Weighted Interval Scheduling

February 14, 2022

[1]:
```
import random

def random_request():
    return [sorted(random.sample(range(100),2)), random.random()*10]
```

[3]:
```
random_request()
```

[3]:
```
[[38, 54], 4.1886485190133635]
```

[4]:
```
def make_requests(n):
    return [random_request() for i in range(n)]
```

[5]:
```
def compatible(r1, r2):
    return r2[0][1] <= r1[0][0] or r2[0][0] >= r1[0][1]

def is_compatible(request, solution):
    return all(compatible(request, r) for r in solution)
```

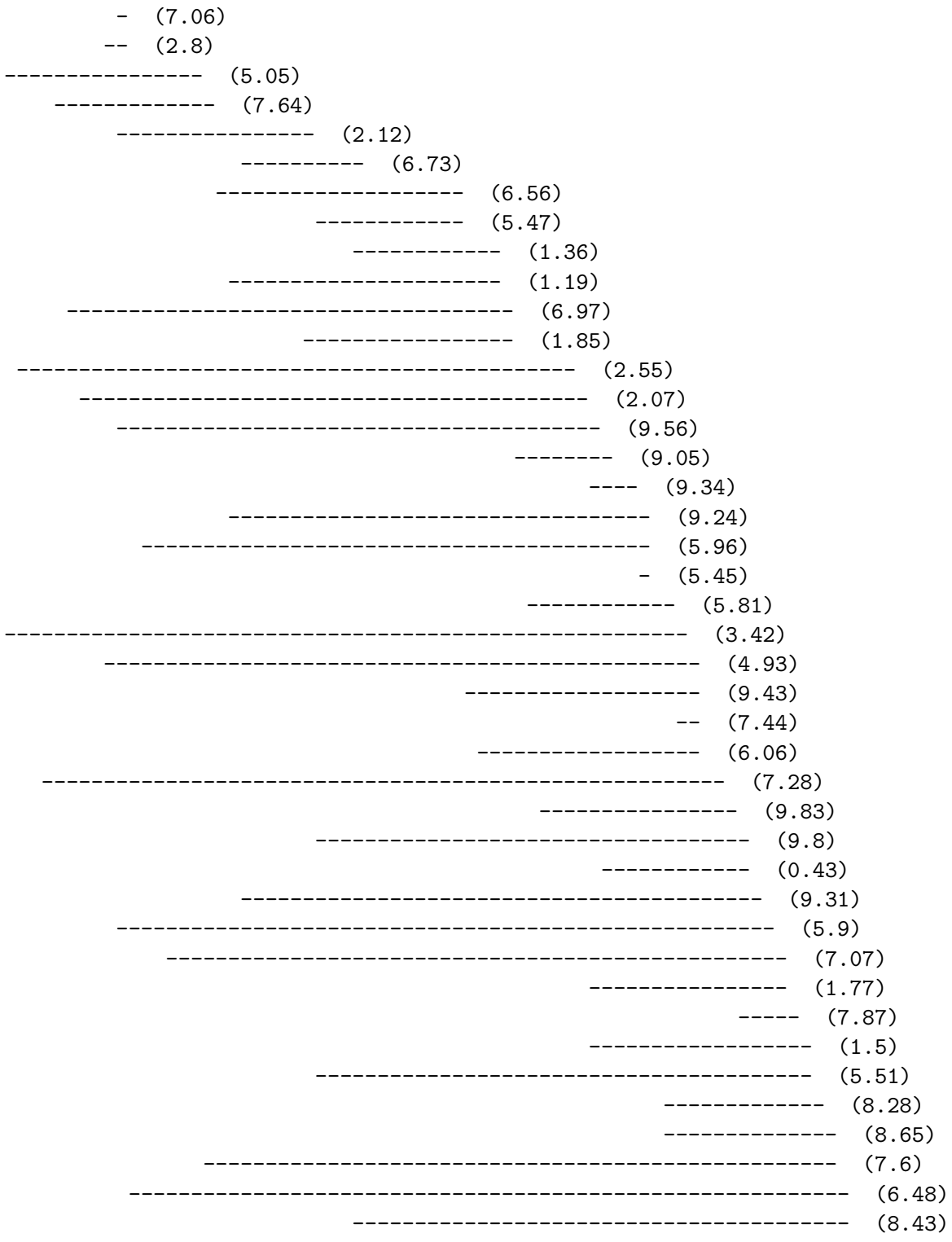
[24]:
```
def plot_requests(requests):
    for r in sorted(requests, key=lambda x : x[0][1]):
        print(" "*(r[0][0]) + "-"*(r[0][1]-r[0][0]) + "  (" +␣
 ↪str(round(r[1],2)) + ")")
    #print("total value:",sum(r[1] for r in requests))
    total_value = sum(r[1] for r in requests)
    print(f"total value: {total_value}")
```

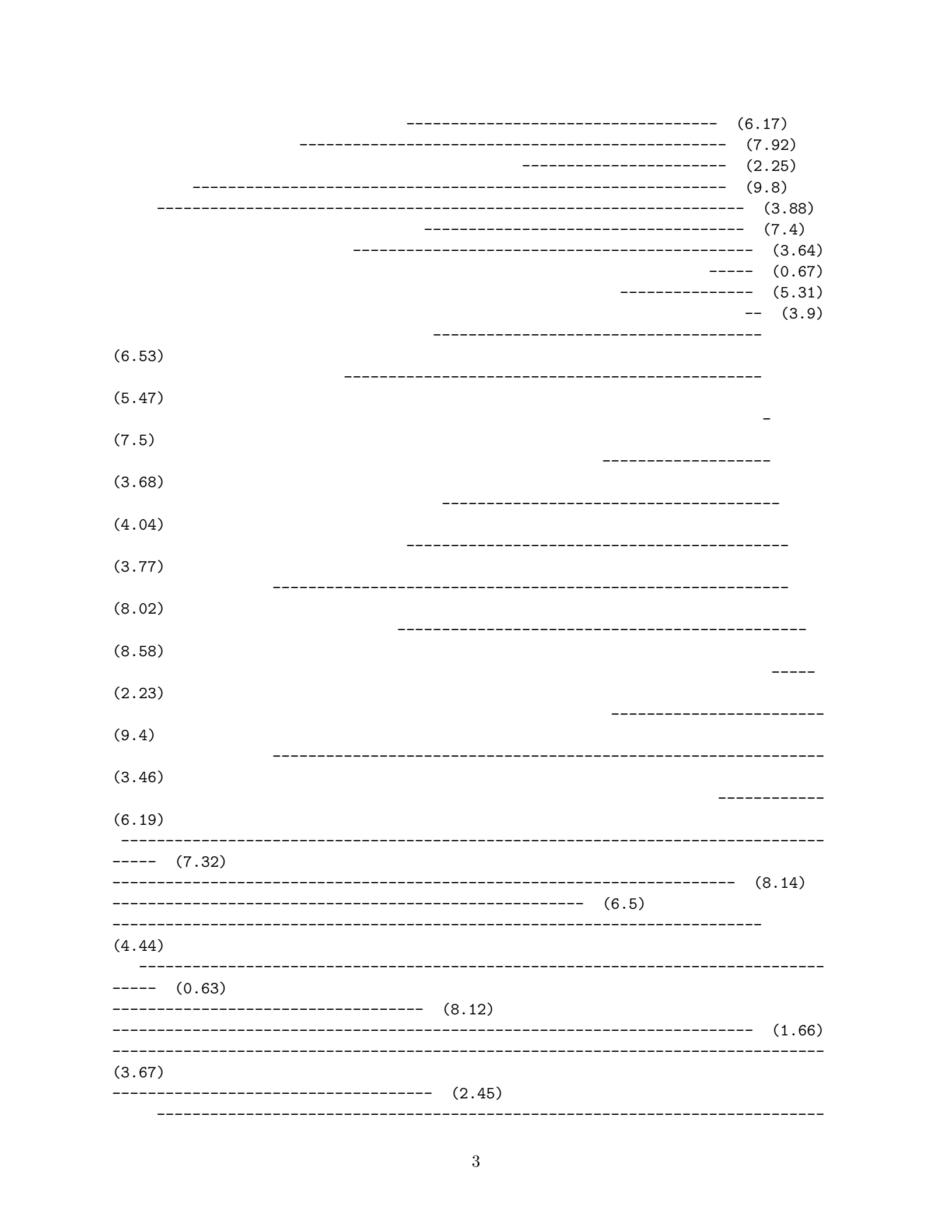
[7]:
```
# best = most valuable
def greedy(requests):
    sorted_requests = sorted(requests, key=lambda r: r[1], reverse=True)
    solution = []
    solution.append(sorted_requests.pop(0))

    while len(sorted_requests) > 0:
        request = sorted_requests.pop(0)
        if is_compatible(request, solution):
            solution.append(request)

    return solution
```

[8]:
```
requests = make_requests(100)
```

[9]:
```
sol = greedy(requests)
```

[10]:
```
plot_requests(requests)
```





```
-------  (3.64)
-------------------------------------------------------  (2.34)
    ----  (6.18)
-----------------------------------------------------------  (3.3)
-----------------------------------------------------------  (5.58)
-------------------------------------------------------------------  (6.84)
----------------------------------------  (4.39)
        --  (1.03)
     ------  (0.52)
----------------------------  (3.55)
------------------------------  (4.96)
----------------------  (0.35)
-----------------------------------------  (5.2)
-------------------------------------------------------------------------------
(6.05)
---------------  (9.04)
           ---------------------------------------------------------------------
---------------  (1.13)
      ---------  (9.95)
-------------------------------------------------------------------  (7.44)
-----------------------------------  (4.99)
       ----------  (6.91)
--------------------------------------------------  (7.32)
-----------------------------------------------------  (4.82)
----------------------------------------  (1.35)
--------------------------------------------------  (2.16)
----------------------------  (0.16)
---------------------------------  (9.16)
          --------  (7.53)
```

[11]:
```
plot_requests(sol)
```

```
    -------------  (7.64)
                  ----------  (6.73)
                                       ----------------  (9.83)
                                                  -----  (7.87)
                                                              --  (3.9)
                                                                -
(7.5)
                                                                   -----
(2.23)
      ---------  (9.95)
```

[13]:
```
sum(s[1] for s in sol)
```

[13]: 55.64068759685977

[14]:
```
# best = most valuable
# best = shortest
# best = most value-dense (highest value/duration)
```

[15]:
```
def greedy(requests, sort_function):
    sorted_requests = sorted(requests, key=sort_function)
    solution = []
    solution.append(sorted_requests.pop(0))

    while len(sorted_requests) > 0:
        request = sorted_requests.pop(0)
        if is_compatible(request, solution):
            solution.append(request)

    return solution
```

[23]:
```
# request = [[start, end], value]
most_value = lambda req : -req[1]
shortest = lambda req : req[0][1] - req[0][0]
density = lambda req : -req[1]/(req[0][1] - req[0][0])
```

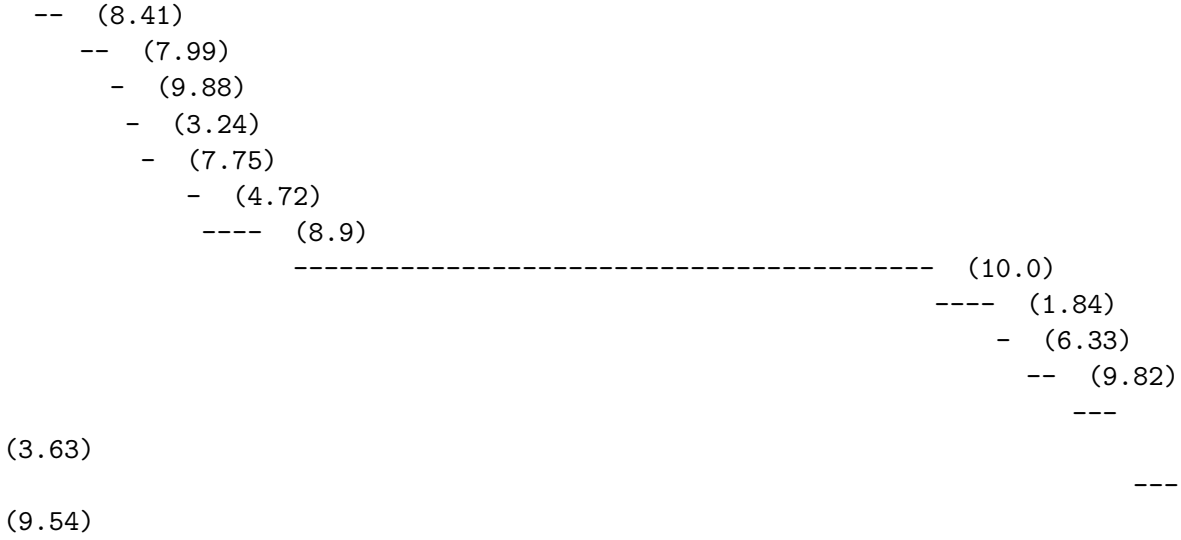
[17]:
```
print(most_value)
```

```
<function <lambda> at 0x1044bf4c0>
```

[30]:
```
requests = make_requests(1000)
```

[31]:
```
s1 = greedy(requests, most_value)
s2 = greedy(requests, shortest)
s3 = greedy(requests, density)
```

[32]:
```
plot_requests(s1)
```



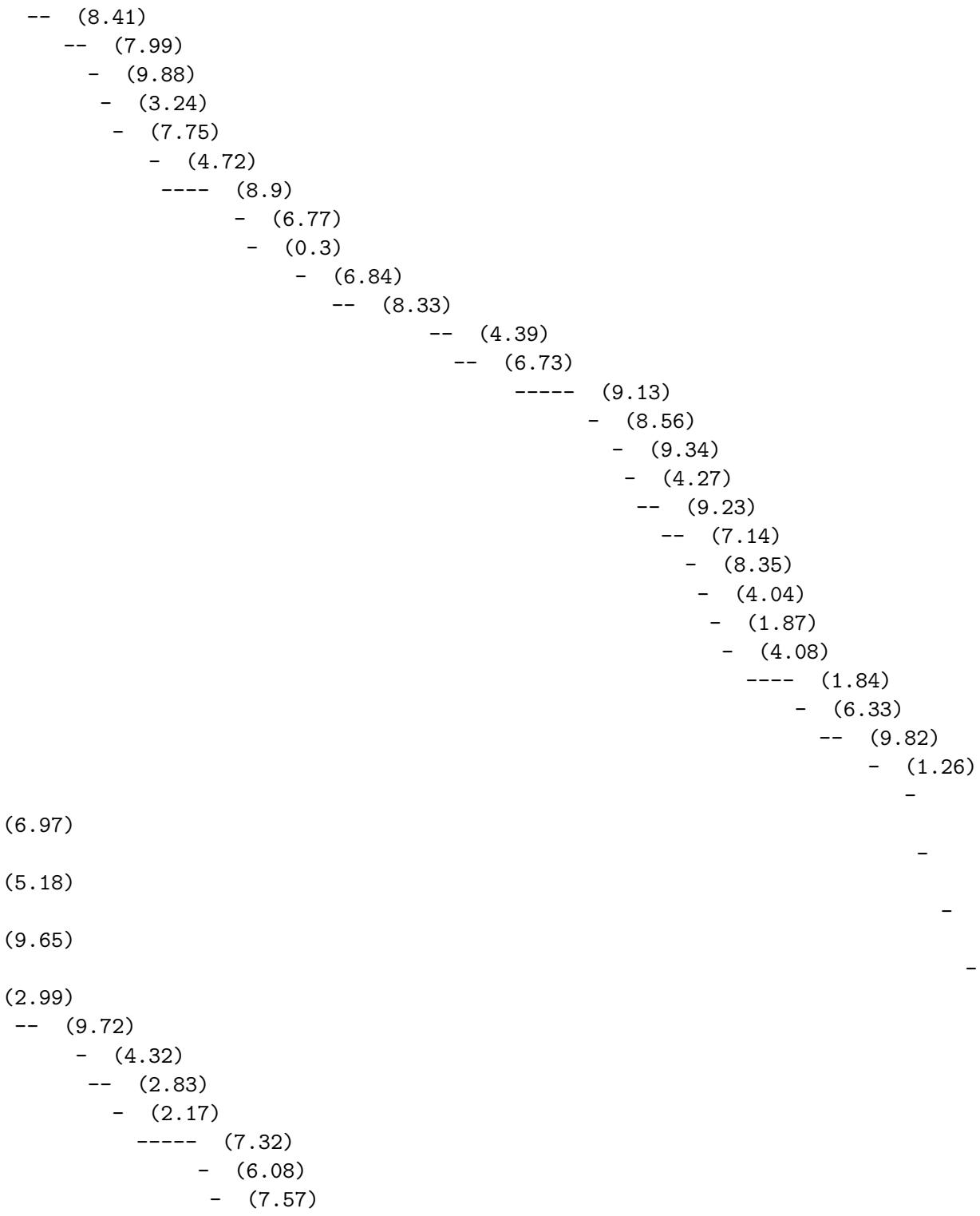
```
                                                                               -
(9.65)
--------------------  (9.98)
total value: 111.67204639509534
```

[33]:
```
plot_requests(s2)
```

```
  --  (8.41)
     -  (2.89)
       -  (9.88)
        -  (3.24)
         -  (7.75)
            -  (4.72)
               --  (1.68)
                   -  (6.77)
                    -  (0.3)
                        -  (6.84)
                           --  (8.33)
                                   --  (4.39)
                                     --  (6.73)
                                          -----  (9.13)
                                                -  (8.56)
                                                  -  (9.34)
                                                   -  (4.27)
                                                    --  (9.23)
                                                      --  (7.14)
                                                        -  (8.35)
                                                         -  (4.04)
                                                          -  (1.87)
                                                           -  (4.08)
                                                             ----  (1.84)
                                                                 -  (6.33)
                                                                   --  (9.82)
                                                                       -  (1.26)
                                                                          -
(6.97)
                                                                           -
(5.18)
                                                                             -
(9.65)
                                                                               -
(2.99)
 --  (9.72)
      -  (4.32)
       --  (2.83)
         -  (2.17)
            --  (0.51)
                -  (6.08)
```

```
                  -  (7.57)
total value: 215.16286366215562
```

[34]:
```
plot_requests(s3)
```




```
total value: 234.29789829029843
```

[ ]:

[ ]: