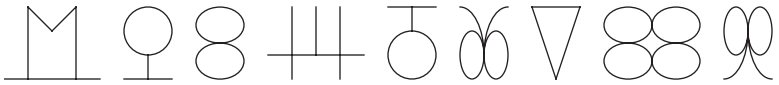
Outline for February 21, 2003

Reading: text, §9.2.3–9.3

Discussion Problem

Analyzing a cipher requires being able to spot patterns. See how good you are. What is the pattern in the following?



Outline for the Day

1. DES
2. Public-Key Cryptography
   a. Basic idea: 2 keys, one private, one public
   b. Cryptosystem must satisfy:
      i. given public key, CI to get private key;
      ii. cipher withstands chosen plaintext attack;
      iii. encryption, decryption computationally feasible [note: commutativity ***not*** required]
   c. Benefits: can give confidentiality or authentication or both
3. RSA
   a. Provides both authenticity and confidentiality
   b. Go through algorithm:

      Idea: $C = M^e \bmod n$, $M = C^d \bmod n$, with $ed \bmod \phi(n) = 1$.

      Proof: $M^{\phi(n)} \bmod n = 1$ [by Fermat's theorem as generalized by Euler]; follows immediately from $ed \bmod \phi(n) = 1$.

      Public key is (e, n); private key is d. Choose $n = pq$; then $\phi(n) = (p–1)(q–1)$.
   c. Example:

      $p = 5$, $q = 7$; $n = 35$, $\phi(n) = (5–1)(7–1) = 24$. Pick $d = 11$. Then $de \bmod \phi(n) = 1$, so choose $e = 11$. To encipher 2, $C = M^e \bmod n = 2^{11} \bmod 35 = 2048 \bmod 35 = 18$, and $M = C^d \bmod n = 18^{11} \bmod 35 = 2$.
   d. Example: $p = 53$, $q = 61$, $n = 3233$, $\phi(n) = (53–1)(61–1) = 3120$. Take $d = 791$; then $e = 71$. Encipher M = RENAISSANCE: A = 00, B = 01, …, Z = 25, blank = 26. Then:

      M = RE NA IS SA NC Eblank = 1704 1300 0818 1800 1302 0426

      $C = (1704)^{71} \bmod 3233 = 3106$; *etc.* = 3106 0100 0931 2691 1984 2927