



CD Final Project

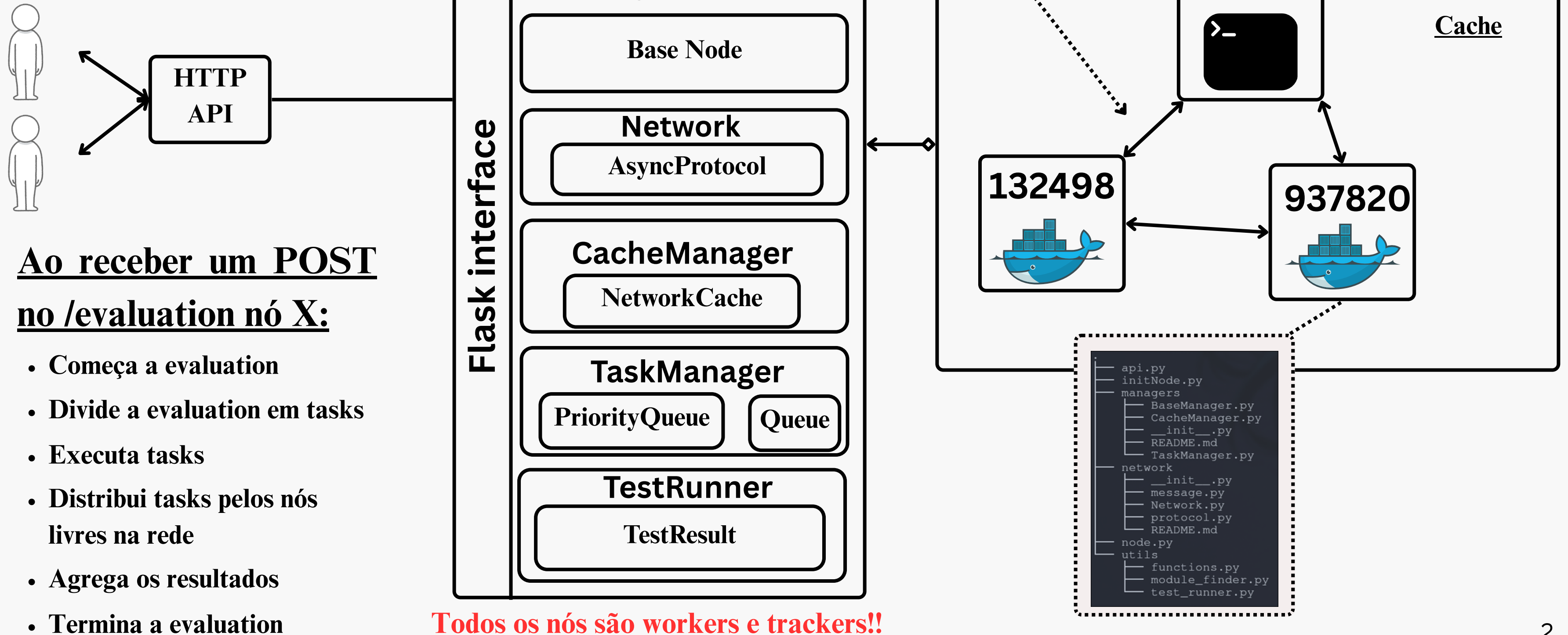
Distributed CD tester

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Architecture



Network Protocol

```
{
  "cmd": "RECOVERY_ELECTION",
  "data": {
    "candidate_id": "123456789",
    "failed_node": "987654321",
    "extra": "...",
    "failed_node_addr": "192.73.81.43:8002",
    "timestamp": 1710000000.0
  },
  "ip": "192.168.1.10",
  "port": 8001,
  "timestamp": 1710000000.0
}
```

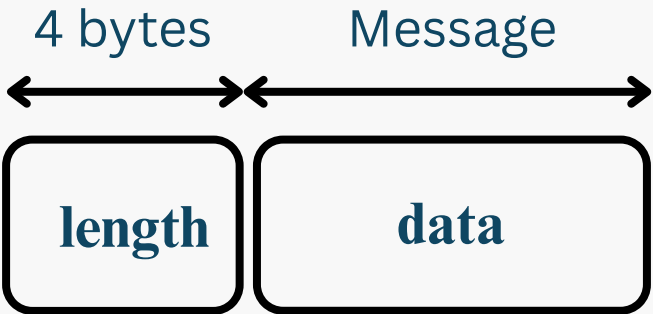
```
{
  "cmd": "TASK_SEND",
  "data": {
    "project_ID": "172927292791",
    "module": "test_mod1.py",
    "project_name": "nome_projeto",
    "api_port": 5001,
    "eval_id": "1234567890",
    "url": "https://github.com/...",
    "token": "hjsjh1ka019",
    "type": "url"
  },
  "ip": "192.168.1.10",
  "port": 8001,
  "timestamp": 1710000000.0
}
```

```
{
  "cmd": "HEARTBEAT",
  "data": {
    "id": "123456789",
    "peers_ip": ["192.168.1.11:25000"]
  },
  "ip": "192.168.1.10",
  "port": 8001,
  "timestamp": 1710000000.0
}
```

```
{
  "cmd": "CACHE_UPDATE",
  "data": {
    "addr": "192.73.82.43:8002",
    "peers_ip": get_peers_ip(),
    "evaluations": self.network_cache["evaluations"],
    "projects": self.network_cache["projects"],
    "stats": self._get_status(),
  },
  "ip": "192.168.1.10",
  "port": 8001,
  "timestamp": 1710000002.0
}
```

```
{
  "cmd": "EVALUATION_RESPONSABILITY_UPDATE",
  "data": {
    "project_id": "123456789",
    "new_node": "987654321",
    "eval_id": "68611"
  },
  "ip": "192.168.1.11",
  "port": 8001,
  "timestamp": 1710000001.0
}
```

Tipo	Descrição
CACHE_UPDATE	Atualização do cache de estado da rede
HEARTBEAT	Sinaliza que o nó está ativo
CONNECT	Solicita entrada em uma rede existente
CONNECT_REP	Resposta à solicitação de conexão
TASK_ANNOUNCE	Anúncio de disponibilidade de tarefas
TASK_REQUEST	Solicitação de tarefa
TASK_SEND	Envio de tarefa para execução
TASK_CONFIRM	Confirmação de receção de tarefa
PROJECT_ANNOUNCE	Anúncio de novo projeto
RECOVERY_ELECTION	Mensagem de candidatura para eleição de nó de recuperação
RECOVERY_ELECTION_REP	Resposta de participação na eleição de recuperação
EVALUATION_RESPONSIBILITY_UPDATE	Atualização de responsável por projeto/avaliação
RECOVERY_ELECTION_RESULT	Resultado da eleição de recuperação



ex: Heartbeat

```
{
  "cmd": "HEARTBEAT",
  "data": { ... },
  "ip": "192.168.1.10",
  "port": 8001,
  "timestamp": 1710000000.0
}
```

Fault tolerance mechanisms

Detecção de Falha

- Cada nó envia mensagens **HEARTBEAT** a cada 7 segundos via UDP
- Um nó é considerado falho após 21 segundos ($3 * \text{HEARTBEAT_INTERVAL}$) sem heartbeats
- Sistema mantém registro de nós falhos em `failed_nodes` para evitar reconexão imediata

Processo de Eleição

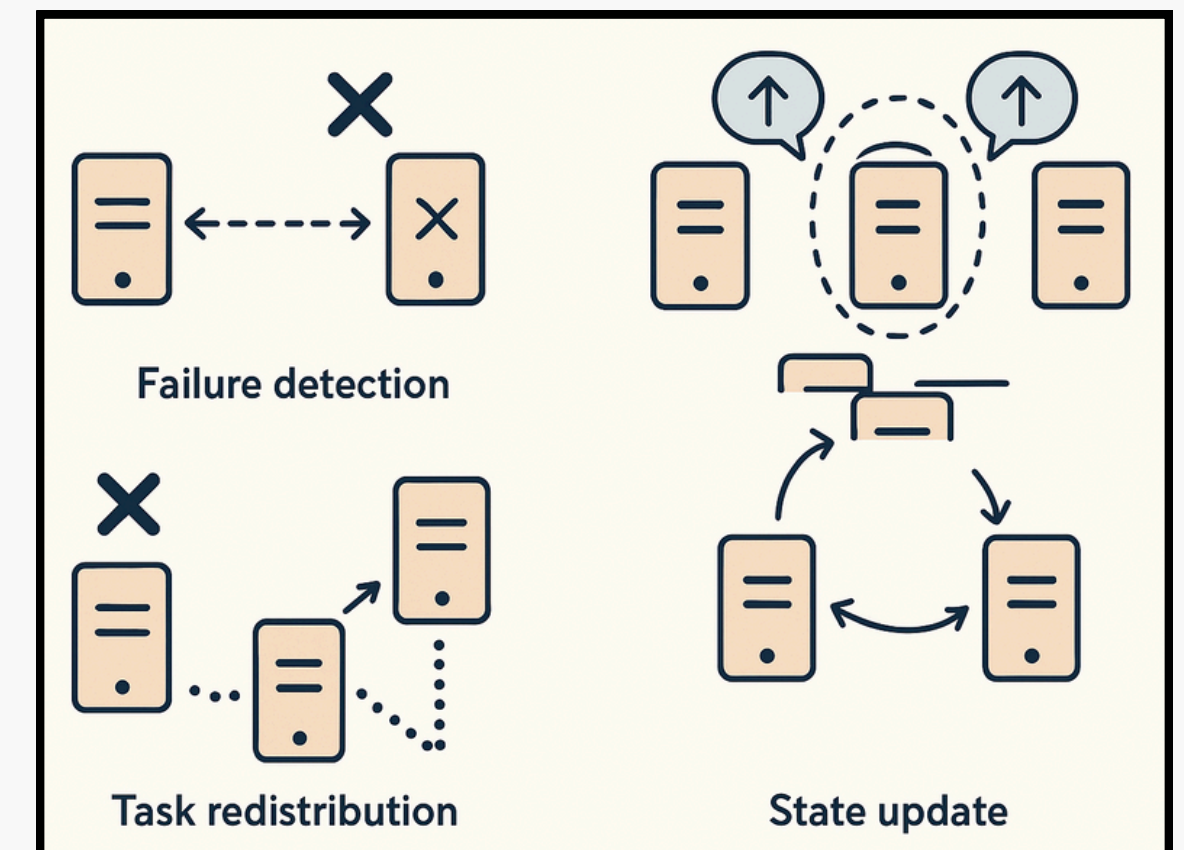
- Quando um nó responsável falha, inicia-se uma eleição via **RECOVERY_ELECTION**
- Os nós candidatos enviam suas propostas para assumir tarefas do nó falho
- Algoritmo determinístico elege o nó com menor `**node_id`

Redistribuição de Tarefas

- Tarefas do nó falho são movidas para a **priority_queue** para processamento imediato
- O sistema rastreia módulos com status "running" ou "pending"
- Nó eleito assume a responsabilidade pelos projetos via atualização de cache

Reatualização do Estado

- Mensagens **CACHE_UPDATE** são enviadas a cada 5 segundos
- O nó eleito anuncia alterações via **EVALUATION_RESPONSIBILITY_UPDATE**
- Sistema implementa timeout adaptativo baseado na performance da rede



Tests

Map reduce

```
Created module test_basic.py for project 1749386942.7851088174938567813719845405
Added task 1749386942.7851088174938567813719845405::test_basic.py to queue
Created module test_broker.py for project 1749386942.7851088174938567813719845405
```



```
Sending task 1749386942.7851088174938567813719845405::test_broker.py to ('192.168.0.3', 8004)
Sending task 1749386942.7851088174938567813719845405::test_subtopic.py to ('192.168.0.3', 8003)
Updated module test_broker.py status to running
Task 1749386942.7851088174938567813719845405::test_broker.py confirmed by ('192.168.0.3', 8004)
```



```
DEBUG - Received task result from ('192.168.0.3', '8004')
```

Reassign

```
INFO - Task 1749385694.759445174938567813719845405::test_wire.py added to priority queue
INFO - Reassigned task 1749385694.759445174938567813719845405::test_wire.py from failed node 192.168.0.3:8002
WARNING - Node 174938568223392687152 is considered failed.
```

Evaluation com 8 projetos

Nós	Tempo (s)
8	50~
4	72~
2	120~

Internet off

```
WARNING - Node 174938568021479843617 is considered failed.
INFO - Removed peer 174938568021479843617 from the list of peers
WARNING - Starting recovery process for failed node 174938568021479843617
INFO - Looking for active evaluations for node 174938568021479843617
INFO - Found address 192.168.0.3:8004 for node 174938568021479843617 in peers
```



Internet on

```
Node 174938568021479843617 has recovered and is back online
Added peer 174938568021479843617 to the list of peers
Heartbeat received from 192.168.0.3:8004
```

Cache propagation

```
DEBUG - Propagating cache to all nodes
DEBUG - Updated status for node 192.168.0.3:8004
DEBUG - Merged cache update from 192.168.0.3:8004
```

Cleaning

```
/app # ls
__pycache__      managers      requirements.txt
api.py           network      utils
initNode.py     node.py
```

Recovery Node

```
WARNING - Node 174938421025134621170 is considered failed.
INFO - Removed peer 174938421025134621170 from the list of peers
INFO - Looking for active evaluations for node 174938421025134621170
INFO - Found address 192.168.0.3:8001 for node 174938421025134621170 in peers
INFO - Found active evaluations for node 174938421025134621170: {'1749384210251346211701': ['17493842137174938421025134621170']}
DEBUG - Deleted status for node 192.168.0.3:8001 from cache
DEBUG - Received election candidate 174938421191185266821 for failed node 174938421025134621170
```



```
INFO - Responsibility for the project 1749384231.442137174938421025134621170 transferred to 192.168.0.3:8004
INFO - Responsibility for the project 1749384230.522273174938421025134621170 transferred to 192.168.0.3:8004
```