

Medical Record as a Semantic Graph

Relations between Observations,
suspected Health Issues and
prescribed Activities

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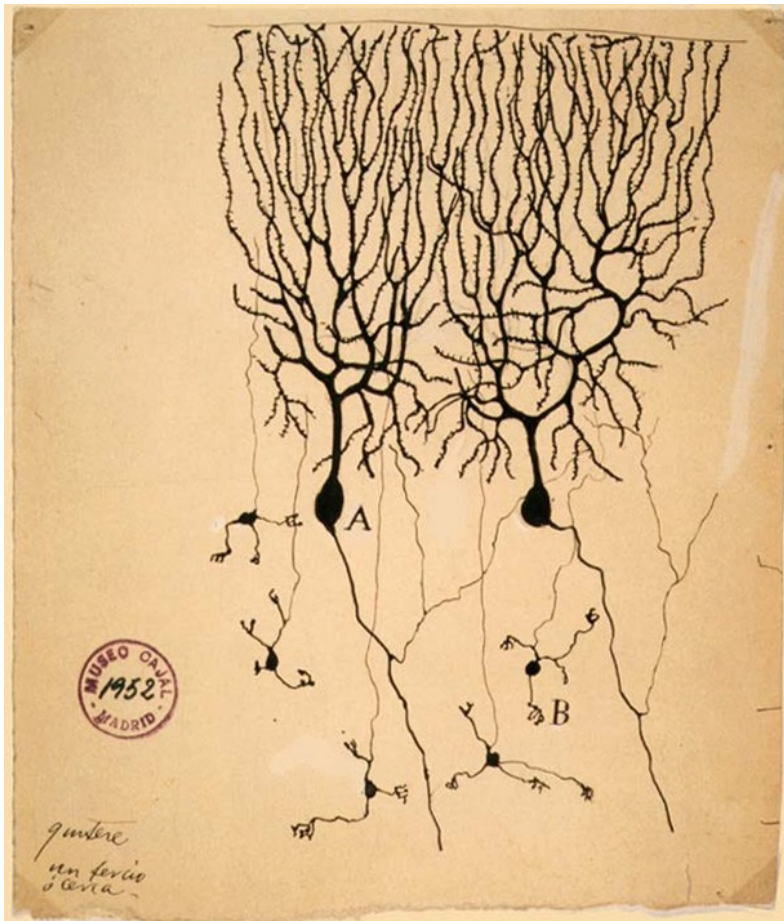
Objectives

- Health problems solving
- Better collaborations between the members of multidisciplinary care team
- Make medical reasoning more transparent
- 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 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 traditional documents.
- A graph provides only a global summary, 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, ...
- But here without any assessment on these facts.
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“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): time

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

Health Issue Node (3): scenario

- “Positive Issues” represent abnormal findings to be further analyzed 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” 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
- Color
- 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. GNUHealth, 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 unsuspected 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 nuse students:

Conclusions

- Interactive graphs have a huge potential.
- Graph Databases provide better logical support for medical problem solving.
- Graph Screens are very natural presentations.
- Support of Care Team collaborative work, the actors sharing what they know and what they think about the known facts.
- Useful for students training.

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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