HW6

Alberc Ej Salcedo

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1 Modular Exponentiation

1. Compute the binary expansion of 2019
   $2019 = 2(1009) + 1$
   $1009 = 2(504) + 1$
   $504 = 2(252) + 0$
   $252 = 2(126) + 0$
   $126 = 2(63) + 0$
   $63 = 2(31) + 1$
   $31 = 2(15) + 1$
   $15 = 2(7) + 1$
   $7 = 2(3) + 1$
   $3 = 2(1) + 1$
   $1 = 2(0) + 1$

2. $(13^{2^{16}} + 2^9 + 2^7 + 2^6 + 2^5 + 2^1 + 2^0)\ mod\ 37$
   $= (13^{210} * 13^{2^9} * 13^{2^8} * 13^{2^7} * 13^{2^6} * 13^{2^5} * 13^{2^1} * 13^{2^0})\ mod\ 37$
   $13^{2^0}\ mod\ 37 = 13$
   $13^{2^1}\ mod\ 37 = 21$
   $13^{2^2}\ mod\ 37 = 34$
   $13^{2^3\ mod\ 37} = 9$
   $13^{2^4\ mod\ 37} = 7$
   $13^{2^5\ mod\ 37} = 12$
   $13^{2^6\ mod\ 37} = 33$
   $13^{2^7\ mod\ 37} = 16$
   $13^{2^8\ mod\ 37} = 34$
   $13^{2^9\ mod\ 37} = 9$
   $13^{2^{10}\ mod\ 37} = 7$

   $13^{2019}\ mod\ 37 = 370577376$

2 Greatest Commonm Divisor

1. gcd(288, 126)
   Factor: $1, 2, 3, 4, 6, 8, 9, 12, 16, 18, 24, 32, 36, 48, 72, 96, 144, 288$
   Factor: $1, 2, 3, 6, 7, 9, 14, 18, 21, 42, 63, 126$

gcd: 18

2. gcd(899, 703)
   Factor $899 = 1, 29, 31, 899$
   Factor $703 = 1, 19, 37, 703$
   gcd: 1