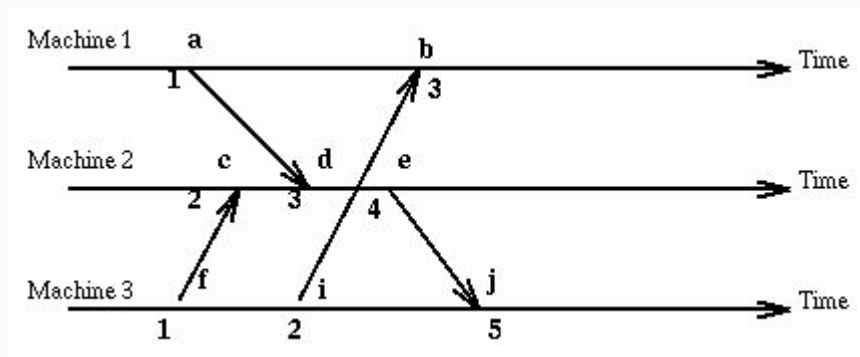# Sistemas Distribuídos

Ramon Melo

O problema

Processos produzem e enviam eventos de forma concorrente

Não há memória compartilhada entre processos

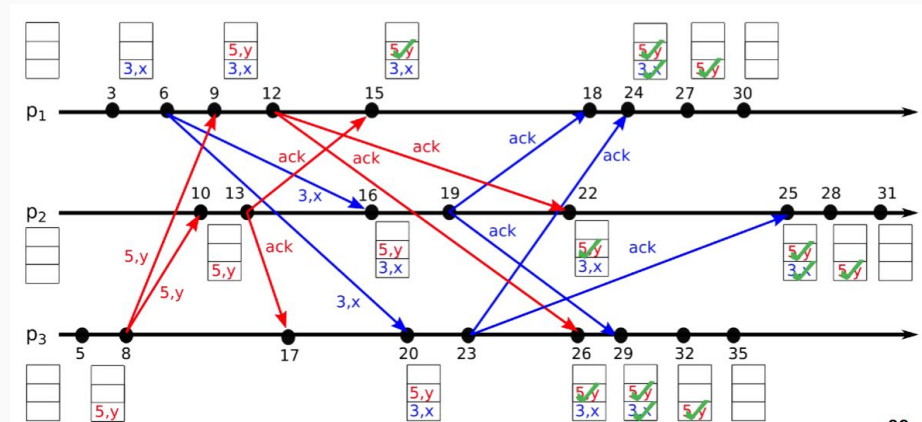Processos não necessariamente estão com os relógios sincronizados

A solução

Processos comunicam-se através de *sockets*

Relógio lógico substitui o relógio verdadeiro

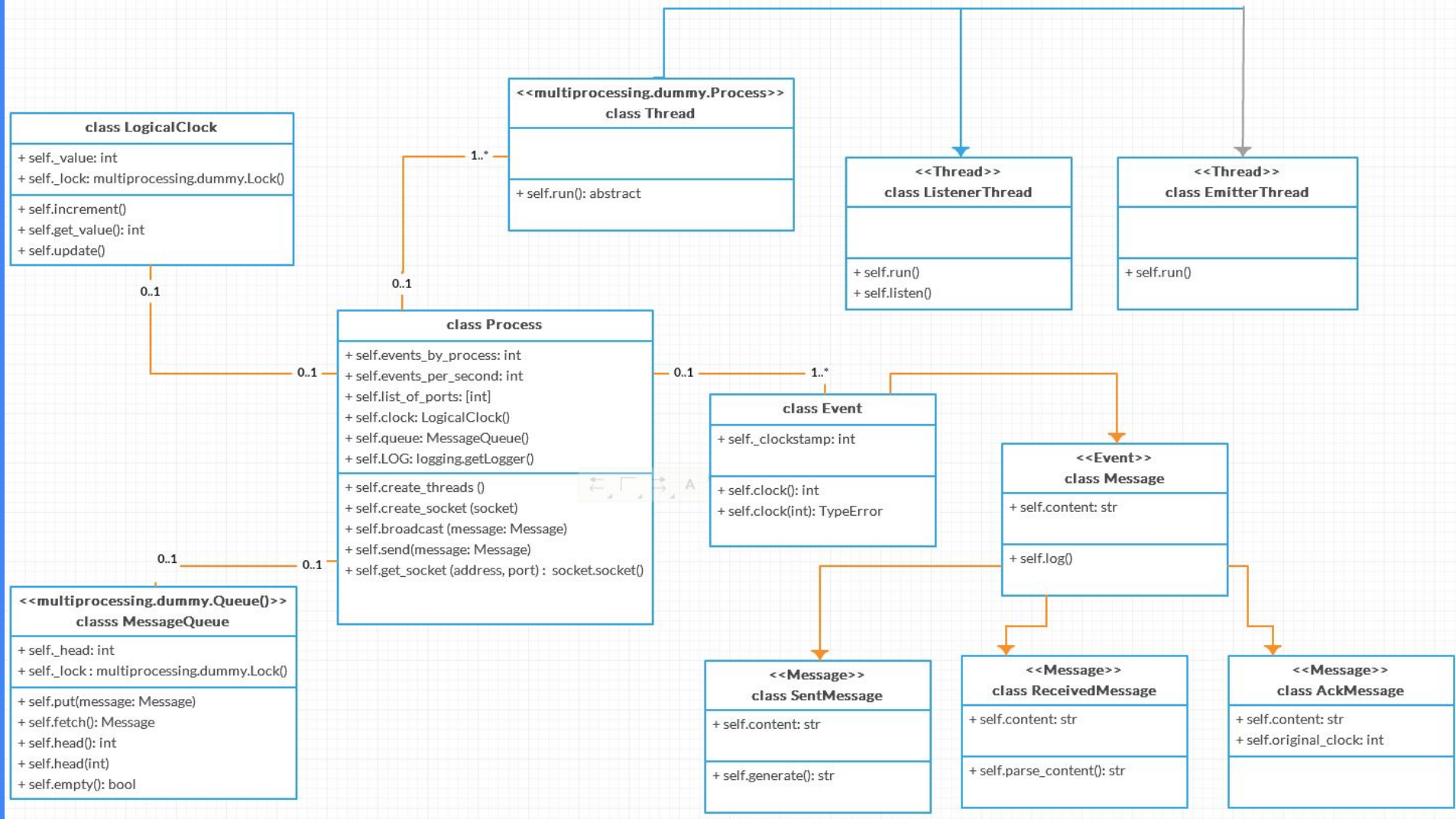Eventos gravados somente após confirmação de todos

Implementação

Python 3.5

+

multiprocessing

class LogicalClock

+ self._value: int
+ self._lock: multiprocessing.dummy.Lock()

+ self.increment()
+ self.get_value(): int
+ self.update()

<<multiprocessing.dummy.Process>>
class Thread

+ self.run(): abstract

<<Thread>>
class ListenerThread

+ self.run()
+ self.listen()

<<Thread>>
class EmitterThread

+ self.run()

class Process

+ self.events_by_process: int
+ self.events_per_second: int
+ self.list_of_ports: [int]
+ self.clock: LogicalClock()
+ self.queue: MessageQueue()
+ self.LOG: logging.getLogger()

+ self.create_threads ()
+ self.create_socket (socket)
+ self.broadcast (message: Message)
+ self.send(message: Message)
+ self.get_socket (address, port) : socket.socket()

class Event

+ self._clockstamp: int

+ self.clock(): int
+ self.clock(int): TypeError

<<Event>>
class Message

+ self.content: str

+ self.log()

<<multiprocessing.dummy.Queue()>>
classs MessageQueue

+ self._head: int
+ self._lock : multiprocessing.dummy.Lock()

+ self.put(message: Message)
+ self.fetch(): Message
+ self.head(): int
+ self.head(int)
+ self.empty(): bool

<<Message>>
class SentMessage

+ self.content: str

+ self.generate(): str

<<Message>>
class ReceivedMessage

+ self.content: str

+ self.parse_content(): str

<<Message>>
class AckMessage

+ self.content: str
+ self.original_clock: int

1..*

0..1

0..1

0..1

0..1

0..1

1..*

0..1

0..1

3 threads por processo

- Thread principal inicia as demais e grava as mensagens
- Thread servidora recebe e parseia mensagens (maior gargalo)
- Thread cliente produz eventos e envia mensagens

- Fila de mensagens com cadeado intermedia comunicação

Módulos

- Multiprocessing.dummy (Process, Queue, Lock)

- socket, select

- re

Módulos

- Multiprocessing.dumm

- socket, select

- **re**

```python
69  def parse_content(self):
70      try:
71          if "ACK" in self.content:
72              pattern = r"<(\d*)-(\d*)>.*<(\d*)>\s" \
73                  r"from\s([\d.]+) to ([\d.]+)\s\(([\d\s\-.:]*)\)"
74              match = re.search(pattern, self.content)
75              self.emitter_clock = match.group(1)
76              self.emitter_id = match.group(2)
77              self.original_clock = match.group(3)
78
79              if self.process.register(self.emitter_id, self.original_clock):
80                  message = self.process.queue.fetch()
81                  message.log()
82
83                  self.process.queue.head = max(self.process.queue.head,
84                                       self.original_clock) + 1
85          else:
86              pattern = r"<(\d*)-(\d*)>.*from ([\d.]+) " \
87                  r"to ([\d.]+): ([\w\s',]+) \(([\d\s\-.:]*)\)"
88              match = re.search(pattern, self.content)
89              if match:
90                  self.emitter_clock = int(match.group(1))
91                  self.emitter_id = match.group(2)
92                  self.emitter_content = match.group(5)
93
94                  self.process.register(self.emitter_id, self.original_clock)
95      except Exception:
96          if __debug__:
97              traceback.print_exc()
```

8-10000-18000.log

```
INFO:manager:Accepting connection from 127.0.0.1:42120
INFO:manager:<10-8002 SENT from 0.0.0.0 to 0.0.0.0: say, say, say what you want but don't play games with m
INFO:manager:<1-8005 SENT from 0.0.0.0 to 0.0.0.0: but maybe tomorrow, you'll change your mind, maybe tomor
INFO:manager:<14-8003 SENT from 0.0.0.0 to 0.0.0.0: life ain't so bad at all if you live life off the wall
INFO:manager:<2-8007 SENT from 0.0.0.0 to 0.0.0.0: now i've learned that love needs expression but i learne
INFO:manager:<7-8007 SENT from 0.0.0.0 to 0.0.0.0: but, if you're thinkin' about my baby it don't matter if
INFO:manager:<16-8003 SENT from 0.0.0.0 to 0.0.0.0: she's saying that's okay hey baby do what you please i
INFO:manager:<12-8006 SENT from 0.0.0.0 to 0.0.0.0: now i've learned that love needs expression but i learn
INFO:manager:<9-8007 SENT from 0.0.0.0 to 0.0.0.0: i always feel like somebody's watching me and i have no
INFO:manager:<11-8000 SENT from 0.0.0.0 to 0.0.0.0: do you remember the time when we first met girl do you
INFO:manager:<9-8007 SENT from 0.0.0.0 to 0.0.0.0: you rocked my world, you know you did and everything i d
INFO:manager:<8-8001 SENT from 0.0.0.0 to 0.0.0.0: the way you make me feel you really turn me on you knock
INFO:manager:<4-8004 SENT from 0.0.0.0 to 0.0.0.0: showin' how funky and strong is your fight it doesn't ma
INFO:manager:<6-8005 SENT from 0.0.0.0 to 0.0.0.0: but maybe tomorrow, you'll change your mind, maybe tomo
INFO:manager:<18-8006 SENT from 0.0.0.0 to 0.0.0.0: don't blame it on the sunshine don't blame it on the mo
INFO:manager:<22-8006 SENT from 0.0.0.0 to 0.0.0.0: tell me why is it so that i never can say goodbye (2018
INFO:manager:<13-8002 SENT from 0.0.0.0 to 0.0.0.0: just stop pressuring me stop pressuring me make me wann
INFO:manager:<25-8002 SENT from 0.0.0.0 to 0.0.0.0: Leave me alone stop it just stop doggin' me around (201
INFO:manager:<17-8007 SENT from 0.0.0.0 to 0.0.0.0: keep on with the force don't stop don't stop till you g
INFO:manager:<26-8006 SENT from 0.0.0.0 to 0.0.0.0: now i've learned that love needs expression but i learn
INFO:manager:<5-8004 SENT from 0.0.0.0 to 0.0.0.0: but maybe tomorrow, you'll change your mind, maybe tomor
INFO:manager:<33-8002 SENT from 0.0.0.0 to 0.0.0.0: heal the world make it a better place for you and for m
INFO:manager:<30-8002 SENT from 0.0.0.0 to 0.0.0.0: she's a dance, dance, dance, dance, dancing machine, wa
INFO:manager:<21-8003 SENT from 0.0.0.0 to 0.0.0.0: let's dance, let's shout, shake your body down to the g
INFO:manager:<15-8001 SENT from 0.0.0.0 to 0.0.0.0: now i've learned that love needs expression but i learn
INFO:manager:<53-8001 SENT from 0.0.0.0 to 0.0.0.0: i'm so confused will you show to me you'll be there for
INFO:manager:<27-8007 SENT from 0.0.0.0 to 0.0.0.0: say, say, say what you want but don't play games with w
INFO:manager:<23-8003 SENT from 0.0.0.0 to 0.0.0.0: tell me why is it so that i never can say goodbye (2018
INFO:manager:<24-8000 SENT from 0.0.0.0 to 0.0.0.0: Leave me alone stop it just stop doggin' me around (201
INFO:manager:<20-8005 SENT from 0.0.0.0 to 0.0.0.0: life ain't so bad at all if you live life off the wall
INFO:manager:<19-8004 SENT from 0.0.0.0 to 0.0.0.0: i always feel like somebody's watching me and i have no
INFO:manager:<37-8006 SENT from 0.0.0.0 to 0.0.0.0: do you remember the time when we first met girl do you
INFO:manager:<45-8004 SENT from 0.0.0.0 to 0.0.0.0: i always feel like somebody's watching me and i have no
INFO:manager:<65-8001 SENT from 0.0.0.0 to 0.0.0.0: now i've learned that love needs expression but i learn
INFO:manager:<46-8002 SENT from 0.0.0.0 to 0.0.0.0: but, if you're thinkin' about my baby it don't matter i
INFO:manager:<29-8003 SENT from 0.0.0.0 to 0.0.0.0: but maybe tomorrow, you'll change your mind, maybe tomo
INFO:manager:<32-8003 SENT from 0.0.0.0 to 0.0.0.0: when we're all the same, cause the blood inside me is i
INFO:manager:<44-8002 SENT from 0.0.0.0 to 0.0.0.0: cause this is thriller thriller night and no one's gonn
INFO:manager:<28-8000 SENT from 0.0.0.0 to 0.0.0.0: keep on with the force don't stop don't stop till you g
INFO:manager:<39-8003 SENT from 0.0.0.0 to 0.0.0.0: i'm so confused will you show to me you'll be there for
INFO:manager:<78-8001 SENT from 0.0.0.0 to 0.0.0.0: they're all in line waitin' for you so know the truth y
INFO:manager:<36-8005 SENT from 0.0.0.0 to 0.0.0.0: now i've learned that love needs expression but i learn
INFO:manager:<42-8006 SENT from 0.0.0.0 to 0.0.0.0: they're all in line waitin' for you so know the truth y
```

p	λ	tempo (s)	p	λ	tempo (s)	p	λ	tempo (s)
2	1	28.52374	2	1	286.246658	2	1	2998.55037
2	2	12.420049	2	2	148.901997	2	2	1494.091501
2	10	2.959135	2	10	29.346077	2	10	297.763825
4	1	59.568429	4	1	585.1391	4	1	5883.879098
4	2	29.813078	4	2	296.462348	4	2	2979.343469
4	10	5.086868	4	10	59.496107	4	10	600.332818
8	1	109.699103	8	1	1152.87353	8	1	11834.078567
8	2	55.250551	8	2	585.239865	8	2	5929.261745
8	10	10.990417	8	10	113.358163	8	10	1182.840992

Tabela 1: (a) $n = 100$; (b) $n = 1000$; (c) $n = 10000$.

Obrigado