Archival Code: FORTRAN and the "Father" of Facial Recognition Technologies

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Founded in 2009 by Dr. Lori Emerson, the Media Archaeology Lab is utterly unique not only because it is an open, accessible space for anyone to come and perform hands-on experiments with its extensive collection but also because it demonstrates alternative paths in the history of technology and empowers visitors to imagine an alternative present and future. The lab hosts reading groups, artist residencies, events, retro game nights, and workshops on how to fix your old or new devices and even on how to build your own mesh network.

In short, the MAL is a community-driven hub for preserving and exploring the history of technology.

Canadian A.I. as a techno-national project

Machine Landscapes is building the first critical history of how Canada has reached its current international leadership position in artificial intelligence (A.I.) by recognizing and reconstructing the Canadian contributions to the state-of-the-art in machine learning, then critically analyzing those developments within the theoretical and research frameworks of critical digital humanities, feminist science and technology studies, and critical algorithm studies.

Digital Studies / Le champ numérique

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Open Library of Humanities

Synthetic Media and Deepfakes: Tactical Media in the Pluriverse

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Drawing from Rita Raley's understanding of tactical media and the writings of scholars such as Arturo Escobar on the pluriverse, this paper broadens discussion of deepfakes to first consider other synthetic media, specifically images produced by GANs, and then use that discussion to bridge into potential positive forms of deepfakes that arise from the foregrounding of deepfakes' production of digitally manipulated bodies and events. Because deepfakes disrupt traditional links between representation and the "real," they can be used to imagine and represent knowledge, histories, and future events in the pluriverse that are in opposition to colonial and patriarchal logics. This paper proposes three instances in which deepfakes can be repurposed into tactical media invested in the pluriverse's alterity: in the anonymizing of footage and/or witness testimony, as in the film *Welcome to Chechnya* (France 2020); in the generation of documentary re-enactment, in particular for events where there are little to no actual footage of an event; and in the creation of alternate histories and counterfactuals that reveal the narratives and power dynamics within accepted "history." This paper presents the author's prototypes of deepfakes variously as documentary re-enactment and alternate histories but, to be clear, the hope is not to promote these prototypes. Rather, this paper is intended to provide groundwork from which other scholars, in particular those from intersectionally disadvantaged populations, can use deepfakes in ways that generate, encourage, and support social justice, equality, and nonhierarchy.

S'inspirant de la conception des médias tactiques de Rita Raley et des écrits de chercheurs tels

“The Flexible Face: Unifying the Protocols of Facial Recognition Technologies”

- **citizenship**
- **gatekeeping citizenship resources (i.e. social and physical mobility)**
- **crises**

FRTs are combinations of the:

- **Technical**
- **Representational**
- **Political**

The Production and Circulations of Power within FRTs

- Larger strategies of domination (top-down power)
- Subjectification (bottom-up power)
- Feature creep and the normalizing of the technology

IEEE Technology and Society

Delta Airlines facial recognition biometric scanning technology, Hartsfield-Jackson International Airport, Atlanta, GA, Nov. 19, 2018.

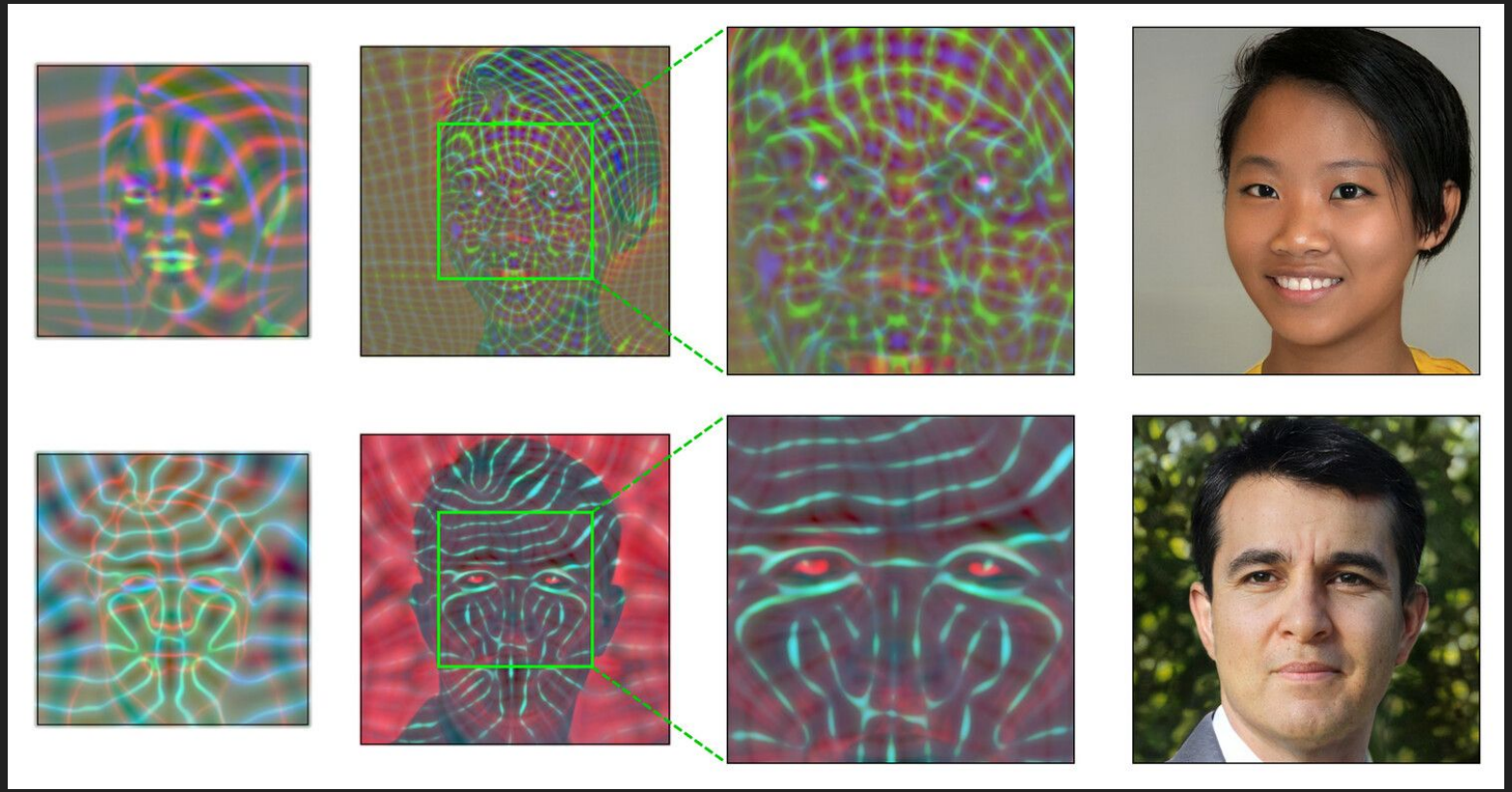
Aaron Tucker

The Citizen Question

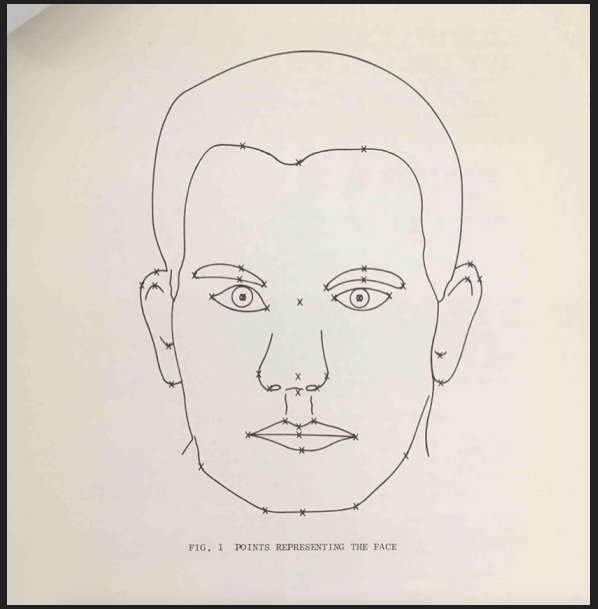
Making Identities Visible Via Facial Recognition Software at the Border

Digital Object Identifier 10.1109/MTS.2020.3031847
Date of current version: 2 December 2020

“Haunting, Blackness, and Algorithmic Thought” by Ezekiel Dixon-Román and Ramon Amaro



A braided media archeology



Archival Material from the Bledsoe Papers
University of Texas at Austin

- Tracing FRTs in the context of Wolfgang Ernst's understanding of **the operative moment** which helps to reconstruct the evolutions of **technical protocols**
- Lisa Gitelman's framing of digital media as structured, maintained and controlled by **hegemonic bureaucratic functioning** which reveals FRTs' **political protocols**
- Anna Munster's work wherein intense attention is paid to **the flux of relationships forming and unforming in durational and dynamic pulses within the image-making** of technological-biological networks that then form **representational protocols**.

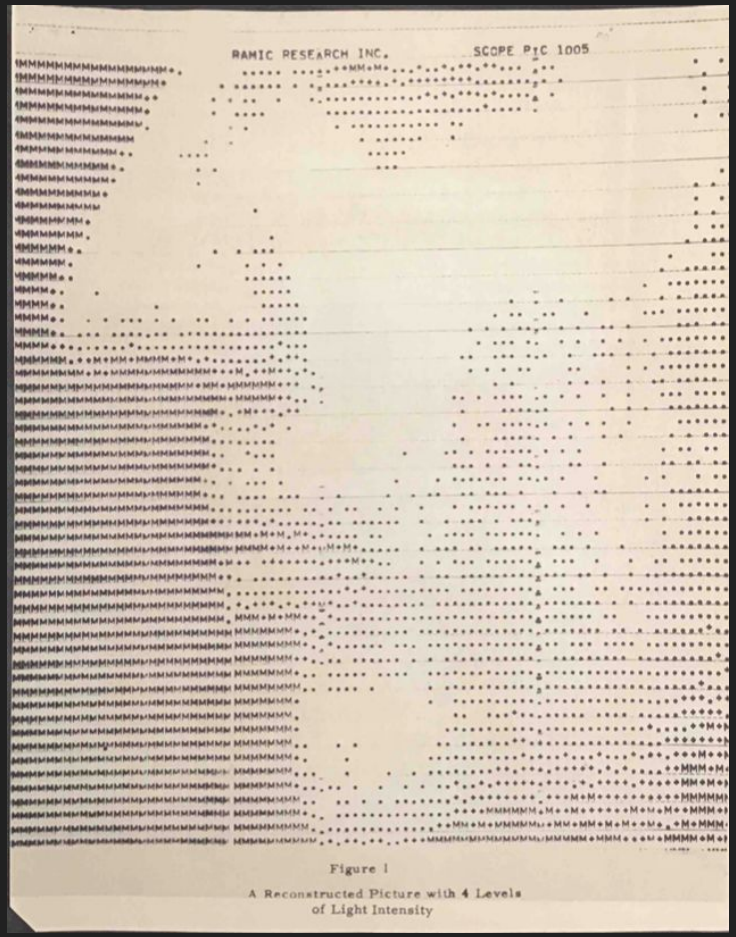


Figure 1
A Reconstructed Picture with 4 Levels of Light Intensity

Archival Material from the Bledsoe Papers
University of Texas at Austin

Entangled Media Archaeologies as Interrogations of Constellations of Power

- Reveals how power expresses itself in colonial, misogynist, anti-black logics
- Historicizing v. the extreme speed of state-of-the-art technological development
- Works symbiotically with critical making and research creation

Key Historical Case Studies

- Francis Galton, a racist 19th century scientistic, and his papers at The National Archive in London U.K.
- Original archival work drawing from primary sources at the papers of Woodrow “Woody” Bledsoe, the “father” of modern FRTs (University of Texas at Austin).
- An original translation from the Japanese of the Nippon Electric Company’s work on the first public demonstration of FRTs in 1970 (built on research done at The British Library, London, U.K.)

The Woodrow “Woody” W. Bledsoe Papers

Dolph Briscoe Center for American History - University of Texas at Austin (August 2022)

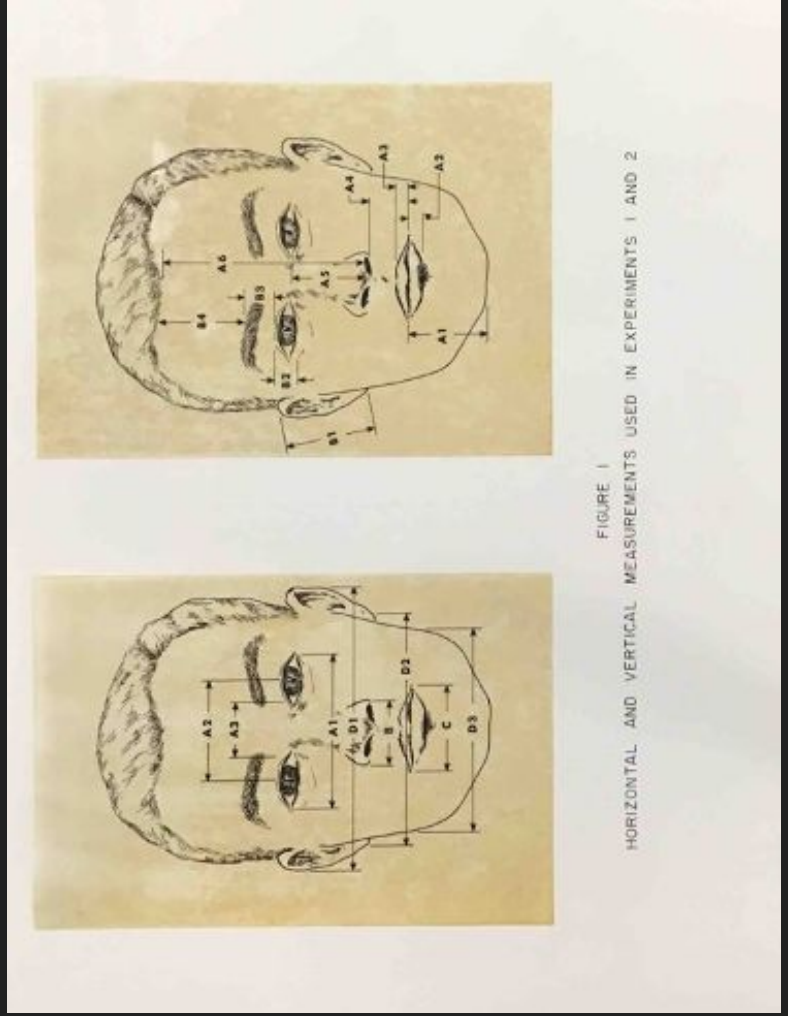
Woodrow “Woody” W. Bledsoe

Considered the “father” of automated facial recognition technologies

Began his career doing 1950s mostly classified work at the American Defence-led Sandia Corporation on aspects of nuclear fallout and missile-air defence

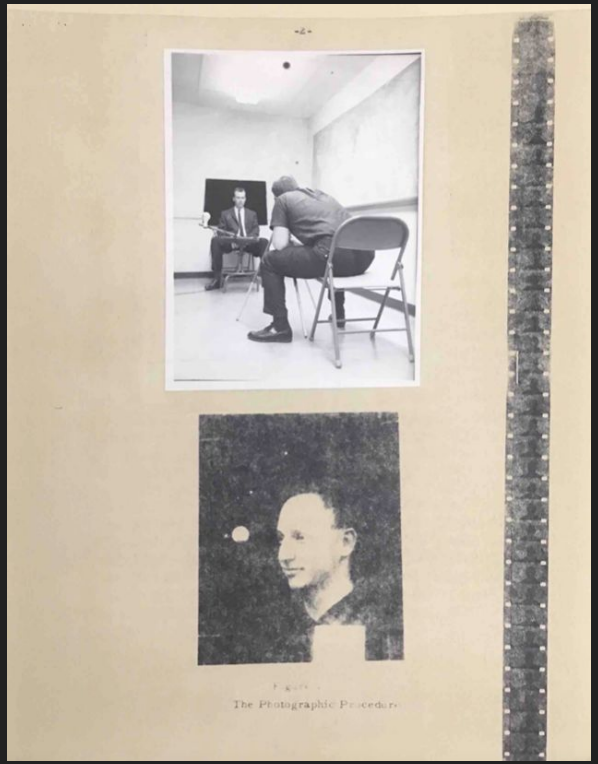
Started Panoramic Research, where he did the bulk of his FRT work, in early 1960s with a team that included co-authors Helen Chan Wolf, Lawrence Chowdy, and Charles L. Bisson.

The popular narrative is that he left FRT research in the late 1960s; became a key A.I. researcher in the decades to follow.



Archival Material from the Bledsoe Papers University of Texas at Austin

Expert in the field



Received and read research on the state of the art of FRTs into the 1980s (correspondence)

Gave talks at: 1968 at Texas Christian University; in Edinburgh in 1973; and in Austin, Texas in 1991; contacted by West Midlands police in 1987.

“I worked at one time on a device for recognizing human faces. An interesting, challenging project which will eventually succeed. It could be very helpful ~~to the police~~ for check cashing, drug control etc, but it could also be used for evil by a wicked dictator, to help control a helpless population.” (Sciences Futures Talk - May 12 1984)

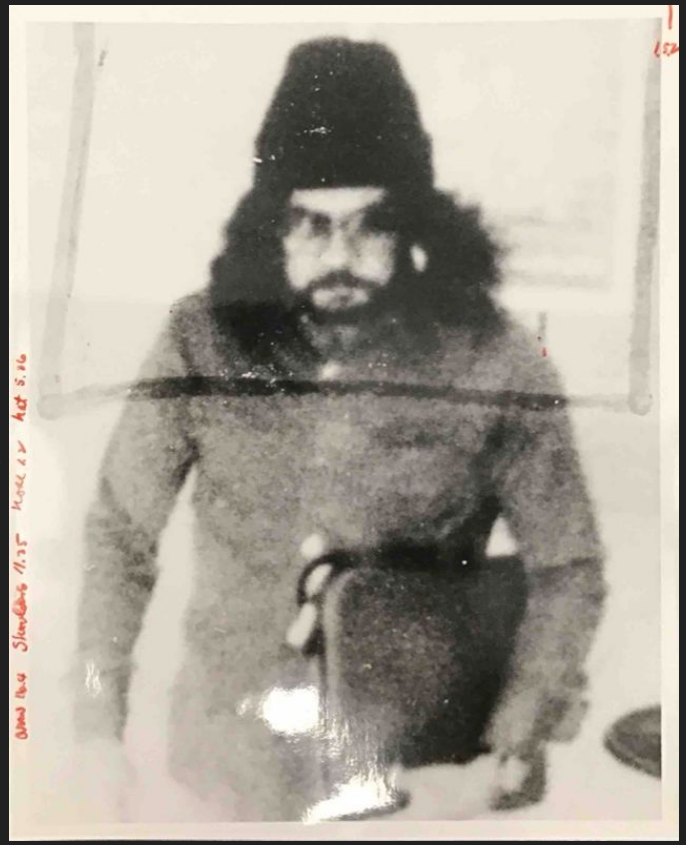
Solving for Faces in CCTV Footage

Stanley Casper commissioned Bledsoe to use an automated FRT to determine whether a man on trial was the robber. Bledsoe was also to be an expert witness at the trial.

Recommended by **Paul Ekman (inventor of The Facial Action Coding System (FACS)).**

Using photos, of the robber and of the defendant, to match identities

Code written in FORTRAN



Thank you!

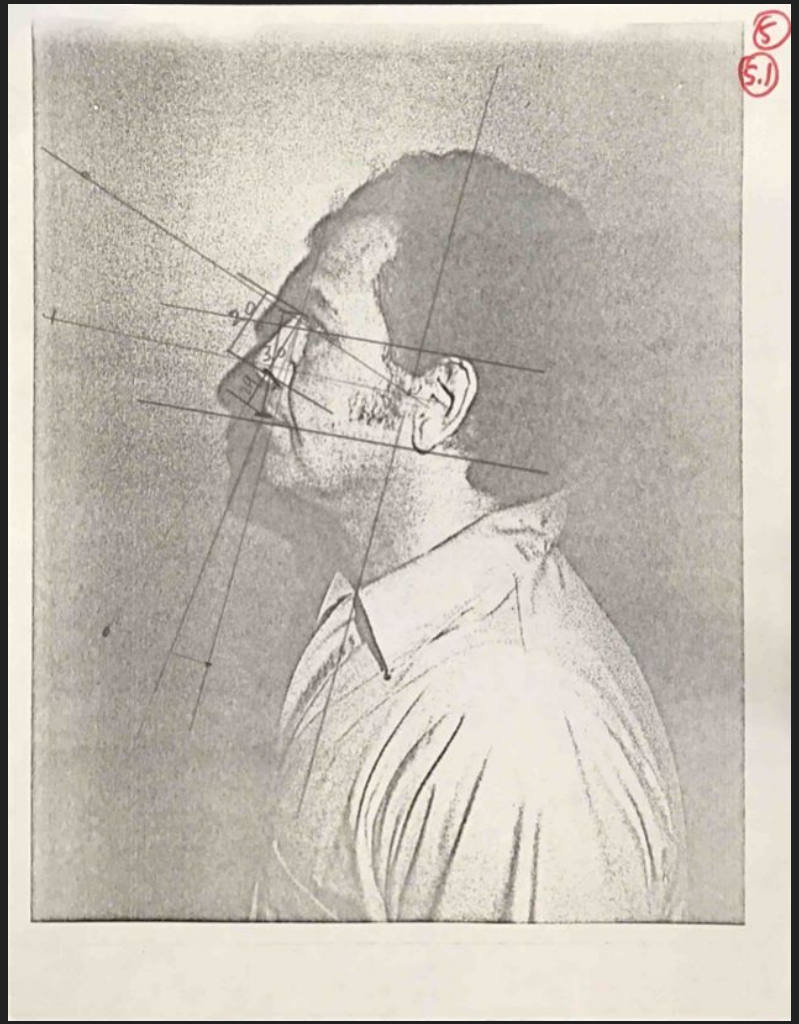
Ralph Kolewe (Toronto)

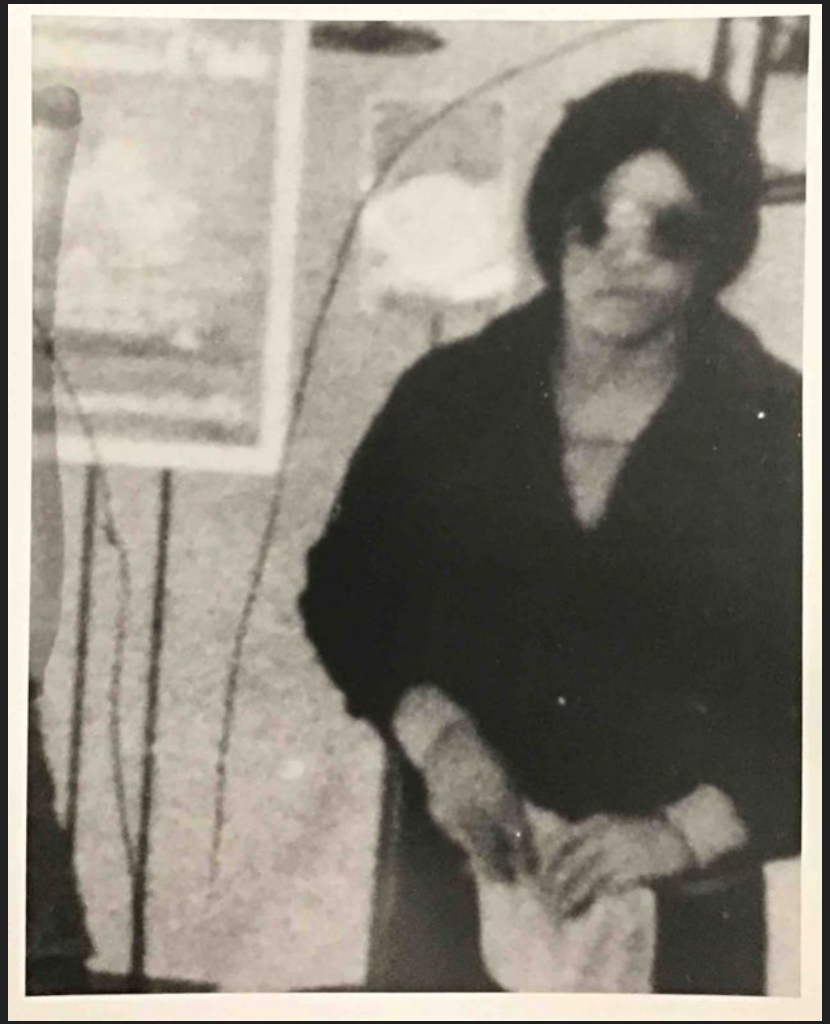
libi rose striegl (Managing Director)

Eric Perez

Chris Torrence

Andrew/Spike Brandt



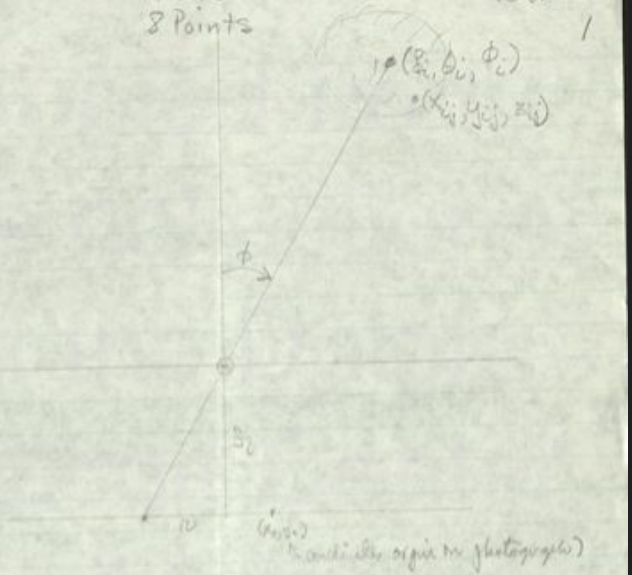


Picture #	NOSE WIDTH	SHOULDER WIDTH	NOSE SHOULDER				
DEFENDANT							
(1.6)	1.75	18.1	.0967	.0039 .00975			
(2.6)	1.60	16.8	.0952	.0024			
(17.4.2)	.82	9.2	.0891	-.0037			
(17.6)	1.85	20.5	.0902	-.0026			
			FIRST TWO				
			Mean .096				
			σ .00011				
			Mean .0928				
			σ .0032				
BANK ROBBER	min	max					
1.2	1.37	1.45	13.4+	.102 .108	-.00052	1	5 6
1.5.1	2.2	2.33	21.2+	.107 .110	.00148	4	4 1
1.5.2		1.2	11.5+	.104 .104	-.00452	1	10 4
1.6	2.12	2.35	20.7+	.102 .114	.00548	1	0 6
2.2	1.45	1.67	14.0+	.104 .119	.01048	1	5 4
2.41	1.3	1.35	11.5+	.113 .117	.00848	10	3 5

HEAD
8 Points

16 June 8-

1



Cameras with focal length f is positioned at the origin, pointed straight up.

The center of ith (1st or 2nd) head is located at $(\rho_i, \theta_i, \phi_i)$, and it is rotated about this center with rotation (θ_i', ϕ_i').

The structure of the head is fixed. The n points on it are located at $(\rho^j, \theta^j, \phi^j)$, with respect to the center at the origin and a fixed rotation $(0, 0)$.

3

Unknowns

8 (7) $\rho_i, \theta_i, \phi_i, \theta_i', \phi_i', f_i, x_{i0}, y_{i0}$ $i = 1, 2$

3n ρ^j, θ^j, ϕ^j $j = 1, 2, \cdots, n$

Knowns (needed from measured on photographs) x_{ij}, y_{ij}

$4n$ x_{ij}, θ_{ij} $i = 1, 2$, $j = 1, 2, \cdots, n$

$x_{ij} = x_{i0} + x_{ij}\cos\theta_{ij} + y_{ij}\sin\theta_{ij}$, $y_{ij} = y_{i0} - x_{ij}\sin\theta_{ij} + y_{ij}\cos\theta_{ij}$

$4n = 3n + 8$, $\boxed{n = 8}$

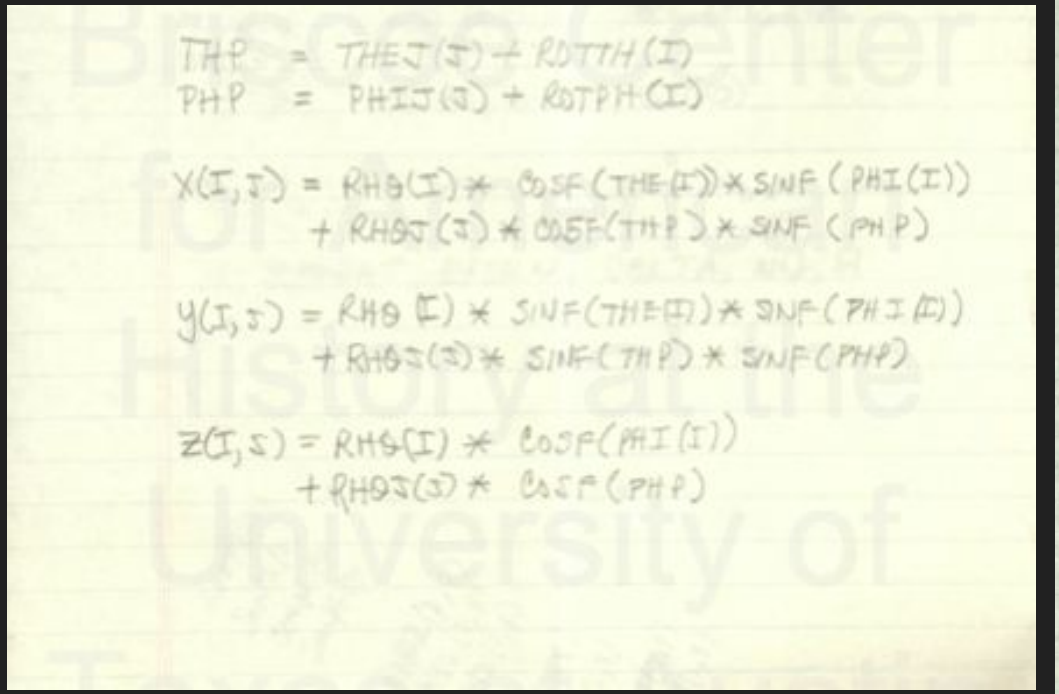
Problem

To determine whether 3 equations (1), (2), (3) are consistent.

If they are consistent, then the two sets of measurements (x_{ij}, θ_{ij}), $j = 1, n$ and (y_{ij}, θ_{ij}), $j = 1, n$

represent the same head (located at two different positions, with different rotations, and photographed by two different cameras).

Handwritten FORTRAN code (.FTN)

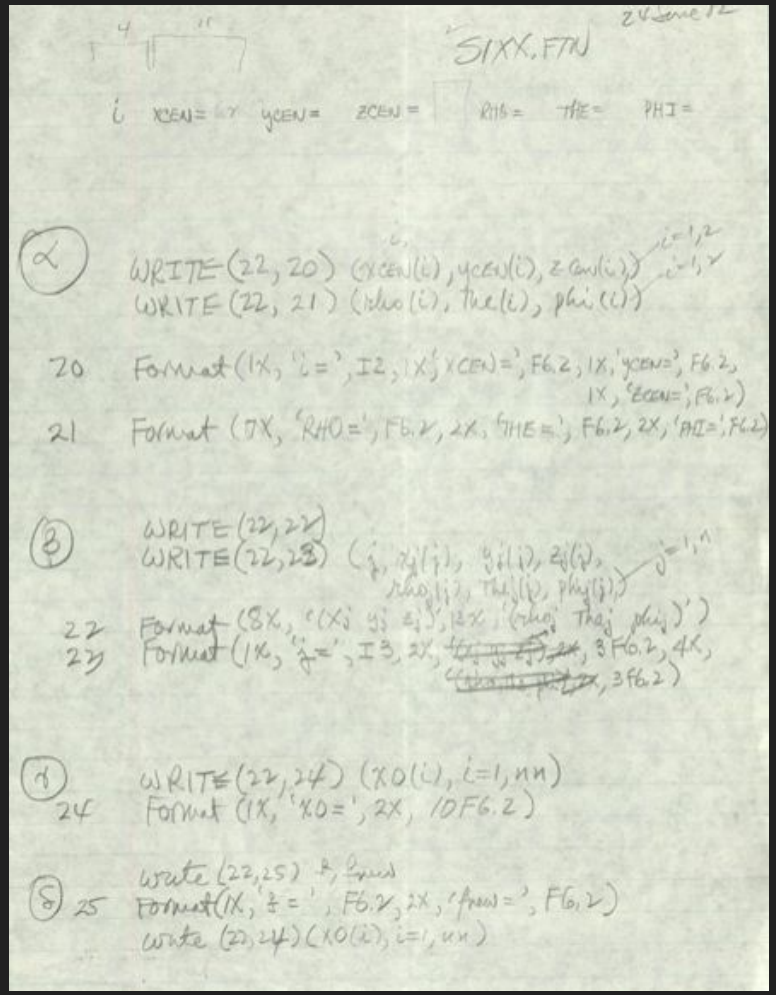


```
THP  = THEJ(J) + RDTTH(I)
PHP  = PHIJ(J) + RDTPH(I)

X(I,J) = RHS(I) * COSF(THE(I)) * SINF(PHI(I))
       + RHSJ(J) * COSF(THP) * SINF(PHP)

Y(I,J) = RHS(I) * SINF(THE(I)) * SINF(PHI(I))
       + RHSJ(J) * SINF(THP) * SINF(PHP)

Z(I,J) = RHS(I) * COSF(PHI(I))
       + RHSJ(J) * COSF(PHP)
```



```
SIXX.FTN

i  XCEN=  YCEN=  ZCEN=  RHS=  THE=  PHI=

(a)  WRITE(22,20) (xcen(i), ycen(i), zcen(i))   i=1,2
     WRITE(22,21) (rho(i), the(i), phi(i))

20   Format(1X,'i=',I2,1X,'XCEN=',F6.2,1X,'YCEN=',F6.2,
          1X,'ZCEN=',F6.2)
21   Format(0X,'RHO=',F6.2,2X,'THE=',F6.2,2X,'PHI=',F6.2)

(b)  WRITE(22,22)
     WRITE(22,23) (j, xj(j), yj(j), zj(j),
                   rhoj(j), thej(j), phij(j))   j=1,n
22   Format(8X,'(Xj  yj  zj)',12X,'(rhoj  thej  phij)')
23   Format(1X,'j=',I3,2X,3F6.2,4X,3F6.2)

(c)  WRITE(22,24) (XO(i), i=1,nn)
24   Format(1X,'XO=',2X,10F6.2)

(d)  write(22,25) r, fmod
25   Format(1X,'r=',F6.2,2X,'fmod=',F6.2)
     write(22,24)(XO(i), i=1,nn)
```

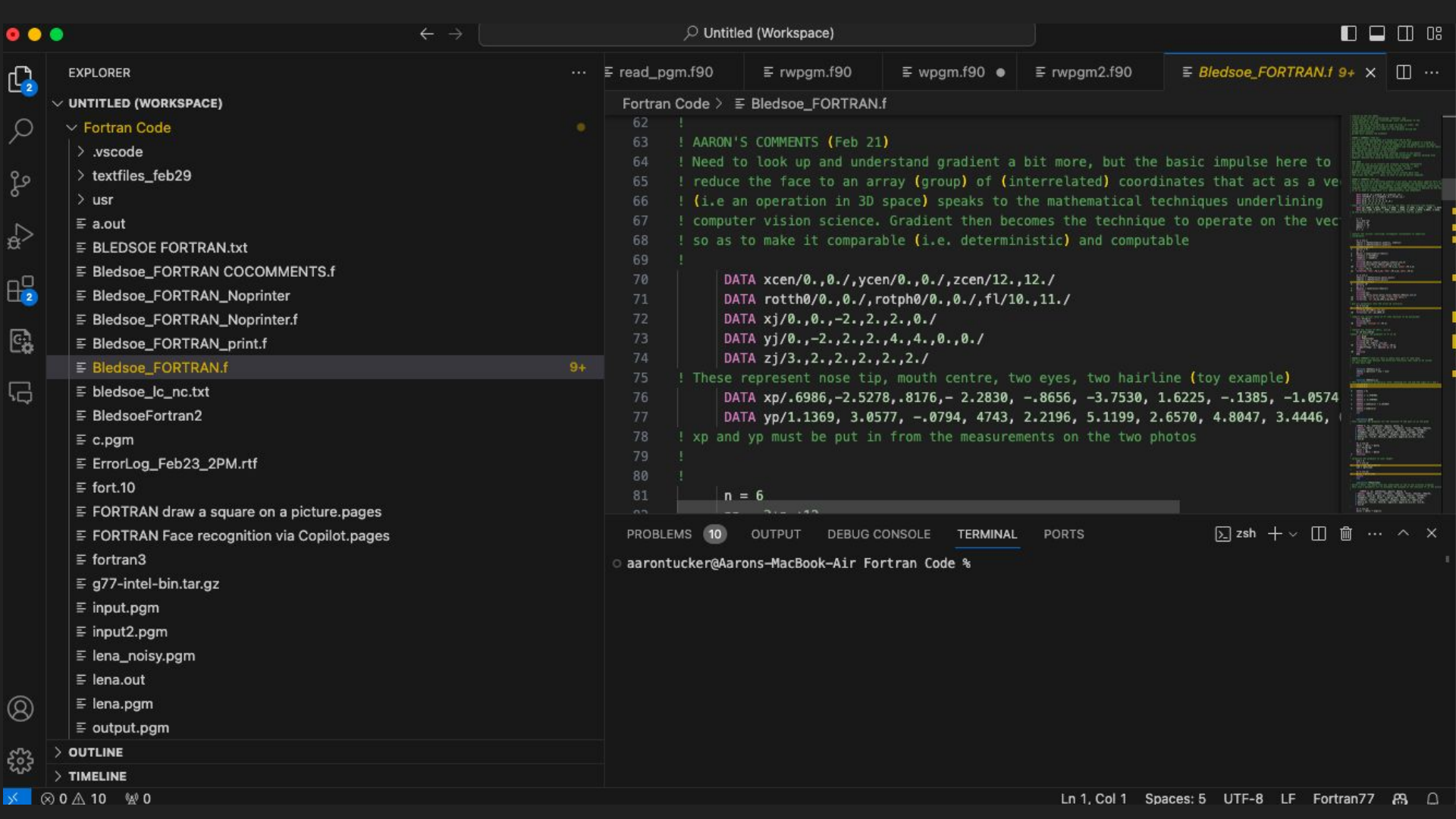
```
      iterat = 10
      epsiln = .01
      delta = .1
      h = .1
c
c     convert the initial (starting) rectangular coordinates to spherical
c     coordinates.
c
      do 2 i=1,2
      rho(i) = rhofun(xcen(i),ycen(i), zcen(i))
      the(i) = thefun(xcen(i),ycen(i))
      if(rho(i))3,4,3
 4    phi(i) = 0.
      go to 5
 3    phi(i) = acos(zcen(i)/rho(i))
 5    rotth(i) =rotth0(i)
      rotph(i) = rotph0(i)
 2    continue
      write(22,20)(i,xcen(i),ycen(i),zcen(i),i=1,2)
      write(22,21)(rho(i),the(i),phi(i),i=1,2)

 20   format(1x,'i= ',i2,1x,'xcen=',f6.2,1x,'ycen=',f6.2,1x,
     2       'zcen=',f6.2)
 21   format(7x,'rho=',f6.2,2x,'the=',f6.2,2x,'phi=',f6.2)
c
      do 6 j=1,n
      rhoj(j) = rhofun(xj(j),yj(j),zj(j))
      thej(j) = thefun(xj(j),yj(j))
      if(rhoj(j))7,8,7
 8    phij(j) = 0
      go to 9
 7    phij(j) = acos(zj(j)/rhoj(j))
 6    continue
      write(22,22)
      write(22,23)(j,xj(j),yj(j),zj(j),
     2     rhoj(j),thej(j),phij(j),j=1,n)
 22   format(8x,'(xj yj zj)',13x,'(rhoj thej phij)')
 23   format(1x,'j=',i3,2x,3f6.2,4x,3f6.2)
c
c     put all parameters into the array x0 initially
      do 9 i=1,nn
 9    x0(i) = rho(i)
      write(22,24)(x0(i),i=1,nn)
 24   format(1x,'x0=',2x, 10f6.2)

c
c     compute the initial value of ff (the function to be minimized)
      call ff(x0,f)
      write(22,26)f
 26   format(1x,'initial f=',f6.2)
      stop
c
c     iterate new values of x0(i), i=1,nn
      do 10 k=1,iterat
c     obtain in gr(nn) the gradient of ff at x0
      call grad
      call ffmin(fnew)
      write(22,25) f, fnew
      write(22,24) (x0(i), i=1,nn)
 25   format(1x,f6.2,2x,f6.2,2x,10f6.2)
```

```
      end
c
      subroutine ffmin(fnew)
c     this uses a parabolic fit to estimate the minimum of the function ff
c     in the direction of the gradient gr
c
      common h, nn, iterat, epsiln, delta, h,
     1 rho(2), the(2), phi(2), rotth(2), rotph(2), f1(2),
     2 rhoj(6), thej(6), phij(6),
     3 xp(2,8), yp(2,8),
     4 xcen(2), ycen(2), zcen(2), rotth0(2), rotph0(2), xj(8), yj(8),
     * zj(8),
     5 gr(40), x0(40), x1(40), x2(40),
     6 costh(2), sinth(2), cosph(2), sinph(2),
     7 rho2(2,8), the2(2,8), phi2(2,8), r(2,8), th(2,8), xpp(2,8),
     * ypp(2,8),
     8 x(2,8), y(2,8), z(2,8)
c
      do 2 i=1,nn
      x1(i) = x0(i) + h*gr(i)
 2    x2(i) = x0(i) + 2*h*gr(i)
c
      call ff(x1,f1)
      call ff(x2,f2)
c     select the value of h which minimizes ff in the direction gr
      hmin = (3.*ff + f2 - 4*f1)*h)/(2*(f2 - 2*f1+ff))
c     evaluate ff there getting fnew
      do 3 i=1,nn
 3    x0(i) = x0(i) + hmin*gr(i)
      call ff(x0,fnew)
      return
      end
c
      subroutine ff(xx,f)
      common h, nn, iterat, epsiln, delta, h,
     1 rho(2), the(2), phi(2), rotth(2), rotph(2), f1(2),
     2 rhoj(6), thej(6), phij(6),
     3 xp(2,8), yp(2,8),
     4 xcen(2), ycen(2), zcen(2), rotth0(2), rotph0(2), xj(8), yj(8),
     * zj(8),
     5 gr(40), x0(40), x1(40), x2(40),
     6 costh(2), sinth(2), cosph(2), sinph(2),
     7 rho2(2,8), the2(2,8), phi2(2,8), r(2,8), th(2,8), xpp(2,8),
     * ypp(2,8),
     8 x(2,8), y(2,8), z(2,8)
c
      dimension xx(40)

c     given the values xx(0),....,xx(nn), which represent estimated
c     values for the various parameters rho,the,phi, etc, this computes
c     the picture coordinates x(i,j), y(i,j), and compares them with the
c     observed picture coordinates  xp(i,j) and y(i,j), and returns the
c     sum of the squares of the differences, ff.
c     at first the array xx is put into rho, the, phi, etc
c
      do 1 i=1,nn
 1    rho(i) = xx(i)
      write(22,30)(xx(i),i=1,nn)
 30   format(1x,'xx',2x,30f6.2)
c
```


Untitled (Workspace)
EXPLORER
UNTITLED (WORKSPACE)
Fortran Code
.vscode
textfiles_feb29
usr
a.out
BLEDSOE FORTRAN.txt
Bledsoe_FORTRAN COCOMMENTS.f
Bledsoe_FORTRAN_Noprinter
Bledsoe_FORTRAN_Noprinter.f
Bledsoe_FORTRAN_print.f
Bledsoe_FORTRAN.f 9+
bledsoe_lc_nc.txt
BledsoeFortran2
c.pgm
ErrorLog_Feb23_2PM.rtf
fort.10
FORTRAN draw a square on a picture.pages
FORTRAN Face recognition via Copilot.pages
fortran3
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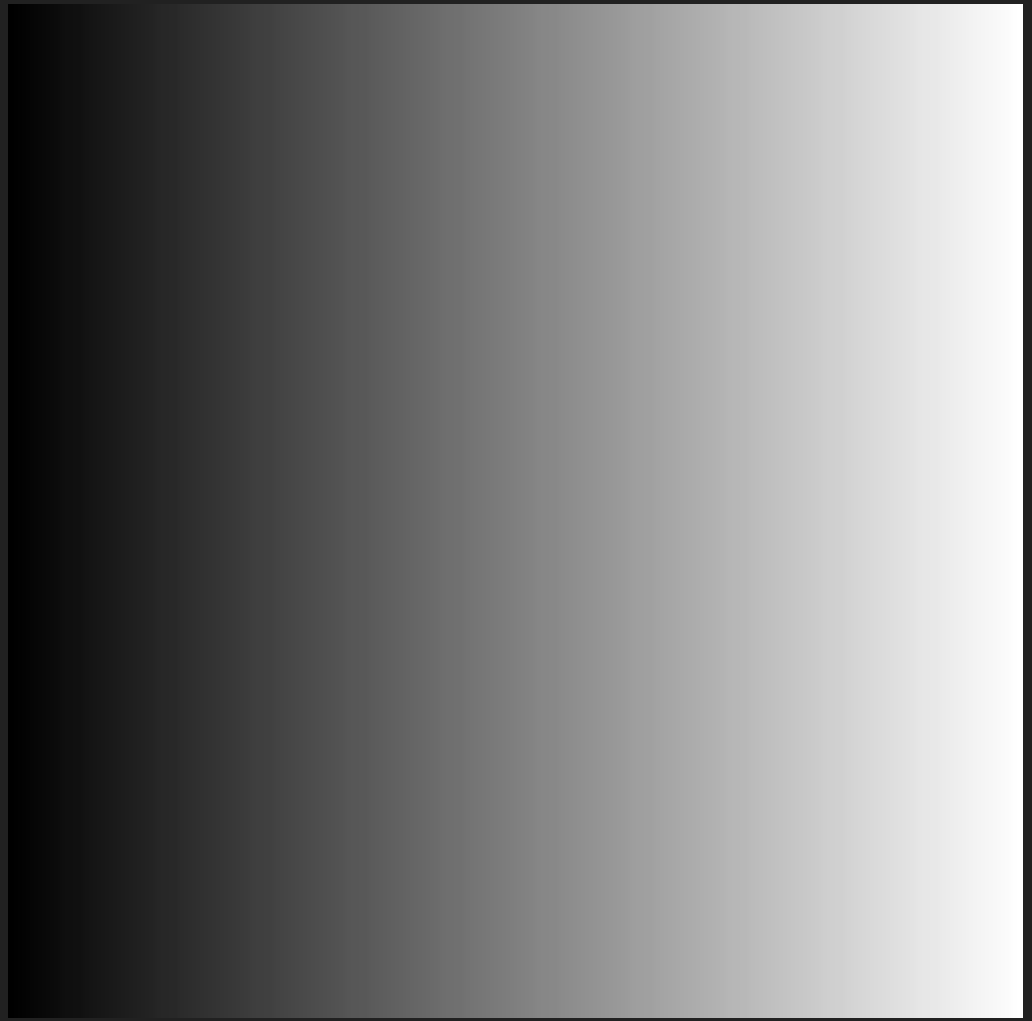
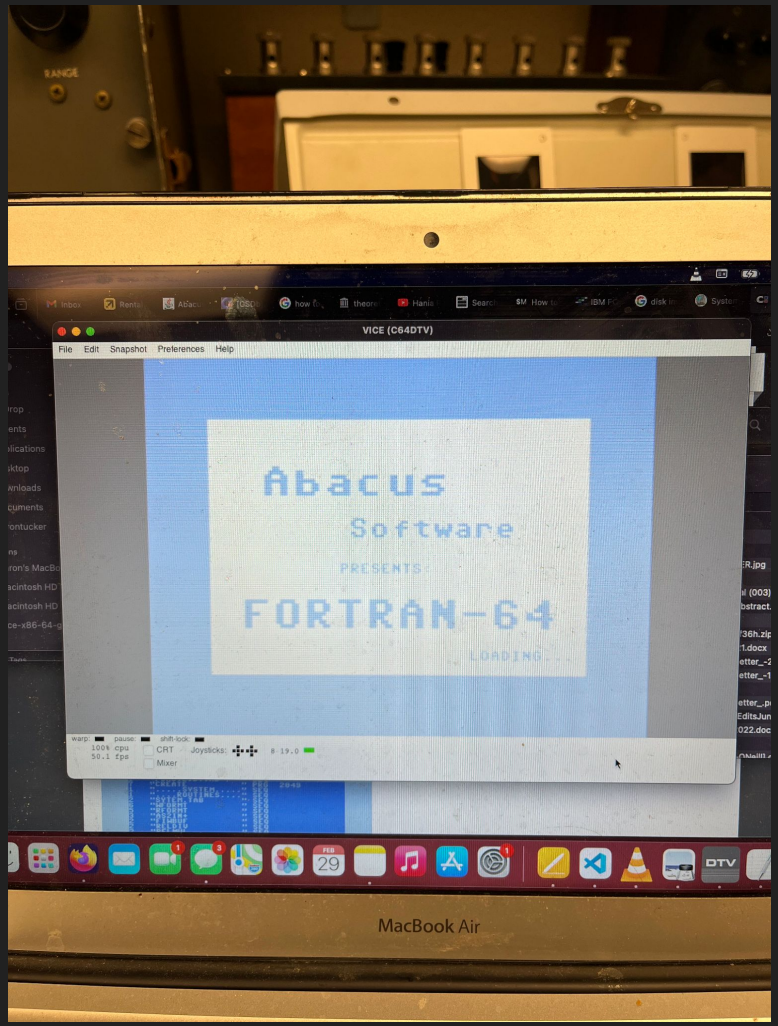
input.pgm
input2.pgm
lena_noisy.pgm
lena.out
lena.pgm
output.pgm
OUTLINE
TIMELINE
read_pgm.f90
rwpgm.f90
wpgm.f90
rwpgm2.f90
Bledsoe_FORTRAN.f 9+
Fortran Code > Bledsoe_FORTRAN.f
62 !
63 ! AARON'S COMMENTS (Feb 21)
64 ! Need to look up and understand gradient a bit more, but the basic impulse here to
65 ! reduce the face to an array (group) of (interrelated) coordinates that act as a ve
66 ! (i.e an operation in 3D space) speaks to the mathematical techniques underlining
67 ! computer vision science. Gradient then becomes the technique to operate on the vec
68 ! so as to make it comparable (i.e. deterministic) and computable
69 !
70 DATA xcen/0.,0./,ycen/0.,0./,zcen/12.,12./
71 DATA rotth0/0.,0./,rotph0/0.,0./,fl/10.,11./
72 DATA xj/0.,0.,-2.,2.,2.,0./
73 DATA yj/0.,-2.,2.,2.,4.,4.,0.,0./
74 DATA zj/3.,2.,2.,2.,2.,2./
75 ! These represent nose tip, mouth centre, two eyes, two hairline (toy example)
76 DATA xp/.6986,-2.5278,.8176,- 2.2830, -.8656, -3.7530, 1.6225, -.1385, -1.0574
77 DATA yp/1.1369, 3.0577, -.0794, 4743, 2.2196, 5.1199, 2.6570, 4.8047, 3.4446,
78 ! xp and yp must be put in from the measurements on the two photos
79 !
80 !
81 n = 6
PROBLEMS 10
OUTPUT
DEBUG CONSOLE
TERMINAL
PORTS
zsh
aarontucker@Aarons-MacBook-Air Fortran Code %
0 10 0
Ln 1, Col 1
Spaces: 5
UTF-8
LF
Fortran77

The joy of:

a) Debugging and Running in Virtual Environments; Layers of Errors (in VSCode, after running)
b) Learning Co-Pilot
c) Hunting down a (working) FORTRAN77 Compiler

FORTRAN and Images: Strengths and Weaknesses




VICE (C64DTV)
File Edit Snapshot Preferences Help
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Software
PRESENTS
FORTRAN-64
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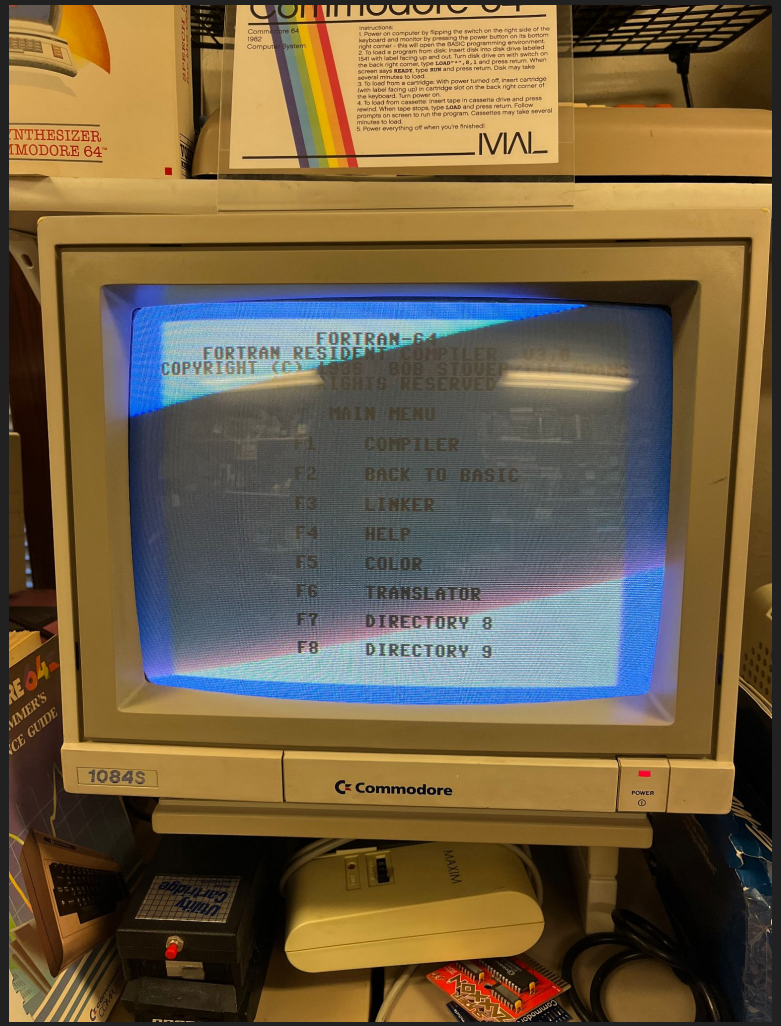
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F1 COMPILER
F2 BACK TO BASIC
F3 LINKER
F4 HELP
F5 COLOR
F6 TRANSLATOR
F7 DIRECTORY 8
F8 DIRECTORY 9
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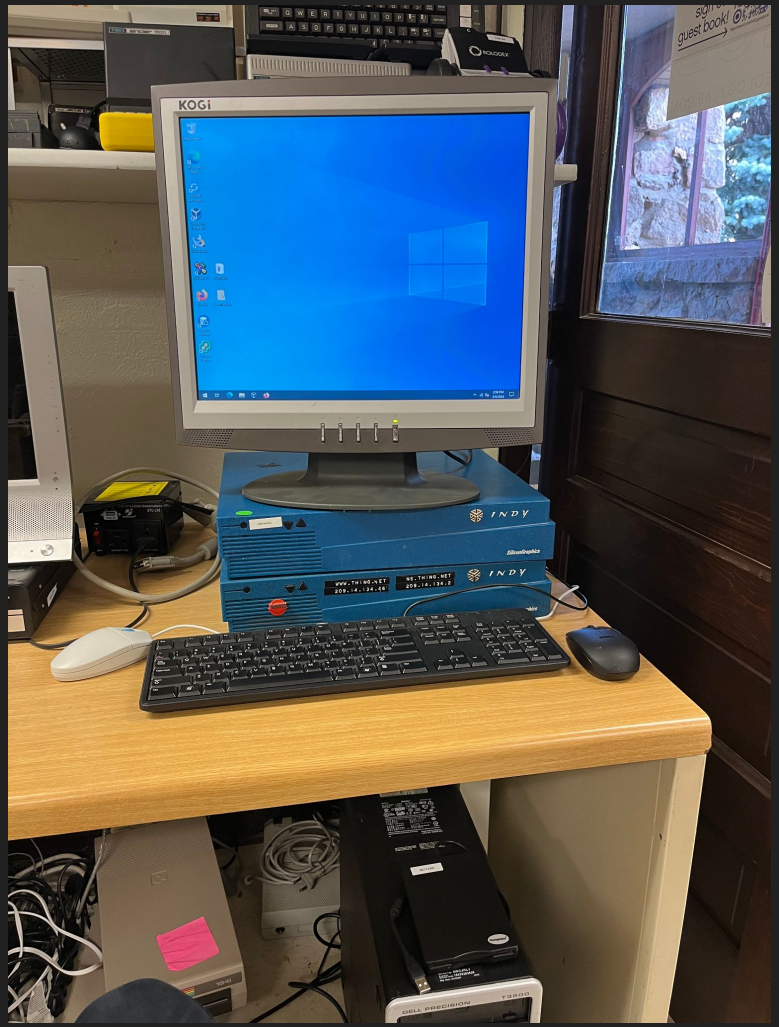
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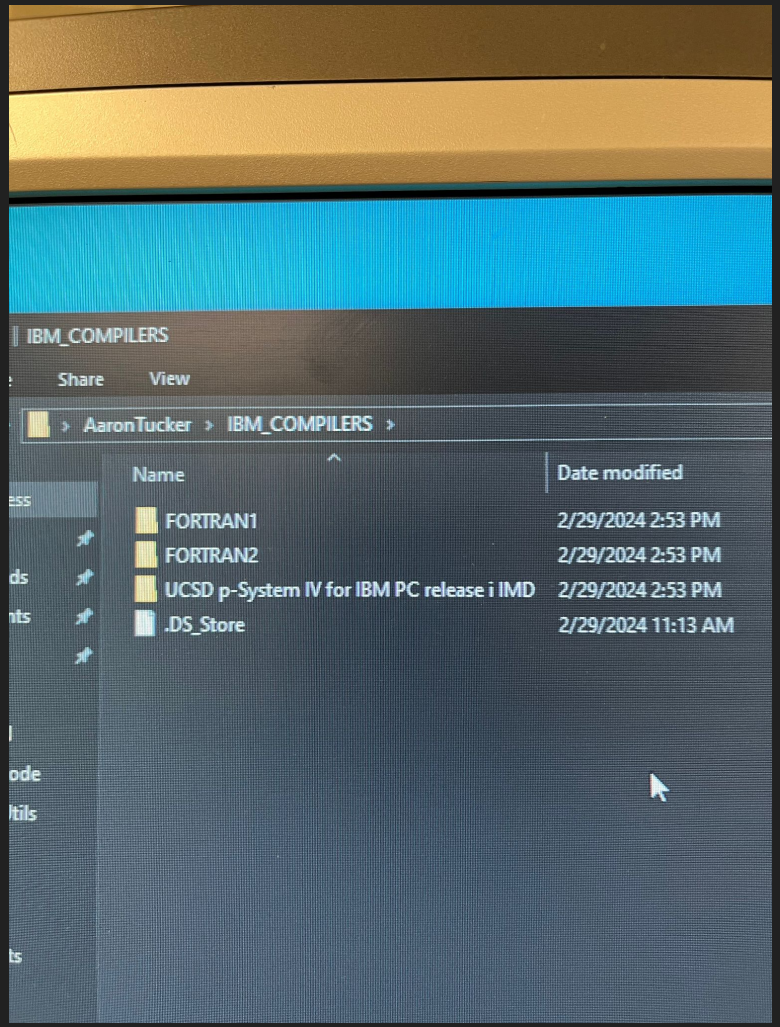
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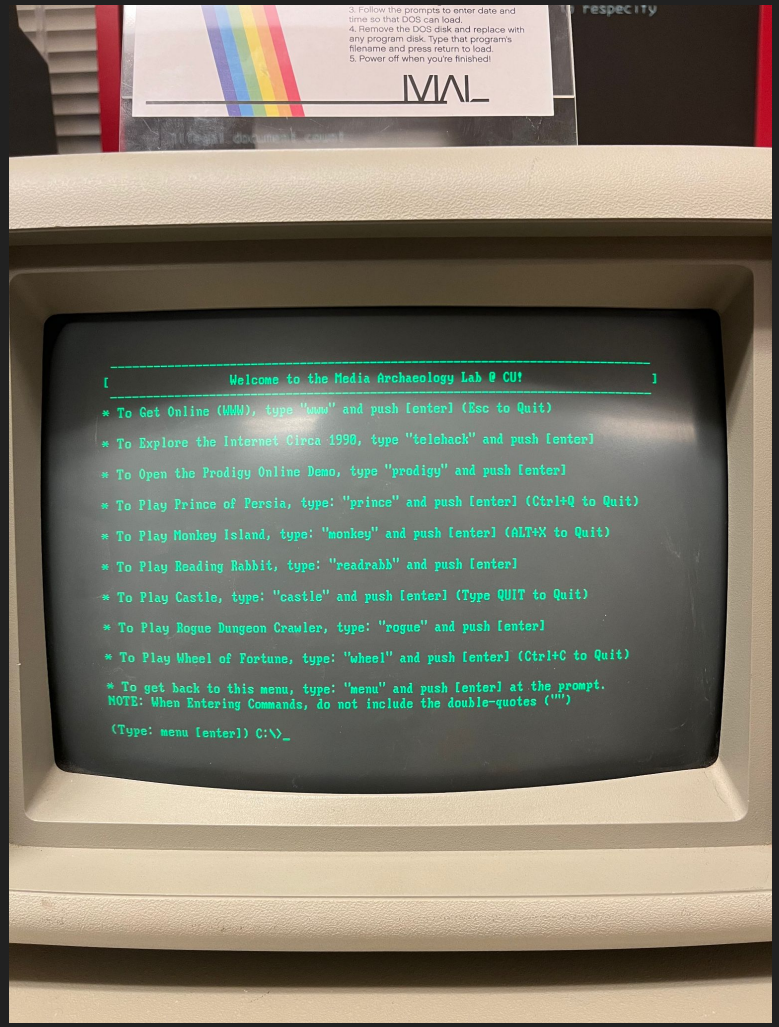
IBM PC 5150


Welcome to the Media Archaeology Lab @ CU!
* To Get Online (WWW), type "www" and push [enter] (Esc to Quit)
* To Explore the Internet Circa 1990, type "telehack" and push [enter]
* To Open the Prodigy Online Demo, type "prodigy" and push [enter]
* To Play Prince of Persia, type: "prince" and push [enter] (Ctrl+Q to Quit)
* To Play Monkey Island, type: "monkey" and push [enter] (ALT+X to Quit)
* To Play Reading Rabbit, type: "readrabb" and push [enter]
* To Play Castle, type: "castle" and push [enter] (Type QUIT to Quit)
* To Play Rogue Dungeon Crawler, type: "rogue" and push [enter]
* To Play Wheel of Fortune, type: "wheel" and push [enter] (Ctrl+C to Quit)
* To get back to this menu, type: "menu" and push [enter] at the prompt.
NOTE: When Entering Commands, do not include the double-quotes ("")
(Type: menu [enter]) C:\>

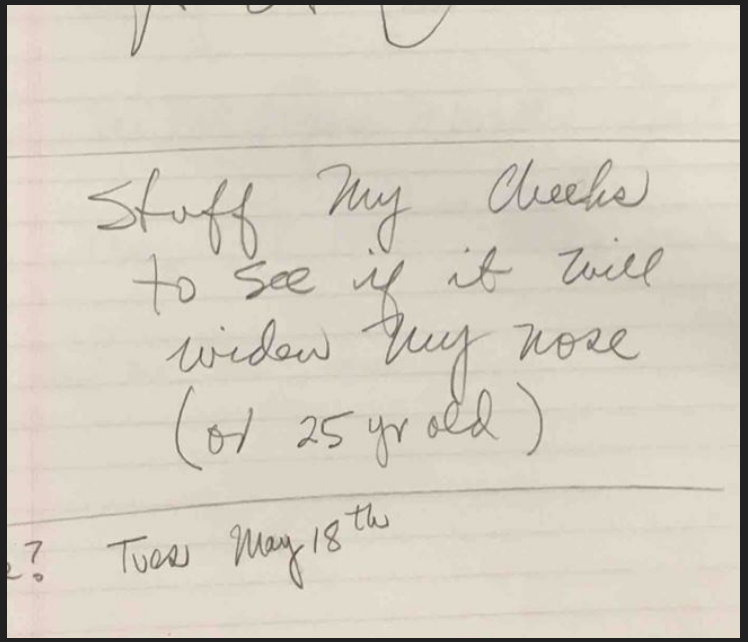
Bledsoe: “I feel helpless working with so little” (hand scrawled note)

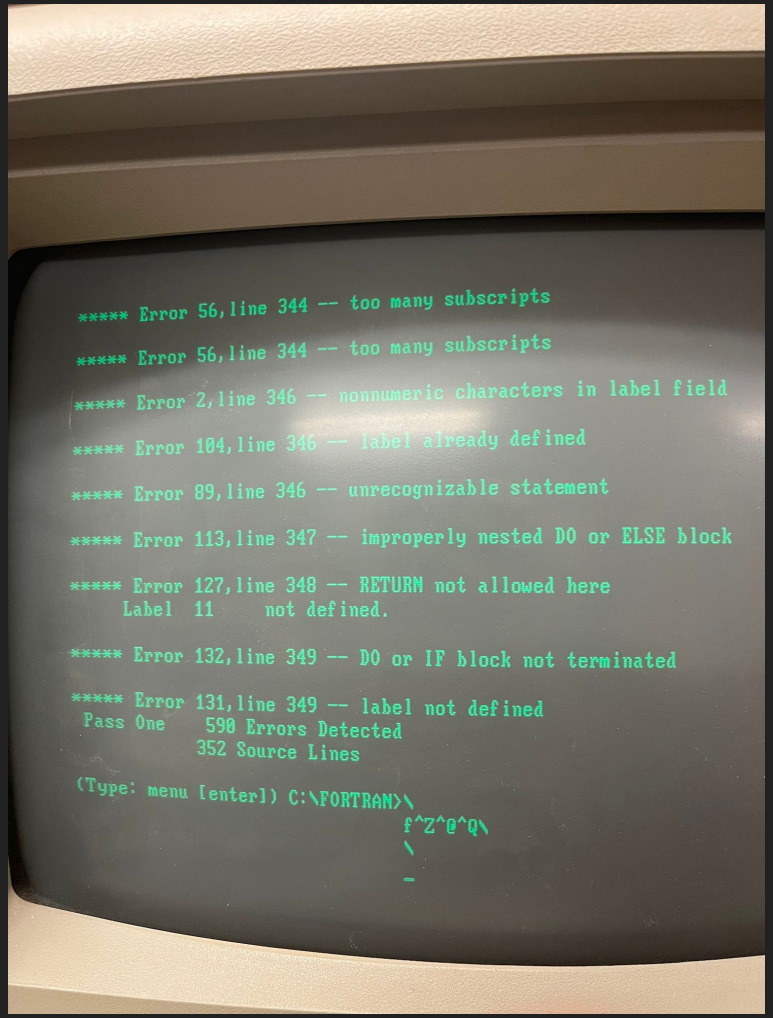
A productive failure: “Can not identify, only exclude”

a. Camera placement + camera movement - how that effects capture of the face -> getting from 2D to 3D space (Head rotation and tilt)

b. Non-cooperative faces (sunglasses, beard)

c. “Non-cooperative faces” -> Distortion of the face (“We tried a few simple experiments where we stuff our cheeks with cotton, and used a boxer’s mouth guard”)





Productive Failure

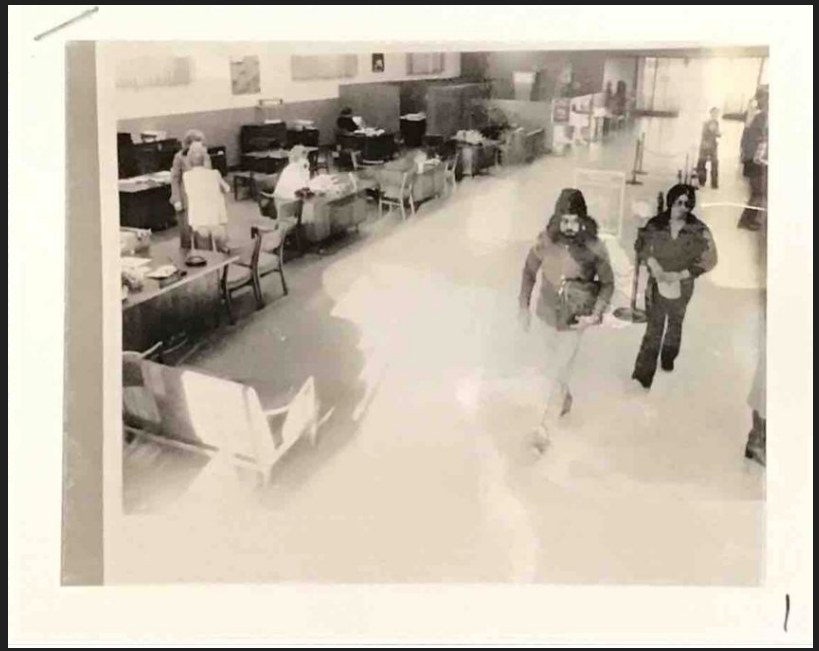
Colliding physical and virtual pasts - emulators, VS Code, Co Pilot and the physical machines

Media Archaeology in action!

Spherical Coordinates and the Body in Bledsoe's Code vs Image Processing

Interfacing with Past Machines

Collaboration and Multiple Expertise



Next Steps

Still trying to get this program working; (at least) one fatal and major error

Writing about the methodologies and importance of this project

Larger project of media archeology of facial recognition technologies

What are YOU interested in, in relation to this project?

Questions?

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Interoperable and Standardized Algorithmic Images: The Domestic War on Drugs and Mugshots Within Facial Recognition Technologies and Generative AI

Abstract
Beginning in the 1990s, the National Institute of Standards and Technology (NIST) leveraged the 1980s’ American War on Drugs to improve and expand facial recognition technology (FRT) infrastructure, including the domestic building of FRTs reliant on mugshots that continue to be in operation in 2024. When examining the network of mugshot databases gathered by the NIST, such as the Multiple Encounters Dataset (MEDS) I and II (2010) and Special Database 18 Mugshot Identification Database (SD-18) (2016), it is clear that the same gendered and racialized dynamics present in policing practices related to the War on Drugs is reflected in the mugshot databases that are used for FRT research and evaluation, forming a dense informatics of domination. This chapter details the SD-18 and MEDS databases, as well as the MORPH database, showcasing how their representational, technical, and political protocols operate. Doing so means grappling with the face as a long-time site of political power within the networks of entwined protocols. Yet, within the biopolitical logics of the datasets and the facial images’ deployments within FRTs, such circulations of power are subsumed by technical protocols, wherein the desires for frictionless interoperability supersedes political and representational protocols that confront what it means to target the face in algorithmic technologies. Further, in the contemporary moment, these interoperable images do not remain contained to mugshot datasets, but leak into other forms of image-making and visual culture, including into contemporary generative artificial intelligence systems such as DALL-E.

Keywords: facial recognition technologies (FRTs), mugshots, facial data, War on Drugs, policing practices, algorithmic governance

FRTs Monitoring and Controlling Social and Physical Mobility

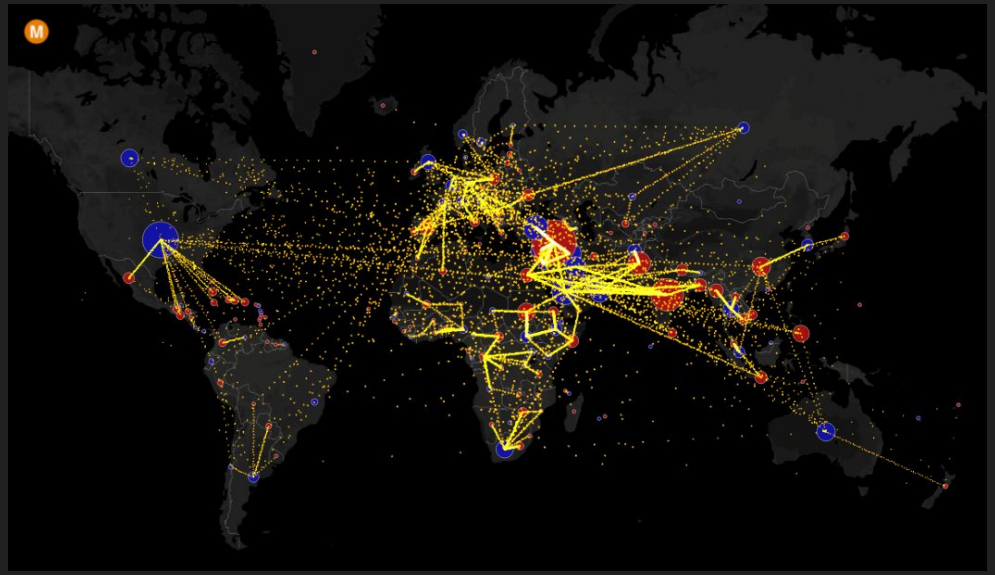

Image of global migration, World Economic Forum

I am particularly concerned about FRTs as technologies based in logics of **interdiction** (the sorting of "legal" from "illegal" resources and populations)

The use of FRTs in the present moment and near-future of:

- **climate catastrophe**
- **war**
- **mass migration**