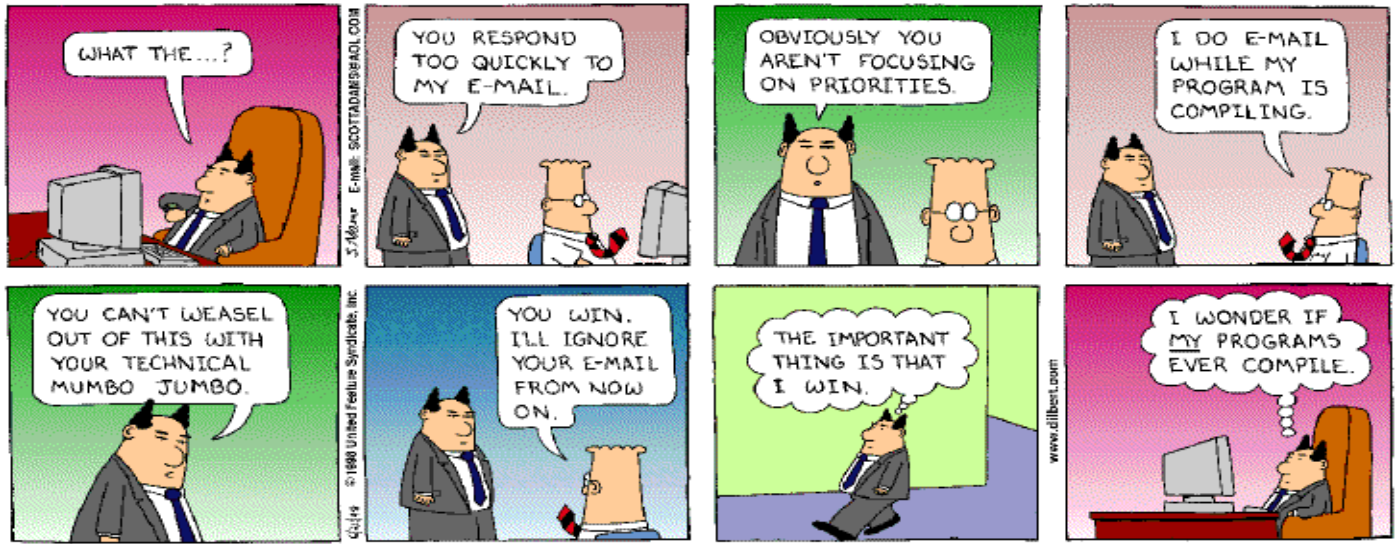
ORF 201

COMPUTER METHODS FOR PROBLEM SOLVING

Lecture 3

Decisions, Decisions



The *For* Loop

Recall the **`while`** loop from FahrCels3:

```
fahr=lower;
while(fahr<=upper) {
        .
        .
        .
        fahr=fahr+step;
}
```

This pattern is very common. In such cases, it is better to use a **`for`** loop

General pattern:

```
for (i=begin;i<end;i=i+incr){}
```

There are three parts inside the parens:

```
for (fahr=lower;fahr<=upper;fahr=fahr+step) {
        .
}
```

- an initialization statement: `i = begin`
- a logical condition: `i < end`
- an index update expression: `i = i+incr`

Note: there are only *two* semicolons.

More on For

Recall the basic pattern:

```
for (i=begin;i<end;i=i+incr) {
        .
        .
        .
}
```

Variable **i** is called the *looping index*.
The looping index should always be an integer.

The symbol **++** is called the *increment operator*. It means add **1** to the variable to which it is attached. Right here. Right now.

```
i=i+incr;
```

is equivalent to

```
i+=incr;
```

```
for (i=begin;i<end;i++){
        .
        .
        .
}
```

```
i=i+1;
```

is equivalent to

```
i++;
```

This loop is by far the most common loop construct.

Computing Square Roots

The algorithm:

Given: a number x Guess a value for $\sqrt{x}$, say $x/2$ Call it r. Divide it into x.	Call that number s. If $r > \sqrt{x}$, then $s < \sqrt{x}$, and vice versa. Okay, average the two and call that r : $r \leftarrow \frac{r+s}{2}$ Repeat these steps until $r^2 \approx x$

In Java:

```
r = x/2;
err = Math.abs(x - r*r);
while (err > EPSILON) {
    s = x/r;
    r = (r+s)/2;
    err = Math.abs(x - r*r);
}
```

Using a **do-while** loop

```
r = x/2;
do {
    s = x/r;
    r = (r+s)/2;
    err = Math.abs(x-r*r);
} while (err > EPSILON);
```

In this case, a **do-while** loop is better!

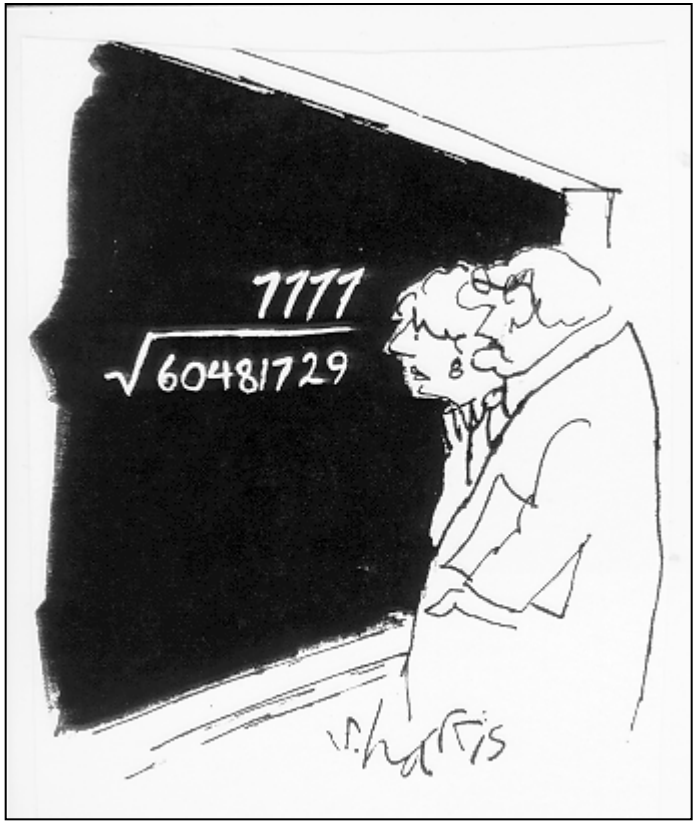
Computing Square Roots: From 1 to 19

```
import java.text.DecimalFormat;
public class Sqrt
{
    static final double EPSILON = 1.0e-10;
    public static void main(String[] args)
    {
       int i;
       double x,r,s,err;
       DecimalFormat xfmt = new DecimalFormat("000.#");
       DecimalFormat xfmt = new DecimalFormat("000.#####");
       for (i=1; i<20; i++) {
           x = i;
           r = x/2;
           do {
              s = x/r;
              r = (r+s)/2;
              err = Math.abs(x - r*r);
           } while (err > EPSILON);
           System.out.print(xfmt.format(x)+"\t");
           System.out.println(rfmt.format(r));
       }
    }
}
```

`static final`... means that the variable can never be changed

Here's the Output

```
1.0     1.0
2.0     1.41421
3.0     1.73205
4.0     2.0
5.0     2.23607
6.0     2.44949
7.0     2.64575
8.0     2.82843
9.0     3.0
10.0    3.16228
11.0    3.31662
12.0    3.4641
13.0    3.60555
14.0    3.74116
15.0    3.87298
16.0    4.0
17.0    4.12311
18.0    4.24264
19.0    4.3589
```



"A wonderful square root. Let's hope it can be used for the good of mankind."