

Medical Record as a Semantic Graph

Relations between Observations,
suspected Health Issues and
prescribed Activities

IWEEE-2015

8th International Workshop on e-Health in Emerging Economies

Las Palmas, 25 Sept 2015

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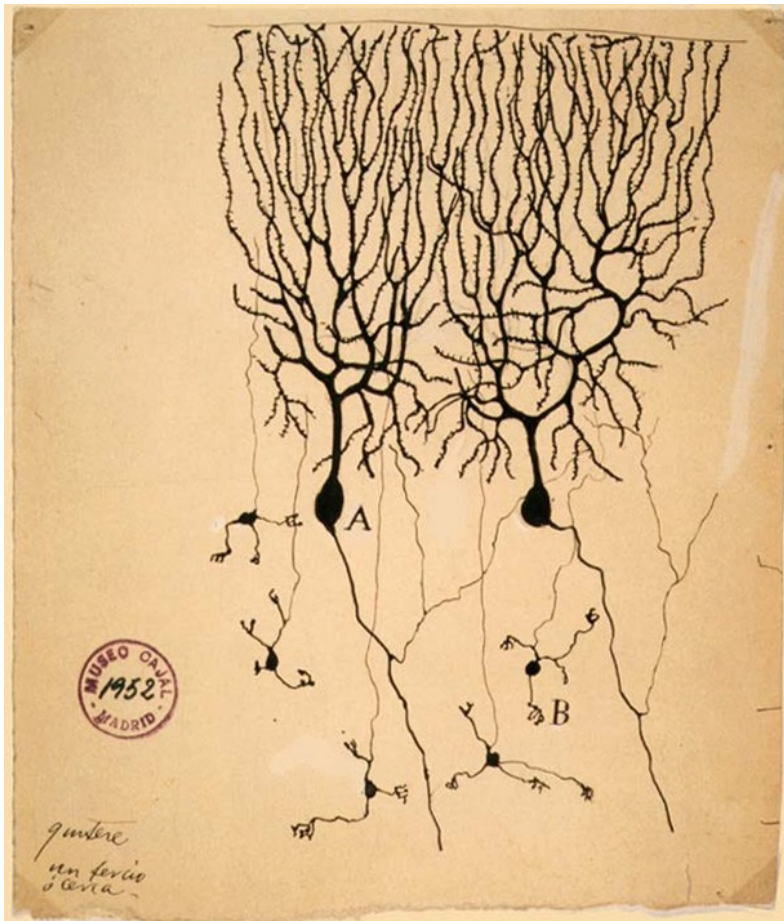
Objectives

- Support of health problems management.
- Make explicit medical reasoning more transparent
- Better collaborations between the members of multidisciplinary care team.
- Training tools for medical students and nurses

Approaches

- Focus on the relations between the informations in the patient record.
- Graphs are very natural human way of thinking, in fact based on graphs.

Neurons from Cajal in the 19th century to the computer age



Navigation in a Graph Database

- A kind of NoSQL database where any node can be directly linked with any other nodes, in a non hierarchical space of millions of nodes.
- Nodes and links may have attributes, as type, degree of belief, importance, ... and a specific content including any kind of documents.
- A graph provides a global overview, a kind of structured table of content.
- Contextual menus provide the details on request, as well a way to enter new data.

“Observation” Nodes

- Any fact having been observed as declarations of the patient, examinations, lab test, images, etc... as “key-value” entities, and summarized by a short title.
- But here without any assessment on these facts.

“Health Issue” Nodes (1)

- Any point of concern needing attention, as complaint of the patient and/or abnormal findings.
- Issues are motivated by one or more Observations.
- Either a preliminary “hypothesis” requiring more investigations.
- or a “diagnose” requiring a treatment.
- To be presented as a global “Problem List”.

“Health Issue” Node (2)

- A “risk” is a potential issue in the future.
- “Past history” of closed Issues must remain visible at the bottom of the “Problem List”.
- An issue may be linked to elements of medical knowledge.

Health Issue Node (3)

- “Positive Issues” represent abnormal findings to be further analysed and treated.
- “Negative Issues” represent issues to be excluded, as in the case of a check-up.
- In both cases recommendations could be proposed as “To do next”

“Action” Nodes

- Any task to be performed for the patient as asking more questions, order for lab tests, prescription of medications.
- Every Action is expected to return a result.
- New results are recorded as Observations and may lead to re-evaluation of the Issues, in the perspective of an “Iterative care process”.

Relationships

- Links between nodes.
- An Observation can “SUGGEST” some Health Issue.
- A Health Issue can lead to a “RECOMMENDED” an Action.
- A Health Issue can be “ASSOCIATED” with Knowledge nodes.

Visual presentations

- Type of node
 - Importance
 - Degree of certainty
 - Normality
 - Latest or previous version
 - ...
- Shape (rectangle, circle)
 - Size
 - Colour
 - Intensity
 - Pictogram
 - ...

Computer events on a node

- Zoom to the content.
 - Select the presentation of a subset of the graph.
 - Create a new node or a new version of an existing node.
 - Create a new relation.
 - Jump to external software e.g. Orthanc, IPath, etc
- Fly over
 - Left mouse click
 - Right mouse click
 - Double click
 - Drag and drop
 - ...

Access to medical knowledge

- Possible as far as a Health Issue are well defined and identified.
- Often no diagnose yet, but issues like “infectious syndrome” or “back pain”.
- Anyhow the critical question is “What to do next”.
- Step by step development of relations with semantic medical knowledge bases.

Research

- Will become possible when a large set of patient records will become available.
- Graph technology can help to discover unexpected relations between some conditions, as already in use in other domains, as banking or marketing.

Open Source

- The project is based on Open Source components as Linux, Neo4j, D3.js, Popoto.js, etc...
- Freely available in the public domain.
New developments are shared in Open Source.
- Transparency about how the programs exactly work.
- No dependence on any single software provider.

Intended users

- Members of Collaborative Care Teams working across Internet.
Local actors in developing regions should go as far as possible before asking international experts.
- Experts will review the graph and if necessary provide advices.
- Training sessions for medical and nurse students:

New Graph Partners are very welcome

- Medical:
Try to use this experimental version and provide suggestions about improvements. (on-line access in preparation).
- Informatics:
Software extensions, make a much more convivial human interface, integration with other Open Source medical systems.
- Sponsors:
Would help to speed up the developments in the not for profit ISfTeH.
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Conclusions

- What most matter is the the management of health problems and support for care providers.
- The Logic of Graph Databases provide a huge potential.
- Interactive Graphs Presentations are a very natural way to share complex information.