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## Administrivia

- (None.)

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## A Little About X (“The X Window System”) — Basic Ideas

- Some operating systems include GUI support in the “kernel”. UNIX takes a different, layered approach. Slower, but safer and more flexible.
- Basic idea — separate processing from GUI and allow them to be on the same computer or different computers — client/server model, with
  - Applications that want to do GUI input/output — e.g., Firefox, PDF viewers, etc.
  - Program to manage display, accepts input. Can be a process running alongside clients, or a whole operating system (for an “X terminal”), or an application running on a different operating system (“X emulator for Windows”).(Which is which?)
- X defines protocol for client/server communication.

### A Little About X — Using Application Programs

- Most X-based applications support a common set of command-line parameters (e.g., `-geometry` to set initial size and position).
- `.Xresources` can provide other configuration information.
- To copy and paste text — highlight with left mouse button, paste with middle mouse button. Works with all “standard” X applications (whatever that means!).  
(Copy/cut/paste with CUA keys (control-C, etc.) also available as part of “desktop environment” described later.)

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### A Little About X — Writing Application Programs

- How to write a program with a GUI? Can make calls to X library functions directly — set up window(s), main processing loop to handle “events”.  
(Example.)
- Or can use a higher-level “widget set” (buttons, menus, etc.): Motif, GTK, etc.  
(Why several? Well, this is UNIX.)  
Also try wxWidgets (cross-platform GUI library).

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### A Little About X — User Interface

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- Separate “window manager” controls how user interacts with windows — how they’re arranged on the screen, how the user moves them around, etc. Examples include `twm`, `fvwm`, Window Maker. (Why several? You know.) `switchdesk` provides limited ability to change window manager. To tweak further, edit appropriate dot-something files in home directory.
- In addition, can have a “desktop environment” that provides additional features. Examples include CDE (Sun), KDE, GNOME. Desktop environments provide something that looks more like Mac/Windows interface, but at a performance cost.
- A somewhat extreme view: “A window manager is a mechanism for managing xterms.” (Similarly: “A mouse is a device for selecting xterms.”)

### A Little About X — Remote Access

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- Can start a second X server on Linux machines via:  

```
X :1 -query machine -once
```

Switch back and forth with control-alt-F7/F8. (Or that’s how it worked at one point. May have changed in newest Fedora.)
- `ssh` with `-X` allows running X client programs. (Sometimes this is the default.)
- VNC (Virtual Network Computing) is another protocol for remote access. Try `vncviewer`.

### A Little About X — Configuration

- To find out what programs/configuration options are being used for graphical login, etc. — start in `/etc/event.d/prefdm`. (For recent releases of Fedora Linux anyway. Formerly in `/etc/inittab`.)
- (Hardware configuration options in `/etc/X11/xorg.conf`.)

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### Minute Essay

- Any questions about X, window managers, etc?

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