Async APIs in funcX

Kir Nagaitsev
import time
from funcx.sdk.client import FuncXClient
from funcx.utils.errors import TaskPending

def double_delayed(x):
    import time
    # simulate a function that takes a bit of time
    time.sleep(1)
    return x * 2

fxc = FuncXClient()

# tutorial endpoint
ep_id = '4b116d3c-1703-4f8f-9f6f-39921e5864df'
func_id = fxc.register_function(double_delayed)
Existing funcX Model

```python
x = 50

task_id = fxc.run(x, endpoint_id=ep_id, function_id=func_id)

while True:
    try:
        # HTTP task query
        result = fxc.get_result(task_id)
        print(result)
        break
    except TaskPending:
        # task is still pending, continue waiting
        print('Task pending')
        time.sleep(1)
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Expected Output:
```
Task pending
```
Existing funcX Model

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Expected Output:

Task pending
100
Async API introduces WebSockets under the hood!
funcX SDK
(Async API model)
Submit Task
funcX SDK
(Async API model)

Submit Task

HTTP

funcX web service

WebSocket service
funcX SDK
(Async API model)

Submit Task
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Internally: Outstanding tasks? Form WebSocket connection
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Get Result

funcX web service

WebSocket service

WebSocket
funcX SDK
(Async API model)

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Get Result

WebSocket service

funcX web service
funcX SDK
(Async API model)

Submit Task

Internally: Outstanding tasks? Form WebSocket connection

Get Result

Internally: No more outstanding tasks? Close WebSocket connection
Basic Async API Example

```python
from funcx.sdk.client import FuncXClient
from double_delayed import double_delayed

fxc = FuncXClient(asynchronous=True)
# tutorial endpoint
ep_id = '4b116d3c-1703-4f8f-9f6f-39921e5864df'
func_id = fxc.register_function(double_delayed)

async def task():
    x = 50
    result = await fxc.run(x, endpoint_id=ep_id, function_id=func_id)
    print(result)

fxc.loop.run_until_complete(task())
```

# If running in Jupyter notebook, just do: await task()
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Expected Output: 100
funcX Executor API is built on top of async interface
class FuncXExecutor(concurrent.futures.Executor):

    def submit(self, function, *args, endpoint_id=None, container_uuid=None, **kwargs):
        ...

    (Runs async WebSocket code on a separate thread under the hood)
from funcx import FuncXClient
from funcx.sdk.executor import FuncXExecutor
...

fxc = FuncXClient()
fx = FuncXExecutor(fxc)

# tutorial endpoint
endpoint_id = '4b116d3c-1703-4f8f-9f6f-39921e5864df'

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future = fx.submit(double_delayed, x, endpoint_id=endpoint_id)
result = future.result()
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Executor Example

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Expected Output: 100
Executor Batching (Next SDK Release)

```python
fxc = FuncXClient()
fx = FuncXExecutor(fxc, batch_enabled=True, batch_interval=1.0)
def run():
    futures = []
    for _ in range(50):
        x = random.randint(0, 100)
        future = fx.submit(double_delayed, x, endpoint_id=ep_id)
        futures.append(future)

    for future in futures:
        result = future.result()
        print(f'Result: {result}"

t = timeit.timeit(run, number=1)
print(f'Time: {round(t, 2)}s')
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Expected Output:

```
<Results>
Time: 8.47s
```
What’s Next?

- Robustness improvements: WebSocket connection loss, recovering tasks that were submitted but not received
- Task cancellation
Summary

- Existing HTTP query model works fine for fire-and-forget usage or long running tasks
- Async API is better for speed and complex async use-cases
- FuncX Executor is equally good for speed (thin layer built on top of async interface) and more user-friendly
- Both Async API and Executor allow you to forget about task_id
- Slides: https://github.com/Loonride/funcx-async-parslfest-2021
Questions?