

# UCS 1411 - Operating Systems Lab

## Exercise 11 – Threading Applications

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Write a multithreaded program that calculates various statistical values for a list of numbers. This program will be passed a series of numbers on the command line and will then create three separate worker threads. One thread will determine the average of the numbers, the second will determine the maximum value, and the third will determine the minimum value.

### Main Program

```
#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

float avg;
int max;
int min;

void *average(void *val)
{
    int sum = 0;
    int *ival = (int *)val;

    for (int i = 1; i <= ival[0]; i++)
    {
        sum += ival[i];
    }

    avg = sum / ival[0] ;
    pthread_exit(0);
}

void *maximum(void *val)
{
    int *ival = (int *)val;
    max = ival[1];
    for (int i = 1; i <= ival[0]; i++)
        if (max < ival[i])
            max = ival[i];

    pthread_exit(0);
}

void *minimum(void *val)
{
    int *ival = (int *)val;
    min = ival[1];
    for (int i = 1; i <= ival[0]; i++)
        if (min > ival[i])
```

```

        min = ival[i];

    pthread_exit(0);
}

int main(int argc, char *argv[])
{
    pthread_t thread1, thread2, thread3;
    pthread_attr_t attr;

    //Initialising with default attributes
    pthread_attr_init(&attr);

    if (argc < 2)
    {
        fprintf(stderr, "usage: ./exe-file <integer value>\n");
        return -1;
    }

    int *val = calloc(100, sizeof(int));

    //Storing No. of elements in the first index of array
    val[0] = argc - 1;

    for (int i = 1; i < argc; i++)
        val[i] = atoi(argv[i]);

    pthread_create(&thread1, &attr, average, val);
    pthread_create(&thread2, &attr, maximum, val);
    pthread_create(&thread3, &attr, minimum, val);

    pthread_join(thread1, NULL);
    pthread_join(thread2, NULL);
    pthread_join(thread3, NULL);

    printf("\nAverage value is: %.3f\n", avg);
    printf("\nMaximum value is: %d\n", max);
    printf("\nMinimum value is: %d\n", min);

    free(val);
}

```

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## Output

```
./exec-Threads 2 3 4 9 12 34 123 54 23
```

```
Average value is: 29.000
```

```
Maximum value is: 123
```

```
Minimum value is: 2
```

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