ITINERARIO DE INFORMÁTICA BIOMÉDICA

Victor Maojo, MD, PhD, FACMI

Director, Grupo de Informática Biomédica

Universidad Politecnica de Madrid

vmaojo@fi.upm.es

Asignaturas

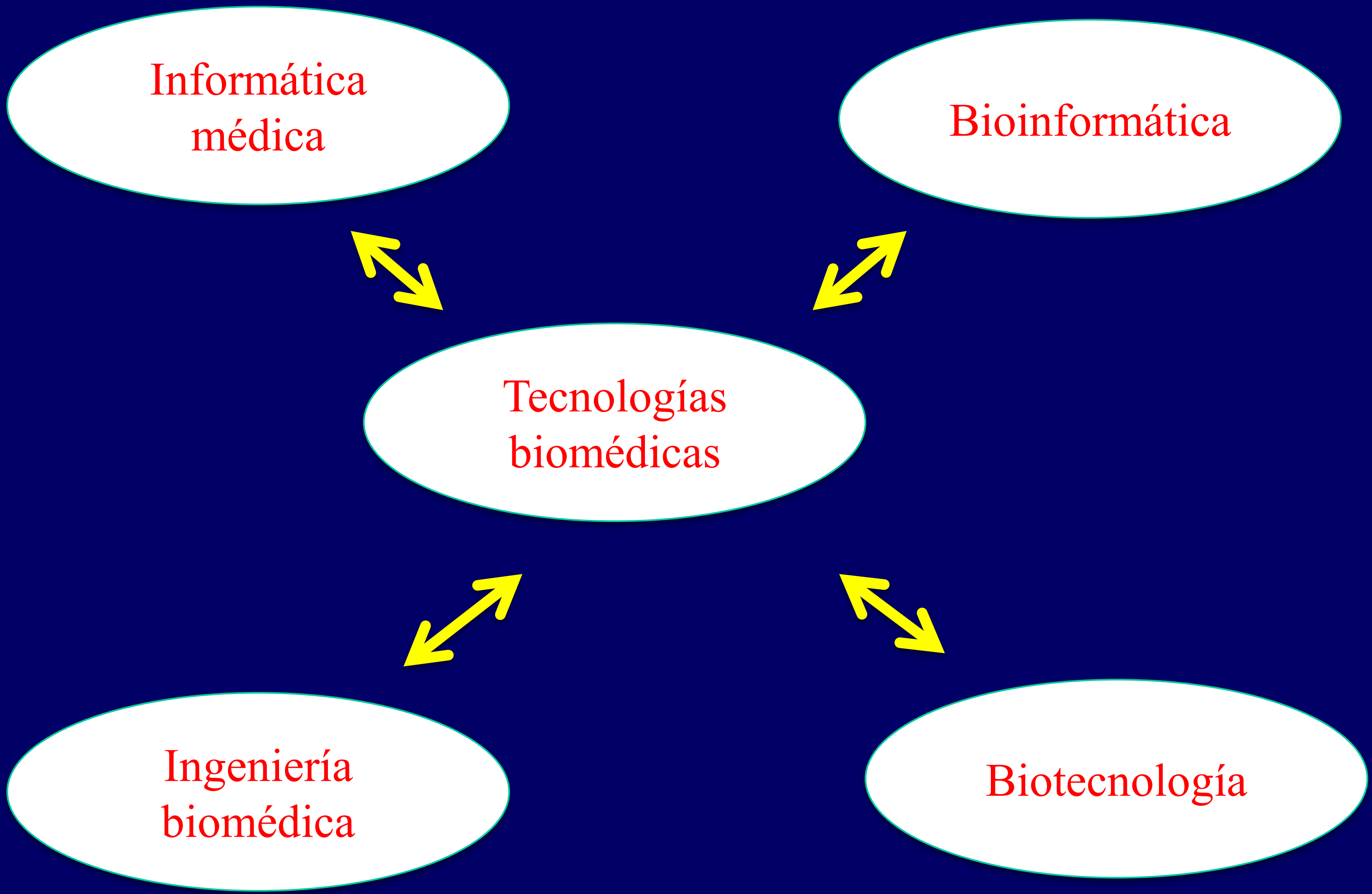
Itinerario 2 Informática Biomédica

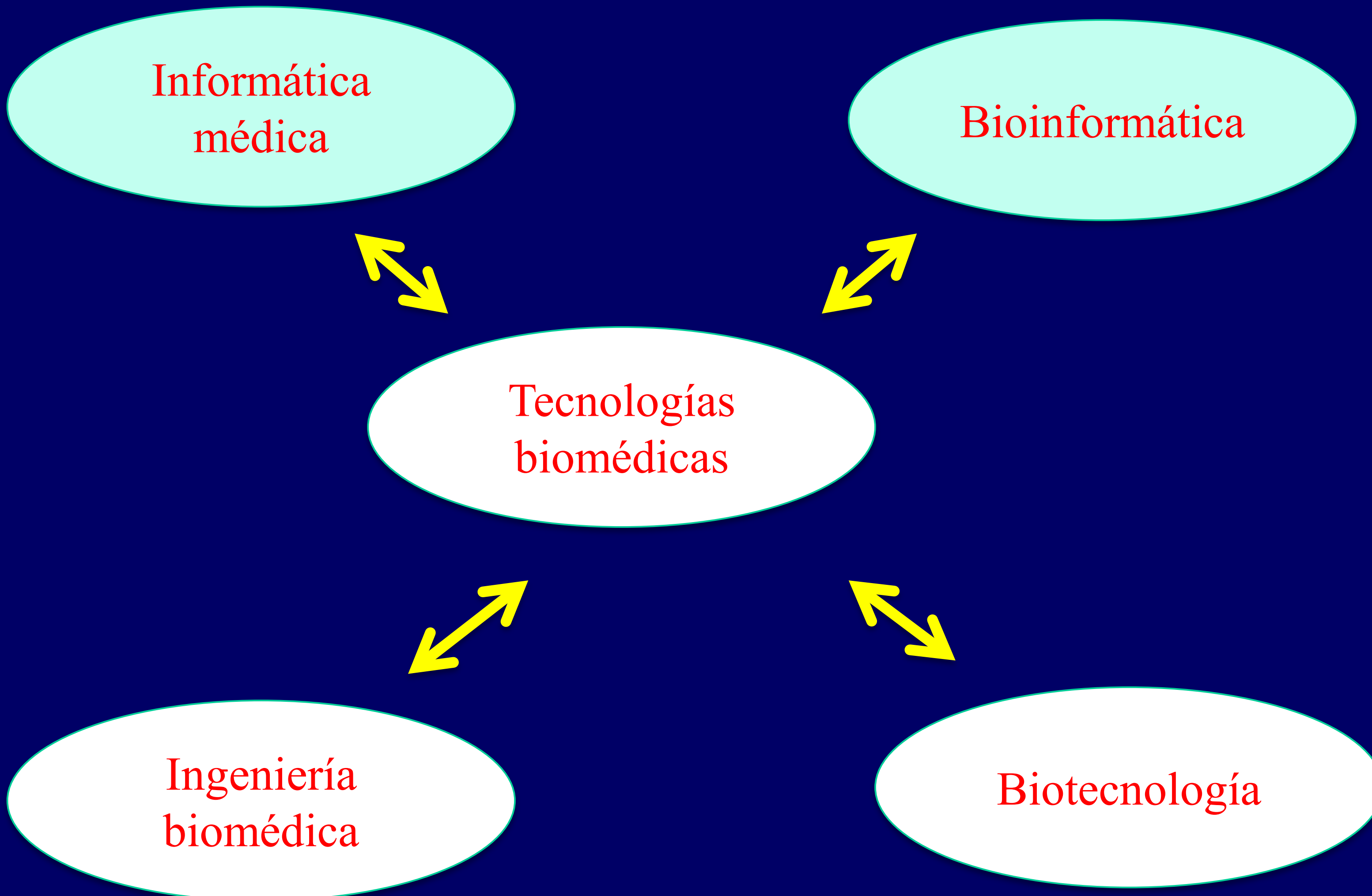
		4 ECTS	4 ECTS	4 ECTS	4 ECTS	4 ECTS	4 ECTS	6 ECTS
Curso 4º	S7		Tecnologías Web en biomedicina	Sistemas de Información Biomédica	Bases de Datos y Sistemas de Salud Pública	Bioinformática	OPT*	Trabajo fin de Grado
	S8	Minería de datos en Biomedicinas	NLP y recuperación de información	Historias clínicas, terminologías y estándares	Sistemas de ayuda a la decisión médica	e-health	OPT*	

* OPTATIVAS DE ITINERARIO / PRÁCTICAS EXTERNAS (8 ECTS) u otras definidas en la programación docente anual o créditos reconocidos por la realización de actividades de representación, culturales, etc (máx 6ECTs)

Profesionales

- Pocos programas de formación en España
- Muchas ofertas en EEUU y Europa (programas y trabajo)
- Profesores con prestigio investigador
- Bastantes becas disponibles en el propio centro y muchísimas ofertas de empresas
- Perspectivas profesionales extraordinarias (sobre todo en el extranjero, de momento…)
- Posibilidades de crear start-ups con poca inversión y mucho futuro
- Ampliar formación y perspectivas de trabajo


Informática médica
Bioinformática
Tecnologías biomédicas
Ingeniería biomédica
Biotecnología


Informática médica
Bioinformática
Tecnologías biomédicas
Ingeniería biomédica
Biotecnología

Informática médica: Concepto

- Área interdisciplinar, que se encuentra entre la informática y la medicina
- Herramientas son secundarios
- Énfasis: información y gestión del conocimiento

Informatica médica: hitos

Hitos:

Años 50: Ordenadores en hospitales

Años 60: hospital y aplicaciones clínicas (HIS, registros médicos, de laboratorio)

Años 70: Inteligencia Artificial en la toma de decisión Medicina-

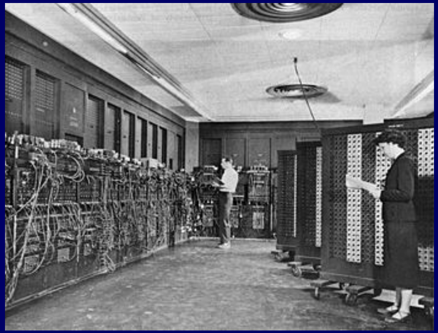
Años 80: ordenadores personales: aplicaciones en el hogar y la oficina

Años 90: Internet y WWW - pacientes

siglo XXI

*Enlace a la Bioinformática *Medicina de precisión *Nanomedicina *Pacientes digitales *Redes sociales

Primeros sistemas de IM: años 60



ENIAC,
University of
Pennsulvania

Homer Warner,
University of Utah

Akron Children's Hospital (Ohio)

Massachusetts General Hospital
(Barnett)

3 July 1959, Volume 130, Number 3366 SCIENCE

Reasoning Foundations of Medical Diagnosis

Symbolic logic, probability, and value theory aid our understanding of how physicians reason.

Robert S. Ledley and Lee B. Lusted

The purpose of this article is to analyze the complicated reasoning processes inherent in medical diagnosis. The importance of this problem has received recent emphasis by the increasing interest in the use of electronic computers as an aid to medical diagnostic processes (*1*, *2*). Before computers can be used effectively for such purposes, however, we need to know more about how the physician makes a medical diagnosis.

If a physician is asked, "How do you make a medical diagnosis?" his explanation of the process might be as follows. "First, I obtain the case facts from the patient's history, physical examination, and laboratory tests. Second, I evaluate the relative importance of the different signs and symptoms. Some of the data may be of first-order importance and other data of less importance. Third, to make a differential diagnosis I list all the diseases which the specific case can reasonably resemble. Then I exclude one disease after another from the list until it becomes apparent that the case can be fitted into a definite disease category, or that it may be one of several possible diseases, or else that its exact nature cannot be determined." This, obviously, is a greatly simplified explanation of the process of diagnosis, for the physician might also comment that after seeing a patient he often has a "feeling about the case." This "feeling," although hard to explain, may be a summation of his impressions concerning the way the data seem to fit together, the patient's reliability, general appearance, facial expression, and so forth; and the physician might add that such thoughts do influence the considered diagnoses. No one can doubt that complex reasoning processes are involved in making a medical diagnosis. The diagnosis is important because it helps the physician to choose an optimum therapy, a decision which in itself demands another complex reasoning process.

This complex reasoning process must be integrated by the physician with a large store of possible diseases. It is widely believed that errors in differential diagnosis result more frequently from errors of omission than from other sources. For instance, concerning such errors of omission, Clendening and Hashinger (*3*) say: "How to guard against incompleteness I do not know. But I do know that, in my judgment, the most brilliant diagnosticians of my acquaintance are the ones who do remember and consider the most possibilities."

Computers are especially suited to help the physician collect and process clinical information and remind him of diagnoses which he may have overlooked. In many cases computers may be as simple as a set of hand-sorted cards, whereas in other cases the use of a large-scale digital electronic computer may be indicated. There are other ways in which computers may serve the physician, and some of these are suggested in this paper. For example, medical students might find the computer an important aid in learning the methods of differential diagnosis. But to use the computer thus we must understand how the physician makes a medical diagnosis. This, then, brings us to the subject of our investigation: the reasoning foundations of medical diagnosis and treatment.

Medical diagnosis involves processes that can be systematically analyzed, as well as those characterized as "intangible." For instance, the reasoning foundations of medical diagnostic procedures are precisely analyzable and can be separated from certain considered intangible judgments and value decisions. Such a separation has several important advantages. First, systematization of the reasoning processes enables the physician to define more clearly the intangibles involved and therefore enables him to concentrate full attention on the more difficult judgments. Second, since the reasoning processes are susceptible to precise analysis, errors from this source can be eliminated. Of course, the methods presented in this paper are not designed for immediate, direct application; rather, they serve as a suggested basis from which more practical procedures can be developed. However, a consideration of foundations is always essential as the first step in the development of practical applications.

The reasoning foundations of medical diagnosis and treatment can be most precisely investigated and described in terms of certain mathematical techniques. Before material to illustrate these techniques was selected, many of the *New England Journal of Medicine*

Dr. Ledley is a part-time member of the staff of the National Academy of Sciences-National Research Council, Washington, D.C., where he is principal investigator of the Survey and Monograph on Electronic Computers in Biology and Medicine. He is on the faculty of the electrical engineering department of George Washington University and mathematician at the Data Processing Systems Division of the National Bureau of Standards. Dr. Lusted is radiologist and associate professor at the University of Rochester School of Medicine, Rochester, N.Y.

The NEW ENGLAND JOURNAL of MEDICINE

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SPECIAL ARTICLE ARCHIVE

Medicine and the Computer — The Promise and Problems of Change

William B. Schwartz, M.D.
N Engl J Med 1970; 283:1257-1264 | December 3, 1970

Abstract
Rapid advances in the information sciences, coupled with the political commitment to broad extensions of health care, promise to bring about basic changes in the structure of medical practice. Computing science will probably exert its major effects by augmenting and, in some cases, largely replacing the intellectual functions of the physician. As the "intellectual" use of the computer influences in a fundamental fashion the problems of both physician manpower and quality of medical care, it will also inevitably exact important social costs — psychologic, organizational, legal, economic and technical. Only through consideration of such potential costs will it be possible to introduce the new technology in an effective and acceptable manner. To accomplish this goal will require new interactions among

MEDIA IN THIS ARTICLE

TABLE 1

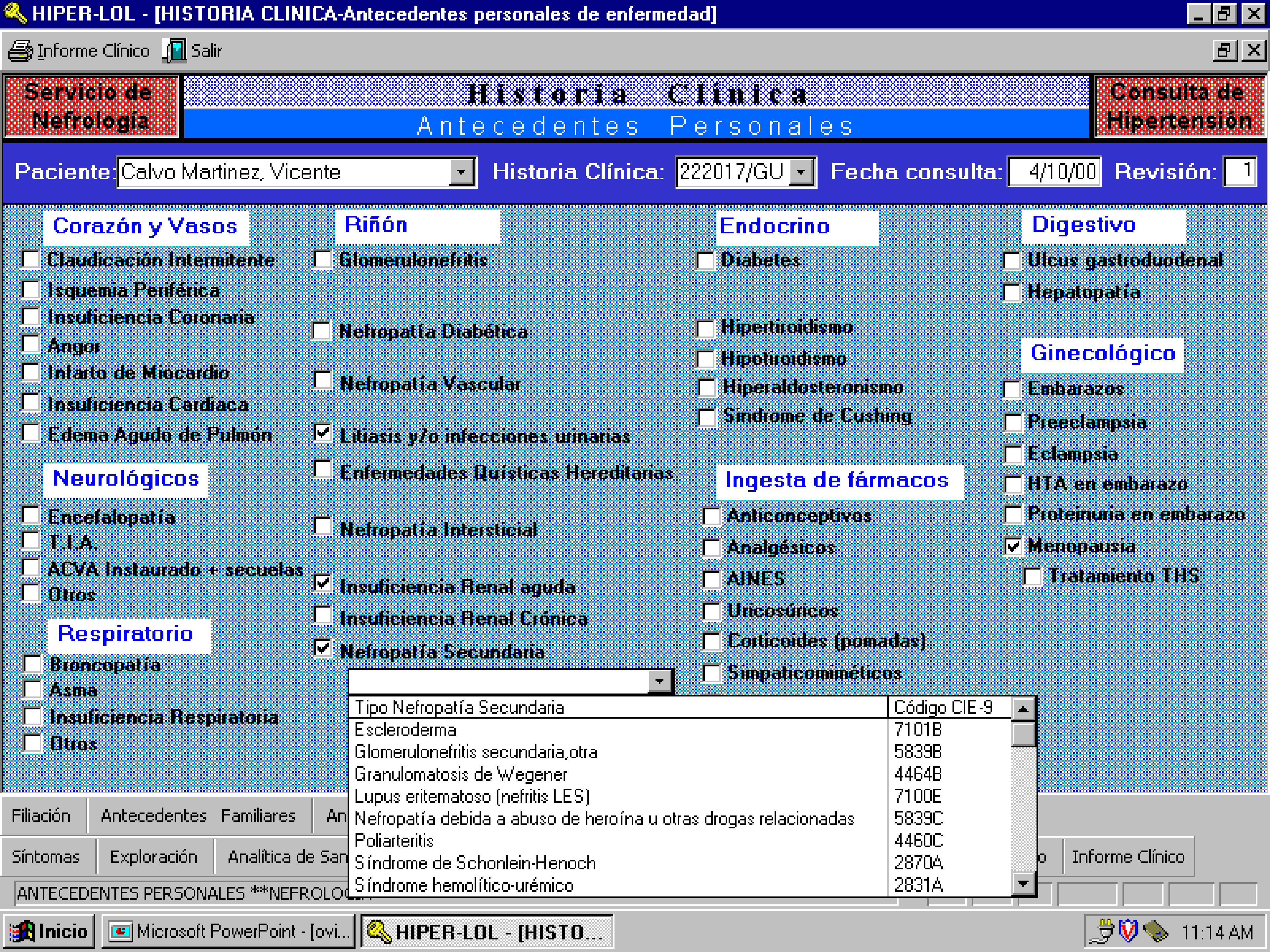
Example of an Actual Consultation in Which the Computer Assists the Physician in the Evaluation of a Complex Acid–Base Disturbance.*

Bioinformática

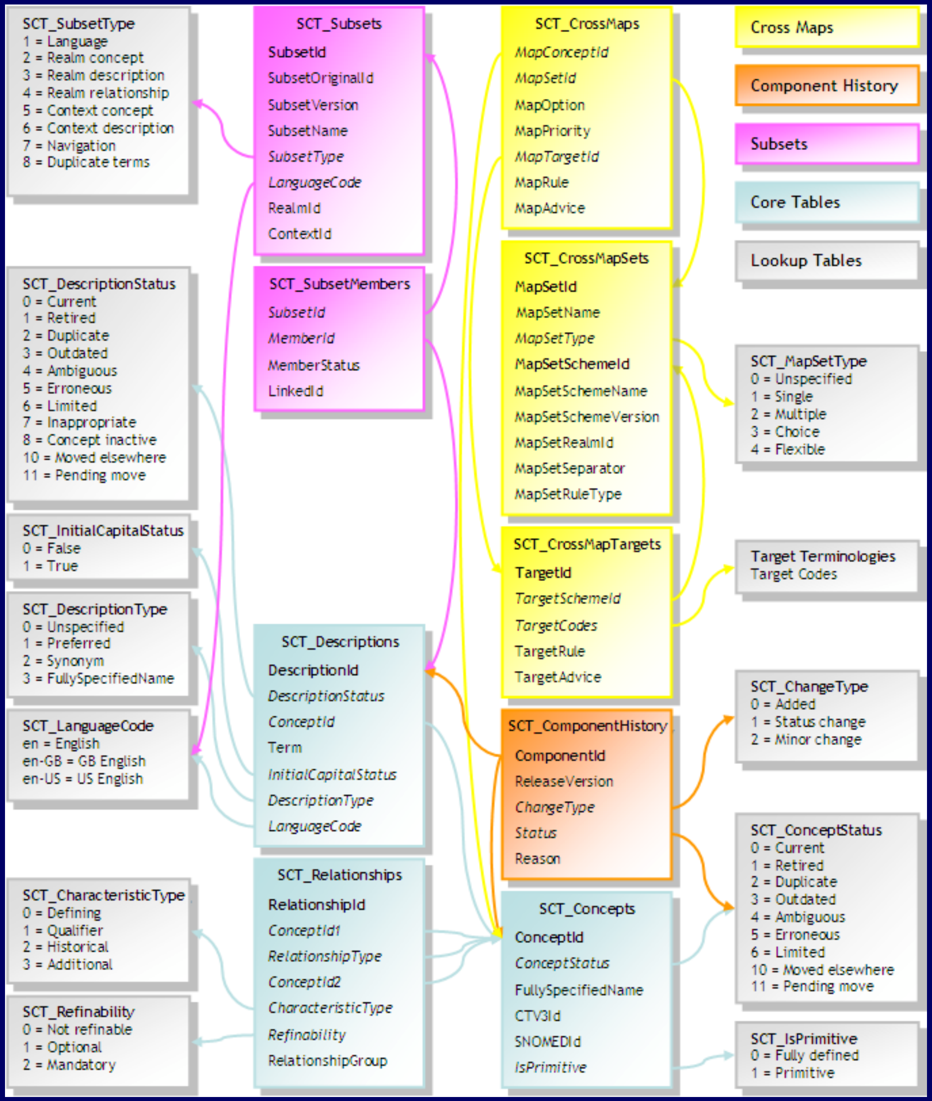
- "La disciplina que incluye los métodos matemáticos, estadísticos y computacionales resolver problemas biológicos usando ADN, ARN y secuencias de aminoácidos e información relacionada”

- Término de origen reciente (años 80), pero con raíces en la biología computacional (años 50)

- Muy relacionado al Proyecto Genoma Humano


HIPER-LOL - [HISTORIA CLINICA-Antecedentes personales de enfermedad]
Informe Clínico
Salir
Servicio de Nefrología
Historia Clínica
Antecedentes Personales
Consulta de Hipertensión
Paciente: Calvo Martinez, Vicente
Historia Clínica: 222017/GU
Fecha consulta: 4/10/00
Revisión: 1
Corazón y Vasos
Claudicación Intermitente
Isquemia Periférica
Insuficiencia Coronaria
Angor
Infarto de Miocardio
Insuficiencia Cardiaca
Edema Agudo de Pulmón
Neurológicos
Encefalopatía
T.I.A.
ACVA Instaurado + secuelas
Otros
Respiratorio
Broncopatía
Asma
Insuficiencia Respiratoria
Otros
Riñón
Glomerulonefritis
Nefropatía Diabética
Nefropatía Vascular
Litiasis y/o infecciones urinarias
Enfermedades Quísticas Hereditarias
Nefropatía Intersticial
Insuficiencia Renal aguda
Insuficiencia Renal Crónica
Nefropatía Secundaria
Tipo Nefropatía Secundaria | Código CIE-9
Esclerodermia | 7101B
Glomerulonefritis secundaria,otra | 5839B
Granulomatosis de Wegener | 4464B
Lupus eritematoso (nefritis LES) | 7100E
Nefropatía debida a abuso de heroína u otras drogas relacionadas | 5839C
Poliarteritis | 4460C
Síndrome de Schonlein-Henoch | 2870A
Síndrome hemolítico-urémico | 2831A
Endocrino
Diabetes
Hipertiroidismo
Hipotiroidismo
Hiperaldosteronismo
Síndrome de Cushing
Ingesta de fármacos
Anticonceptivos
Analgésicos
AINES
Uricosúricos
Corticoides (pomadas)
Simpaticomiméticos
Digestivo
Ulcus gastroduodenal
Hepatopatía
Ginecológico
Embarazos
Preeclampsia
Eclampsia
HTA en embarazo
Proteinuria en embarazo
Menopausia
Tratamiento THS
Filiación
Antecedentes Familiares
Síntomas
Exploración
Informe Clínico
ANTECEDENTES PERSONALES **NEFROLO
Inicio
Microsoft PowerPoint - [ovi...
HIPER-LOL - [HISTO...
11:14 AM

SNOMED CT (Systematized Nomenclature of Medicine-Clinical Terms)



En Ghana

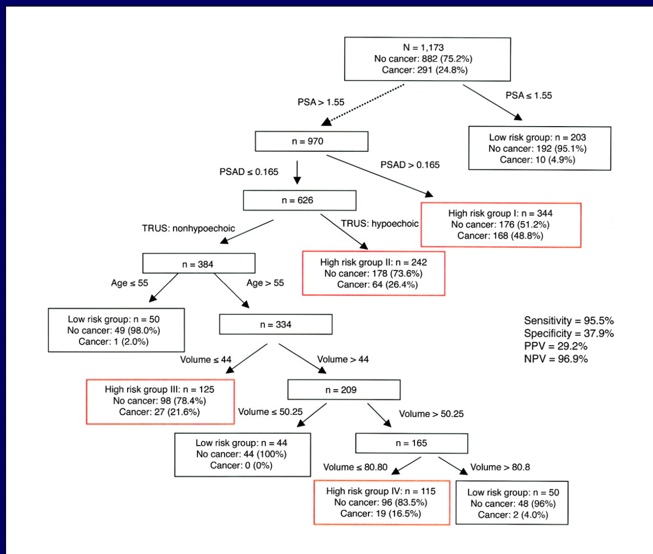
«Es imposible perder historias clínicas aquí

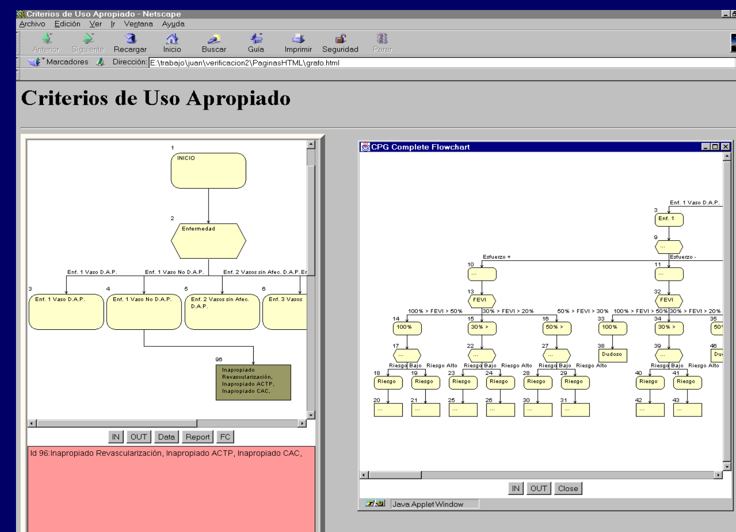
Proceso diagnóstico

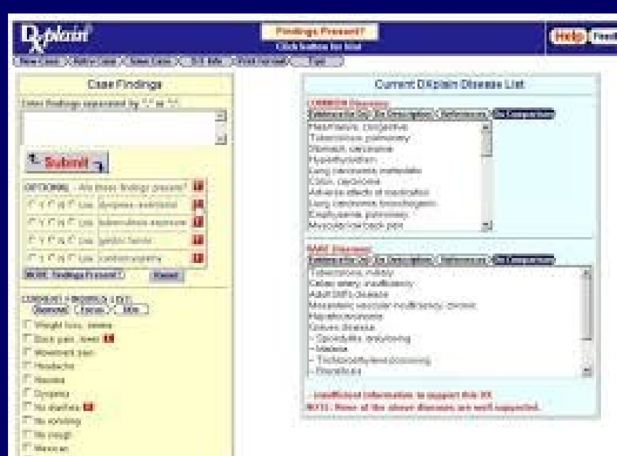
- Generación de hipótesis
- Refinamiento de hipótesis
- Las pruebas de diagnóstico
- Razonamiento causal
- Verificación de diagnóstico

Dr House

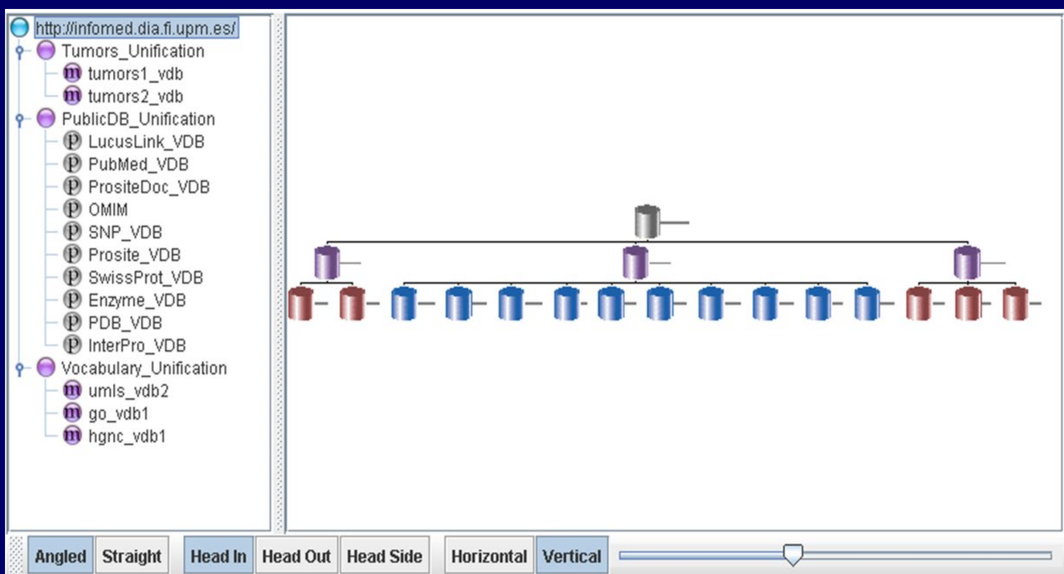
Toma de decisiones





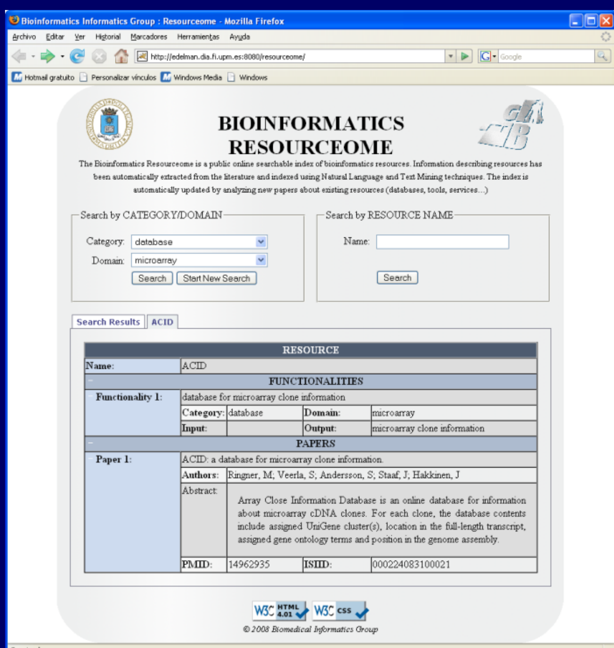


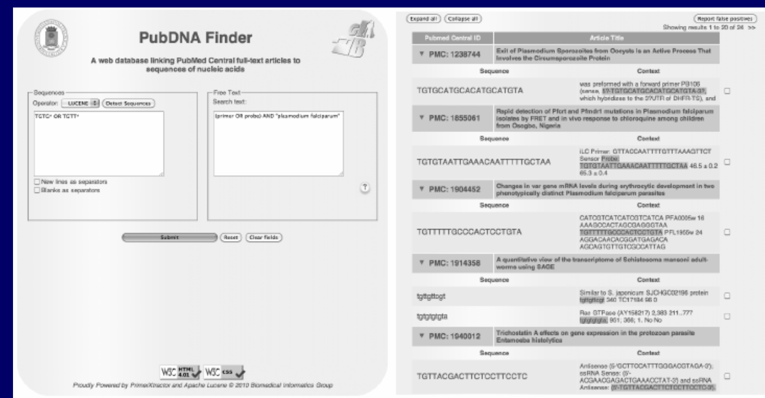
Sistemas de información

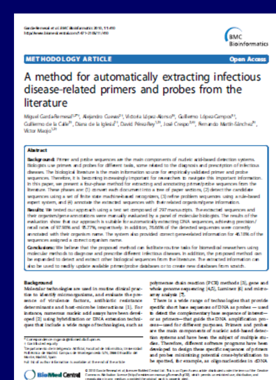


BIRI: minería de textos para la creación automática de un inventario de recursos de bioinformática

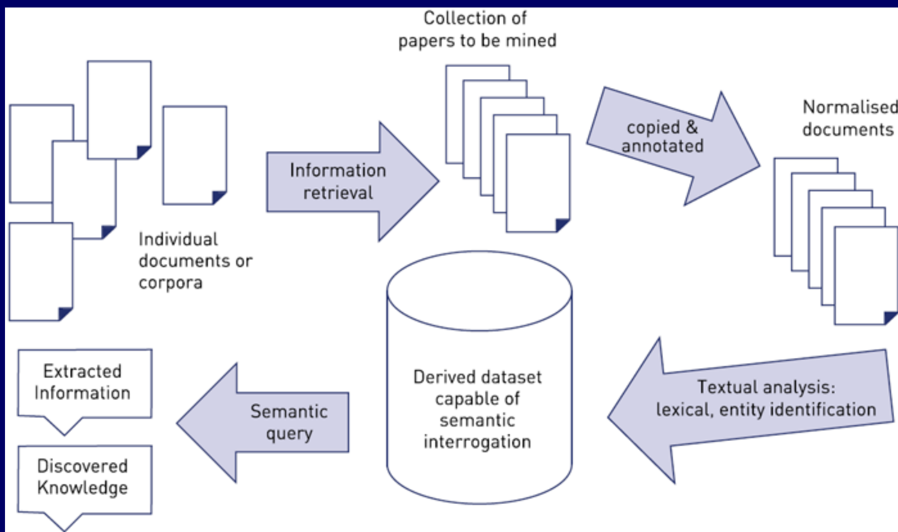
BIRI: minería de textos para la creación automática de un inventario de recursos de bioinformática

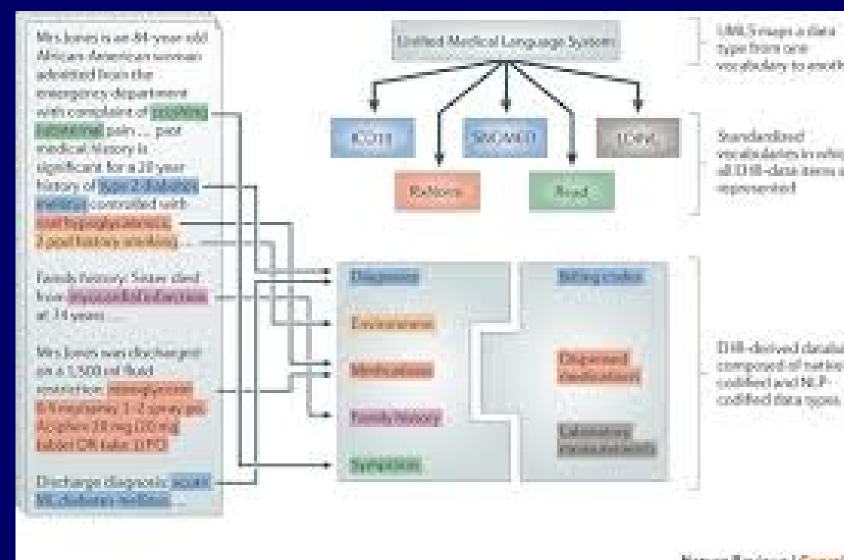




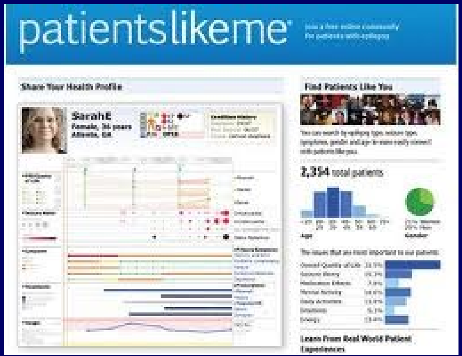


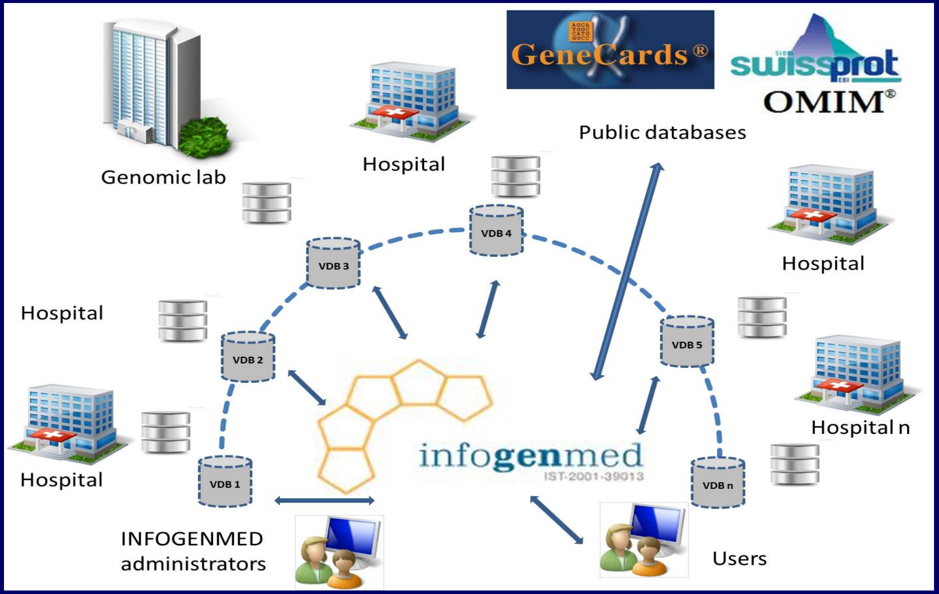
Historias clínicas en África


Collection of
papers to be mined
Information
retrieval
copied &
annotated
Normalised
documents
Individual
documents or
corpora
Derived dataset
capable of
semantic
interrogation
Textual analysis:
lexical, entity identification
Semantic
query
Extracted
Information
Discovered
Knowledge

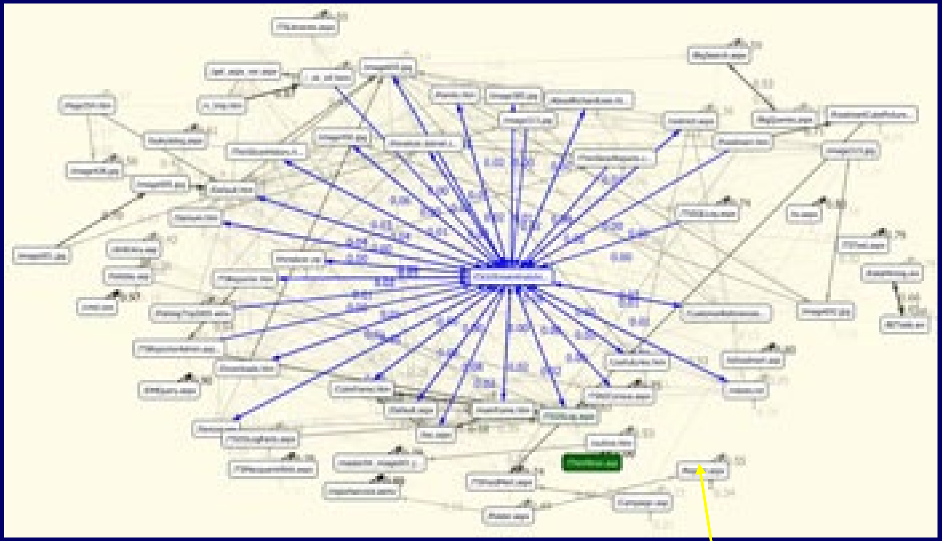

Unified Medical Language System
SNOMED
RxNorm
Read
Diagnoses
Billing codes
Medications
Family history
Symptoms
Nature Reviews | Genetics

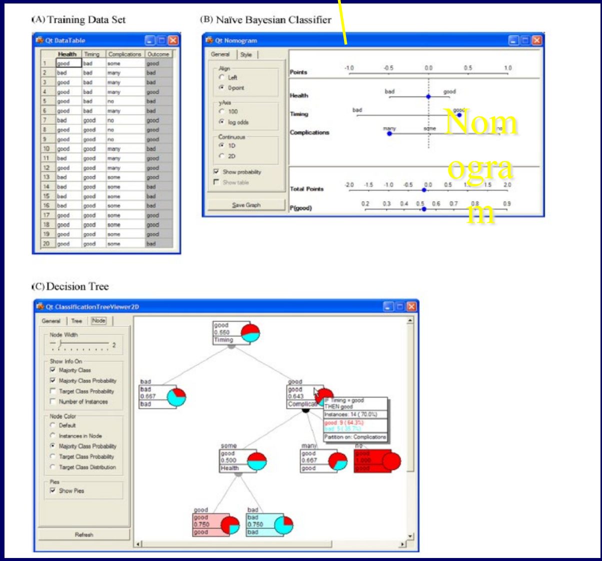
Tecnologías Web



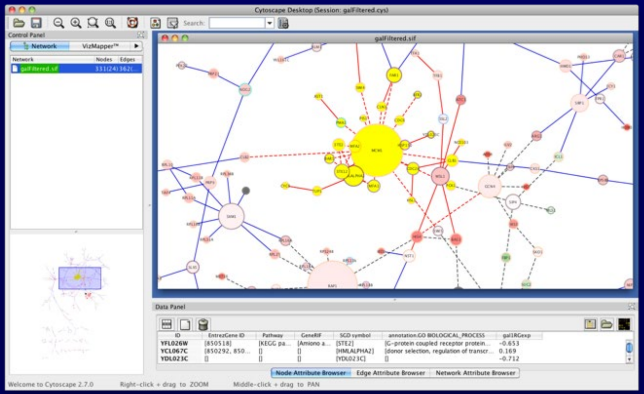


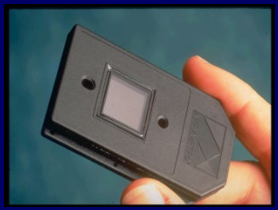
Minería de datos

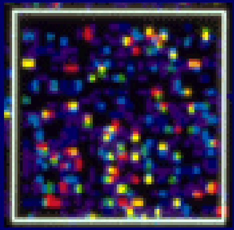


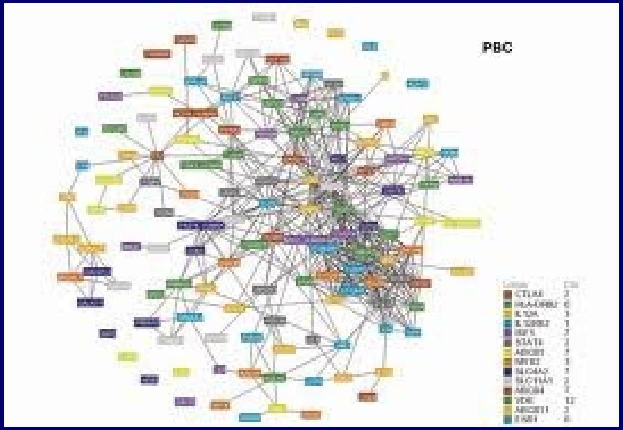


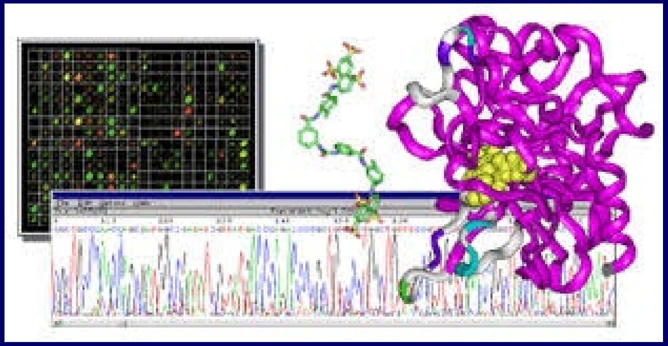
Bioinformática

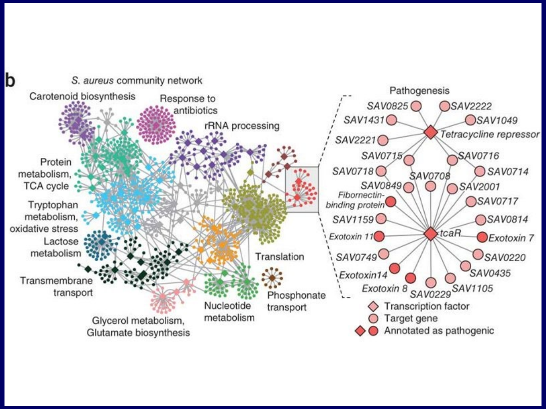






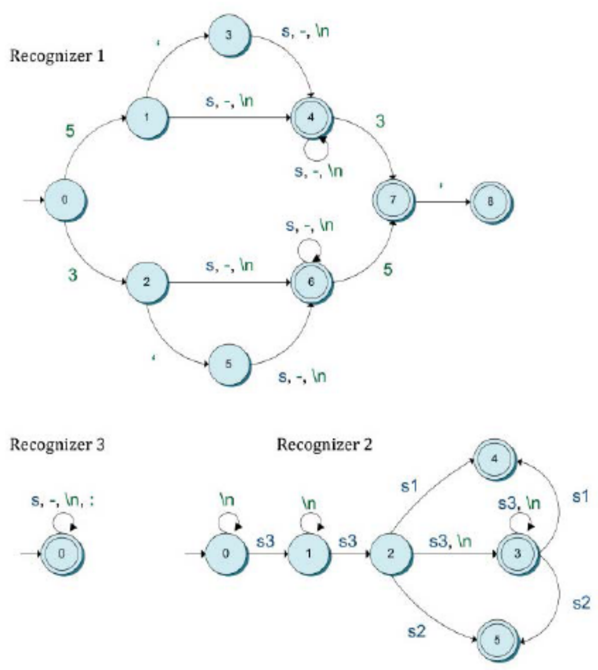






Minería de textos y recuperación de

Rule-based Approaches



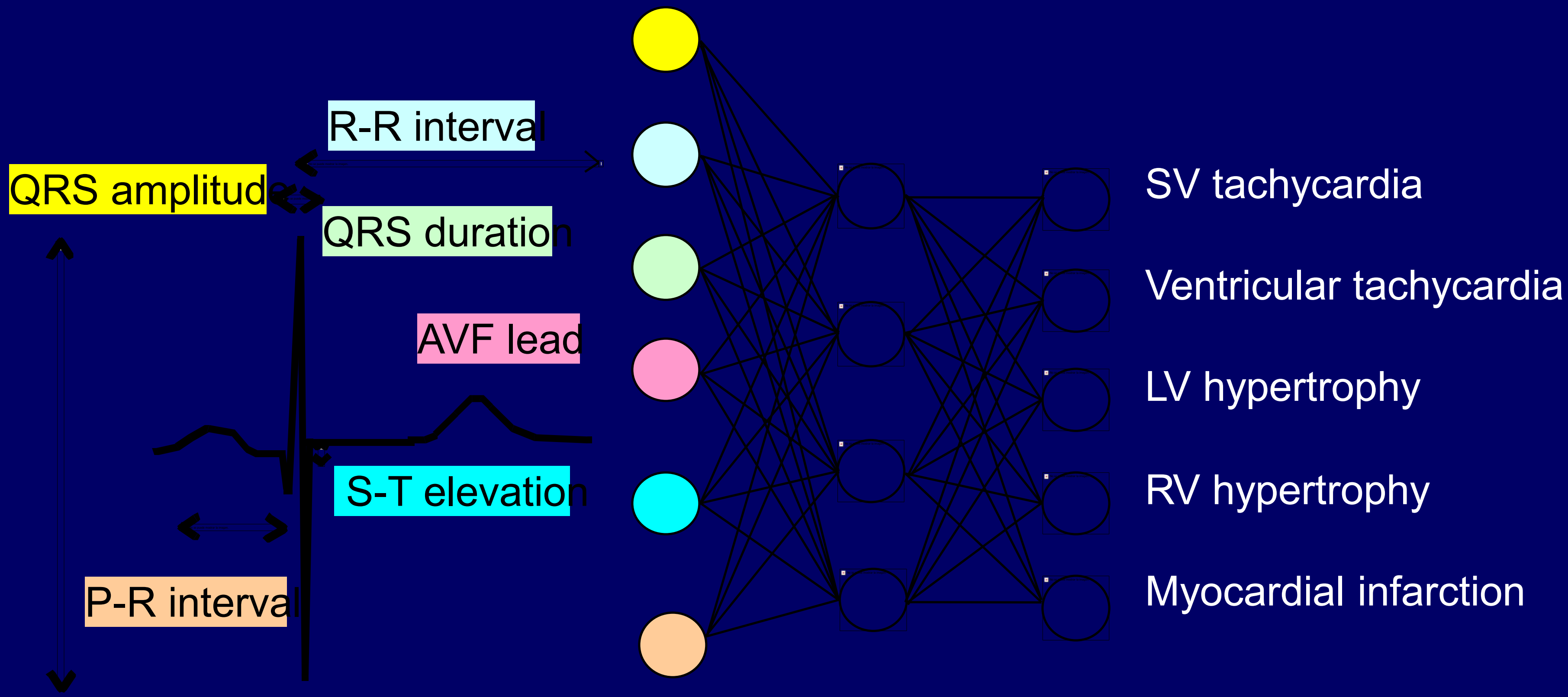
Detector	PMID	Text String	List of Tokens
1	19781080	...primers AA247 (5'-TGCCATTGCCAAAGAGAC-3') and pLQ510-rp1...	{"TGCCATTGCCAAAGAGAC"}
1	19664269	...mecA gene, mecAR (5'-TTACTCATGCCATACATAAATGGATA-\nGACG-3') and mecAF...	{"TTACTCATGCCATACATAAATGGATA", "GACG"}
1	19379498	...specific primer pair traD-F (5'-caatgcttgatctatttggtag-3') and traD-R...	{"caatgcttgatctatttggtag"}
1	19758438	...MY 09, 5-CGT CCM\n ARR GGA WAC TGA TC-3; where M = A/C, W = A/T...	{"CGT", "CCM", "ARR", "GGA", "WAC", "TGA", "TC"}
2	19799780	B-globin outside R @ CTC AAG TTC TCA GGA TCC A @ 1st round PCR primer for Human Beta globin DNA	{"CTC", "AAG", "TTC", "TCA", "GGA", "TCC", "A"}
2	18847469	btherm @ GAT GTG CCG GGC TCC TGC ATG @ This study	{"GAT", "GTG", "CCG", "GGC", "TCC", "TGC", "ATG"}
2	18154687	Stx1 @ GTA CGT CTT TAC TGA TGA TTG ATA GTG GCA CAG GG @ 35 @ 73.5	{"GTA", "CGT", "CTT", "TAC", "TGA", "TGA", "TTG", "ATA", "GTG", "GCA", "CAG", "GG"}
2	19558693	...are listed below.\n EP1- F ATG GTG GGC CAG CTT GTC\n EP1- R...	{"ATG", "GTG", "GGC", "CAG", "CTT", "GTC"}
3	19754958	...with primer N309 (ACATGCGGATCCCTCGAGCCTTTGAA-\nGATGACTAACTCCCCA) and N297...	{" ACATGCGGATCCCTCGAGCCTTTGAA", "GATGACTAACTCCCCA"}
3	19737401	...and 3' AAGCT TGGTA CCTCA CTGCA\nGCAGA GCGCT GAGGC CCAGC AGCAC. The resulting PCR...	{"AAGCT", "TGGTA", "CCTCA", "CTGCA", "GCAGA", "GCGCT", "GAGGC", "CCAGC", "AGCAC"}
3	19149882	1 @ XAC0340 @ 432 @ gATACCCCATATgAATgCgAT	{"gATACCCCATATgAATgCgAT"}
3	19775435	20 @ F:GAGATGGATTAACCAGATGTCTTAAAAACTATCGTAAC	{":","GAGATGGATTAACCAGATGTCTTAAAAACTATCGTAAC"}

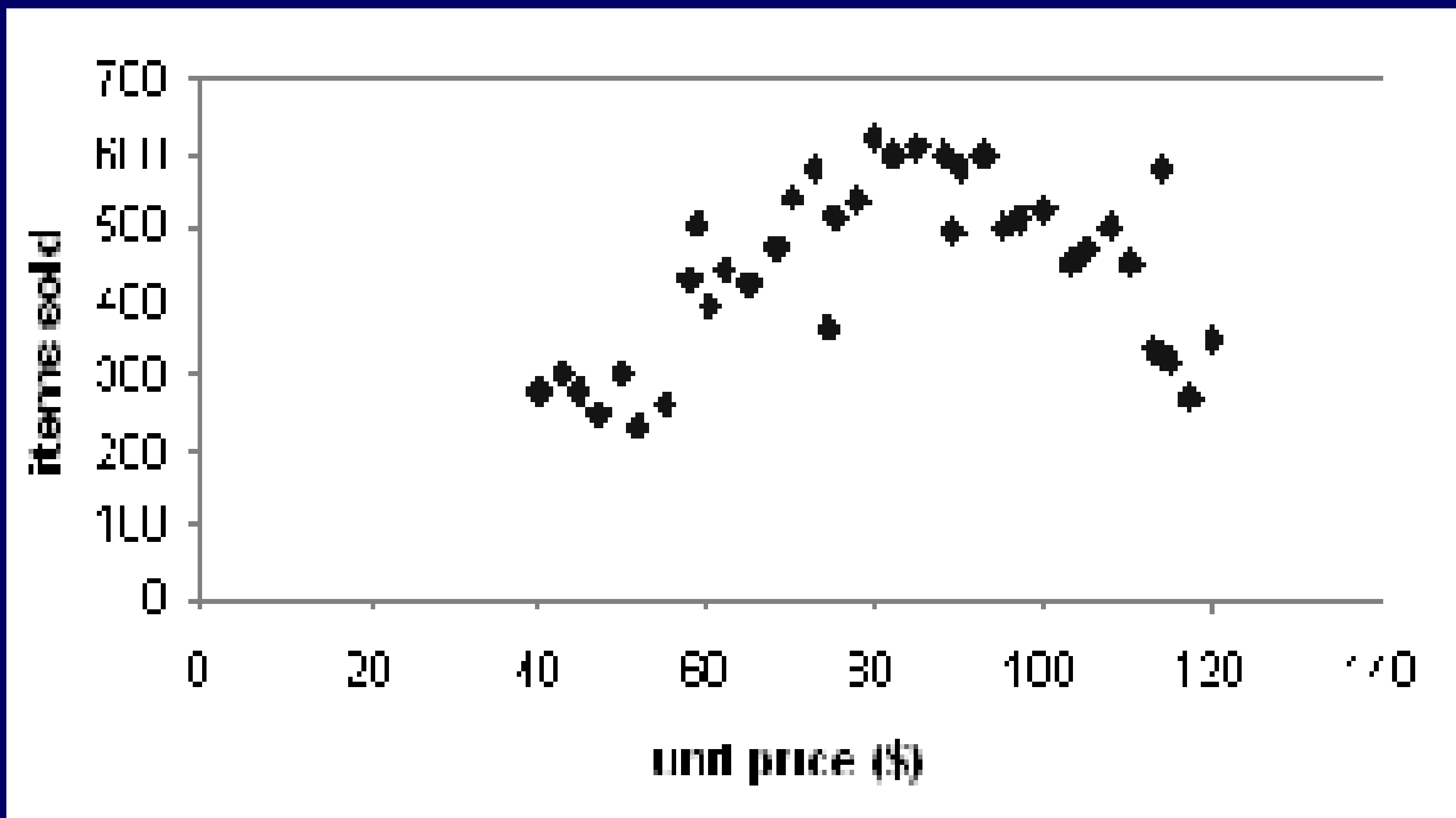
Aprendizaje automático

Índice

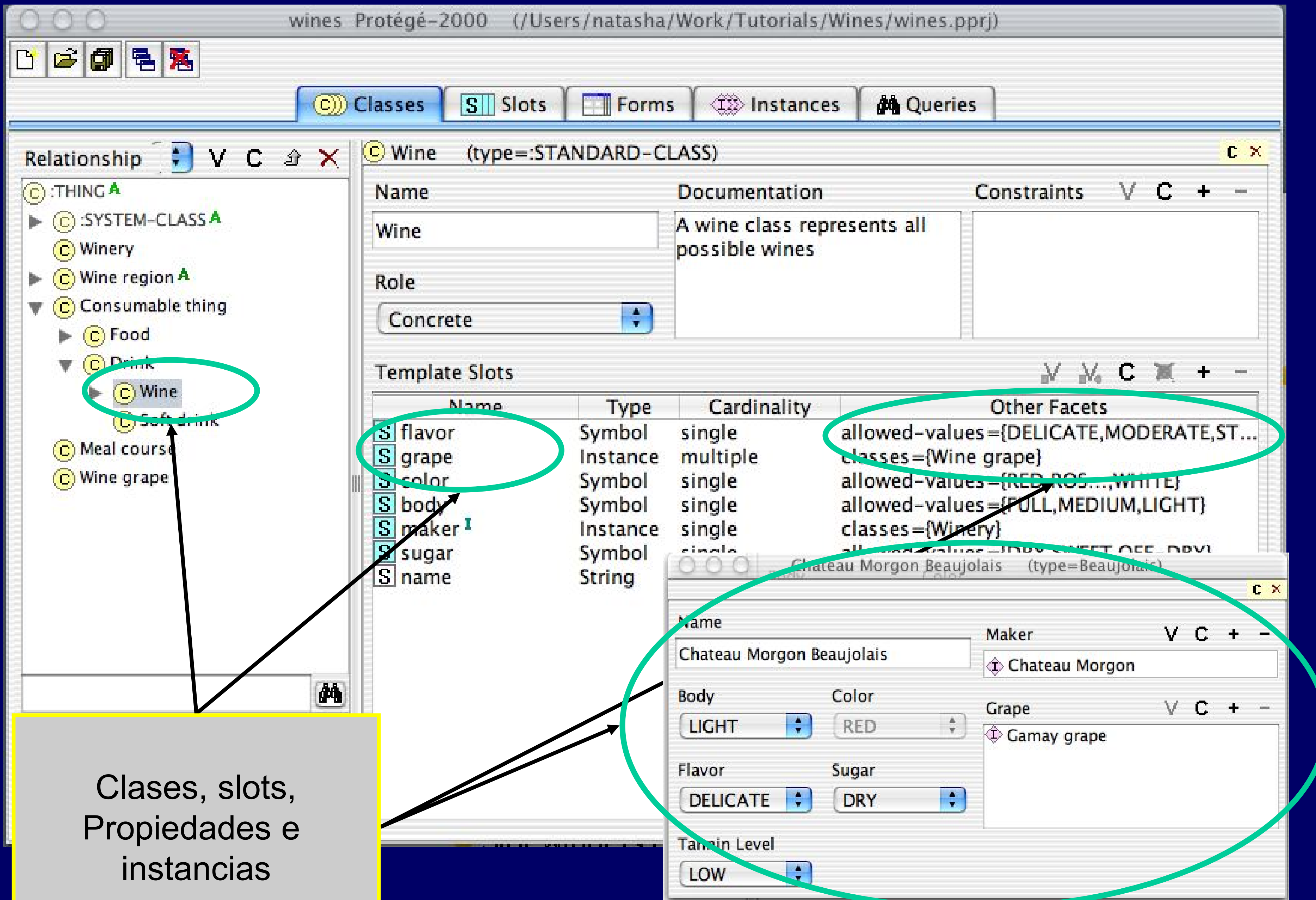
Diagnosis and Classification

ECG Interpretation

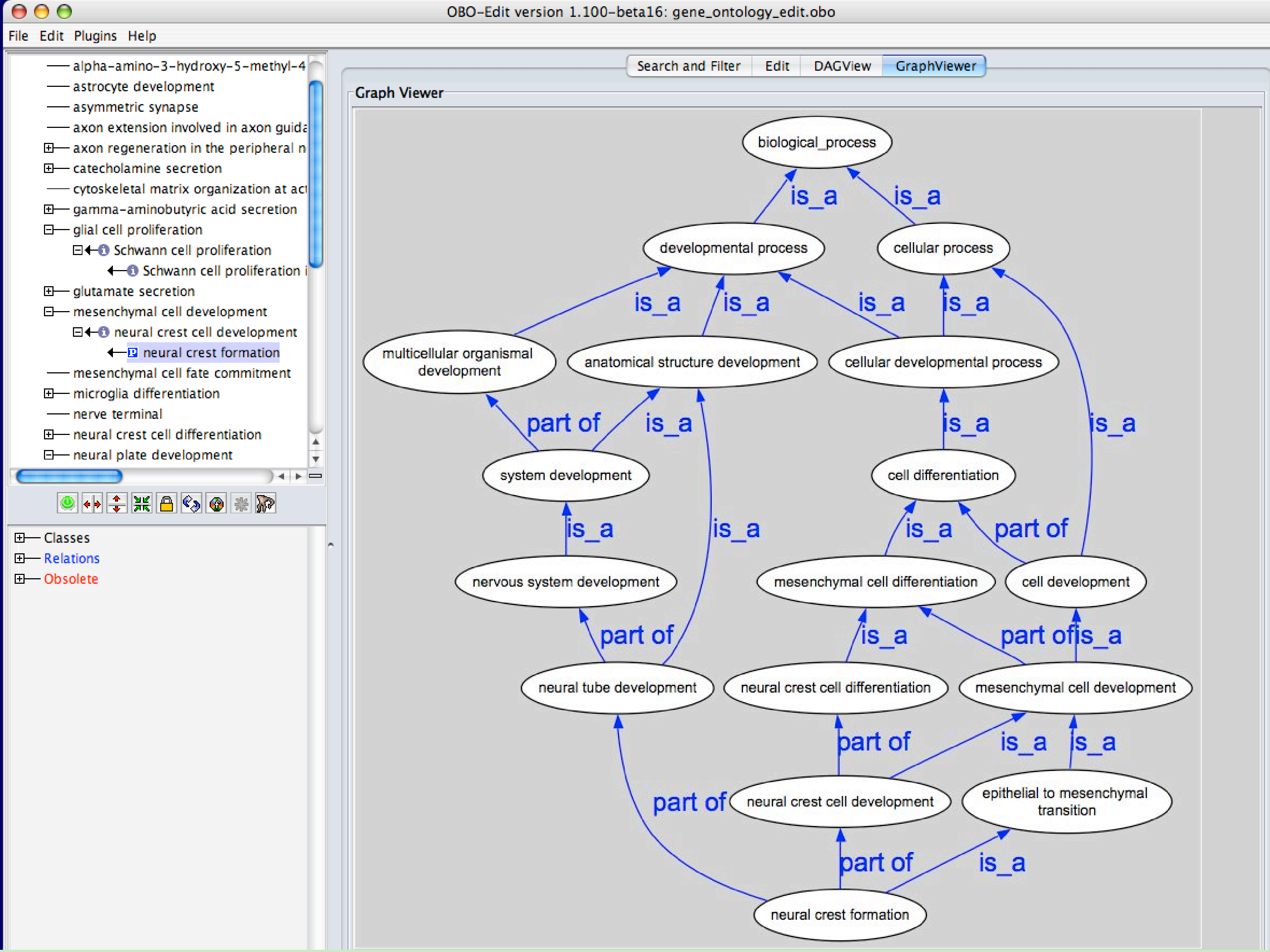




700
500
400
300
200
100
0
items sold
0
20
40
60
100
120
unit price ($)



Clases, slots, Propiedades e instancias



Terms are defined graphically relative to other terms