CptS 360 (System Programming)
Unit 18c: Curses (Selected Topic)

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Motivation

- *curses(3)* is the standard for character-based GUIs
- allows a character-based GUI that looks identical on all platforms
- works nicely over a slow network line, even (shudder) a dial-up

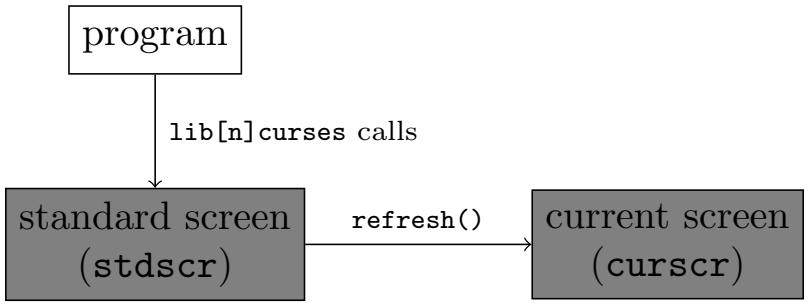
References

- Stones & Matthew "Beginning Linux Programming", Ch. 6
- *man* pages
- Raymond & Ben-Halim "Writing Programs with NCURSES"
  http://invisible-island.net/ncurses/ncurses-intro.html
- "A Hacker's Guide to NCURSES"
  http://invisible-island.net/ncurses/hackguide.html

Curses vs. Ncurses

- grew out of the *vi* editor (the ancestor of *vim(1)*)
- Ncurses is a freely-available replacement for the (discontinued) 4.4BSD curses.
- Also available for Windows and practically any other platform.
- To use:
  - `#include <curses.h>` (or `#include <ncurses.h>`).
  - Link to `-lcurses` (or `-lncurses`).

Logical vs. Physical Screens



- User makes updates to logical screens, then calls `refresh()` to sync logical (`stdscr`) with physical (`curscr`).
  (Think `stdio` with a mandatory *flush(3)*.)
- This is to allow batch updates that optimize cursor motion.
- coordinate system:
  - `(0,0)` is upper left.
  - `(LINES-1, COLS-1)` is lower right.

Skeleton Program

```
#include <curses.h>
...
initscr();
move(5,15);
printw("%s", "Hello, World!");
refresh();
sleep(2);
endwin();
```

(run demos/d*n*_simple)

Basic Functions: Screen Output I

- *addch(3)*
  replaces the character at the current cursor position with `ch`
- *addchstr(3)*
  adds a whole string of (non-control) characters at the current cursor position
- *printw(3)*
- *refresh(3)*
- *box(3)*
  draws a box around a window. Use `ACS_VLINE` and `ACS_HLINE` for a better-looking box.
- *insch(3)*
  inserts a character before the character under the current position. Stuff may be pushed off the right of the screen

(run `demos/dn_fancier`)

Basic Functions: Screen Output II

- *insertln(3)*
  insert a blank line above the current line. The bottom line is lost.
- *delch(3)*
  delete the current character on a line. Characters to the right are moved one unit left and a blank is inserted.
- *deleteln(3)*
- *beep(3)*
- *flash(3)*

Basic Functions: Reading from the "Screen"

- *inch(3)*
- *instr(3)*
- *innstr(3)*

Clearing the Screen

- *erase(3)*
  writes blanks to every non-blank screen location
- *clear(3)*
  clears screen and forces complete screen blank on next refresh. Use with `refresh()` for a complete screen redraw.
- *clrtobot(3)*
- *clrtoeol(3)*

Moving the Cursor

- *move(3)*
  move to `(y, x)` on the screen
- *leaveok(3)*
  sets a flag to determine where the physical cursor is left after an update. (An optimization usually ignored.)
- Prefix "`mv`" to just about any other output routine to move to a position (given by the first two arguments).

Cursor and Character Attributes

- *curs_set(3)*
- *attron(3)*
- *attroff(3)*
- *attrset(3)*

Keyboard Modes

These control echoing:

- *echo(3)*
- *noecho(3)*

These control canonical/non-canonical input:

- *noraw(3)*
  normal, line buffered cooked (canonical) mode (which is the default)
- *nocbreak(3)*
  cooked, but leaves special character handling alone
- *cbreak(3)*
  non-canonical, but special characters handled by kernel
- *raw(3)*
  non-canonical, no signals, no SW flow control

Windows

- *newwin(3)*
- *delwin(3)*
- add "`w`" prefix to previous output functions to specify the window (given by the first argument).
- After the `mv` prefix, if there is one.

Moving and Updating a Window

- *mvwin(3)*
  move window to a new location (all parts must fit)
- *wrefresh(3)* refreshes the specified window, regardless of overlapping windows.
- *wclear(3)*
- *werase(3)*
- *touchwin(3)*
  treat contents of window as needing an update during *refresh(3)* of overlapping windows
- *scrollok(3)*
  Allow a window to scroll.
- *scroll(3)*
  Force a scroll.

Optimizing Screen Refreshes

- *wnoutrefresh(3)*
- *doupdate(3)*

These allow multiwindow batch refreshes.

Subwindows

Like windows, but aligned to a window, sharing character space.

- *subwin(3)*
- *derwin(3)*
  like subwin, but relative coordinates

This is mainly for scrolling a part of a bigger window.

Keypad Mode

- *keypad(3)*
- Curses takes over keyboard translation, especially of function and similar keys.
- Problems with timing (used to detect key combinations), esp. over networks.

Color

- *has_colors(3)*
- *start_color(3)*
- *init_pair(3)*
  sets a color (fg, bg) pair
- *COLOR_PAIR(3)*
  invokes a color pair defined by *init_pair(3)*
- *pair_content(3)*
  pulls a color pair apart
- *wattron(3)*
  allows a mask of attributes (including color, blink, highlight)
- *init_color(3)*
  allows redefinition of color RGB values

(run `demos/d`*n*`_cursed_fortune`)

Pads

- logical screen bigger than physical screen
- *newpad(3)*
- *prefresh(3)*
  says what part of the pad should appear on the screen

Ncurses Extensions

- The Panels Library
  Extension to support overlapping windows.
- The Menu Library
  Extension to support menu selectors.
- The Forms Library
  Extension for data entry. (There's some redundancy in the name.)