

## **GCC and tips**

- GNU Compiler Collection consists of many language front ends to the gnu compiler
- here we will look at some of the common options to gcc and g++
- these slides are simply a taster and huge simplification of how GCC might be used

## **GCC debugging**

- all front ends (in our case: gcc, g++ and gm2) accept `-g -O0` which tell the compiler not to optimize and emit debugging information for gdb

# GCC debugging

- turn on all warnings by: `-Wall`
- so our command line to compile `hello.c` is:
- ```
$ gcc -g -O0 -Wall -c hello.c
```
- notice that this compiles `hello.c` but does not link it
- to link this we can:

```
$ gcc -g hello.o
```

# GCC debugging

- we could combine the last two steps by:

```
$ gcc -g -O0 -Wall hello.c
```

## Debugging your code

```
$ gdb a.out  
(gdb) break exit  
(gdb) run  
(gdb) quit
```

■ set break points, single step code, finish functions, invoke functions as necessary

```
(gdb) print t  
(gdb) break pf  
(gdb) print pf(t)  
(gdb) next  
(gdb) step  
(gdb) finish
```

# Valgrind

- no excuse for not using this program!
- it requires no effort to run your executable in valgrind
- ```
$ valgrind ./a.out
```
- valgrind is a memory mismanagement detector, it can detect using memory which has not been allocated or has been freed

## What is wrong with this code?

```
#include <stdlib.h>

void myfunc (int n)
{
    int* a = malloc(n * sizeof(int));

    a[n] = 0;
}

int main ()
{
    myfunc(3);
    return 0;
}
```

## Valgrind gives you a huge hint

```
$ valgrind ./a.out
==30984== Command: ./a.out
==30984==
==30984== Invalid write of size 4
==30984==    at 0x400511: myfunc (bad.c:7)
==30984==    by 0x400526: main (bad.c:12)
==30984== Address 0x518b04c is 0 bytes after a block of size 12 alloc'd
```



# Making your program go faster

- firstly profile your code to check if there are any obvious inefficiencies

- ```
$ gcc -g -O0 -pg -c foo.c  
$ gcc -g -pg foo.o
```

## Making your program go faster

- again we could combine these two commands with

```
$ gcc -g -O0 -pg foo.c
```

- most large projects will involve a discrete compile and link step

## Making your program go faster

- run your program as before

```
$ ./a.out
```

- now invoke the profiler

```
$ gprof a.out
```

## Making your program go faster

Each sample counts as 0.01 seconds.

| %<br>time | cumulative<br>seconds | self<br>seconds | calls      | self<br>s/call | total<br>s/call | name     |
|-----------|-----------------------|-----------------|------------|----------------|-----------------|----------|
| 35.38     | 20.64                 | 20.64           | 4771989280 | 0.00           | 0.00            | IN       |
| 25.59     | 35.56                 | 14.93           | 1049864543 | 0.00           | 0.00            | scan     |
| 15.22     | 44.44                 | 8.88            | 345772285  | 0.00           | 0.00            | makeMove |
| 8.52      | 49.41                 | 4.97            | 868833748  | 0.00           | 0.00            | INCL     |
| 7.34      | 53.69                 | 4.28            | 10274416   | 0.00           | 0.00            | evaluate |

we could choose to rewrite the functions IN, scan or makemove

## Making your code go even faster

- use options: `-O1` or `-O2` or `-O3` on the command line to `gcc`
- these optimizations may vary according to architecture

## Making your code go even faster

- for detail as to which optimizations they turn on use:

```
$ gcc -c -Q -O3 --help=optimizers | grep enabled
```

- to see the difference between -O2 and -O3 use:

```
$ gcc -c -Q -O3 --help=optimizers > /tmp/O3-opts  
$ gcc -c -Q -O2 --help=optimizers > /tmp/O2-opts  
$ diff /tmp/O2-opts /tmp/O3-opts | grep enabled
```

## Making your code go even faster

- if you don't need full compliant math code, you could use the `-ffast-math` option (which will inline `sin`, `cos`, `tan` etc)

```
$ gcc -O3 -ffast-math -c foo.c  
$ gcc -O3 -ffast-math foo.o
```

## Size of code generated

- you can always check the size of your code via:

```
$ size a.out
```

- also optimize for space via the option `-Os`

```
$ gcc -Os -c foo.c  
$ gcc -Os foo.o
```