# Objective 11b: Naughty/Nice List with Blockchain Investigation Part 2

> The SHA256 of Jack's altered block is: 58a3b9335a6ceb0234c12d35a0564c4e f0e90152d0eb2ce2082383b38028a90f. If you're clever, you can recreate the original version of that block by changing the values of only 4 bytes. Once you've recreated the original block, what is the SHA256 of that block?

`Difficulty: 5/5`

## Solution

> *But we in it shall be remembered-we few, we happy few, we band of brothers; for he today that finishes 11b with me shall be my brother, be he ne'er so vile...*

11b.

The premise was simple: find the block that contains the data on Jack, change 4 bytes in it to display the original data, all while the MD5 hash of the block remained unchanged. We're given some hints: Jack used a type of hash collision called **UNICOLL**. Jack's score was originally overwhelmingly negative and is now overwhelmingly positive. And, Shinny Upatree swears he didn't write the PDF document attached to Jack's block.

Finding the block isn't difficult: creating a list of scores of the blocks in the chain shows one block with a score of `ffffffff (4294967295)`, which matches what we learned from Tinsel Upatree about Jack's score. The block in question also has two documents, one of which is a very large PDF attachment. Dumping the block and the individual attachments shows that the block matches the SHA256 hash in the objective, so we know we've identified the block with Jack's data.

```
xps15$ ls -l block.dat 129459.bin 129459.pdf
-rw-r--r-- 1 jra jra   108 Dec 12 23:14 129459.bin
-rw-r--r-- 1 jra jra 40791 Dec 13 22:22 129459.pdf
-rw-r--r-- 1 jra jra 41411 Dec 12 15:09 block.dat
xps15$ sha256sum block.dat
58a3b9335a6ceb0234c12d35a0564c4ef0e90152d0eb2ce2082383b38028a90f  block.dat
xps15$ md5sum block.dat
b10b4a6bd373b61f32f4fd3a0cdfbf84  block.dat
xps15$
```

Now that we've identified the block, let's take a look at the data in the block. We can understand the data format of the block from the Python code:

```
def load_a_block(self, fh):
    self.index = int(fh.read(16), 16)
    self.nonce = int(fh.read(16), 16)
    self.pid = int(fh.read(16), 16)
    self.rid = int(fh.read(16), 16)
```

```
    self.doc_count = int(fh.read(1), 10)
    self.score = int(fh.read(8), 16)
    self.sign = int(fh.read(1), 10)
    count = self.doc_count
    while(count > 0):
        l_data = {}
        l_data['type'] = int(fh.read(2),16)
        l_data['length'] = int(fh.read(8), 16)
        l_data['data'] = fh.read(l_data['length'])
        self.data.append(l_data)
        count -= 1
```

We can take a look at the block with `xxd`:

```
00000000: 3030 3030 3030 3030 3030 3031 6639 6233  000000000001f9b3
00000010: 6139 3434 3765 3537 3731 6337 3034 6634  a9447e5771c704f4
00000020: 3030 3030 3030 3030 3030 3031 3266 6431  0000000000012fd1
00000030: 3030 3030 3030 3030 3030 3030 3032 3066  000000000000020f
00000040: 3266 6666 6666 6666 6631 6666 3030 3030  2fffffffff1ff0000
00000050: 3030 3663 ea46 5340 303a 6079 d3df 2762  006c.FS@0:`y..'b
00000060: be68 467c 27f0 46d3 a7ff 4e92 dfe1 def7  .hF|'.F...N.....
00000070: 407f 2a7b 73e1 b759 b8b9 1945 1e37 518d  @.*{s..Y...E.7Q.
00000080: 22d9 8729 6fcb 0f18 8dd6 0388 bf20 350f  "..)o........ 5.
```

Starting at byte `0x40 (64)`, we can decode the block this way:

- `doc_count = 2`
- `score = ffffffff`
- `sign = 1`

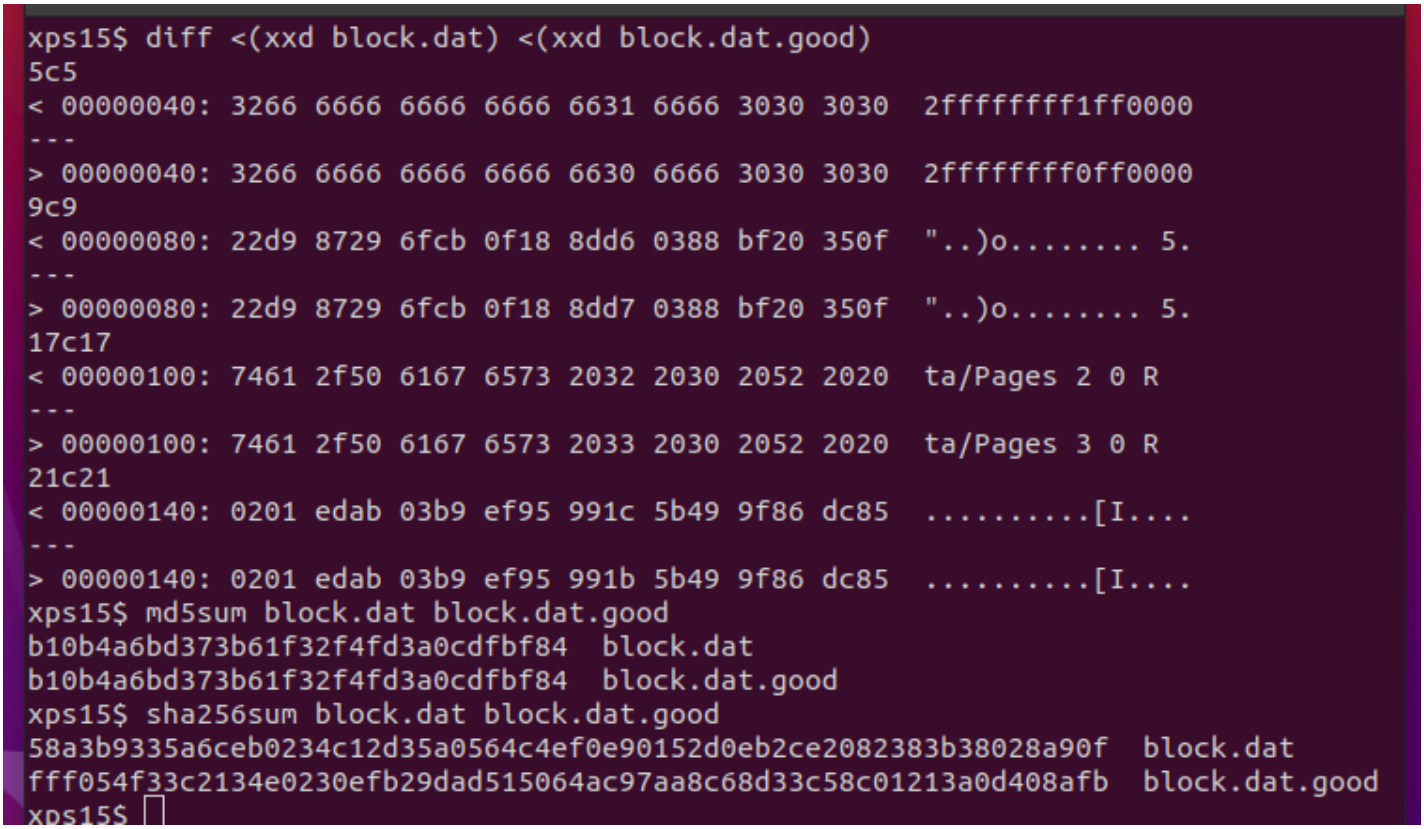
The next set of bytes are the attached documents. The first is of type `0xff (255)`, which is defined as `255:'Binary blob'` in `naughty_nice.py`. Examining the attachment shows that it appears to be completely random data.

From the CollTris presentation, we know that in a UNICOLL collision, the 10th character in the prefix block is incremented by 1, while the 10th character in the next block is decremented by 1. In the Naughty/Nice blockchain, the 10th character in the second block of 64 bytes is the `sign`, which determines whether the score is `naughty (0)` or `nice (1)`. Jack was able to change the `sign` from `0 -> 1`, also changing the 10th byte in the next 64-byte segment, in the binary blob of 'random' data. Reversing those changes with a hex editor allows us to fix Jack's score, while the MD5 hash of the block remains unchanged.

The second set of changed bytes is in the attached PDF. Viewing the PDF shows almost identical statements from various people, all attesting that Jack Frost is the most wonderful person on the planet. Shinny Upatree, however, swears that this isn't what he wrote for the event. We can use a tool like `pdf2txt` to extract all of the text from the PDF and see what is hidden:

```
xps15$ pdf2txt 129459.pdf
“Earlier today, I saw this bloke Jack Frost climb into one of our cages and repeatedly kick a wombat. I
don’t know what’s with him… it’s like he’s a few stubbies short of a six-pack or somethin’. I don’t think
the wombat was actually hurt… but I tell ya, it was more ‘n a bit shook up. Then the bloke climbs outta
the cage all laughin’ and cacklin’ like it was some kind of bonza joke. Never in my life have I seen
someone who was that bloody evil...”


Quote from a Sidney (Australia) Zookeeper

I have reviewed a surveillance video tape showing the incident and found that it does, indeed, show
that Jack Frost deliberately traveled to Australia just to attack this cute, helpless animal.  It was
appalling.

I tracked Frost down and found him in Nepal. I confronted him with the evidence and, surprisingly, he
seems to actually be incredibly contrite. He even says that he’ll give me access to a digital photo that
shows his “utterly regrettable” actions. Even more remarkably, he’s allowing me to use his laptop to
generate this report - because for some reason, my laptop won’t connect to the WiFi here.

He says that he’s sorry and needs to be “held accountable for his actions.” He’s even said that I should
give him the biggest Naughty/Nice penalty possible. I suppose he believes that by cooperating with me,
that I’ll somehow feel obliged to go easier on him. That’s not going to happen… I’m WAAAAY
smarter than old Jack.

Oh man… while I was writing this up, I received a call from my wife telling me that one of the pipes in
our house back in the North Pole has frozen and water is leaking everywhere. How could that have
happened?

Jack is telling me that I should hurry back home. He says I should save this document and then he’ll go
ahead and submit the full report for me.  I’m not completely sure I trust him, but I’ll make myself a
note and go in and check to make absolutely sure he submits this properly.

Shinny Upatree
3/24/2020
```

Hidden in the PDF is the actual text Shinny wrote, where we see that Jack had access to the report and blockchain submission system. Using a tool that creates collisions in PDF files, Jack was able to hide his fake report inside the one submitted[1]. We can reverse this by reversing the results of the tool with a hex editor on the block: by incrementing `Pages 2` and decrementing the corresponding byte in the next block. `diff` shows the changes between the original and 'good' block, while the MD5 remains the same. The SHA256 hashes, however, are different:




The SHA256 hash of the 'good' block is `fff054f33c2134e0230efb29dad515064ac97aa8c68d33c58c01213a0d408afb`.

## Answer

`fff054f33c2134e0230efb29dad515064ac97aa8c68d33c58c01213a0d408afb`

1. I may have used this technique on this PDF as well... ■