

## Handout 5

# Fun with **while** loops

### 5.1 Geometric series

What does this code do? Work through this code by hand (meaning work with paper, not on the computer) to figure out what the code does.

```
#include <stdio.h>
#include <math.h>
#include <stdlib.h>

int main()
{
    double sum=0;
    double term =1;
    double max = 10;

    double k=0;
    while(k<=max)
    {
        sum = sum + term;
        term = term/2;
        k++;
    }

    printf("The sum is %lf\n", sum);
}
```

Then modify the code to construct a program `geosum.c` that takes in a number  $n$  and computes the sum

$$1 + \frac{1}{3} + \frac{1}{9} + \frac{1}{27} + \cdots + \frac{1}{3^n}.$$

## 5.2 Bisection search

Here is some pseudo code for a procedure to estimate  $\sqrt{2}$  with error less than 0.001.

1. Go through the pseudo code to make sure you understand what the procedure is doing.
2. Convert the pseudo code to a program called `bisection.c`. Tun the program. Does it work as you hoped?

```
// variables
error = 0.001
low = 0.0           // lower bound
high = 10.0        // upper bound
mid = 0.0          // current estimate

// bisection search loop
while (high - low > error)
{
    mid = 0.5*(high + low)

    if (mid*mid > 2)
        high = mid
    else
        low = mid
}

// print result
print mid
```

3. Now modify the code to compute an estimate for  $2^{1/3}$ .

## 5.3 Challenge: bisection search for $n^{\text{th}}$ roots

Write a bisection search program that takes in the following input

- a positive integer  $n$
- a positive number  $x$
- a positive number  $\varepsilon$

and computes  $x^{1/n}$  with error less than  $\varepsilon$ .