Natural Language Processing

KING'S College LONDON

NIHR | Maudsley Biomedical Research Centre

Introduction

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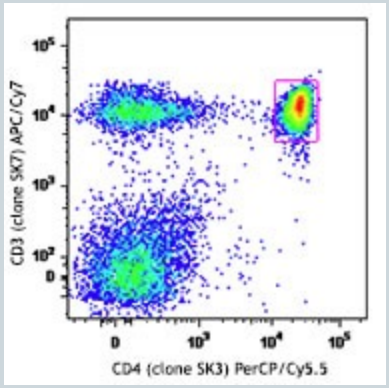
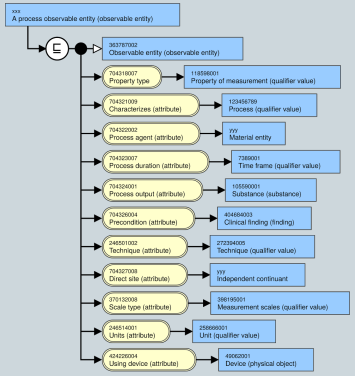
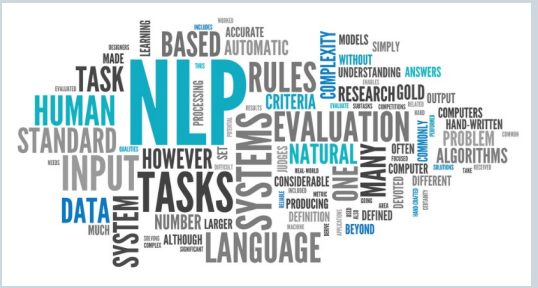
Introduction – my journey







Motivation – reusing the health record

- Thomas Willis in “Dr. Willis’s Practice of Physick Being All the Medical Works of That Renowned and Famous Physician” 1684.

  > *“weigh all the symptoms, and to put them, with exact Diaries of the Diseases, into writing; then diligently to meditate on these, and to compare some with others; and then [begin] to adopt general Notions from particular Events”*

- Reuse of the medical record

- Computerisation of the record allows us to magnify the efforts of Willis by many degrees e.g. for
  - Observational studies
  - Trial recruitment
  - Case identification
  - Retrospective cohorts
  - Individual risk prediction

Electronic health records (EHRs) – structured and unstructured information

HAEMATOLOGY

HAEMOGLOBIN (g/L)	151
HCT	0.422
RED CELL COUNT	4.83
MCV	87.4
MCH	31.3
MCHC (g/L)	* 358
RDW	
PLATELET COUNT	
MPV	
WHITE CELL COUNT	
Neutrophils	
Lymphocytes	
Monocytes	
Eosinophils	
Basophils	
ESR	

BIOCHEMISTRY

SODIUM
POTASSIUM
CHLORIDE
BICARBONATE
UREA
CREATININE
estimated GFR

Clinical Findings

Concept ID	Preferred term
16932000	Nausea and vomiting
68566005	Urinary tract infectious disease
38341003	Hypertensive disorder
49436004	Atrial fibrillation
49218002	Hip pain
301011002	Escherichia coli urinary tract infect
40835002	Coffee ground vomiting
167667006	Fecal occult blood: negative

Procedures

Concept ID	Preferred term
52734007	Total replacement of hip
117010004	Urine culture
76009000	Esophagogastroduodenoscopy
91251008	Physical therapy procedure

Reason: CHECK ETT TUBE PLACEMENT, ?PNA, CHF
[**Signature 1**]
UNDERLYING MEDICAL CONDITION:
85 y/o male s/p acute mi and catherization now in ccu with cardiogenic shock
REASON FOR THIS EXAMINATION:
CHECK ETT TUBE PLACEMENT
?PNA
CHF
[**Signature 1**]
FINAL REPORT
CLINICAL INDICATION: Assess endotracheal tube placement in patient with congestive heart failure.

Comparison is made to previous study of one day earlier. An endotracheal tube is present, in satisfactory position. A Swan-Ganz catheter terminates in the proximal left pulmonary artery and has been withdrawn in the interval. An intraaortic balloon pump terminates about 3.3 cm below the superior aspect of the aortic knob, and a nasogastric tube terminates in the region of the gastroduodenal junction.

How much unstructured, textual information is in an EHR?

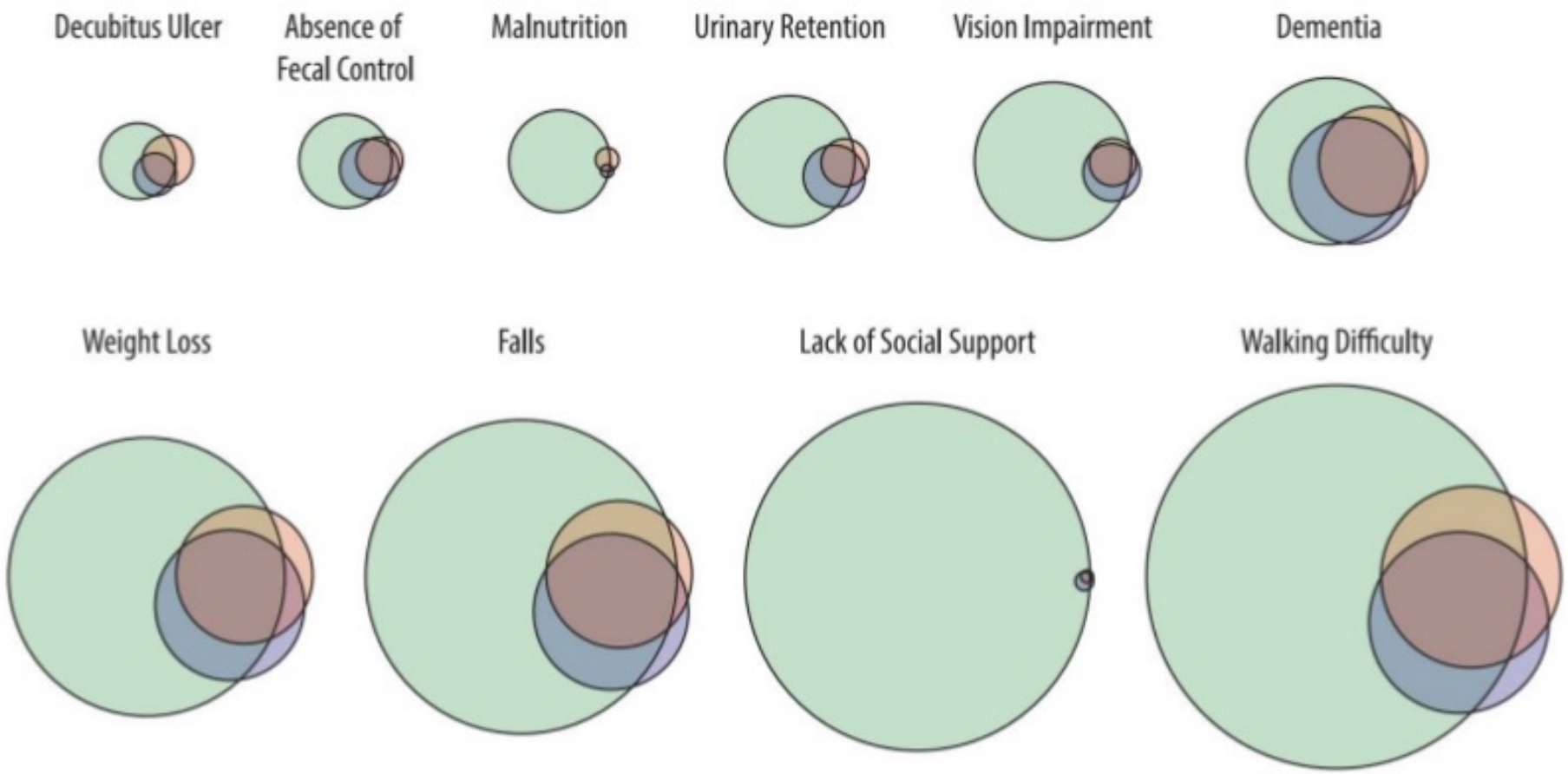
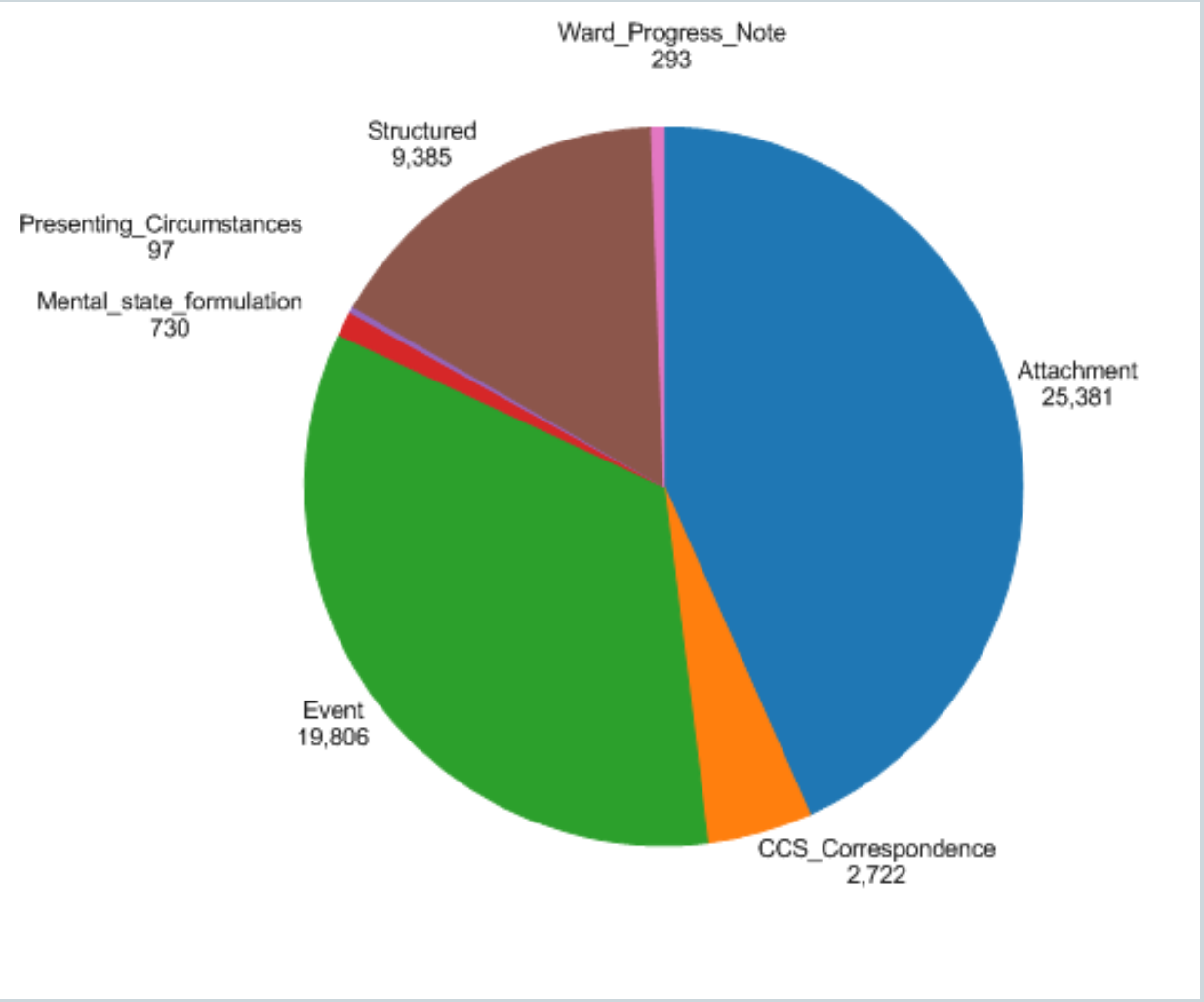


Figure 2. Green: Unstructured free text EHR data; Other colours: structured data. "The value of Unstructured Electronic Health Record Data in Geriatric Syndrome Case Identification". (Kharrazi et al., 2018)

An example – Mini Mental State Examinations



Natural Language Processing

Write a short definition of natural language processing

Natural Language Processing (NLP) is a field of artificial intelligence that focuses on enabling computers to understand, interpret, and generate human language. It involves analyzing and processing natural language data, such as text or speech, to perform tasks like translation, sentiment analysis, speech recognition, and information extraction. NLP combines linguistics, computer science, and machine learning to bridge the gap between human communication and computer understanding.

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plus

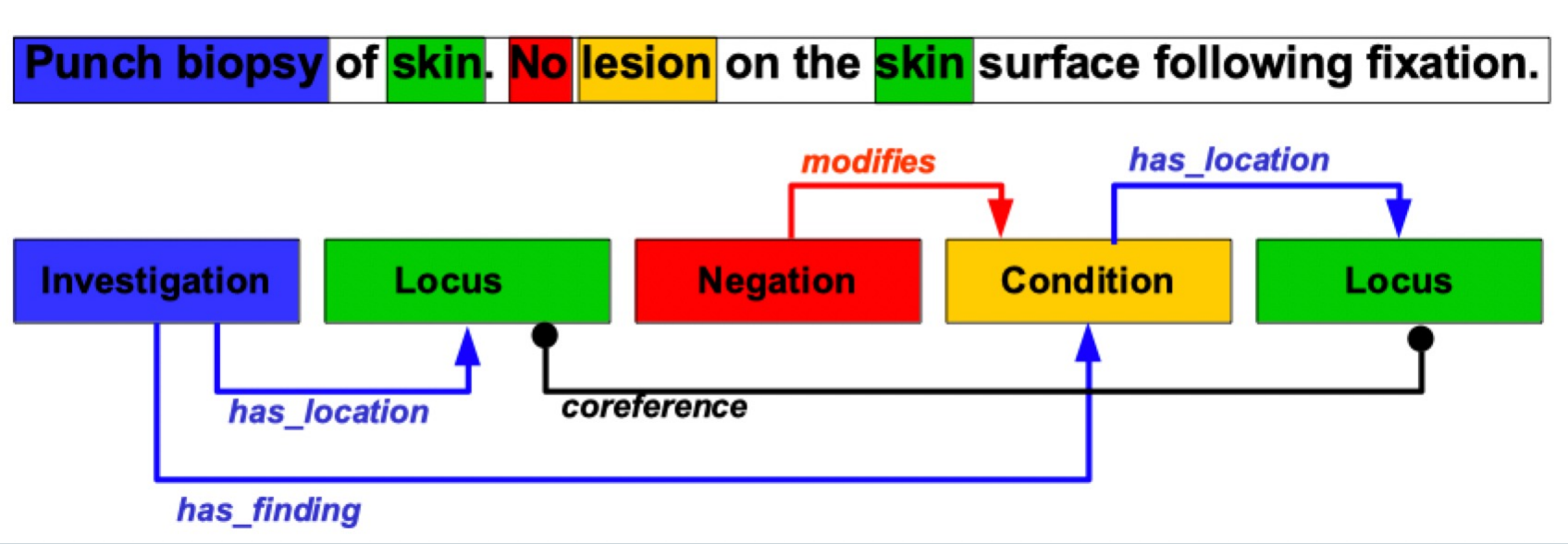
- Search
- Question answering
- Summarisation
- Document classification
- Dialogue

Information extraction

the process of deriving disambiguated quantifiable data from natural language texts in service of some pre-specified precise information need

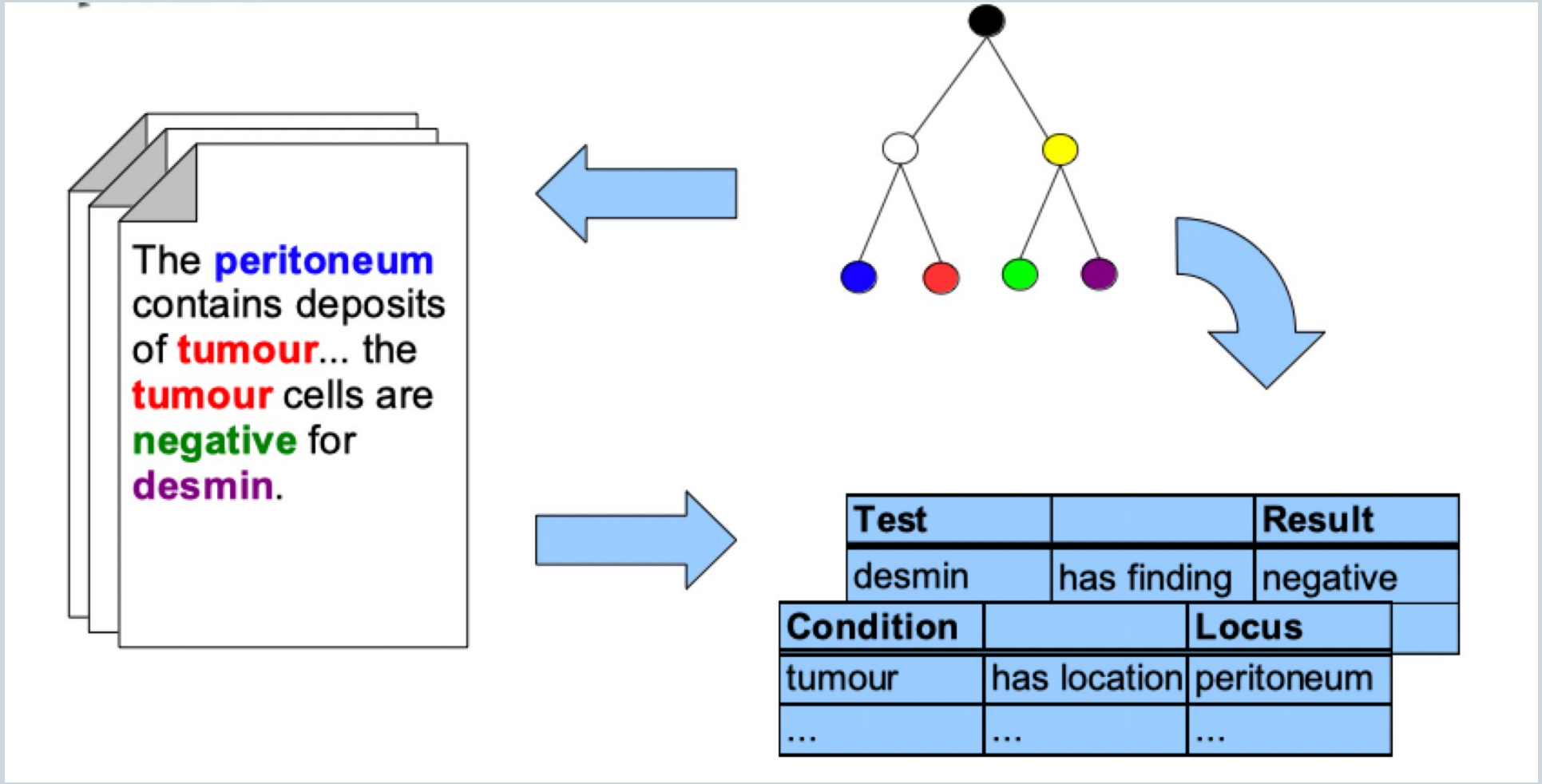
(Cunningham, in Encyclopedia of Language and Linguistics, 2nd Edition, pages 665–677, 2005.).

Information extraction



- We might extract:
  - Entities and their co-referents
  - Negation, certainty
  - Relations
  - Events
  - Temporal expressions and relations

Entity linking



This half-day session

How do we represent or *model* language in the computer?

How do we train or *supervise* the computer to solve problems involving language?

What can we use NLP of the health record for?

Content

- Introduce some key ideas and intuitions
- Some simple examples and practicals to illustrate these ideas
- (Some practicals use a little bit of the Python programming language. Don’t worry – you don’t need to know Python to follow them)
- A demo of a working system
- A presentation of some real-world use cases

Course material

All course material can be found on GitHub

Let’s take a look:

https://github.com/KCL-Health-NLP/nlp-half-day-workshop/tree/main

Thank you

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