



ISL

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Network Programming #7

ISL (IoT Standard Lab)

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01 Multicast

Sender & Receiver

```
int main(int argc, char *argv[])
{
    int send_sock;
    struct sockaddr_in mul_addr;
    int time_live=TTL;
    FILE *fp;
    char buf[BUF_SIZE];

    if(argc!=3){
        printf("Usage : %s <GroupIP> <PORT>\n", argv[0]);
        exit(1);
    }

    send_sock=socket(PF_INET, SOCK_DGRAM, 0);
    memset(&mul_addr, 0, sizeof(mul_addr));
    mul_addr.sin_family=AF_INET;
    mul_addr.sin_addr.s_addr=inet_addr(argv[1]); // Multicast
    mul_addr.sin_port=htons(atoi(argv[2])); // Multicast

    setsockopt(send_sock, IPPROTO_IP,
        IP_MULTICAST_TTL, (void*)&time_live, sizeof(time_live));

    if((fp=fopen("news.txt", "r"))==NULL)
        error_handling("fopen() error");

    while(!feof(fp)) /* Broadcasting */
    {
        fgets(buf, BUF_SIZE, fp);
        sendto(send_sock, buf, strlen(buf),
            0, (struct sockaddr*)&mul_addr, sizeof(mul_addr));
        sleep(2);
    }
    fclose(fp);
    close(send_sock);
}
```

```
#define TTL 64
#define BUF_SIZE 30
void error_handling(char *message);
```

UDP 소켓

멀티캐스트 TTL 설정

Table 12.1 Multicast Address Ranges

CIDR	Range	Assignment
224.0.0.0/24	224.0.0.0 → 224.0.0.255	Local Network Control Block
224.0.1.0/24	224.0.1.0 → 224.0.1.255	Internetwork Control Block
	224.0.2.0 → 224.0.255.255	AD HOC Block
224.1.0.0/16	224.1.0.0 → 224.1.255.255	ST Multicast Group Block
224.2.0.0/16	224.2.0.0 → 224.2.255.255	SDP/SAP Block
	224.3.0.0 → 231.255.255.255	Reserved
232.0.0.0/8	232.0.0.0 → 232.255.255.255	Source Specific Multicast (SSM)
233.0.0.0/8	233.0.0.0 → 233.255.255.255	GLOP Block
	234.0.0.0 → 238.255.255.255	Reserved
239.0.0.0/8	239.0.0.0 → 239.255.255.255	Administratively Scoped Block

멀티캐스트 가입

```
int main(int argc, char *argv[])
{
    int recv_sock;
    int str_len;
    char buf[BUF_SIZE];
    struct sockaddr_in adr;
    struct ip_mreq join_addr;

    if(argc!=3){
        printf("Usage : %s <GroupIP> <PORT>\n", argv[0]);
        exit(1);
    }

    recv_sock=socket(PF_INET, SOCK_DGRAM, 0);
    memset(&adr, 0, sizeof(adr));
    adr.sin_family=AF_INET;
    adr.sin_addr.s_addr=htonl(INADDR_ANY);
    adr.sin_port=htons(atoi(argv[2]));

    if(bind(recv_sock, (struct sockaddr*)&adr, sizeof(adr))==-1)
        error_handling("bind() error");

    join_addr.imr_multiaddr.s_addr=inet_addr(argv[1]);
    join_addr.imr_interface.s_addr=htonl(INADDR_ANY);

    setsockopt(recv_sock, IPPROTO_IP,
        IP_ADD_MEMBERSHIP, (void*)&join_addr, sizeof(join_addr));

    while(1)
    {
        str_len=recvfrom(recv_sock, buf, BUF_SIZE-1, 0, NULL, 0);
        if(str_len<0)
            break;
        buf[str_len]=0;
        fputs(buf, stdout);
    }
    close(recv_sock);
    return 0;
}
```

```
struct ip_mreq
{
    struct in_addr imr_multiaddr;
    struct in_addr imr_interface;
}
```

Sender

Receiver

실행결과

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/multicast$ ./receiver 224.1.1.2 8080
Ministry to form panel to remedy CPA exam
The Ministry of Finance and Economy announced its plans yesterday to create a committee to reform the controversial CPA (certified public accountant) examination system.
Although CPAs will not be among the committee's members, accountants say that the committee will in all likelihood tackle issues that have been previously raised by them with the ministry.

Last year, the ministry mandated the Financial Supervisory Service (FSS) to create over 1,000 new CPAs - a first in Korea's accounting history - citing the need to promote sound accounting practices industry wide.
The government, however, apparently overlooked a law that requires a CPA to receive at least two years of practical training at a public accounting firm.
After realizing that, the FSS then suggested that firms listed on the Korea Stock Exchange accommodate the newly minted CPAs, but accountants rejected the idea.
"The main purpose of selecting more CPAs is to ensure transparent accounting," said Yoon Jong-wook, head of the CPAs' own committee for improving training conditions.
"If accountants are pushed into regular companies for training, they will fail to be trained as professionals, and also be influenced by the CEOs when carrying out audits," he said.
The committee has staged numerous strikes outside the FSS building after discovering that 412 out of the 966 CPAs selected this year are still in search of training positions.
The FSS, meanwhile, insists that they are under no obligation to find suitable training positions for the CPAs, and have left that responsibility up to the finance ministry.
The ministry expects the newly launched committee to submit a proposal for overhauling the CPA
```

Receiver

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/multicast$ ./sender 224.1.1.2 8080
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/multicast$
```

Sender

02 Broadcast

Sender & Receiver

```
int main(int argc, char *argv[])
{
    int send_sock;
    struct sockaddr_in broad_adr;
    FILE *fp;
    char buf[BUF_SIZE];
    int so_brd=1;

    if(argc!=3) {
        printf("Usage : %s <Broadcast IP> <PORT>\n", argv[0]);
        exit(1);
    }

    send_sock=socket(PF_INET, SOCK_DGRAM, 0);
    memset(&broad_adr, 0, sizeof(broad_adr));
    broad_adr.sin_family=AF_INET;
    broad_adr.sin_addr.s_addr=inet_addr(argv[1]);
    broad_adr.sin_port=htons(atoi(argv[2]));

    setsockopt(send_sock, SOL_SOCKET,
        SO_BROADCAST, (void*)&so_brd, sizeof(so_brd));
    if((fp=fopen("news.txt", "r"))==NULL)
        error_handling("fopen() error");

    while(!feof(fp))
    {
        fgets(buf, BUF_SIZE, fp);
        sendto(send_sock, buf, strlen(buf),
            0, (struct sockaddr*)&broad_adr, sizeof(broad_adr));
        //sleep(2);
    }

    close(send_sock);
    return 0;
}
```

Sender

```
int main(int argc, char *argv[])
{
    int recv_sock;
    struct sockaddr_in adr;
    int str_len;
    char buf[BUF_SIZE];

    if(argc!=2) {
        printf("Usage : %s <PORT>\n", argv[0]);
        exit(1);
    }

    recv_sock=socket(PF_INET, SOCK_DGRAM, 0);

    memset(&adr, 0, sizeof(adr));
    adr.sin_family=AF_INET;
    adr.sin_addr.s_addr=htonl(INADDR_ANY);
    adr.sin_port=htons(atoi(argv[1]));

    if(bind(recv_sock, (struct sockaddr*)&adr, sizeof(adr))==-1)
        error_handling("bind() error");

    while(1)
    {
        str_len=recvfrom(recv_sock, buf, BUF_SIZE-1, 0, NULL, 0);
        if(str_len<0)
            break;
        buf[str_len]=0;
        fputs(buf, stdout);
    }

    close(recv_sock);
    return 0;
}
```

Receiver

| 실행 결과

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/broadcast$ ./receiver 8080
Ministry to form panel to remedy CPA exam
The Ministry of Finance and Economy announced its plans yesterday to create a committee to reform the controversial CPA (certified public accountant) examination system.
Although CPAs will not be among the committee's members, accountants say that the committee will in all likelihood tackle issues that have been previously raised by them with the ministry.
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```

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/broadcast$ ./sender 255.255.255.255 8080
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/broadcast$
```

Receiver

Sender

실행 결과

255.255.255.255로 데이터를 전송하면, 전송한 호스트가 속한 네트워크로 데이터가 전송된다 - Local 브로드캐스트

PROBLEMSOUTPUTDEBUG CONSOLETERMINALPORTS

```
smalldragon@windowubuntu:~/Workspace$ ./receiver 6200
Ministry to form panel to remedy CPA exam
The Ministry of Finance and Economy announced its plans yesterday to create a committee to examine the CPA (certified public accountant) examination system.
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The ministry expects the newly launched committee to submit a proposal for overhauling the CPA exam system by year's end.
(AaaXX@koreaherald.co.kr)

GlaxoSmithKline president named head of Asia-Pacific region
The Korean branch of British pharmaceutical company GlaxoSmith- Kline (GSK) announced that its president, Kim, who took the top position in GlaxoSmithKline Korea in November 1997, will also head the Asia-Pacific region.
"Kim was elected to head the Asia Pacific region because he showed great leadership and a long-standing deficit to profits," the company said.
The Korean manager also showed great interest in social responsibility, sponsoring soccer camps for ill children.
"Y plan on enlarging the business strategy I employed for the Korean market to cover the Asia-Pacific region."
```

SSH: window-vm

PROBLEMSOUTPUTDEBUG CONSOLETERMINAL

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/broadcast$ ./receiver 6200
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"Y plan on enlarging the business strategy I employed for the Korean market to cover the Asia-Pacific region."
```

WSL: Ubuntu

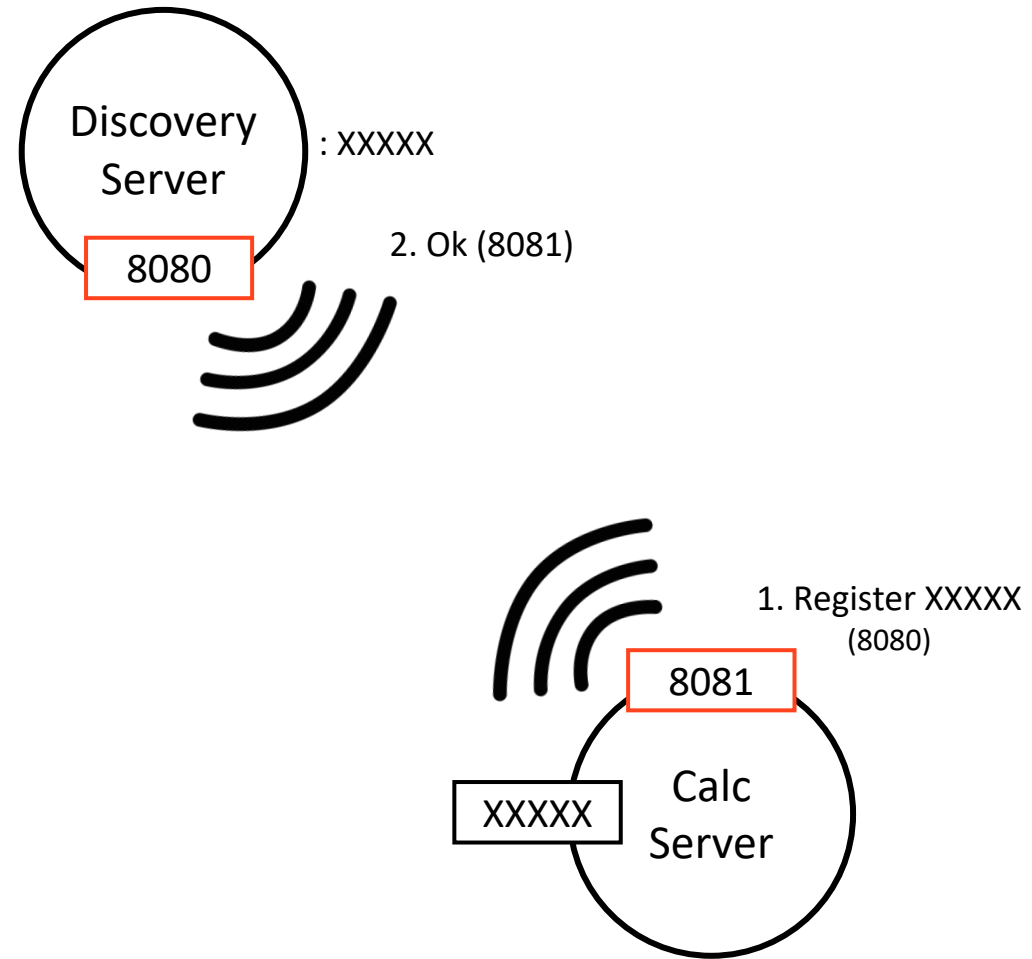
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/broadcast\$./sender 255.255.255.255 6200
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/broadcast\$

Receiver(ubuntu 1)

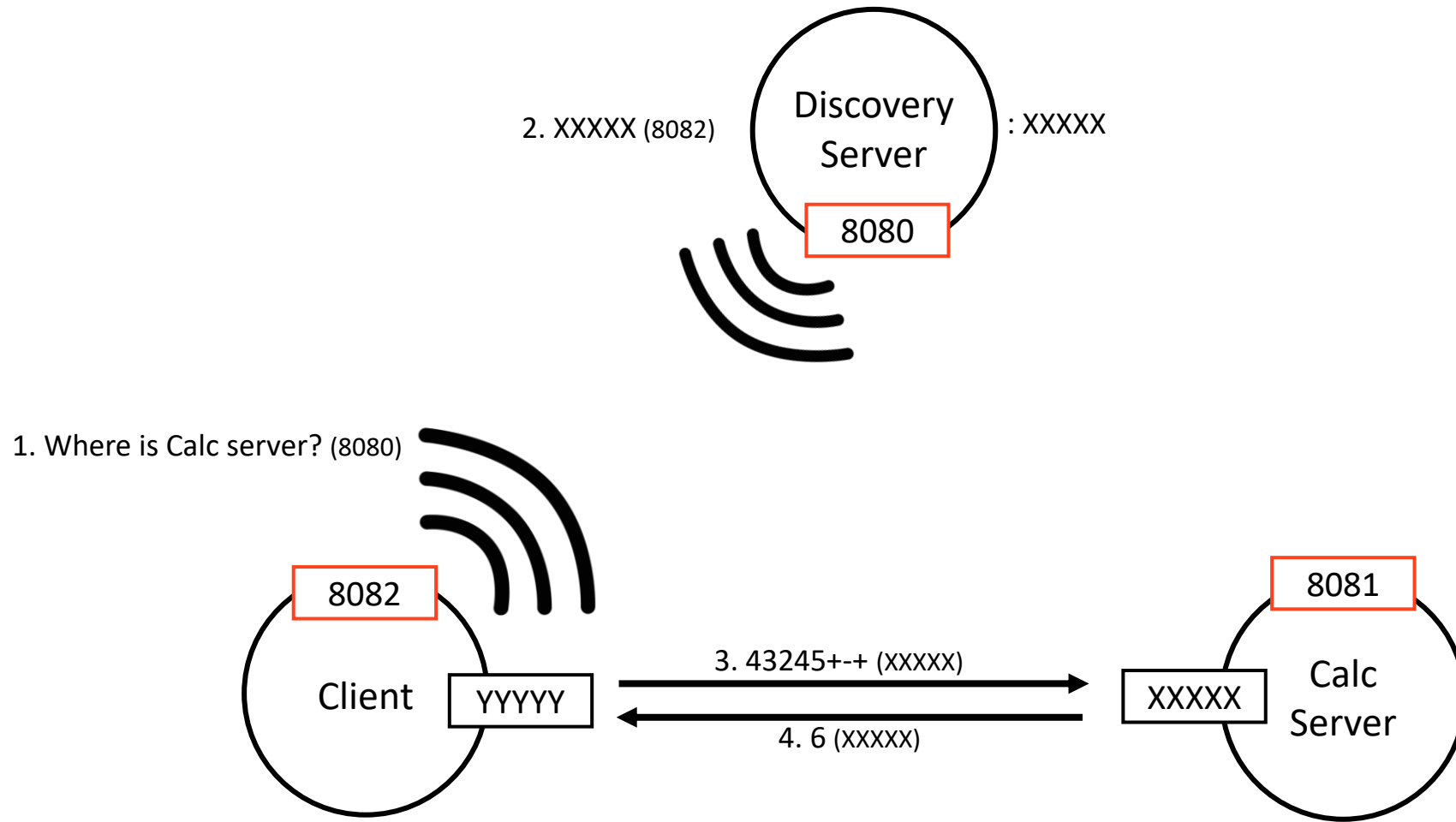
Receiver(ubuntu 2)

Sender(ubuntu 2)

Discovery & Calc Server : Register



Discovery & Calc Server : Register



03 Network assignment #7

Discovery & Calc Server

1. Register

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server discovery
Discovery Server operating...
Calc Server(31646) registered
█
```

Discovery Server

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server calc
Register calc server
Calc Server(31646) operating...
█
```

Calc Server

2. Discovery

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server discovery
Discovery Server operating...
Calc Server(31646) registered
█
```

Discovery Server

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server calc
Register calc server
Calc Server(31646) operating...
connected client: 4
closed client: 4
█
```

Calc Server

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./client
Start to find calc server
Found calc server(31646)
Operand count: 3
Operand 0: 1
Operand 1: 5
Operand 2: 4
Operator 0: +
Operator 1: -
Operation result: 2
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ █
```

Client

03 Network assignment #7

Discovery & Calc Server

1. Register Fail (calc 서버 2개 이상 등록 시도 시)

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server discovery
Discovery Server operating...
Calc Server(32631) registered
█
```

Discovery Server

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server calc
Register calc server
Calc Server(32631) operating...
█
```

Calc Server 1

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server calc
Register calc server
Fail
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ █
```

Calc Server 2

2. Discovery Fail (현재 등록된 calc 서버가 없을 시)

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./server discovery
Discovery Server operating...
█
```

Discovery Server

```
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ ./client
Start to find calc server
Fail
smalldragon@SD-DESKTOP:~/Workspace/socket/socket7/discovery$ █
```

Client

Discovery & Calc Server

- server.c

1. 서버 실행 시 main 함수 인자로 discovery 및 calc를 받아 서버 실행 모드를 선택하도록 함.

Ex) ./server discovery | ./server calc

2. discovery를 입력 받을 경우 아래와 같이 동작함

1. 포트 8080으로 소켓을 생성하고 Discovery Server operating... 메시지를 표준 출력함

2. 8080 포트 소켓에서 server:XXXXX(포트번호) 형식의 문자열 데이터를 받을 경우 calc 서버라 판단하고, calc 서버가 포트번호 8081번으로 열었던 소켓에게 아래와 같은 메시지를 브로드캐스트로 보냄

1. 문자열에서 포트번호에 해당되는 부분(XXXXX)을 파싱하여 포트번호만 따로 저장해두고 Calc Server registered(포트번호)를 표준 출력 후, 문자열 success를 calc 서버에게 전송함

2. 만약 discovery 서버에 이미 등록된 calc 서버가 존재한다면 문자열 fail을 calc 서버에게 전송함

3. 8080포트 소켓에서 문자열 client를 받을 경우 클라이언트라 판단하고, 클라이언트가 8082번으로 열었던 소켓으로 아래와 같은 메시지를 브로드캐스트로 전송함

1. calc 서버가 등록되어 있었다면 포트번호를 전송함

2. calc 서버가 등록되지 않았다면 문자열 fail을 전송함

Discovery & Calc Server

- server.c

3. calc를 입력받을 경우 아래와 같이 동작함

1. 10000~50000 사이의 수를 랜덤으로 생성(rand()함수 활용)하고 "Register calc server"를 표준 출력함
2. Discovery 서버가 수신 대기하고 있는 8080 포트로 브로드캐스트 메시지를 문자열 "server: 랜덤생성포트번호"로 전송함
3. 8081 포트로 소켓을 생성하고 discovery 서버의 메시지를 수신 대기함
 1. 이 때 문자열 success를 받았을 경우, "Calc Server(포트번호) operating..."를 표준 출력하고 Calc 서버를 구동함
 2. 문자열 fail을 받았을 경우, "Fail"을 표준 출력하고 프로그램을 종료함

4. Calc 서버는 다음과 같이 구동함

1. 멀티플렉싱 방식으로 구현함
 1. select()를 활용하여 하나의 프로세스로 여러 클라이언트의 요청을 처리할 수 있는 서버를 구현함
2. 클라이언트가 새롭게 연결되었을 경우 "connected client: fd(클라이언트 소켓 파일 디스크립터)"를 표준 출력함
3. 클라이언트가 전송한 Network assignment #2와 같은 계산 요청 메시지를 받았을 경우, 계산을 하고 결과를 클라이언트에게 전송함
4. 이 후 클라이언트의 소켓을 닫고 "closed client: fd"를 표준 출력함

Discovery & Calc Server

- client.c

1. 클라이언트 실행 시 어떠한 매개변수도 받지 않고 실행

Ex) ./client

2. "Start to find calc server"를 표준 출력하고 8082번 포트로 소켓을 생성해서 8080번 포트로 수신 대기하고 있는 discovery 서버에게 브로드캐스트 메시지로 문자열 "client"를 전송함

1. 문자열 fail을 받았을 경우, "Fail"을 표준 출력하고 프로그램을 종료

2. Calc 서버의 포트번호를 받았을 경우, "Found calc server(포트번호)"를 표준 출력하고 calc 서버와 통신하기 위해 127.0.0.1 주소와 해당 포트번호로 TCP 소켓을 생성

3. Calc 서버에게 Network assignment #2와 같은 계산 데이터를 전송하고 결과를 대기함

1. Network assignment #2와 똑같은 표준 출력과 표준 입력 양식으로 데이터를 입력 받음

2. 오버플로우가 나는 Operand count 값을 받을 경우, 데이터를 전송하지 않고 소켓을 닫고 종료 함

3. 계산 결과를 서버에게 받으면 이를 "Operation result: "과 함께 출력 한 뒤에 소켓을 닫고 프로그램을 종료 함

Multi Process Calculator Server

- 참고사항

1. 과제에서 의도한 대로 데이터를 주고받고 이를 출력하는 방식이 아닌, 겉으로 출력 결과만 똑같이 보인다면 점수 없음

- 제출관련

1. 서버 프로그램은 `server.c`, 클라이언트 프로그램은 `client.c`로 명명하여 과제 진행
2. 빌드 시(gcc) Warning이 발생해서는 안됨
3. 제출 시 파일들을 “자신의 학번.tar” 파일로 제출

Ex) 2020324067.tar

~/Workspace/socket1/(server.c, client.c)

```
smalldragon@DESKTOP-PMPPMH:~/Workspace$ tar cvf 2020324067.tar -C socket1 server.c client.c
server.c
client.c
```

압축파일명 폴더명 파일명 파일명

4. 과제는 10점 만점
5. 제출 기한: 2023.05.12(금) PM 11:59
6. 지각 제출 허용: 2023.05.16(화) PM 11:59 / 하루 늦을 때 마다 2점 씩 감점
지각제출 시 보낼 이메일: minji001011@naver.com
7. 기한 안에 아예 제출을 하지 않았을 시 점수 없음