Multimedia Programming

Steganography

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Example: hide messages in images

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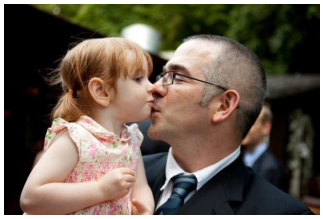
Example: hide messages in images

Steganography



(53, 64, 22)

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8 bits each

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...

56 32 98 105 116 115 32 101 97 99 104

8 bits each

(53, 64, 22)

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...

56 32 98 105 116 115 32 101 97 99 104

8 bits each

Replace color bytes with character bytes

Main driver

```
if sys.argv[1] == '-e':
  message = sys.argv[2]
  pic = Image.open(sys.argv[3])
  encode(message, pic)
  pic.save(sys.argv[4])

elif sys.argv[1] == '-d':
  pic = Image.open(sys.argv[2])
  message = decode(pic)
  print message
```

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$ steg –e 'ABCDEF' in.jpg out.jpg

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Encode

```
def encode(message, pic):
  assert len(message) < 256, 'Message is too long'
  set_red(pic, 0, 0, len(message))
  i = 1
  for c in message:
    set_red(pic, 0, i, ord(c))
    i += 1
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Decode

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def decode(pic):
  num_chars = get_red(pic, 0, 0)
  message = ''
  for i in range(1, num_chars+1):
    message += chr(get_red(pic, 0, i))
    i += 1
  return message
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Why not `str`?

Decode

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    i += 1
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def get_red(pic, x, y):
  r, g, b = pic.getpixel((x, y))
  return r
```


Result

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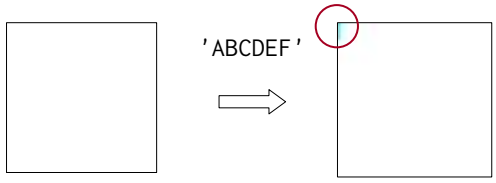
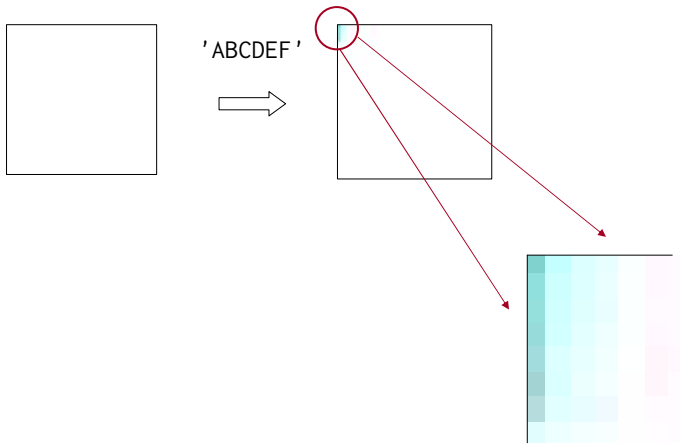


Result



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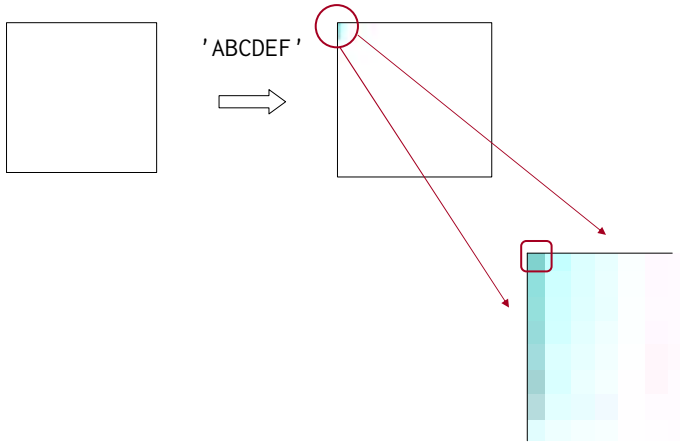

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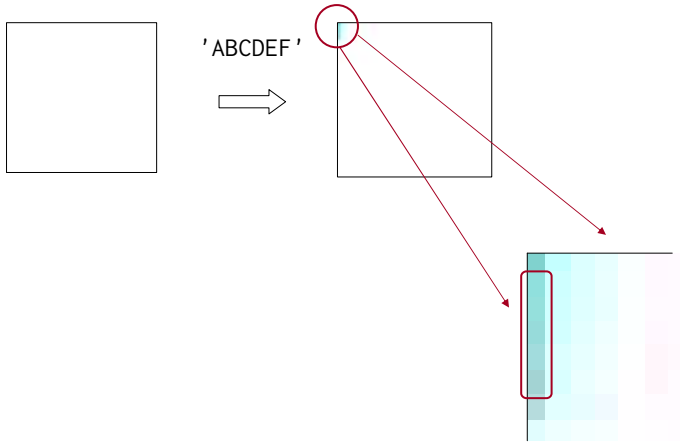

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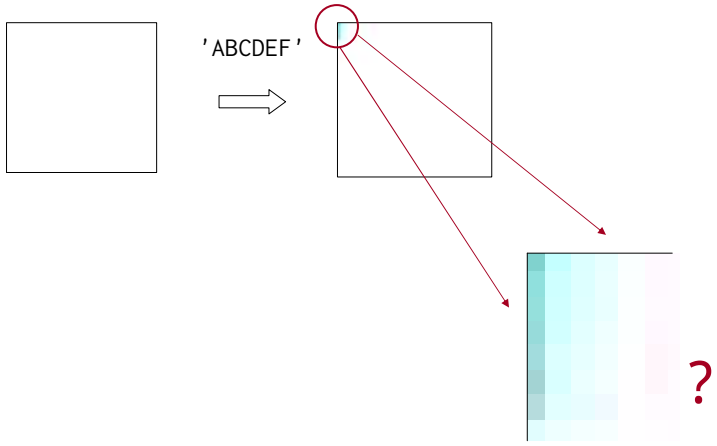

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Use a *lossless* format like PNG instead

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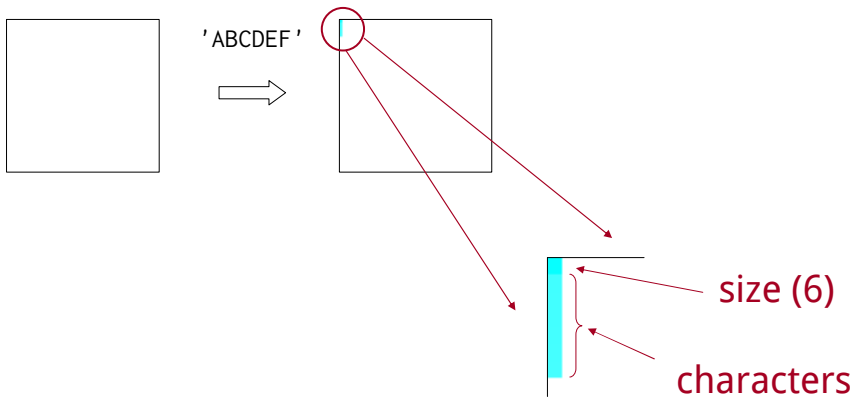
Easy to fix...

Result



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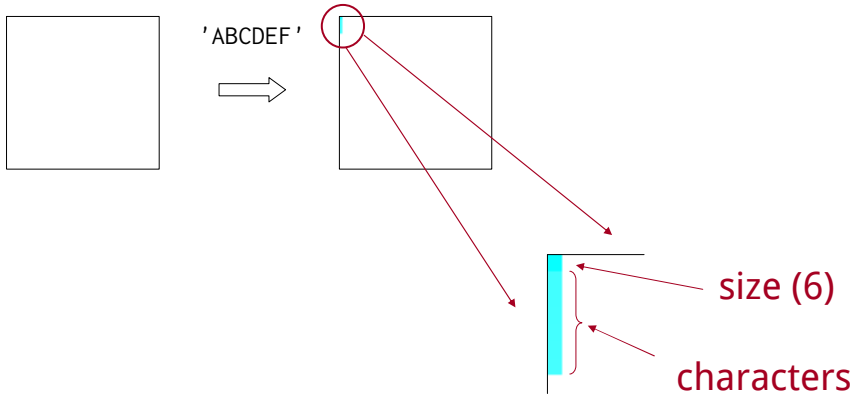

Not very well hidden...

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(8 bits/character) / (3 bytes/pixel) = 3 pixels/character

Solution: only use the least significant bit of the color in each pixel

Human eye cannot see difference between (140, 37, 200) and (141, 36, 201)

'A' = 65_{10} = 01000001_2

(8 bits/character) / (3 bytes/pixel) = 3 pixels/character

(With one bit unused)

Extract bits

```
def get_bits(char):
  num = ord(char)
  result = [0] * 8
  for i in range(8):
    if (num % 2) != 0:
      result[i] = 1
    num /= 2
  return result
```


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```

char	'A'
num	65_{10} = 01000001_2
result	[1,0,0,0,0,0,0,0]
i	0

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char	'A'
num	32_{10} = 00100000_2
result	[1,0,0,0,0,0,0,0]
i	1

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```

char	'A'
num	16_{10} = 00010000_2
result	[1,0,0,0,0,0,0,0]
i	2

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  for i in range(8):
    if (num % 2) != 0:
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  return result
```

char	'A'
num	1_{10} = 00000001_2
result	[1,0,0,0,0,0,1,0]
i	6

Combine with pixels

```
def combine(pixel, bits):
  assert len(pixel) == len(bits), 'Length mismatch'
  pixel = list(pixel)
  for i in range(len(pixel)):
    even = 2 * (pixel[i] / 2)
    if bits[i]:
      even += 1
    pixel[i] = even
  return tuple(pixel)
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Test

```
for (p, b) in (((  0,   0,   0), (0, 1, 0)),
               ((  1,   1,   1), (1, 0, 1)),
               ((  2,   2,   2), (1, 0, 1)),
               ((255, 255, 255), (0, 1, 1))):
  result = combine(p, b)
  print p, '+', b, '=>', result
```

```
(0, 0, 0) + (0, 1, 0) => (0, 1, 0)
(1, 1, 1) + (1, 0, 1) => (1, 0, 1)
(2, 2, 2) + (1, 0, 1) => (3, 2, 3)
(255, 255, 255) + (0, 1, 1) => (254, 255, 255)
```


Write the other functions

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Most important message: bits don't mean anything

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Meaning comes from how we act on them

created by

Greg Wilson

November 2010