TP: Elliptic Curve Cryptography

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1 SAGE

Download and install the Sage library [1].

2 NIST Curve P-192

The following elliptic-curve of equation:

$$E : y^2 = x^3 - 3x + b \mod p$$

is defined in [2], with:

$$\begin{aligned} p &= 6277101735386680763835789423207666416083908700390324961279 \\ n &= 6277101735386680763835789423176059013767194773182842284081 \\ b &= \texttt{0x64210519e59c80e70fa7e9ab72243049feb8deecc146b9b1} \\ G_x &= \texttt{0x188da80eb03090f67cbf20eb43a18800f4ff0afd82ff1012} \\ G_y &= \texttt{0x07192b95ffc8da78631011ed6b24cdd573f977a11e794811} \end{aligned}$$

where n is the group order and $G = (G_x, G_y)$ is a generator of this group.

1. Verify that p is a prime.
2. Verify that n is a prime.
3. Implement the elliptic curve addition algorithm
4. Implement the double and add algorithm
5. Verify that $nG = \mathcal{O}$. Therefore G is a generator of the elliptic-curve group of prime order n

3 EC El-Gamal Encryption

Implement El-Gamal encryption and decryption over the NIST curve P-192.

References

1. Sage Mathematical Library, Available at `http://www.sagemath.org/`
2. FIPS PUB 186-3, *Digital Signature Standard (DSS)*. Available at `http://csrc.nist.gov/publications/fips/fips186-3/fips_186-3.pdf`