The Photophile HDR Image Browser

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Motivation

- Existing browsers are divided in two camps:
  - File browsers with no cataloging features
  - Catalogers with no file browsing features
- None of the existing browsers support HDR
  - High dynamic range imaging considered too special-interest by most software makers
- Philosophical disagreements with the status quo too numerous to mention

Goals

- Browsing High Dynamic Range Images
  - *Radiance* RGBE format
  - TIFF LogLuv and floating point formats
  - Making HDR images from bracketed exposures
- Maintaining Catalog Information
  - Subjects, keywords, albums, comments, etc.
- Tracking Image Files
  - Leave file management & modification to user

Realized Features

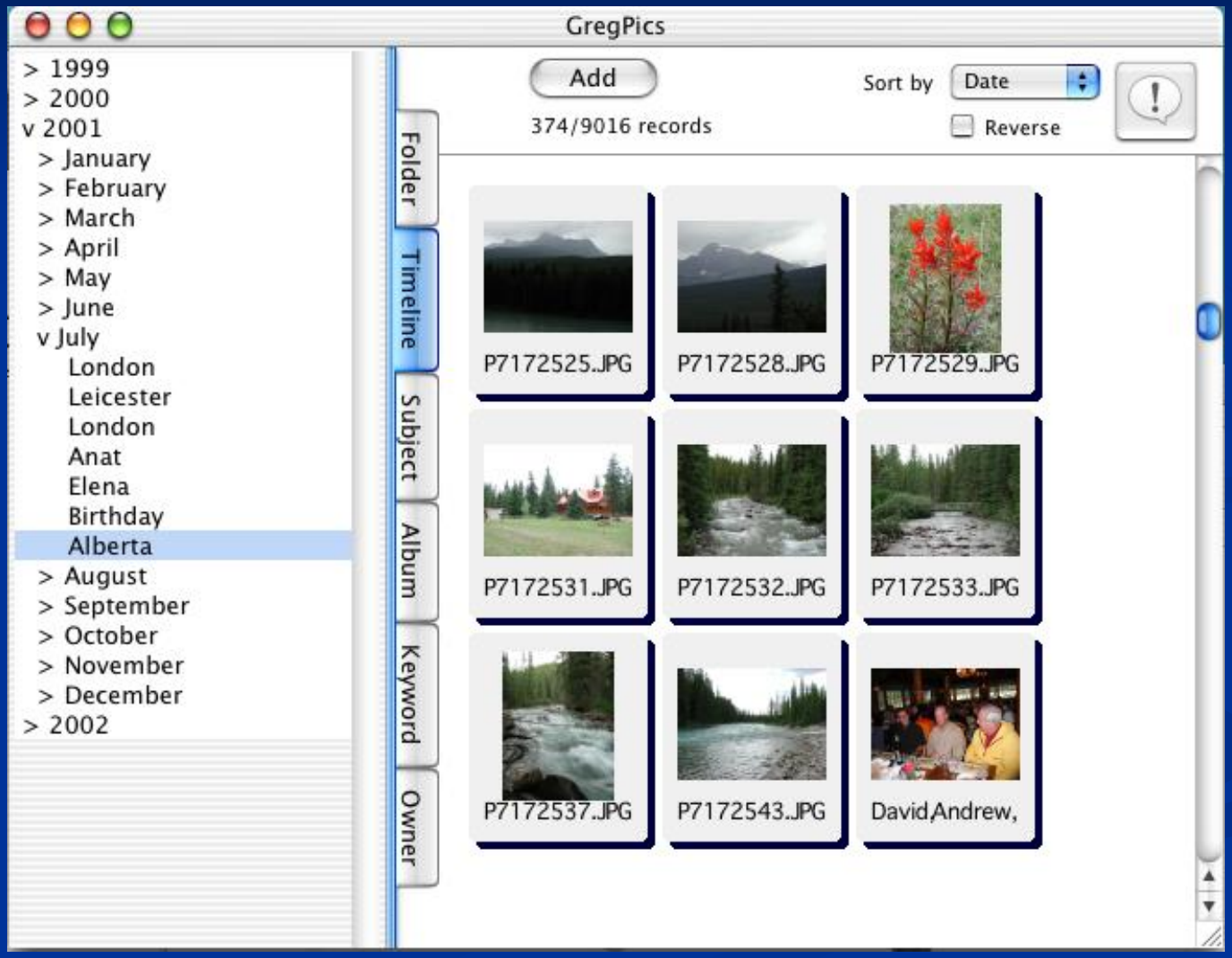
- Fast, interactive response
- Thumbnails accessible when images are not
- Interprets Exif header information
- Builds photo albums & web pages
- Displays & edits image information
- Provides drag & drop functionality

Unrealized Features

- User-defined database fields (nearly there)
- Accurate color reproduction on all devices
- Plug-in interface for photo printing services
- Printing(!)
- Linux and Windows versions
- More supported image formats
  - Currently JPEG, TIFF, *Radiance*, OpenEXR

Browser Layout

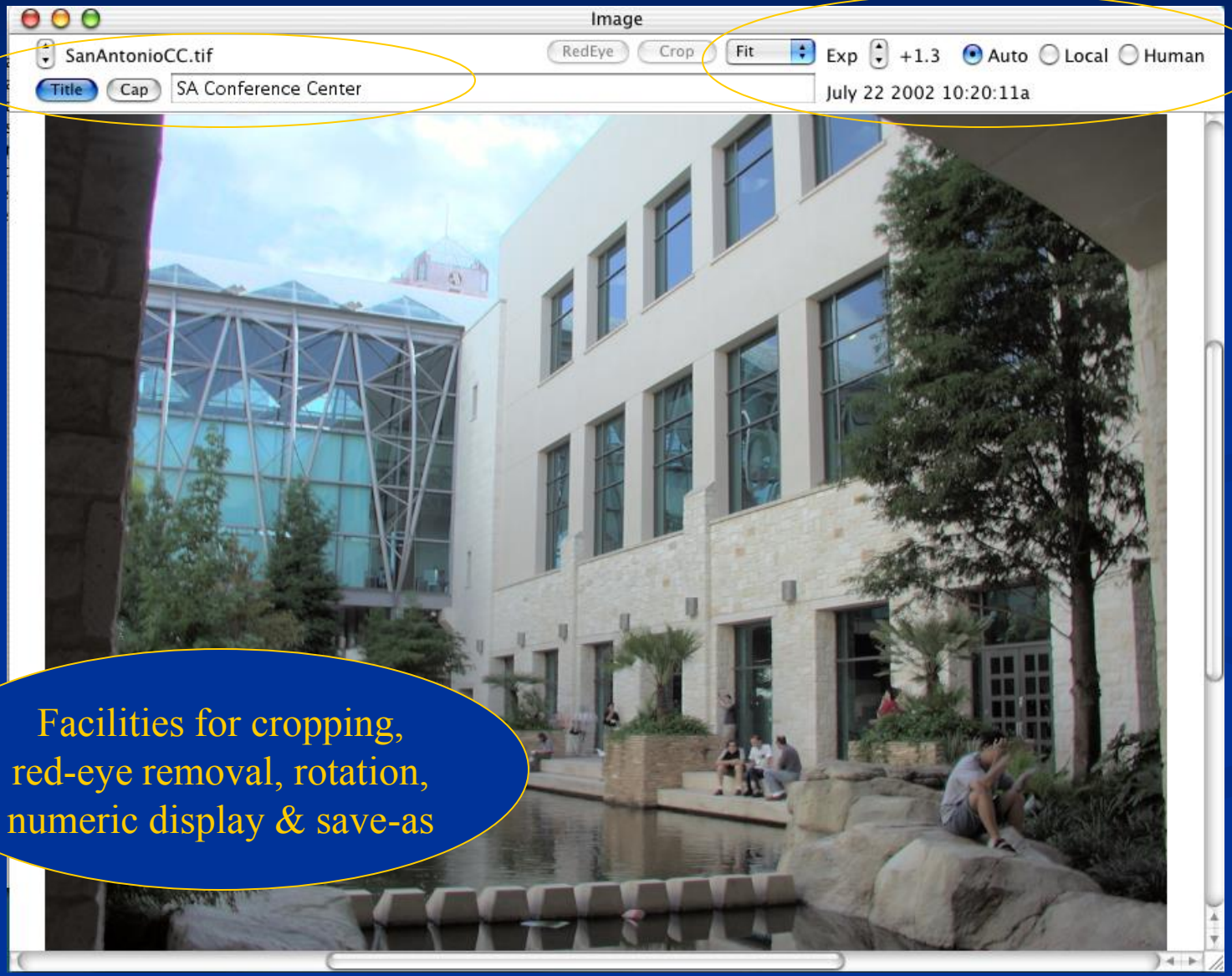
Selector Tabs permit multiple image selection from file system or catalog DB



Thumbnail sizes up to 320-pixel resolution preview

Viewer Layout

Handy settings of title & caption



Controls for display size and tone-mapping

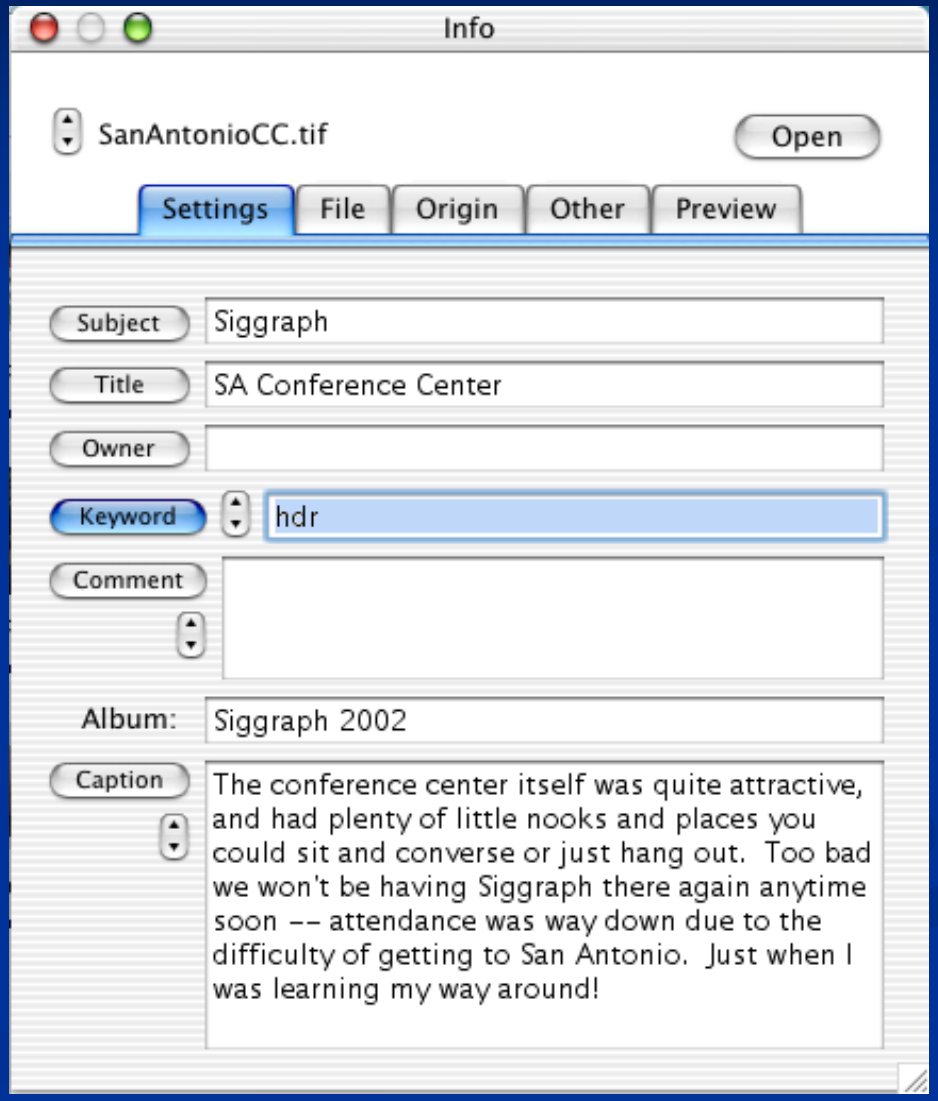
Facilities for cropping, red-eye removal, rotation, numeric display & save-as

Info Window Layout

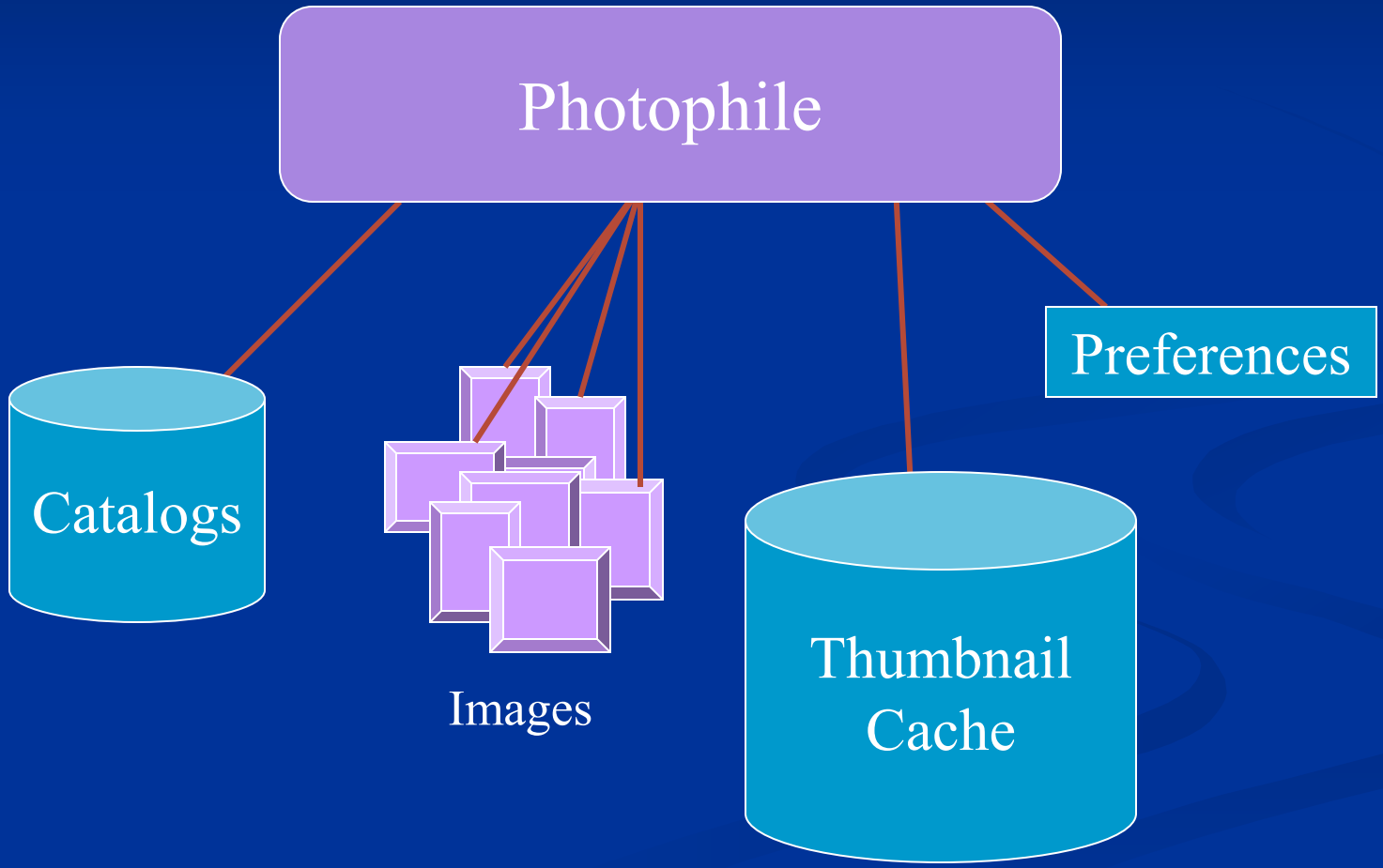
Provides convenient access to individual image settings and information

Most functionality is duplicated in application Set menu, which are more convenient for setting values on multiple images

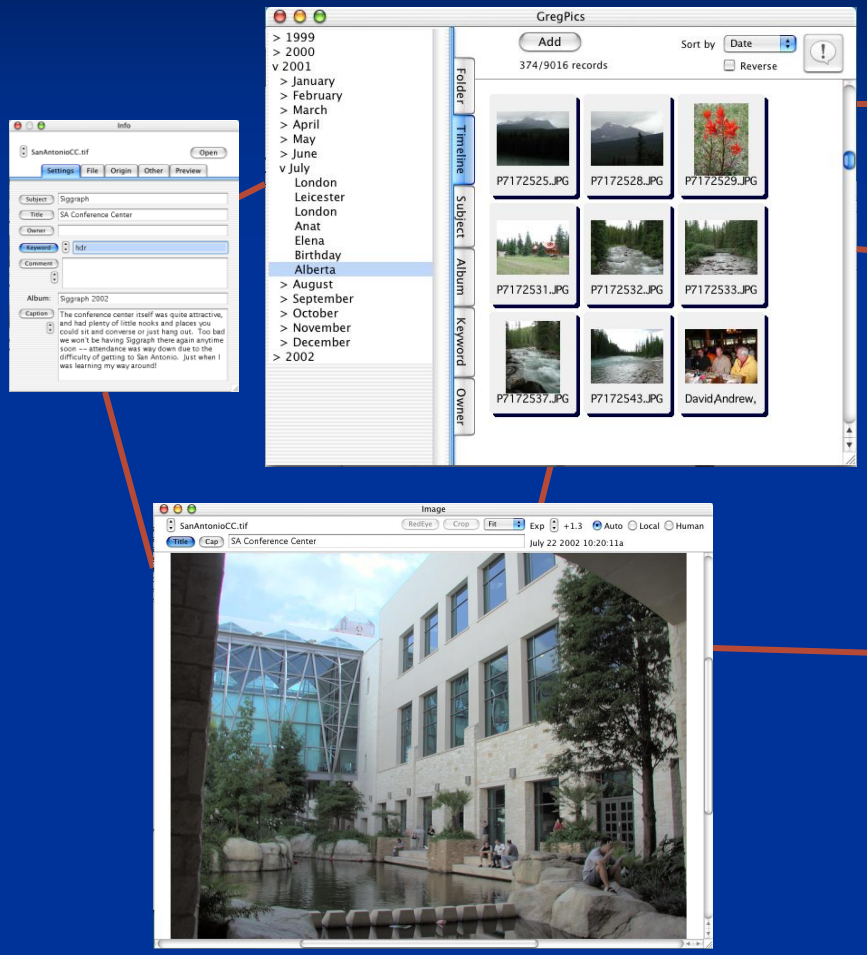
A handy browser “pop-up” feature also provides a preview and detailed image information on any selected thumbnail, and info listing is offered as alternative to thumbnail display

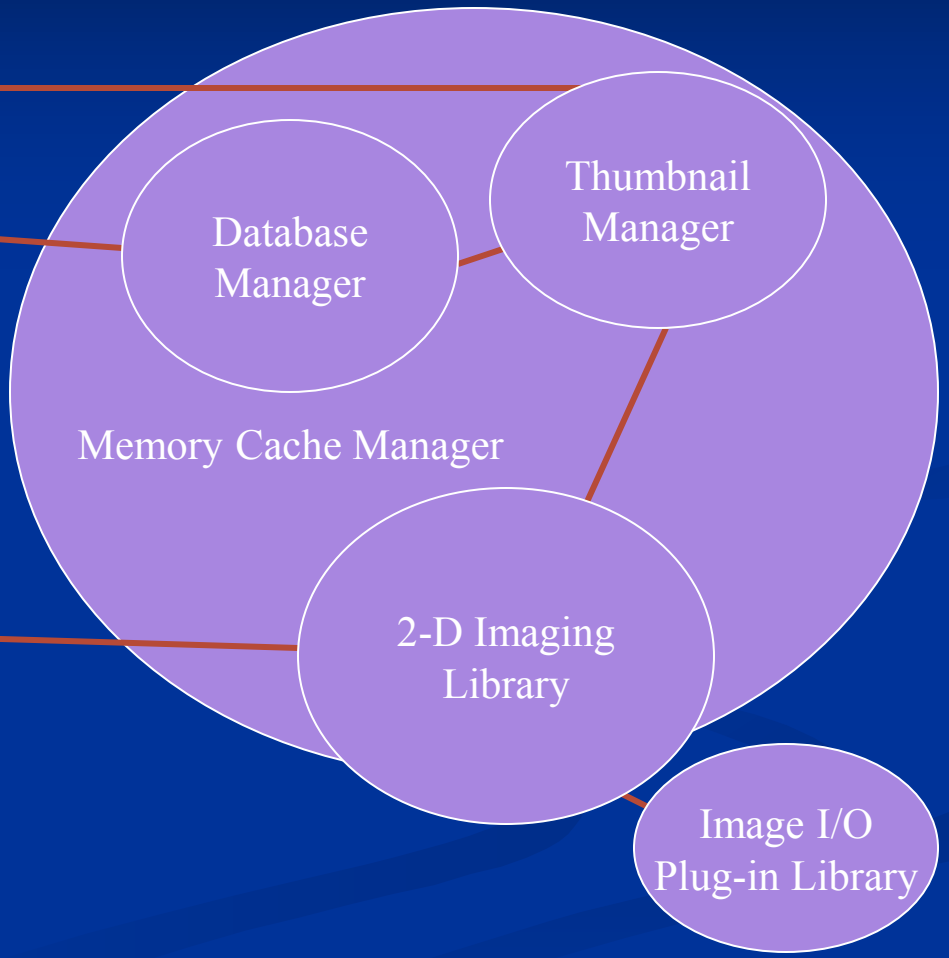


Browser Files



Browser Architecture





System-Specific GUI

System-Independent Library

High Dynamic Range Photography

- Most mid-priced digital cameras offer an “exposure bracket” mode
- Exif header includes exposure information
- Photophile extracts Exif exposure data
- Uses overlapping regions to get response
  - Debevec & Malik invented basic technique, though we use method of Mitsunaga & Nayar
- The trick is image registration (alignment)

LDR Exposure Registration

The *median threshold bitmap* (MTB) allows us to quickly compare and align different images, because it is constant with respect to exposure for any camera with a monotonic response function

The same is not true for an edge map, which changes with exposure even with careful normalization and approximate response curves

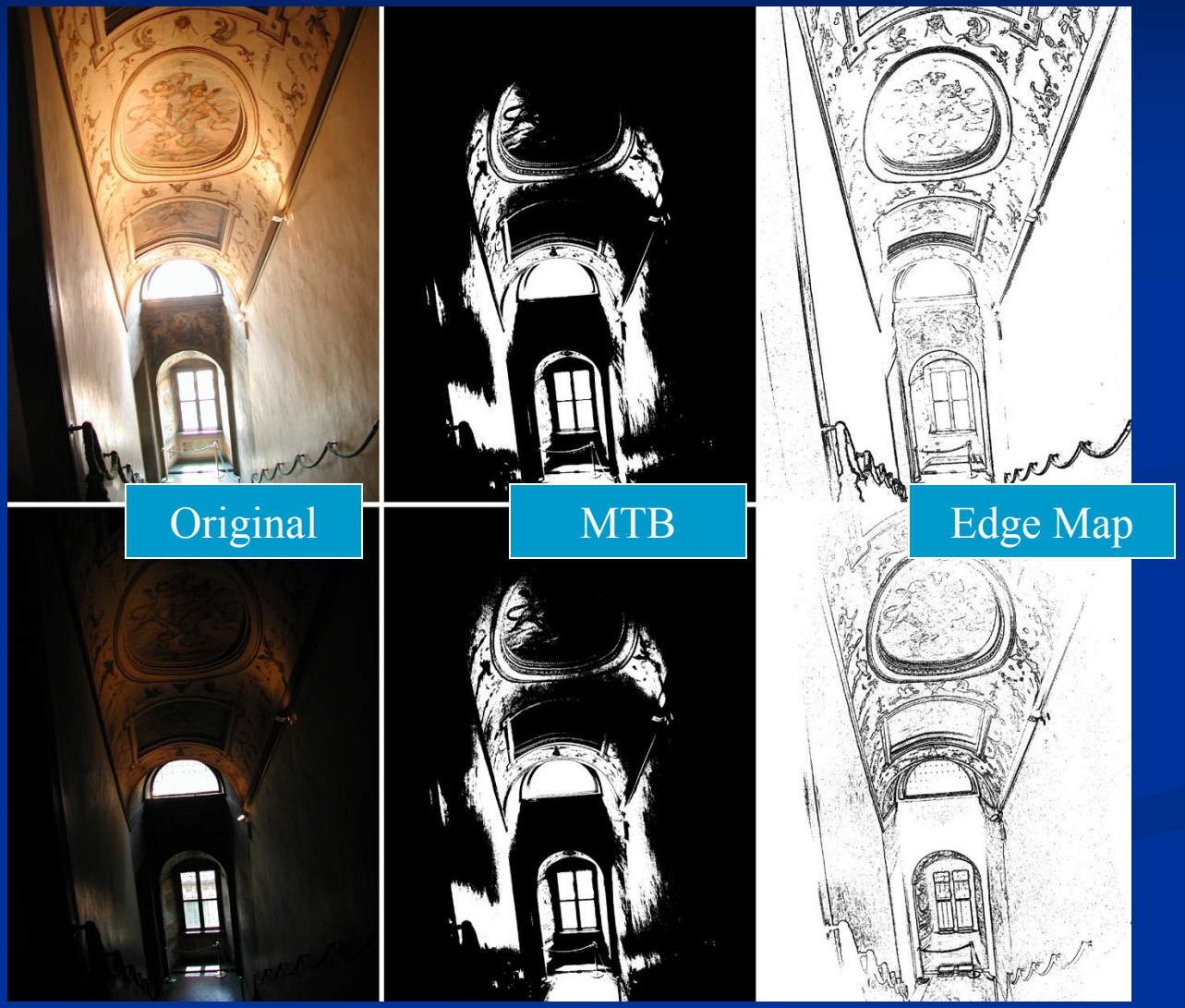


Image Pyramid Alignment

Grayscale images are scaled down repeatedly to create an image pyramid, which is then converted into MTBs for comparison

The smallest images are aligned first within a ±1 pixel distance, which corresponds to a ±32 pixel distance in the original

This becomes the MSB in the offset, which is shifted and used as the starting point for the next higher resolution alignment, and so on to the top

Alignment Results

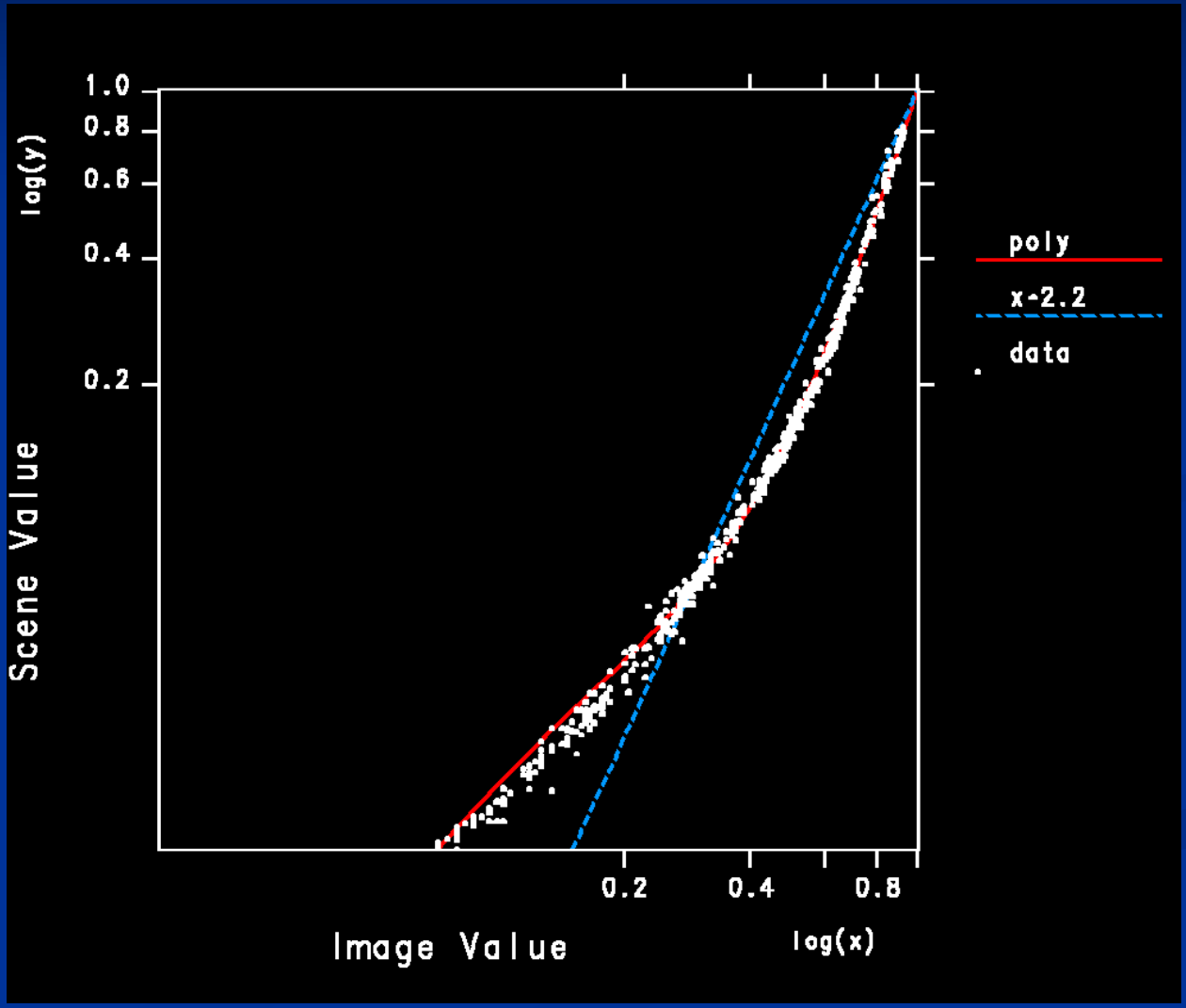
5 unaligned exposures Close-up detail MTB alignment

Time: About 1 second/exposure for 3 MPixel image

Camera Response Recovery

Overlapping exposures allow us to extract the camera response function based on multiple measures of the same samples in a suitable static scene

A low-order polynomial is fit to the data, and the computed response function is stored for subsequent reuse on images taken with the same camera make and model

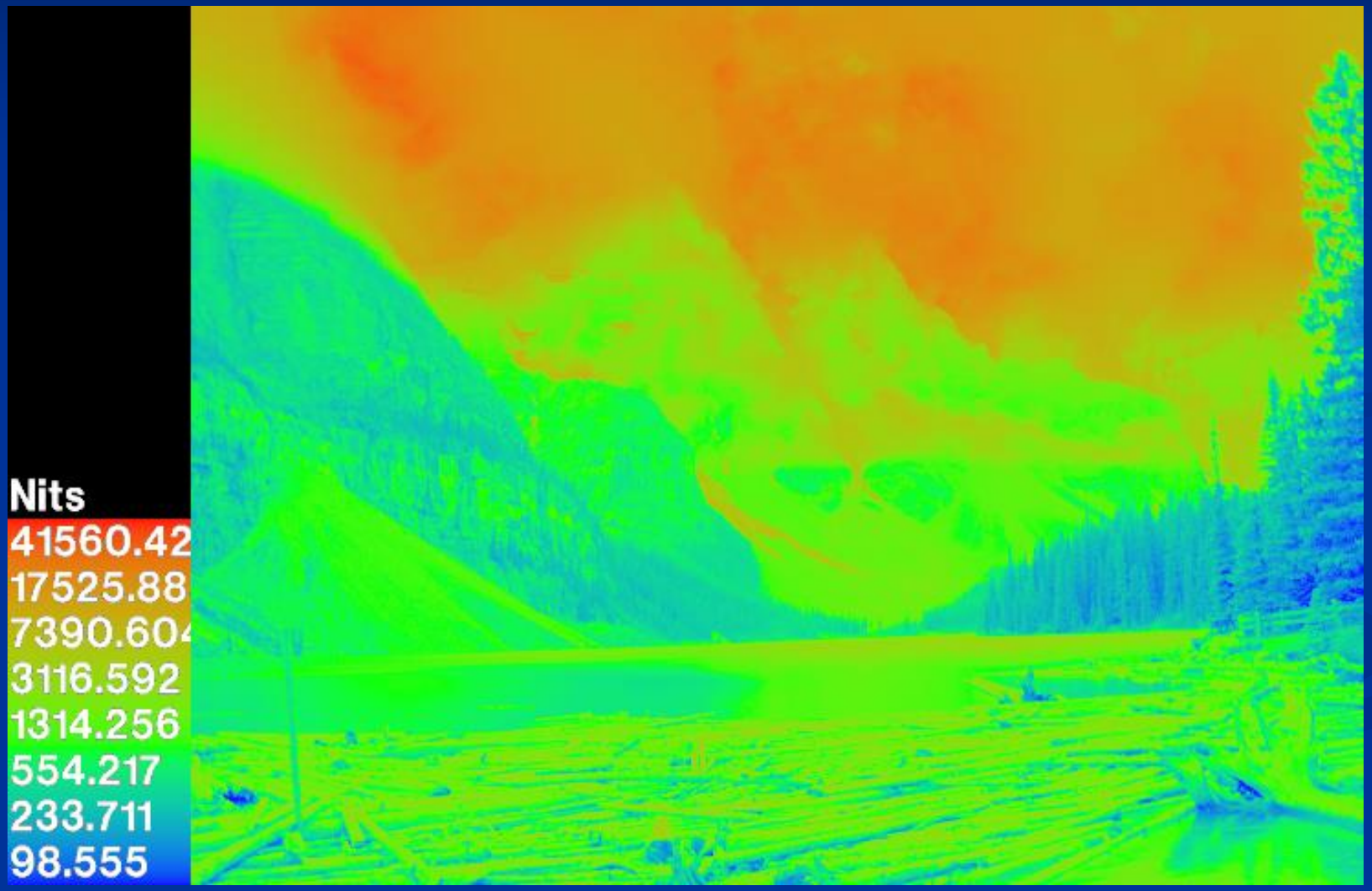


Auto-bracket Exposures

Elapsed time:

1.5 seconds with Olympus C-3040

Combined HDR Image



Tone-mapped Display

Best Single Exposure

DEMO

Photophile

The Future

- Port to Windows, Linux? (Volunteers?)
- Could be very useful for Radiology
  - X-rays are typically 16-bit samples
  - Catalog model fits well to medical patients
- Additional image enhancement filters
- Web interface to Photophile catalogs (cgi?)
- How would one market such a product?