791, 5793, 5797, 5799, 5801, 5803, 5807, 5809, 5811, 5813, 5817, 5819, 5821, 5823, 5827, 5829, 5831, 5833, 5837, 5839, 5841, 5843, 5847, 5849, 5851, 5853, 5857, 5859, 5861, 5863, 5867, 5869, 5871, 5873, 5877, 5879, 5881, 5883, 5887, 5889, 5891, 5893, 5897, 5899, 5901, 5903, 5907, 5909, 5911, 5913, 5917, 5919, 5921, 5923, 5927, 5929, 5931, 5933, 5937, 5939, 5941, 5943, 5947, 5949, 5951, 5953, 5957, 5959, 5961, 5963, 5967, 5969, 5971, 5973, 5977, 5979, 5981, 5983, 5987, 5989, 5991, 5993, 5997, 5999, 6001, 6003, 6007, 6009, 6011, 6013, 6017, 6019, 6021, 6023, 6027, 6029, 6031, 6033, 6037, 6039, 6041, 6043, 6047, 6049, 6051, 6053, 6057, 6059, 6061, 6063, 6067, 6069, 6071, 6073, 6077, 6079, 6081, 6083, 6087, 6089, 6091, 6093, 6097, 6099, 6101, 6103, 6107, 6109, 6111, 6113, 6117, 6119, 6121, 6123, 6127, 6129, 6131, 6133, 6137, 6139, 6141, 6143, 6147, 6149, 6151, 6153, 6157, 6159, 6161, 6163, 6167, 6169, 6171, 6173, 6177, 6179, 6181, 6183, 6187, 6189, 6191, 6193, 6197, 6199, 6201, 6203, 6207, 6209, 6211, 6213, 6217, 6219, 6221, 6223, 6227, 6229, 6231, 6233, 6237, 6239, 6241, 6243, 6247, 6249, 6251, 6253, 6257, 6259, 6261, 6263, 6267, 6269, 6271, 6273, 6277, 6279, 6281, 6283, 6287, 6289, 6291, 6293, 6297, 6299, 6301, 6303, 6307, 6309, 6311, 6313, 6317, 6319, 6321, 6323, 6327, 6329, 6331, 6333, 6337, 6339, 6341, 6343, 6347, 6349, 6351, 6353, 6357, 6359, 6361, 6363, 6367, 6369, 6371, 6373, 6377, 6379, 6381, 6383, 6387, 6389, 6391, 6393, 6397, 6399, 6401, 6403, 6407, 6409, 6411, 6413, 6417, 6419, 6421, 6423, 6427, 6429, 6431, 6433, 6437, 6439, 6441, 6443, 6447, 6449, 6451, 6453, 6457, 6459, 6461, 6463, 6467, 6469, 6471, 6473, 6477, 6479, 6481, 6483, 6487, 6489, 6491, 6493, 6497, 6499, 6501, 6503, 6507, 6509, 6511, 6513, 6517, 6519, 6521, 6523, 6527, 6529, 6531, 6533, 6537, 6539, 6541, 6543, 6547, 6549, 6551, 6553, 6557, 6559, 6561, 6563, 6567, 6569, 6571, 6573, 6577, 6579, 6581, 6583, 6587, 6589, 6591, 6593, 6597, 6599, 6601, 6603, 6607, 6609, 6611, 6613, 6617, 6619, 6621, 6623, 6627, 6629, 6631, 6633, 6637, 6639, 6641, 6643, 6647, 6649, 6651, 6653, 6657, 6659, 6661, 6663, 6667, 6669, 6671, 6673, 6677, 6679, 6681, 6683, 6687, 6689, 6691, 6693, 6697, 6699, 6701, 6703, 6707, 6709, 6711, 6713, 6717, 6719, 6721, 6723, 6727, 6729, 6731, 6733, 6737, 6739, 6741, 6743, 6747, 6749, 6751, 6753, 6757, 6759, 6761, 6763, 6767, 6769, 6771, 6773, 6777, 6779, 6781, 6783, 6787, 6789, 6791, 6793, 6797, 6799, 6801, 6803, 6807, 6809, 6811, 6813, 6817, 6819, 6821, 6823, 6827, 6829, 6831, 6833, 6837, 6839, 6841, 6843, 6847, 6849, 6851, 6853, 6857, 6859, 6861, 6863, 6867, 6869, 6871, 6873, 6877, 6879, 6881, 6883, 6887, 6889, 6891, 6893, 6897, 6899, 6901, 6903, 6907, 6909, 6911, 6913, 6917, 6919, 6921, 6923, 6927, 6929, 6931, 6933, 6937, 6939, 6941, 6943, 6947, 6949, 6951, 6953, 6957, 6959, 6961, 6963, 6967, 6969, 6971, 6973, 6977, 6979, 6981, 6983, 6987, 6989, 6991, 6993, 6997, 6999, 7001, 7003, 7007, 7009, 7011, 7013, 7017, 7019, 7021, 7023, 7027, 7029, 7031, 7033, 7037, 7039, 7041, 7043, 7047, 7049, 7051, 7053, 7057, 7059, 7061, 7063, 7067, 7069, 7071, 7073, 7077, 7079, 7081, 7083, 7087, 7089, 7091, 7093, 7097, 7099, 7101, 7103, 7107, 7109, 7111, 7113, 7117, 7119, 7121, 7123, 7127, 7129, 7131, 7133, 7137, 7139, 7141, 7143, 7147, 7149, 7151, 7153, 7157, 7159, 7161, 7163, 7167, 7169, 7171, 7173, 7177, 7179, 7181, 7183, 7187, 7189, 7191, 7193, 7197, 7199, 7201, 7203, 7207, 7209, 7211, 7213, 7217, 7219, 7221, 7223, 7227, 7229, 7231, 7233, 7237, 7239, 7241, 7243, 7247, 7249, 7251, 7253, 7257, 7259, 7261, 7263, 7267, 7269, 7271, 7273, 7277, 7279, 7281, 7283, 7287, 7289, 7291, 7293, 7297, 7299, 7301, 7303, 7307, 7309, 7311, 7313, 7317, 7319, 7321, 7323, 7327, 7329, 7331, 7333, 7337, 7339, 7341, 7343, 7347, 7349, 7351, 7353, 7357, 7359, 7361, 7363, 7367, 7369, 7371, 7373, 7377, 7379, 7381, 7383, 7387, 7389, 7391, 7393, 7397, 7399, 7401, 7403, 7407, 7409, 7411, 7413, 7417, 7419, 7421, 7423, 7427, 7429, 7431, 7433, 7437, 7439, 7441, 7443, 7447, 7449, 7451, 7453