gRPC: Remote Procedure Call

Introduction to Middleware

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Outline

1 Technology Overview
2 Assignment Part I
3 Server Implementation
4 Client Implementation
5 Assignment Part II
Technology Overview

Goals
Provide platform independent remote procedure call mechanism.

Features
- Protocol buffers as interface description language.
- Stub code generation for multiple languages (C++, Java, Python, Go, Ruby, JavaScript, PHP, C# ...).
- Binary transport format with compact data representation.
- Supports streaming arguments during remote call.
- Synchronous and asynchronous invocation code.
- Compression support at transport level.
- Security support at transport level.

... http://www.grpc.io
Examples To Begin With ...

> git clone http://github.com/d-iii-s/teaching-introduction-middleware.git

C

> cd teaching-introduction-middleware/src/grpc-basic-server/c
> cat README.md

Java

> cd teaching-introduction-middleware/src/grpc-basic-server/java
> cat README.md

Python

> cd teaching-introduction-middleware/src/grpc-basic-server/python
> cat README.md
syntax = "proto3";

message AnExampleRequest { ... }
message AnExampleResponse { ... }

service AnExampleService {
  rpc OneToOneCall (AnExampleRequest) returns (AnExampleResponse) { } 
  rpc OneToStreamCall (AnExampleRequest) 
    returns (stream AnExampleResponse) { } 
  rpc StreamToStreamCall (stream AnExampleRequest) 
    returns (stream AnExampleResponse) { } 
}
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Assignment

Server
Implement a server that will provide information on current time.
- The server should accept a spec of what fields to return.
- Fields should be standard YYYY-MM-DD HH:MM:SS.

Client
Implement a client that will query server time:
- Pick a random combination of fields.
- Query information on current time.
- Print the time.

Interoperability
Implement compatible clients and servers in two languages.
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C++ Service Basics

Implementation

class MyService : public AnExampleService::Service {
  grpc.Status OneToOne (grpc.ServerContext *context,
      const AnExampleRequest *request, AnExampleResponse *response) {
    // Method implementation goes here ...
    return (grpc.Status::OK);
  }

  ...
}

Execution

MyService service;
grpc.ServerBuilder builder;
builder.AddListeningPort ("localhost:8888", grpc.InsecureServerCredentials ());
builder.RegisterService (&service);
std::unique_ptr<grpc.Server> server (builder.BuildAndStart ());

server->Wait ();
Java Service Basics

Implementation

class MyService extends AnExampleServiceGrpc.AnExampleServiceImplBase {
    @Override public void OneToOne (
        AnExampleRequest request,
        io.grpc.stub.StreamObserver<AnExampleResponse> responseObserver) {
        // Method implementation goes here ... 
        responseObserver.onNext (response);
        responseObserver.onCompleted ();
    }
    ...
}

Execution

io.grpc.Server server = io.grpc.ServerBuilder
    .forPort (8888).addService (new MyService ()).build ().start ();

server.awaitTermination ();
Python Service Basics

**Implementation**

```python
class MyServicer (AnExampleServiceServicer):
    def OneToOne (self, request, context):
        # Method implementation goes here ...
        return response
```

**Execution**

```python
server = grpc.server (
    futures.ThreadPoolExecutor (
        max_workers = SERVER_THREAD_COUNT))
add_AnExampleServiceServicer_to_server (MyServicer (), server)
server.add_insecure_port ("localhost:8888")
server.start ()
```
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C++ Client Basics

Connection

```cpp
class CppClient {

public:
    std::shared_ptr<grpc.Channel> channel = grpc.CreateChannel(
        "localhost:8888", grpc.InsecureChannelCredentials());

private:
};
```

Invocation

```cpp
class CppClient {

public:
    grpc.ClientContext context;
    AnExampleResponse response;
    std::shared_ptr<AnExampleService::Stub> stub = AnExampleService::NewStub(channel);
    grpc.Status status = stub->OneToOne(&context, request, &response);
    if (status.ok()) {
        // Response available here ...
    }
};
```
Java Client Basics

Connection

```java
io.grpc.ManagedChannel channel = io.grpc.ManagedChannelBuilder
  .forAddress("localhost", 8888)
  .usePlaintext()
  .build();
```

Invocation

```java
AnExampleServiceGrpc.AnExampleServiceBlockingStub stub =
  AnExampleServiceGrpc.newBlockingStub (channel);
AnExampleResponse response = stub.oneToOne (request);
// Response available here ...
```
Python Client Basics

Connection

```
with grpc.insecure_channel("localhost:8888") as channel:
```

Invocation

```
stub = AnExampleServiceStub(channel)
response = stub.OneToOne(request)
# Response available here ...
```
Show Your Code ...

Query Host Name

> hostname
u1-22

Run Screen Sharing

> x11vnc -viewonly
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# Assignment

## Performance

Measure the performance of your implementation.

## Experiment Design

Stick to the following, or provide arguments for why not:

- Random field mix, each field with probability $1/2$.
- Measure at least two minutes long traffic.
- Report average invocation throughput.
- No printing during measurement.
- Compare with past assignments.
Submission

**GitLab**

**Requirements**
- Use the assignment subdirectory.
- Write brief report in SOLUTION.md.
- Include build scripts with instructions.
- Do not commit binaries or temporary build artifacts.
- Tag your solution with ‘task-03‘ and push the tag.