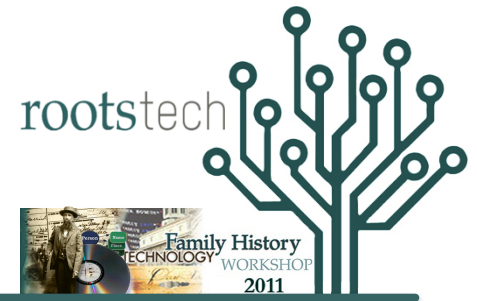


Family History Technology:



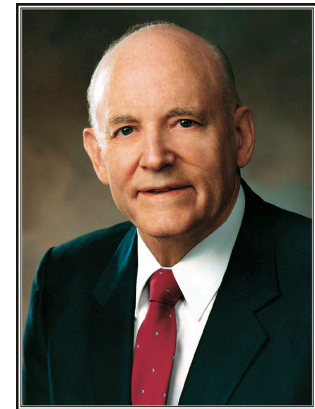
Where have we **Been?** ...
BEGUN

... and where are we **GOING?**

William Barrett
Department of Computer Science
Brigham Young University

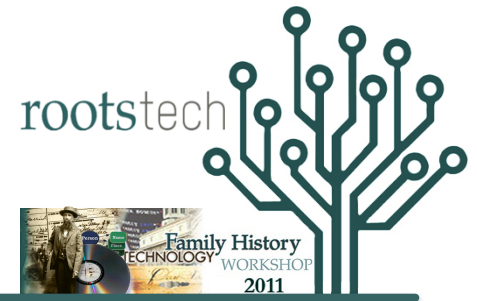
Family History Technology

“The Lord has guided the development of information technology and accelerated its role in work for the dead, and will continue to do so. However, we stand only on the threshold of what we can do with these tools. I feel that our most enthusiastic projections can capture only a tiny glimpse of how these tools can help us - and of the eternal consequences of these efforts.”



-President Howard W. Hunter, 100th anniversary of the Genealogical Society of Utah

Technology Milestones in Family History

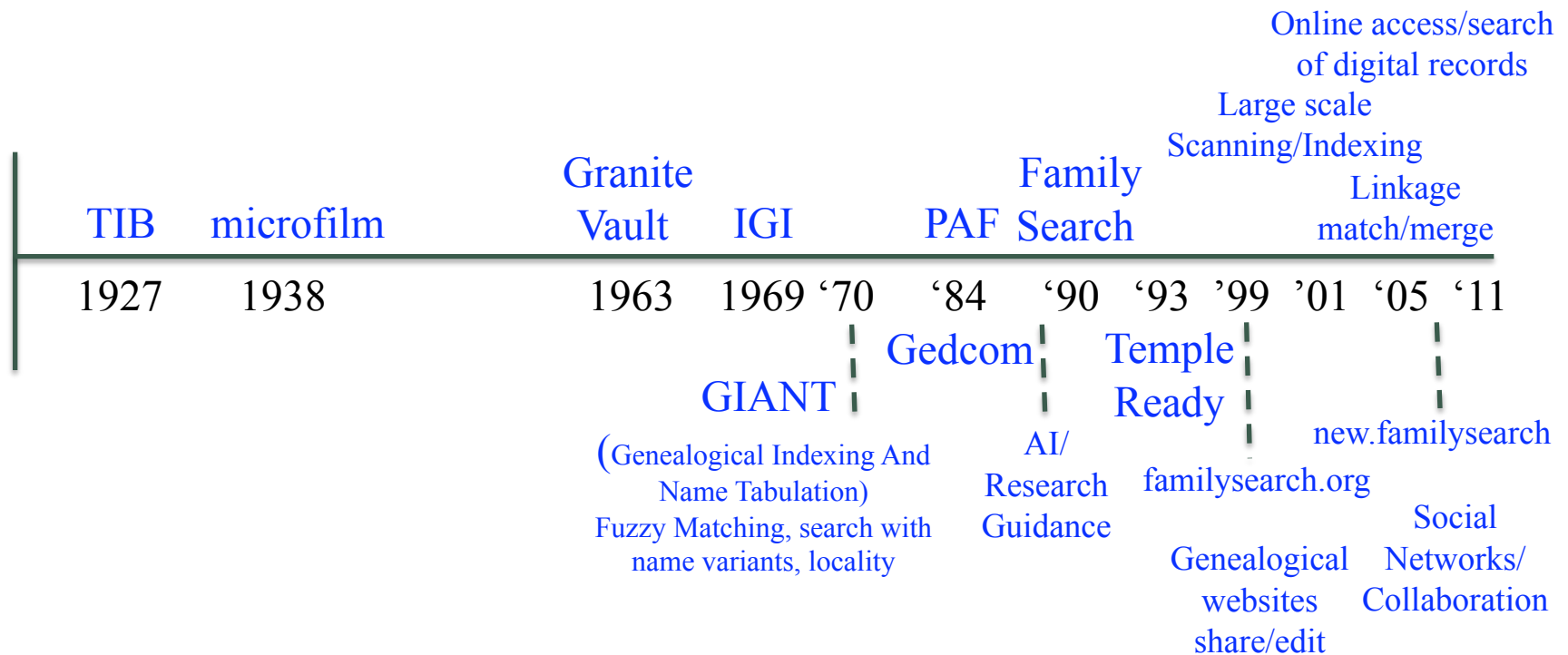


1927 1938 1963 1969 '70 '84 '90 '93 '99 '01 '05 '11

Past Century

A banner for the Family History Technology Workshop 2011. It features a collage of historical images, including a man in a military uniform and a woman in a historical dress. Overlaid on the collage are icons for a CD-ROM, a tablet, and a smartphone. The text "Family History TECHNOLOGY WORKSHOP 2011" is prominently displayed in the center.

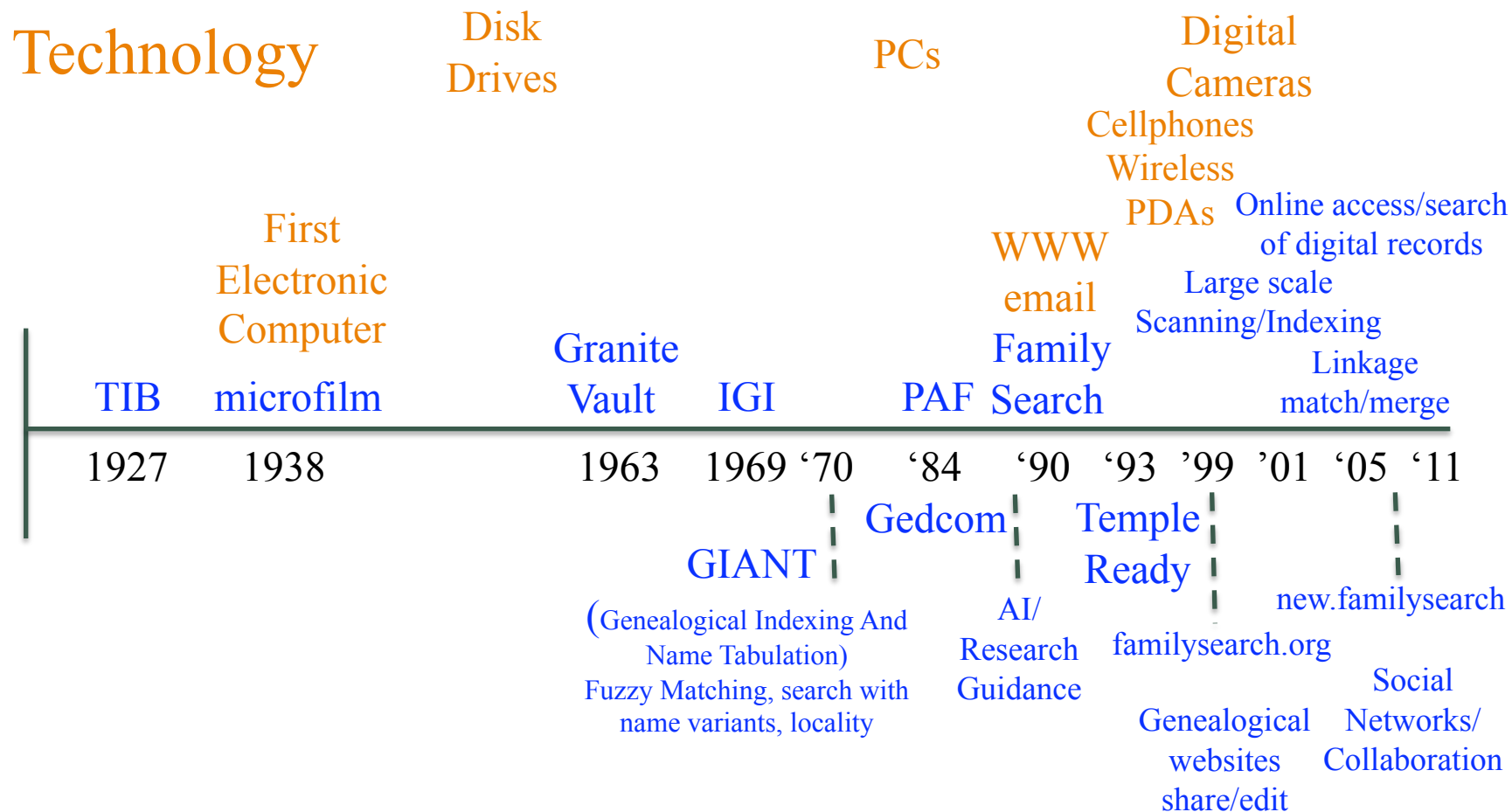
Family History



Technology Milestones in Family History



Family History

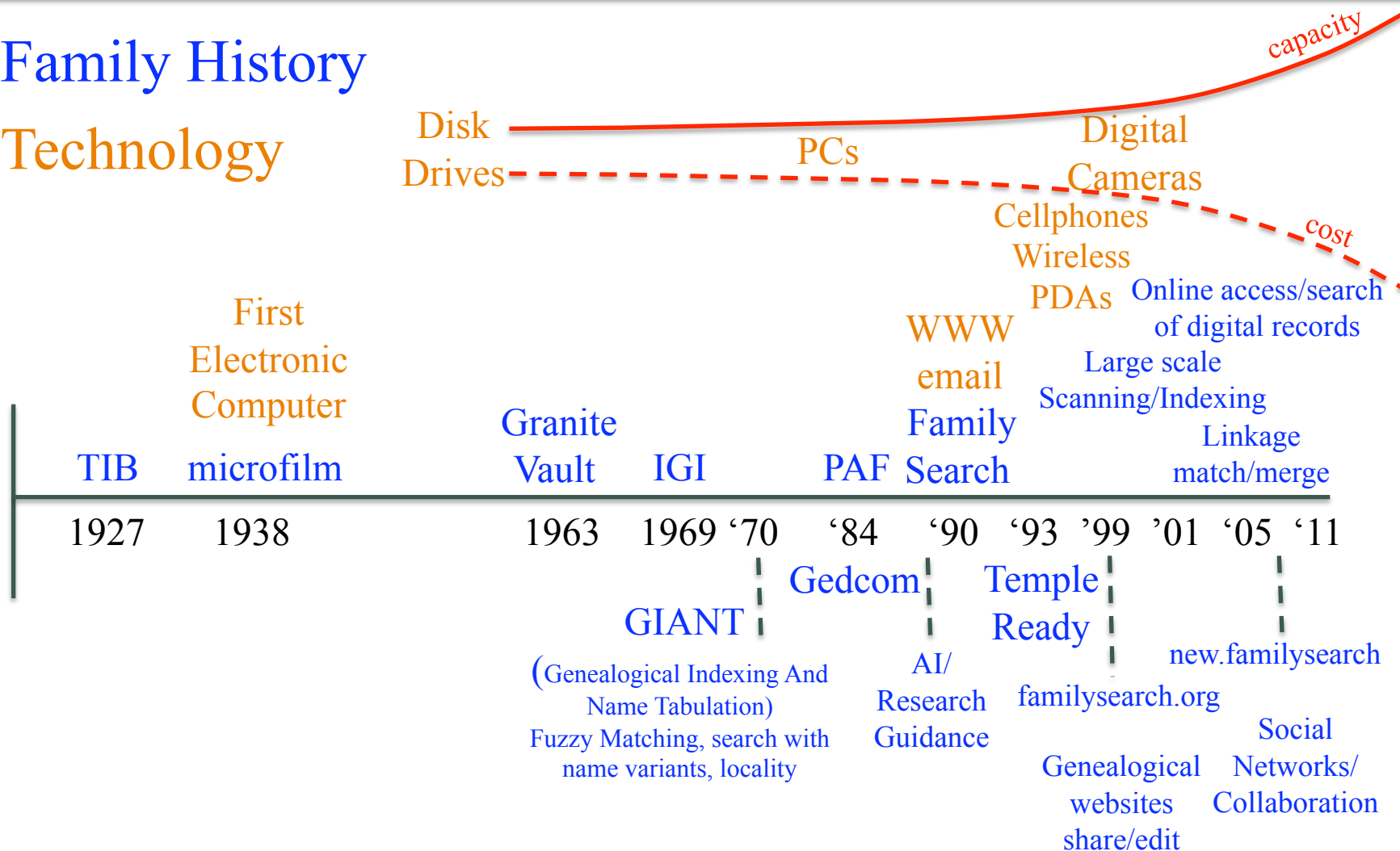


Technology Milestones in Family History



Family History

Technology

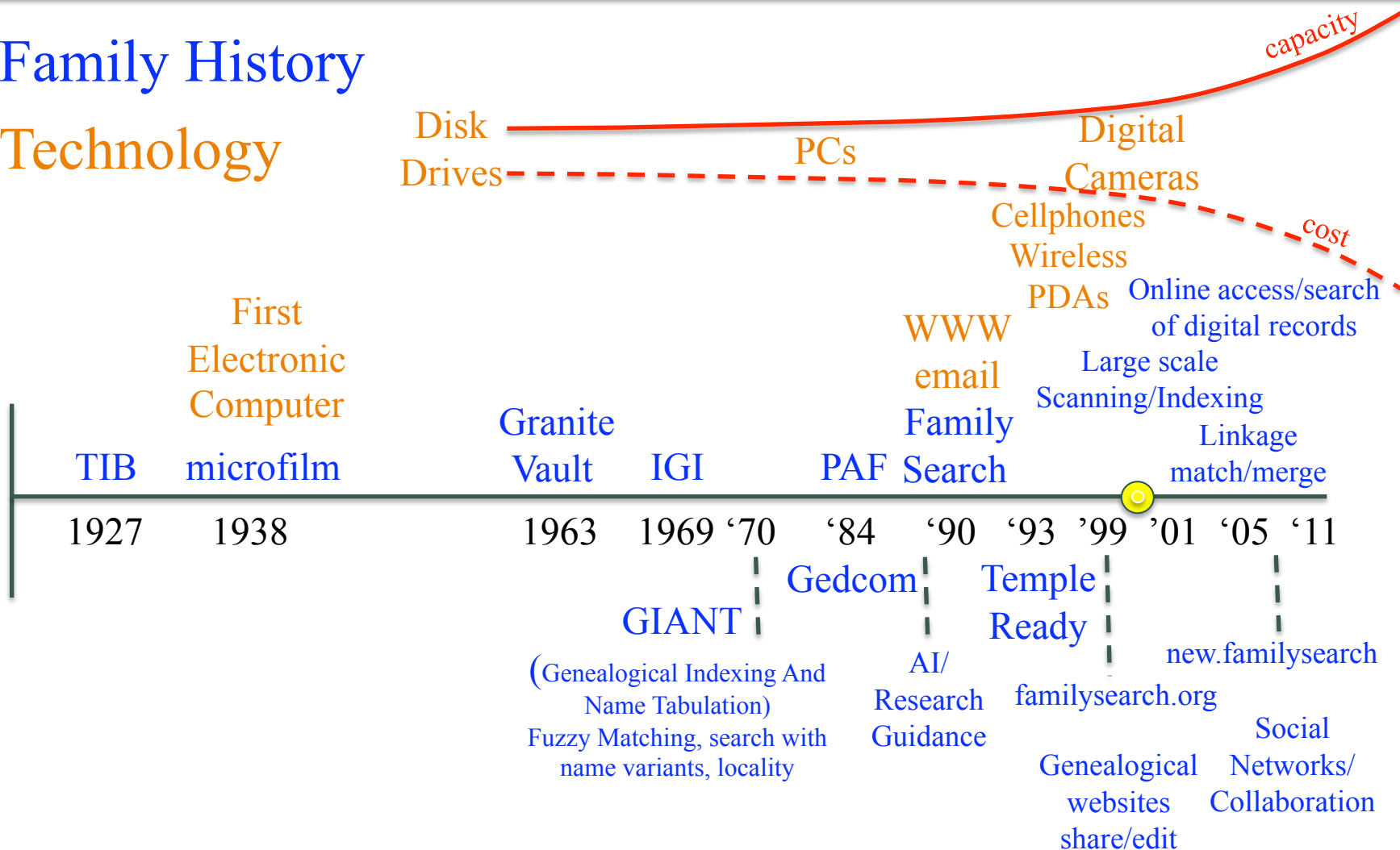


Technology Milestones in Family History

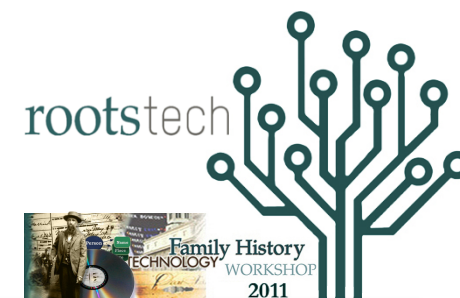


Family History

Technology

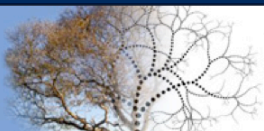


Family History Technology Workshop (fht.byu.edu)



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Related Conferences & Workshops

- [Computerized Genealogy Conference](#)
- [Annual BYU Genealogy & Family History Conference](#)

[Click here for information on the 2011 Conference](#)

10th Annual Workshop on Technology for
Family History and Genealogical Research

April 28, 2010
Salt Lake Convention Center



Current Technology Innovation in the CS Department

- [Digital Roots](#)
- [OnePage Genealogy](#)
- [Relationship Finder](#)

Important Dates

January 21, 2011
Papers Due

February 11, 2011
Day of Conference

Previous Workshops

- [2010](#)
- [2009](#)
- [2008](#)
- [2007](#)
- [2006](#)
- [2005](#)
- [2004](#)
- [2003](#)
- [2002](#)
- [2001](#)

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FAMILYSEARCH
WHERE GENERATIONS MEET

CONFERENCE ON COMPUTERIZED
FamilyHistory
& GENEALOGY

2010 LOCATION CHANGE
SALT PALACE, SALT LAKE CITY
With the National Genealogical Society Conference

Conference on Computerized Family History and Genealogy | Other Family History Programs | BYU Conferences and Workshops

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Related Items

- Family History Technology Workshop
- FamilySearch Developers Conference
- Genealogy & Family History Conference

Tools

- Tell a Friend

SHARE

Announcement

Brigham Young University is pleased to participate with FamilySearch in redesigning three former conferences, the Conference on Computerized Family History, the Technology Workshop and the FamilySearch Developers Conference, all together and offering even more to those interested in the important work of family history.

[More info about RootsTech...](#)

The new conference will be called **RootsTech** and will be held **February 10-12, 2011** at the Salt Palace in Salt Lake City.

Join the [Mailing List](#) to stay informed about BYU Genealogy Conferences.

You can also view the previous [2010 Conference on Computerized Family History and Genealogy site](#)

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Family History Technology Workshop

Click here for information on the 2011 Conference

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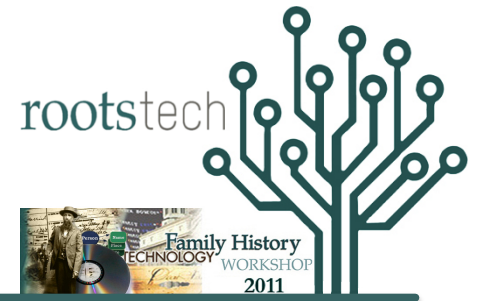
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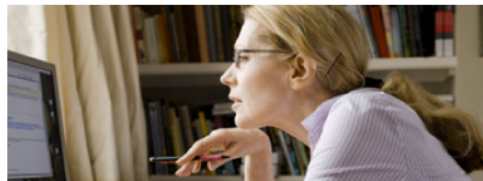
Users + Implementers + Creators = Rootstech



Technology Users



Technology Implementers



Technology Creators



Advances (FHTW today)

- Record Match – Patrick Schone
Evaluation/merge – precision/recall - useable
- Historical Social Networks – Doug Kennard
History by association (Ancestral Pioneer Past – 1997)
- Record Linkage – Randy Wilson
Machine Learning Algorithms
– improves with data, large training sets, features
- Folk Date Pattern – Justin Selliger – user-friendly date range input
- Deep Zoom (Pivot) – Engh, Gehring
Intuitive, interactive, visually explore, browse, cull large
data corpus, including photos
- Preserving, promoting perpetuating innovation, solutions, challenges:
“Competition” – Luke Hutchison

Advances (Beau Sharbrough)

- availability of records
- innovative linking of records

2 trees link to same vital record

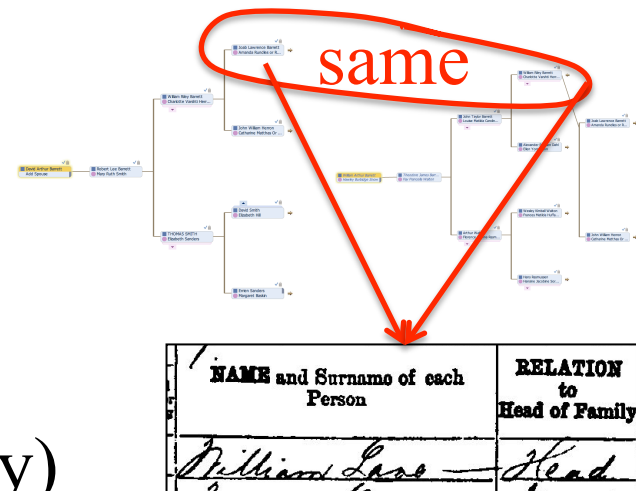
⇒ same person

(Ancestry's “shaky leaf” technology)

- Family History site-building technologies (TNG)
- Knowledge Base of Records

+

Individual Tree Information



Research Task List

(GenSmarts)

Advances (Dallan Quass)

- Matching people in family trees with records
- Large-scale, accessible infrastructure for collaboration and social networking
 - Facebook, Twitter, Google Wave
- Increased access to genealogical information
 - Billions of searchable records ([Ancestry](#), [FamilySearch](#))
 - Increase in number of microfilms indexed (“ ”)
- Genealogy Wiki's for sharing of information:
 - [Wiki.familysearch.org](#), [WeRelate](#)

Advances (Heath Nielson)

- Interactive Genealogical Websites where content can be changed, added to and shared)
- Increased access to source records
- Increased storage capacity and bandwidth enabling the scanning, storing and serving of records across the Internet

Advances (Kirk Duffin)

- Online searching and browsing through
 - Hierarchical digital image transmission
 - Automatic scanning and processing of microfilm
 - Associated storage technologies
- Progress in automatic matching / merging
- Human-assisted computing where full automation is not yet possible (e.g. handwriting, speech recognition)

Advances (Jack Reese)

- Scanning, storage, indexing and search technologies:
lowered cost, time => increased productivity, success
- Digital imaging (high-speed, high-res, low-cost replacing – film-based technologies)
- Bandwidth (high-speed, low-cost, last-mile to in-home delivery – replacing trips to archives, libraries, etc.)
- Search engines (aggregate and make searchable collections previously fragmented and distributed around the world)
- Hinting (finds and suggests likely matching records automatically showing connection to existing tree)
- Social networking (collaboration, quickly learn what has been done, less duplication and reinventing the wheel)

Advances (Alan Eaton)

- Single, unified, online family tree wherein everybody's view is sharable and preserved (OGF)
- Images tied to indexes
- Source standardization
- Mass digitization of records
- Indexing utilizing the masses
- Velocity of indexing
- Cloud computing concepts
(including GenealogyCloud.com)

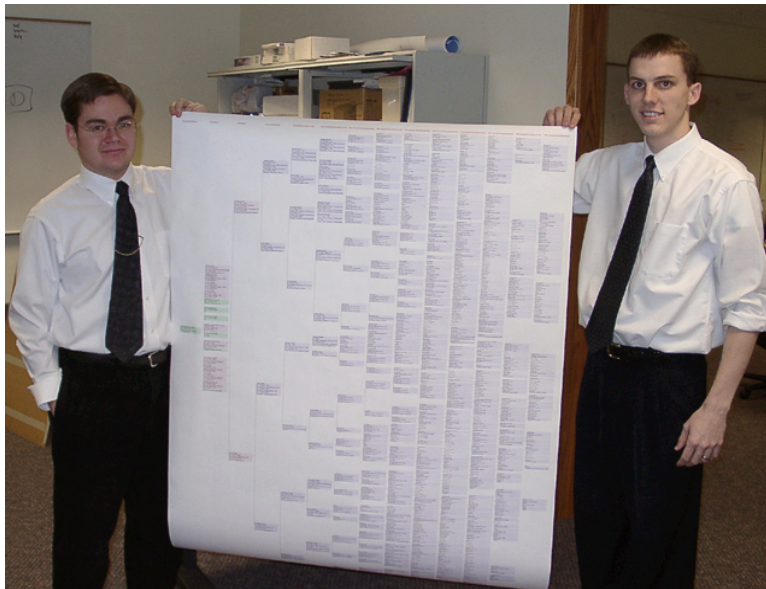
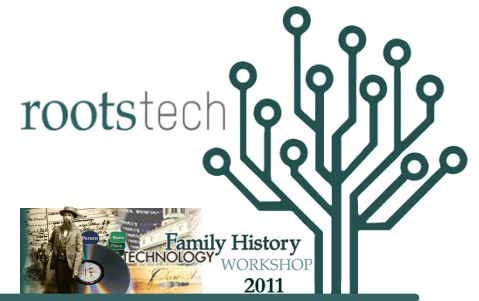
Advances (Bill Harten)

- **Key Advances (That We Have Yet To Take Advantage Of)**
- Affordable storage and delivery infrastructure for evidence images
- The union of LDS official ordinance records with extended linkage
- Research guidance tools to help researchers select the best source for their research objective

Advances (FHTW)

- Transliteration of non-roman text – Lonsdale
- Automating Exposure for Microfilm Scanning
– Nielson, et al (Scanstone)
- Machine-learning, neural net: Record Linkage, matching
– Giraud-Carrier, Pixton
- Social Networks for Family History – Giraud-Carrier
- Geo-Location Personal Names – Brown, Lonsdale
- WeRelate.org World's largest genealogical wiki – Quass

www.onepagegenealogy.com



14-generation pedigree
on 1 page

Relative Finder

(<http://roots.cs.byu.edu/digroots/>)



Relative Finder

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username:

password:

Login

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Welcome to Relative Finder(Beta)!

Relative Finder can tell you how you are related to prophets **are undergoing some updates**

Haven't used the site before? [Click here](#)

Relatives of William Barrett *****

Kimball: Becky's FFFFFFFF = your MFFMFFFFFP = R. KIMBALL(1595,England); U. SCOTT(15

Lund: Ryan's MMFFMFFMMFMP = your MFFFFMMFMMP = D. BAXTER(1626,Massachusetts); E. (16

Larsen: Alan's FFMFMFP = your MMFFFF = C. JACOBSEN(1732,Denmark); K. JORGENSEN

...

******* Relatives Among the Prophets:**

Smith: Joseph's FFFFMP = your MFMMMFMFMMP = T. FRENCH(1608); M. SCUDAMORE(1612,Eng

Young: Brigham's MFMMMFP = your MFFFFMFFFF = F. PEABODY(1613,England)

...

Packer: Boyd's MMFFFF = your MMMFMFF = A. ANDERSSON(1730,Sweden)

...

Kimball: Heber's FFFFFP = your MFFMFFFFFP = R. KIMBALL(1595,England); U. SCOTT(15

...

William Barrett, you are of royal lineage. Here are some of your royal ancestors.

Henry III (1206-1272) King Of ENGLAND is your 21st greatgrandfather.

Louis VIII "the Lion" (1187-1226) King Of FRANCE is your 22nd greatgrandfather.

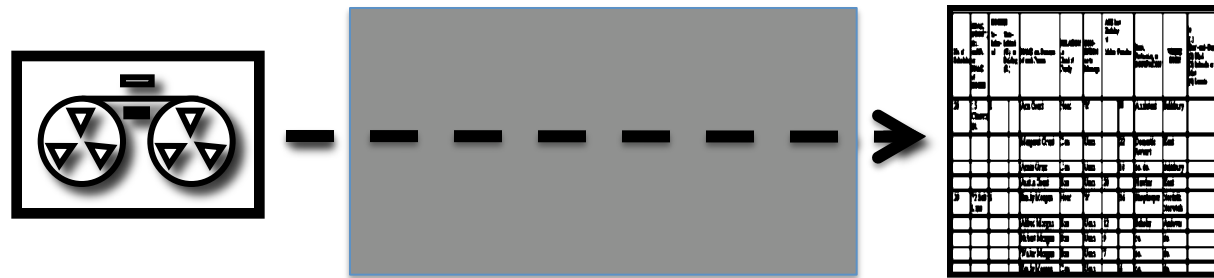
Phillipp II (1176-1208) King Of GERMANY is your 23rd greatgrandfather.



You are participating in the beta test of **Relative**
[click here to give us feedback.](#)

Find out how you are related to your friends and many other famous people, leaders, kings, queens, etc.

The Digital Microfilm Pipeline*



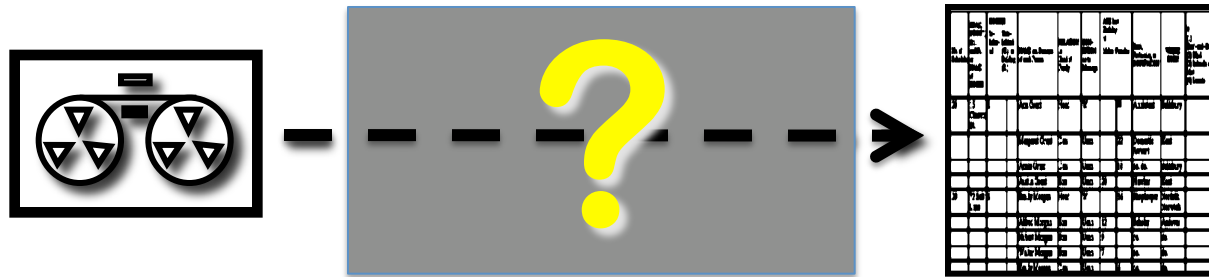
Film
in

Searchable
Text Out

* Ty Davies, Jake Gehring

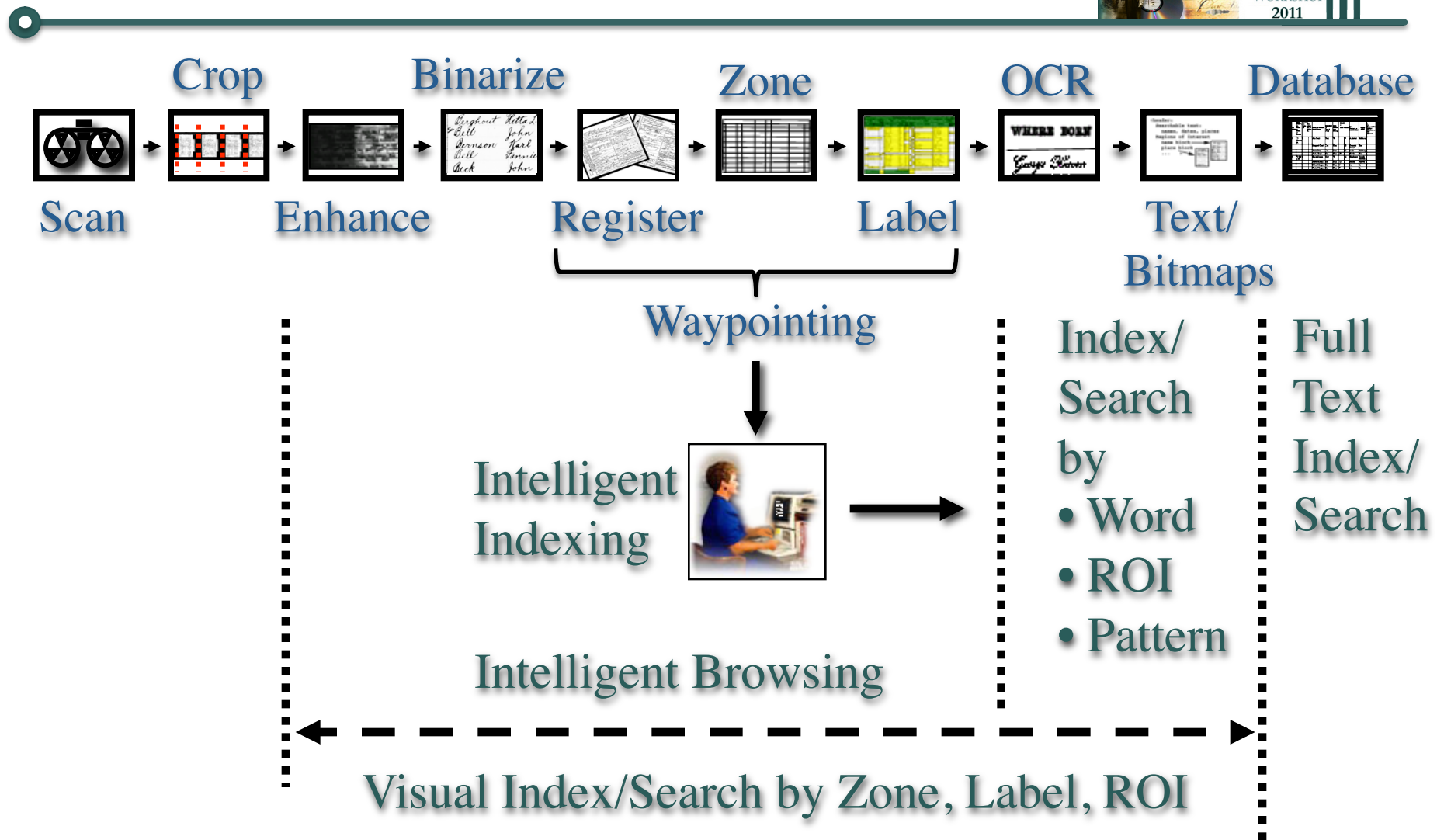
The Digital Microfilm Pipeline

What's inside
the box?

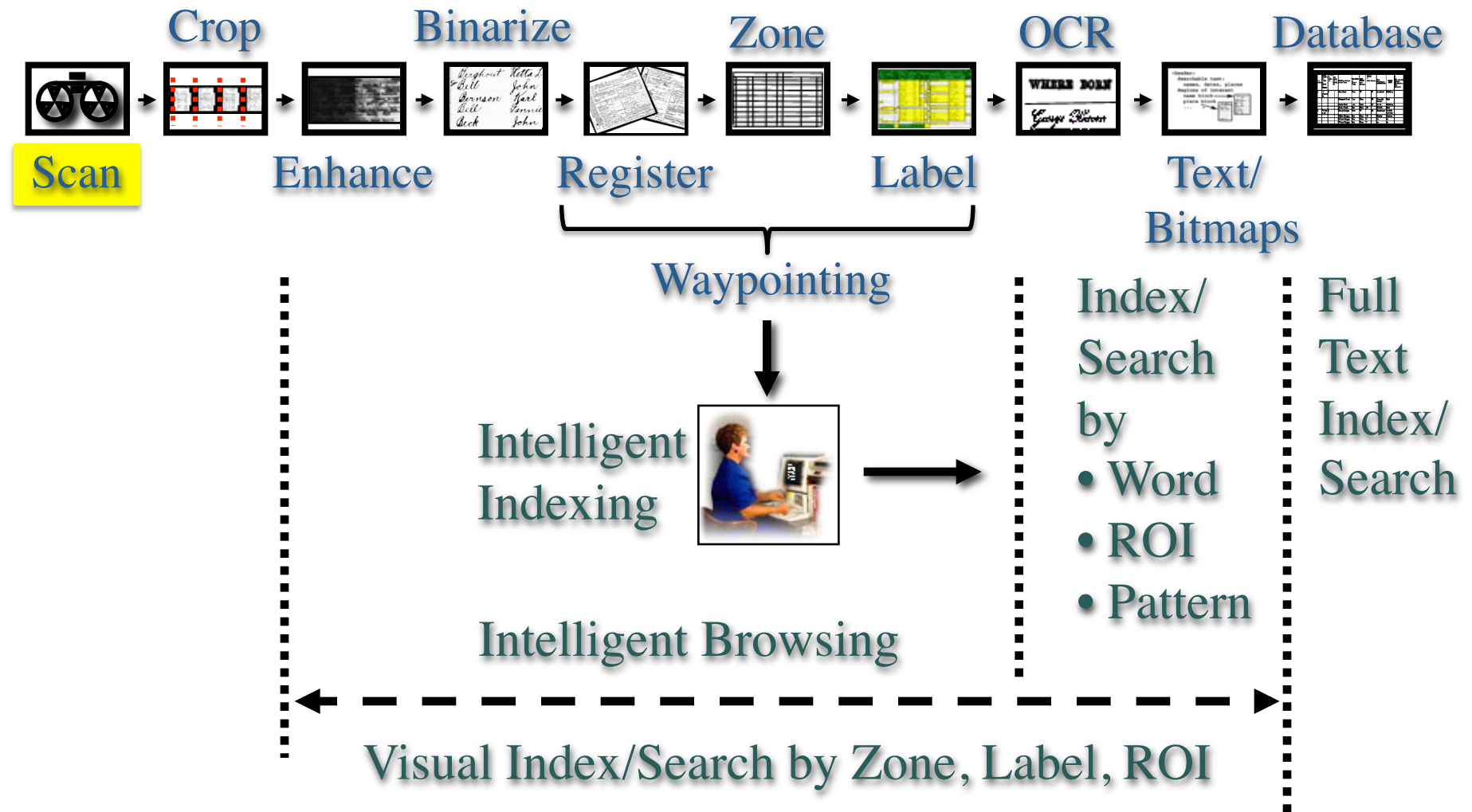


What processing steps have to happen
in between?

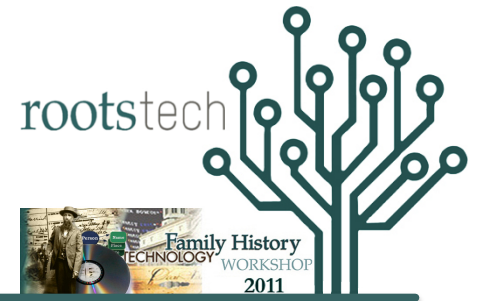
The Digital Microfilm Pipeline



The Digital Microfilm Pipeline



Scanning the Granite Vault



2.5 Million rolls of microfilm

~ 1300 images per roll

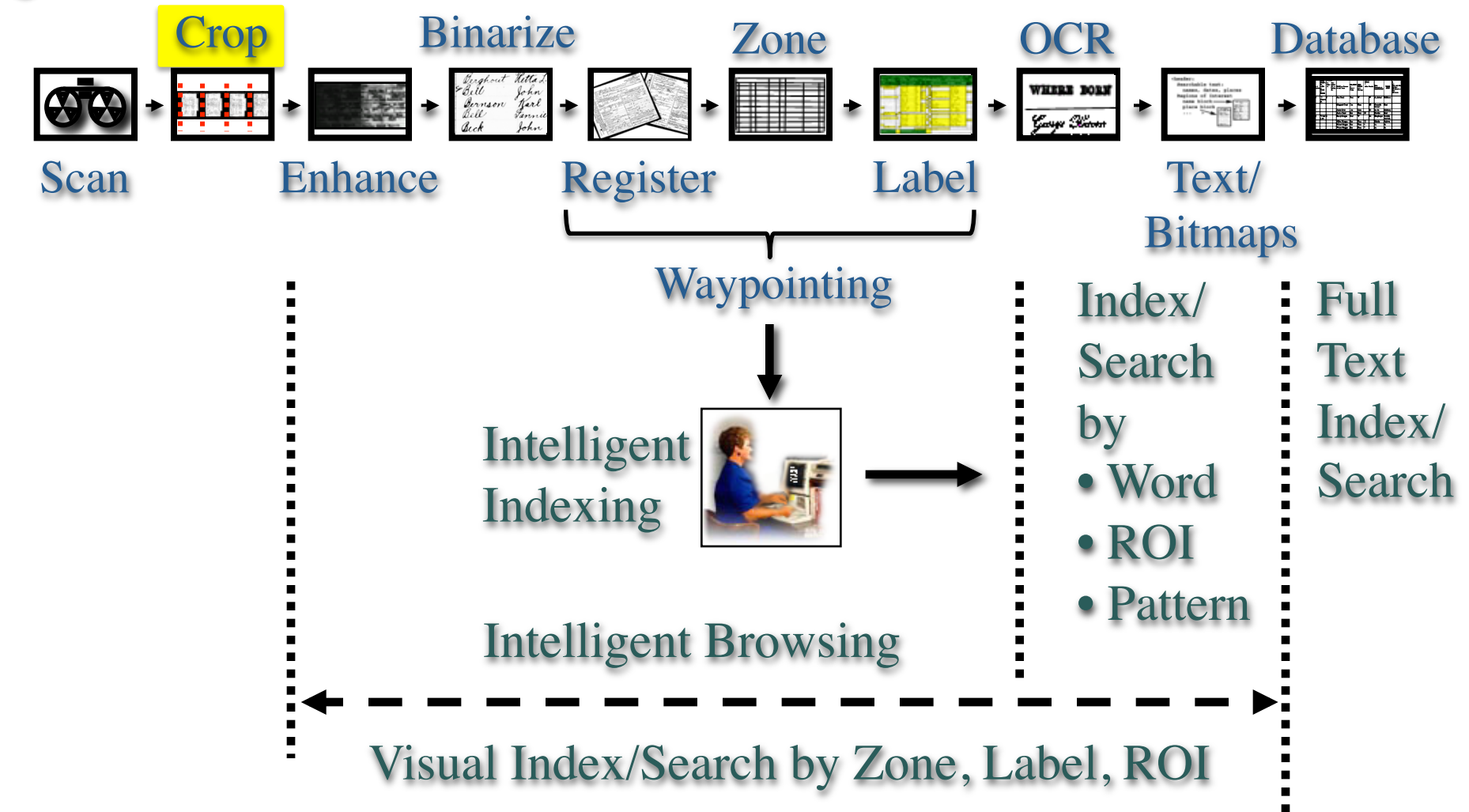
Up to 25 Megabytes per image

$1300 \times 25,000,000 \times 2,500,000$

$= 81.25 \text{ Petabytes}$



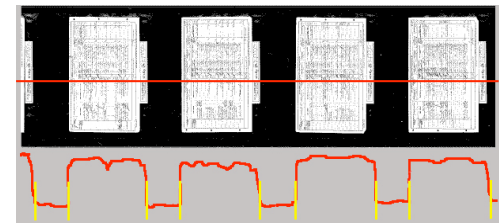
The Digital Microfilm Pipeline



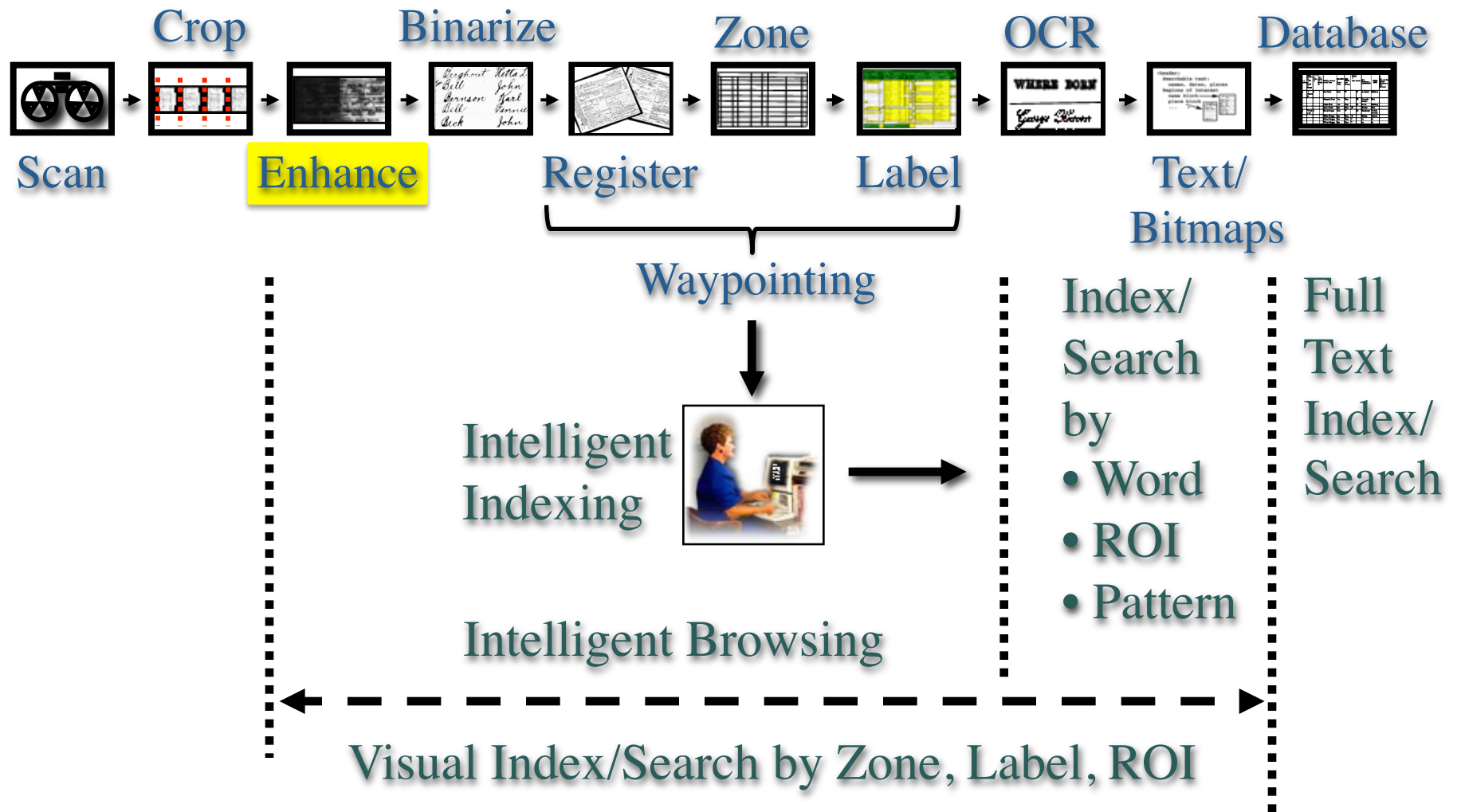
The logo for the Rootstech Family History Technology Workshop 2011. It features the word "rootstech" in a teal, lowercase, sans-serif font. To the right of the text is a stylized tree graphic where the branches are composed of circuit board traces, and the leaves are represented by small circles. Below the main text, there is a smaller rectangular image showing a man in a suit and hat standing next to a large, colorful, abstract graphic that resembles a DNA helix or a stylized letter 'G'. Overlaid on this smaller image is the text "Family History TECHNOLOGY WORKSHOP 2011" in a serif font, with "Family History" in a larger size and "TECHNOLOGY WORKSHOP 2011" in a smaller size below it.

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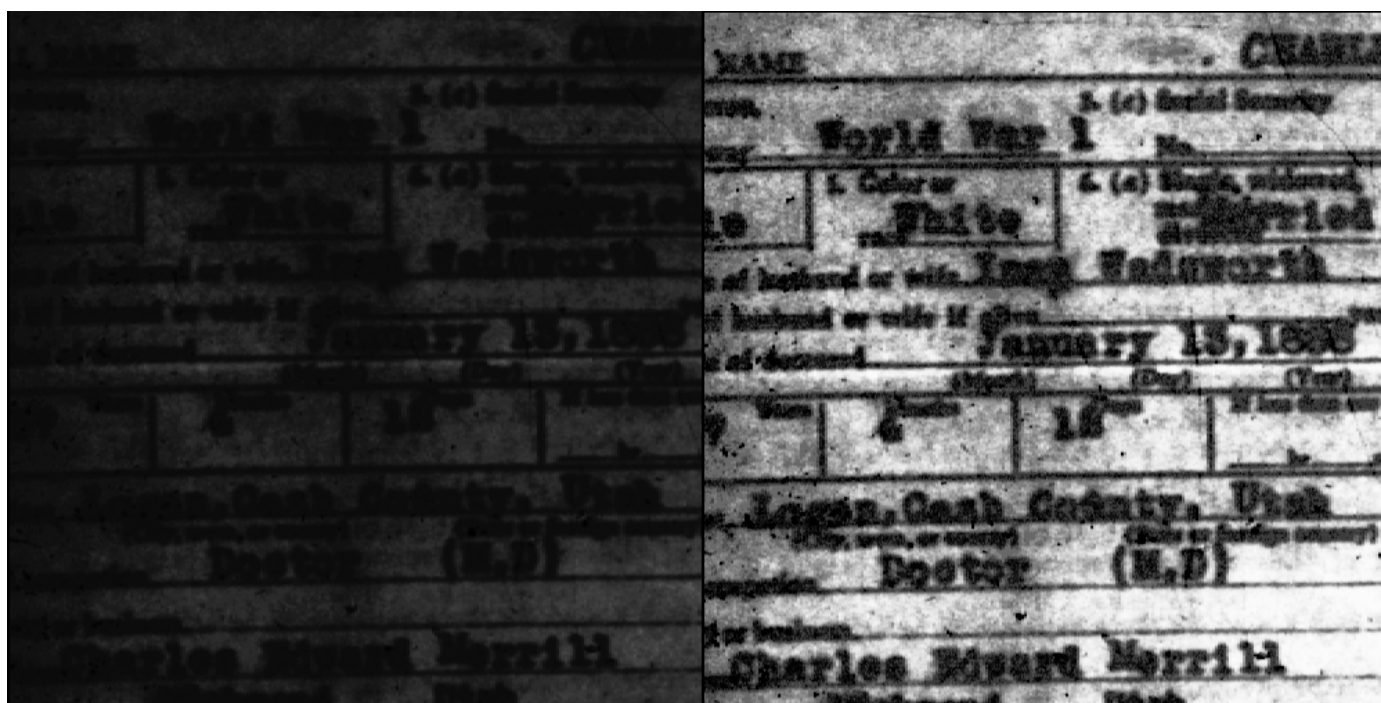
- Scan continuously in Ribbons →
- Crop in batch, exploit consensus →



The Digital Microfilm Pipeline

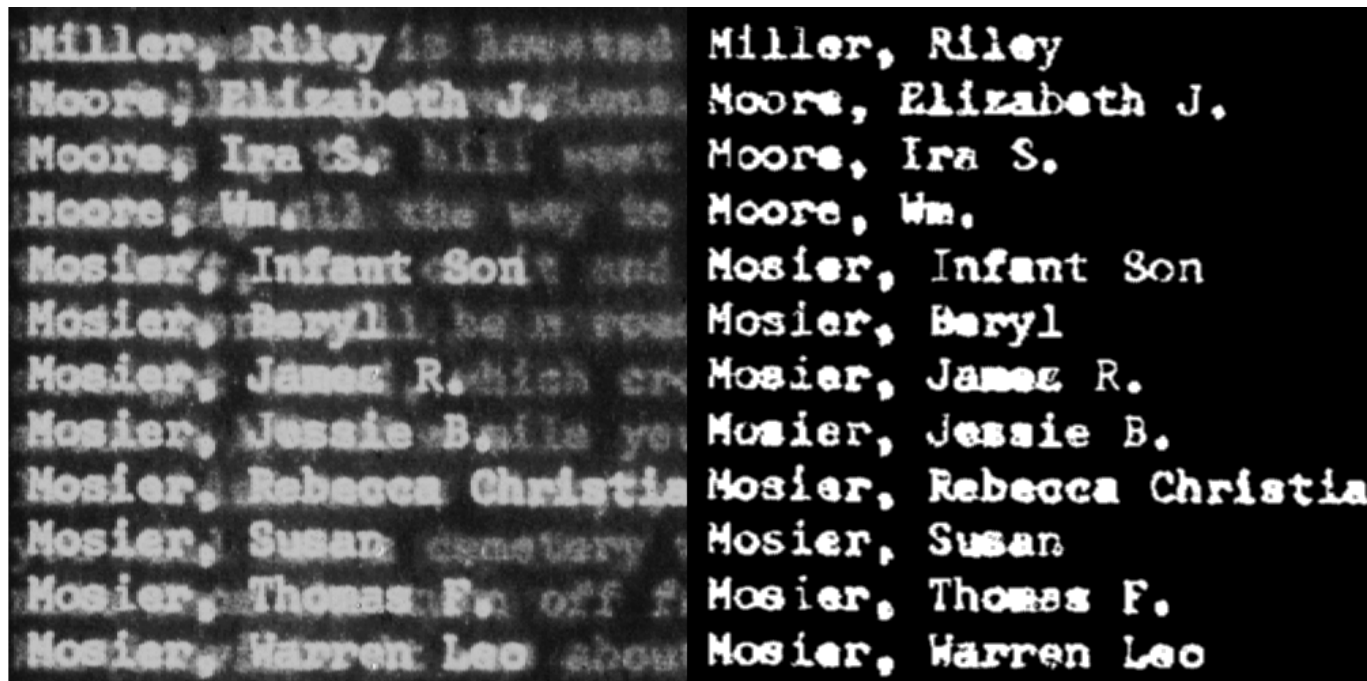


Histogram Enhancement



(Left) Original scanned record (Right) After Enhancement

Threshold Enhancement



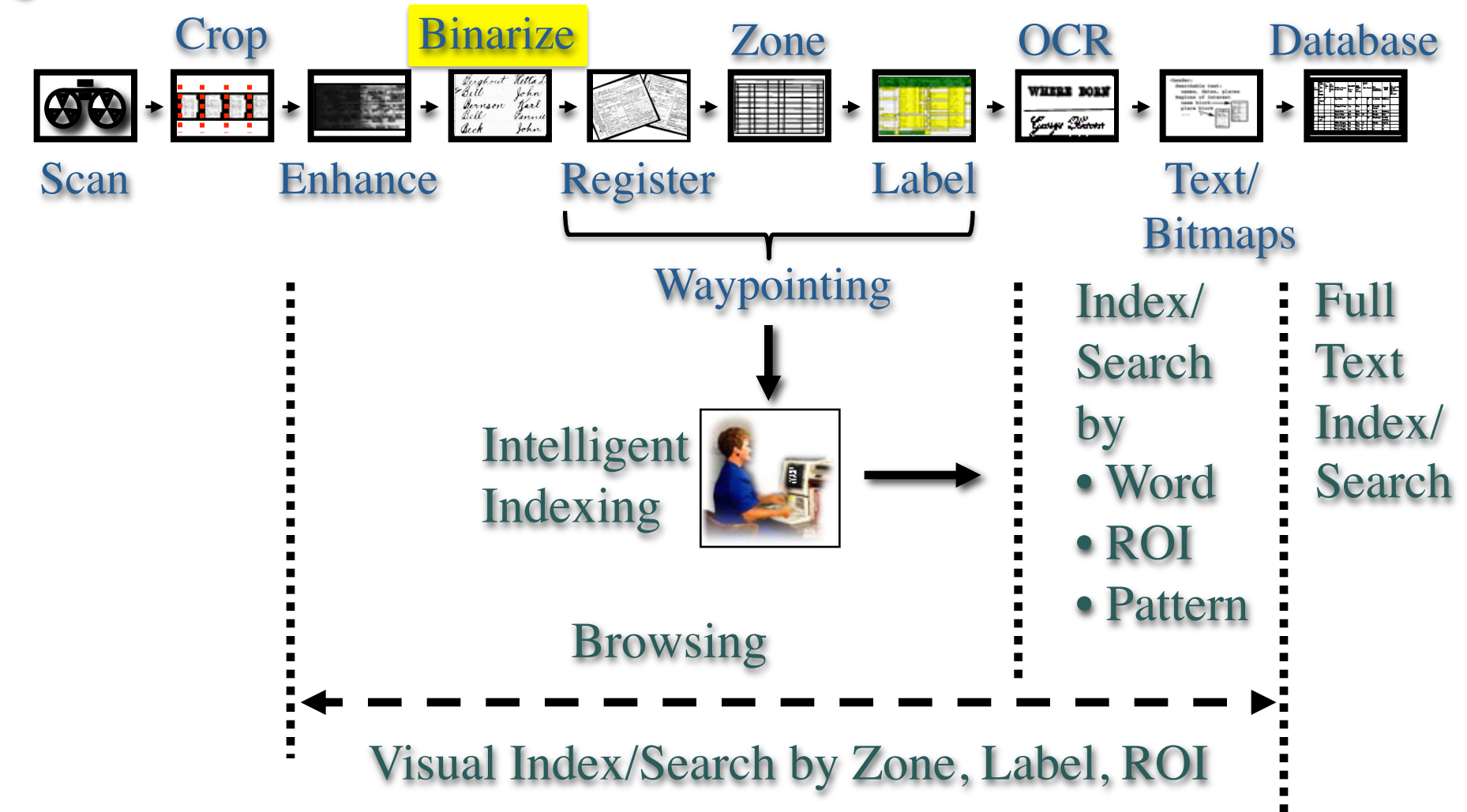
(Left) Original scanned record (Right) After thresholding for Bleed-through removal, with Enhancement, and Antialiasing

Stroke Enhancement

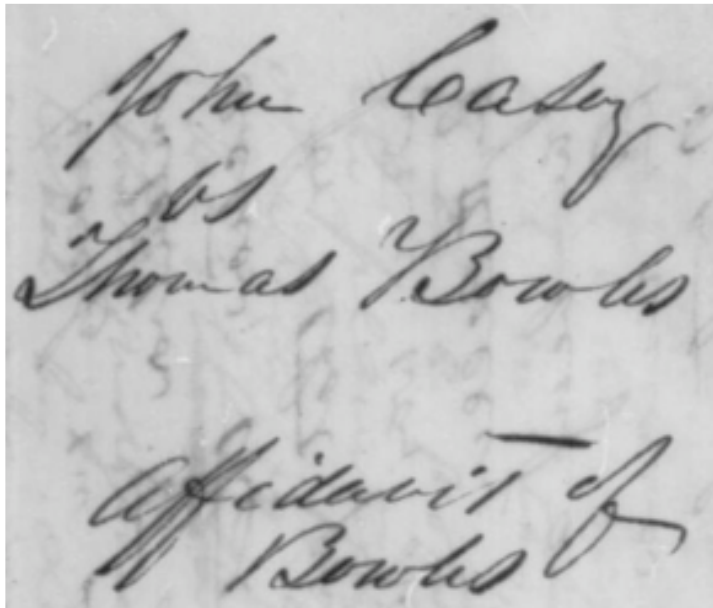


(Left) Original scanned record (Right) After
Matched Filter Stroke Enhancement

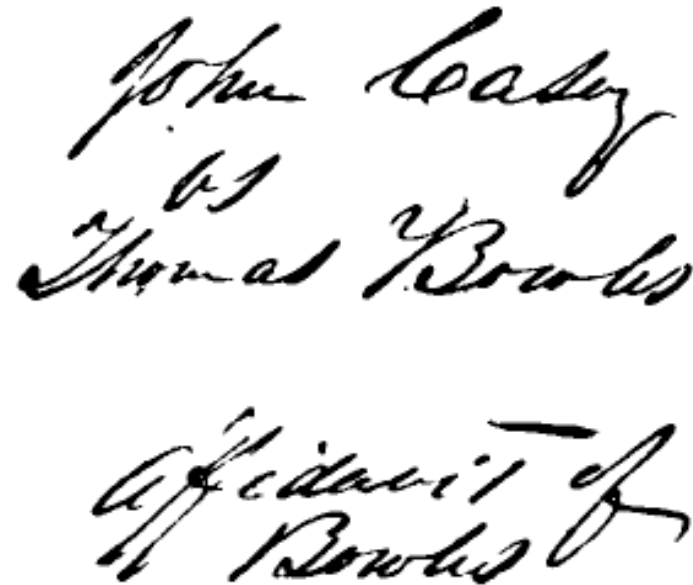
The Digital Microfilm Pipeline



Binarization



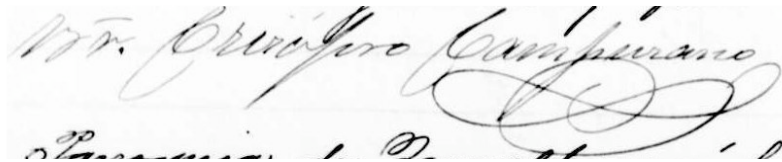
(a) Original Image



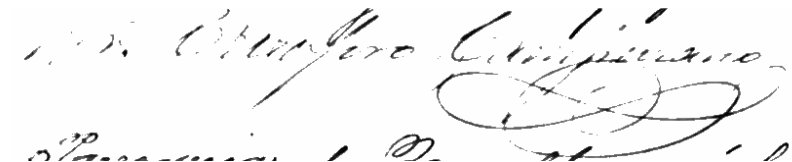
(b) Binarized Result

Median Filter Subtraction for background elimination

Binarization



(a) Original with background removed



(b) First set of text pixels (S_1)

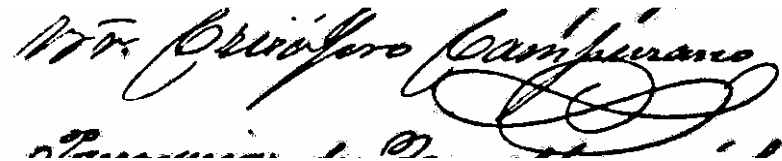


(c) Second set of text pixels (S_2)



(d) Third set of text pixels (S_3)

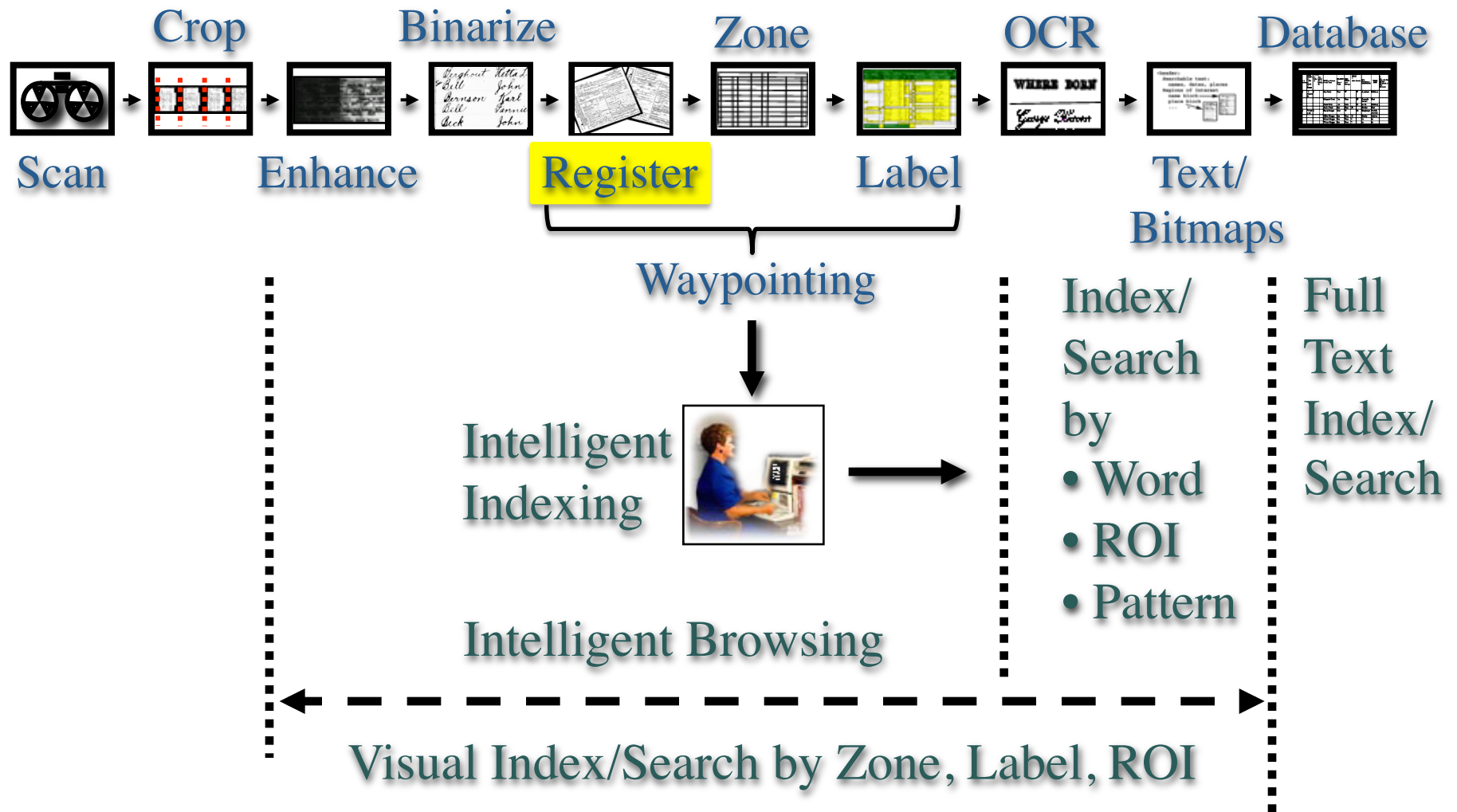
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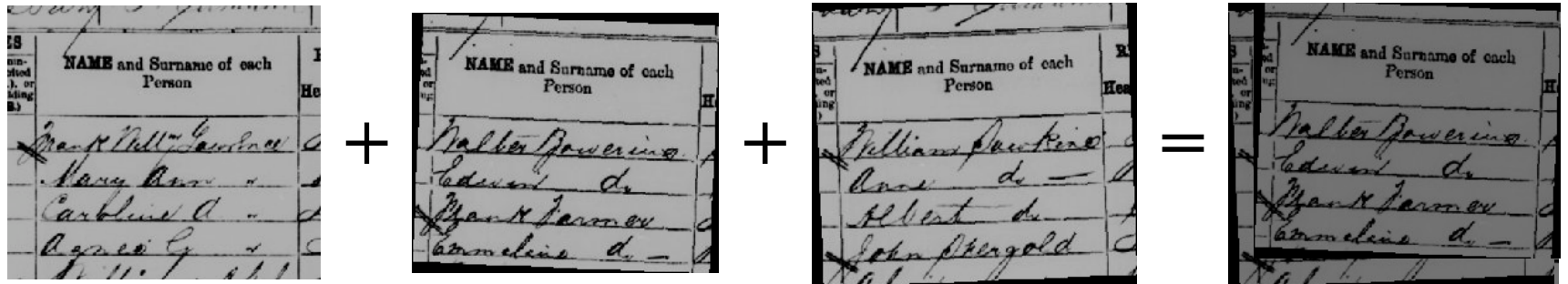
(f) Result($S_1 + S_2 + S_3 + S_4$)

Recursive Otsu Intensity Parsing and Accumulation

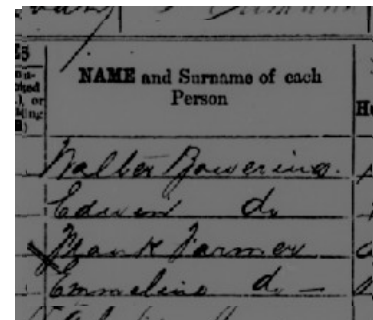
The Digital Microfilm Pipeline



Registration



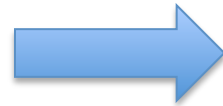
Not registered



Registered

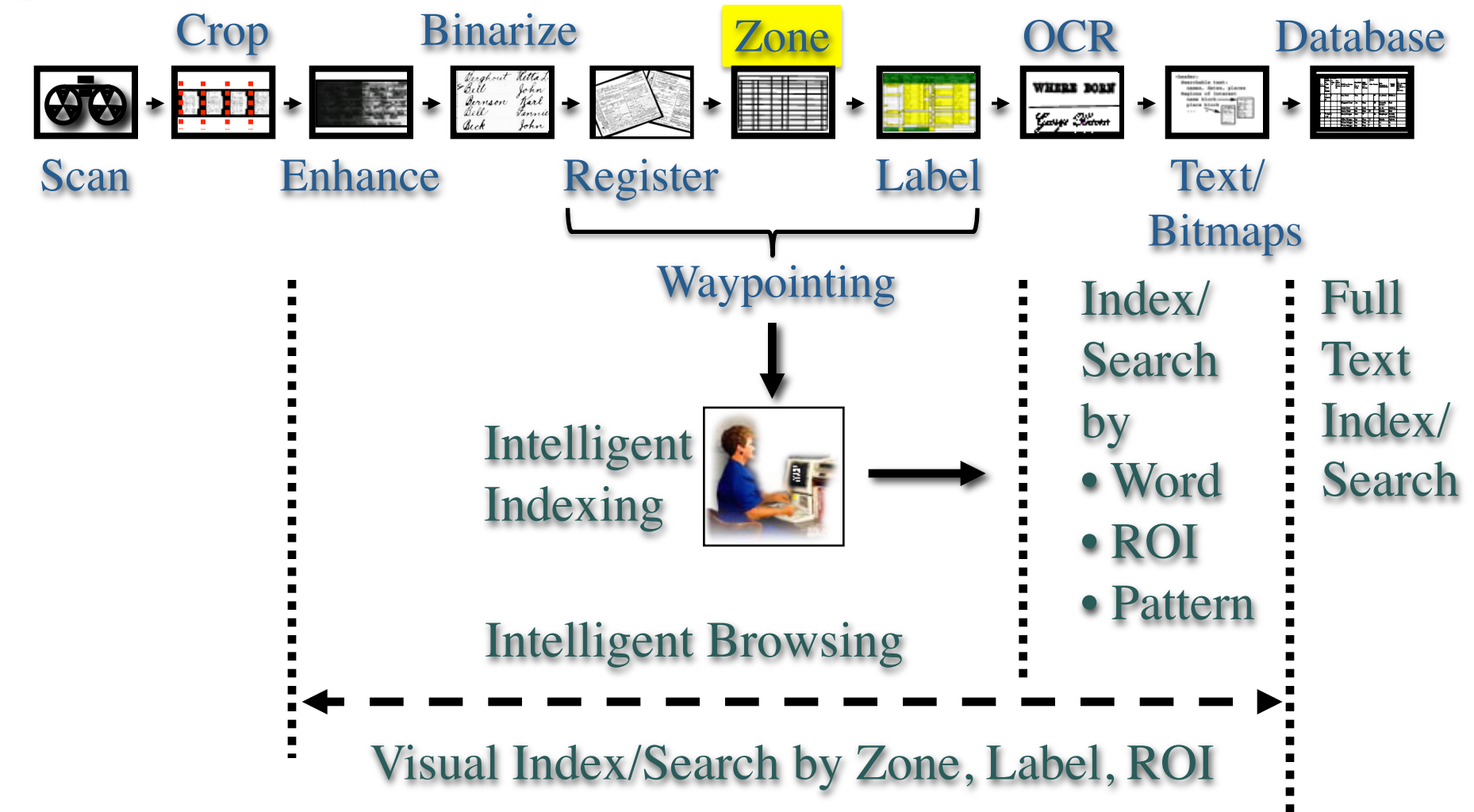
Documents must be aligned, rotated and scaled to register them

Register



Alignment, rotation and scaling using the Fourier-Mellin Transform allows registration to sub-degree and sub-pixel accuracy.

The Digital Microfilm Pipeline



Zoning

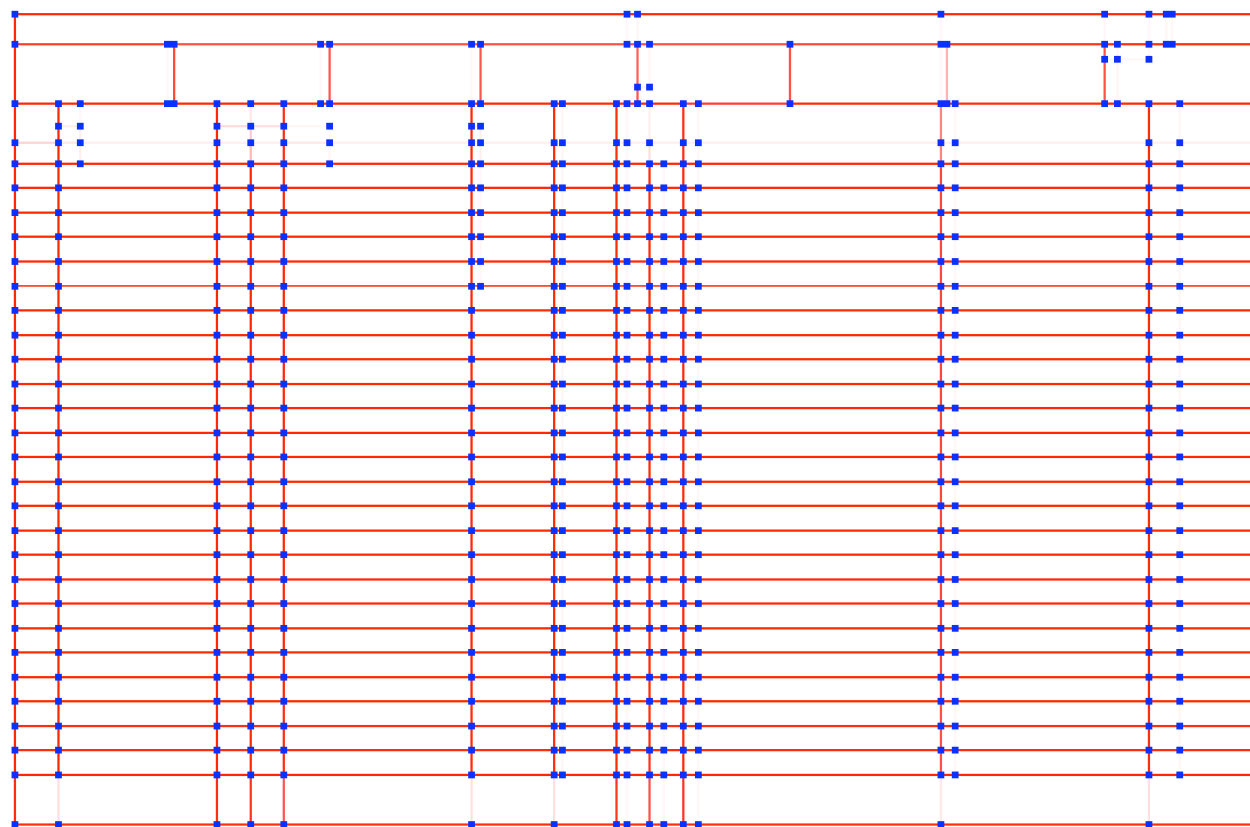
Page 2] The undermentioned Houses are situate within the Boundaries of the

Civil Parish (or Township) of	City or Municipal Borough of	Municipal Ward of	Parliamentary Borough of	Town or Village or Hamlet of	Urban Sanitary District of	Rural Sanitary District of	Religious Parish or District of		
R. Edmund.	Dahsburg	St Edmund	Dahsburg	St Edmund	Dahsburg				
No. of Schedule and No. or NAME of HOUSE	ROAD, STREET, &c.	HOUSES	NAME and Surname of each Person	RELATION to Head of Family	CON. DITION as to Marriage	AGE last Birthday of	Rank, Profession, or OCCUPATION	WHERE BORN	(1) Deaf-and-Dumb (2) Blind (3) Imbecile or Idiot (4) Lunatic
8 (included)	10 St.	1	Charles Holloway	Head	Mar	40	Van Keeper	St. Edmund	
9 (included)	10 St.	1	Edward H. d.	Wife	Mar	40	Assist. d. d.	St. Edmund	
10 (included)	10 St.	1	Edward d.	Son	Mar	18	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	17	d. d.	St. Edmund	
	10 St.	1	Thomas d.	Son	Mar	16	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	15	d. d.	St. Edmund	
10 (included)	10 St.	1	Robert d.	Head	Mar	40	Assist. d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	18	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	17	d. d.	St. Edmund	
11 (included)	10 St.	1	John Hart	Head	Mar	40	Assist. d. d.	St. Edmund	
	10 St.	1	Elizabeth Hart	Wife	Mar	40	d. d.	St. Edmund	
	10 St.	1	William Hart	Son	Mar	18	d. d.	St. Edmund	
12 (included)	10 St.	1	Charles d.	Head	Mar	40	Schoolmaster	St. Edmund	
	10 St.	1	John d.	Son	Mar	18	d. d.	St. Edmund	
	10 St.	1	Thomas d.	Son	Mar	17	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	16	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	15	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	14	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	13	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	12	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	11	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	10	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	9	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	8	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	7	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	6	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	5	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	4	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	3	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	2	d. d.	St. Edmund	
	10 St.	1	John d.	Son	Mar	1	d. d.	St. Edmund	
	10 St.	1	William d.	Son	Mar	0	d. d.	St. Edmund	
Total of Houses...		1							

NOTE.—Draw the pen through such of the words of the headings as are inappropriate.

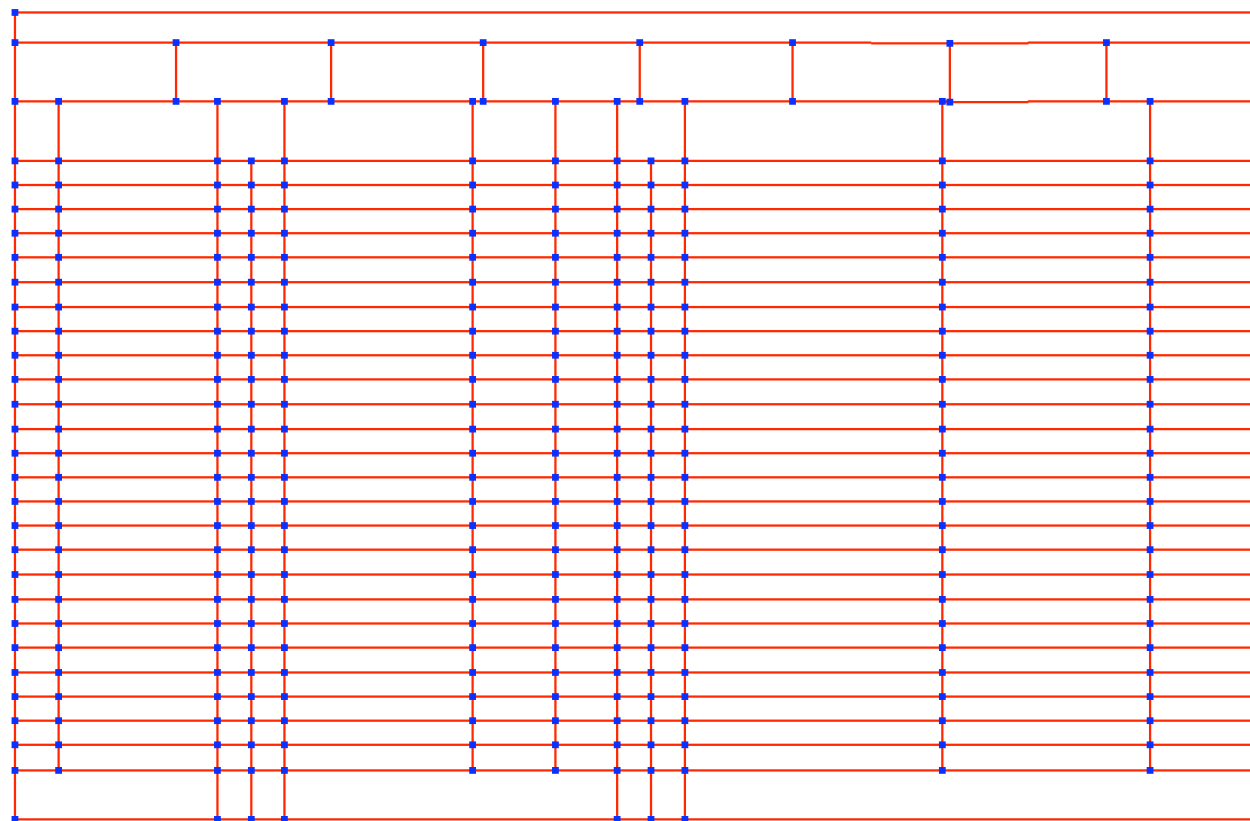
Line detection and local refinement for document zoning

Zoning by Consensus



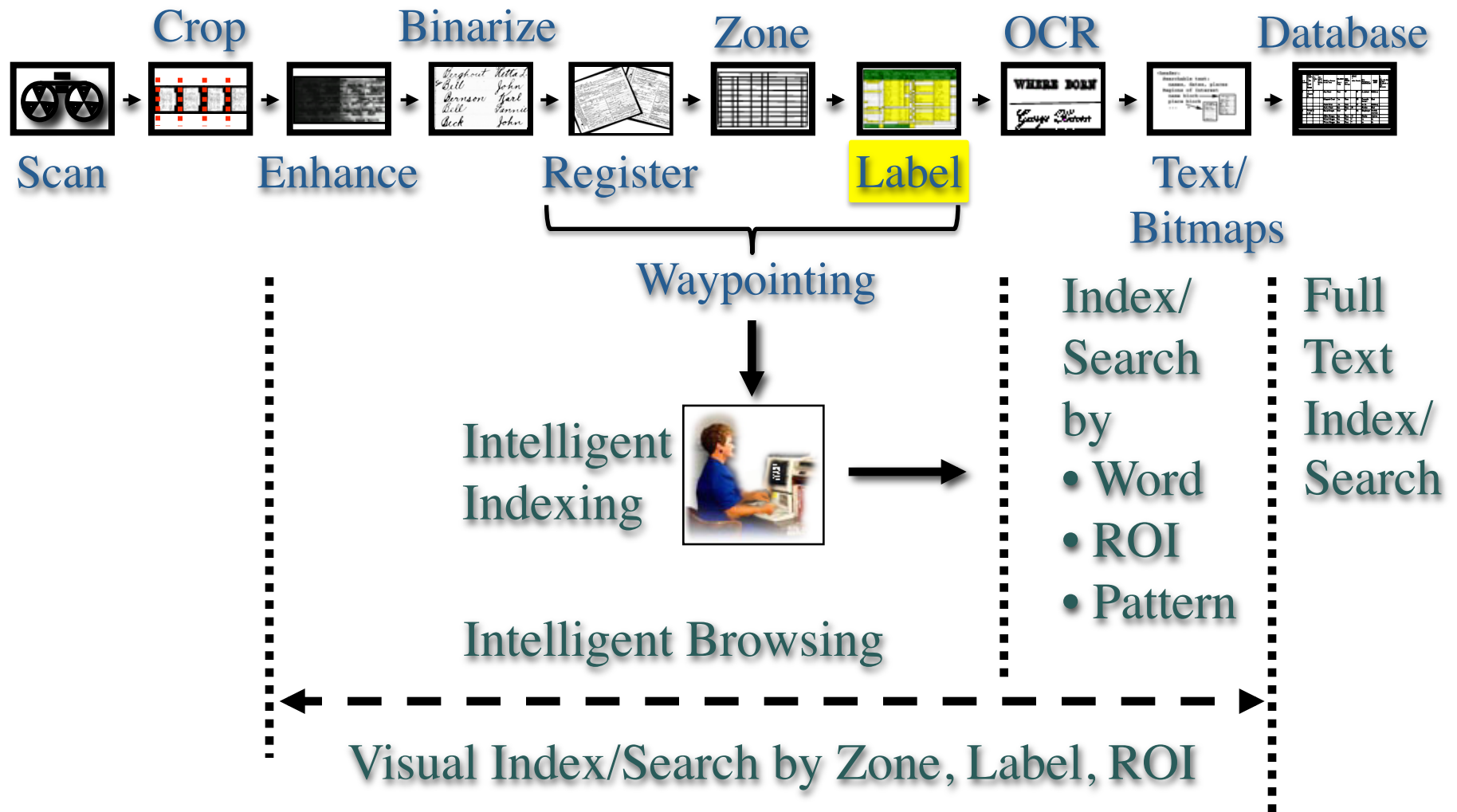
Consensus from 28 frames

Zoning by Consensus



Final Zone Template

The Digital Microfilm Pipeline



WHERE BORN

WHERE BORN

WHERE BORN

Label Handwriting

The image displays three examples of handwritten labels, each enclosed in a light blue oval. A red waveform is overlaid on each label, representing a signal or pattern. Blue arrows point from the waveform to the corresponding label.

- Top Label:** The handwritten text is "Martin. Nilt". The waveform shows a series of peaks and valleys, indicating the rhythm of the handwriting.
- Middle Label:** The handwritten text is "Nilt". The waveform shows a single, sharp peak, indicating a quick, decisive stroke.
- Bottom Label:** The handwritten text is "Nilt. Nilt". The waveform shows a series of peaks and valleys, indicating the rhythm of the handwriting.

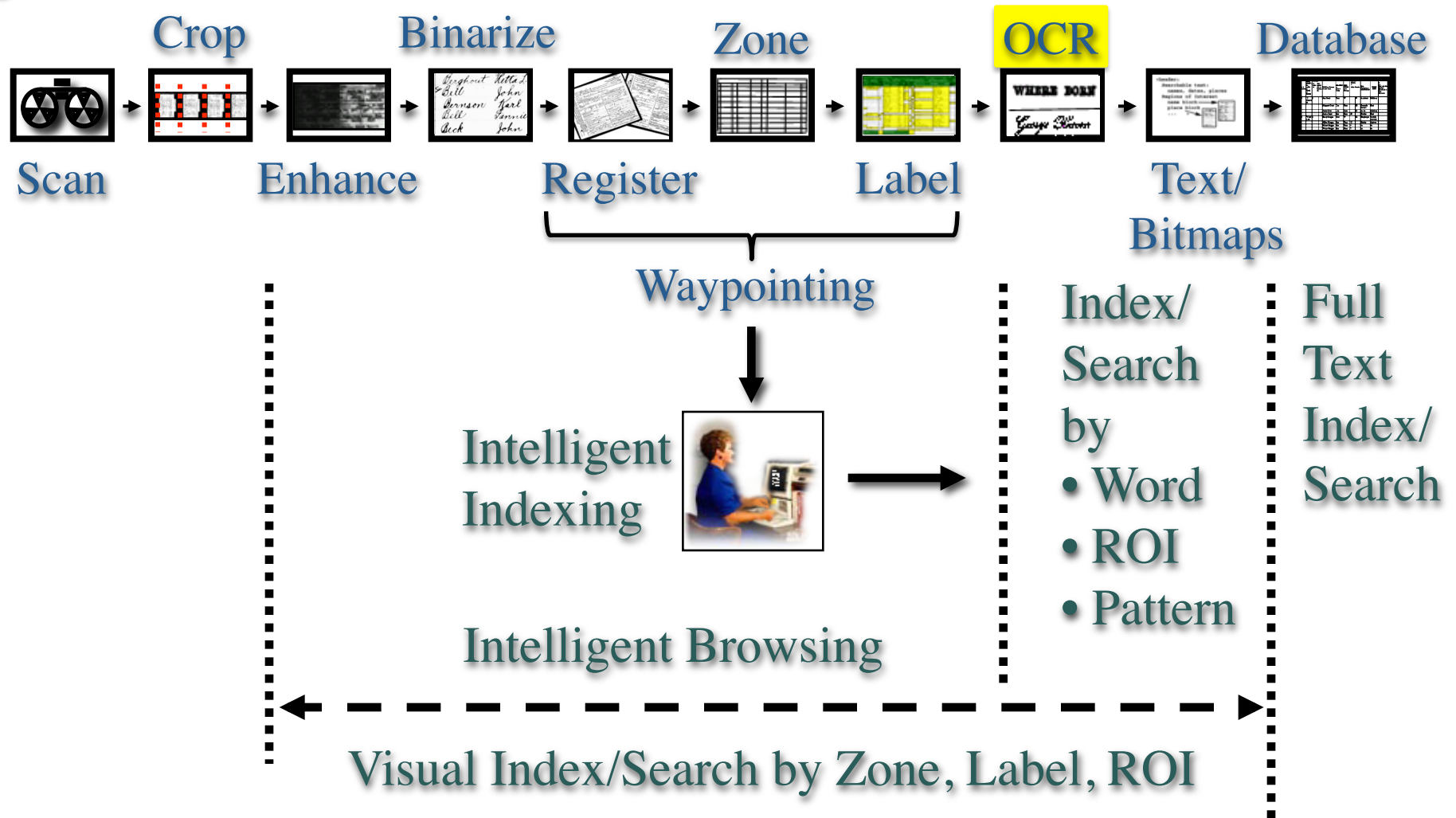
The background of the image shows a stack of historical documents, likely census records, with handwritten entries. The documents are titled "The Undersigned House on above within the boundaries of the" and "The Undersigned House on above within the boundaries of the". The documents are filled with handwritten names and addresses, such as "Martin. Nilt", "Nilt", and "Nilt. Nilt".

PUBLIC RECORD OFFICE						Reference:- <i>RG 11/2072.</i>	COPYRIGHT PHOTOGRAPH - NOT TO BE REPRODUCED PHOTOGRAPHICALLY WITH- OUT PERMISSION OF THE PUBLIC RECORD OFFICE, LONDON
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A banner for the Family History Technology Workshop 2011. It features a collage of images including a man in a suit, a CD-ROM, and various historical documents and maps. The text "Family History TECHNOLOGY WORKSHOP 2011" is prominently displayed in the center.

The undermentioned Houses are situate within the Boundaries of the										Page 1
Civil Parish (or Township) of	City or Municipal Borough of	Municipal Ward of	Parliamentary Borough of	Town or Village or Hamlet of	Urban Sanitary District of				Statistical Parish or District of	
Sutton Coldfield & Peter			Wotton	Bromston					4	
No. of Schedule	ROAD, STREET, &c., and No. or NAME of HOUSE	HOUSES Inhabited (U), or Building (B)	NAME and Surname of each Person	RELATION to Head of Family	CON-DITION as to Marriage	AGE last Birthday of	Rank, Profession, or OCCUPATION	WHERE BORN	(1) Deaf-and-Dumb (2) Blind (3) Imbecile or Idiot (4) Lunatic	
1	Bromston Road		John John Bromston	Husband	Married	46	Manager of Smith and Son's, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000	Bromston		
			Charles Ann Bromston	Wife	Do	26		Widening		
			Elizabeth Bromston	Daughter	Do	5		Widening		
			Edna Bromston	Do	Do	3		Widening		
			John John Bromston	Do	Do	13		Widening		
			Elizabeth Taylor	Servant	Married	28	Book	Bromston		
			Elizabeth Bromston	Servant	Single	11	Housemaid	Widening		
			Elizabeth Ann Bromston	Servant	Single	10	Nurse	Widening		
2	Hornby	1	William J. Hornby	Head	Married	40	In Commission	Widening		
			George Hill	Servant	Married	28	Bromston	Widening		
			Elizabeth George Bromston	Wife	Married	23	Widening	Widening		
3	Bromston	1	Robert Bromston	Head	Married	40	Widening	Widening		
			George C. Bromston	Daughter	Married	20	Widening	Widening		
3	Bromston	1	Elizabeth Bromston	Wife	Married	21	Widening	Widening		
4	Bromston	1	Elizabeth Bromston	Wife	Married	22	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	Wife	Married	20	Widening	Widening		
			Elizabeth Bromston	W						

The Digital Microfilm Pipeline



Machine-Printed OCR

A solved problem?

Archivo de la Parroquia
— de —
SANTA MARIA de los LAGOS
— JALISCO —
BAUTISMO DE HIJOS LEGITIMOS
VOLUMEN NUM. 104 1897 1899
Academia Mexicana de Genealogía y Heráldica

NAME and Surname of each Person

PLACE OF ABODE			
Street, avenue, road, etc.	House number (in cities or towns)	Number of dwelling house in order of visitation	Number of family in order of visitation
1	2		

LOCATION.				NAME of each person whose place of abode on June 1, 1900, was in this family. Enter surname first, then the given name and middle initial, if any. INCLUDE every person living on June 1, 1900. Omit children born since June 1, 1900.	RELATION. Relationship of each person to the head of the family.
IN CITIES.		Number of dwelling house, in the order of visitation.	Number of family, in the order of visitation.		
Street.	House Number.			1	2
				<i>Carlos Lucas family</i>	
				<i>1300 over from Shurt</i>	

FILMADO POR LA SOCIEDAD GENEALOGICA		LOCALIDAD QUE CUBRE EL REGISTRO	
EN MEXICO		PARROQUIA DE SANTIAGO TEMAPACHE VER. DIOCESIS DE TUXPAM VER. MEX.	
IAFO	REDUCCION (X)	TITULO DEL REGISTRO	
IAGO MEJIA M	40	BAUTISMOS	
DE FILMACION	EXPOSICION	ITEM 1	
15 1984	20		
O DE EMULSION	NUMERO DE CAMARA		
6-452-1	51896		
O DEL PROYECTO	NUMERO DEL ROLLO		
C-2-059	1		

Sort of ... depending on resolution, clarity, noise, etc.

Handwriting Recognition

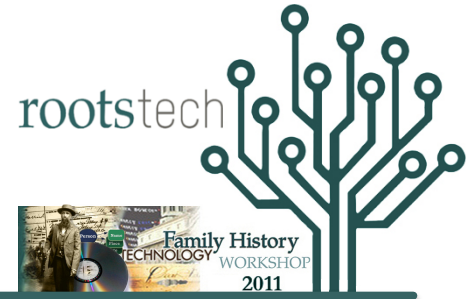
Definitely **NOT** a solved problem

The collage consists of three images illustrating handwriting recognition challenges:

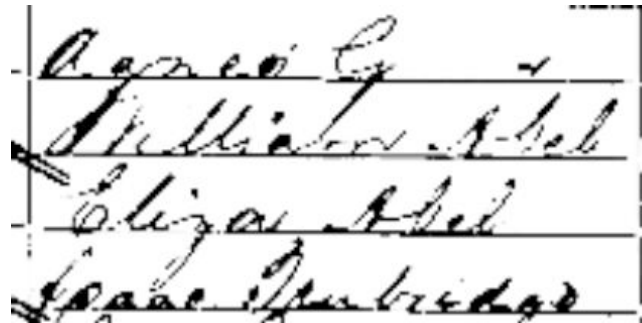
- Top Left:** A census form with handwritten entries in cursive. The form includes columns for "No. of Inhabitants", "NAME and Surname of each Person", "RELATION to Head of Family", "AGE last Birthday", "Rank, Profession, or OCCUPATION", and "Sex".
- Top Right:** A document with handwritten text in cursive. The text is overlaid with yellow highlights and red annotations. The highlighted text includes: "commissioned officer of surgeon should happen to die he is to be continued on the pay until as to of front men for Country eight Rangere pay for the subter &c. I am &c. GYFF".
- Bottom Left:** A handwritten letter in cursive script. The text reads: "My uncle had left his nephew and traveled some 12 or 14 miles to ward earth age, when being with out chart or compass and as the snow fell so thick and fast that no land scape or mark or road was vis able lost and he wildered over came with fatigue Hunger and cold he fel a sleep laying on his face. where he was found some 4 or 6 days after frose stiff leaving a widow and Seven small children to mourn the loss of the man who saved them".

Cursive, off-line handwriting recognition is an area of active research

Handwriting Recognition Challenges/Opportunities



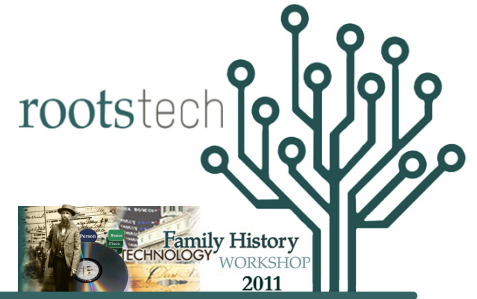
- Image quality is not always good
 - Fading of documents/acetate-based microfilm
 - Original document written with quill-pen



- But documents were usually written meticulously
 - Older handwriting more regular, so simpler to match than modern handwriting
 - Different approach required (e.g. stroke ordering problem)

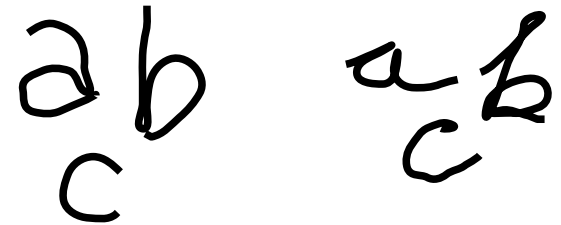
Handwriting Recognition

Past Approaches

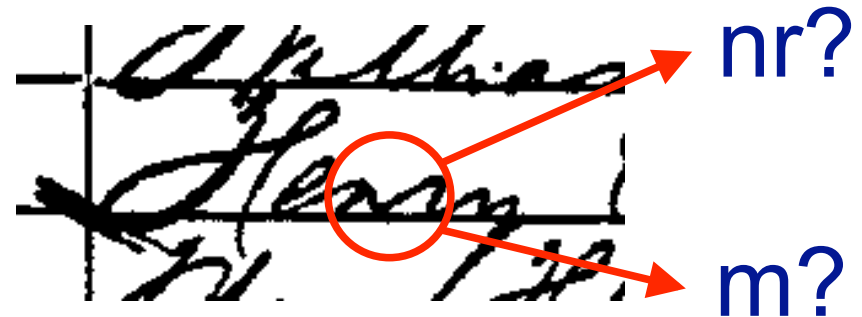


- An example of some steps in the recognition process:

- *Handwriting style clustering*



- *Letter recognition*

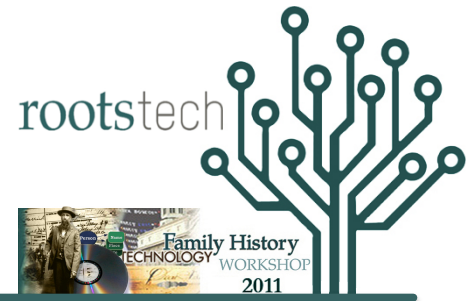


- *Approximate string matching*

Smith
Smythe

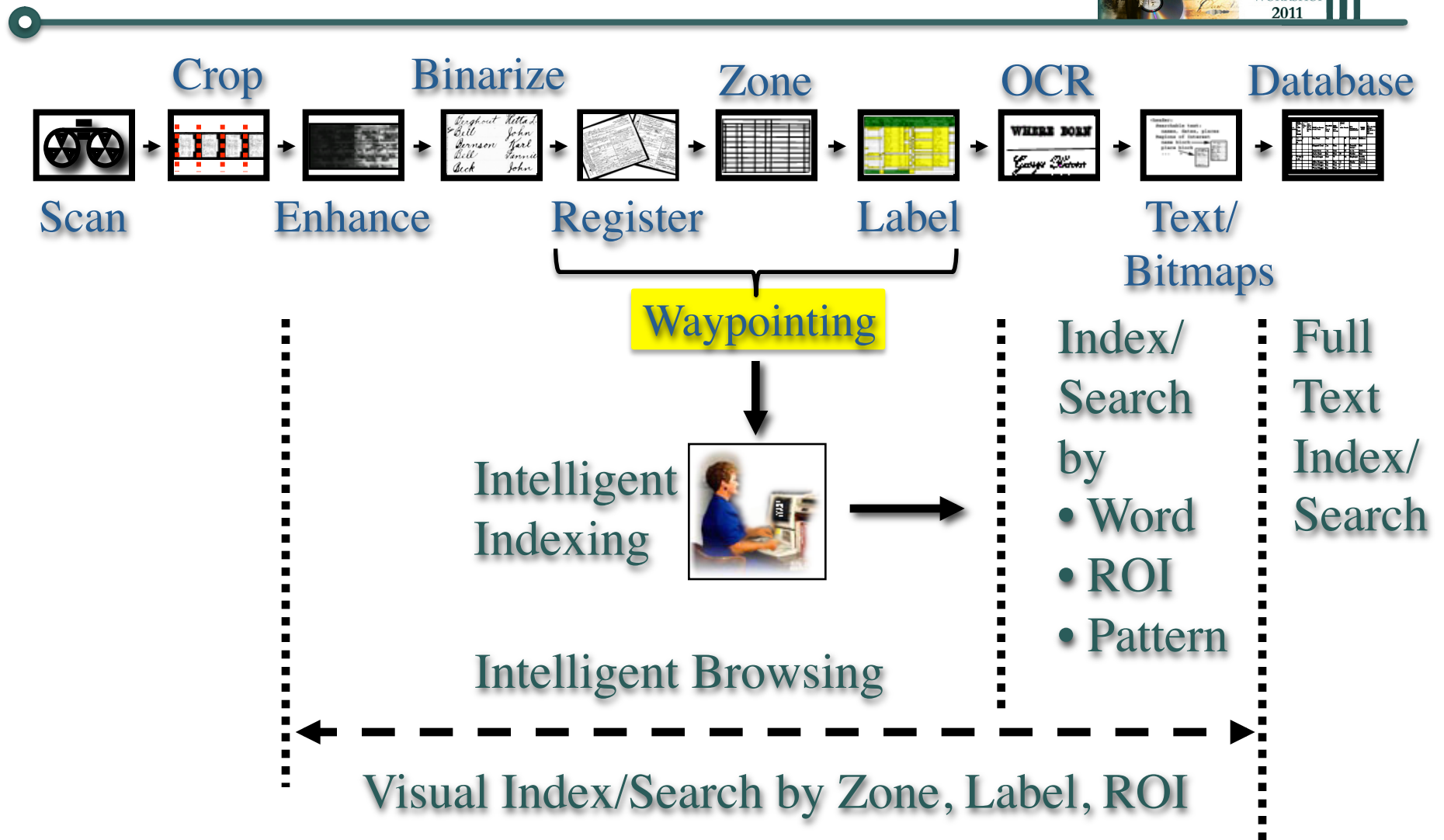
Handwriting Recognition

Future Approaches

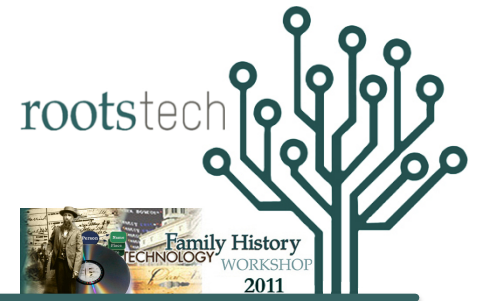


- Exploit manually-indexed, ground-truthed data to train algorithms
- Training may be required for each new handwriting style / time period
- (Semi-) Automated extraction system: Intelligent assistant to indexer, or use as “Indexer B.”
- Use image morphing/pattern recognition: don’ t have to recognize explicitly, only implicitly
- Use contextual information to increase confidence

The Digital Microfilm Pipeline



Automated Waypointing: Extract content from titleboards*



Focus on key fields:

- Record type
- Place
- Date range
- Repository
- Film number

FILMADO POR LA SOCIEDAD GENEALOGICA		LOCALIDAD QUE COBRE EL REGISTRO	
EN MEXICO		PARROQUIA DE SANTIAGO TEMAPACHE VER. DIOCESIS DE TUXPAM VER. MEX.	
FOTOGRAFO	REDUCCION (X)	TITULO DEL REGISTRO	
SANTIAGO MEJIA M	40	BAUTISMOS	
FECHA DE FILMACION	EXPOSICION		
JUN 15 1984	20		
NUMERO DE EMULSION	NUMERO DE CAMARA		
7456-452-1	51896	ITEM 1	
NUMERO DEL PROYECTO	NUMERO DEL ROLLO		
MEXC-2-059	1		

OCR/Index the text

* David Ouimette, Jake

Gehring

Automated Waypointing:

Group titleboards uniformly



ENGLAND		BISHOP'S TRANSCRIPTS	
COUNTY			
DERBYSHIRE		Baptisms	
PARISH		Marriages	
Hayfield		Burials	
		YEARS	
		1662-1810	

FILMED AT LICHFIELD, STAFFORDSHIRE, ENGLAND, BY THE GENEALOGICAL SOCIETY, SALT LAKE CITY, UTAH, U.S.A. JANUARY 1966

Archivo de la Parroquia	
- de -	
SANTA MARIA de los LAJOS	
- JALISCO -	
BAUTISMO DE HIJOS LEGITIMOS	
VOLUMEN NUM. 104 1897 1899	
Academia Mexicana de Genealogía y Heráldica	
Reductor	SEP - 23 DE 1957

...

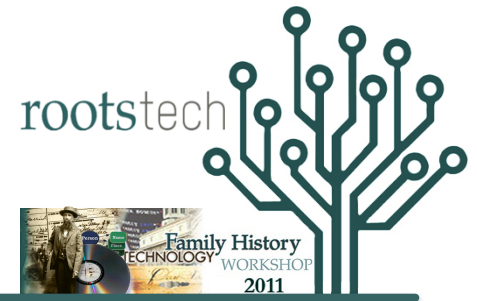
MICROFILMED BY THE GENEALOGICAL SOCIETY SALT LAKE CITY, UTAH AT:		LOCALITY OF RECORD	
STATE DEPT. HEALTH		HAWAII	
HONOLULU HI 96801			
OPERATOR	REDUCTION X	TITLE OF RECORD	
STEVE BALDRIDGE	16 X	HAWAII, MAUI, KAUAI	
DATE FILMED	LIGHT METER SETTING	NIHAU BIRTHS,	
17 AUG 1978	64-2	DEATHS, MARRIAGE	
FILM EMULSION NUMBER	FILM UNIT SER NO	VOLUME/S	
7252 11	GS1 5481	Item 3	
PROJECT NUMBER	ROLL NUMBER	YEAR 'S INCLUDED	
HA00009	17	1862 - 1896	

FILMADO POR LA SOCIEDAD GENEALOGICA		LOCALIDAD QUE COBRE EL REGISTRO	
EN MEXICO		PARROQUIA DE SANTIAGO	
		TEMAPACHE VER. DIOCESIS	
		DE TUXPAM VER. MEX.	
FOTOGRAFO	REDUCCION (X)	TITULO DEL REGISTRO	
SANTIAGO MEJIA M	40	BAUTISMOS	
FECHA DE FILMACION	EXPOSICION		
JUN 15 1984	20		
NUMERO DE EMULSION	NUMERO DE CAMARA		
7456-452-1	51896		
NUMERO DEL PROYECTO	NUMERO DEL ROLLO	ITEM 1	
MEXC-2-059	1		

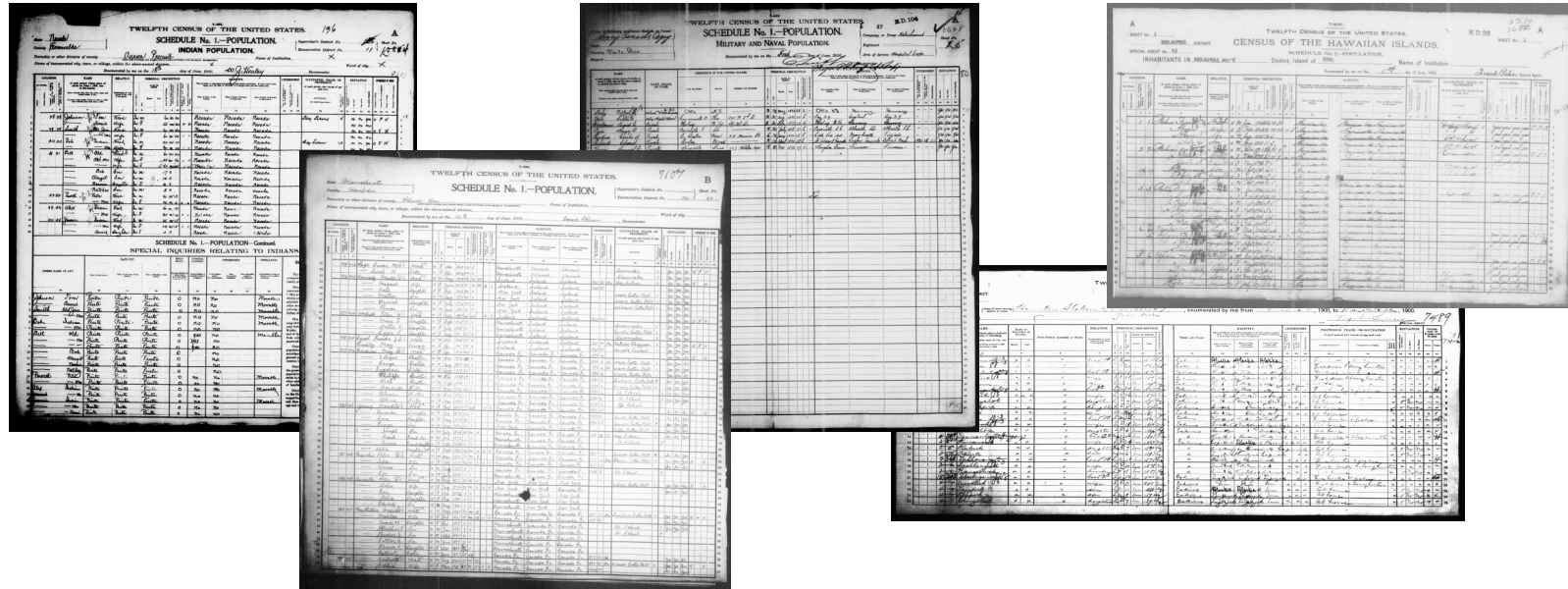
...

To facilitate collection analysis and indexing prep

Automated Waypointing: Classify images that look alike



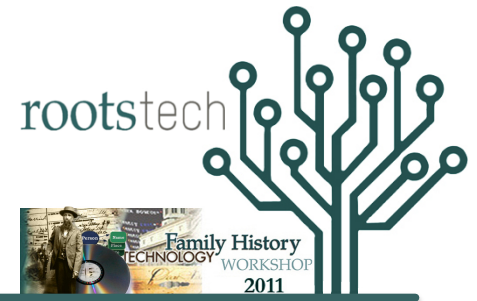
Example 1: There are five distinct forms used in the 1900 census. They need to be treated differently when indexing



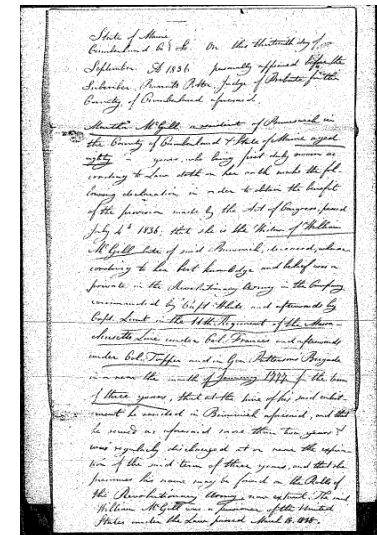
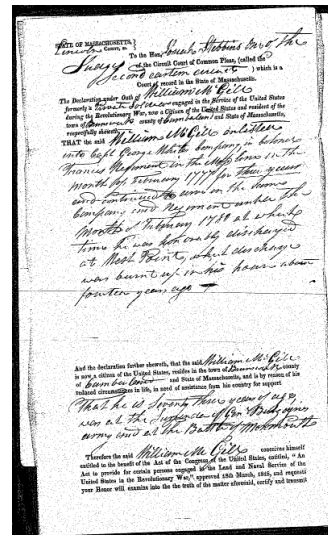
Tool for index batching and automated waypointing

Automated Waypointing:

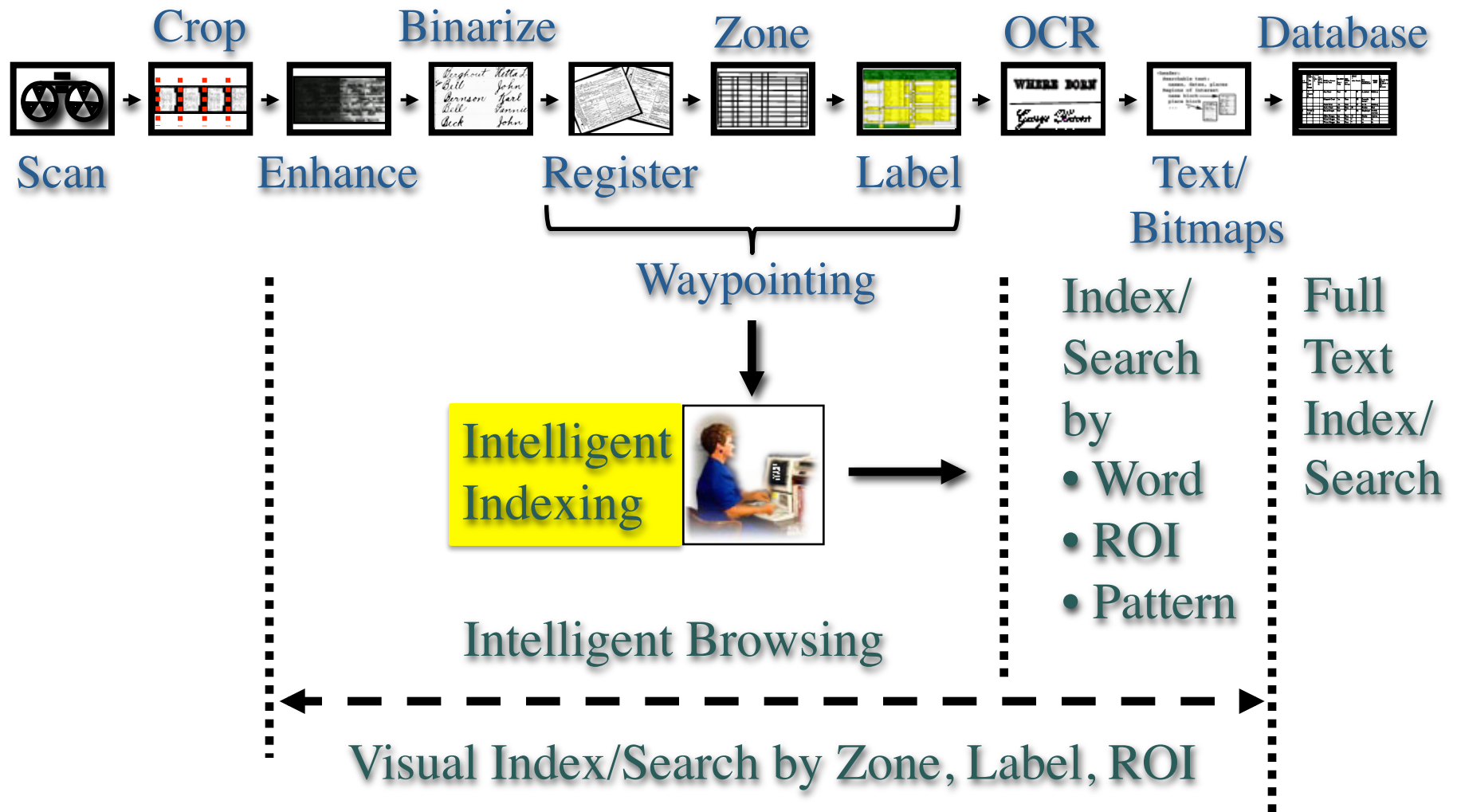
Classify images that look alike



- Tool for waypointing and index batching
- Example 2: Create brief indexes (e.g., Rev War pensions)
 - Isolate images to send to indexers (e.g., a single card image which precedes dozens of pages in a pension packet)
 - Waypoint entire set of images, including indexed images

A blank pension packet form with handwritten entries. The form has a header section with "SERVICE" and "NUMBER" labels. Under "SERVICE", the word "Mass" is handwritten. Under "NUMBER", the number "K 23952" is handwritten. Below the header, there are two columns of horizontal lines for text. The left column contains the handwritten name "Mc Gill, William" and the right column contains "Martha".

The Digital Microfilm Pipeline



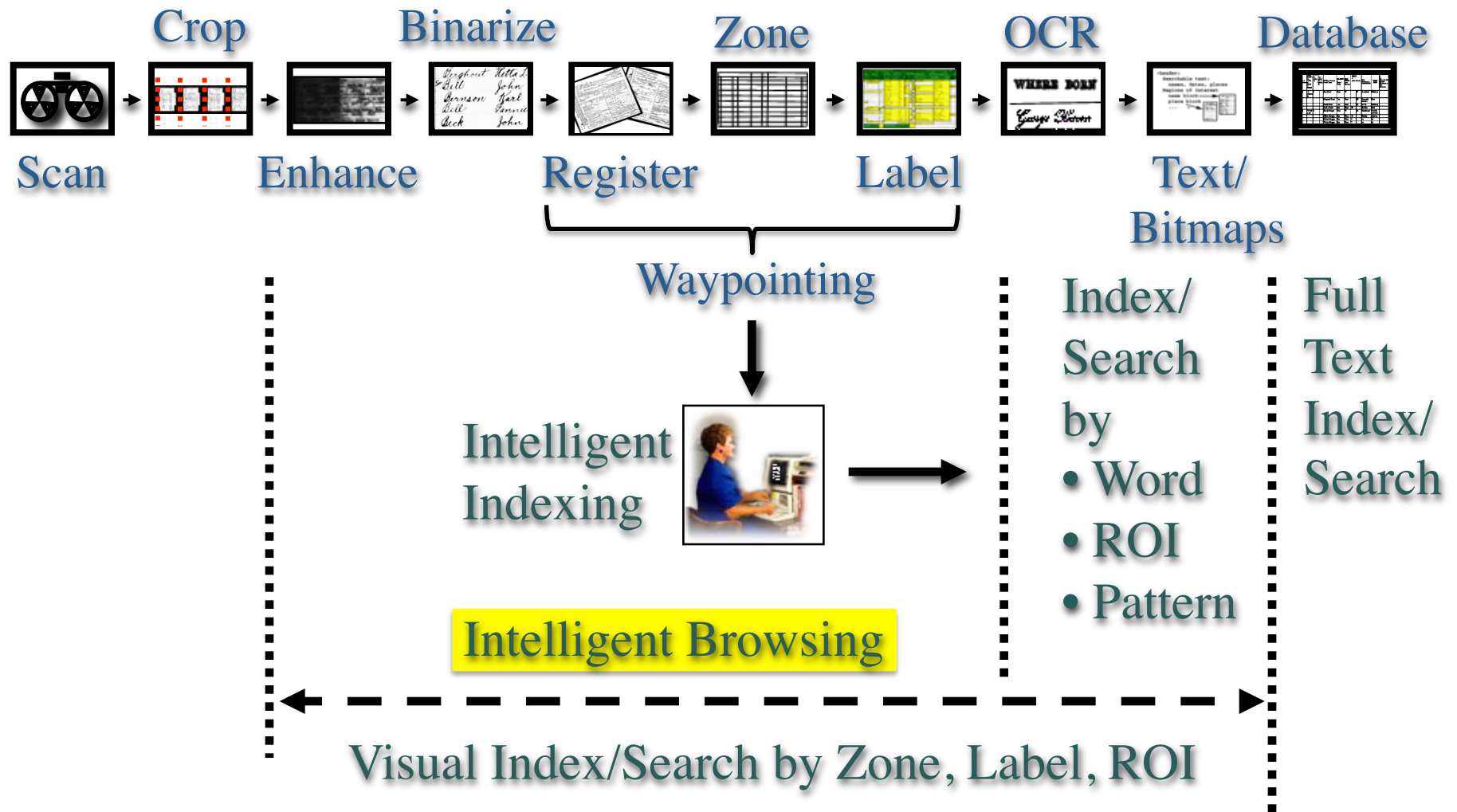
Intelligent Indexing



Agent “looking over the shoulder” of the indexer:

- Name glyphs + ground truth = **Training Set**
for recognition algorithms
- Agreement/disagreement with other indexer weights
prior/conditional **probabilities**
- “Remembers” **image patterns** and characters from
previously entered names to prompt indexer and refine
probabilities and training set
- Exploits **contextual constraints** from surrounding data

The Digital Microfilm Pipeline

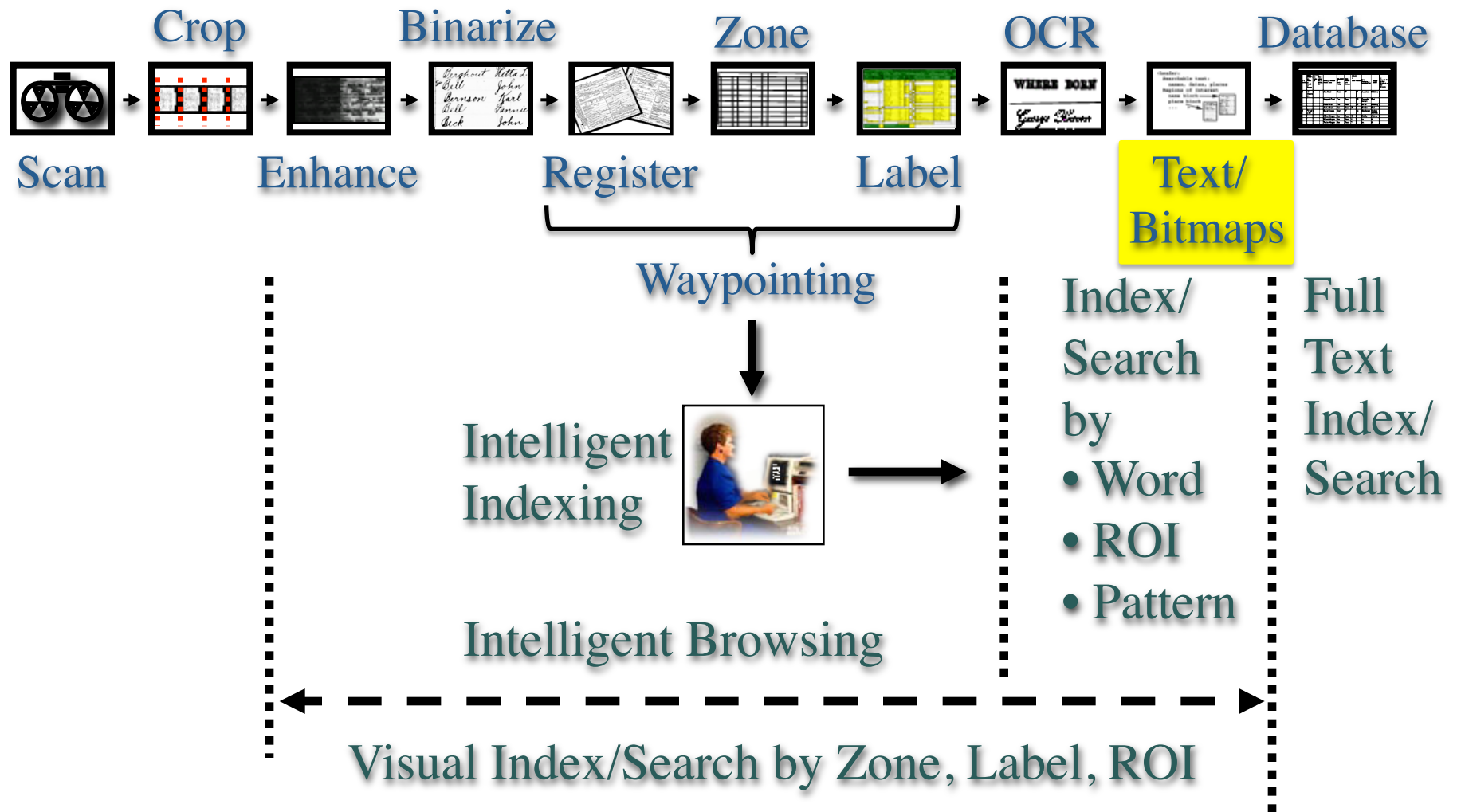


Intelligent Browsing



- Use automated waypointing for light to fine-grained, hierarchical frame to field level **snap-click browsing**
- Capture and “remember” the frames and fields the user is browsing. Ask: “**5 others users have interest in this name – would you like to know who they are?**”
- “**Amazon Browsing**: “Users who looked at this also looked at the following frames/fields/names ...”
- **Hyperlinking of fields** to source data or related information in this or other collections

The Digital Microfilm Pipeline



Search by Words/Patterns

<header :

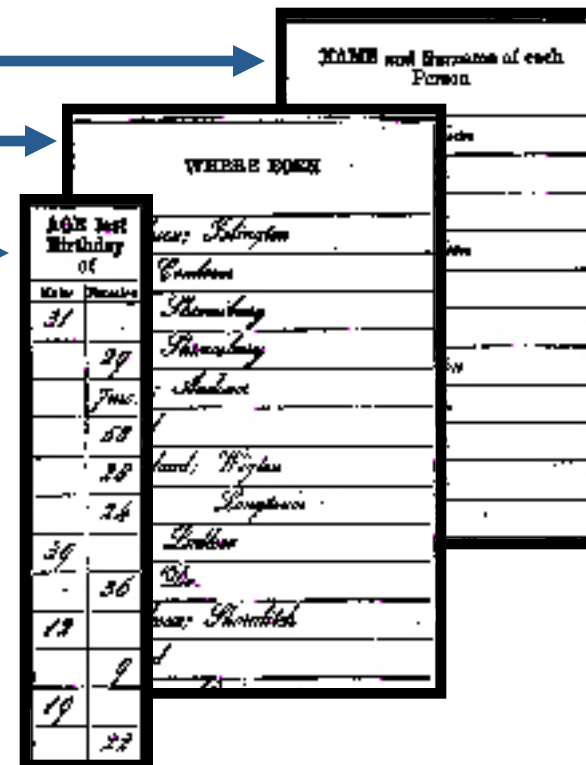
Name fields

Place fields

Date fields

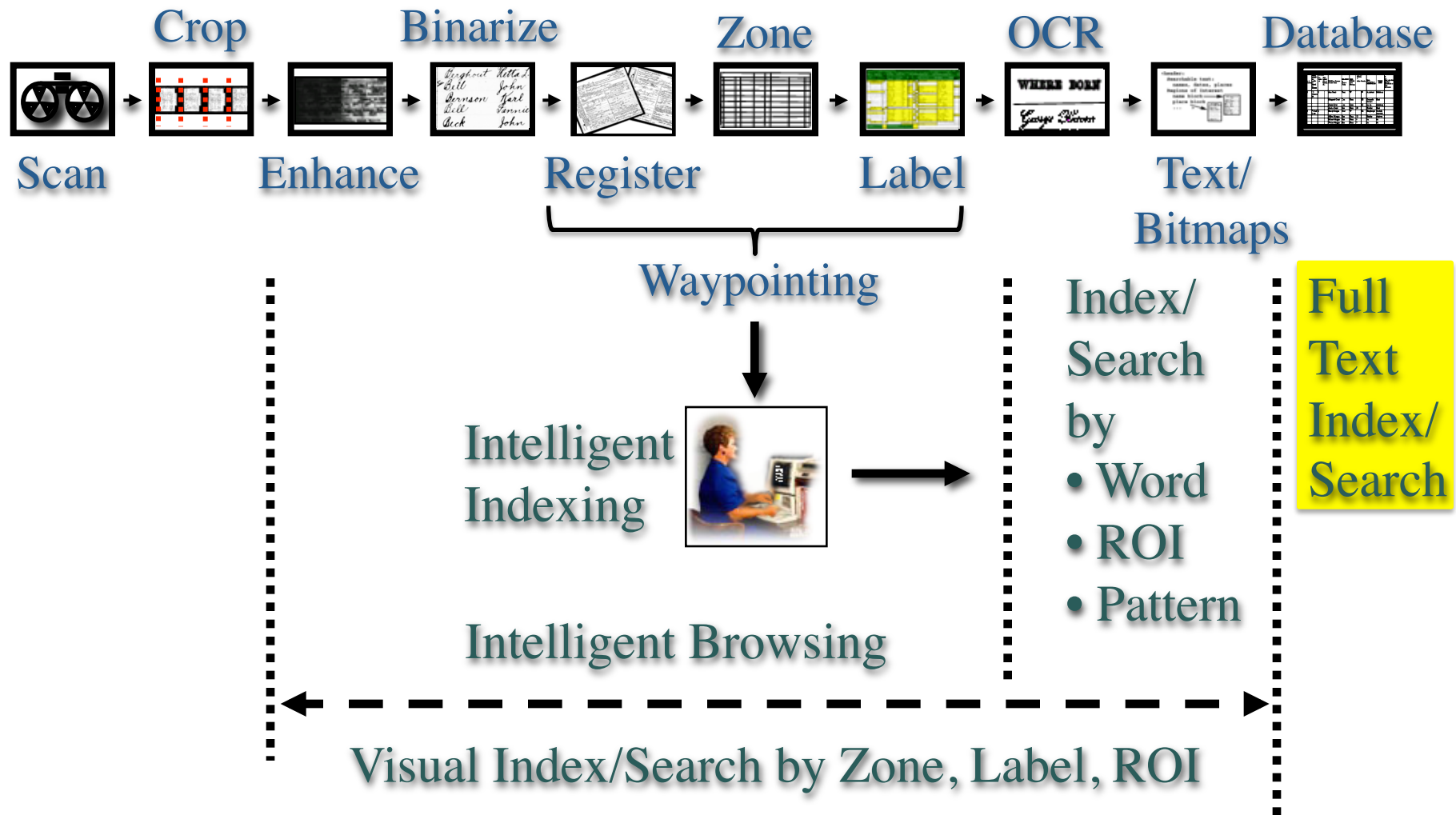
Regions of Interest:

Partial Search:
Words, Bitmaps,
Regions of Interests
Logical Groupings



AGE last Birthday of		NAME and Residence of each Person
31	Male	Wife: Kelington
27	Female	Children
26	Female	Children
25	Female	Children
24	Female	Children
23	Female	Children
22	Female	Children
21	Female	Children
20	Female	Children
19	Female	Children
18	Female	Children
17	Female	Children
16	Female	Children
15	Female	Children
14	Female	Children
13	Female	Children
12	Female	Children
11	Female	Children
10	Female	Children
9	Female	Children
8	Female	Children
7	Female	Children
6	Female	Children
5	Female	Children
4	Female	Children
3	Female	Children
2	Female	Children
1	Female	Children

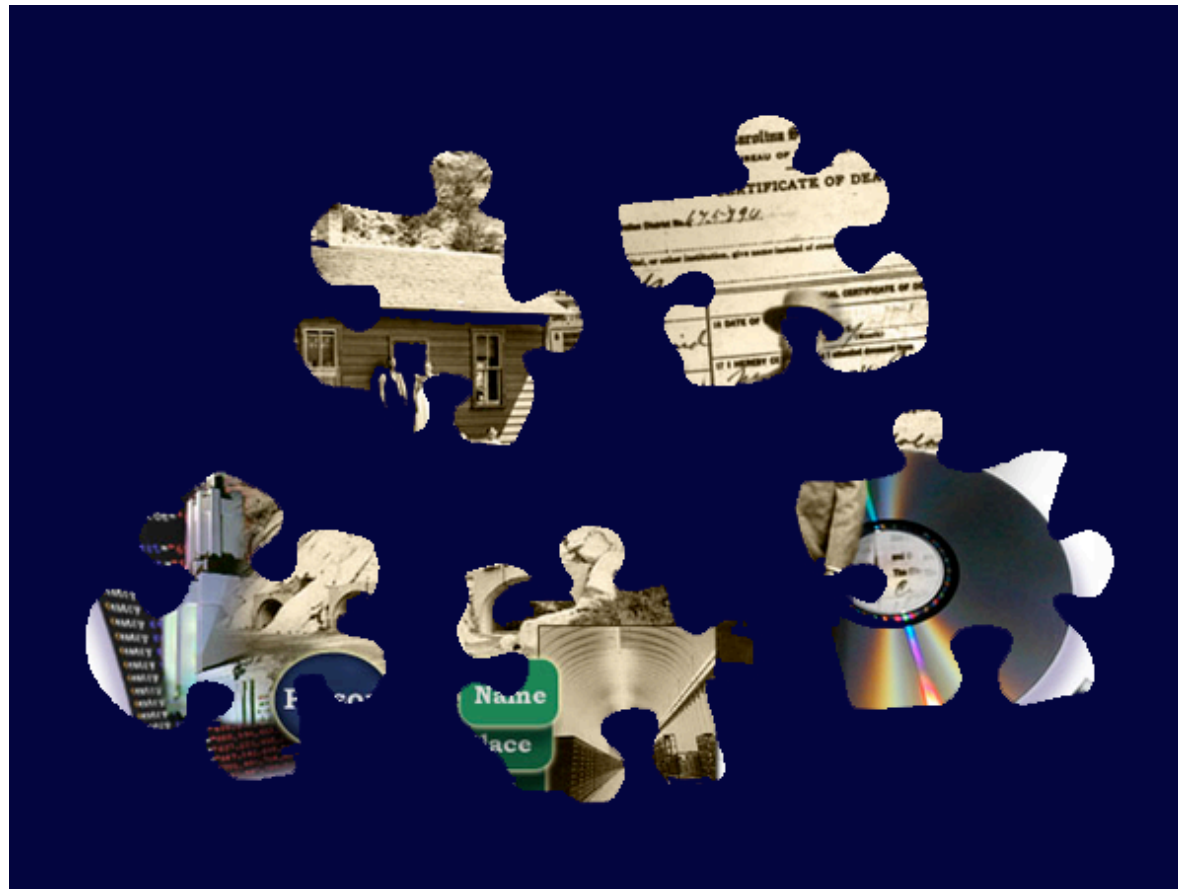
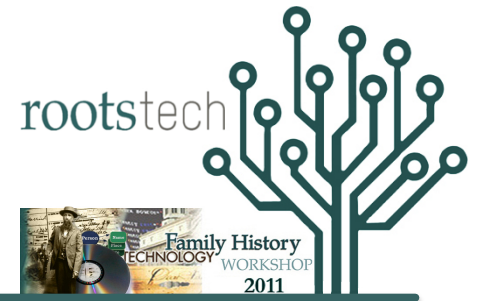
The Digital Microfilm Pipeline



Full Text Database Search

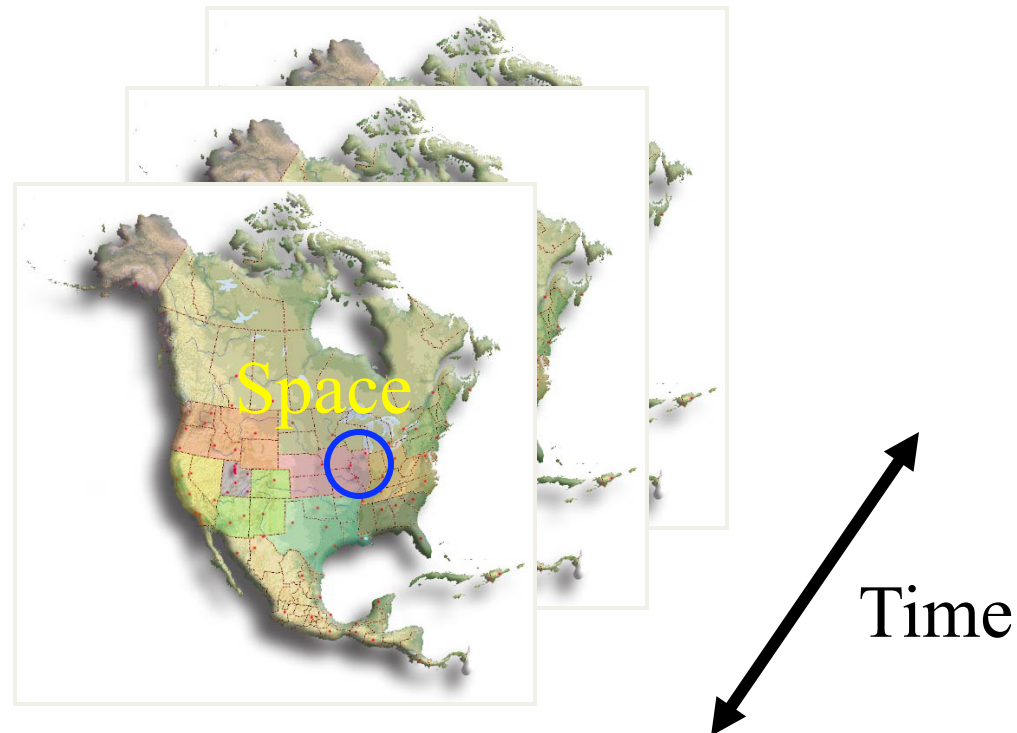
No. of Schedule	ROAD, STREET, &c., and No. or NAME of HOUSE	HOUSES		NAME and Surname of each Person	RELATION to Head of Family	CON- DIT- ION as to Marriage	AGE last Birthday of		Rank, Profession, or OCCUPATION	WHERE BORN	If (1) Deaf-and-Dumb (2) Blind (3) Imbecile or Idiot (4) Lunatic
		In- habit- ed	Unin- habited (U). or Building (B.)				Males	Females			
28	15 Church St.	1		Ann Grant	Head	W		50	Anniutant	Salisbury	
				Margaret Grant	Dau	Unm		22	Domestic Servant	Kent	
				Annie Grant	Dau	Unm		18	do. do.	Salisbury	
				Austin Grant	Son	Unm	20		Hawker	Kent	
29	72 Salt Lane	1		Emily Morgan	Head	W		34	Shopkeeper	Norfolk, Norwich	
				Alfred Morgan	Son	Umn	12		Scholar	Andover	
				Hubert Morgan	Son	Umn	9		do.	do.	
				Walter Morgan	Son	Umn	7		do.	do.	
				Emily Morgan	Dau	Umn		4	do.	do.	

What are the other Pieces of the Puzzle?

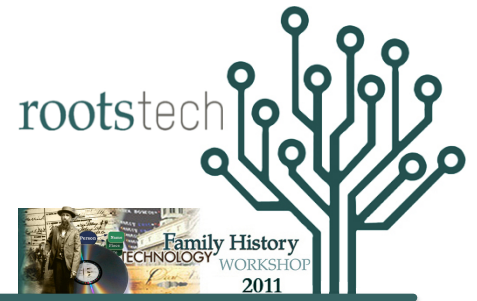


Future Directions

- Longitudinal Search and Visualization
<proximity- space - # names - time>

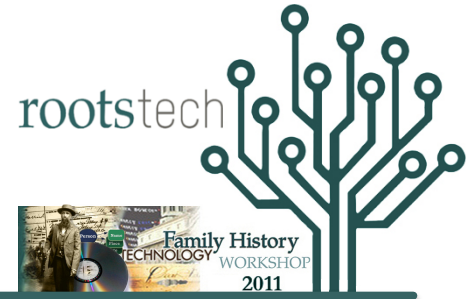


Future Development: What is Needed (Dallan Quass)



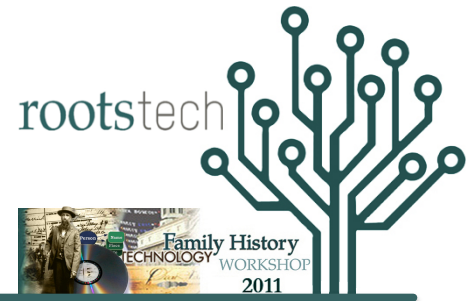
- A comprehensive catalog of genealogical source information
 - when people "get stuck" - consult the catalog to find sources
- Collaboration models that allow people to maintain their private version of the data independently – like the google wave protocol or distributed version control systems
- “Push” systems for doing genealogy: The system prompts me by posting items on my "wall" telling me interesting things I could be doing to learn more about my genealogy

Future Development: What is Needed (Heath Nielson)



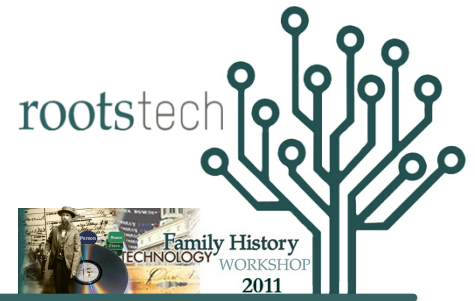
- A Common Genealogical Data Model: so that developers, providers and users can structure and link data unambiguously – "stitching" trees together. (Similar problem with Medical Data Records)
- Bi-directional linking of Conclusion Data ↔ Source Data: Access to, and sharing of conclusional and source data suggests a need to bridge the gap between the two sources of data – invites more careful interpretation Increasing access ***and*** accessibility to source records. Need more compelling and efficient interfaces and algorithms to navigate, search and find data of interest.
- 12-bit (HDR) microfilm scanning to reduce sensitivity of film scanning to changes in film density and to maximize the dynamic range of the (8-bit) output

Future Development: What is Needed (Kirk Duffin)



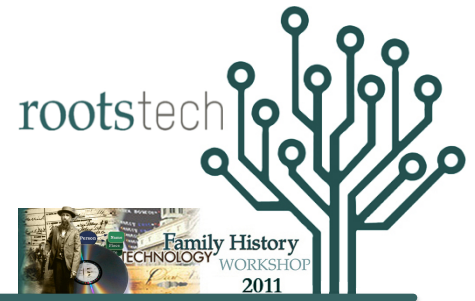
- Closer coupling and improvement in human-assisted computing.
Why? Because data acquisition will far outstrip available human resources,
Human resources will outstrip need for expert genealogical knowledge
- Intelligent research assistants (computers)
 - highly specialized to answer specific questions or expedite menial tasks.
- Handwriting recognition system: human transcriber transparently trains computer:
 - makes connections between strokes and output text
 - exploits name authority and locality
 - becomes expert on this recorder's handwriting and the specialized domain
 - eventually system makes suggestions; human becomes arbiter
- Geographic Assistants with specific knowledge about a geographic area over time:
Could explain to a relatively new researcher how the place in question no longer exists by that name and is now known by a different name -- and by the way, it also exists in a different county now, because of boundary changes that took place in 18xx.

Future Development: What is Needed (Kirk Duffin)



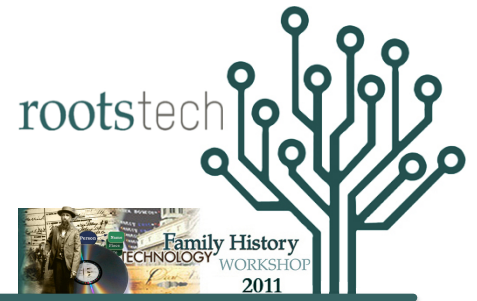
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Could explain to a relatively new researcher how the place in question no longer exists by that name and is now known by a different name -- and by the way, it also exists in a different county now, because of boundary changes that took place in 18xx.
- Defining standards and protocols so that knowledge can be shared between artificial assistants.
- Improvements multi-lingual knowledge and transliteration so that researchers in one country are not required to become experts in the language and culture of their ancestors before doing effective research

Future Development: What is Needed (Kirk Duffin)



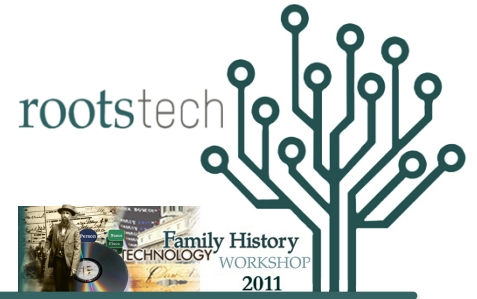
- Dynamic user interfaces and displays for multi-resolution, multi-layered views of a person's digital assets (photos, journals, documents, videos, sound recordings, etc.)
- Expand focus from individuals to families: Family history is typically an individual endeavor. But families are tracked through history, often as a set of individuals.
- Intelligent Data Mining: Analyze entire cross-sectional collections of data and collect them longitudinally. How does the 1830 census of an entire town connect with the 1840 census of the same town? And with subsequent censuses? Can family connections be automatically generated across these data sets? Then start connecting census info with that of neighboring locations. Can we automatically identify who moved? Who got married? Discover where they came from? Can this facilitate automatic creation of verifiable reference info for individuals, families? Can similar information also be gleaned from a comprehensive analysis of parish records?
- This will be of increasing importance for Church family history work because there is going to be a need to identify and do the work for those who have no descendants. These can only be found by expanding the research work from individuals to groups.

Future Development: What is Needed



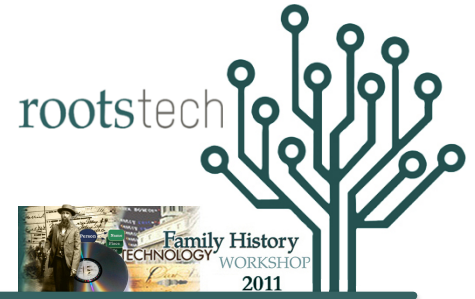
- Interchange format standards – a worthy GEDCOM successor
- Cloud/synch – same content available everywhere from my PC, to TV, tablet, smart phone, game console, car, etc...
- Better entity extraction – to create relationships between data mined from records
- Better search – interactive “hinting” search (i.e., Google instant), name-place-date-event entity extraction, etc.
- Links\connections\hints from tree framework (vitals, census, etc.) to rich media (stories, newspapers, yearbooks, photos, movies, videos, local histories, etc. adding meaning and detail beyond dates and names)

Future Development: What is Needed (Alan Eaton)



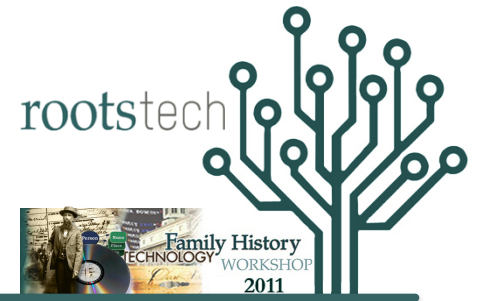
- Synchronization of the cloud(s)
- Sourcing
- Ease of consumption of genealogy services and data
- Everything fully indexed and/or structured

Future Development: What is Needed (Bill Harten)



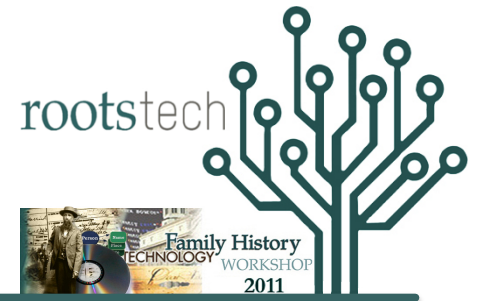
- **Challenge: Evidence-based Genealogical Computing.**
- **Evidence-centric data model and computerized evidence-linking:** Need to be able to verify, change, extend conclusions. Cannot build on other's conclusions alone – must follow source references. Need to see an image of the evidence.
- GEDCOM's syntax and extensibility was conceived for this evidence-oriented purpose, but its first and only application has been to represent only our linked conclusions, because the community demanded computerized pedigrees first. Work on linked conclusions without linked evidence will need to be done over.
- This has been understood by many since the early 90s, yet nothing substantive has happened to address it.

Back to the *FUTURE*



If hindsight is 20-20, what about foresight?

Back to the *FUTURE*



If hindsight is 20-20, what about foresight?



Back to the *FUTURE*

If hindsight is 20-20, what about foresight?



What kind of Family History Technologies might be with us in the year 2020?

Back to the *FUTURE*

Smartphones/Cameras/Recorders with

- “flex-cell” HHD display, contact scan, OCR
- HHD photo, full motion video, sound
- *IntelliSpeech* indexing, search and retrieval
- Virtual presence with multiple callers, collaborators
- Virtual networking with devices and friends
- Smart authentication and dynamic portal connect
- 1-10 terabytes of memory



Back to the *FUTURE*

Personal “Wall” for digital assets



explore, view, query, organize
photos, movies, music, recordings,
digital documents, files, etc.

- Speech and gesture interaction and control
- Shared views, virtual presence with social network
- Virtual travel and presence to any destination
- Smart authentication, device and network connect
- 1-2 petabytes of memory

Back to the *FUTURE*

Intelligent Genealogical Research Assistant

- Organizes and keeps track of photos, movies, digital documents, files, sources, what you were working on, names, dates, etc.
- Fully speech aware and interactive
- Domain, geographical, linguistic expertise
- Suggests what to work on next, asks good questions
- Accepts assignments, searches and mines data while you sleep; presents findings in the morning



How to move *FORWARD*?

rootstech



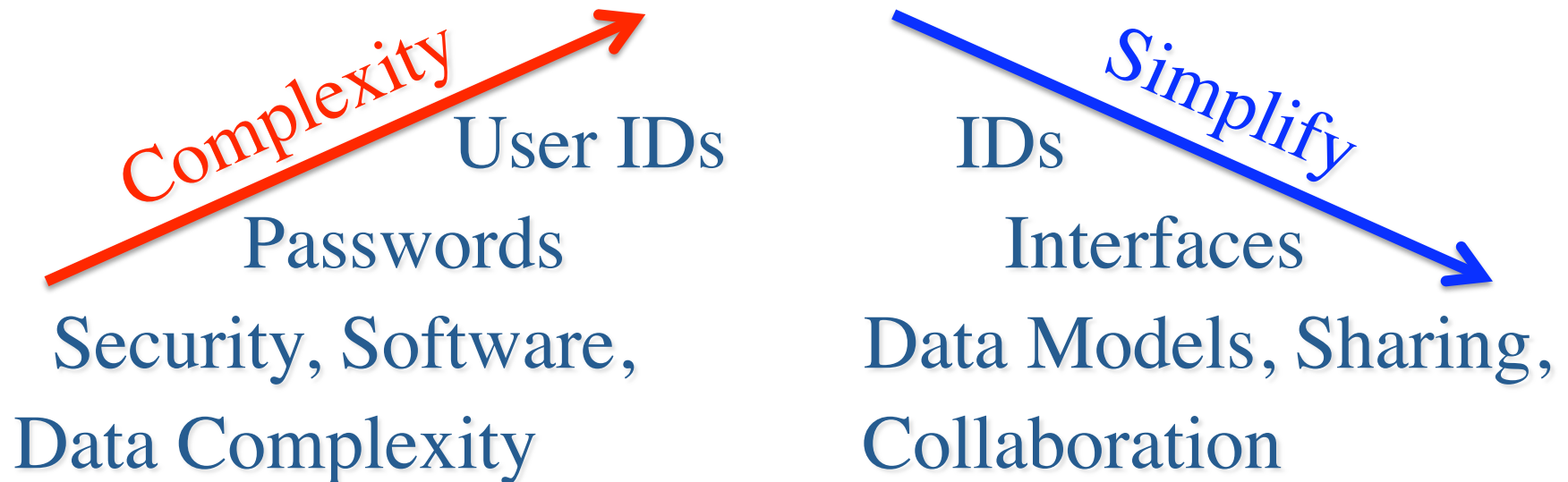
How to move *FORWARD?*

rootstech



Competition!

The Need to Simplify



There is a great need to simplify and unify technologies, algorithms and data

Fun + Experience + Reward

- The busy mother of 3
- A turning-the-heart experience
- Rewarding: don't go away empty-handed
- Pac-Man genealogist
- The “20-minute genealogist”

Curt Witcher genealogy – get a life

The Need to Unify

- Common Data Model
- Record Linkage and Merging
- Standardized collaboration model
- Closer Human + Computer coupling
- Genealogy and Source Data

Of all of these, perhaps the most unifying concept of all is that this is the Lord's work to link and unite families in His temples.