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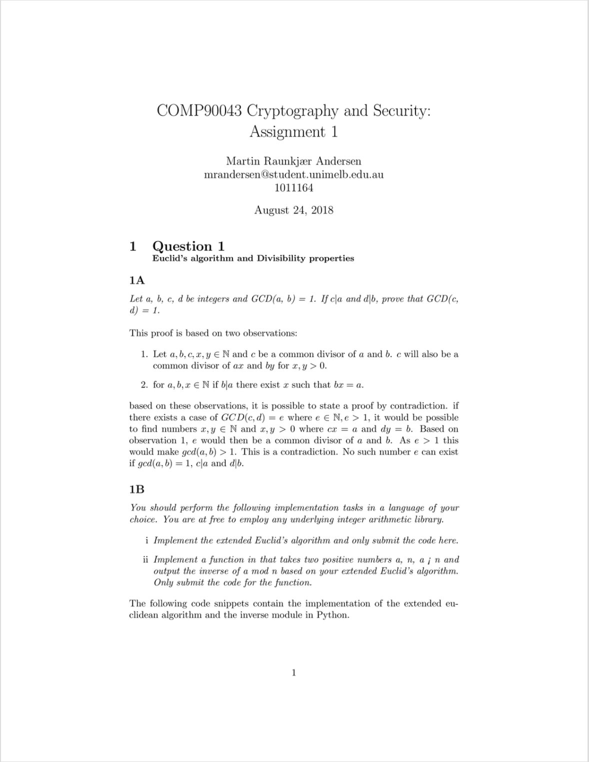

COMP90043 Cryptography and Security:
Assignment 1

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1 Question 1

Euclid's algorithm and Divisibility properties

1A

Let a, b, c, d be integers and GCD(a, b) = 1. If c|a and d|b, prove that GCD(c, d) = 1.

This proof is based on two observations:

1. Let $a, b, c, x, y \in \mathbb{N}$ and c be a common divisor of a and b. c will also be a common divisor of ax and by for $x, y > 0$.
2. for $a, b, x \in \mathbb{N}$ if $b|a$ there exist x such that $bx = a$.

based on these observations, it is possible to state a proof by contradiction. if there exists a case of $GCD(c, d) = e$ where $e \in \mathbb{N}, e > 1$, it would be possible to find numbers $x, y \in \mathbb{N}$ and $x, y > 0$ where $cx = a$ and $dy = b$. Based on observation 1, e would then be a common divisor of a and b. As $e > 1$ this would make $gcd(a, b) > 1$. This is a contradiction. No such number e can exist if $gcd(a, b) = 1$, $c|a$ and $d|b$.

1B

You should perform the following implementation tasks in a language of your choice. You are at free to employ any underlying integer arithmetic library.

i *Implement the extended Euclid's algorithm and only submit the code here.*

ii *Implement a function in that takes two positive numbers a, n, a ¡ n and output the inverse of a mod n based on your extended Euclid's algorithm. Only submit the code for the function.*

The following code snippets contain the implementation of the extended euclidean algorithm and the inverse module in Python.