分散式系統

Lab: Remoting

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操作一: SOAP-based Web Services 開發 (平台: Node.js)

1. 建立一個新的資料夾「lab-remoting」，在此目錄下，新建一個 soap 目錄
2. 在此 lab-remoting 目錄中建立一個新的 package.json 檔案，內容如下:

```
 {
    "name": "dslab-remoting",
    "version": "1.0.0",
    "dependencies": {
       "soap": "^0.36.0",
       "@grpc/grpc-js": "^1.2.2",
       "@grpc/proto-loader": "*"
    }
}
```

3. 在和 package.json 同一個目錄下，於命令列執行 npm install，安裝所需模組
4. 確認 Adder.wsdl、AddMu.wsdl、soapClient.js 與 soapServer.js 等檔案存在 lab-remoting/soap 目錄中。
5. 開啟並了解 soapServer.js 程式碼的功能與意義:
   (1) 請將 soapServer.js 中，含「讀入 wsdl 檔」功能的敘述 (請貼上整個 statement，也就是分號前的所有程式碼)，貼在下面「答」之後

   答:

```
const xml = require('fs').readFileSync('Adder.wsdl', 'utf8');
```

   (2) 請將 soapServer.js 中，含「實作 add 並回傳 x 和 y 之和的實作」功能的敘述(請貼上整個 statement)，貼在下面「答」之後

   答:

```
const service = {
      CalculatorImplService: {
            CalculatorImplPort: {
                  add: function (args) {
                        return {result: args.x + args.y};
                    }
                }
            }
        };
```

(3) 在程式中，建立 http server 後，指派給一個變數，該變數的名稱為何? 這個 http server 傾聽的通訊埠號(port number)為何?

答:

指派的變數為 server。

Port number=8192。

(4) soap.listen(...)中傳入了四個參數，包含 WSDL、http server、服務的實作與一個此服務的掛載網址，請寫出此網址為何?

答:

http://localhost:8192/Adder?wsdl

6. 開啟並了解 soapClient.js 程式碼的功能與意義:
   (1) 引入 soap 函式庫後，程式呼叫了 soap 的 createClient 的方法，這個方法傳入二個參數，其中一個是 SOAP Server 的 WSDL 的位址。請問此位址為何?

   答:

   http://localhost:8192/Adder?wsdl

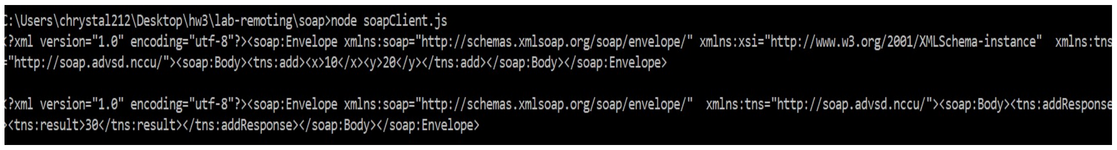
   (2) 由 createClient 方法所傳入的回呼函式中有二個參數，分別為 err 與 client，由 client 我們可以直接呼叫 client.add 來呼叫 SOAP Server 上的加法函式。其中，args 指的就是傳入遠端 add 呼叫的參數 x 與 y，請問 x 與 y 的值各為何?

   答:

   X=3, y=2

7. 切換目錄到/soap
8. 執行 node soapServer.js，在 console 中應出現 server initialized
9. 執行 node soapClient.js，觀察 console 所印出的執行結果。
10. 修改 soapClient.js 中的 args，試著藉由呼叫 SOAP Server 計算 x=10, y=20 的結果。將 soapClient.js 所印出在 console 中的 SOAP 訊息貼在下面。

答:



```
:\Users\chrystal212\Desktop\hw3\lab-remoting\soap>node soapClient.js
?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"  xmlns:tns
="http://soap.advsd.nccu/"><soap:Body><tns:add><x>10</x><y>20</y></tns:add></soap:Body></soap:Envelope>

?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"  xmlns:tns="http://soap.advsd.nccu/"><soap:Body><tns:addResponse
<tns:result>30</tns:result></tns:addResponse></soap:Body></soap:Envelope>
```

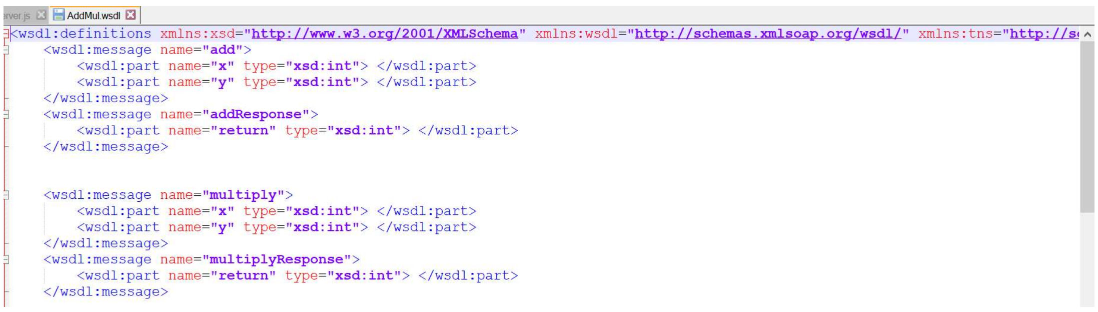
<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:tns="http://soap.advsd.nccu/"><soap:Body><tns:add><x>10</x><y>20</y></tns:add></soap:Body></soap:Envelope>

<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/" xmlns:tns="http://soap.advsd.nccu/"><soap:Body><tns:addResponse><tns:result>30</tns:result></tns:addResponse></soap:Body></soap:Envelope>

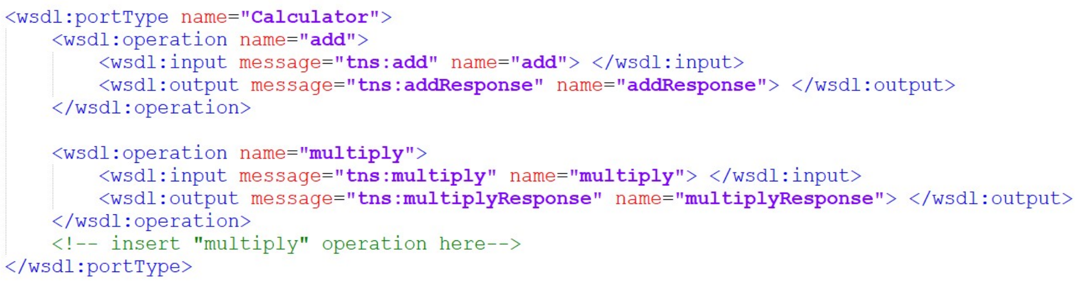
操作二: 寫作新的 SOAP 乘法(multiply)服務

1. 請根據操作一中的觀察，修改 soapServer.js，將引入的 wsdl 檔案由 Adder.wsdl 改為 AddMul.wsdl。
2. 根據 AddMul.wsdl 中的註解，參考 add 服務的定義，定義乘法(multiply)服務的相關 wsdl 宣告。將修改後的 AddMul.wsdl 貼在答的下方 (提示: 可參考 AddMul.wsdl 中的註解)

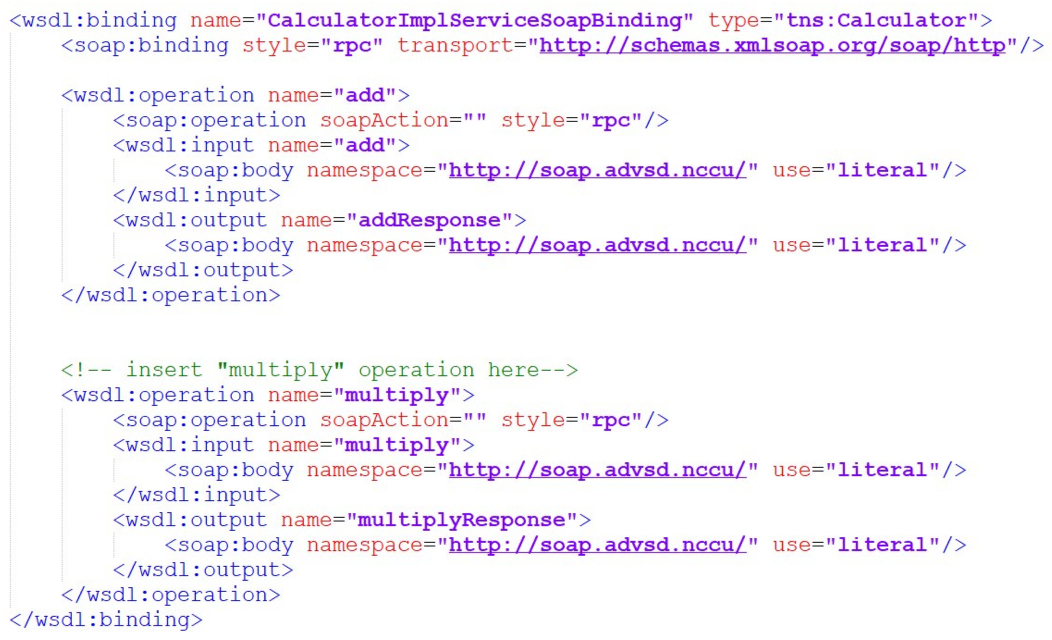
   答:



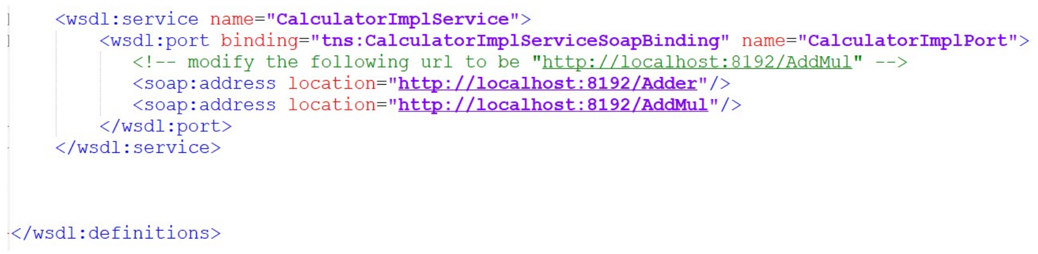
```
<wsdl:definitions xmlns:xsd="http://www.w3.org/2001/XMLSchema" xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/" xmlns:tns="http://s
    <wsdl:message name="add">
        <wsdl:part name="x" type="xsd:int"> </wsdl:part>
        <wsdl:part name="y" type="xsd:int"> </wsdl:part>
    </wsdl:message>
    <wsdl:message name="addResponse">
        <wsdl:part name="return" type="xsd:int"> </wsdl:part>
    </wsdl:message>


    <wsdl:message name="multiply">
        <wsdl:part name="x" type="xsd:int"> </wsdl:part>
        <wsdl:part name="y" type="xsd:int"> </wsdl:part>
    </wsdl:message>
    <wsdl:message name="multiplyResponse">
        <wsdl:part name="return" type="xsd:int"> </wsdl:part>
    </wsdl:message>
```



```
<wsdl:portType name="Calculator">
    <wsdl:operation name="add">
        <wsdl:input message="tns:add" name="add"> </wsdl:input>
        <wsdl:output message="tns:addResponse" name="addResponse"> </wsdl:output>
    </wsdl:operation>

    <wsdl:operation name="multiply">
        <wsdl:input message="tns:multiply" name="multiply"> </wsdl:input>
        <wsdl:output message="tns:multiplyResponse" name="multiplyResponse"> </wsdl:output>
    </wsdl:operation>
    <!-- insert "multiply" operation here-->
</wsdl:portType>
```



```
<wsdl:binding name="CalculatorImplServiceSoapBinding" type="tns:Calculator">
    <soap:binding style="rpc" transport="http://schemas.xmlsoap.org/soap/http"/>

    <wsdl:operation name="add">
        <soap:operation soapAction="" style="rpc"/>
        <wsdl:input name="add">
            <soap:body namespace="http://soap.advsd.nccu/" use="literal"/>
        </wsdl:input>
        <wsdl:output name="addResponse">
            <soap:body namespace="http://soap.advsd.nccu/" use="literal"/>
        </wsdl:output>
    </wsdl:operation>


    <!-- insert "multiply" operation here-->
    <wsdl:operation name="multiply">
        <soap:operation soapAction="" style="rpc"/>
        <wsdl:input name="multiply">
            <soap:body namespace="http://soap.advsd.nccu/" use="literal"/>
        </wsdl:input>
        <wsdl:output name="multiplyResponse">
            <soap:body namespace="http://soap.advsd.nccu/" use="literal"/>
        </wsdl:output>
    </wsdl:operation>
</wsdl:binding>
```



```
    <wsdl:service name="CalculatorImplService">
        <wsdl:port binding="tns:CalculatorImplServiceSoapBinding" name="CalculatorImplPort">
            <!-- modify the following url to be "http://localhost:8192/AddMul" -->
            <soap:address location="http://localhost:8192/Adder"/>
            <soap:address location="http://localhost:8192/AddMul"/>
        </wsdl:port>
    </wsdl:service>


</wsdl:definitions>
```

```
<wsdl:definitions xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:wsdl="http://schemas.xmlsoap.org/wsdl/"
xmlns:tns="http://soap.advsd.nccu/"
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
xmlns:ns1="http://schemas.xmlsoap.org/soap/http"
name="CalculatorImplService" targetNamespace="http://soap.advsd.nccu/">
    <wsdl:message name="add">
        <wsdl:part name="x" type="xsd:int"> </wsdl:part>
        <wsdl:part name="y" type="xsd:int"> </wsdl:part>
    </wsdl:message>
    <wsdl:message name="addResponse">
        <wsdl:part name="return" type="xsd:int"> </wsdl:part>
    </wsdl:message>

    <wsdl:message name="multiply">
        <wsdl:part name="x" type="xsd:int"> </wsdl:part>
        <wsdl:part name="y" type="xsd:int"> </wsdl:part>
    </wsdl:message>
    <wsdl:message name="multiplyResponse">
        <wsdl:part name="return" type="xsd:int"> </wsdl:part>
    </wsdl:message>

    <wsdl:portType name="Calculator">
        <wsdl:operation name="add">
            <wsdl:input message="tns:add" name="add"> </wsdl:input>
            <wsdl:output message="tns:addResponse"
name="addResponse"> </wsdl:output>
        </wsdl:operation>

        <wsdl:operation name="multiply">
            <wsdl:input message="tns:multiply" name="multiply">
</wsdl:input>
            <wsdl:output message="tns:multiplyResponse"
name="multiplyResponse"> </wsdl:output>
        </wsdl:operation>
        <!-- insert "multiply" operation here-->
    </wsdl:portType>

    <wsdl:binding name="CalculatorImplServiceSoapBinding"
type="tns:Calculator">
        <soap:binding style="rpc"
transport="http://schemas.xmlsoap.org/soap/http"/>

        <wsdl:operation name="add">
            <soap:operation soapAction="" style="rpc"/>
            <wsdl:input name="add">
                <soap:body namespace="http://soap.advsd.nccu/"
use="literal"/>
            </wsdl:input>
            <wsdl:output name="addResponse">
                <soap:body namespace="http://soap.advsd.nccu/"
use="literal"/>
            </wsdl:output>
        </wsdl:operation>
```

```
                <!-- insert "multiply" operation here-->
                <wsdl:operation name="multiply">
                    <soap:operation soapAction="" style="rpc"/>
                    <wsdl:input name="multiply">
                        <soap:body namespace="http://soap.advsd.nccu/"
        use="literal"/>
                    </wsdl:input>
                    <wsdl:output name="multiplyResponse">
                        <soap:body namespace="http://soap.advsd.nccu/"
        use="literal"/>
                    </wsdl:output>
                </wsdl:operation>
            </wsdl:binding>

            <wsdl:service name="CalculatorImplService">
                <wsdl:port binding="tns:CalculatorImplServiceSoapBinding"
        name="CalculatorImplPort">
                   <!-- modify the following url to be "http://localhost:8192/AddMul"
        -->
                   <soap:address location="http://localhost:8192/Adder"/>
                   <soap:address location="http://localhost:8192/AddMul"/>
                </wsdl:port>
            </wsdl:service>
       </wsdl:definitions>
```

3. 修改 soapServer.js，在 service 中新增 multiply 服務與實作
4. 修改 soapServer.js，在修改存取網址為「AddMul」:

```
 soap.listen(server, '/AddMul', service, xml, function () {
     console.log('server initialized');
});
```

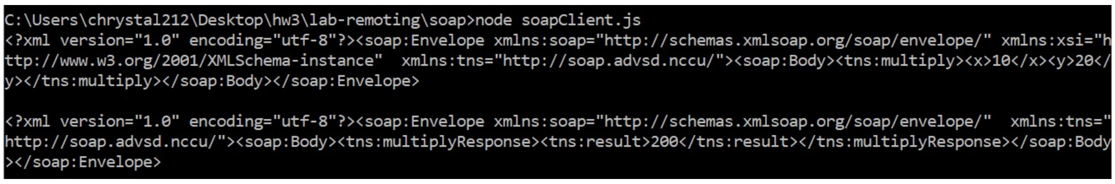
5. 關掉並重新執行 soapServer.js，在 console 中應出現 server initialized
6. 修改 soapClient.js，將 url 改為 http://localhost:8192/AddMul?wsdl
   const url = 'http://localhost:8192/AddMul?wsdl';
7. 修改 soapClient.js，將 client.add 改為 client.multiply

提示:
```
 client.multiply(args, function (err, result,    rawResponse, soapHeader,
 rawRequest) {
         if (err) console.log(err);
         console.log(rawRequest);
```

```
        console.log('');
        console.log(rawResponse);
    });
```

8. 修改 soapClient.js 中的 args，試著藉由呼叫 SOAP Server 計算 x=10, y=20 的結果。將 soapClient.js 所印出在 console 中的 SOAP 訊息貼在下面。

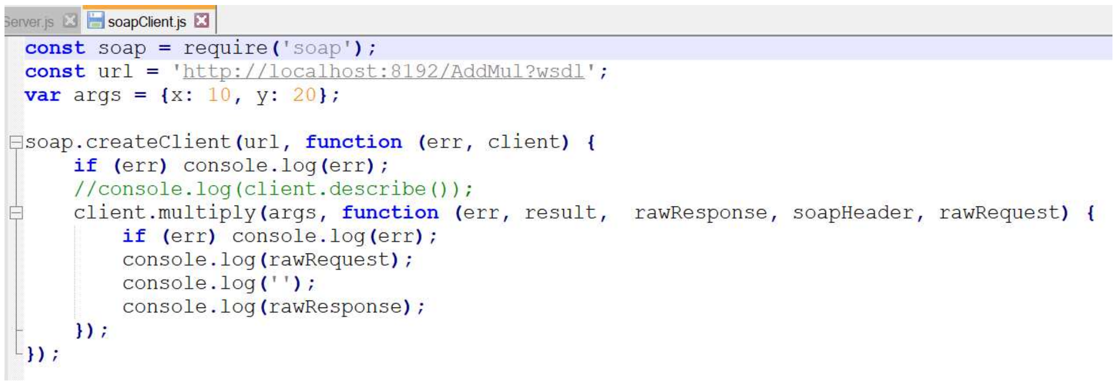
答:



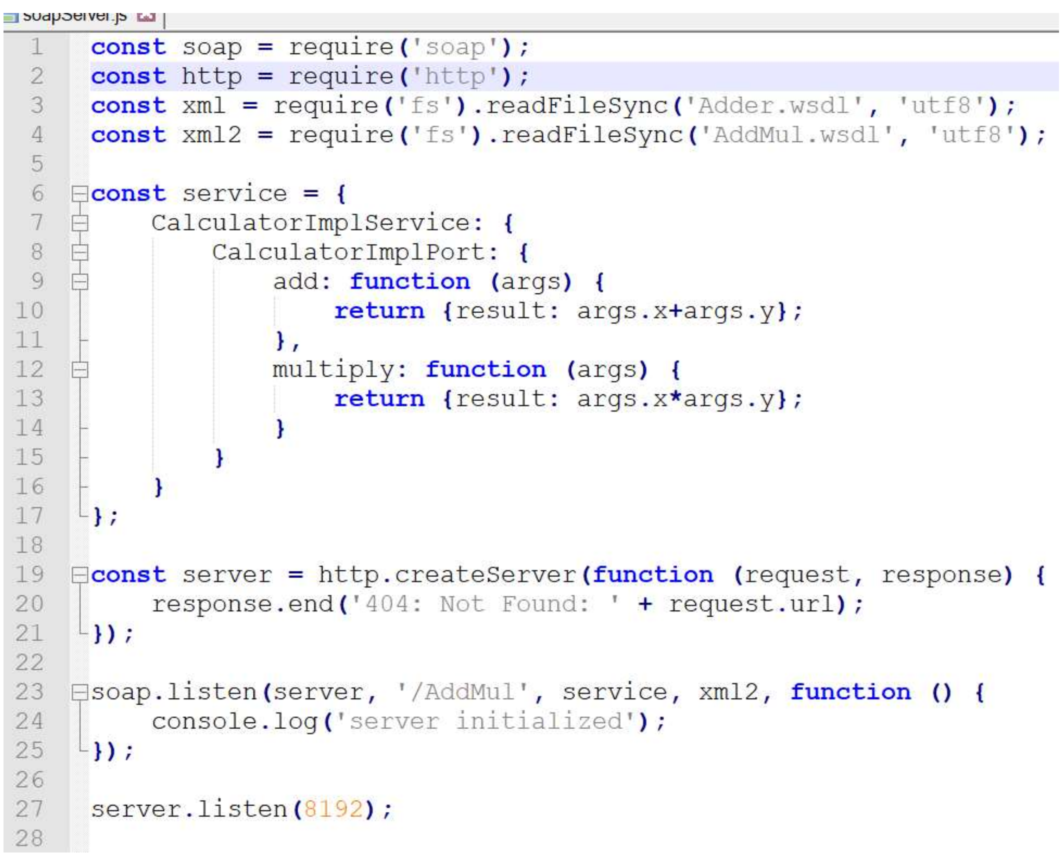
```
C:\Users\chrystal212\Desktop\hw3\lab-remoting\soap>node soapClient.js
<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/" xmlns:xsi="h
ttp://www.w3.org/2001/XMLSchema-instance"  xmlns:tns="http://soap.advsd.nccu/"><soap:Body><tns:multiply><x>10</x><y>20</
y></tns:multiply></soap:Body></soap:Envelope>

<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"  xmlns:tns="
http://soap.advsd.nccu/"><soap:Body><tns:multiplyResponse><tns:result>200</tns:result></tns:multiplyResponse></soap:Body
></soap:Envelope>
```

<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:tns="http://soap.advsd.nccu/"><soap:Body><tns:multiply><x>10</x><y>20</y></tns:multiply></soap:Body></soap:Envelope>

<?xml version="1.0" encoding="utf-8"?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/" xmlns:tns="http://soap.advsd.nccu/"><soap:Body><tns:multiplyResponse><tns:result>200</tns:result></tns:multiplyResponse></soap:Body></soap:Envelope>



```
const soap = require('soap');
const url = 'http://localhost:8192/AddMul?wsdl';
var args = {x: 10, y: 20};

soap.createClient(url, function (err, client) {
    if (err) console.log(err);
    //console.log(client.describe());
    client.multiply(args, function (err, result,  rawResponse, soapHeader, rawRequest) {
        if (err) console.log(err);
        console.log(rawRequest);
        console.log('');
        console.log(rawResponse);
    });
});
```


soapServer.js

```javascript
const soap = require('soap');
const http = require('http');
const xml = require('fs').readFileSync('Adder.wsdl', 'utf8');
const xml2 = require('fs').readFileSync('AddMul.wsdl', 'utf8');

const service = {
    CalculatorImplService: {
        CalculatorImplPort: {
            add: function (args) {
                return {result: args.x+args.y};
            },
            multiply: function (args) {
                return {result: args.x*args.y};
            }
        }
    }
};

const server = http.createServer(function (request, response) {
    response.end('404: Not Found: ' + request.url);
});

soap.listen(server, '/AddMul', service, xml2, function () {
    console.log('server initialized');
});

server.listen(8192);
```

9. 結束後記得關閉 soapServer.js

操作三: gRPC 開發 (平台: Node.js)

1. 在「lab-remoting/rpc」目錄下，應該看到 client.js, helloworld.proto 及 server.js 等三個檔案
2. 開啟並了解 helloworld.proto 與 server.js 程式碼的功能與意義:
   (1) rpc SayHello (HelloRequest) returns (HelloReply) {}中用到二個訊息 HelloRequest 和 HelloReply，

```
 message HelloRequest {
     string name = 1;
}
message HelloReply {
 string message = 1;
}
```

   請問裡面的 name=1、message=1，是什麼意思?

   答:

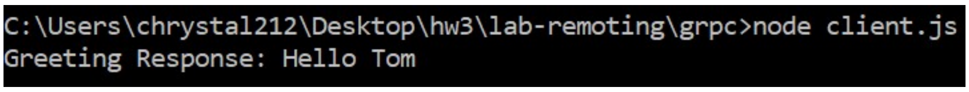
   Name 就是傳入參數的名字。Message 就是回傳的訊息。這邊=1 是指那個 message 的第一個參數，id=1 的意思。

(2) 找出程式從那裡讀入 helloworld.proto 定義檔?
(請整個敘述貼在下方)
答:

```
var PROTO_PATH = __dirname + '/helloworld.proto';

var grpc = require('@grpc/grpc-js');
var protoLoader = require('@grpc/proto-loader');
var packageDefinition = protoLoader.loadSync(
    PROTO_PATH,
    {
        keepCase: true,
        longs: String,
        enums: String,
        defaults: true,
        oneofs: true
    });
var hello_proto = grpc.loadPackageDefinition(packageDefinition).helloworld;
```

(3) 觀察 sayHello 函式中如何處理傳入訊息(如何取得參數值 name)之後回傳(本題不需作答)。
(4) 觀察 server.addService()中，sayHello 函式是如何登錄到服務中

3. 依序執行 server.js、client.js 觀察執行結果。



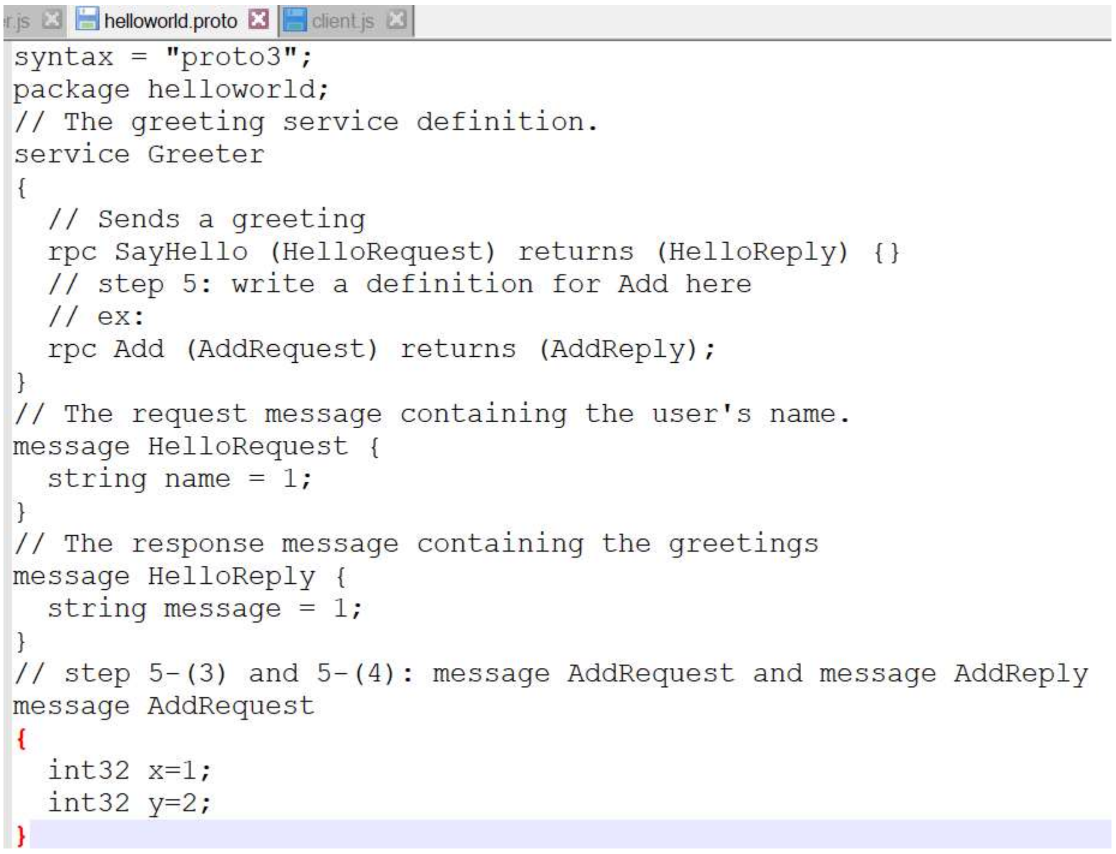
```
C:\Users\chrystal212\Desktop\hw3\lab-remoting\grpc>node client.js
Greeting Response: Hello Tom
```

4. 請修改 helloworld.proto、server.js 與 client.js，加入一個新的遠端 gRPC 函式。(請參考程式中的註解與 sayHello 的範例)
(1) 功能:傳入 2 個值 x、y，回傳 results 為 x+y 的結果
(2) 名稱: Add (Helloworld.proto), add(server.js 和 client.js):
(3) 訊息與參數: AddRequest，參數依序為 int32 x 與 int32 y
(4) 回傳訊息與參數: AddReply，參數為 int32 result
(5) 修改 server.js 模仿 function sayHello 加入新的函式 function add
(6) 修改 server.js，在 server.addService 中登錄 add 函式
(7) 修改 client.js，模仿 client.sayHello 新增 client.add
(8) 測試程式執行結果 (記得重開 server.js, 3+2 應等於 5)

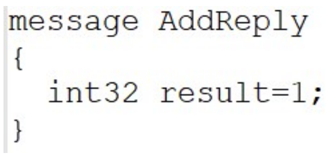
5. 請將修改後的 helloworld.proto、server.js 與 client.js 貼下面。

答:

helloworld.proto:

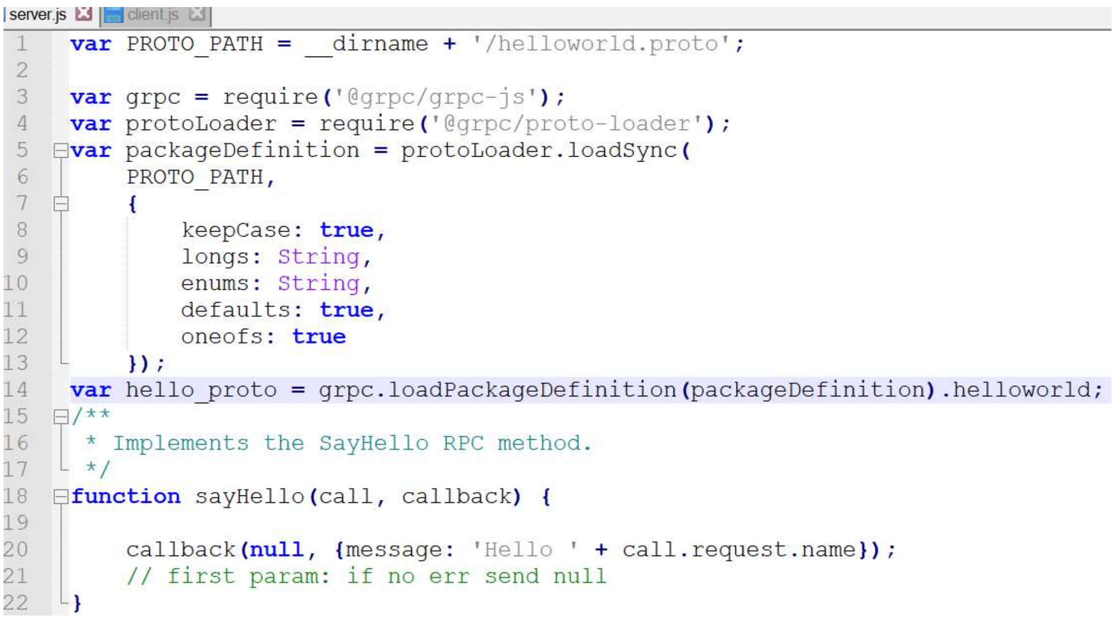


```
syntax = "proto3";
package helloworld;
// The greeting service definition.
service Greeter
{
  // Sends a greeting
  rpc SayHello (HelloRequest) returns (HelloReply) {}
  // step 5: write a definition for Add here
  // ex:
  rpc Add (AddRequest) returns (AddReply);
}
// The request message containing the user's name.
message HelloRequest {
  string name = 1;
}
// The response message containing the greetings
message HelloReply {
  string message = 1;
}
// step 5-(3) and 5-(4): message AddRequest and message AddReply
message AddRequest
{
  int32 x=1;
  int32 y=2;
}
```

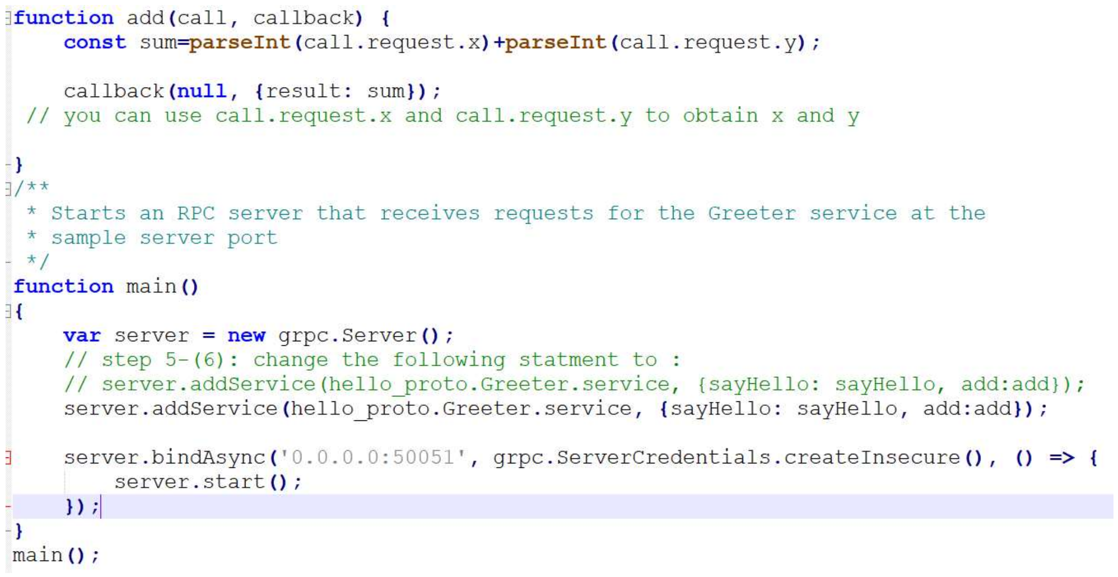


```
message AddReply
{
  int32 result=1;
}
```

server.js:

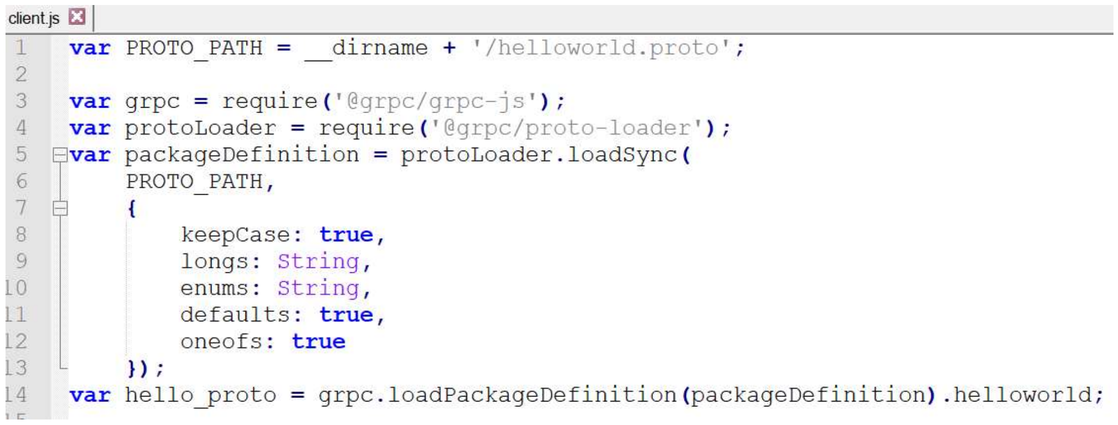


```
var PROTO_PATH = __dirname + '/helloworld.proto';

var grpc = require('@grpc/grpc-js');
var protoLoader = require('@grpc/proto-loader');
var packageDefinition = protoLoader.loadSync(
    PROTO_PATH,
    {
        keepCase: true,
        longs: String,
        enums: String,
        defaults: true,
        oneofs: true
    });
var hello_proto = grpc.loadPackageDefinition(packageDefinition).helloworld;
/**
 * Implements the SayHello RPC method.
 */
function sayHello(call, callback) {

    callback(null, {message: 'Hello ' + call.request.name});
    // first param: if no err send null
}
```



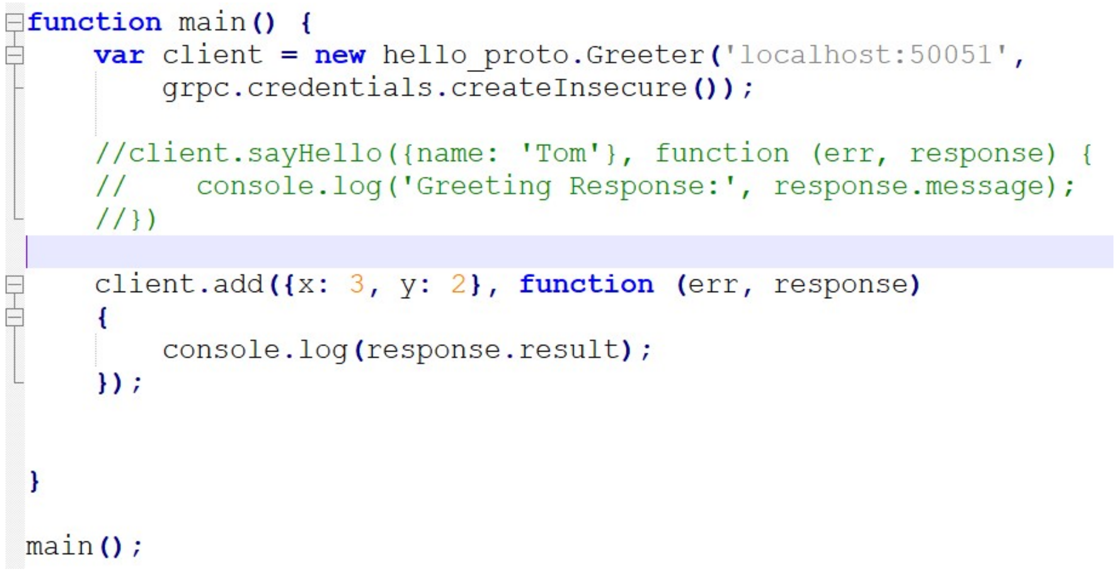
```
function add(call, callback) {
    const sum=parseInt(call.request.x)+parseInt(call.request.y);

    callback(null, {result: sum});
 // you can use call.request.x and call.request.y to obtain x and y

}
/**
 * Starts an RPC server that receives requests for the Greeter service at the
 * sample server port
 */
function main()
{
    var server = new grpc.Server();
    // step 5-(6): change the following statment to :
    // server.addService(hello_proto.Greeter.service, {sayHello: sayHello, add:add});
    server.addService(hello_proto.Greeter.service, {sayHello: sayHello, add:add});

    server.bindAsync('0.0.0.0:50051', grpc.ServerCredentials.createInsecure(), () => {
        server.start();
    });
}
main();
```

client.js:



client.js

```
var PROTO_PATH = __dirname + '/helloworld.proto';

var grpc = require('@grpc/grpc-js');
var protoLoader = require('@grpc/proto-loader');
var packageDefinition = protoLoader.loadSync(
    PROTO_PATH,
    {
        keepCase: true,
        longs: String,
        enums: String,
        defaults: true,
        oneofs: true
    });
var hello_proto = grpc.loadPackageDefinition(packageDefinition).helloworld;
```



```
function main() {
    var client = new hello_proto.Greeter('localhost:50051',
        grpc.credentials.createInsecure());

    //client.sayHello({name: 'Tom'}, function (err, response) {
    //    console.log('Greeting Response:', response.message);
    //})

    client.add({x: 3, y: 2}, function (err, response)
    {
        console.log(response.result);
    });


}

main();
```