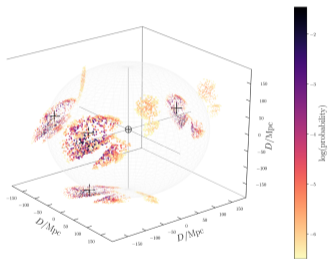


My Text in Your *Handwriting*

Tom S. F. Haines
T.S.F.Haines@bath.ac.uk



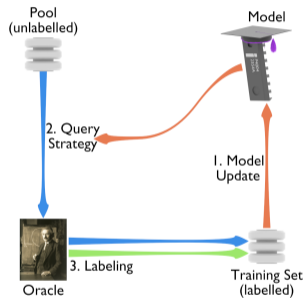
I apply *machine learning* to many problems...



- **Laser Interferometer Gravitational-wave Observatory**
- Inferring locations of coalescing binary neutron stars



- Background subtraction
- Finding objects in CCTV



- Active learning
- When ML identifies the data it can learn the most from

Quiz format

1 *All experimenters which*

he reflected, he considered

A

he reflected, he considered

B

← Sample of authors real handwriting

} One real, one fake

Quiz format

1 *All experimenters which*

he reflected, he considered

A

he reflected, he considered

B

← Sample of authors real handwriting

} Identify fake

2 above cited extracts will show.

and shook her head.

A

and shook her head.

B

3 adding many compliments:

the Kildare street club.

A

the Kildare street club

B

4 Topsy always made great

and another LAWYER

A

and another LAWYER

B

2 above cited extracts will show.

and shook her head.

A

and shook her head.

B

3 adding many compliments:

the Kildare street club.

A

the Kildare street club

B

4 Topsy always made great

and another LAWYER

A

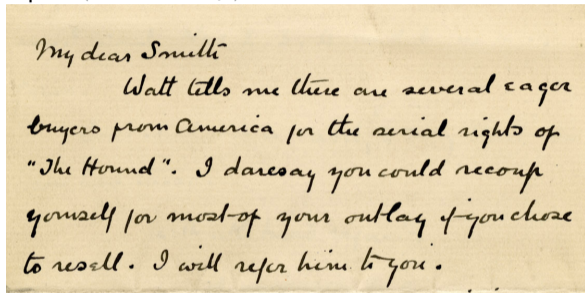
and another LAWYER

B

Handwriting generation

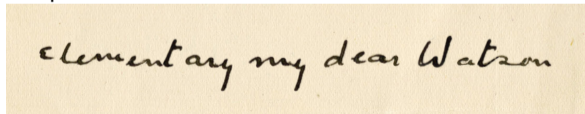
- Aim: **Fool human beings**
- User-guided texture synthesis:
 - User specified text to generate
 - Handwriting from a specific author

Input: (Sir. Arthur Conan Doyle)



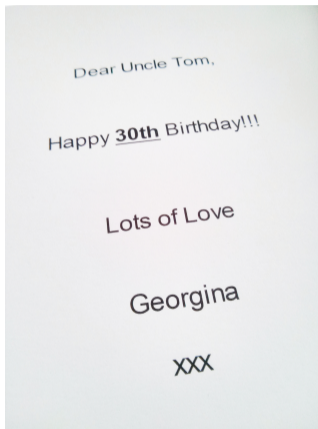
My dear Smith
Watt tells me there are several eager
buyers from America for the serial rights of
"The Hound". I dare say you could recoup
yourself for most of your outlay if you chose
to resell. I will refer him to you.

Output:



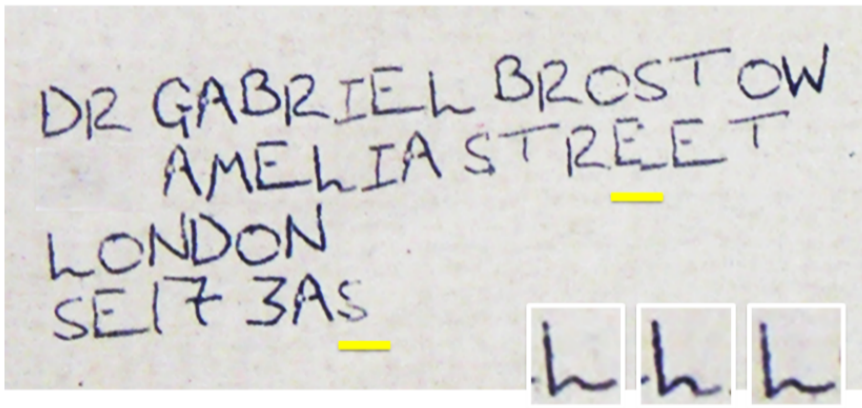
elementary my dear Watson

Why? – Gifts



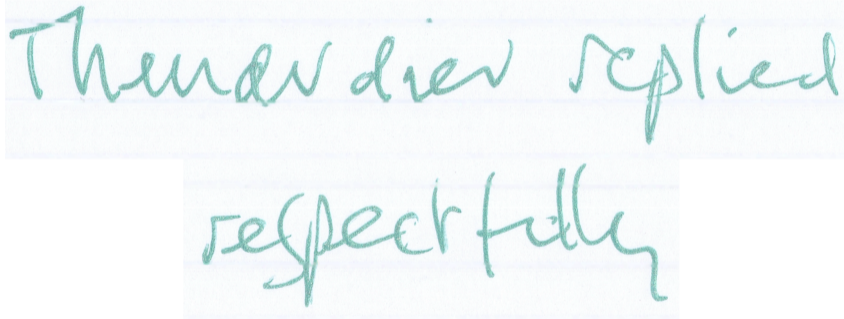
Gift sent without giver present (e.g. via Amazon)
Handwriting model = giver or celebrity

Why? – Camouflage



Camouflaging important documents in post, e.g. bank cards (above)

Why? – Disability



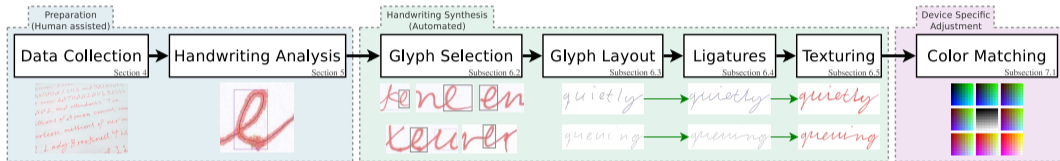
Therapist replied
respectfully

Synthesise handwriting after a disability (e.g. stroke, above) affects writing

Why? – Artistic

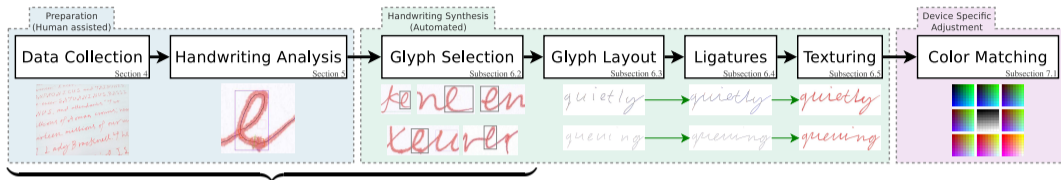


Artistic, e.g. comic book lettering (above, from Batman)



1. Data collection
2. Analysis (tagging)
3. **Synthesis**
4. Colour matching

Cost function



Minimise:

$$C(R, t, A) = G_A(g, t) + S_A(g, x) + L_A(g, x, l) + T_A(g, x, l, R).$$

- Note: Random numbers are used such that it's a draw, rather than just optimisation

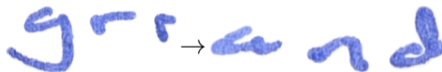
Cost function

Minimise:

$$C(R, t, A) = \underline{G_A(g, t)} + S_A(g, x) + L_A(g, x, l) + T_A(g, x, l, R).$$

Glyph Selection term:

- Match glyphs to user text



ground

Cost function

Minimise:

$$C(R, t, A) = G_A(g, t) + \underline{S_A(g, x)} + L_A(g, x, l) + T_A(g, x, l, R).$$

Glyph layout term:

- Horizontal and vertical offsets



Handwritten blue ink example showing the transformation of the word "and" from a spaced-out form to a compact form with horizontal and vertical offsets.

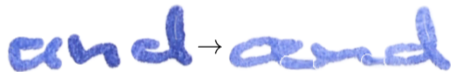
Cost function

Minimise:

$$C(R, t, A) = G_A(g, t) + S_A(g, x) + \underline{L_A(g, x, l)} + T_A(g, x, l, R).$$

Ligature term:

- For joined up handwriting



and → and

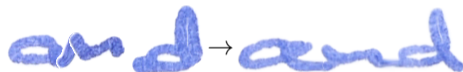
Cost function

Minimise:

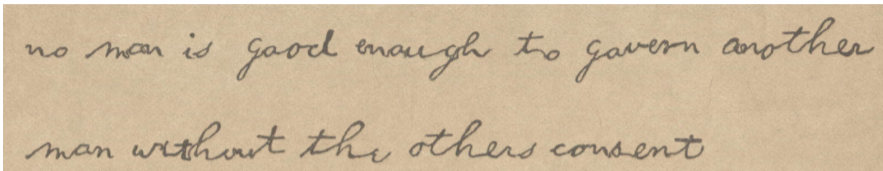
$$C(R, t, A) = G_A(g, t) + S_A(g, x) + L_A(g, x, l) + \underline{T_A(g, x, l, R)}.$$

Texturing term:

- Creates one continuous line

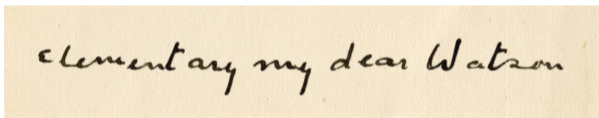


Results – qualitative



no man is good enough to govern another
man without the others consent

(Abraham Lincoln)



elementary my dear Watson

(Sir Arthur Conan Doyle)

I paint flowers so they will not die

(Frida Kahlo)

Results – quantitative

- User study, 100 participants
- Multiple parts; identifying fake given real most challenging (for us):

1 *All experimenes which*

he reflected, he considered

A

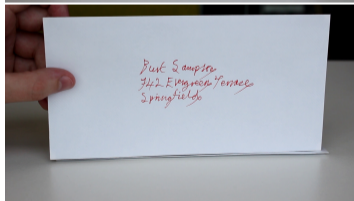
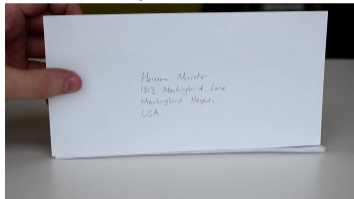
he reflected, he considered

B

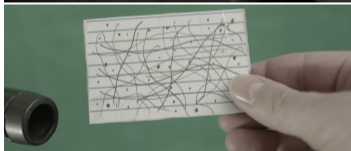
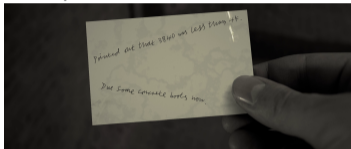
- Users right 52% of the time (50% = can't tell)

More results

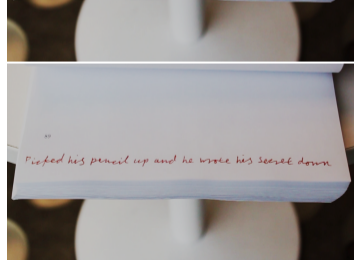
Post intercept:



Film production:



Music flipbook:



That's all folks

(Mel Blanc's handwriting)

Questions?