Advent of Code [About] [Events] [Shop] [Settings] [Log Out] jhillierdavis 37* {'year':2021} [Calendar] [AoC++] [Sponsors] [Leaderboard] [Stats] Day 19: Beacon Scanner	
As your probe drifted down through this area, it released an assortment of beacons and scanners into the water. It's difficult to navigate in the pitch black open waters of the ocean trench, but if you can build a map of the trench using data from the scanners, you should be able to safely reach the bottom.  The beacons and scanners float motionless in the water; they're designed to maintain the same position for long periods of time. Each scanner is capable of detecting all beacons in a large cube centered on the scanner; beacons that are at most 1000 units away from the scanner in each of the three axes (%, %), and [2) have their precise position determined relative to the scanner. However, scanners cannot detect other scanners. The submarine has automatically summarized the relative positions of beacons detected by each scanner (your puzzle input).  For example, if a scanner is at [3,9,2] coordinates [500,8,-500] and there are beacons at [500,1008,-1500] and [1501,8,-500], the scanner could report that the first beacon is at [1008,1000,-1000] (relative to the scanner) but would not detect the second beacon at all.  Unfortunately, while each scanner can report the positions of all detected beacons relative to itself, the scanners do not know their own position.  You'll need to determine the positions of the beacons and scanners	Pexip - Join the team responsible for creating the video platform connecting people across borders, businesses and technologies. We're hiring!
The scanners and beacons map a single contiguous 3d region. This region can be reconstructed by finding pairs of scanners that have overlapping detection regions such that there are at least 12 beacons that both scanners detect within the overlap. By establishing 12 common beacons, you can precisely determine where the scanners are relative to each other, allowing you to reconstruct the beacon map one scanner at a time.  For a moment, consider only two dimensions. Suppose you have the following	
<pre>scanner reports: scanner 0 0,2 4,1 3,3 scanner 11,-1 -5,0 -2,1</pre>	
Drawing X increasing rightward, y increasing upward, scanners as S, and beacons as B, scanner 0 detects this: B. BB S Scanner 1 detects this:	
BBBBBBBBB	
BSB. S Unfortunately, there's a second problem: the scanners also don't know their rotation or facing direction. Due to magnetic alignment, each scanner is rotated some integer number of 90-degree turns around all of the X, Y, and Z axes. That is, one scanner might call a direction positive X, while another scanner might call that direction negative Y. Or, two scanners might agree on which direction is positive X, but one scanner might be upside-down from the perspective of the other scanner. In total, each	
scanner could be in any of 24 different orientations: facing positive or negative x, y, or z, and considering any of four directions "up" from that facing.  For example, here is an arrangement of beacons as seen from a scanner in the same position but in different orientations:  scanner 01,-1,1 -2,-2,2	
-3,-3,3 -2,-3,1 5,6,-4 8,0,7 scanner 0 1,-1,1 2,-2,2 3,-3,3 2,-1,3	
-5,4,-6 -8,-7,0  scanner 01,-1,-1 -2,-2,-2 -3,-3,-3 -1,-3,-2 4,6,5 -7,0,8	
scanner 0 1,1,-1 2,2,-2 3,3,-3 1,3,-2 -4,-6,5 7,0,8 scanner 0	
1,1,1 2,2,2 3,3,3 3,1,2 -6,-4,-5 0,7,-8  By finding pairs of scanners that both see at least 12 of the same beacons, you can assemble the entire map. For example, consider the following report:	
scanner 0 404, -588, -901 528, -643, 409 -838, 591, 734 390, -675, -793 -537, -823, -458 -485, -357, 347 -345, -311, 381 -661, -816, -575 -876, 649, 763	
-618, -824, -621 553, 345, -567 474, 580, 667 -447, -329, 318 -584, 868, -557 544, -627, -890 564, 392, -477 455, 729, 728 -892, 524, 684 -689, 845, -530	
423,-701,434 7,-33,-71 630,319,-379 443,580,662 -789,900,-551 459,-707,401 scanner 1 686,422,578 605,423,415 515,623,706	
515,917,-361 -336,658,858 95,138,22 -476,619,847 -340,-569,-846 567,-361,727 -460,603,-452 669,-402,600 729,430,532 -500,-761,534 -322,571,750	
-466, -666, -811 -429, -592, 574 -355, 545, -477 703, -491, -529 -328, -685, 520 413, 935, -424 -391, 539, -444 586, -435, 557 -364, -763, -893 807, -499, -711	
755, -354, -619 553, 889, -390  scanner 2 649, 640, 665 682, -795, 504 -784, 533, -524 -644, 584, -595 -588, -843, 648 -30, 6, 44	
-674,560,763 500,723,-460 609,671,-379 -555,-800,653 -675,-892,-343 697,-426,-610 578,704,681 493,664,-388 -671,-858,530 -667,343,800	
571,-461,-707 -138,-166,112 -889,563,-600 646,-828,498 640,759,510 -630,509,768 -681,-892,-333 673,-379,-804 -742,-814,-386 577,-820,562	
scanner 3589,542,597 605,-692,669 -500,565,-823 -660,373,557 -458,-679,-417 -488,449,543 -626,468,-788 338,-750,-386 528,-832,-391	
562, -778, 733 -938, -730, 414 543, 643, -506 -524, 371, -870 407, 773, 750 -104, 29, 83 378, -903, -323 -778, -728, 485 426, 699, 580 -438, -605, -362	
-469,-447,-387 509,732,623 647,635,-688 -868,-804,481 614,-800,639 595,780,-596 scanner 4 727,592,562 -293,-554,779	
441,611,-461 -714,465,-776 -743,427,-804 -660,-479,-426 832,-632,460 927,-485,-438 408,393,-506 466,436,-512 110,16,151 -258,-428,682 -393,719,612	
-211, -452, 876 808, -476, -593 -575, 615, 604 -485, 667, 467 -680, 325, -822 -627, -443, -432 872, -547, -609 833, 512, 582 807, 604, 487 839, -516, 451	
891,-625,532 -652,-548,-490 30,-46,-14  Because all coordinates are relative, in this example, all "absolute" positions will be expressed relative to scanner 0 (using the orientation of scanner 0 and as if scanner 0 is at coordinates 0,0,0).  Scanners 0 and 1 have overlapping detection cubes; the 12 beacons they both detect (relative to scanner 0) are at the following coordinates:	
-618,-824,-621 -537,-823,-458 -447,-329,318 404,-588,-901 544,-627,-890 528,-643,409 -661,-816,-575 390,-675,-793 423,-701,434 -345,-311,381	
459,-707,401 -485,-357,347  These same 12 beacons (in the same order) but from the perspective of scanner 1 are:  686,422,578 605,423,415 515,917,-361 -336,658,858 -476,619,847	
-460,603,-452 729,430,532 -322,571,750 -355,545,-477 413,935,-424 -391,539,-444 553,889,-390  Because of this, scanner 1 must be at 68,-1246,-43 (relative to scanner 0).  Scanner 4 overlans with scanner 1: the 12 beacons they both detect	
Scanner [4] overlaps with scanner [1]; the 12 beacons they both detect (relative to scanner [0]) are:  459,-707,401 -739,-1745,668 -485,-357,347 432,-2009,850 528,-643,409 423,-701,434 -345,-311,381 408,-1815,803 534 -1912 768	
534,-1912,768 -687,-1600,576 -447,-329,318 -635,-1737,486  So, scanner 4 is at -20,-1133,1061 (relative to scanner 0).  Following this process, scanner 2 must be at 1105,-1205,1229 (relative to scanner 0) and scanner 3 must be at -92,-2380,-20 (relative to scanner 0).  The full list of beacons (relative to scanner 0) is:	
-892,524,684 -876,649,763 -838,591,734 -789,900,-551 -739,-1745,668 -706,-3180,-659 -697,-3072,-689 -689,845,-530 -687,-1600,576	
-661,-816,-575 -654,-3158,-753 -635,-1737,486 -631,-672,1502 -624,-1620,1868 -620,-3212,371 -618,-824,-621 -612,-1695,1788 -601,-1648,-643 -584,868,-557 -537,-823,-458	
-532,-1715,1894 -518,-1681,-600 -499,-1607,-770 -485,-357,347 -470,-3283,303 -456,-621,1527 -447,-329,318 -430,-3130,366 -413,-627,1469 -345,-311,381	
-36, -1284, 1171 -27, -1108, -65 7, -33, -71 12, -2351, -103 26, -1119, 1091 346, -2985, 342 366, -3059, 397 377, -2827, 367 390, -675, -793 396, -1931, -563	
404, -588, -901 408, -1815, 803 423, -701, 434 432, -2009, 850 443, 580, 662 455, 729, 728 456, -540, 1869 459, -707, 401 465, -695, 1988 474, 580, 667	
496,-1584,1900 497,-1838,-617 527,-524,1933 528,-643,409 534,-1912,768 544,-627,-890 553,345,-567 564,392,-477 568,-2007,-577 605,-1665,1952 612,-1593,1893	
612,-1593,1893 630,319,-379 686,-3108,-505 776,-3184,-501 846,-3110,-434 1135,-1161,1235 1243,-1093,1063 1660,-552,429 1693,-557,386 1735,-437,1738 1749,-1800,1813	
1749,-1800,1813 1772,-405,1572 1776,-675,371 1779,-442,1789 1780,-1548,337 1786,-1538,337 1847,-1591,415 1889,-1729,1762 1994,-1805,1792 In total, there are 79 beacons.	
Assemble the full map of beacons. How many beacons are there?  Your puzzle answer was 383.  The first half of this puzzle is complete! It provides one gold star: *  Part Two	
Sometimes, it's a good idea to appreciate just how big the ocean is. Using the Manhattan distance, how far apart do the scanners get?  In the above example, scanners 2 (1105,-1205,1229) and 3 (-92,-2380,-20) are the largest Manhattan distance apart. In total, they are 1197 + 1175 + 1249 = 3621 units apart.  What is the largest Manhattan distance between any two scanners?  Answer: [Submit]	
Although it hasn't changed, you can still get your puzzle input.	

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