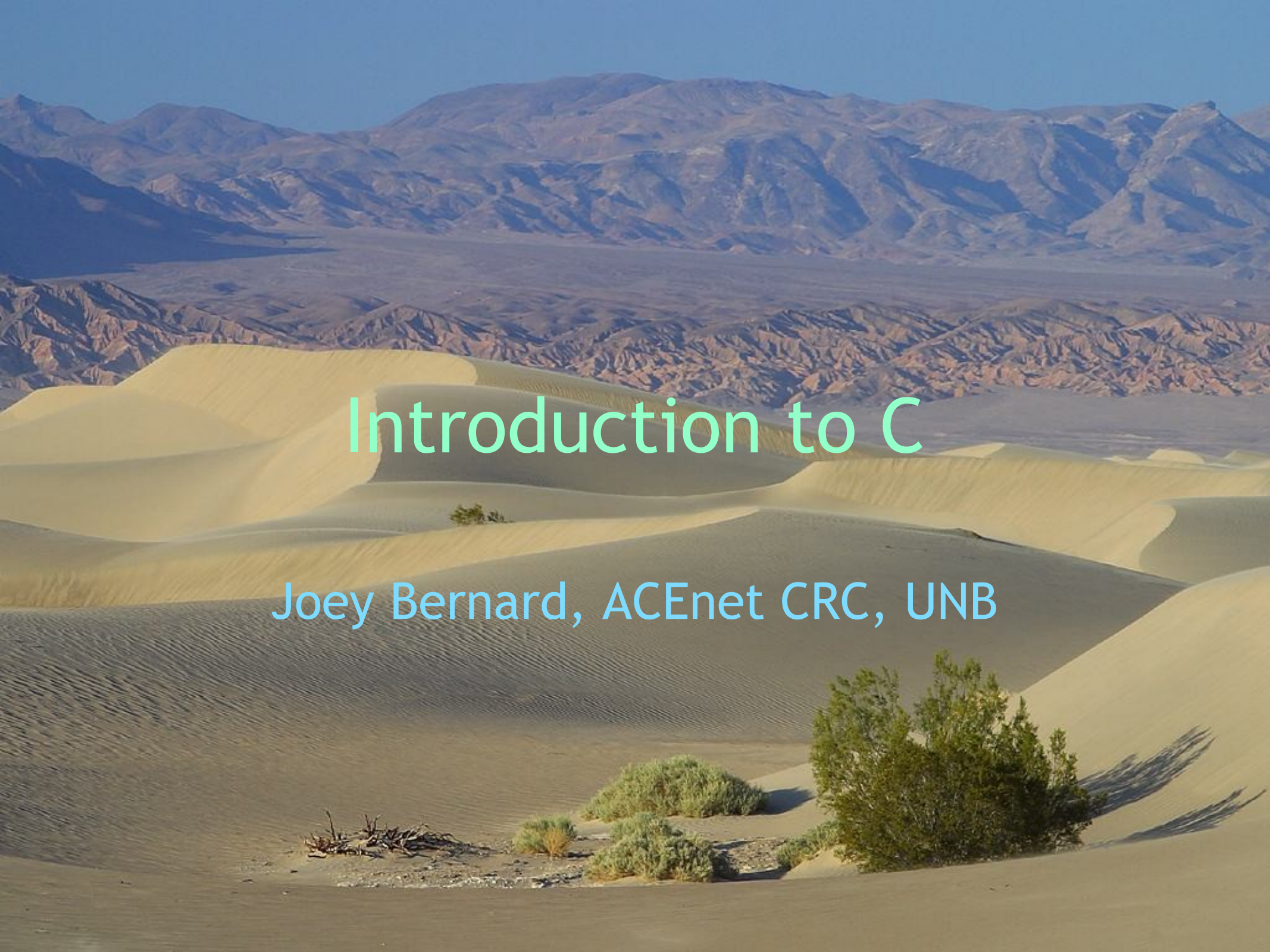


A wide-angle photograph of a desert landscape. In the foreground, there are large, smooth sand dunes with some small, dark green shrubs and a pile of dry sticks. The middle ground shows more dunes and a small cluster of trees. In the background, there are rugged, brown mountains under a clear blue sky.

Introduction to C

Joey Bernard, ACEnet CRC, UNB

Outline

- Languages and compilers available
- Example: write - build - test
- Libraries
- Debugging
- **make**



hello.c

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

```
void main () {  
    printf("Hello World!\n");  
}
```



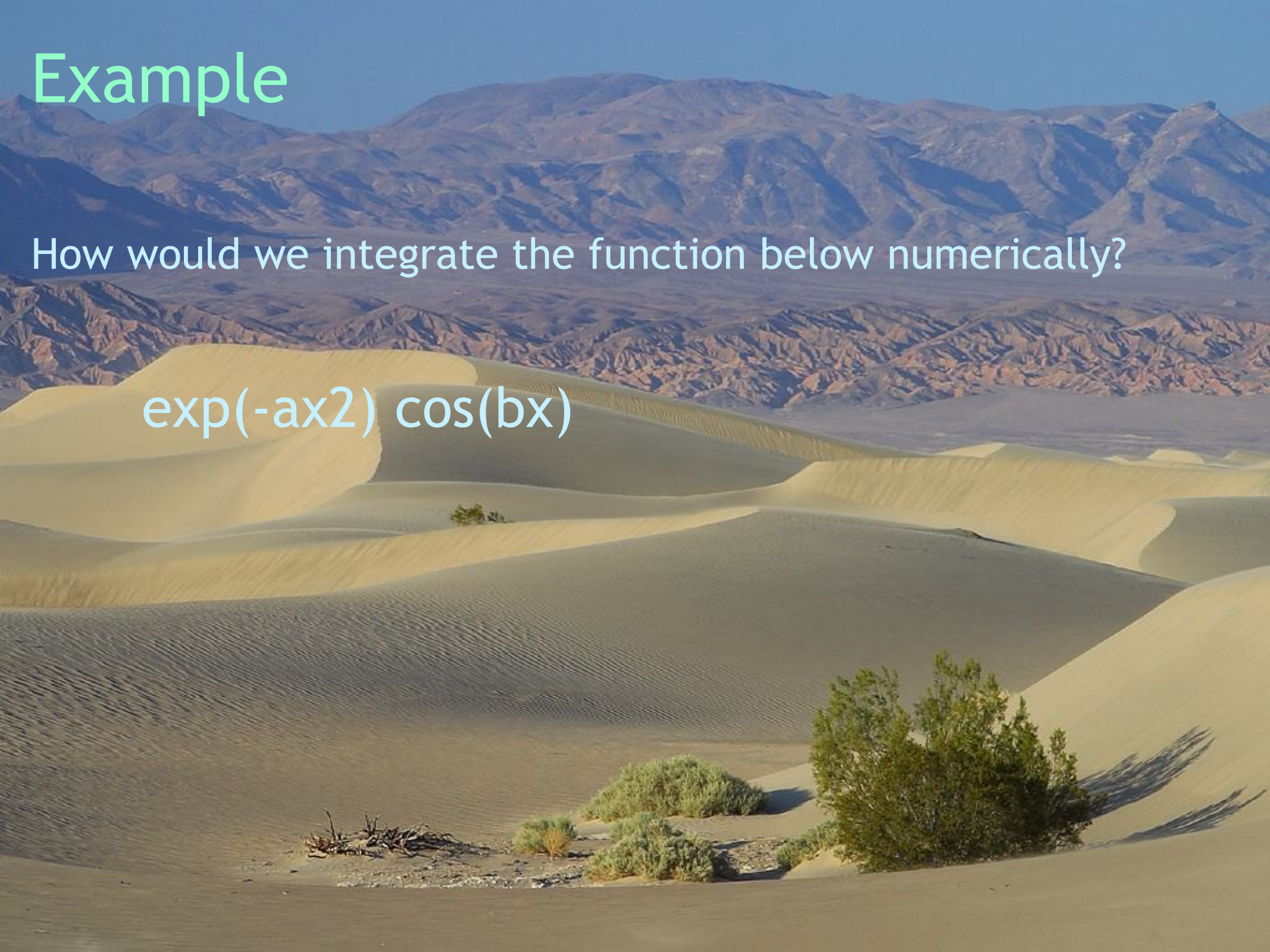
Languages and Compilers

- Fortran
 - f77, f95 (SunStudio)
 - pgf77, pgf95 (Portland Group)
 - gfortran (GNU)
- C
 - cc (SunStudio)
 - pgcc (Portland Group)
 - gcc (GNU)
- C++
 - CC (SunStudio)
 - pgCC, pgc++ (Portland Group)
 - g++, cpp (GNU)

Example

How would we integrate the function below numerically?

$$\exp(-ax^2) \cos(bx)$$



int1.c

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

double f(double x, double a, double b) {
    double f = exp(-a*x*x)*cos(b*x);
    return(f);
}

int main(int argc, char *argv[]) {
    double xleft=-4.5, xright=4.5;
    int n=100;
    double dx = (xright-xleft) / n;
    double s = 0.0, x;
    for (int i=0; i<n; i++) {
        x = (xleft - dx/2) + i*dx;
        s += f(x, 0.2, 2.5) * dx;
    }
    printf("The integral is %lf\n", s);
}
```

How to Compile?

```
cc int1.c
```

```
int1.o(.text+0x49): In function `f':
```

```
: undefined reference to `exp'
```

```
int1.o(.text+0x71): In function `f':
```

```
: undefined reference to `cos'
```

Why didn't it work?

```
cc int1.c -lm
```

A Few Other Libraries

- FFTW
 - fast Fourier transforms
- HDF, netCDF
 - data exchange formats
- BLAS, LAPACK
 - linear algebra
- GSL
 - GNU Scientific Library
- many, many more ...



Another attempt (int2.c)

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

double f(double x, double a, double b) {
    double f = exp(-a*x*x)*cos(b*x);
    return(f);
}

int main(int argc, char **argv) {
    double xleft, xright;
    int n;
    printf("Enter no. of intervals and left and right integration limits: ");
    scanf("%d %lf %lf", n, xleft, xright);
    double dx = (xright - xleft)/n;
    double s=0.0, x;
    for (int i=0; i<n; i++) {
        x = (xleft - dx/2) + i*dx;
        s += f(x, 0.2, 2.5) * dx;
    }
    printf("The integral is %lf\n", s);
}
```

What changed?

- Why doesn't it work?
- We can use diff to get differences between two files

```
diff int1.c int2.c
10,11c10,13
<  double xleft=-4.5,xright=4.5
<  int n=100;
---
>  double xleft, xright;
>  int n;
>printf("Enter no. of intervals and left and right integration
limits: ");
>  scanf("%d %lf %lf", n, xleft, xright);
```

Debuggers?

- dbx with SunStudio
- gdb GNU debugger
- totalview commercial
- What can we do?
 - Step through code
 - Examine variables
 - See where a crash happened
 - Require compilation with "-g" option

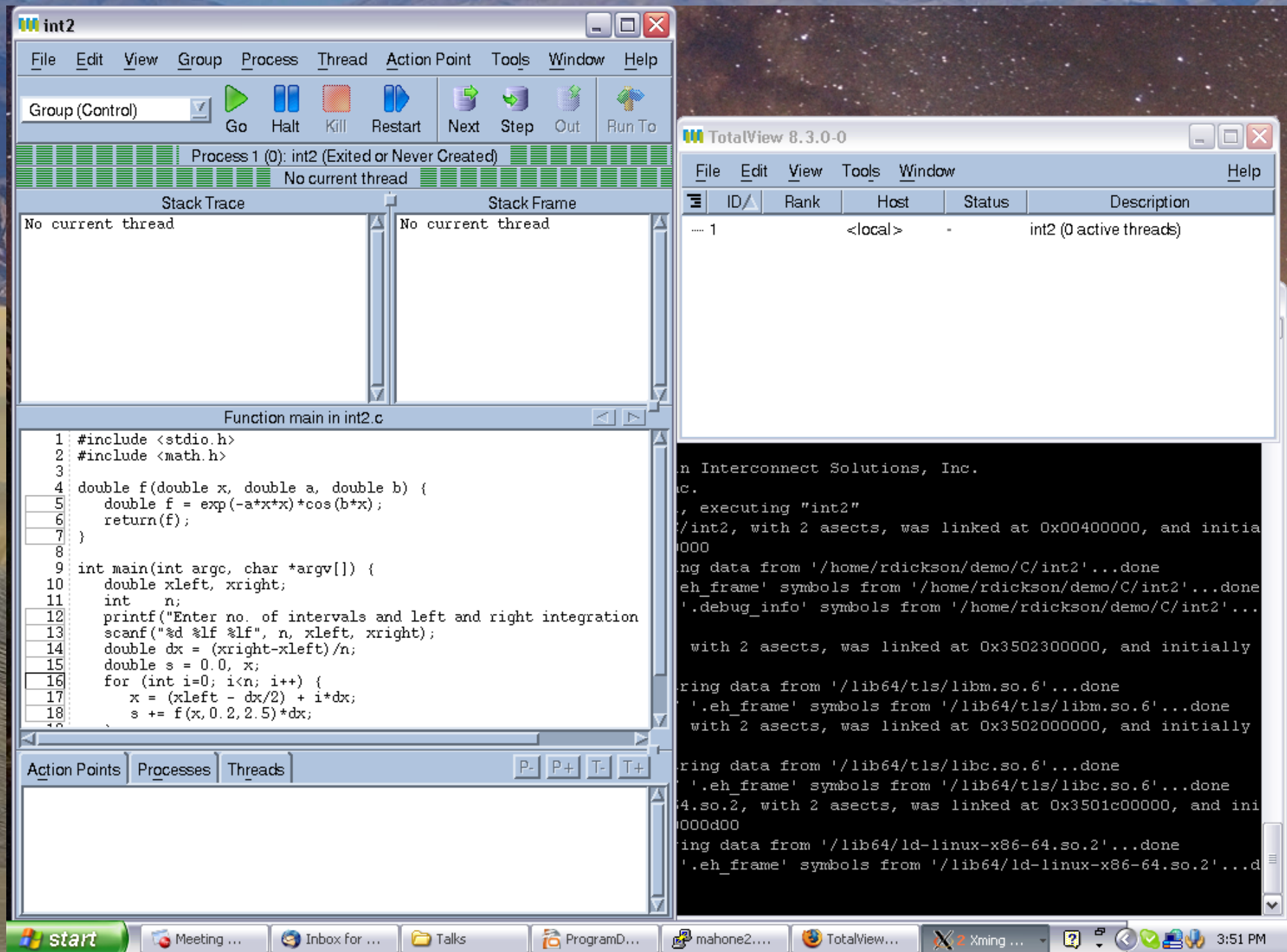
Totalview

- graphical debugger
 - need an X11 server

```
cc int2.c -lm -g -o int2  
totalview int2
```

- then the GUI appears

What does it look like?



Using man

> man scanf
SCANF(3)

Linux Programmer's Manual

NAME

scanf, fscanf, sscanf, vscanf, vsscanf, vfscanf - input format co

SYNOPSIS

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

```
int scanf(const char *format, ...);
```

```
int fscanf(FILE *stream, const char *format, ...);
```

```
int sscanf(const char *str, const char *format, ...);
```

```
#include <stdarg.h>
```

```
int vscanf(const char *format, va_list ap);
```

```
int vsscanf(const char *str, const char *format, va_list ap);
```

```
int vfscanf(FILE *stream, const char *format, va_list ap);
```

DESCRIPTION

call-by-value VS call-by-reference

...

```
printf("Enter no. of intervals and left and right integration  
limits: ");
```

```
scanf("%d %lf %lf", &n, &xleft, &xright);  
double dx = (xright - xleft) / n;
```

...

Compiling Multiple Files

```
gcc function.c int4.c -lm -o int4
```



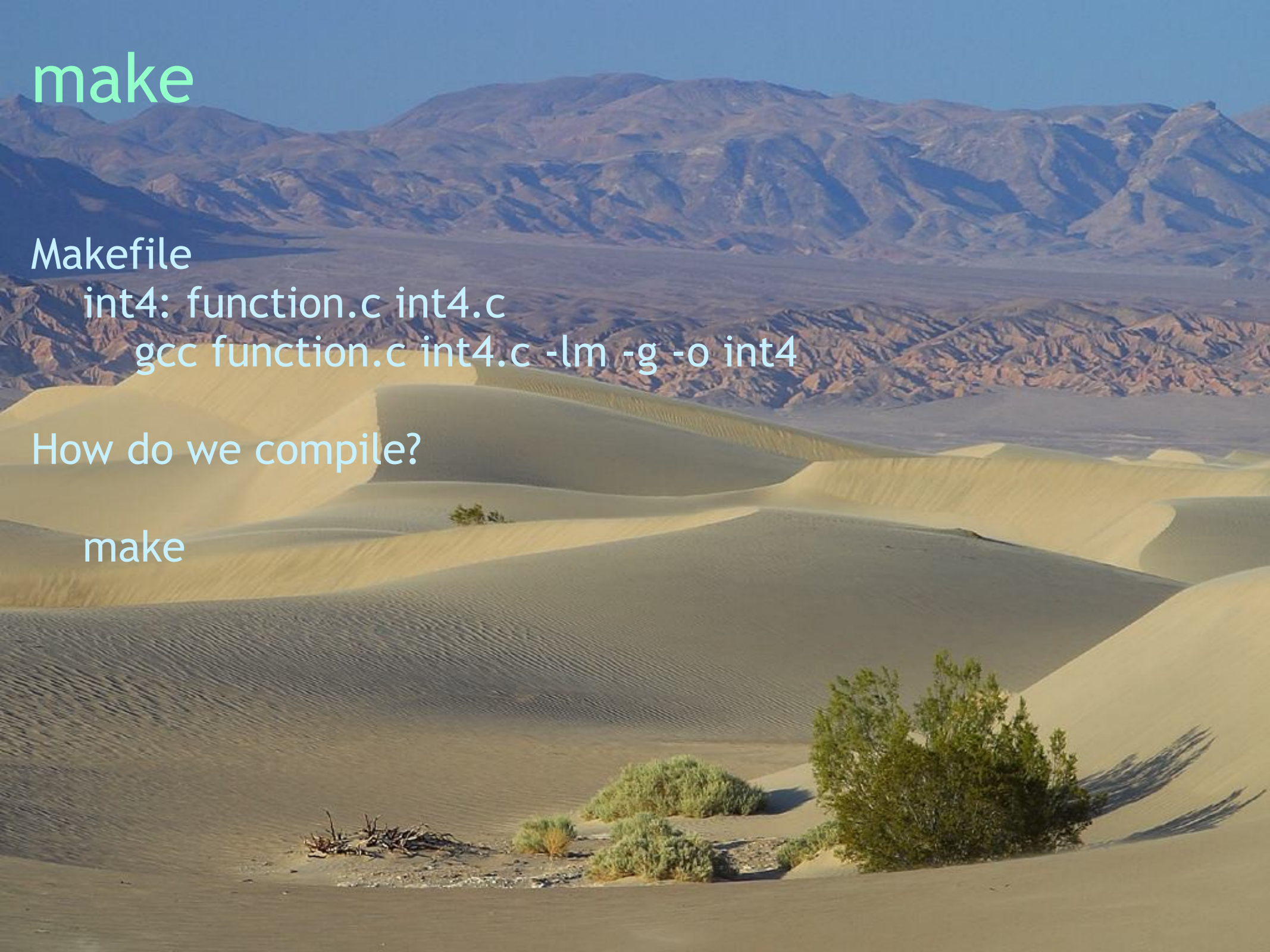
make

Makefile

```
int4: function.c int4.c  
gcc function.c int4.c -lm -g -o int4
```

How do we compile?

make



Where to go for help

- man pages
- "--help" options
 - cc --help
- ACEnet wiki <http://wiki.ace-net.ca>
- Search the web
- Books
 - Kernighan and Ritchie *The C Programming Language*
- ACEnet support support@ace-net.ca











