Programação Distribuida - Relógios vetoriais

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Repositório: https://github.com/arielril/distr-prog-vectorial-clocks

Introdução

Neste trabalho é apresentado uma implementação de um programa distribuido que utiliza relógios vetoriais para sincronização entre processos. Cada processo do programa distribuido possui uma lista de referência para identificacação de onde esta cada processo (IP e porta) para realizar o envio de pacotes UDP.

Desenvolvimento

Para realizar o desenvolvimento deste trabalho foi utilizado a linguagem de programação **Python** e os pacotes:

- socket: utilizado para comunicação UDP
- threading: para execução dos procesos de recebimento e envio de mensagens de forma independente

Organização

O programa desenvolvido esta organizado em:

- Index
- Starter
- Node

Index

Este é o arquivo principal para organizar a incialização dos processos e coordenação de encerramento. Neste arquivo é realizado o parsing do arquivo de configuração (data/config) na função parse_config e é realizado a inicialização da espera do inicio de execução executando a função await_start.

```
_name__ == "__main__":
try:
   parser = argparse.ArgumentParser(description="Something")
   parser.add argument(
        "-c", dest="config", help="config file path starting at cwd"
   parser.add_argument("--id", dest="process_id", help="the id of the process")
   args = parser.parse_args()
   has_required_config = (args.config == None or len(args.config) < 1) or (
        args.process_id == None
       or len(args.process_id) < 1</pre>
       or int(args.process_id, 10) < 1 # process IDs must be greater than 0
    if has_required_config:
       parser.print_help()
       sys.exit(0)
   configs = parse_config(args.config)
   node_config = get_process_config(configs, args.process_id)
   actual_node = create_node(*node_config)
   node_locations = get_node_locations(configs)
   node_locations.pop(args.process_id)
   actual_node.set_node_locations(node_locations)
   listen_thread = threading.Thread(target=node_listen, args=(actual_node,))
   actual_node.await_start()
   listen_thread.start()
   node_interact(actual_node)
   sys.exit(0)
```

Starter

Ester arquivo foi criado apenas para inicializar a execução do programa, realizando o envio de uma mensagem de inicialização para os processos usando um grupo multicast.

```
import struct
import socket

mcast = ("224.1.1.1", 8888)

s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM, socket.IPPROTO_UDP)
s.setsockopt(socket.IPPROTO_IP, socket.IP_MULTICAST_TTL, 32)
s.setsockopt(socket.IPPROTO_IP, socket.IP_MULTICAST_LOOP, 1)

s.setsockopt(
    socket.IPPROTO_IP,
    socket.IP_ADD_MEMBERSHIP,
    struct.pack("4sl", socket.inet_aton(mcast[0]), socket.INADDR_ANY),
)

# tested on ipsec connection on wireshark
s.sendto(b"start_bitches", mcast)
s.close()
```

Node

Este é o arquivo principal do trabalho, pois possui toda a lógica para comunicação entre processos, sincronização de processos utilizando relógios vetoriais e controle do relógio local de cada processo. Cada instância possui um dicionário informando onde cada processo está localizado para envio de mensagens de sincronização. Neste arquivo existe os métodos:

- _init__: para realizar a inicialização de uma instância de um processo
- *interact*: o qual realiza a geração de eventos locais (incremento do relógio local) e realiza a geração de eventos de mensagem para entre processos (incremento do relógio local e envio de mensagem para outro processo)
- listen: para receber as mensagens de outros procesoss e realizar a sincronização do relógio vetorial
- await_start: para esperar a mensagem de inicialização, escutando o grupo multicast
 UDP

```
class Node:
    local_events = []
    # sent messages
    message_events = []
    received_messages = []
```

```
clock = 0
vclock = []
multicast_group = ("224.1.1.1", 8888)
start_message = "start_bitches"
node_locations = {}
die = False
def __init__( --
): ...
def set_node_locations(self, locations: dict): --
def init_vec_clock(self): "
def increment_clock(self): "
def retrieve clock(self): ...
def update_clock(self, remote_clock, remote_id): ...
def interact(self): ...
def send_message(self): ...
def add_message_event(self, clock, dst_node_id): --
def send_local_event(self): --
def listen(self): --
def get_sleep_time(self): --
def show_results(self): ...
```

Demonstração

Máquinas virtuais

Para inicias as máquinas virtuais para a demonstração é necessário ter a ferramenta **vagrant**(https://www.vagrantup.com) instalada além de possuir VirtualBox instalado. Após instalar as ferramentas necessárias é preciso estar na pasta machine, a qual contém o arquivo Vagrantfile com as configurações necessárias para inciar 3 máquinas virtuais, para executar o comando vagrant up.



Simulação

Para executar a simulação é possível iniciar a quantidade que quiser de conexões com as máquinas virtuais, para este trabalho foi utilizado 3 máquinas virtuais. Para este trabalho foi utilizado 6 terminais, 2 em cada máquina virtual. Em 5 terminais foram inicializados os processos para execução da simulação e um terminal foi utilizado para executar o arquivo de inicialização.

X %1 machine: vagrant ssh host-1 — vagrant (ssh) \ominus /agrant@host1:-/code\$ make PID=1 run[]	X Y2 machine: vagrant ssh host-2 - vagrant (ssh) \odot vagrant@host2:-/code\$ make PID=3 run[]	X % machine: vagrant sah host-8 – vagrant (sah) vagrant@host3:~/code\$ make PID=\$[]
proc 1	proc 3	proc 5
× ℃4 machine: vagrant seh host-1 — vagrant (seh) ⊖ vagrant@host1:-/code\$ make PID>2[]		X % machine: vagrant sah host-8 — vagrant (sah) ogrant@host3:-/code\$ make start
proc 2	proc 4	starter

X1 machine: vagrant ssh host-1 — vagrant (ssh)		
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