Nifty Assignments 2005
Photomosaics

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Overview

- What are Photomosaics ® + Examples
- Programming Concepts
- Programming Options
- Contests and Databases
- Patent Implications

® Photomosaic is a registered trademark of Runaway Technology

What are Photomosaics

- A *mosaic* is a image rendered by a large number of small objects (historically glass and stone)
- In a *photomosaic*, the image is a large picture, which is rendered from smaller pictures
  - Viewed up close, the smaller pictures should be identifiable; from afar they integrate into the image
- Often there is a relationship between the two:
  - An artist rendered from his/her art works
  - A student rendered from his/her classmates
  - A campus landmark rendered from campus photos
  - …your students will come up with “interesting” combinations, guaranteed to upset someone: its art!

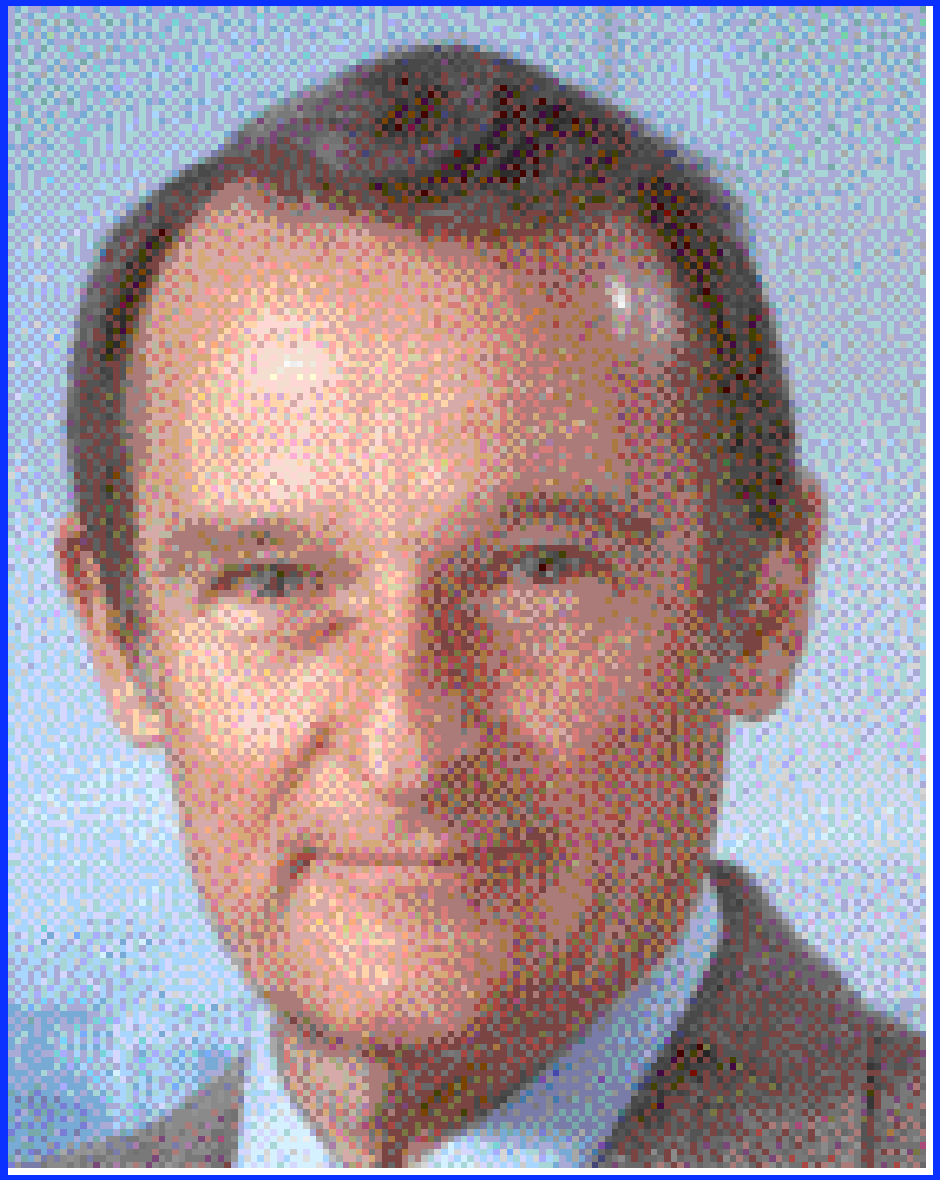
Database Pictures

Each database picture is rectangular, with the same aspect ratio (here photos are square)

Excerpt from a database of CD covers, containing about 1,200 pictures.

A Large Image to Render

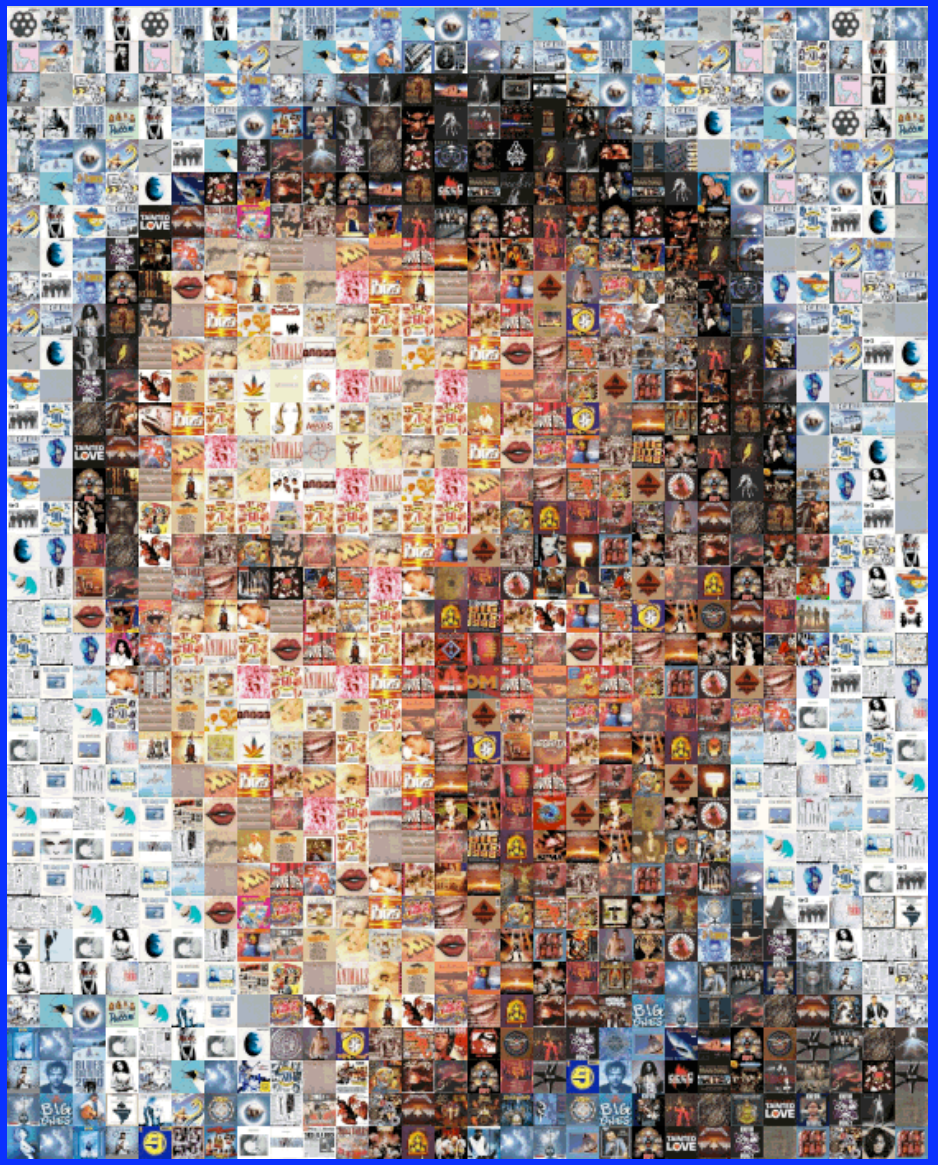
Seymour Cray



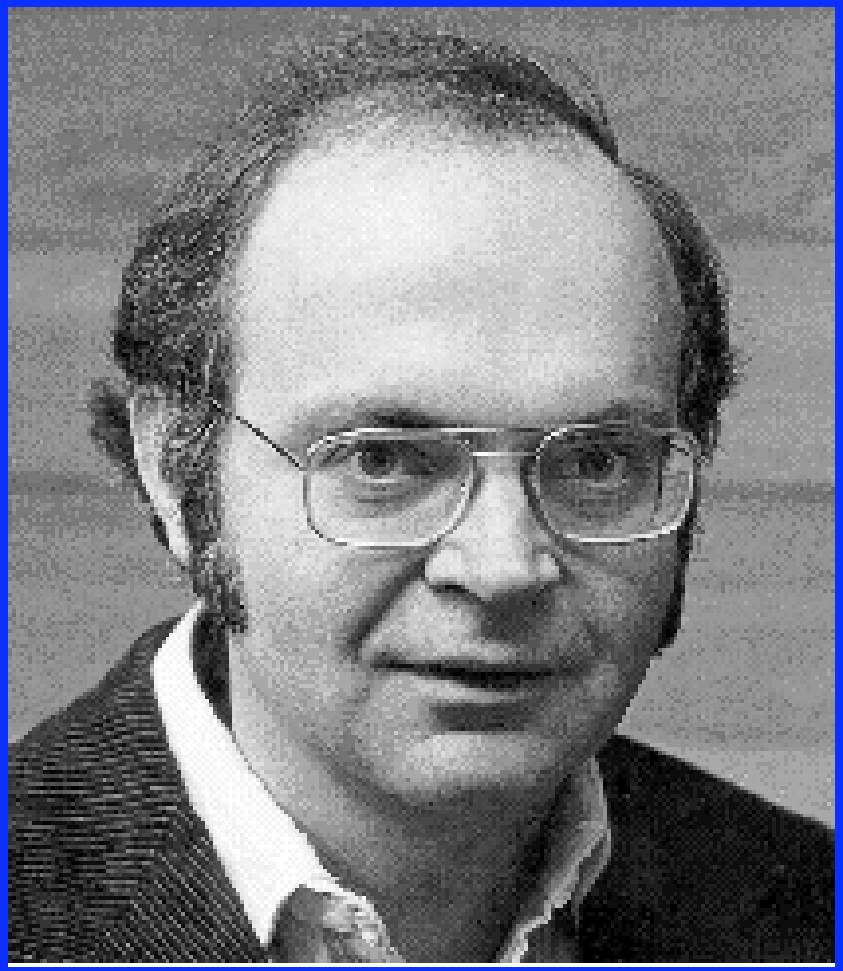
The Image Rendered by 980 CD Covers

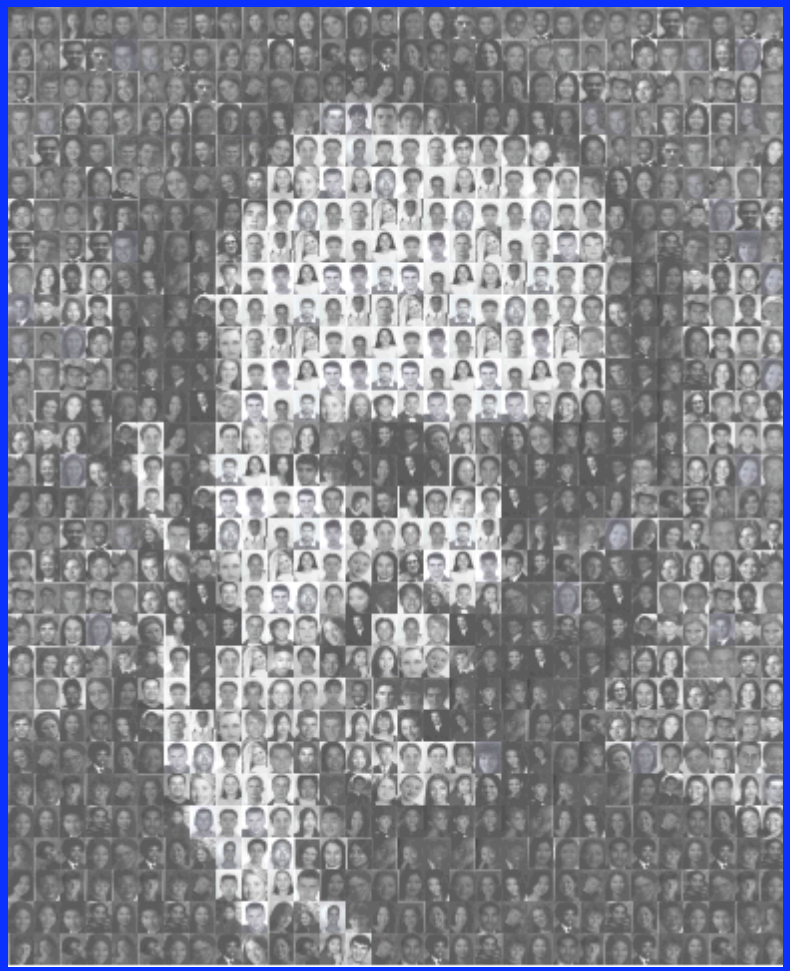
Limiting 10 reuses of any database picture with a minimum distance of 3 between reused pictures

(it helps to squint)



Don Knuth Rendered by 900 Student Photos





Full Size Student Photo

The Assignment

- Write a program that produces photomosaics
- The minimal program must…
  - Read a database of pictures, displaying it
    - Displaying a database ~ constructing a photomosaic, spatially
  - Read an image to render
  - Render/display image (regions->database pictures)
- Optional (simple vs. complicated assignment)
  - Square vs. Rectangular picture database
  - Sampling size (increase/decrease rendered image size)
  - Built-in vs. plug-in similarity metric(s)
  - Special constraints on rendering: reuse/distance
  - Input/Calculate/Output vs. GUI (via MVC pattern)

Programming Concepts

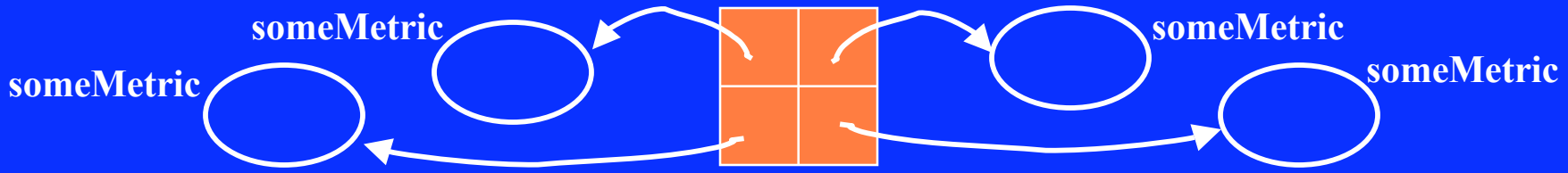
- Arrays
  - 1-d array of Picture objects (in a picture database)
  - 2-d array of pixels ("implicit" in each picture)
- Loops
  - Reading all the Picture files in a folder
  - Examining all the pixels in pictures to summarize them
  - Scanning regions in the Image to render
  - Scanning for the "closest" match in the database
- Using many classes to build an application
- Reading Javadoc
  - The FileSelector and Picture classes
  - Metric interface

Major Provided Components

- FileSelector class
  - Easy interface to file-selection GUI
- Picture class (about a dozen methods total)
  - constructor
  - makeEmptyPicture
  - Overlay (a region by another picture)
  - display
  - get/set Color (at coordinate), other accessors
  - …
- Metric interface
  - copy
  - makeSummary (overloaded for whole picture/region)
  - distanceTo (another Metric object)

More On (plug-in) Metrics

- I provide one: Intensity
  - Assume a gray scale
  - Computes/Stores 1 average in [0,255]
- Students write at least one: RGB
  - Computes 3 averages (for R, G, B separately) in [0,255]
- I provide a Quad Metric-Decorator
  - Implements Metric, constructor has Metric parameter
  - Is a Metric that duplicates its Metric parameter for each of 4 quadrants (storing more fine-grained data)



  - Summary delegate; distance delegate (sum of distances)
  - new Quad(new Quad(some metric)) provides 16 regions!

Programming Options

- Constraints
  - Maximum reuse for database pictures
  - Minimum distance from a picture to any other use of it
  - Spiral rendering from center (vs. top-down/left-right)
- Color shifting to increase database size/usefulness
- Filtering of pictures (e.g., color -> gray scale)
- Control Flow
  - Input/Calculate/Output
  - Menu (but still text) Driven (write as “Model”)
  - Full-blown GUI
    - I have students write the Model as an earlier assignment (providing them with a textual View/Controller), then have them write a full MVC GUI at the end of the semester

Contests: Something for Everyone

- **Best Metric (on instructor database and image)**
- **Best Art: (on student database image)**
  - **Use the Pritchard Scale**
  - ***If the photomosaic's score for perfection is plotted along the horizontal of a graph, and its importance is plotted on the vertical, then calculating the total area of the curve yields the measure of its greatness.***
- **Quick Rendering: Severe Time Limitations**
- **Best Databases found or created**

Database Sources

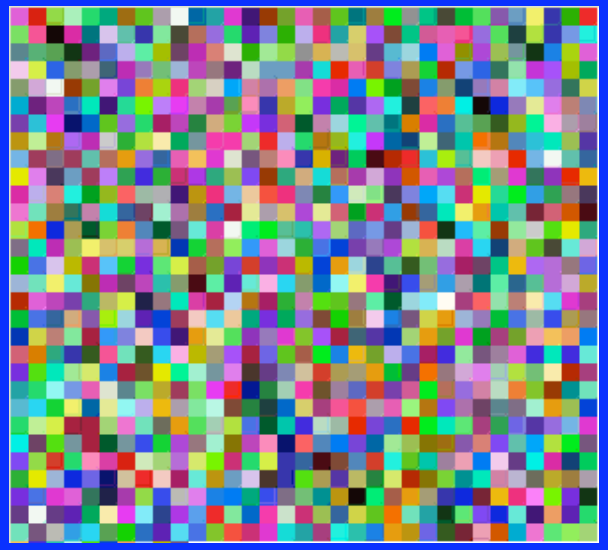
- Google the Web
  - I've found cd covers, beer labels, Christmas cards, etc. (tools are available to batch convert pictures to the appropriate sizes)
- Ask students
  - They do even better googling
  - If they have digital cameras, create your own
- Tools: Converting Movies -> Frames
- Cheating: shift pictures
  - redder/greener/bluer
    - Students can easily write filters for the Picture class

Patent Issues

- This topic is a 50 minute talk itself!
- I am not a lawyer; here are some “facts”
  - Creating photomosaics is patented
    - Unlike copyright, there is no fair use
    - Can teach how to make them, but not make them
  - Owner wouldn’t license patent for class use
  - Damages are based on lost income
  - David Evans (UVa) has made photomosaics; published in campus newspaper and on web
  - Photomosaic program on the web
- Will your school support you in a lawsuit? Talk to your school’s legal folks

Using Blobs

- Students can use bw/color blobs to test their programs without ever producing a "photomosaic"



Database of 1000 random colors