Network Security

CSE-537

Practical Assignment 2(PA2)

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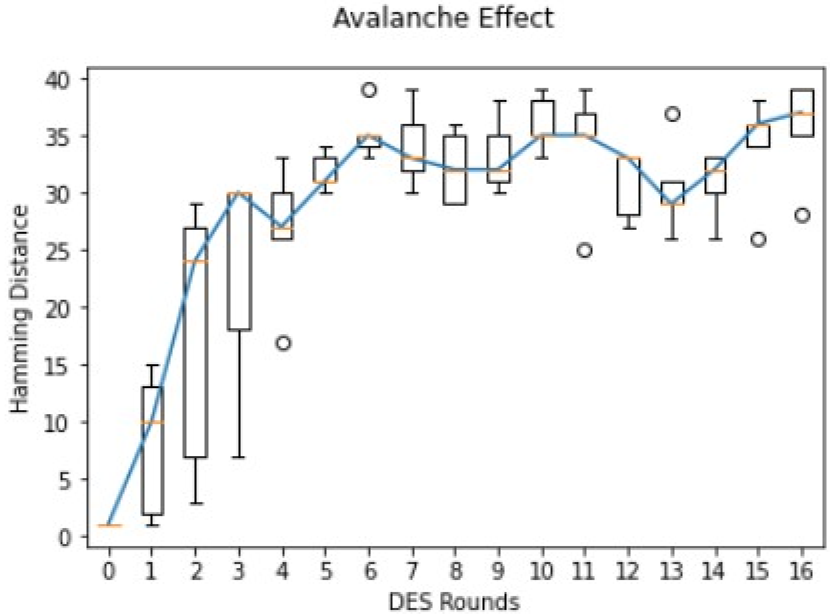
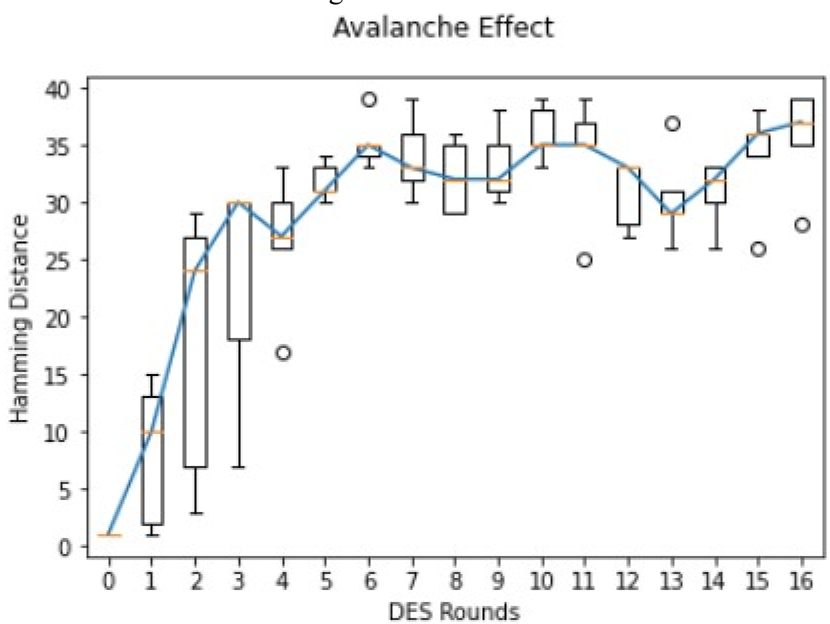
GITHUB Link - [Practical Assignment - 2]()

Plots of Hamming Distance for -

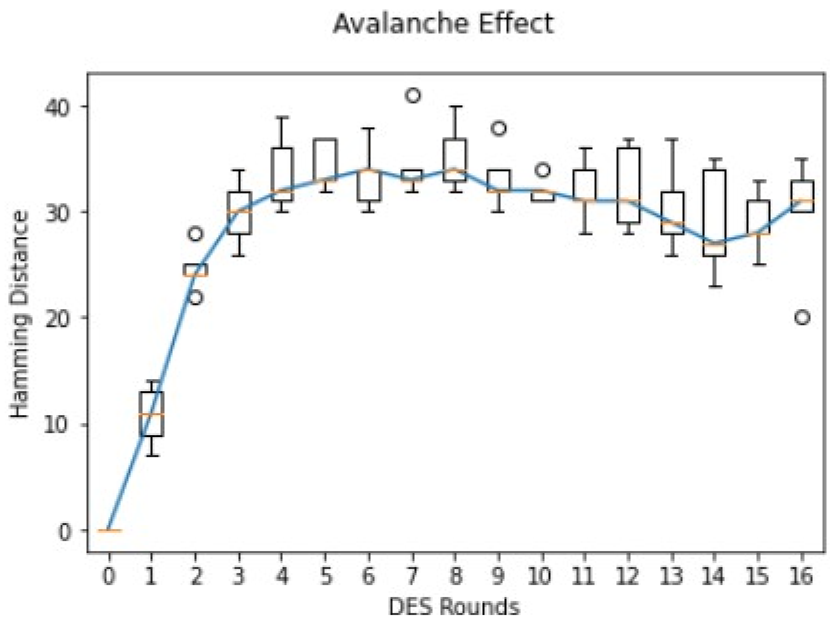
1. 5 different Plaintexts -



2. 5 different Hamming Distances -



3. 5 different Secret Keys -



Code -

```
# -*- coding: utf-8 -*-
"""18075001_AasavBadera_CSE-537_PracticalAssignment2.ipynb

Automatically generated by Colaboratory.

Original file is located at
    https://colab.research.google.com/drive/11rkOZ8RwB_urJOUT8bAzXNJnsZHPccEf
"""

import matplotlib.pyplot as plot
from tabulate import tabulate
import statistics

"""#DES Implementation"""

import sys
# DES implementation taken from
https://gist.github.com/eigenein/1275094#file-pydes-py-L61
# _pythonMajorVersion is used to handle Python2 and Python3 differences.
_pythonMajorVersion = sys.version_info[0]

# Modes of crypting / cyphering
ECB =   0
CBC =   1
```

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# Modes of padding
PAD_NORMAL = 1
PAD_PKCS5 = 2

# PAD_PKCS5: is a method that will unambiguously remove all padding
#            characters after decryption, when originally encrypted with
#            this padding mode.
# For a good description of the PKCS5 padding technique, see:
# http://www.faqs.org/rfcs/rfc1423.html

# The base class shared by des and triple des.

lis_main=[]
class _baseDes(object):
    def __init__(self, mode=ECB, IV=None, pad=None, padmode=PAD_NORMAL):
        if IV:
            IV = self._guardAgainstUnicode(IV)
        if pad:
            pad = self._guardAgainstUnicode(pad)
        self.block_size = 8
        # Sanity checking of arguments.
        if pad and padmode == PAD_PKCS5:
            raise ValueError("Cannot use a pad character with PAD_PKCS5")
        if IV and len(IV) != self.block_size:
            raise ValueError("Invalid Initial Value (IV), must be a multiple of
" + str(self.block_size) + " bytes")

        # Set the passed in variables
        self._mode = mode
        self._iv = IV
        self._padding = pad
        self._padmode = padmode

    def getKey(self):
        """getKey() -> bytes"""
        return self.__key

    def setKey(self, key):
        """Will set the crypting key for this object."""
        key = self._guardAgainstUnicode(key)
        self.__key = key

    def getMode(self):
        """getMode() -> pyDes.ECB or pyDes.CBC"""
        return self._mode
```

```
    def setMode(self, mode):
        """Sets the type of crypting mode, pyDes.ECB or pyDes.CBC"""
        self._mode = mode

    def getPadding(self):
        """getPadding() -> bytes of length 1. Padding character."""
        return self._padding

    def setPadding(self, pad):
        """setPadding() -> bytes of length 1. Padding character."""
        if pad is not None:
            pad = self._guardAgainstUnicode(pad)
        self._padding = pad

    def getPadMode(self):
        """getPadMode() -> pyDes.PAD_NORMAL or pyDes.PAD_PKCS5"""
        return self._padmode

    def setPadMode(self, mode):
        """Sets the type of padding mode, pyDes.PAD_NORMAL or
pyDes.PAD_PKCS5"""
        self._padmode = mode

    def getIV(self):
        """getIV() -> bytes"""
        return self._iv

    def setIV(self, IV):
        """Will set the Initial Value, used in conjunction with CBC mode"""
        if not IV or len(IV) != self.block_size:
            raise ValueError("Invalid Initial Value (IV), must be a multiple of
" + str(self.block_size) + " bytes")
        IV = self._guardAgainstUnicode(IV)
        self._iv = IV

    def _padData(self, data, pad, padmode):
        # Pad data depending on the mode
        if padmode is None:
            # Get the default padding mode.
            padmode = self.getPadMode()
        if pad and padmode == PAD_PKCS5:
            raise ValueError("Cannot use a pad character with PAD_PKCS5")

        if padmode == PAD_NORMAL:
```

```
            if len(data) % self.block_size == 0:
                # No padding required.
                return data

            if not pad:
                # Get the default padding.
                pad = self.getPadding()
            if not pad:
                raise ValueError("Data must be a multiple of " +
str(self.block_size) + " bytes in length. Use padmode=PAD_PKCS5 or set the pad
character.")
            data += (self.block_size - (len(data) % self.block_size)) * pad

        elif padmode == PAD_PKCS5:
            pad_len = 8 - (len(data) % self.block_size)
            if _pythonMajorVersion < 3:
                data += pad_len * chr(pad_len)
            else:
                data += bytes([pad_len] * pad_len)

        return data

    def _unpadData(self, data, pad, padmode):
        # Unpad data depending on the mode.
        if not data:
            return data
        if pad and padmode == PAD_PKCS5:
            raise ValueError("Cannot use a pad character with PAD_PKCS5")
        if padmode is None:
            # Get the default padding mode.
            padmode = self.getPadMode()

        if padmode == PAD_NORMAL:
            if not pad:
                # Get the default padding.
                pad = self.getPadding()
            if pad:
                data = data[:-self.block_size] + \
                       data[-self.block_size:].rstrip(pad)

        elif padmode == PAD_PKCS5:
            if _pythonMajorVersion < 3:
                pad_len = ord(data[-1])
            else:
                pad_len = data[-1]
```

```
            data = data[:-pad_len]

        return data

    def _guardAgainstUnicode(self, data):
        # Only accept byte strings or ascii unicode values, otherwise
        # there is no way to correctly decode the data into bytes.
        if _pythonMajorVersion < 3:
            if isinstance(data, unicode):
                raise ValueError("pyDes can only work with bytes, not Unicode
strings.")
        else:
            if isinstance(data, str):
                # Only accept ascii unicode values.
                try:
                    return data.encode('ascii')
                except UnicodeEncodeError:
                    pass
                raise ValueError("pyDes can only work with encoded strings, not
Unicode.")
        return data

#############################################################################
#                   DES                     #
#############################################################################
class des(_baseDes):
    """DES encryption/decrytpion class
    Supports ECB (Electronic Code Book) and CBC (Cypher Block Chaining) modes.
    pyDes.des(key,[mode], [IV])
    key  -> Bytes containing the encryption key, must be exactly 8 bytes
    mode -> Optional argument for encryption type, can be either pyDes.ECB
        (Electronic Code Book), pyDes.CBC (Cypher Block Chaining)
    IV   -> Optional Initial Value bytes, must be supplied if using CBC mode.
        Must be 8 bytes in length.
    pad  -> Optional argument, set the pad character (PAD_NORMAL) to use
        during all encrypt/decrpt operations done with this instance.
    padmode -> Optional argument, set the padding mode (PAD_NORMAL or
        PAD_PKCS5) to use during all encrypt/decrpt operations done
        with this instance.
    """


    # Permutation and translation tables for DES
    __pc1 = [56, 48, 40, 32, 24, 16,  8,
          0, 57, 49, 41, 33, 25, 17,
```

```
     9,  1, 58, 50, 42, 34, 26,
    18, 10,  2, 59, 51, 43, 35,
    62, 54, 46, 38, 30, 22, 14,
     6, 61, 53, 45, 37, 29, 21,
    13,  5, 60, 52, 44, 36, 28,
    20, 12,  4, 27, 19, 11,  3
]

# number left rotations of pc1
__left_rotations = [
    1, 1, 2, 2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 2, 1
]

# permuted choice key (table 2)
__pc2 = [
    13, 16, 10, 23,  0,  4,
     2, 27, 14,  5, 20,  9,
    22, 18, 11,  3, 25,  7,
    15,  6, 26, 19, 12,  1,
    40, 51, 30, 36, 46, 54,
    29, 39, 50, 44, 32, 47,
    43, 48, 38, 55, 33, 52,
    45, 41, 49, 35, 28, 31
]

# initial permutation IP
__ip = [57, 49, 41, 33, 25, 17, 9,  1,
    59, 51, 43, 35, 27, 19, 11, 3,
    61, 53, 45, 37, 29, 21, 13, 5,
    63, 55, 47, 39, 31, 23, 15, 7,
    56, 48, 40, 32, 24, 16, 8,  0,
    58, 50, 42, 34, 26, 18, 10, 2,
    60, 52, 44, 36, 28, 20, 12, 4,
    62, 54, 46, 38, 30, 22, 14, 6
]

# Expansion table for turning 32 bit blocks into 48 bits
__expansion_table = [
    31,  0,  1,  2,  3,  4,
     3,  4,  5,  6,  7,  8,
     7,  8,  9, 10, 11, 12,
    11, 12, 13, 14, 15, 16,
    15, 16, 17, 18, 19, 20,
    19, 20, 21, 22, 23, 24,
    23, 24, 25, 26, 27, 28,
```

```python
        27, 28, 29, 30, 31,  0
    ]

    # The (in)famous S-boxes
    __sbox = [
        # S1
        [14, 4, 13, 1, 2, 15, 11, 8, 3, 10, 6, 12, 5, 9, 0, 7,
         0, 15, 7, 4, 14, 2, 13, 1, 10, 6, 12, 11, 9, 5, 3, 8,
         4, 1, 14, 8, 13, 6, 2, 11, 15, 12, 9, 7, 3, 10, 5, 0,
         15, 12, 8, 2, 4, 9, 1, 7, 5, 11, 3, 14, 10, 0, 6, 13],

        # S2
        [15, 1, 8, 14, 6, 11, 3, 4, 9, 7, 2, 13, 12, 0, 5, 10,
         3, 13, 4, 7, 15, 2, 8, 14, 12, 0, 1, 10, 6, 9, 11, 5,
         0, 14, 7, 11, 10, 4, 13, 1, 5, 8, 12, 6, 9, 3, 2, 15,
         13, 8, 10, 1, 3, 15, 4, 2, 11, 6, 7, 12, 0, 5, 14, 9],

        # S3
        [10, 0, 9, 14, 6, 3, 15, 5, 1, 13, 12, 7, 11, 4, 2, 8,
         13, 7, 0, 9, 3, 4, 6, 10, 2, 8, 5, 14, 12, 11, 15, 1,
         13, 6, 4, 9, 8, 15, 3, 0, 11, 1, 2, 12, 5, 10, 14, 7,
         1, 10, 13, 0, 6, 9, 8, 7, 4, 15, 14, 3, 11, 5, 2, 12],

        # S4
        [7, 13, 14, 3, 0, 6, 9, 10, 1, 2, 8, 5, 11, 12, 4, 15,
         13, 8, 11, 5, 6, 15, 0, 3, 4, 7, 2, 12, 1, 10, 14, 9,
         10, 6, 9, 0, 12, 11, 7, 13, 15, 1, 3, 14, 5, 2, 8, 4,
         3, 15, 0, 6, 10, 1, 13, 8, 9, 4, 5, 11, 12, 7, 2, 14],

        # S5
        [2, 12, 4, 1, 7, 10, 11, 6, 8, 5, 3, 15, 13, 0, 14, 9,
         14, 11, 2, 12, 4, 7, 13, 1, 5, 0, 15, 10, 3, 9, 8, 6,
         4, 2, 1, 11, 10, 13, 7, 8, 15, 9, 12, 5, 6, 3, 0, 14,
         11, 8, 12, 7, 1, 14, 2, 13, 6, 15, 0, 9, 10, 4, 5, 3],

        # S6
        [12, 1, 10, 15, 9, 2, 6, 8, 0, 13, 3, 4, 14, 7, 5, 11,
         10, 15, 4, 2, 7, 12, 9, 5, 6, 1, 13, 14, 0, 11, 3, 8,
         9, 14, 15, 5, 2, 8, 12, 3, 7, 0, 4, 10, 1, 13, 11, 6,
         4, 3, 2, 12, 9, 5, 15, 10, 11, 14, 1, 7, 6, 0, 8, 13],

        # S7
        [4, 11, 2, 14, 15, 0, 8, 13, 3, 12, 9, 7, 5, 10, 6, 1,
         13, 0, 11, 7, 4, 9, 1, 10, 14, 3, 5, 12, 2, 15, 8, 6,
         1, 4, 11, 13, 12, 3, 7, 14, 10, 15, 6, 8, 0, 5, 9, 2,
```

```
         6, 11, 13, 8, 1, 4, 10, 7, 9, 5, 0, 15, 14, 2, 3, 12],

        # S8
        [13, 2, 8, 4, 6, 15, 11, 1, 10, 9, 3, 14, 5, 0, 12, 7,
         1, 15, 13, 8, 10, 3, 7, 4, 12, 5, 6, 11, 0, 14, 9, 2,
         7, 11, 4, 1, 9, 12, 14, 2, 0, 6, 10, 13, 15, 3, 5, 8,
         2, 1, 14, 7, 4, 10, 8, 13, 15, 12, 9, 0, 3, 5, 6, 11],
    ]


    # 32-bit permutation function P used on the output of the S-boxes
    __p = [
        15, 6, 19, 20, 28, 11,
        27, 16, 0, 14, 22, 25,
        4, 17, 30, 9, 1, 7,
        23,13, 31, 26, 2, 8,
        18, 12, 29, 5, 21, 10,
        3, 24
    ]

    # final permutation IP^-1
    __fp = [
        39,  7, 47, 15, 55, 23, 63, 31,
        38,  6, 46, 14, 54, 22, 62, 30,
        37,  5, 45, 13, 53, 21, 61, 29,
        36,  4, 44, 12, 52, 20, 60, 28,
        35,  3, 43, 11, 51, 19, 59, 27,
        34,  2, 42, 10, 50, 18, 58, 26,
        33,  1, 41,  9, 49, 17, 57, 25,
        32,  0, 40,  8, 48, 16, 56, 24
    ]

    # Type of crypting being done
    ENCRYPT =   0x00
    DECRYPT =   0x01

    # Initialisation
    def __init__(self, key, mode=ECB, IV=None, pad=None, padmode=PAD_NORMAL):
        # Sanity checking of arguments.
        if len(key) != 8:
            raise ValueError("Invalid DES key size. Key must be exactly 8 bytes
long.")
        _baseDes.__init__(self, mode, IV, pad, padmode)
        self.key_size = 8
```

```
        self.L = []
        self.R = []
        self.Kn = [ [0] * 48 ] * 16 # 16 48-bit keys (K1 - K16)
        self.final = []

        self.setKey(key)

    def setKey(self, key):
        """Will set the crypting key for thi print('\n')s object. Must be 8 
bytes."""
        _baseDes.setKey(self, key)
        self.__create_sub_keys()

    def __String_to_BitList(self, data):
        """Turn the string data, into a list of bits (1, 0)'s"""
        if _pythonMajorVersion < 3:
            # Turn the strings into integers. Python 3 uses a bytes
            # class, which already has this behaviour.
            data = [ord(c) for c in data]
        l = len(data) * 8
        result = [0] * l
        pos = 0
        for ch in data:
            i = 7
            while i >= 0:
                if ch & (1 << i) != 0:
                    result[pos] = 1
                else:
                    result[pos] = 0
                pos += 1
                i -= 1

        return result

    def __BitList_to_String(self, data):
        """Turn the list of bits -> data, into a string"""
        result = []
        pos = 0
        c = 0
        while pos < len(data):
            c += data[pos] << (7 - (pos % 8))
            if (pos % 8) == 7:
                result.append(c)
                c = 0
            pos += 1
```

```
        if _pythonMajorVersion < 3:
            return ''.join([ chr(c) for c in result ])
        else:
            return bytes(result)

    def __permutate(self, table, block):
        """Permutate this block with the specified table"""
        return list(map(lambda x: block[x], table))

    # Transform the secret key, so that it is ready for data processing
    # Create the 16 subkeys, K[1] - K[16]
    def __create_sub_keys(self):
        """Create the 16 subkeys K[1] to K[16] from the given key"""
        key = self.__permutate(des.__pc1,
self.__String_to_BitList(self.getKey()))
        i = 0
        # Split into Left and Right sections
        self.L = key[:28]
        self.R = key[28:]
        while i < 16:
            j = 0
            # Perform circular left shifts
            while j < des.__left_rotations[i]:
                self.L.append(self.L[0])
                del self.L[0]

                self.R.append(self.R[0])
                del self.R[0]

                j += 1

            # Create one of the 16 subkeys through pc2 permutation
            self.Kn[i] = self.__permutate(des.__pc2, self.L + self.R)

            i += 1

    # Main part of the encryption algorithm, the number cruncher :)
    def __des_crypt(self, block, crypt_type):
        """Crypt the block of data through DES bit-manipulation"""
        block = self.__permutate(des.__ip, block)
        self.L = block[:32]
        self.R = block[32:]

        # Encryption starts from Kn[1] through to Kn[16]
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        if crypt_type == des.ENCRYPT:
            iteration = 0
            iteration_adjustment = 1
        # Decryption starts from Kn[16] down to Kn[1]
        else:
            iteration = 15
            iteration_adjustment = -1

        i = 0
        while i < 16:
            # Make a copy of R[i-1], this will later become L[i]
            tempR = self.R[:]

            # Permutate R[i - 1] to start creating R[i]
            self.R = self.__permutate(des.__expansion_table, self.R)

            # Exclusive or R[i - 1] with K[i], create B[1] to B[8] whilst here
            self.R = list(map(lambda x, y: x ^ y, self.R, self.Kn[iteration]))
            B = [self.R[:6], self.R[6:12], self.R[12:18], self.R[18:24],
self.R[24:30], self.R[30:36], self.R[36:42], self.R[42:]]
            # Optimization: Replaced below commented code with above
            #j = 0
            #B = []
            #while j < len(self.R):
            #    self.R[j] = self.R[j] ^ self.Kn[iteration][j]
            #    j += 1
            #    if j % 6 == 0:
            #        B.append(self.R[j-6:j])

            # Permutate B[1] to B[8] using the S-Boxes
            j = 0
            Bn = [0] * 32
            pos = 0
            while j < 8:
                # Work out the offsets
                m = (B[j][0] << 1) + B[j][5]
                n = (B[j][1] << 3) + (B[j][2] << 2) + (B[j][3] << 1) + B[j][4]

                # Find the permutation value
                v = des.__sbox[j][(m << 4) + n]

                # Turn value into bits, add it to result: Bn
                Bn[pos] = (v & 8) >> 3
                Bn[pos + 1] = (v & 4) >> 2
                Bn[pos + 2] = (v & 2) >> 1
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                Bn[pos + 3] = v & 1

                pos += 4
                j += 1

            # Permutate the concatination of B[1] to B[8] (Bn)
            self.R = self.__permutate(des.__p, Bn)

            # Xor with L[i - 1]
            self.R = list(map(lambda x, y: x ^ y, self.R, self.L))
            # Optimization: This now replaces the below commented code
            #j = 0
            #while j < len(self.R):
            #   self.R[j] = self.R[j] ^ self.L[j]
            #   j += 1

            # L[i] becomes R[i - 1]
            self.L = tempR;lis_main.append(self.L+self.R)

            i += 1
            iteration += iteration_adjustment

        # Final permutation of R[16]L[16]
        self.final = self.__permutate(des.__fp, self.R + self.L);
lis_main.append(self.final)
        return self.final


    # Data to be encrypted/decrypted
    def crypt(self, data, crypt_type):
        """Crypt the data in blocks, running it through des_crypt()"""

        # Error check the data
        if not data:
            return ''
        if len(data) % self.block_size != 0:
            if crypt_type == des.DECRYPT: # Decryption must work on 8 byte
blocks
                raise ValueError("Invalid data length, data must be a multiple
of " + str(self.block_size) + " bytes\n.")
            if not self.getPadding():
                raise ValueError("Invalid data length, data must be a multiple
of " + str(self.block_size) + " bytes\n. Try setting the optional padding
character")
            else:
```

```
                data += (self.block_size - (len(data) % self.block_size)) * 
self.getPadding()
            # print "Len of data: %f" % (len(data) / self.block_size)

        if self.getMode() == CBC:
            if self.getIV():
                iv = self.__String_to_BitList(self.getIV())
            else:
                raise ValueError("For CBC mode, you must supply the Initial 
Value (IV) for ciphering")

        # Split the data into blocks, crypting each one seperately
        i = 0
        dict = {}
        result = []
        #cached = 0
        #lines = 0
        while i < len(data):
            # Test code for caching encryption results
            #lines += 1
            #if dict.has_key(data[i:i+8]):
                #print "Cached result for: %s" % data[i:i+8]
            #    cached += 1
            #    result.append(dict[data[i:i+8]])
            #    i += 8
            #    continue

            block = self.__String_to_BitList(data[i:i+8])

            # Xor with IV if using CBC mode
            if self.getMode() == CBC:
                if crypt_type == des.ENCRYPT:
                    block = list(map(lambda x, y: x ^ y, block, iv))
                    #j = 0
                    #while j < len(block):
                    #    block[j] = block[j] ^ iv[j]
                    #    j += 1

                processed_block = self.__des_crypt(block, crypt_type)

                if crypt_type == des.DECRYPT:
                    processed_block = list(map(lambda x, y: x ^ y, 
processed_block, iv))
                    #j = 0
                    #while j < len(processed_block):
```

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                #   processed_block[j] = processed_block[j] ^ iv[j]
                #   j += 1
                iv = block
            else:
                iv = processed_block
        else:
            processed_block = self.__des_crypt(block, crypt_type)


        # Add the resulting crypted block to our list
        #d = self.__BitList_to_String(processed_block)
        #result.append(d)
        result.append(self.__BitList_to_String(processed_block))
        #dict[data[i:i+8]] = d
        i += 8

    # print "Lines: %d, cached: %d" % (lines, cached)

    # Return the full crypted string
    if _pythonMajorVersion < 3:
        return ''.join(result)
    else:
        return bytes.fromhex('').join(result)

def encrypt(self, data, pad=None, padmode=None):
    """encrypt(data, [pad], [padmode]) -> bytes
    data : Bytes to be encrypted
    pad  : Optional argument for encryption padding. Must only be one byte
    padmode : Optional argument for overriding the padding mode.
    The data must be a multiple of 8 bytes and will be encrypted
    with the already specified key. Data does not have to be a
    multiple of 8 bytes if the padding character is supplied, or
    the padmode is set to PAD_PKCS5, as bytes will then added to
    ensure the be padded data is a multiple of 8 bytes.
    """
    data = self._guardAgainstUnicode(data)
    if pad is not None:
        pad = self._guardAgainstUnicode(pad)
    data = self._padData(data, pad, padmode)
    return self.crypt(data, des.ENCRYPT)

def decrypt(self, data, pad=None, padmode=None):
    """decrypt(data, [pad], [padmode]) -> bytes
    data : Bytes to be encrypted
    pad  : Optional argument for decryption padding. Must only be one byte
```

```
        padmode : Optional argument for overriding the padding mode.
        The data must be a multiple of 8 bytes and will be decrypted
        with the already specified key. In PAD_NORMAL mode, if the
        optional padding character is supplied, then the un-encrypted
        data will have the padding characters removed from the end of
        the bytes. This pad removal only occurs on the last 8 bytes of
        the data (last data block). In PAD_PKCS5 mode, the special
        padding end markers will be removed from the data after decrypting.
        """
        data = self._guardAgainstUnicode(data)
        if pad is not None:
            pad = self._guardAgainstUnicode(pad)
        data = self.crypt(data, des.DECRYPT)
        return self._unpadData(data, pad, padmode)

"""#Auxiliary Functions"""

def hamming_dis(s,t):
    return sum([s[i] != t[i] for i in range(len(s))])
def encrypt_plaintext(k,pt,key):
    l=[]
    for plaintext in pt:
        d=k.encrypt(plaintext)
        l.append(lis_main.copy())
        lis_main.clear()
    return l

def plot_graph(l,name,increment,initial):
    base, compare, x, hamming = l[0], l[1:], initial, []
    for i,li in enumerate(compare):
        temp = []
        temp.append(x)
        x += increment
        for j,string in enumerate(li):
            str1, str2 = ''.join([str(x) for x in base[j]]).strip(),
''.join([str(x) for x in compare[i][j]]).strip()
            temp.append(hamming_dis(str1, str2))

        hamming.append(temp)

    plot_lis = []
    for j in range(len(hamming[0]) - 1):
        temp = []
        for i in range(len(hamming)):
            temp.append(hamming[i][j])
```

```
        plot_lis.append(temp)

    plot_lis = tuple(plot_lis)
    medians = [statistics.median(test_list) for test_list in plot_lis]

    fig = plot.figure()
    plot.boxplot(plot_lis, positions = [l for l in range(17)])
    plot.plot([l for l in range(17)], medians)
    fig.suptitle(name)
    plot.xlabel('DES Rounds')
    plot.ylabel('Hamming Distance')
    fig.savefig(name+'.png')

    plot.show()

"""#Initialize main text"""

k = des(b"faignope")

"""#Part-i"""

pti=[b'klamrapl',b'klamraal',b'klawrapl',b'klamrapc',b'klamraql',b'tlamrapl']
plot_graph(encrypt_plaintext(k,pti,b"faignope"),"Avalanche Effect",0,1)

"""#Part-ii"""

ptii=[b'klamrapl',b'klcmrapl',b'flemrapl',b'klayuafl',b'kdahraeo',b'rlctrayq']
plot_graph(encrypt_plaintext(k,pti,b"faignope"),"Avalanche Effect",0,1)

"""#Part-iii"""

k_list=[des(b'wbvirhep'),des(b'wtsanmef'),des(b'qwigxyjf'),des(b'geljudqj'),des
(b'uokgmlqf'),des(b'ozmvqqmt')]
k_list1=[b'wbvirhep',b'wtsanmef',b'qwigxyjf',b'geljudqj',b'uokgmlqf',b'ozmvqqmt
']
plaintext=b"faignope"

lis=[]
for i,key in enumerate(k_list):
    d=key.encrypt(plaintext)
    lis.append(lis_main.copy())
    lis_main.clear()

plot_graph(lis,"Avalanche Effect",0,0)
```