

# Digital Publishing, High Performance Computing, and the Grid

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# Synopsis

- Evolution of digital publishing
- Why is digital publishing important?
- What can high performance computing and the grid offer?
- A use case for digital publishing on the grid

# Digital publishing is the result of three distinct threads of technology development

- Printing
- Digital computers
- Desktop publishing

# Printing requires ink, paper, and a means to form the image

- The use of a colorant for writing arose with the use of papyrus scrolls for writing in 2400 BC in the Middle East.
- The Chinese developed paper from macerated hemp fibers in water suspension in 150 BC.
- The first book the *Diamond Sutra* was printed using wood-block in China in 868.



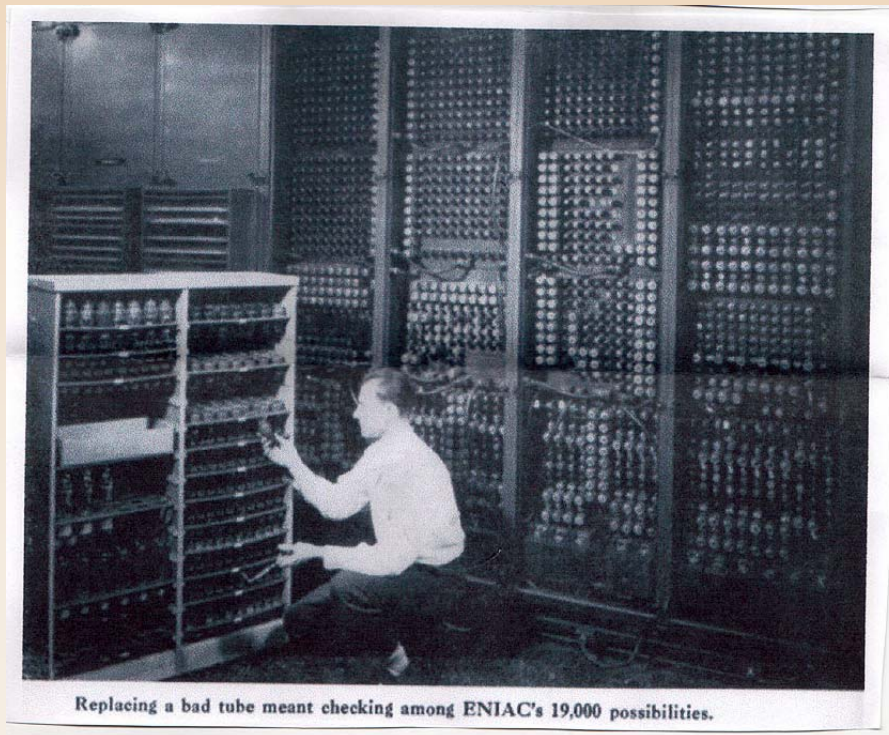
# Further developments made printing more efficient

- A papermaking mill was established in Capellades, Catalonia in 1238.
- Gutenberg invented press and metal type in 1450 precipitating a media “explosion” in Europe – by 1500 more than 9 million printed books were in circulation.
- Lithography was invented by Senefelder in 1799.
- Principle of offset press using a rubber transfer blanket was developed in early 1900s.



# The history of electronic computing is much more recent

- The 30-ton ENIAC computer with 19,000 vacuum tubes and 1,500 relays was placed in service in 1945.
- IBM introduced the 5150 PC in 1981.



# Desktop publishing required a low-cost printer and computer with a GUI, and a simple page description language

- Apple introduced Macintosh PC in 1984.
- HP introduced LaserJet printer in 1984.
- Adobe introduced Postscript in 1985.
- Aldus developed Pagemaker in 1985.



# Commercial presses are based on “impact” printing technologies

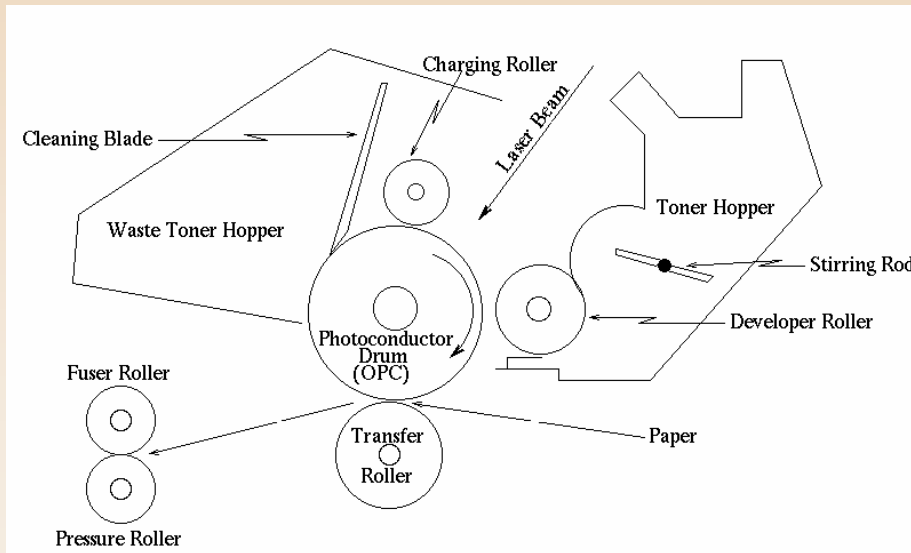
- Letterpress and flexography
- Offset lithography
- Gravure
- Intaglio



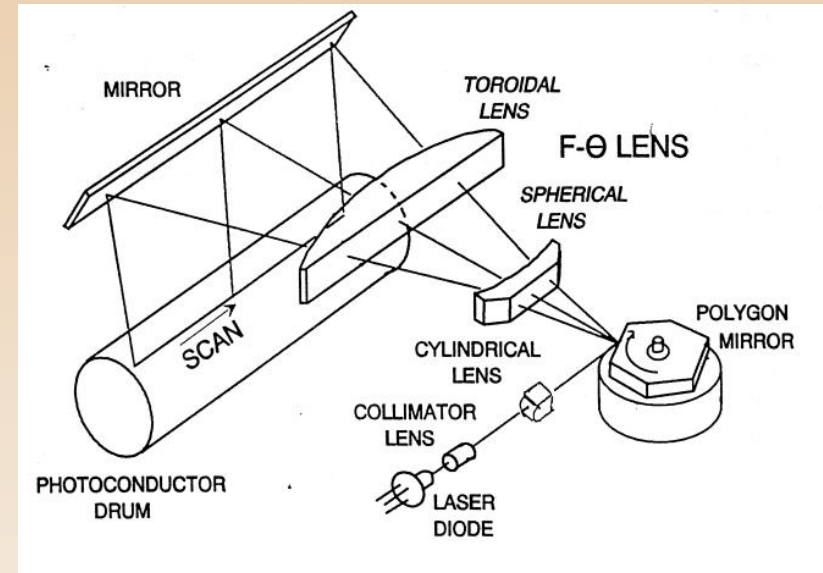
Heidelberg Speedmaster SM 74 offset press  
20"x29", 2-color, 10K sheets/hr.

# Desktop printers use “non-impact” technologies

- Inkjet
- Electrophotography



Schematic of laser (EP) printer



Laser scanning mechanism

# Digital publishing is like desktop publishing on steroids

- Desktop publishing software for document preparation.
- Scaled-up desktop printing technologies



HP Indigo 3050 liquid EP press - 11"x17", 7-color, 2K sheets/hr. 4-color) (67 8.5"x11" ppm)

# Digital publishing is important because...

## printing is not going away

- Commercial printing revenue has approximately doubled during each of the past 10 years
  - ◆ 1983 – \$92.8 B
  - ◆ 1993 – \$176.6 B
  - ◆ 2003 – \$330.5 B
- Paper has features that no other media can offer
  - ◆ visual and tactile aesthetics
  - ◆ scalability in cost, distribution, and size
  - ◆ flexibility and convenience



# Commercial printing generates a wide range of products

- Books
- Periodicals
- Catalogs
- Advertising and solicitation
- Financial and legal
- Packaging
- Technical documents, instructions, and manuals

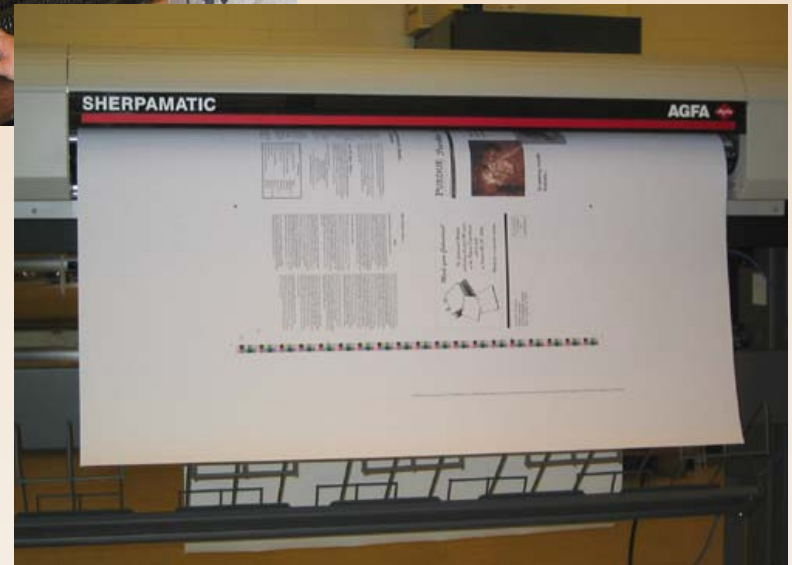
# Digital publishing is important because...

## it will transform commercial printing

- New short-run capabilities
  - ◆ print one copy or a thousand copies
  - ◆ print-on-demand
  - ◆ distribute-then-print
- Variable data printing
  - ◆ every copy can be different
  - ◆ pull content from databases
  - ◆ reformat each copy
- Workflow

# Stages 1 and 2 of the commercial printing workflow

- Document creation
  - ◆ concept
  - ◆ content
  - ◆ design
  - ◆ layout
- Prepress preparation
  - ◆ impose
  - ◆ preflight
  - ◆ proof
  - ◆ generate plate



# Stages 3 and 4 of the commercial printing workflow

- Press work
  - ◆ load paper
  - ◆ set up paper path
  - ◆ set up inks
  - ◆ monitor quality
- Finishing and distribution
  - ◆ cut
  - ◆ bind
  - ◆ ship



# Digital technologies have impacted commercial printing, but...

- Print shops remain a cottage industry of small-to-medium sized, highly capitalized businesses.
  - ◆ \$5M to \$10M sales
  - ◆ typically fewer than 20 employees
  - ◆ approximately 45K shops in U.S.
- Components of workflow have been separately digitized. Paradigm hasn't changed.
- Owners resist investment in digital technologies due to fear of obsolescence and cost of maintenance.
- Variable data printing is not well-understood or widely used.
- Skilled labor is increasingly difficult to find.



# What does high performance computing and the grid offer?

- Virtually unlimited computational resources when needed, and only when needed.
- Uniform framework for locating and accessing resources.
- Global connectivity.

# Thin-client print shop concept

- Many print shop services and resources become virtual and grid-based.
- The print shop itself may have only limited on-site resources.
- Seamless integration between document designer, content provider, printer, and customer.
- Fully supports “distribute-then-print” as opposed to traditional “print-then-distribute” model.
- More complete support for variable data printing.

# What about high-performance computing?

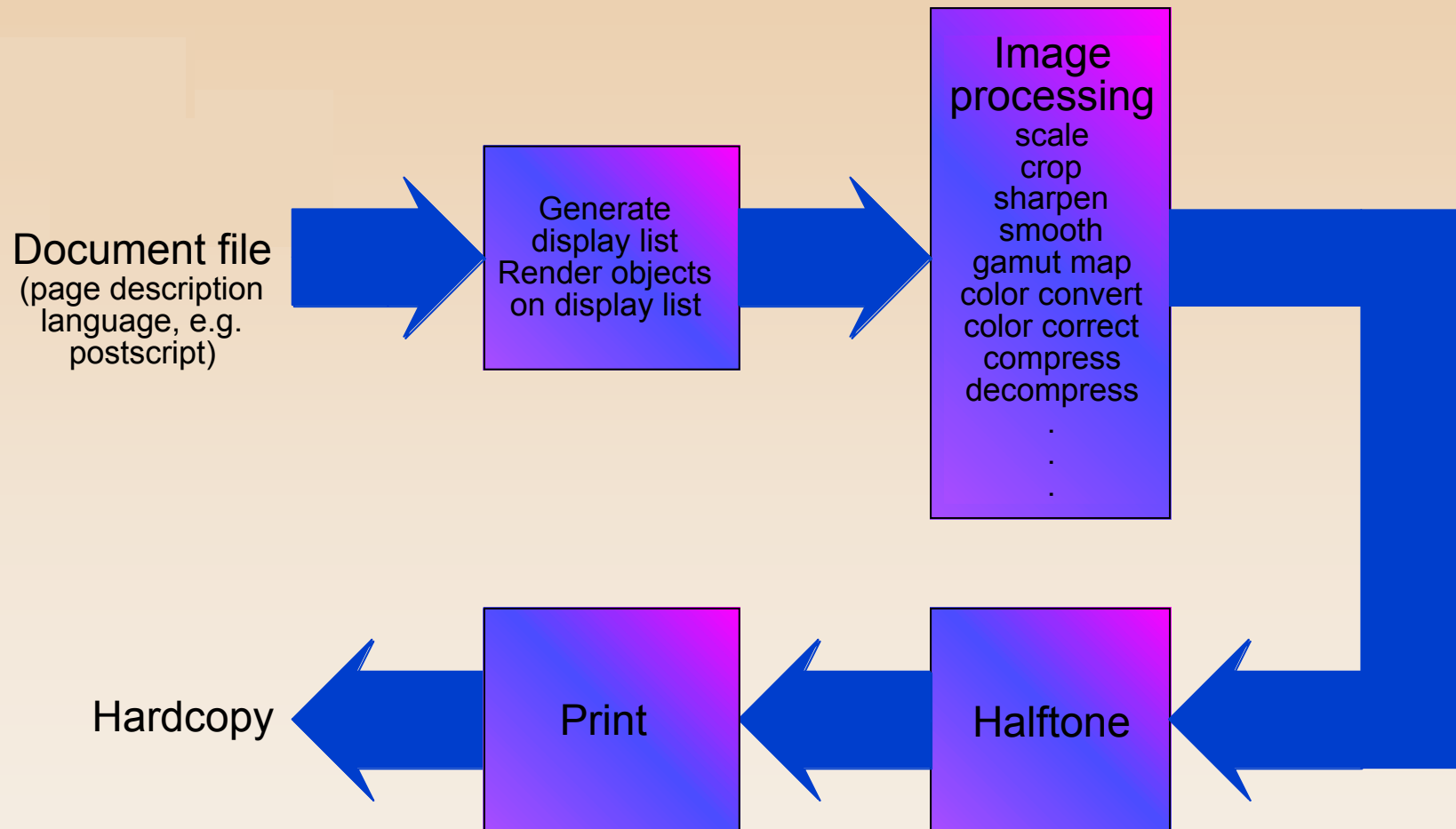
## Four areas of opportunity

- Raster image processing
  - ◆ Text
  - ◆ Graphics/line art
  - ◆ Images
- Image rendering
- Artifact recognition
- Image processing for proofing
  - ◆ Emulate press on display or local printer
  - ◆ Show characteristics of target press
  - ◆ Hide limitations of proofing device

# Raster image processing (ripping)

- In order to print a document, we must transform from a high-level page description language (postscript or PDF) or document description language (PPML) to a raster image suitable for the printer (hardware-ready bits)
- At 800 dpi, a single 8.5"x11" page contains 60 M pixels
- Printing at 67 ppm, we must process 66 M pixels/sec
- What do we have to do with each of those pixels?

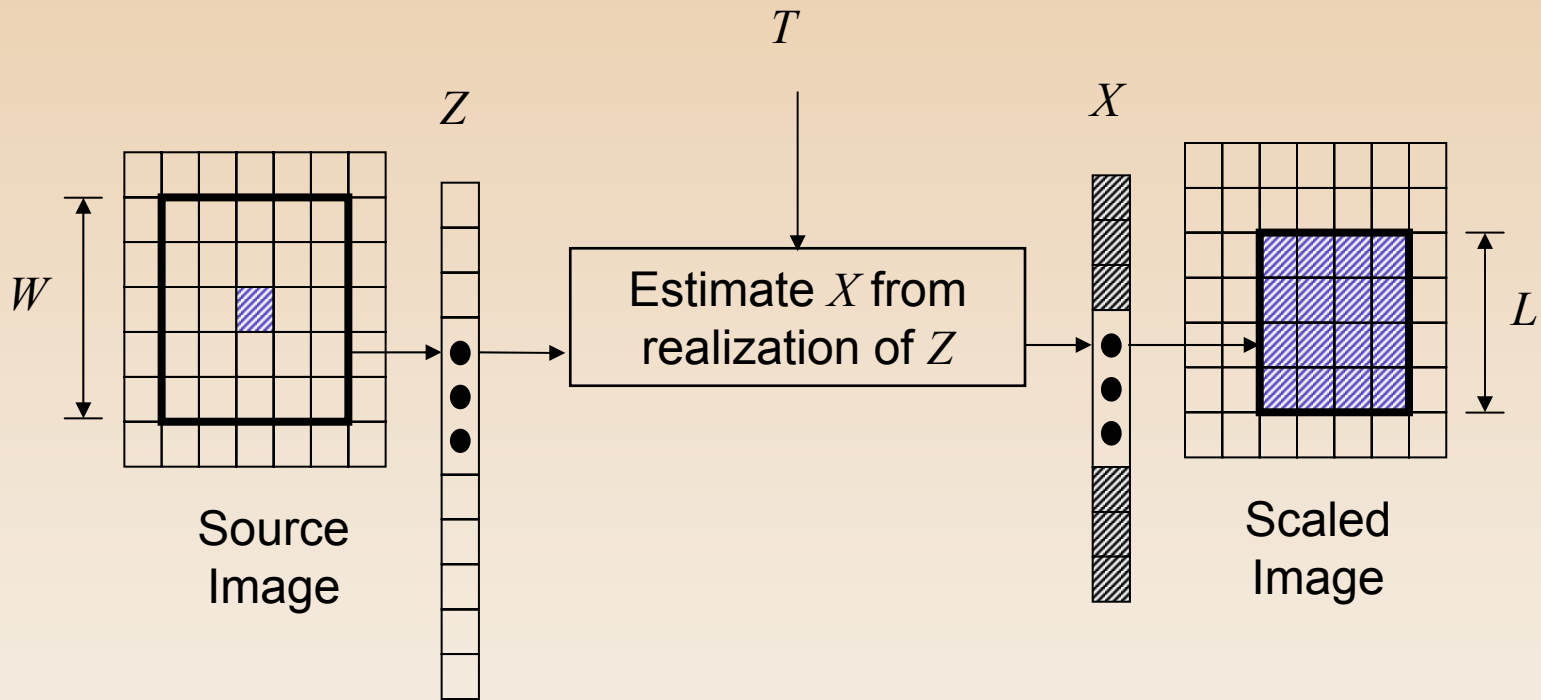
# Imaging pipeline for digital printing



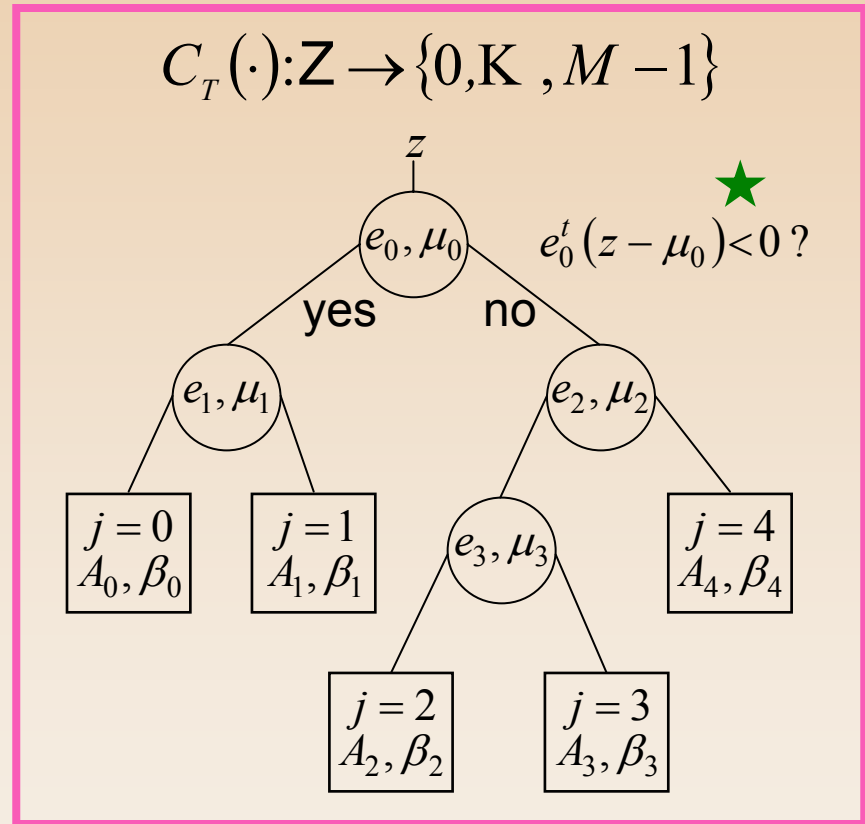
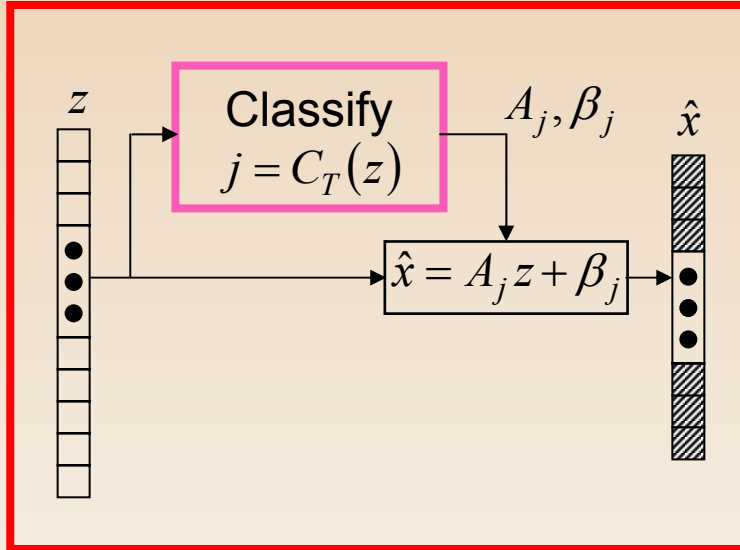
# If we can do it in a \$500 desktop printer, what is the big deal?

- Need higher speed
- Must deliver higher quality – no shortcuts
- Must handle wider range of content
- Opportunity to push the envelope for image quality

# Pushing the envelope: Optimal image scaling by tree- based resolution synthesis



# Structure of estimator



# 4X scaling results



Photoshop Bicubic Interpolation

Tree-Based Resolution Synthesis

# Pushing the envelope: digital halftoning

- Point processes - screening
- Neighborhood processes - error diffusion
- Iterative processes - direct binary search (DBS)



DBS screen



Error diffusion

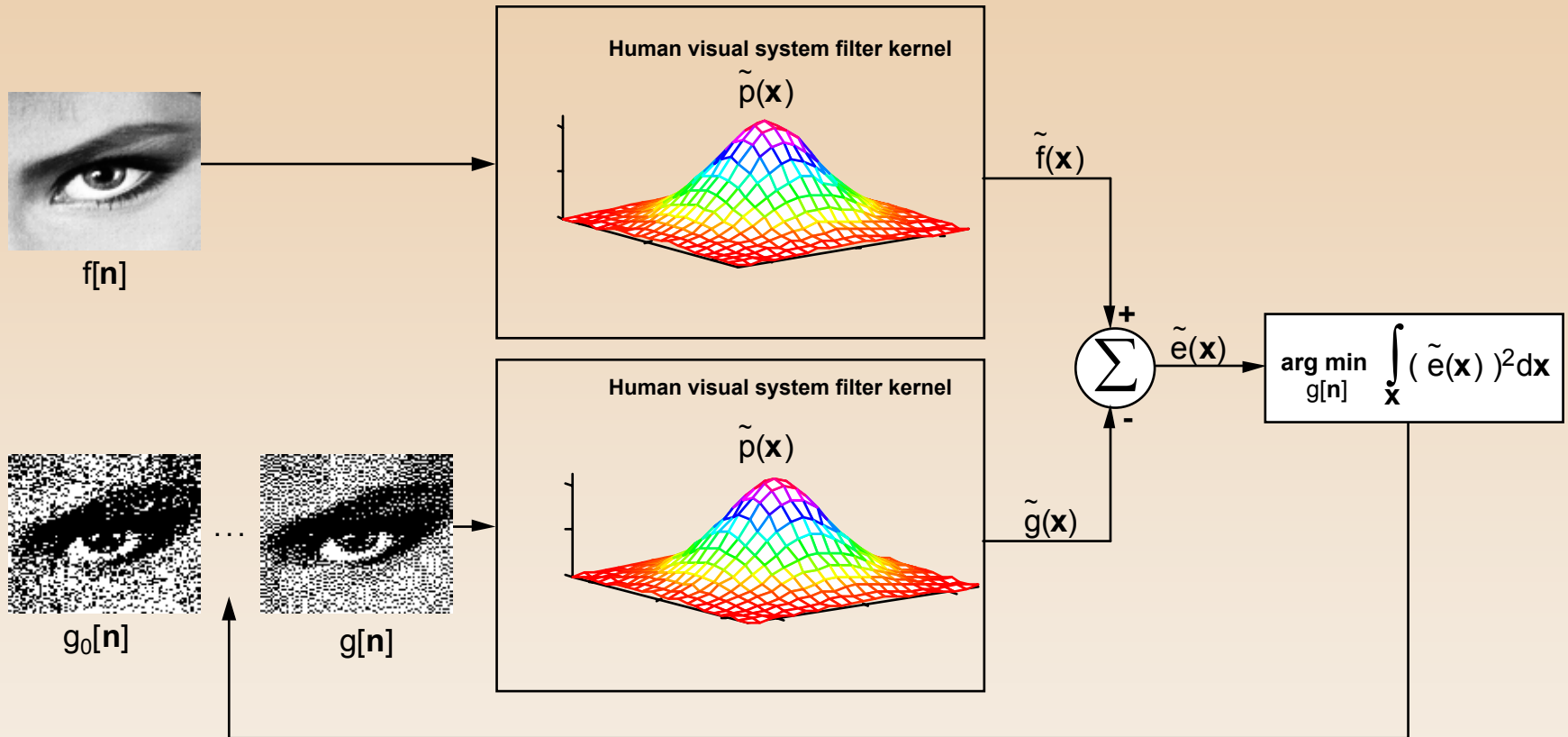


DBS

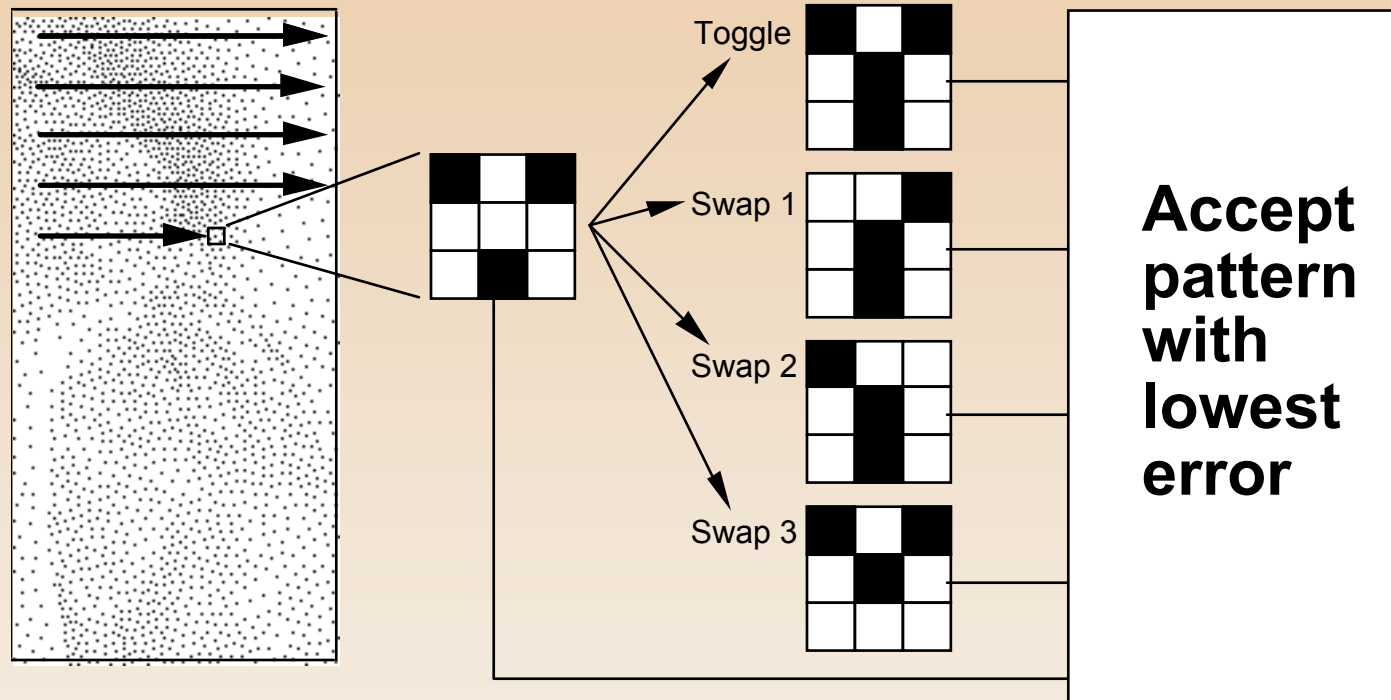
Increasing complexity 

Increasing quality 

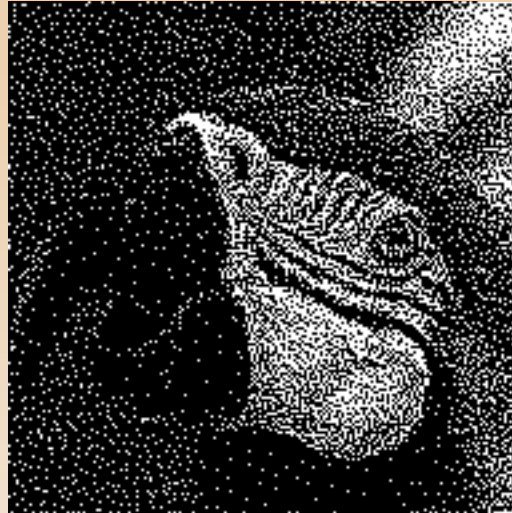
# Direct Binary Search



# The Search Heuristic



# DBS Convergence: 0, 1, 2, 4, 6, and 8 Iterations



# A use case: NAMI West Central Indiana

- Small, struggling, but forward-looking, “start-up” not-for-profit organization in Lafayette, Indiana.
- Mission is to help those afflicted by serious mental illnesses and their families, to educate the community about the nature of serious mental illnesses, and to transform the mental health care system.
- Mailing 2 pieces/month to 1200 addresses – database of 2500 contacts.
- Printing with an HP LaserJet 8550 (6 pages/minute 4-color).

# NAMI WCI monthly mailings



December 2003

## Community Efforts

### Unprecedented Partnerships Key to Improving Referral Network



Chico Hatke, Lafayette Police Department, is one of a group of 48 spearheading improvements to our mental health referral network.

Wabash Valley's community support program, the Crisis Center, nurses on staff at the jail and law enforcement committed to helping those with mental illness were among positives identified in two NAMI-facilitated fall discussions reviewing our local mental health network.

Across the more than 40 participants targeted for improvement included resource coordination, short-term crisis intervention, ease of entering the system and addressing multiple diagnoses, among others.

#### Unified Goal

"People from all different aspects of the mental health industry came together to talk about how to make the whole system better," reports Chico Hatke, Lafayette Police Department. "That made great strides."

Participant Marilyn Mandersak agrees. "I was encouraged by the number of people who recognize the problems mentally ill people and their families are faced with and the eagerness many displayed for modifying the system currently in place."

A profile of that system—a three-page flow chart tracking how patients enter the system—provided a striking visual of the current complexity, and results from a stakeholder survey offered starting discussion points (see sidebar).

#### Next Steps Underway

The October and November sessions were a good beginning, says Teri Bishy, Tipppecanoe Villa director. "It's very important that as a community we're working together. I'm very encouraged."

Bishy is among those who signed on to take a two-pronged next step. She's serving on a committee that's designing a psychiatric-emergency response system. A second group is developing a web-based information system to improve access and coordination of care, also identified as a priority by the President's New Freedom Commission on Mental Health.

"One of the most exciting developments was a call for unprecedented partnerships," says Cecilia Weber, NAMI executive director. "The consensus was that new links must be forged, be they public/private, family/professional or among care providers."



#### Resources

NAMI West Central Indiana Helpline: 423.6939, 24-hour voice mail  
Your call will be answered or returned by a family member or consumer volunteer.

NAMI Resource Center: 8 a.m. to 5 p.m., weekdays  
St. Elizabeth School of Nursing Building, Room 4-901  
Videos, audio tapes and printed materials available for loan.

#### Supporters Sponsors

NAMI West Central Indiana is a local affiliate of National Alliance for the Mentally Ill  
NAMI Web site: [www.nami.org](http://www.nami.org)  
NAMI Helpline: 1.800.950.6264

Support provided by Center for Mental Health Services

Nonprofit  
Organization  
U.S. Postage  
PAID  
Permit No. 623  
Lafayette, IN

#### What?

Next in the informative series of free public forums brought to you by the National Alliance for the Mentally Ill, West Central Indiana

#### When?

Thursday, April 15 (7-8:30 p.m.)

### "Assessing Suicide Risk"



Dr. Brian Primeau

#### Who?

Dr. Primeau will discuss various aspects of assessing suicide risk. He's held various posts at Wabash Valley Hospital for the last 25 years, the last five he's been director of the inpatient adult psychiatric unit. A graduate of the University of Michigan, Dr. Primeau earned his doctorate in clinical psychology at the University of North Carolina and interned at the Indiana University School of Medicine in Indianapolis.

Open discussion follows. Forum moderated by Allison Platt-Sloan.

For more information, call NAMI WCI  
765.423.6929

#### Where?

NAMI West Central Indiana  
The Community's Voice on Mental Illness

Reminder: Journey of Hope family support group will be held Monday, April 12 and Monday April 28, from 7:30 p.m. - 9:00 p.m. West Room West Lounge, St. Elizabeth School of Nursing Bldg, 1508 Tipppecanoe St., Lafayette. For more information please call 765.423.6929.

St. Elizabeth's School of Nursing Building  
1508 Tipppecanoe Street, Lafayette  
Room C-306

(Enter door that faces Tipppecanoe St. on south side of building, adjacent to parking garage; take elevator or stairs down one level)

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# How can high performance computing and the grid help NAMI WCI?

- Time and resources spent as an internal print shop could be better spent helping consumers and their families.
  - ◆ more effective tools for document processing workflow
  - ◆ viable options for outsourcing of printing while allowing involvement in creative process
- Better customization of mailings could more effectively connect to community and increase level of engagement and support.

**Thanks for your interest!**