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Why AI \neq Automated Indexing. What Is and Is Not Possible

Saint George on a Bike

**Joaquim Moré López
Maria Cristina Marinescu**

**DCMI Panel
10-13-2021**

Outline



01 Motivation

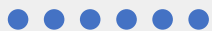
02 AI issues for CH

03 Characteristics of high quality training data

04 Different classifications

05 Issues on evaluation

Motivation



THE BODY OF CHRIST SUPPORTED BY ANGELS BY BARTHOLOMAEUS SPRANGER. PUBLIC DOMAIN



Automatic metadata annotation



New forms of interaction with users
through web-pages and app



Interaction with minorities such as
visually impaired citizens



Improving search engine

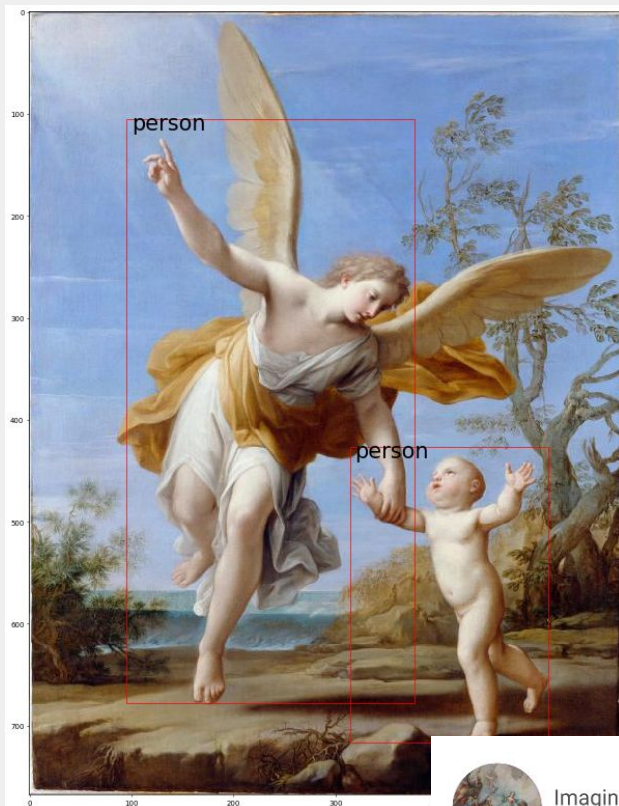
AI issues for CH



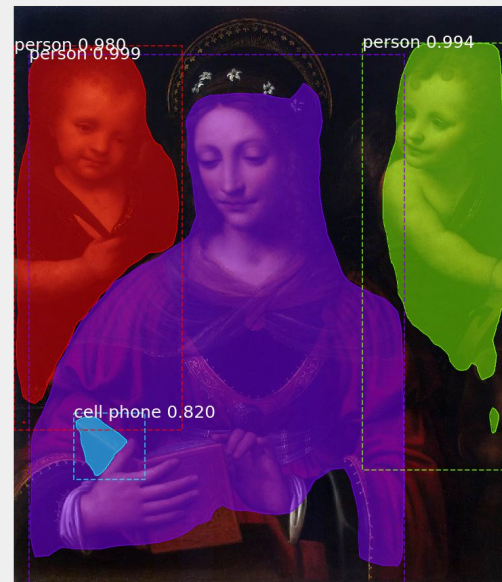
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Imaginary beings and anachronisms



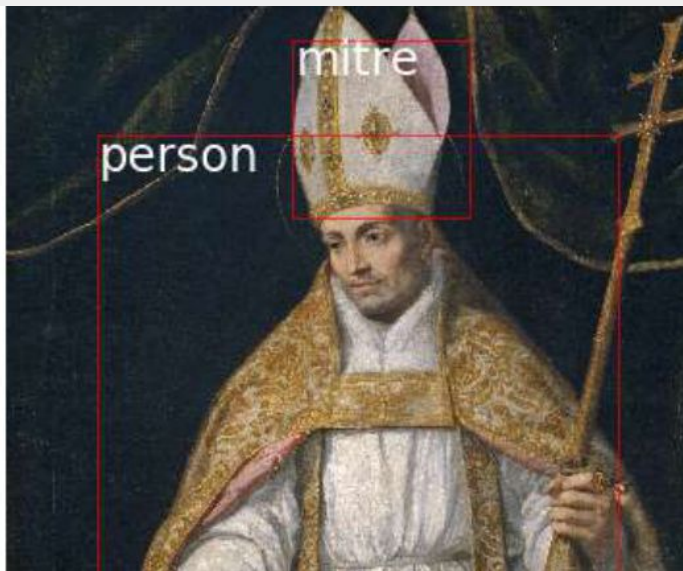
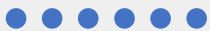
Imaginary beings
Angels, Devils, Witches



Time

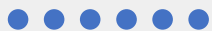


Refining basic classes



Bishop

Challenges when training the painting class detector



- Some classes are represented only in a few images
- Style, medium, color may differ significantly between artists
- Not so many paintings anyway and can't produce them when needed

Visual relations depicted in paintings



Category: Babies in art

From Wikimedia Commons, the free media repository

Subcategories

This category has the following 25 subcategories, out of 25 total.

► Babies in advertisements (85 F)

!

► Massacre of the Innocents (10 C, 1 P, 8 F) *

*

► Paintings of babies (16 C, 208 F)

► Sculptures of babies (6 C, 6 F)

B

► Babies in crest (2 C)

► Baby Buddha (1 C, 19 F)

► Black and white drawings of babies (22 F)

► Breastfeeding in art (9 C, 226 F)

C

► Cartoons of babies (27 F)

► Childbirths in art (12 C, 216 F)

► Cougnou (7 F)

D

► Das Buch vom Klapperstorch (22 F)

F

► Baby-shaped food (14 F)

J

► Jesus Christ as a baby (20 C, 63 F)

L

► Logos Ecomuseo delle Grigne a misura di bambino (19 F)

N

► Baby New Year (1 C, 23 F)

► Newborn babies in art (3 C, 20 F)

► Nude babies in art (3 C, 20 F)

P

► Partida da Monção (Estudo) (2 F)

► Prints of babies (3 C, 56 F)

S

► Sleeping babies in art (6 C, 36 F)

► Swaddling in art (3 C, 75 F)

► Symbols of babies (3 C, 5 F)

T

► Tar baby (3 F)

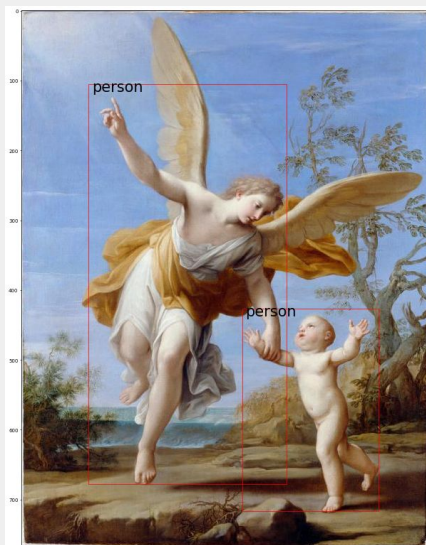
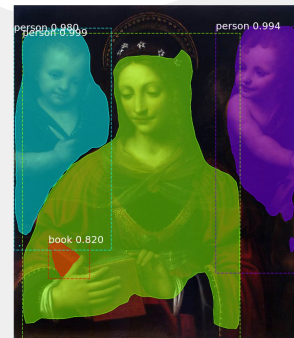
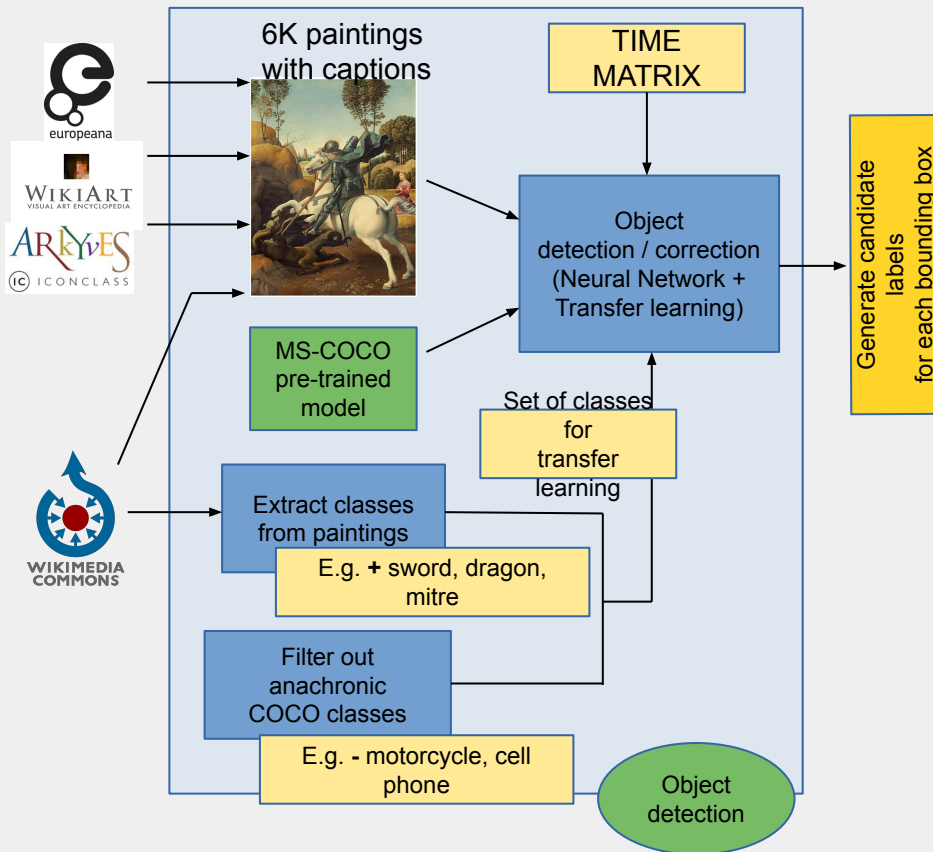
V

► Votive babies (1 C, 6 F)

* People killing other people not represented in Coco and other photograph-based databases



Deep learning for object class detection



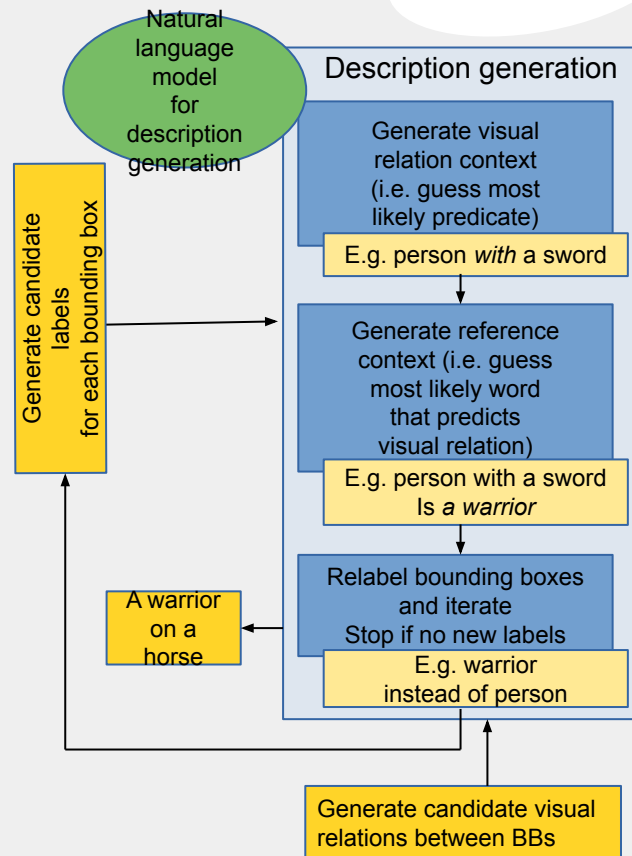
Refining object detection via a language model



A person wearing a crown is a _____ KING/QUEEN

A person riding a horse is a _____ RIDER

- Transformer-based language model
- Model attempts to predict the value of a masked word
- Prediction based on semantic context provided by the other, non-masked, words in the sequence



```
sentence = "a warrior with a sword and a dragon is a ____ ."
print ("original sentence: ", sentence, "\n")
predicted_words = get_predicted_words(sentence)
print ("predicted choices: ", predicted_words)

original sentence:  a warrior with a sword and a dragon is a ____ .

tokenized sentence:  [['CLS]', 'a', 'warrior', 'with', 'a', 'sword', 'and', 'a', 'dragon', 'is', 'a', '[MASK]', '.', '[SEP]']

tokenized sentence indexes:  [101, 1037, 6750, 2007, 1037, 4690, 1998, 1037, 5202, 2003, 1037, 103, 1012, 102]

SEG IDS [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
PREDICTED INDEX tensor([10.0981, 10.0804,  9.3696,  8.1906,  7.9629,  7.4854,  7.4587,  7.4501,
  7.4061,  7.3056,  7.2327,  7.0430,  7.0205,  6.9299,  6.9103,  6.9016,
  6.8952,  6.8943,  6.7134,  6.6758,  6.5051,  6.4793,  6.4634,  6.4424,
  6.4302,  6.4222,  6.4014,  6.2877,  6.2526,  6.2333])
PREDICTED INDEX FIRST 10.08041000366211
predicted choices:  ['hero', 'warrior', 'knight', 'soldier', 'sword', 'dragon', 'hunter', 'character', 'saint', 'leader', 'man', 'coward', 'weapon', 'fighter', 'human', 'god', 'person', 'king', 'shield', 'legend', 'monster', 'sorcerer', 'barbarian', 'horse', 'mage', 'myth', 'woman', 'wizard', 'slayer', 'prince']
```



Iconclass

Outline · Edits · **Clipboard**

0 Abstract, Non-representational Art

1 Religion and Magic

2 Nature

3 Human Being, Man in General

4 Society, Civilization, Culture

5 Abstract Ideas and Concepts

6 History

7 Bible

8 Literature

82 literary characters and objects

82A names of literary characters

82A(...) male literary characters (with NAME)

82A(SIEGFRIED) Siegfried

Siegfried · character · drama · fiction · literary character · literature · man · novel · poetry

See also:

81(NIBELUNGENLIED) 'Nibelungenlied'

HERO

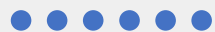
Characteristics of high quality training data



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Saint George on a Bike Dataset



15003 paintings

CC license

Paintings related to SGoaB classes

Resolution of images high enough for working with small objects

API or possibility to scrape the data



Europeana Collection



WIKIART



British Museum



MS COCO



Pharos



Getty Museum



IconClass AI Testset



Museum d'Orsay



Web Gallery of Art



Wikimedia Commons,
WikiData, Wikipedia



Prado Museum



Rijksmuseum

Descriptions in art collections



Unstructured
metadata

This painting tells of **Jacob** the Patriarch's mysterious dream, as told in **Genesis**. He appears asleep, lying on his left shoulder with a tree behind him. On the other side is the ladder of light, by which the angels ascend and descend. This subject demonstrates Ribera's skill at constructing metaphoric discourse. He uses the image of a shepherd resting in the countryside to describe one of the best-known Bible stories. The foreground view of the solidly constructed figure and the scene's realistic features bring realism to the miraculous dream described in a ray of light under a blue and gray sky. Here, Ribera offers one of the numerous proofs of his delicate sense of color and his exquisite compositional capacity, masterfully placing the foreground volumes in diagonal contraposition. This is probably one of the paintings mentioned in 1658 in the inventory of don Jerónimo de la Torre, and it remained in his family until 1718. It reappeared in 1746 among Isabel de Farnesio's paintings, attributed to **Murillo**.

Descriptive sentence classifier



Description classifier

Caption-like
painting
descriptions

```
example1 = "The man is sleeping, leaning on his left arm."  
example2 = "This is one of the most well known biblical episodes."  
p1 = rp.predict(example1)  
print(example1, p1)  
p2 = rp.predict(example2)  
print(example2, p2)
```

The man is sleeping, leaning on his left arm. DESC
This is one of the most well known biblical episodes. NODESC

F1 Score: 0.58

Preprocessing in the descriptive sentence classifier

y=NODESC (probability 0.502, score 0.008) top features

Contribution?	Feature
+1.215	<BIAS>
-1.207	Highlighted in text (sum)

christ carrying the cross

y=NODESC (probability 1.000, score 8.894) top features

Contribution?	Feature
+8.303	Highlighted in text (sum)
+0.591	<BIAS>

christ before pilate

y=NODESC (probability 0.937, score 2.704) top features

Contribution?	Feature
+1.633	Highlighted in text (sum)
+1.071	<BIAS>

view of the golgotha

y=DESC (probability 1.000, score -9.765) top fe

Contribution?	Feature
+11.729	Highlighted in text (sum)
-1.964	<BIAS>

a person carrying the cross

y=DESC (probability 1.000, score -8.625) top fe

Contribution?	Feature
+10.255	Highlighted in text (sum)
-1.630	<BIAS>

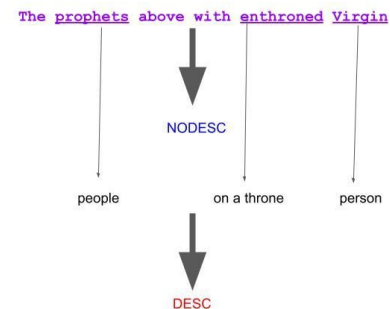
a person before a person

rp.explain("View of the mountain")

y=DESC (probability 0.968, score -3.415) top features

Contribution?	Feature
+5.817	Highlighted in text (sum)
-2.402	<BIAS>

view of the mountain



F1 Score: 0.9

Identifying visual verbs (in progress)

The Martyrdom of Saint James

Ca. 1640. Oil on canvas. Room 010A

The apostle Saint James is shown kneeling with his hands together in prayer, offering his neck up to the sword of the executioner who prepares to decapitate him. Standing before the apostle, wearing a curious sort of headdress, is the authority who decreed his death. Behind Saint James are soldiers with halberds and various other figures who probably represent Herod Agrippa and the Jews who, according to the *Acts of the Apostles* (12:1-2), were pleased with the death of the man they considered their enemy. Their identification as Israelites has been demonstrated by a comparison of their clothing with that of some of the prophets or the sons of Jacob painted by Zurbarán. Above them all, a little angel carries a crown of flowers and a palm frond, the attributes of Christian martyrs. And, on the far right, the head of a dog is visible, the significance of which is not clear but it constitutes one of the painting's most successful fragments. The expansive landscape visible in the background is interrupted by the lower portion of a column set upon a substantial base, a motif that probably alludes to the apostles' status as columns of the Church. The work's sizable dimensions together with its subject matter suggest that it was executed for the altar of a church. When the work was sold in Paris in 1853, the records

MUSEO
NACIONAL
DEL
PRADO

Iconclass

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decapitate

Found 3 notations for query: decapitate.

sections: all 1 9

- 98B(CASSIUS, SP)68 death of Spurius Cassius: he is decapitated because suspected of aspiring to tyranny
- 1162(THREE HEBREWS)61 the three Hebrews, after having been decapitated, carry their own heads
- 98B(TUBERTUS, A.P.)41 A. Postumius Tubertus has his son decapitated for fighting against his orders

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wear

Found 21 notations for query: wear.

pages 1 2 next >

sections: all 1 4 7 9

- 12A7432 wearing of a sack ~ Jewish mourning customs
- 42D322 battle for dominance in marriage ('who wears the breeches')
- 94F743 Jupiter is lured away by Juno wearing Venus' girdle
- 11H(IVO)11 St. Ivo as patron of lawyers, wearing gown and cap
- 94A12 Jason before his uncle Pelias, wearing only one sandal
- 1162(ABRAHAM)41 Abraham, wearing an armour, with a chalice and bread before an altar
- 98B(HOMER)91 idealized portrait of Homer, blind and wearing a crown of laurel

Person

Physical object

DBpedia

WORDNET

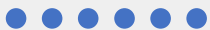
Different classifications



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Different classifications from visual relations



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Search

No notations were found for the query **decapitated people** · [Retry the query including Keys](#)

Iconclass

Options · Login ·

Outline · Edits · **Clipboard**

Found 3 notations for query: **decapitate**.

sections: **all** 1 9

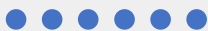
98B(CASSIUS, SP)68 death of Spurius Cassius; he is decapitated because suspected of aspiring to tyranny

1162(THREE HEBREWS)61 the three Hebrews, after having been decapitated, carry their own heads

98B(TUBERTUS, A.P.)41 A. Postumius Tubertus has his son decapitated for fighting against his orders

Spurius Cassius
Postumius Tubertus' son

Different classifications from visual relations



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Search

No notations found for the query **dragon slayers** · [Retry the query including Keys](#)

Iconclass

[Options](#) · [Login](#) ·

[Outline](#) · [Edits](#) · **[Clipboard](#)**

Search

Found 4 notations for query: **slay dragon**.

sections: **all** | 1 | 9

[Include Keys](#)

11H(THEODORE II)51 St. Theodore II on horseback slaying a dragon

95A(CADMUS)34 Cadmus slays the dragon

11H(THEODORE I)11 St. Theodore I and George, both on horseback, simultaneously slay a dragon

11H(THEODORE I)119 St. Theodore I and George, both on horseback, simultaneously slay a dragon - male saint protecting devotees with cloak, 'Schutzmantel'

St. Theodore
Cadmus
St. George
Siegfried

Iconclass

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Found 1 notations for query: **Siegfried**.

sections: **all** | 8

82A(SIEGFRIED) Siegfried

Issues on evaluation



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Variability in reference-based evaluation metrics (e.g. BLEU, ROUGE)



REFERENCE: Madonna with Christ as a child on her lap

Saint Mary holding a child

REFERENCES: Christ Pantocrator, Christ in Majesty

A man sitting on a chair and holding a book

Detected objects:

person_1, crown_1, person_2, halo_1

Reference objects:

('person_1', (449.5, 700.0), 'cc', 20.61)

Visual relationships:

person_1+crown_1:

('person_1 stands', 'person_1 wears crown_1', 'person_1
coiffed_with crown_1') is
king/queen/saint_mary

person_1+person_2:

('person_1 stands', 'person_2 is (child)/(infant)/(dwarf)'),
person_1 holds person_2



Thank you!



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