Python伪造TCP数据包

python Pytohn TCP Socket Markdown

TCP/IP数据包

TCP协议被广泛运用于互联网上的数据传输，它是一种面向连接（连接导向）的、可靠的、基于IP的传输层协议。
一个数据包由IP头部信息、TCP/UDP头部信息和数据构成：

```
Packet = IP Header + TCP/UDP Header + Data
```

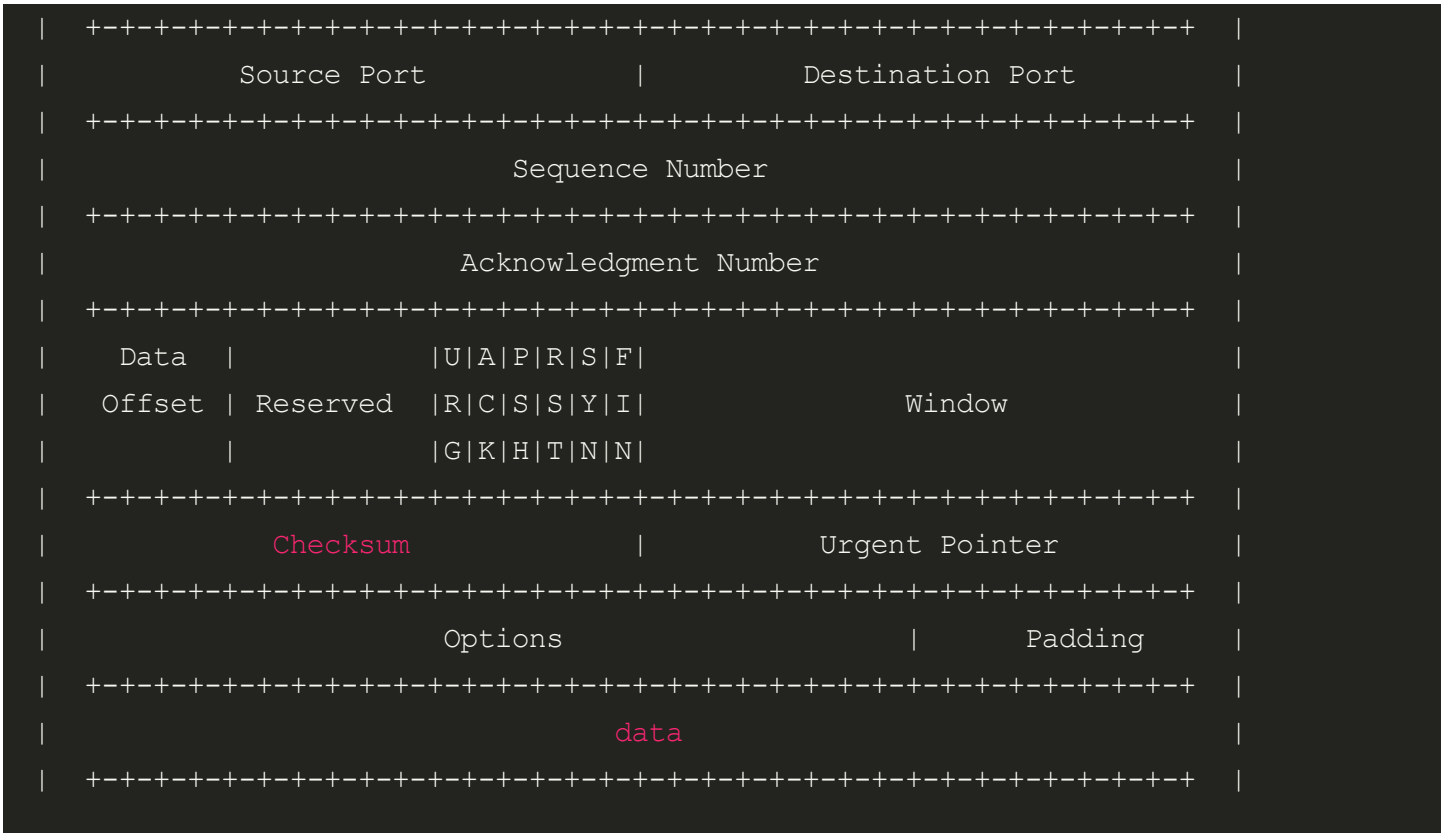
大多数操作系统的socket API都支持包注入（尤其是基于Berkeley Sockets的），微软在windows xp之后为了避免包嗅探限制了原始套接字的能力。此文只适用于UNIX/类UNIX系统。

IP头部格式：

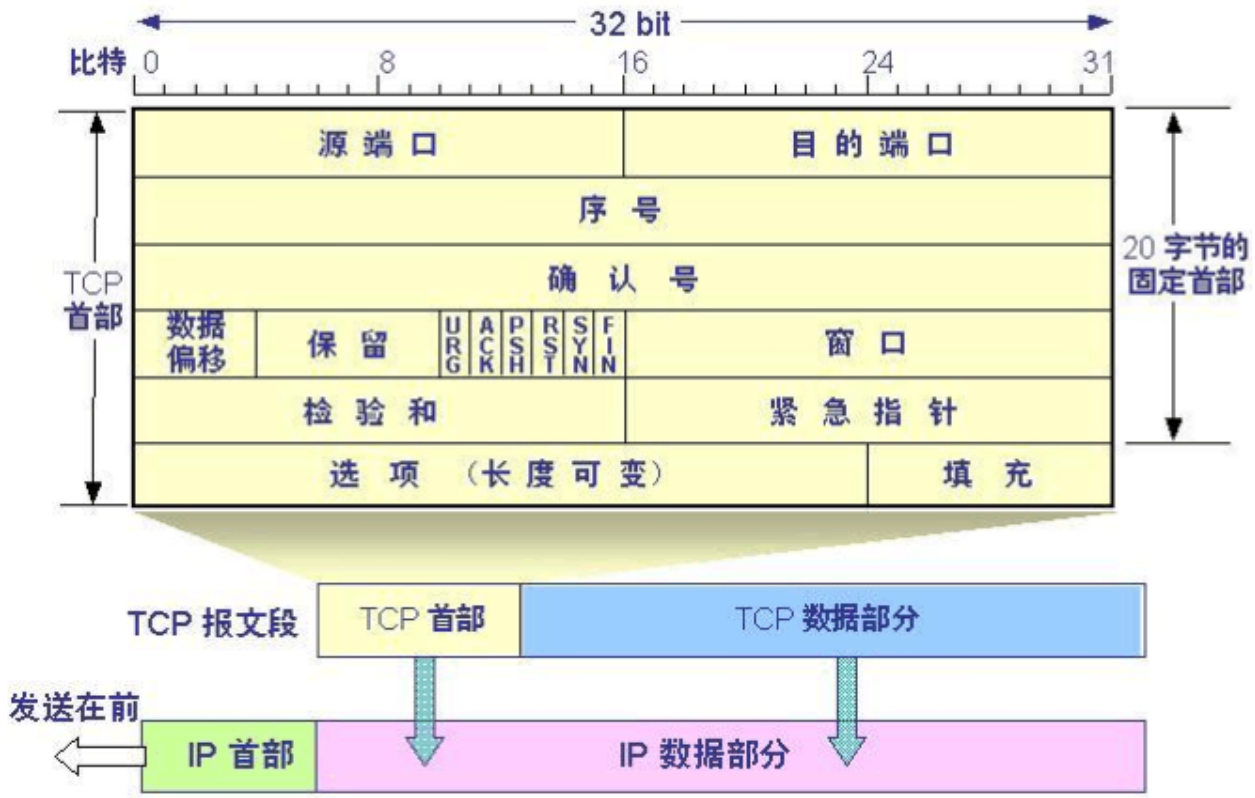
```
|  0 1 2 3 4 5 6 7 8               16              24              31 |
|  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  |
|  Version | IHL | Type of Service |           Total Length            |
|  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  |
|          Identification           | Flags |      Fragment Offset      |
|  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  |
|    Time to Live   |    Protocol   |           Header Checksum         |
|  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  |
|                               Source Address                      |
|  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  |
|                           Destination Address                     |
|  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  |
|                         Options                     |     Padding       |
|  +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+  |
```

TCP头部格式：

```
|  0 1 2 3 4 5 6 7 8               16              24              31 |
```



- Source Port是源端口，16位。
- Destination Port是目的端口，16位。
- Sequence Number是发送数据包中的第一个字节的序列号，32位。
- Acknowledgment Number是确认序列号，32位。
- Data Offset是数据偏移，4位，该字段的值是TCP首部（包括选项）长度乘以4。
- 标志位： 6位，URG表示Urgent Pointer字段有意义：
  ACK表示Acknowledgment Number字段有意义
  PSH表示Push功能，RST表示复位TCP连接
  SYN表示SYN报文（在建立TCP连接的时候使用）
  FIN表示没有数据需要发送了（在关闭TCP连接的时候使用）
- Window表示接收缓冲区的空闲空间，16位，用来告诉TCP连接对端自己能够接收的最大数据长度。
- Checksum是校验和，16位。
- Urgent Pointers是紧急指针，16位，只有URG标志位被设置时该字段才有意义，表示紧急数据相对序列号（Sequence Number字段的值）的偏移。



Socket

套接字是为特定网络协议（例如TCP/IP，ICMP/IP，UDP/IP等）套件对上的网络应用程序提供者提供当前可移植标准的对象。它们允许程序接受并进行连接，如发送和接受数据。为了建立通信通道，网络通信的每个端点拥有一个套接字对象极为重要。

套接字为BSD UNIX系统核心的一部分，而且他们也被许多其他类似UNIX的操作系统包括Linux所采纳。许多非BSD UNIX系统（如ms-dos，windows，os/2，mac os及大部分主机环境）都以库形式提供对套接字的支持。

三种最流行的套接字类型是:stream，datagram和raw。stream和datagram套接字可以直接与TCP协议进行接口，而raw套接字则接口到IP协议，但套接字并不限于TCP/IP。

在python中我们使用socket模块，为了建立一个可以自己构造数据的包，我们使用`SOCK_RAW`这种socket格式，使用`IPPROTO_RAW`协议，它会告诉系统我们将提供网络层和传输层。

```
s = socket.socket(socket.AF_INET,socket.SOCK_RAW,)
```

IP头部信息构造类:

```
class ip():

    def __init__(self, source, destination):
        self.version = 4
        self.ihl = 5 # Internet Header Length
        self.tos = 0 # Type of Service
```

```
        self.tl = 0 # total length will be filled by kernel
        self.id = 54321
        self.flags = 0 # More fragments
        self.offset = 0
        self.ttl = 255
        self.protocol = socket.IPPROTO_TCP
        self.checksum = 0 # will be filled by kernel
        self.source = socket.inet_aton(source)
        self.destination = socket.inet_aton(destination)

    def pack(self):
        ver_ihl = (self.version << 4) + self.ihl
        flags_offset = (self.flags << 13) + self.offset
        ip_header = struct.pack("!BBHHHBBH4s4s",
                    ver_ihl,
                    self.tos,
                    self.tl,
                    self.id,
                    flags_offset,
                    self.ttl,
                    self.protocol,
                    self.checksum,
                    self.source,
                    self.destination)
```

TCP头部信息构造类:

```
class tcp():

    def __init__(self, srcp, dstp):
        self.srcp = srcp
        self.dstp = dstp
        self.seqn = 0
        self.ackn = 0
        self.offset = 5 # Data offset: 5x4 = 20 bytes
        self.reserved = 0
        self.urg = 0
        self.ack = 0
        self.psh = 1
        self.rst = 0
        self.syn = 0
        self.fin = 0
        self.window = socket.htons(5840)
        self.checksum = 0
```

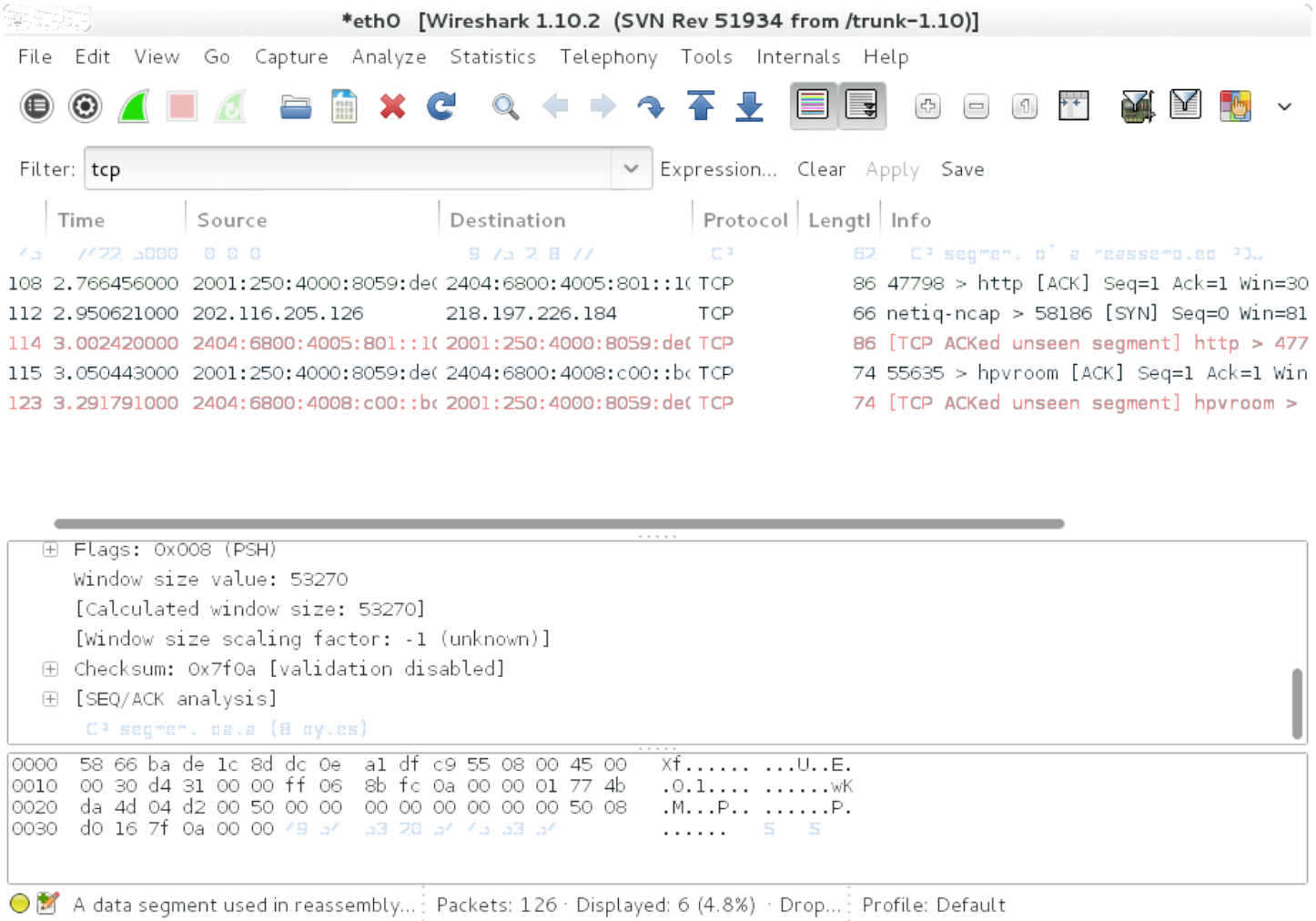
```
        self.urgp = 0
        self.payload = ""

    def pack(self, source, destination):
        data_offset = (self.offset << 4) + 0
        flags = self.fin + (self.syn << 1) + (self.rst << 2) + (self.psh << 3) +
 (self.ack << 4) + (self.urg << 5)
        tcp_header = struct.pack("!HHLLBBHHH",
                    self.srcp,
                    self.dstp,
                    self.seqn,
                    self.ackn,
                    data_offset,
                    flags,
                    self.window,
                    self.checksum,
                    self.urgp)
        #pseudo header fields
        source_ip = source
        destination_ip = destination
        reserved = 0
        protocol = socket.IPPROTO_TCP
        total_length = len(tcp_header) + len(self.payload)
        # Pseudo header
        psh = struct.pack("!4s4sBBH",
              source_ip,
              destination_ip,
              reserved,
              protocol,
              total_length)
        psh = psh + tcp_header + self.payload
        tcp_checksum = checksum(psh)
        tcp_header = struct.pack("!HHLLBBH",
                  self.srcp,
                  self.dstp,
                  self.seqn,
                  self.ackn,
                  data_offset,
                  flags,
                  self.window)
        tcp_header+= struct.pack("H", tcp_checksum) + struct.pack("!H", self.urg
p)
```

校验函数：

```
def checksum(data):
    s = 0
    n = len(data) % 2
    for i in range(0, len(data)-n, 2):
        s+= ord(data[i]) + (ord(data[i+1]) << 8)
    if n:
        s+= ord(data[i+1])
    while (s >> 16):
        print("s >> 16: ", s >> 16)
        s = (s & 0xFFFF) + (s >> 16)
    print("sum:", s)
    s = ~s & 0xffff
```

下面发送一个，然后用wireshark抓一下包：



能看到成功发出。

完整例子：

```
#! /usr/bin/env python
import socket
import struct

def checksum(data):
```

```
    s = 0
    n = len(data) % 2
    for i in range(0, len(data)-n, 2):
        s+= ord(data[i]) + (ord(data[i+1]) << 8)
    if n:
        s+= ord(data[i+1])
    while (s >> 16):
        s = (s & 0xFFFF) + (s >> 16)
    s = ~s & 0xffff
    return s

class ip():

    def __init__(self, source, destination):
        self.version = 4
        self.ihl = 5 # Internet Header Length
        self.tos = 0 # Type of Service
        self.tl = 0 # total length will be filled by kernel
        self.id = 54321
        self.flags = 0 # More fragments
        self.offset = 0
        self.ttl = 255
        self.protocol = socket.IPPROTO_TCP
        self.checksum = 0 # will be filled by kernel
        self.source = socket.inet_aton(source)
        self.destination = socket.inet_aton(destination)

    def pack(self):
        ver_ihl = (self.version << 4) + self.ihl
        flags_offset = (self.flags << 13) + self.offset
        ip_header = struct.pack("!BBHHHBBH4s4s",
                    ver_ihl,
                    self.tos,
                    self.tl,
                    self.id,
                    flags_offset,
                    self.ttl,
                    self.protocol,
                    self.checksum,
                    self.source,
                    self.destination)
        return ip_header

class tcp():
```

```
    def __init__(self, srcp, dstp):
        self.srcp = srcp
        self.dstp = dstp
        self.seqn = 0
        self.ackn = 0
        self.offset = 5 # Data offset: 5x4 = 20 bytes
        self.reserved = 0
        self.urg = 0
        self.ack = 0
        self.psh = 1
        self.rst = 0
        self.syn = 0
        self.fin = 0
        self.window = socket.htons(5840)
        self.checksum = 0
        self.urgp = 0
        self.payload = ""

    def pack(self, source, destination):
        data_offset = (self.offset << 4) + 0
        flags = self.fin + (self.syn << 1) + (self.rst << 2) + (self.psh << 3) +
(self.ack << 4) + (self.urg << 5)
        tcp_header = struct.pack("!HHLLBBHHH",
                     self.srcp,
                     self.dstp,
                     self.seqn,
                     self.ackn,
                     data_offset,
                     flags,
                     self.window,
                     self.checksum,
                     self.urgp)
        #pseudo header fields
        source_ip = source
        destination_ip = destination
        reserved = 0
        protocol = socket.IPPROTO_TCP
        total_length = len(tcp_header) + len(self.payload)
        # Pseudo header
        psh = struct.pack("!4s4sBBH",
              source_ip,
              destination_ip,
              reserved,
```

```
                protocol,
                total_length)
        psh = psh + tcp_header + self.payload
        tcp_checksum = checksum(psh)
        tcp_header = struct.pack("!HHLLBBH",
                  self.srcp,
                  self.dstp,
                  self.seqn,
                  self.ackn,
                  data_offset,
                  flags,
                  self.window)
        tcp_header+= struct.pack("H", tcp_checksum) + struct.pack("!H", self.urg
p)
        return tcp_header

def test(source,site,data):
    s = socket.socket(socket.AF_INET,
                  socket.SOCK_RAW,
                  socket.IPPROTO_RAW)
    src_host=source
    dest_host=socket.gethostbyname(site)
    # IP Header
    ipobj=ip(src_host,dest_host)
    iph=ipobj.pack()
    # TCP Header
    tcpobj=tcp(1234,80)
    tcpobj.data_length=len(data)
    tcph=tcpobj.pack(ipobj.source,ipobj.destination)
    # Injection
    packet=iph+tcph+data
    s.sendto(packet,(dest_host,80))
    s.close()

if __name__ == '__main__':
    test("10.0.0.1","www.baidu.com","ITS TEST")
```

Reference

[0]. 使用Python进行TCP数据包注入（伪造）
[1]. TCP/IP协议头部结构体（网摘小结）
[2]. TCP数据包格式

[3]. Python socket编程
[4]. Python使用struct处理二进制