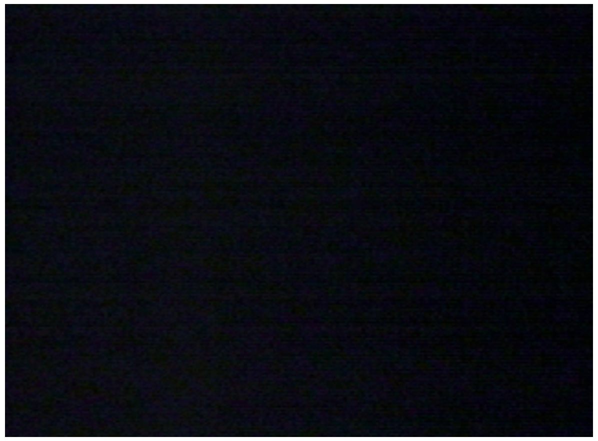
Review

- What is the difference between Smalltalk, Squeak, and Morphic?
- How did the original Smalltalk implement the window system layer architecture?
- What are the most particular qualities of Morphic as a UI toolkit?
- What are morphs, and what is special about them?
- How does Morphic implement widget layout?

The Apple Macintosh

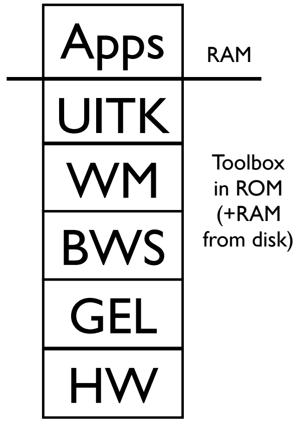
- Introduced in 1984
- Based on PARC Smalltalk, Star, Tajo
- Few technical innovations (QuickDraw)
  - Otherwise, rather steps back
- But landmark in UI design and consistency policies
  - First commercially successful GUI machine
  - Advertised with what is sometimes considered the best commercial in history: http://www.apple-history.com/movies/1984.mov

1984



20 Years Later...

Macintosh: Architecture



- One address space, communication with procedure calls
- "No" OS—app is in charge, everything else is a subroutine library ("Toolbox")
  - Functional, not object-oriented (originally written in Pascal)
  - Organized into Managers
  - Mostly located in "the Mac ROM"

Event Manager

- Event loop core of any Mac app
- Processes events (from user or system) and responds
- Event Manager offers functions to deal with events
  - `extern pascal Boolean` **`GetNextEvent`**`(short eventMask, EventRecord *theEvent);`
- Cooperative Multitasking
  - External: App must allow user to switch to other apps
  - Internal: App must surrender processor to system regularly

```
struct EventRecord {
  short what;    // type of event
  long message; // varies depending
                 // on type
  long when;     // Timestamp in
ticks
  Point where;   // mouse position
                 // in global coords
  short modifiers; // modifier keys
held down
};

Event types
enum {
  nullEvent    =  0,
  mouseDown    =  1,
  mouseUp      =  2,
  keyDown      =  3,
  keyUp        =  4,
  autoKey      =  5,
  updateEvt    =  6,
  diskEvt      =  7,
  activateEvt =  8,
  osEvt        = 15,
};
```

Control Manager

- Controls: Buttons, checkboxes, radio buttons, pop-up menus, scroll bars,...
- Control Manager: Create, manipulate, redraw, track & respond to user actions

Dialog Manager

- Create and manage dialogs and alerts
- (System-) modal, movable (application-modal), or modeless dialog boxes—choice depends on task!

Window Manager(!)

- Not the Window Manager from our layer model
- Create, move, size, zoom, update windows
- App needs to ensure background windows look deactivated (blank scrollbars,...)

Menu Manager

- Offers menu bar, pull-down, hierarch. & pop-up menus
- Guidelines: any app must support Apple, File, Edit, Help, Keyboard, and Application menus

Finder Interface

- Defining icons for applications and documents
- Interacting with the Finder

Other Managers

- Scrap Manager for cut&paste among apps
- Standard File Package for file dialogs
- Help Manager for balloon help
- TextEdit for editing and displaying styled text
- Memory Manager for the heap
- List Manager, Sound Manager, Sound Input Manager,...

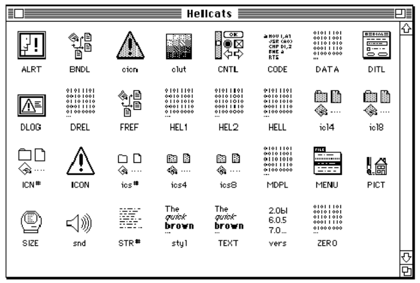
Resource Manager

- Resources are basic elements of any Mac app: Descriptions of menus, dialog boxes, controls, sounds, fonts, icons,...
  - Makes it easier to update, translate apps
- Stored in resource fork of each file
  - Each Mac file has data & resource fork
  - Data fork keeps application-specific data (File Manager)
  - Resource fork keeps resources in structured format (Resource Manager)
    - For documents: Preferences, icon, window position
    - For apps: Menus, windows, controls, icons, code(!)

Resource Manager

- Identified by type (4 chars) and ID (integer)
  - Standard resource types (WIND, ALRT, ICON,...)
  - Custom resource types (defined by app)
- Read and cached by Resource Manager upon request
  - Priorities through search order when looking for resource
    - Last opened document, other open docs, app, system
- Can write resources to app or document resource fork
  - E.g., last window position

ResEdit



- Graphical Resource Editor (Apple)
- Overview of resources in resource fork of any file (app or doc), sorted by resource type
- Opening a type shows resources of that type sorted by their ID
- Editors for basic resource types built in (ICON,DLOG,...)
- Big productivity improvement over loading resources as byte streams

Macintosh: Evaluation

- Availability: high (apps from 1984 still ran on machines from 2005)
- Productivity: originally low (few tools except ResEdit; Mac was designed for users, not programmers)
- Parallelism: originally none, later external+internal
  - External: Desk accessories, Switcher, MultiFinder
  - Internal: Multi-processor support in mid-90's

Macintosh: Evaluation

- Performance: high (first Mac was 68000@1MHz, 128K RAM) – improvement over Smalltalk
- Graphic model: QuickDraw (RasterOp+fonts, curves...)
- Style: most consistent to this day (HI Guidelines, Toolbox)
- Extensibility: low (Toolbox in ROM, later extended via System file)

Macintosh: Evaluation

- Adaptability: medium (System/app/doc preferences in resources, but limited ways to change look&feel)
- Resource sharing: medium (fonts, menu bar shared by apps,...)
- Distribution: none
- API structure: procedural (originally Pascal)
- API comfort: high (complete set of widgets)
- Independency: Medium (most UI code in Toolbox)
- Communication: originally limited to cut&paste

In-Class Exercise: Simple Mac Application

- Write a simple Macintosh application that opens a window and exits upon mouseclick

```
void main (void)
{
      WindowPtr window;
      Rect rect;

      InitGraf (&qd.thePort); // must be called before any other TB Manager (IM IX 2-36)
      InitFonts (); // after ig, call just to be sure (IM IX 4-51)
      FlushEvents(everyEvent,0); // ignore left-over (finder) events during startup
      InitWindows (); // must call ig & if before (IM Toolbox Essentials 4-75; IM I 280)

      InitCursor (); // show arrow cursor to indicate that we are ready

      SetRect (&rect, 100, 100, 400, 300);

      window = NewCWindow (NULL, &rect, "\pMy Test", true, documentProc,
            (WindowPtr) -1, FALSE, 0);

      do {
      }
      while (!Button());

      DisposeWindow (window);
}
```