



# Handwritten Text Recognition (HTR)

Cheryl Lim | DSIF 9 (:  
27<sup>th</sup> May 2023

The background is a dark blue notebook with several white pages. A red paperclip is on the top page. A USB drive is on the right page. A hand-drawn eye is on the left page. A hand-drawn hand is on the bottom right page. The title "Problem Statement" is written in large, bold, black letters on the top page.

# Problem Statement

Teachers spend a *lot* of **time**  
**and effort** on marking.

Solution: develop a model to  
**automate (part of) the marking process.**

# OVERVIEW

## OBJECT DETECTION

isolate the  
handwritten portions

## HTR

decipher what's being written

## MATCH

compare to answer key

1. Si Ying always brings around a few safety pins just in case she needs them urgently.
2. Fatimah wants to visit New York to visit a famous statue made of copper.
3. The insects hovered around the light bulb.
4. My clumsy brother dropped his present right after he unwrapped it.
5. My sister has a huge fear of bumblebees.
6. No one believes what Jeremy says because he lies all the time.
7. COVID-19 is a contagious disease that first started spreading in 2019.
8. I love watching movies, especially action-packed ones.
9. Farhan is terrified of snakes. He cannot even stand to look at pictures of them.
10. Lydia made a beeline for the drinks stall once she reached the canteen.

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**HTR**

*decipher* what's being written

## MATCH

compare to answer key

safety pins

→ safety pins

statue

→ statue

hovered

→ hovered

unwrapped

→ unwrapped

t rrified

→ t rrified

believes

→ believes

disease

→ disease

# OVERVIEW

## OBJECT DETECTION

isolate the  
handwritten portions

## HTR

decipher what's being written

## MATCH

**compare** to answer key

Answer	Input	✓ or X
safety pins	safety pins	✓
statue	statue	✓
hovered	hovered	✓
unwrapped	unwrapped	✓
terrified	t rrified	X

source: spelling worksheets

# preparing the dataset



# expectation

1. Si Ying always brings around a few safety pins just in case she needs them urgently.
2. Fatimah wants to visit New York to visit a famous statue made of copper.
3. The insects hovers around the light bulb.
4. My clumsy brother dropped his present right after he unwrapped it.
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# reality

- Almost there!
- Day: Tuesday Class: P4 Qinness Marks: 9 / 10
- Parent's signature: \_\_\_\_\_
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# draw bboxes + annotate

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# crop (for HTR)

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safety pins

statue

hovered

# augment (for OD)

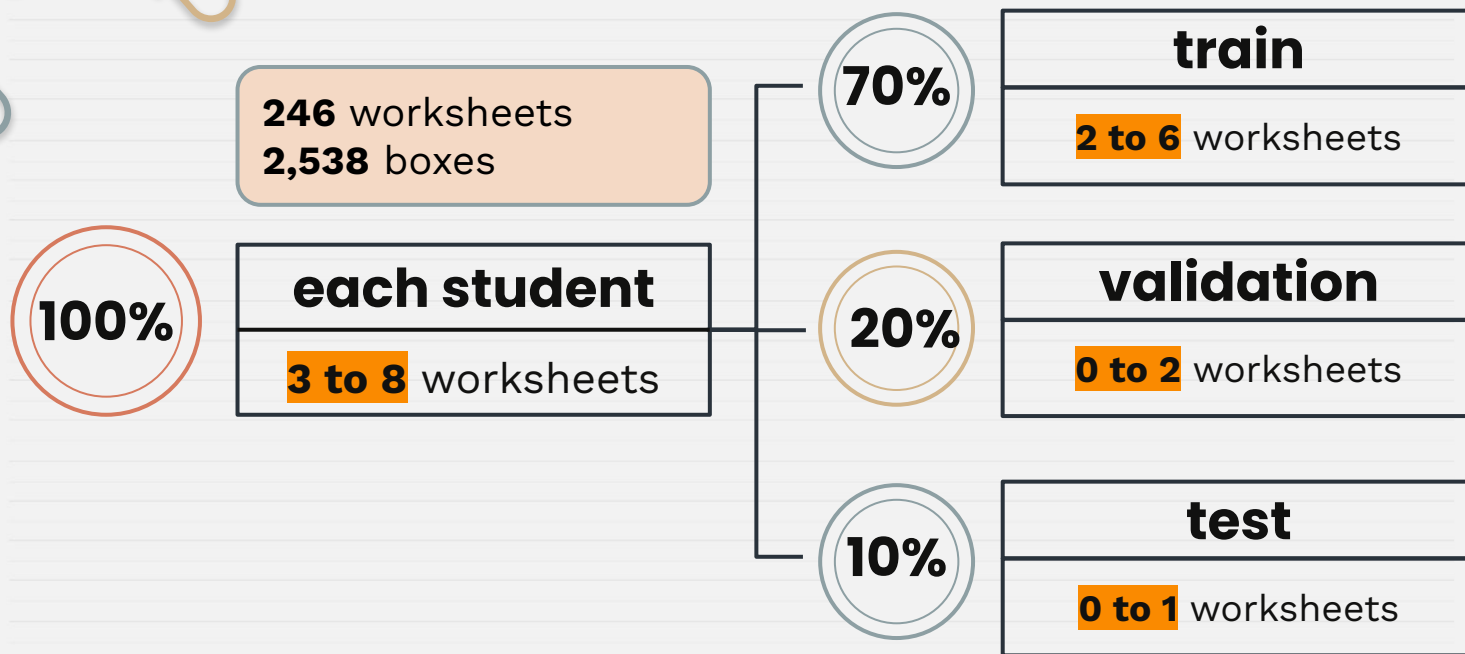
## rotate

1. Si Ying always brings around a few safety pins just in case she needs them urgently.
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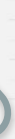
## shear

1. Si Ying always brings around a few safety pins just in case she needs them urgently.
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# train/validation/test



# train/validation/test



**100%**

**246** worksheets  
**2,538** boxes

**each test**

**28 to 32** worksheets

**70%**

**train**

**20 to 22** worksheets

**20%**

**validation**

**6 to 7** worksheets

**10%**

**test**

**2 to 4** worksheets



# object detection using YOLOv8

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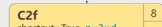
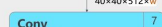
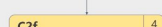
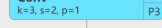
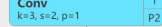
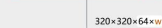
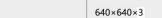
S what

$X_{gt}, Y_{gt}$

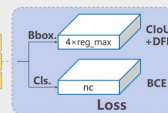
unwrapped

$X_p, Y_p$

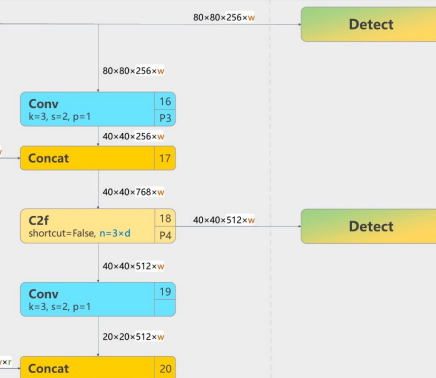
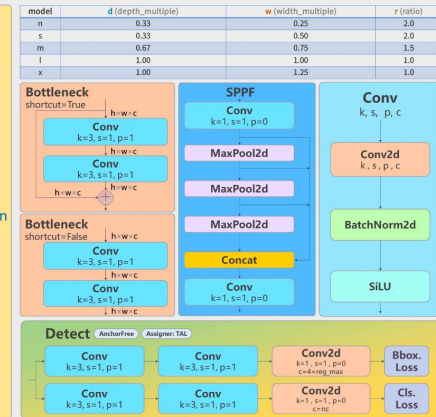
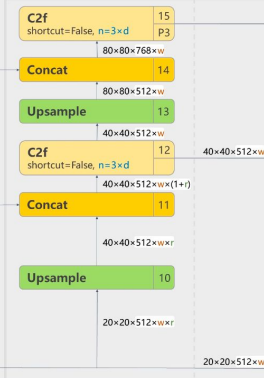
## YOLOv8

YOLOv8  
Backbone  
(P5)

## Backbone



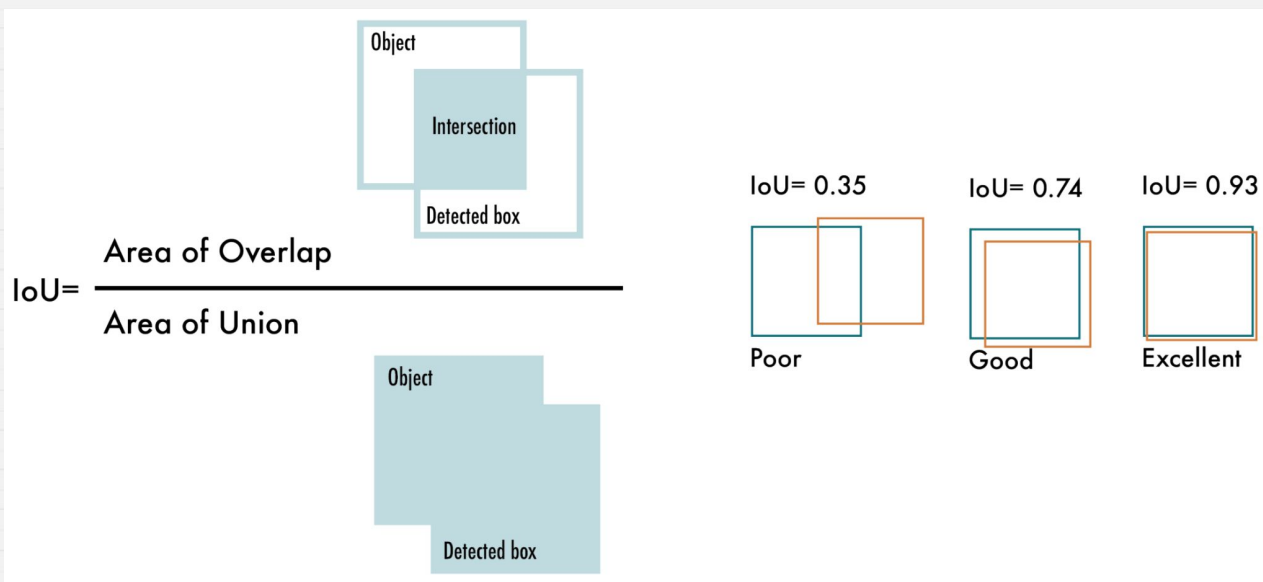
**C2f**  
 shortcut = ? , n



Head



# Intersection over Union (IoU)





# performance

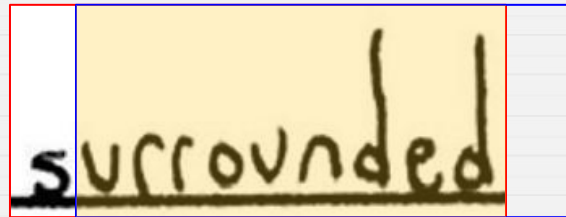
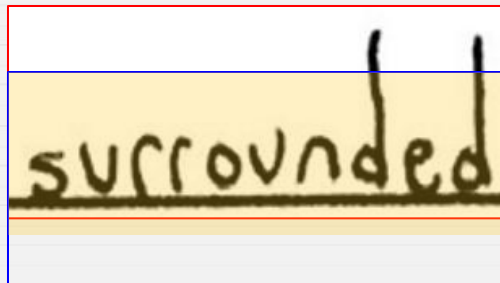
**0.99**

***mAP50***

**0.85**

***mAP50-95***

## Intersection over Union (IoU)



- Are you done with the preparations for Julian's birthday party?
- Despite losing, our team showed sportsmanship by congratulating the winners sincerely.
- Everyone groaned when Mrs Lee announced that she was going to give us a surprise test.
- My brother is in the junior division of his school's basketball club.
- Vignesh practises the piano diligently every day.
- I come from a family of athletes, but I dislike sports.
- My parents watch their favourite television programme every weeknight at 7 o'clock without fail.
- As Siqi was ill, her coach received the medal on her behalf.
- The prize-presentation ceremony went on despite the rain.
- After months of dedication and hard work, we were finally able to win the championship.

- Si Ying always brings around a few safety pin just in case she needs them urgently.
- Fatimah wants to visit New York to visit a famous statue made of copper.
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inaccurate

# imperfección

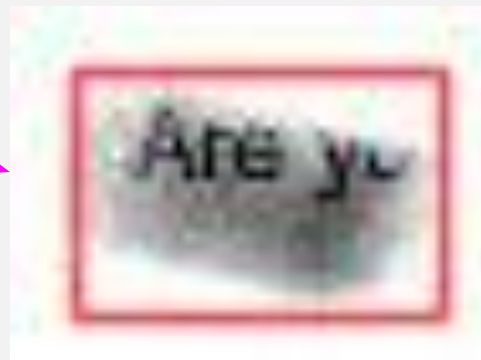
1. Are you done with the perm days for Julian's birthday party?
2. Despite losing, our team showed sports man ship by congratulating the winners sincerely.
3. Everyone groaned when Mrs Lee annocned that she was going to give us a surprise test.
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a sports man ship by c

false positive

# imperfeción


- Are you one with the preparations for Julian's birthday party?
- Although losing, our team showed sportsmanship by congratulating winners sincerely.
- Everyone groaned when Mrs Lee announced that she was going to give us a surprise test.
4. My brother is in the junior division <sup>of</sup> this school's basketball club.
5. Vignesh practises the piano diligently every day.
6. I come from a family of athletes, but I dislike sports.
7. My parents watch their favourite television programme every weeknight at 7 o'clock without fail.
8. As Siqi was ill, her coach received the medal on her behalf.
9. The prize-presentation Ceremony went on despite the rain.
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false negative

# imperfeción

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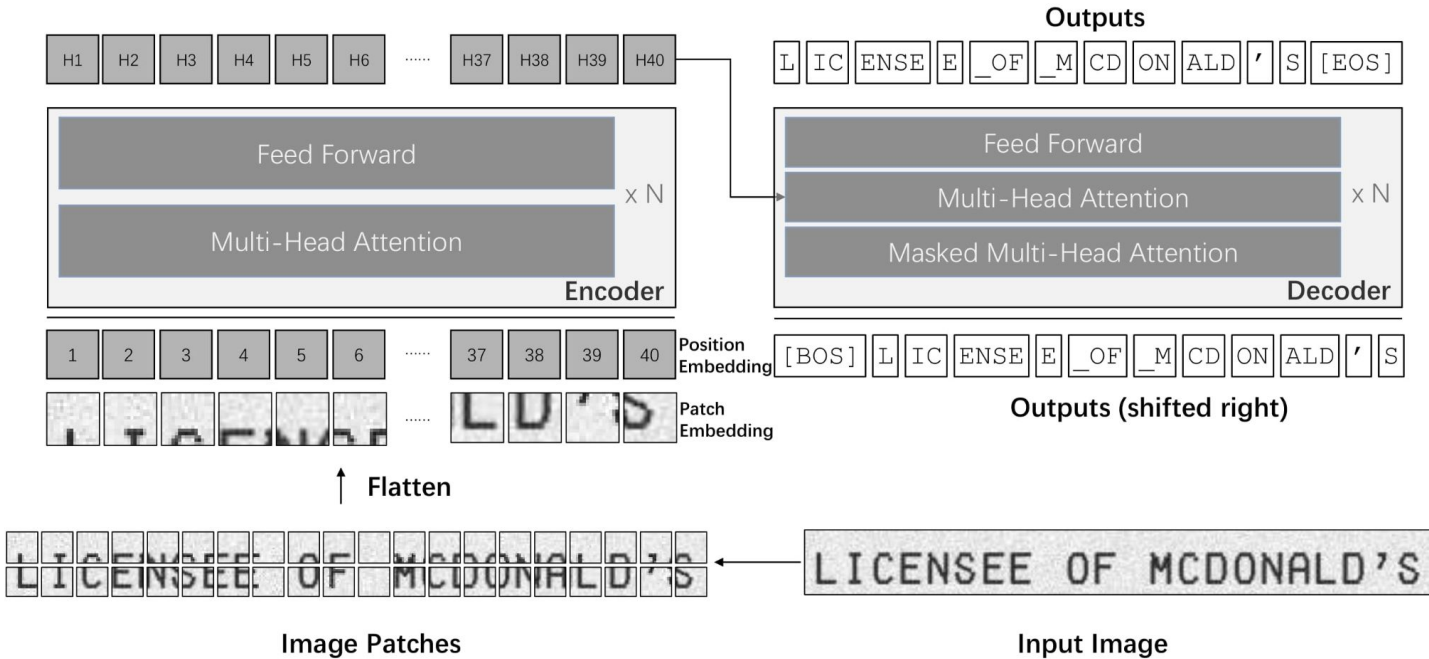
of



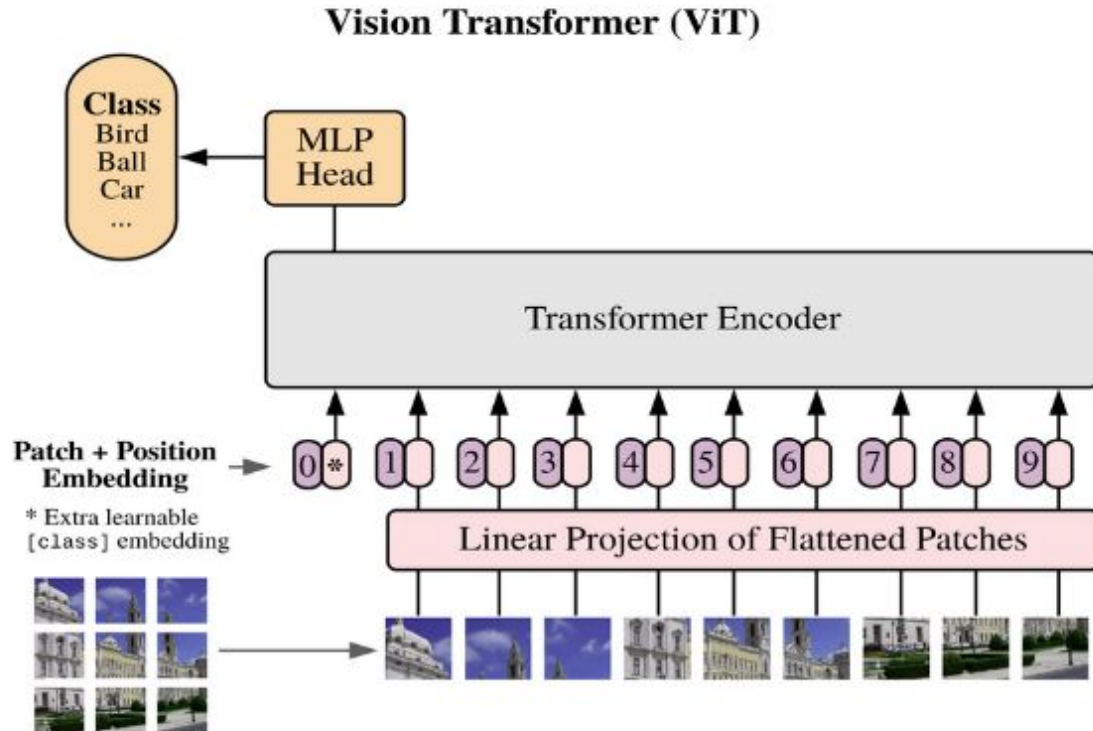
# handwritten text recognition using **TrOCR**



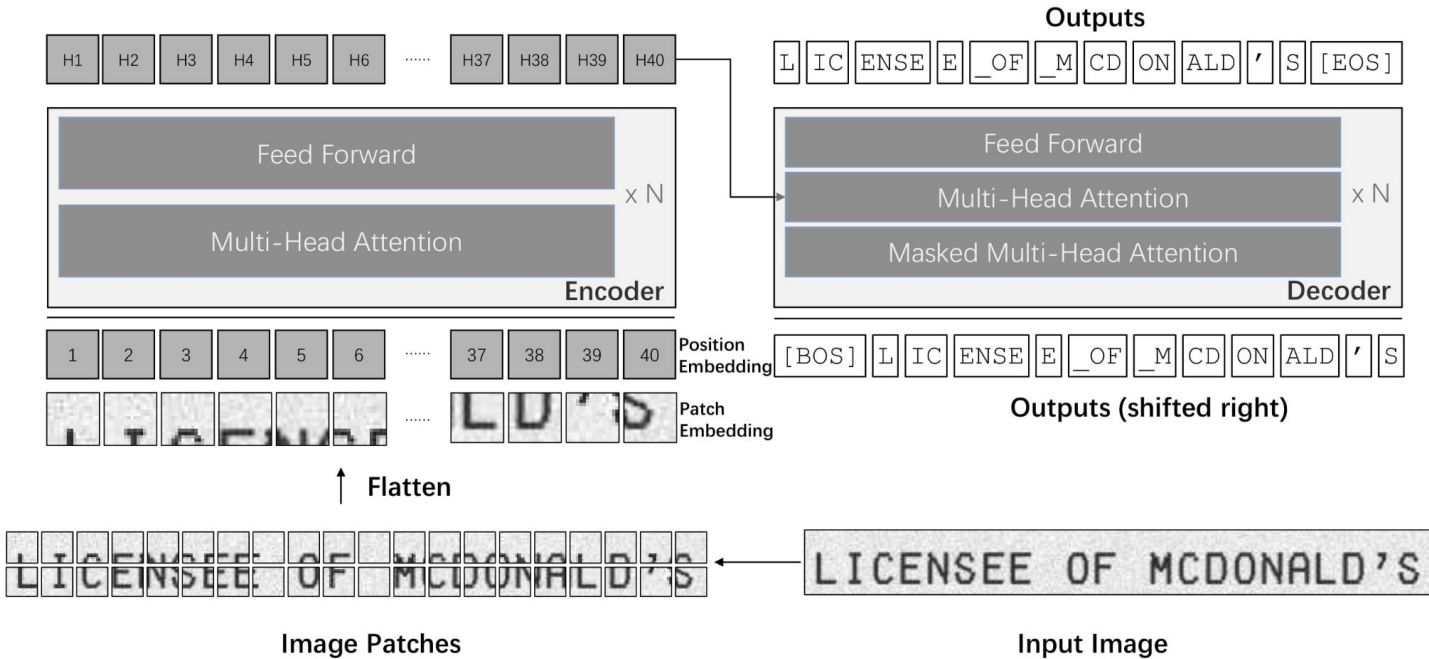
# TrOCR architecture



# Vision Transformer (ViT) architecture



# TrOCR architecture





performance: **WER**

**36.0%**

*w/o custom  
dataset*

**11.2%**

*with custom  
dataset*



performance: **WER**

**1.7%**

*train*

**10.5%**

*validation*

**11.2%**

*test*

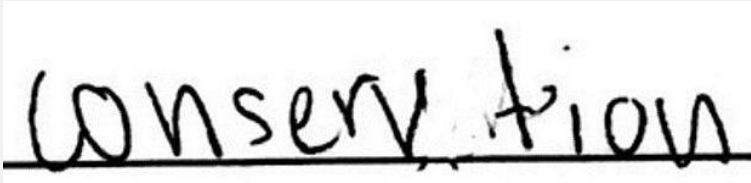
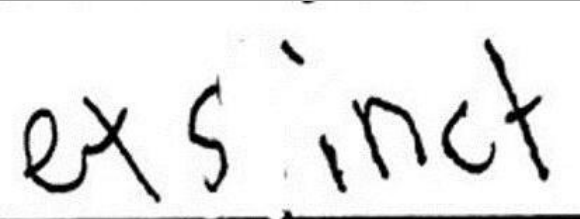


WER  
T/V/T:  
5/40/50

## messy + inconsistent



1. Mother cooked a delicious meal for my birthday.
2. Have you bought all the ingredients we need to bake the cake?
3. The custard made by my grandmother was smooth and creamy.
4. Where is John? Has he disappeared into thin air?
5. Please place the tub of ice cream into the freezer.
6. This secret ~~recipe~~ recipe for pepperoni pizza has been passed down in my family for generations.
7. It is important to wipe down kitchen equipment after each use.
8. You need a sturdy pair of shoes for mountain climbing.
9. Although it was tiring to make the entire bag by myself, my hard work was worthwhile.
10. Robocup is a variation of soccer that involves robots.

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image	ground truth	predicted
	conserv tion	conservation
	ets inct	exsinct
	espaci lly	esPaci ly
	swallowed	swollowed

## input to obj. det. model

1. Dan has been having bad dreams ever since he witnessed that terrible road accident.
2. Please walk on the pavement instead of the road.
3. The victim could not move and had to be carried on a stretcher.
4. My pet bird screeches every morning when it wakes up.
5. Please see a doctor for that nasty cut before it gets infected.
6. My little brother screamed and cried after falling down and getting a few bruises.
7. You will soon see the movie theatre after taking a right turn at that traffic junction.
8. It is important for both drivers and passengers to have their seat belts on at all times.
9. The kind attendant tried her best to soothe the victim she was accompanying to the hospital.
10. The unhelpful onlookers took out their phones to snap pictures of the accident instead of calling for an ambulance.

## output of obj. det. model / input for htr model

witnessed

pavement

stretcher

screeches

nasty

bruises

junction

passengers

attendant

onlookers

## output from htr model

witnessed

pavement

stretcher

screeches

nasty

bruises

junction

passengers

attendant

onlookers



A top-down view of a light blue desk. On the left is a white keyboard. In the center are two overlapping sticky notes, one light blue and one light orange. To the right is a white piece of paper with a scalloped top edge, held by an orange paperclip. A brown pencil with a blue stripe lies at the top right. A small green succulent is at the bottom left.

**use cases**  
**future**  
**applications**



01

## **simple marking**

MCQ (non-OAS),  
FITB, etc.

02

## **beyond EL**

science, math, etc.

03

## **just HTR**

compositions,  
misc. digitisation

04

## **+ NLP**

comprehension,  
comprehension cloze





**Thank you!**

**Any questions? Or suggestions? =)**