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CS 205: Final Exam Question 4

1. **For a given value of D, give an explicit formula for an (x0, y0) and a, b to parameterize the integer solutions to the above. The formula should be in terms of D, and an integer parameter k.**
2. **Are you confident that your parameterization captures all integer solutions to 3x+5y = D? For any D? Why?**

* I am confident that this equation works for this particular problem as 3, 5 are prime numbers which is one the requirements. It will work for any D because we have established a relationship between x and y, that secures particular solutions (integers).

*3x + 5y + 7z = 1*

1. **Prove that for any integer value of z, there are integer solutions for x and y.**

* Assuming z = 0, we can now see if 3x + 5y = 1, has any solutions
* Let d = gcd(3, 5) = 1
* The gcd is 1, 1 divides 1.
* The gcd between 3, 5, 7 is also 1, and 1 divides 1.

1. **Parameterize the set of integer solutions (x, y, z) in terms of an integer z and an integer parameter k. Note, because the above equation represents a place in 3-D space, the solutions are two dimensional, and thus require two parameters (in this case, z and k).**

* x = 2 + 5k - 4m
* y = -1 - 3k + m
* z = m

1. **Are you confident that your parameterization captures all integer solutions (x, y, z)? Why?**

Yes, there are solutions to the equation. The parameterization allows us to find all particular solutions to this Diophantine equation (in particular integers), the parameterization is essentially a relationship (point of intersection) of integers.

*3x + 5y + 7z = 1*

*7x + 3y + 5z = 1*

1. **Are there any integer solutions (x y, z) that satisfy both these equations simultaneously? The intersection of two planes is a line, so give a 1-D integer parameterization of the integer solutions to this system.**

* 9x + 15y + 21z = 3
* -35x + -15y + -25z = -5
* = -26x - 4z = -2
* *z = a*
* = -4a + 2 = 26x
* = (-4a + 2)/26 = x
* = (-2a+1)/13 = x
* 3((-2a+1)/13) + 5y + 7a = 1
* (-6a + 3 / 13) + 5y + 7a = 1
* -6a + 3 + (13)5y + (13)7a = 13
* -6a + 65y + 91a = 10
* 85a + 65y = 10
* 65y = 10 – 85a
* y = (10 – 85a)/65
* y = (10 – 85a)/65
* x = (-2a+1)/13
* z = a

**Bonus:**

Complication is that numbers aren’t relatively prime.

GCD(21, 15) = 3

* x = 1 + 5k – 5m
* y = -6 – 7k
* z = 2 + 3m