ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

Εισαγωγή στον Προγραμματισμό
Introduction to Programming

Διάλεξη 14: GUI

Γ. Παπαγιαννάκης

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο
ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΕΚΠΑΙΔΕΥΣΗ ΚΑΙ ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗ
επένδυση στην κοινωνία της γνώσης
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ & ΘΡΗΣΚΕΥΜΑΤΩΝ, ΠΟΛΙΤΙΣΜΟΥ & ΑΘΛΗΤΙΣΜΟΥ
ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΔΙΑΧΕΙΡΙΣΗΣ
ΕΣΠΑ 2007-2013
πρόγραμμα για την ανάπτυξη
ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ
Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

Άδειες Χρήσης

- Το παρόν εκπαιδευτικό υλικό υπόκειται στην άδεια χρήσης **Creative Commons** και ειδικότερα

Αναφορά Δημιουργού 3.0 - Μη εισαγόμενο Ελλάδα (Attribution 3.0– Unported GR)

- Για εκπαιδευτικό υλικό, όπως εικόνες, που υπόκειται σε άλλου τύπου άδειας χρήσης, η άδεια χρήσης αναφέρεται ρητώς.

Χρηματοδότηση

- Το παρόν εκπαιδευτικό υλικό έχει αναπτυχθεί στα πλαίσια του εκπαιδευτικού έργου του διδάσκοντα.

- Το έργο «**Ανοικτά Ακαδημαϊκά Μαθήματα στο Πανεπιστήμιο Κρήτης**» έχει χρηματοδοτήσει μόνο τη αναδιαμόρφωση του εκπαιδευτικού υλικού.

- Το έργο υλοποιείται στο πλαίσιο του Επιχειρησιακού Προγράμματος «Εκπαίδευση και Δια Βίου Μάθηση» και συγχρηματοδοτείται από την Ευρωπαϊκή Ένωση (Ευρωπαϊκό Κοινωνικό Ταμείο) και από εθνικούς πόρους.

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο

ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΕΚΠΑΙΔΕΥΣΗ ΚΑΙ ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗ
επένδυση στην κοινωνία της γνώσης
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ & ΘΡΗΣΚΕΥΜΑΤΩΝ, ΠΟΛΙΤΙΣΜΟΥ & ΑΘΛΗΤΙΣΜΟΥ
ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΔΙΑΧΕΙΡΙΣΗΣ

ΕΣΠΑ 2007-2013
πρόγραμμα για την ανάπτυξη
ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

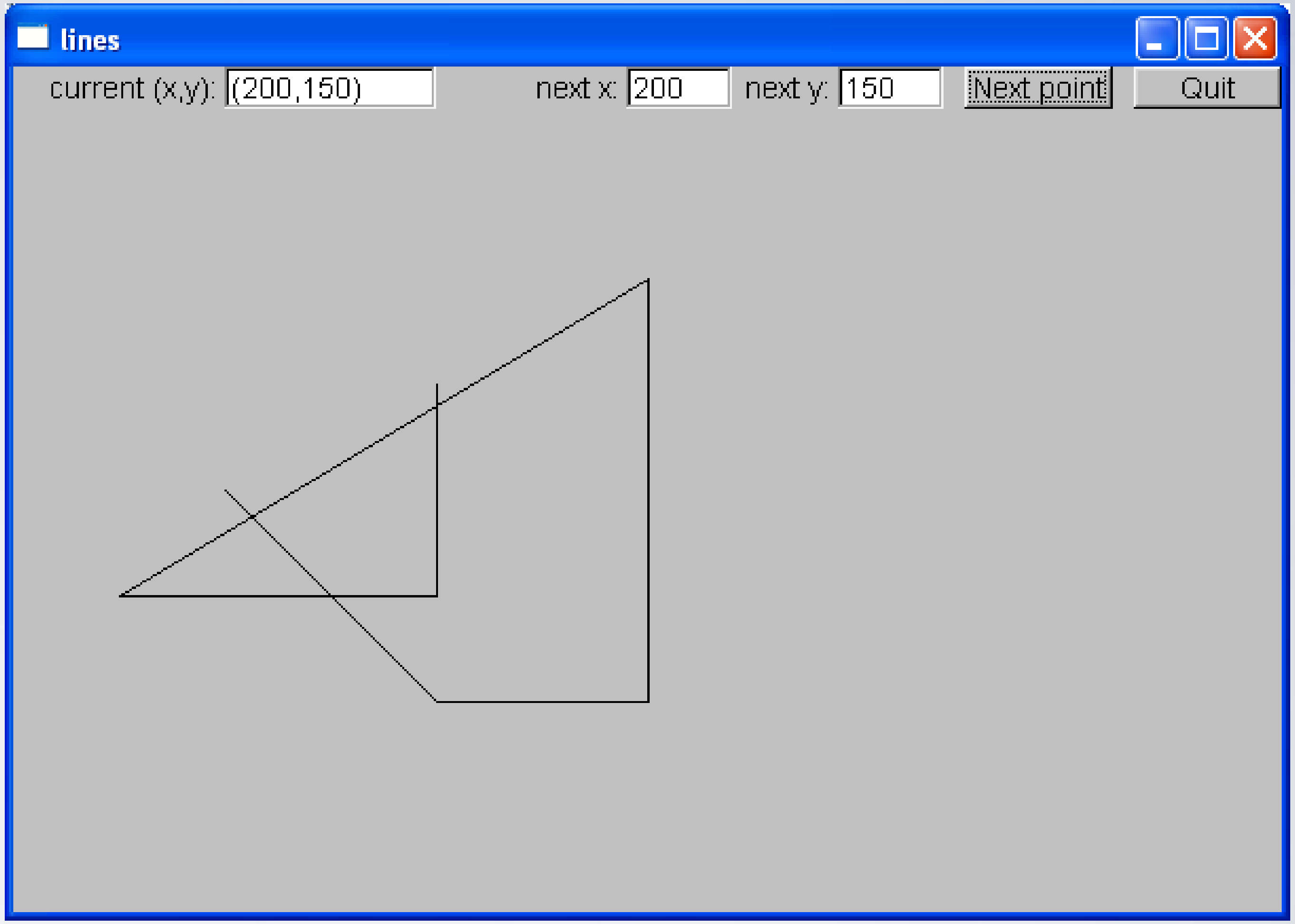
HY-150 Προγραμματισμός
CS-150 Programming

Lecture 14:
Graphical User Interface

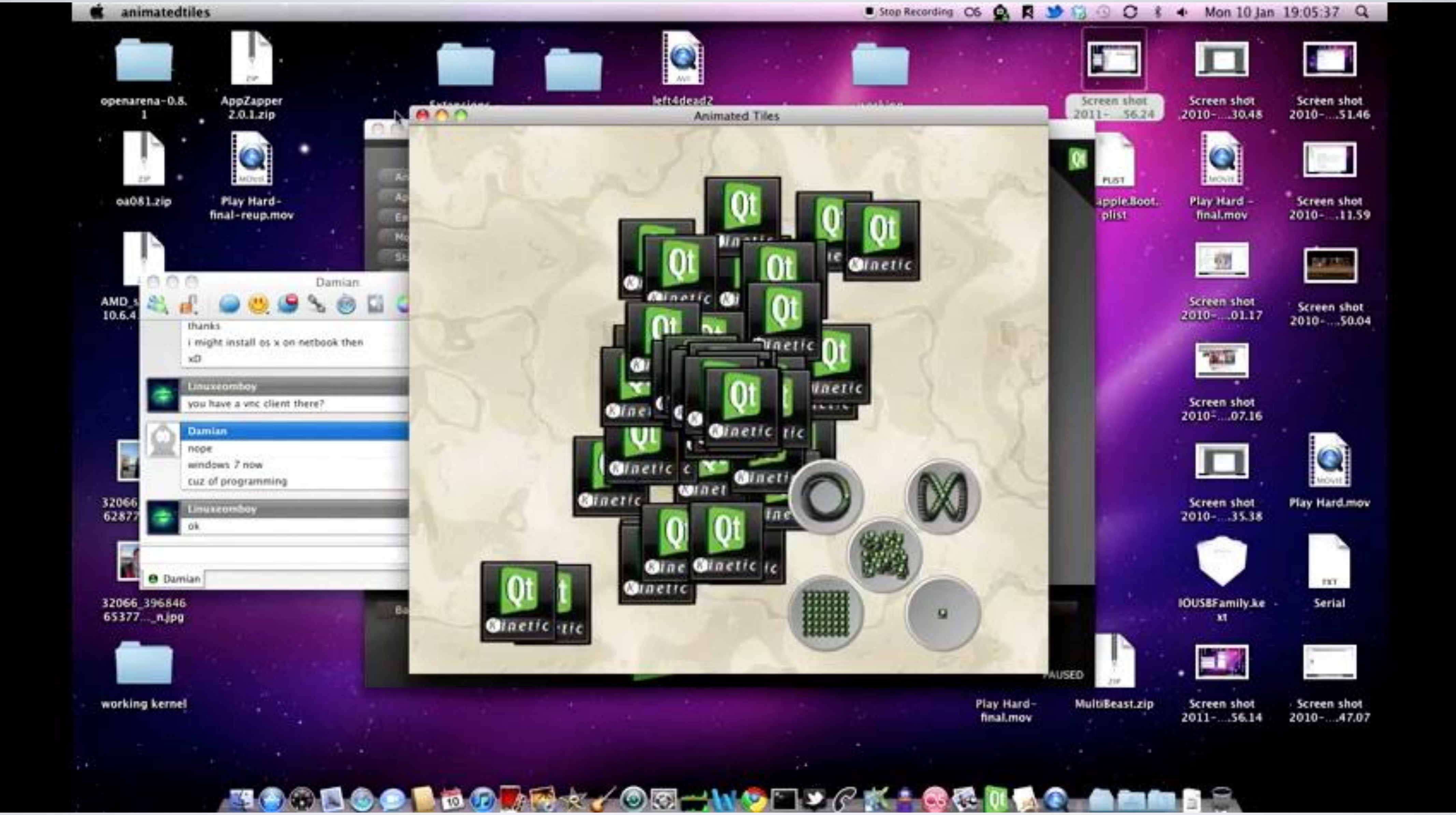
G. Papagiannakis

Overview

- Perspective
  - I/O alternatives
  - GUI
  - Layers of software
- GUI example
- GUI code
  - callbacks



GUI examples I



thanks
i might install os x on netbook then
xD

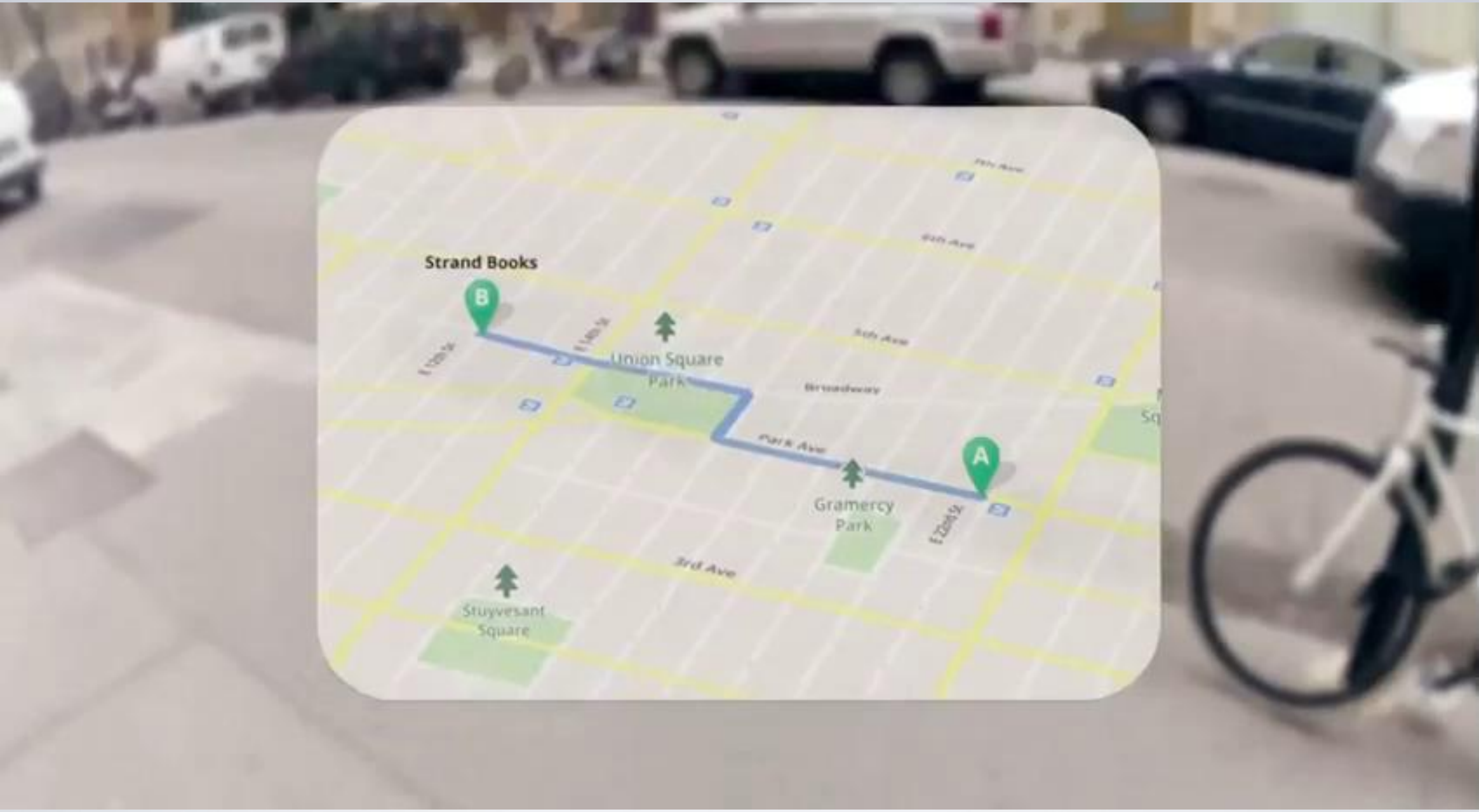
Linuxeomboy
you have a vnc client there?

Damian
nope
windows 7 now
cuz of programming

Linuxeomboy
ok

http://qt.nokia.com/

GUI examples II



Google ProjectGlass

GUI examples III

Microsoft future interfaces Project

I/O alternatives

- Use console input and output
  - A strong contender for technical/professional work
  - Command line interface
  - Menu driven interface
- Graphic User Interface
  - Use a GUI Library
  - To match the "feel" of windows/Mac applications
  - When you need drag and drop, WYSIWYG
  - Event driven program design
  - A web browser – this is a GUI library application
    - HTML / a scripting language
    - For remote access (and more)

Common GUI tasks

- Titles / Text
  - Names
  - Prompts
  - User instructions
- Fields / Dialog boxes
  - Input
  - Output
- Buttons
  - Let the user initiate actions
  - Let the user select among a set of alternatives
    - e.g. yes/no, blue/green/red, etc.

Common GUI tasks (cont.)

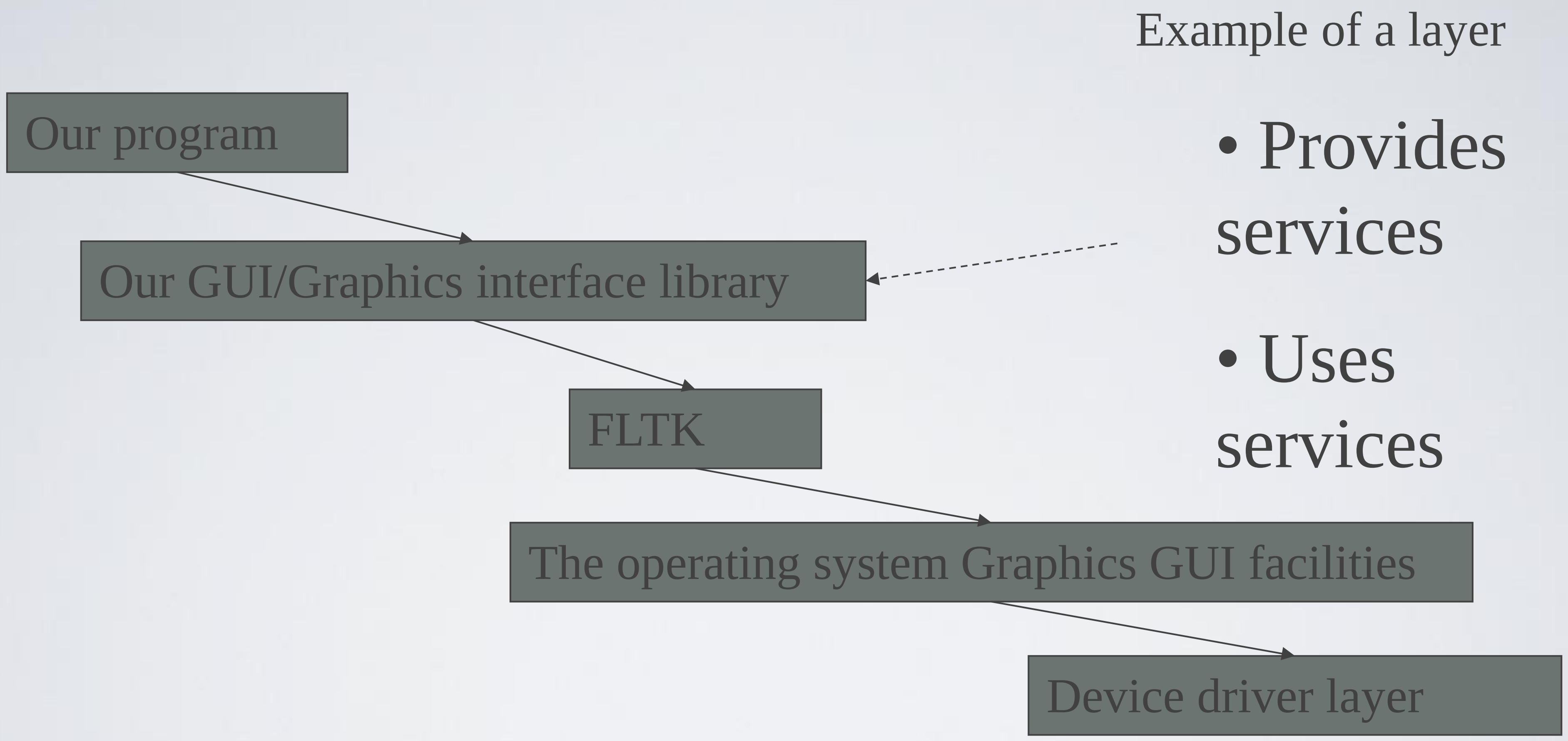
- Display results
  - Shapes
  - Text and numbers
- Make a window “look right”
  - Style and color
    - Note: our windows look different (and appropriate) on different systems
- More advanced
  - Tracking the mouse
  - Dragging and dropping
  - Free-hand drawing

GUI

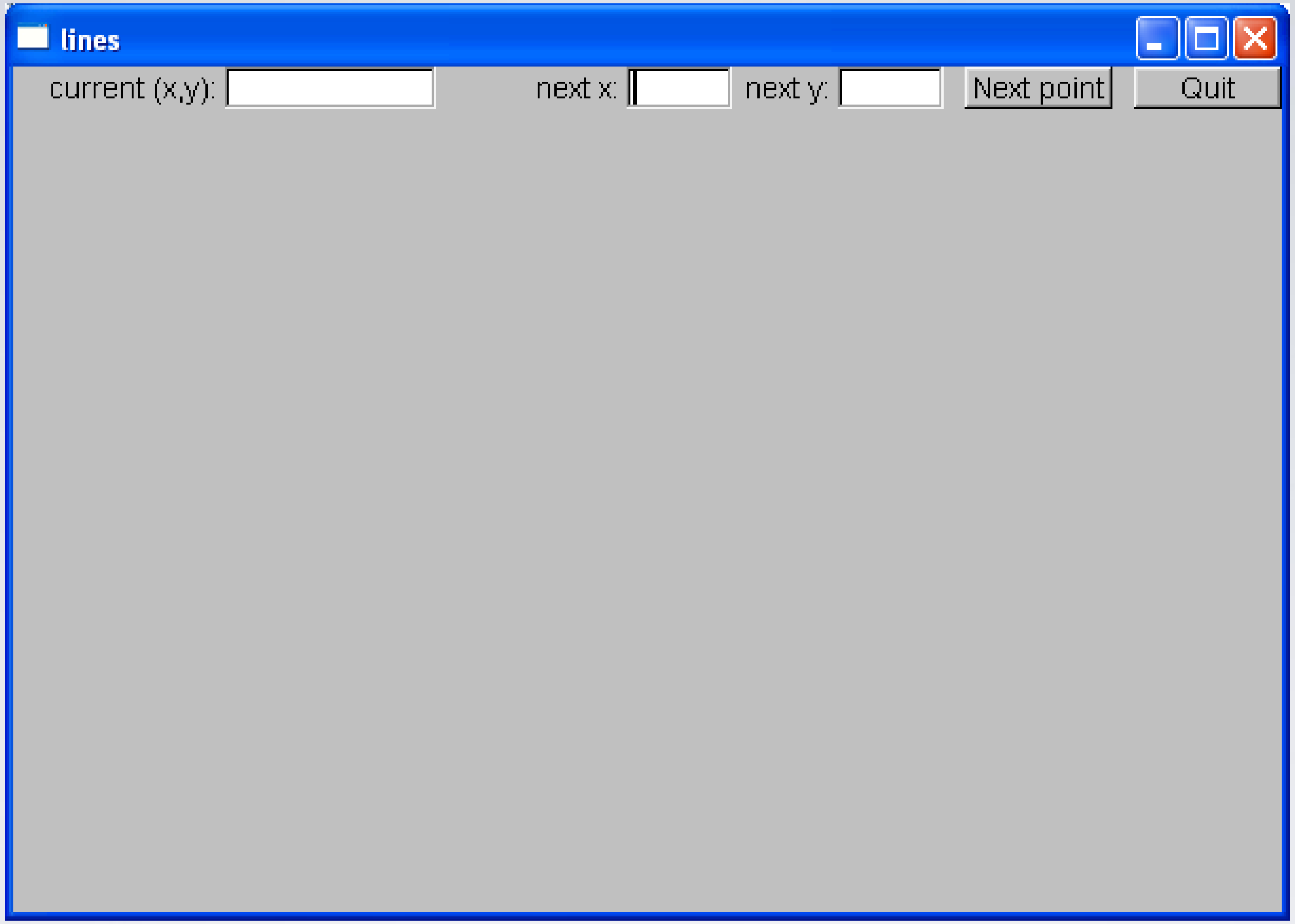
- From a programming point of view GUI is based on two techniques
  - Object-oriented programming
    - For organizing program parts with common interfaces and common actions
  - Events
    - For connecting an event (like a mouse click) with a program action

Layers of software

- When we build software, we usually build upon existing code

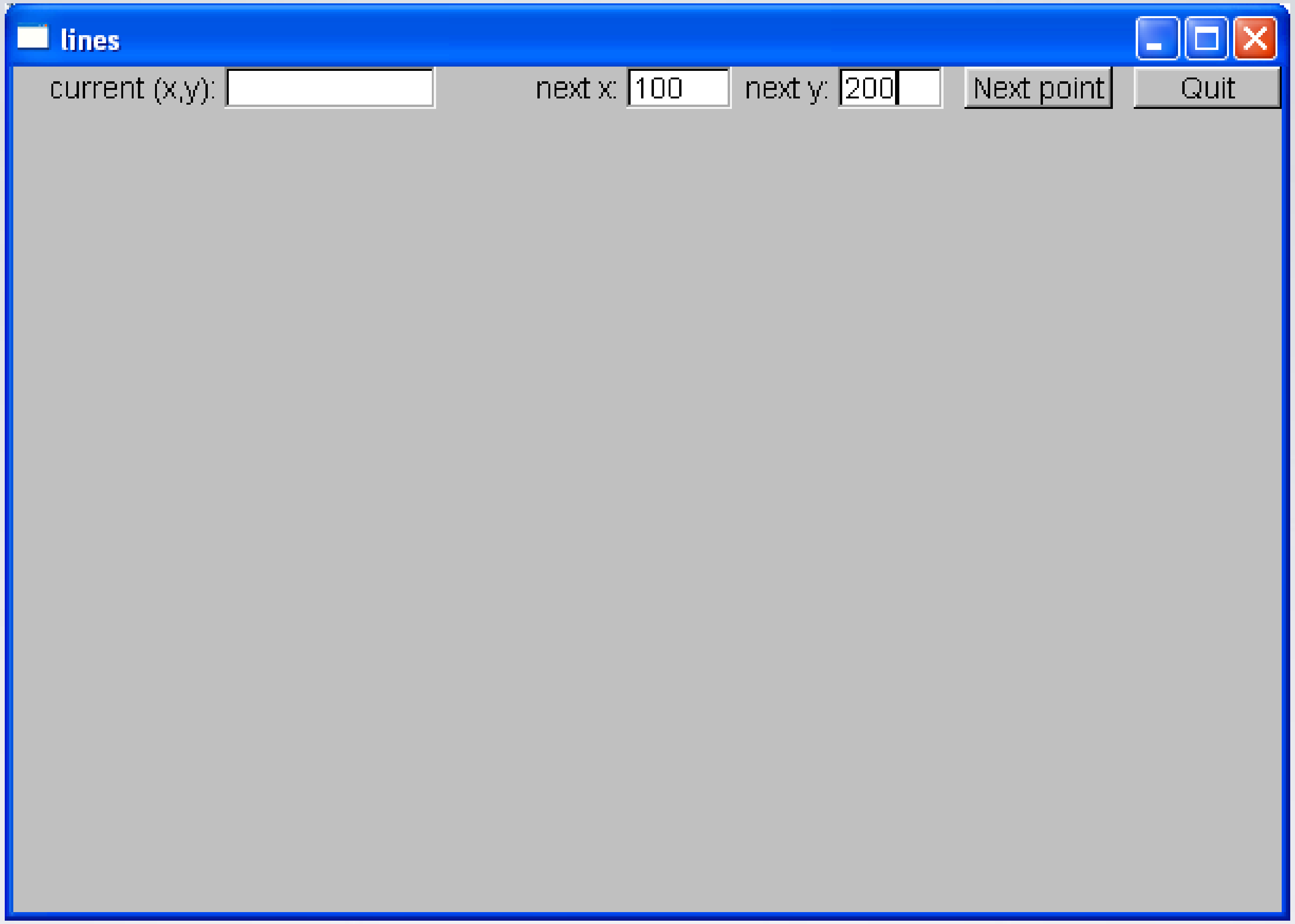


GUI example



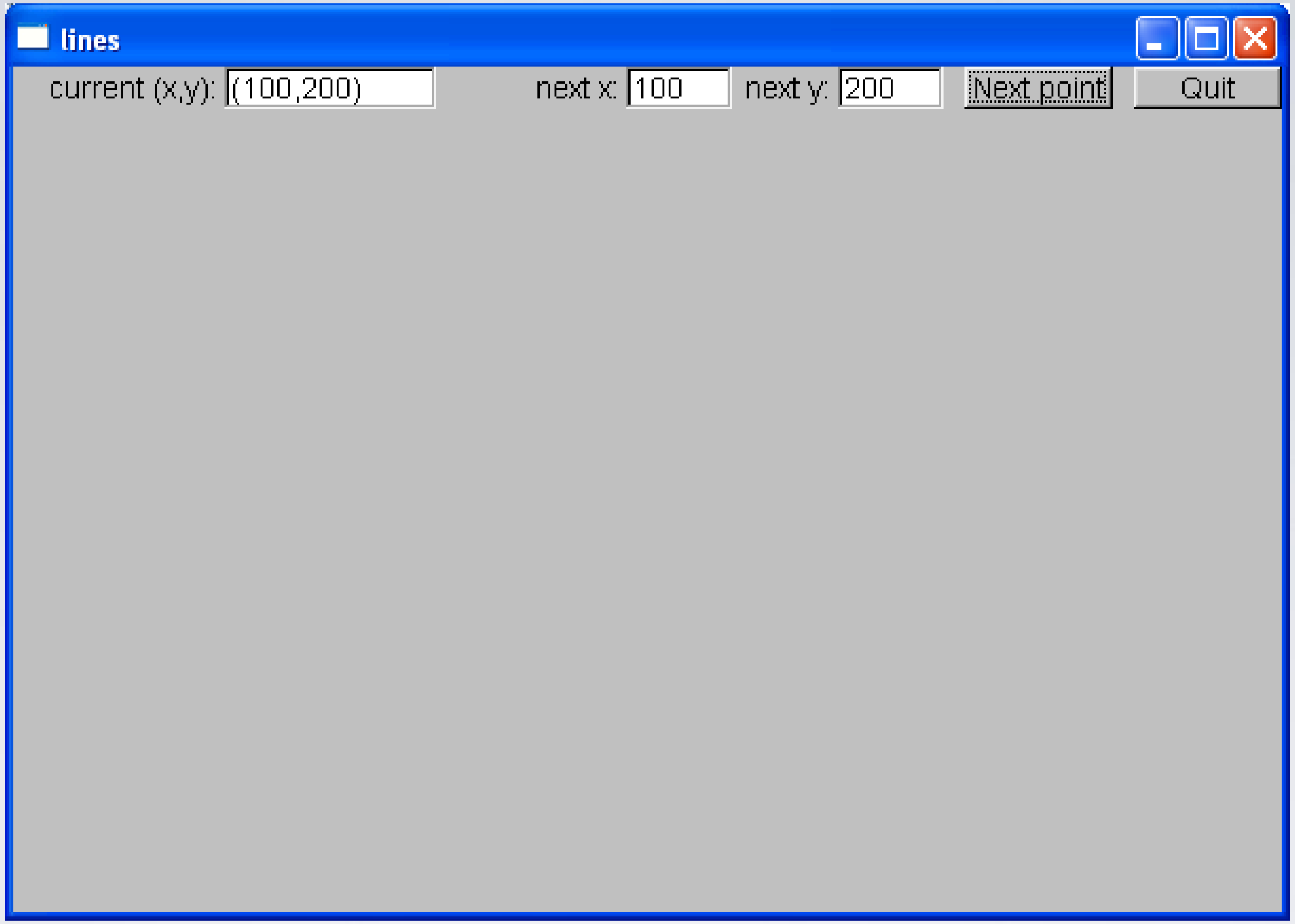
- Window with
  - two **Buttons**, Two **In_box**es, and an **Out_box**

GUI example



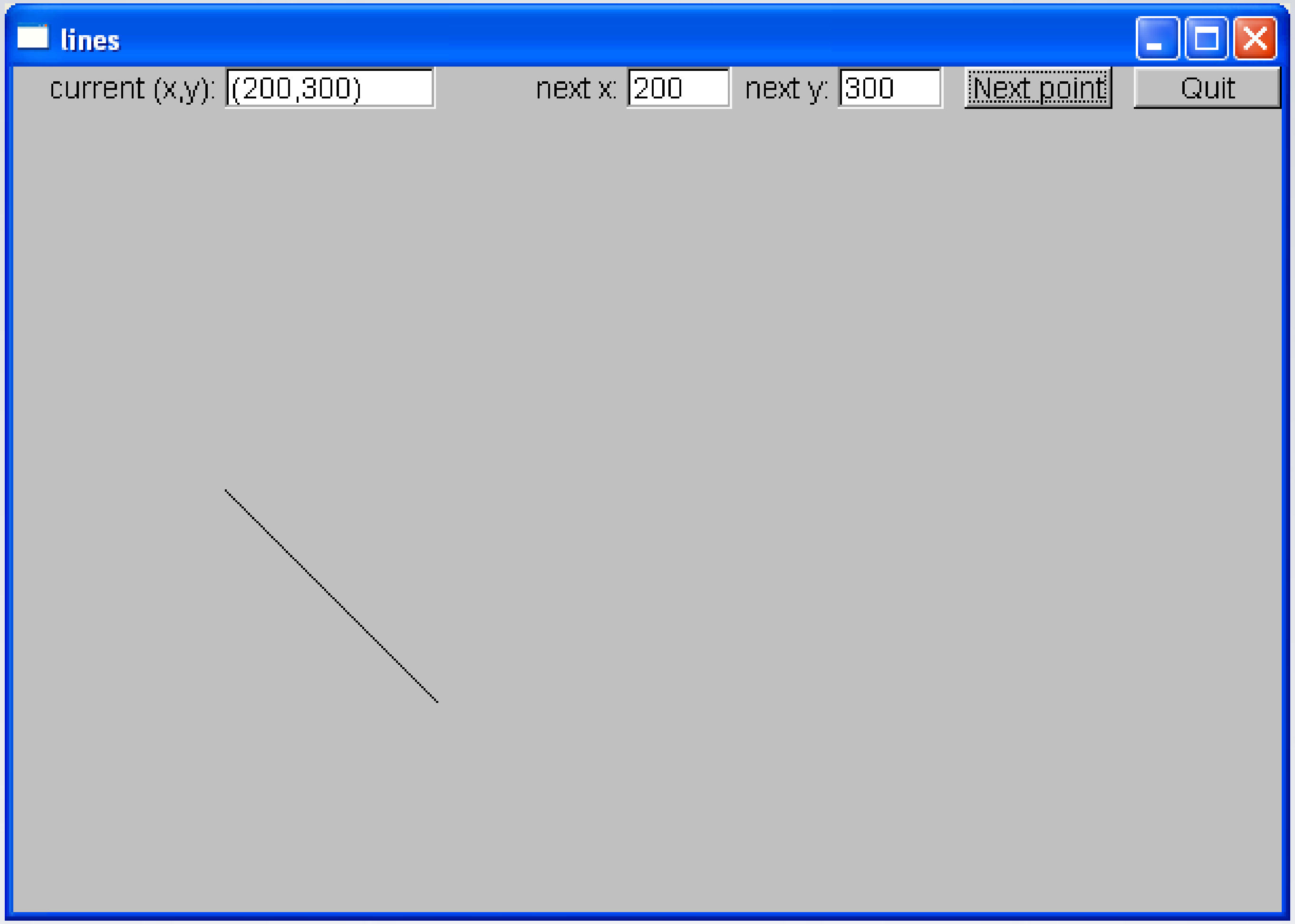
- Enter a point in the **In_box**es

GUI example



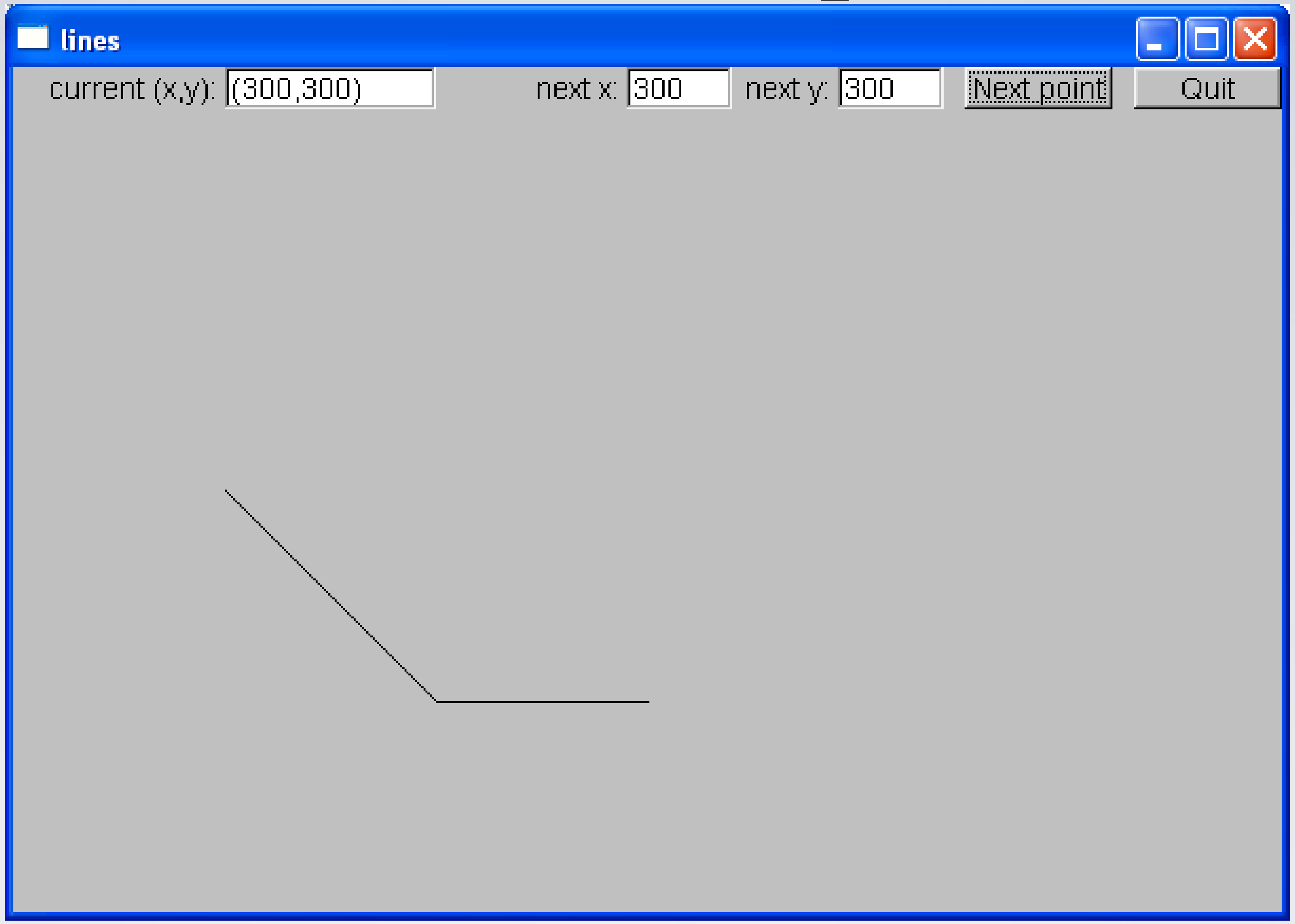
- When you hit **next point** that point becomes the current (x,y) and is displayed in the **Out_box**

GUI example



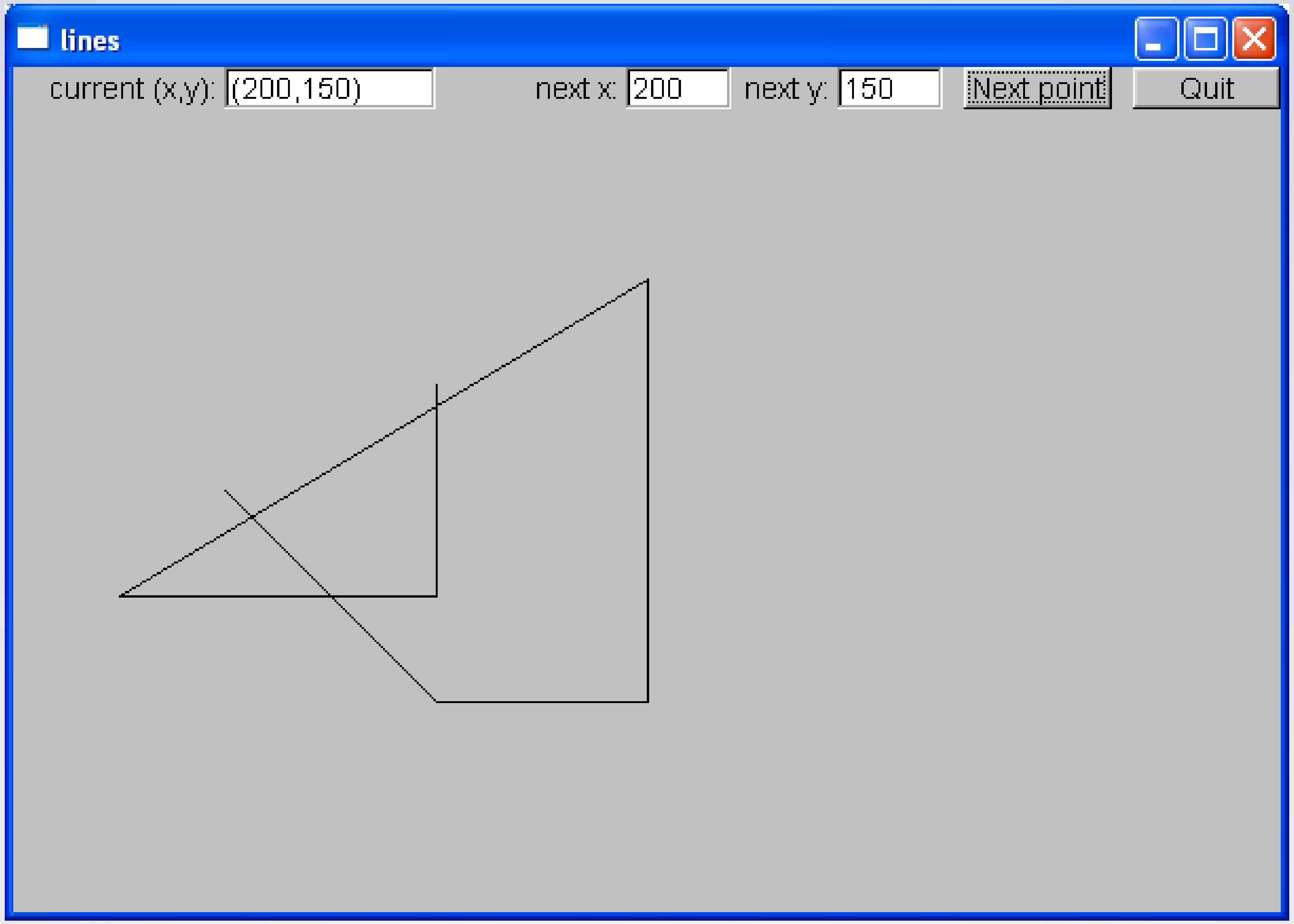
- Add another point an you have a line

GUI example



- Three points give two lines
  - Obviously, we are building a polyline

GUI example



- And so on, until you hit **Quit.**

So what? And How?

- We saw buttons, input boxes and an outbox in a window
  - How do we define a window?
  - How do we define buttons?
  - How do we define input and output boxes?
- Click on a button and something happens
  - How do we program that action?
  - How do we connect our code to the button?
- You type something into a input box
  - How do we get that value into our code?
  - How do we convert from a string to numbers?
- We saw output in the output box
  - How do we get the values there?
- Lines appeared in our window
  - How do we store the lines?
  - How do we draw them?

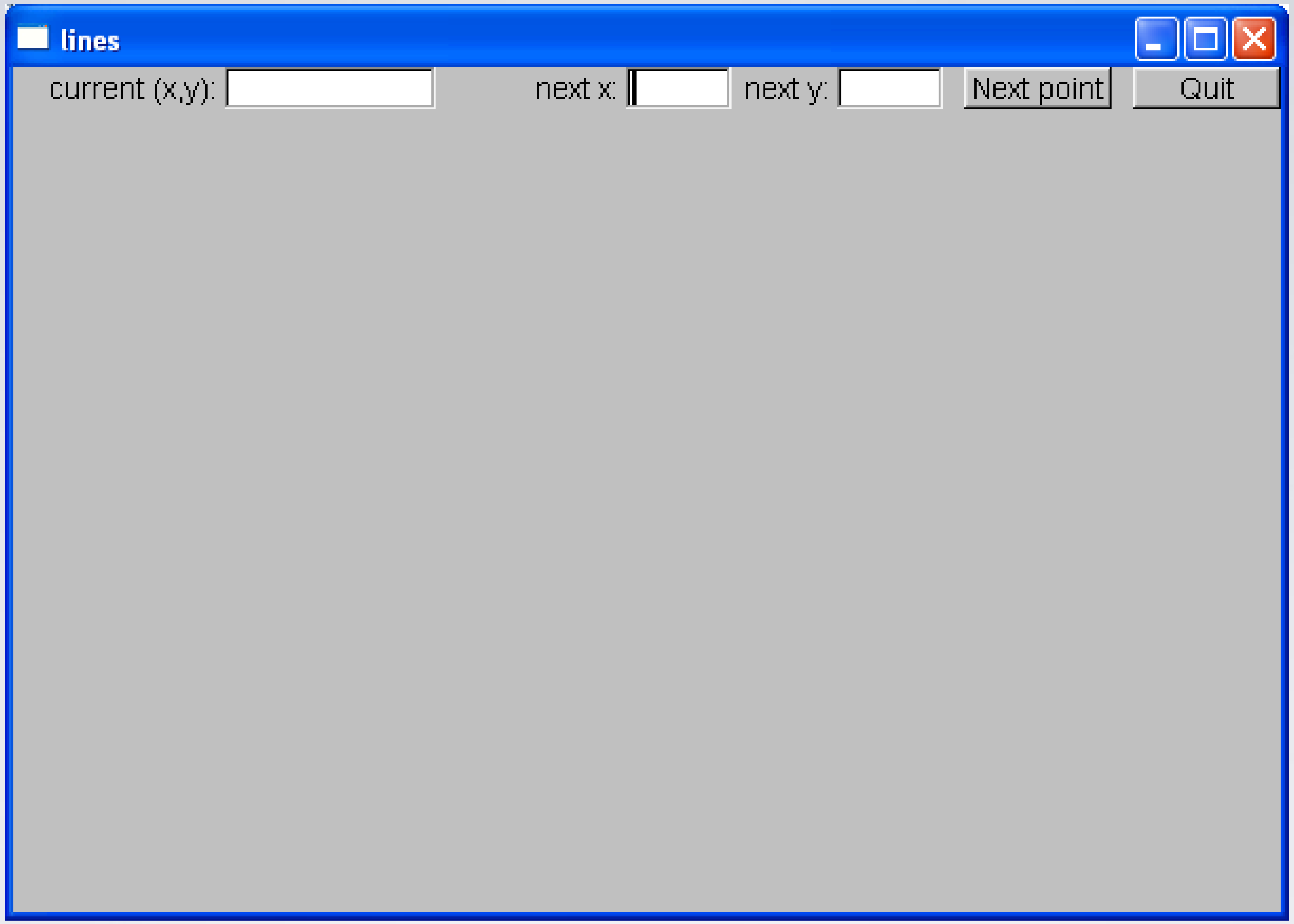
Mapping

- We map our ideas onto the FTLK version of the conventional Graphics/GUI ideas

Define class Lines_window

```
struct Lines_window : Window    // Lines_window inherits from Window
{
   Lines_window(Point xy, int w, int h, const string& title); // declare constructor
   Open_polyline lines;

private:
   Button next_button;                    // declare some buttons – type Button
   Button quit_button;
   In_box next_x;                         // declare some i/o boxes
   In_box next_y;
   Out_box xy_out;

   void next();                           // what to do when next_button is pushed
   void quit();                           // what to do when quit_botton is pushed

   static void cb_next(Address, Address window); // callback for next_button
   static void cb_quit(Address, Address window);   // callback for quit_button
};
```

GUI example



- Window with
    - two **Buttons**, Two **In_box**es, and an **Out_box**

The Lines_window constructor

```
Lines_window::Lines_window(Point xy, int w, int h, const string& title)
   :Window(xy,w,h,title),
             // construct/initialize the parts of the window:
                         // location               size        name           action
   next_button(Point(x_max()-150,0), 70, 20, "Next point", cb_next),
   quit_button(Point(x_max()-70,0), 70, 20, "Quit", cb_quit),       // quit button
   next_x(Point(x_max()-310,0), 50, 20, "next x:"),                  // io boxes
   next_y(Point(x_max()-210,0), 50, 20, "next y:"),
   xy_out(Point(100,0), 100, 20, "current (x,y):")
{
   attach(next_button);              // attach the parts to the window
   attach(quit_button);
   attach(next_x);
   attach(next_y);
   attach(xy_out);
   attach(lines);                    // attach the open_polylines to the window
}
```

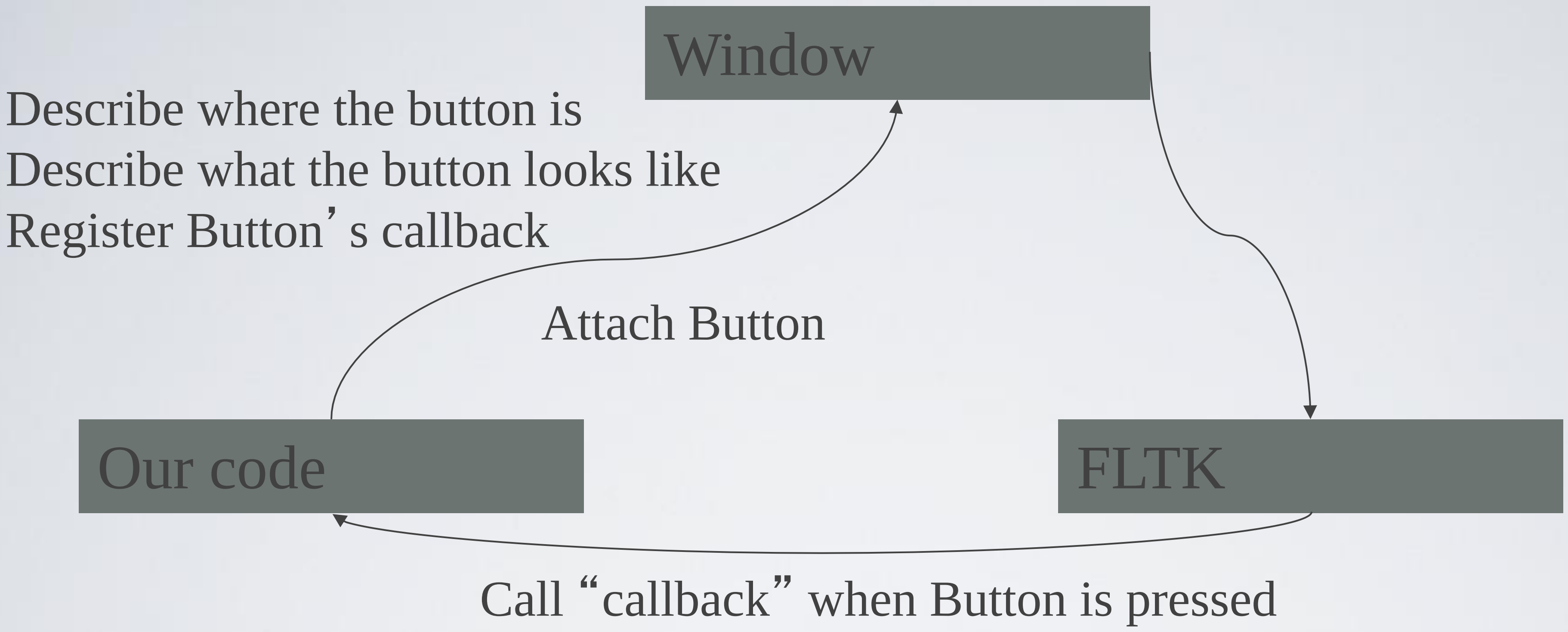
Widgets, Buttons, and Callbacks

- A Widget is something you see in the window which has an action associated with it
- A Button is a Widget that displays as a labeled rectangle on the screen, and when you click on the button, a Callback is triggered
- A Callback connects the button to some function or functions (the action to be performed)

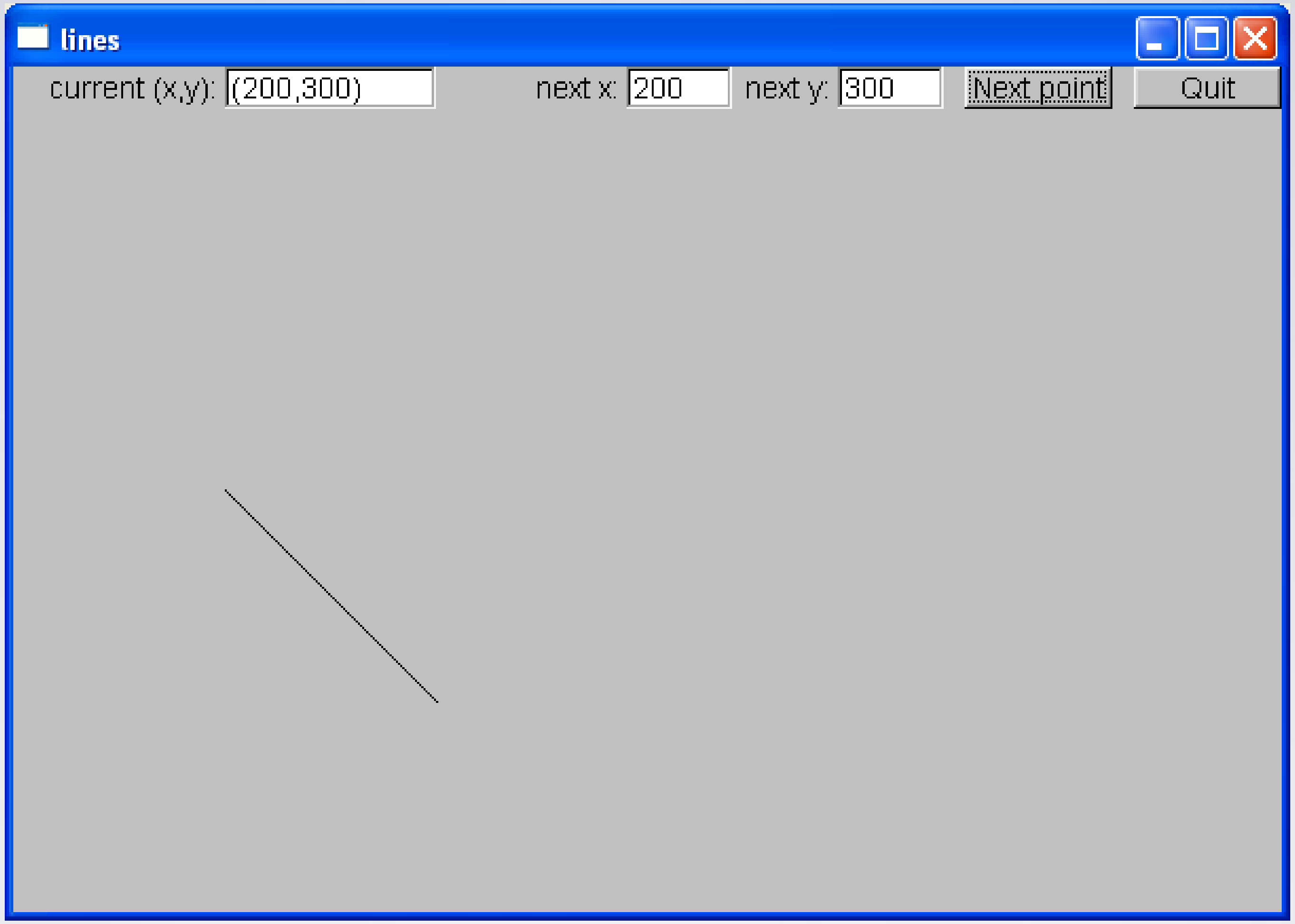
Widgets, Buttons, and Callbacks

```
// A widget is  something you see in the window
// which has an action associated with it

// A Button is a Widget that displays as a labeled rectangle on the screen;
// when you click on the button, a Callback is triggered
// A Callback connects the button to some function

struct Button : Widget {
   Button(Point xy, int w, int h, const string& s, Callback cb)
            :Widget(xy,w,h,s,cb) { }
};
```

How it works


Window
Describe where the button is
Describe what the button looks like
Register Button's callback
Attach Button
Our code
FLTK
Call "callback" when Button is pressed

GUI example



- Add another point an you have a line

Widget

- A basic concept in Windows and X windows systems
  - Basically anything you can see on the screen and do something with is a widget (also called a "control")

```
struct Widget {
   Widget(Point xy, int w, int h, const string& s, Callback cb)
        :loc(xy), width(w), height(h), label(s), do_it(cb)
   { }
   // … connection to FLTK …
};
```

Button

- A Button is a Widget that
  - displays as a labeled rectangle on the screen;
  - when you click on it, a Callback is triggered

```
struct Button : Widget {
   Button(Point xy, int w, int h, const string& s, Callback cb)
            :Widget(xy,w,h,s,cb) { }
};
```

Callback

- Callbacks are part of our interface to "The system"
  - Connecting functions to widgets is messy in most GUIs
  - It need not be, but
    - "the system" does not "know about" C++
    - the style/mess comes from systems designed in/for C/assembler
    - Major systems always use many languages, this is one example of how to cross a language barrier
  - A callback function maps from system conventions back to C++

```
void Lines_window::cb_quit(Address, Address pw)
    // Call Lines_window::quit() for the window located at address pw
{
    reference_to<Lines_window>(pw).quit();          // now call our function
}
```

Map an address into a reference to the type of object residing at that address – to be explained the following chapters

Our “action” code

```
// The action itself is simple enough to write

void Lines_window::quit()
{
   // here we can do just about anything with the Lines_window
   hide();          // peculiar FLTK idiom for “get rid of this window”
}
```

The next function

```
// our action for a click ("push") on the next button

void Lines_window::next()
{
   int x = next_x.get_int();
   int y = next_y.get_int();

   lines.add(Point(x,y));

   // update current position readout:
   stringstream ss;
   ss << '(' << x << ',' << y << ')';
   xy_out.put(ss.str());

   redraw();   // now redraw the screen
}
```

In_box

```
// An In_box is a widget into which you can type characters
// It's "action" is to receive characters

struct In_box : Widget {
  In_box(Point xy, int w, int h, const string& s)
          :Widget(xy,w,h,s,0) { }
  int get_int();
  string get_string();
};

int In_box::get_int()
{
  // get a reference to the FLTK FL_Input widget:
  Fl_Input& pi = reference_to<Fl_Input>(pw);
  // use it:
  return atoi(pi.value());   // get the value and convert
                             // it from characters (alpha) to int
}
```

Summary

- We have seen
  - Action on buttons
  - Interactive I/O
    - Text input
    - Text output
    - Graphical output
- Missing
  - Menu (See Section 16.7)
  - Window and Widget (see Appendix E)
  - Anything to do with tracking the mouse
    - Dragging
    - Hovering
    - Free-hand drawing

- What we haven’t shown, you can pick up if you need it

Next lecture

- During the next lectures will show how the standard vector is implemented using basic low-level language facilities.
- This is where we really get down to the hardware and work our way back up to a more comfortable and productive level of programming.

Acknowledgements

Bjarne Stroustrup

Programming -- Principles and Practice Using C++

http://www.stroustrup.com/Programming/

Thank you!

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο
ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
ΕΚΠΑΙΔΕΥΣΗ ΚΑΙ ΔΙΑ ΒΙΟΥ ΜΑΘΗΣΗ
επένδυση στην κοινωνία της γνώσης
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ & ΘΡΗΣΚΕΥΜΑΤΩΝ, ΠΟΛΙΤΙΣΜΟΥ & ΑΘΛΗΤΙΣΜΟΥ
ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΔΙΑΧΕΙΡΙΣΗΣ
Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης
ΕΣΠΑ 2007-2013
πρόγραμμα για την ανάπτυξη
ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ