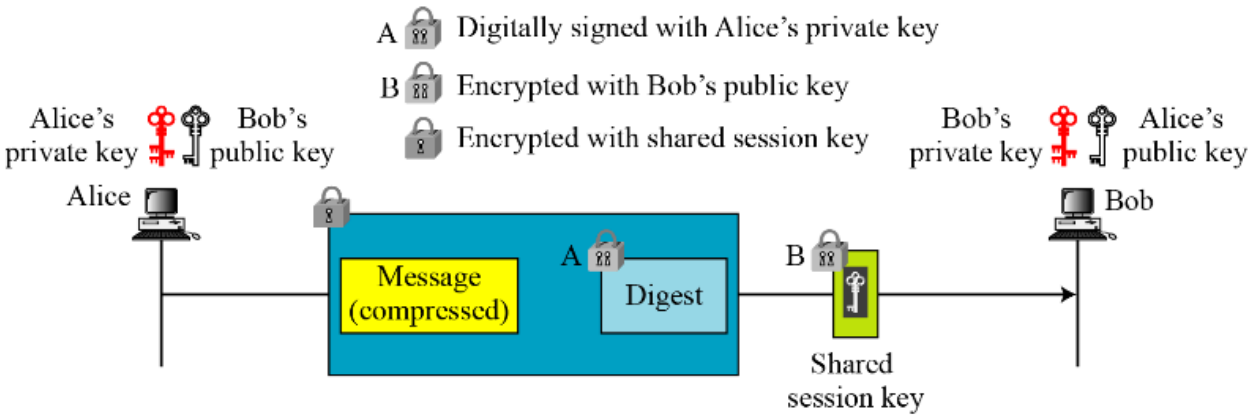
LAB ASSIGNMENT - 1

Deadline: 02/07/2024 (Monday) 11.59 PM

Following diagram shows a secure message transmission protocol:



Algorithms to Implement:

- **Key Generation:**
  - Generate two pairs of RSA keys (public and private).
  - Each key should be stored as separate binary files.
- **Digital Signature:**
  - Take the data file and create a digital signature of the data using the sender's RSA private key.
- **Message Encryption:**
  - Concatenate the generated signature with the data file.
  - Generate a random session key (AES-256)
  - Encrypt the concatenated data file using the generated session key.
  - Encrypt the session key with the recipient's RSA public key.
  - Store the encrypted data file and the encrypted key as two separate binary files.
- **Message Decryption:**
  - Extract the session key by decrypting the encrypted key file using the recipient's RSA private key.
  - Decrypt the data file using the session key.
  - Extract the plaintext data and the digital signature separately.

- **Signature Verification:**
    - Verify the integrity of the data by checking the signature using the sender's RSA public key.

Implementation Guidelines:

- Use OpenSSL libraries (`<openssl/rsa.h>`, `<openssl/pem.h>`, `<openssl/evp.h>`, `<openssl/err.h>`, etc.) to perform the cryptographic operations.
- Implement the following functions:
    - `generate_keys()`
    - `sign_message()`
    - `encrypt_message()`
    - `decrypt_message()`
    - `verify_signature()`

      Ensure that the implemented functions are non-interactive. All necessary files and inputs should be provided as command-line arguments. For example:

    - `./generate_keys`

      `Output: public_key_file, private_key_file`

    - `./sign_message private_key_file data_file`

      `Output: signature_file`

    - `./encrypt_message public_key_file data_file signature_file`

      `Output: encrypted_key_file, encrypted_data_file`

    - `./decrypt_message private_key_file encrypted_data_file encrypted_key_file`

      `Output: decrypted_data_file, decrypted_signature`

    - `./verify_signature public_key_file decrypted_data_file, decrypted_signature`

```
Output: Prints Success/Failure On Screen
```

- Ensure proper error handling for all OpenSSL function calls.