Daily Challenge with Po-Shen Loh

Module 5: Number Theory Tools

Course Name	Covered Topics	Learning Time
Get Ready	Course Introduction Video, Prerequisite Check, Who Should Take This Course, Help Us Know More about You, How to Use This Course	10 - 20 mins
Day 1 Challenge	Remainder mod 10, definition of modular congruency, notation of a modulo b, remainders of n^2, modular addition, subtraction and multiplication, remainders modulo 11, negative remainders	50 - 60 min
Day 2 Challenge	Explanation and motivation for divisibility rules for 3 and 9 and shortcuts for their use; sum and average of an arithmetic progression, triangular numbers, modular multiplication	40 - 50 min
Day 3 Challenge	Explanation and motivation for divisibility rules for 2, 4, and 8 and shortcuts for their use; permutations; divisibility by 12; sum and average of arithmetic progression; negative remainders	50 - 65 min
Day 4 Challenge	Remainders after dividing by 99; factors; patterns in multiples of 9 mod 1; Palindromic numbers; factors of 1001 and 1111; negative remainders; remainders mod 11; arithmetic progression	50 - 60 min
Week 1 Challenge	40-minute-20 practice problem assessment of Day 1 to Day 4 materials	60 minutes (up to 4 tries in total)
Day 5 Challenge	Prime factorization; number of factors; sum of factors; average of factors; sum of reciprocals of factors; product of factors; factors of 111; expanding factors; sum of consecutive powers of 2; geometric series	45 - 55 min
Day 6 Challenge	Number of zeroes at the end of combinatorial expressions such as factorial, ways to choose n objects; modular multiplication; floor function; ways to choose n objects; sum of consecutive powers of 2;	45 - 55 min
Day 7 Challenge	Least Common Multiple (LCM); Greatest Common Divisor (GCD); prime factorization; product of LCM and GCD; quotient of LCM and GCD; factorials;	45 - 55 min
Day 8 Challenge	Motivation for and examples of Euclidean Algorithm for finding GCD; Fibonacci numbers; factors of 111; relatively prime numbers	40 - 50 min
Week 2 Challenge	40-minute-20 practice problem assessment of Day 5 to Day 8 materials	60 minutes (up to 4 tries in total)
Day 9 Challenge	Relatively prime numbers; pattern of cycling remainders; remainders of multiples of 2, 3, 4, 5, 6, 7, 8 and 9; Venn Diagram; Inclusion/exclusion; Euler's Totient Function	45 - 55 min
Day 10 Challenge	Chinese Remainder Theorem and use with composite moduli; negative remainders; solving sets of congruencies; LCM; remainders of multiples of 6 mod 5; negative remainders	80 - 90 min
Day 11 Challenge	Chinese Remainder Theorem with non-relatively-prime moduli; remainders of multiples of 9 mod 12; cycles of remainders of multiples of 9; LCM; reduction of systems of congruencies; unsolvable congruencies	50 - 60 min
Day 12 Challenge	Systems of three congruencies; Euler's Totient Function; remainders modulo composite numbers; pairwise relatively prime numbers; Venn Diagram; factoring; combinatorial counting	60 - 70 min
Week 3 Challenge	40-minute-20 practice problem assessment of Day 5 to Day 8 materials	60 minutes (up to 4 tries in total)
Day 13 Challenge	Factoring tricks for solving algebraic equations; area and perimeter of rectangles; number of ways to factor; equations in $^1/_x$; impossibility of division by 0; number of integers solutions to an equation	50 - 60 min
Day 14 Challenge	Remainders of powers; cycles of remainders of powers; pattern of last two digits of powers of 7; remainders of powers of 7 mod 4; power towers	55 - 60 min
Day 15 Challenge	Multiplicative inverses with respect to a modulus; explanation and motivation for divisibility trick for 7; repeating cycles of remainders	60 - 70 min
Day 16 Challenge	Terminating decimals and their fraction representations; Repeating periods of repeating decimals; Proof of why $\sqrt{2}$ is irrational; Prime factorization; Proof techiques and directions of logic; Proof by contradiction	45 - 55 min
Week 4 Challenge	40-minute-20 practice problem assessment of Day 1 to Day 4 materials	60 minutes (up to 4 tries in total)