The SHA-512 implementation follows the NIST standard and consists of four main steps:

1. **Message Padding**: The input is padded to a multiple of 1024 bits, with the last 128 bits storing the message length.
2. **Message Schedule Generation**: For each 1024-bit block, I create 80 64-bit words. The first 16 come directly from the message block, and the rest are generated using bitwise operations.
3. **Round Processing**: Each block undergoes 80 rounds of processing using special functions:
    - Ch(x,y,z) = (x AND y) XOR ((NOT x) AND z)
    - Maj(x,y,z) = (x AND y) XOR (x AND z) XOR (y AND z)
    - Sigma0(x) = ROTR28(x) XOR ROTR34(x) XOR ROTR39(x)
    - Sigma1(x) = ROTR14(x) XOR ROTR18(x) XOR ROTR41(x)
    - sigma0(x) = ROTR1(x) XOR ROTR8(x) XOR SHR7(x)
    - sigma1(x) = ROTR19(x) XOR ROTR61(x) XOR SHR6(x)
4. **Hash Update**: After processing each block, the working variables are added to the current hash values to produce the updated hash.