

A Massive Repository for the National Medical Knowledge Bank

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Agenda

- National Medical Knowledge Bank (NMKB) Project
- NMKB Features
- Virtual Conferences
- Intelligent Agent-Based Active Learning Framework
- Case Finder
- Data Warehouse Requirements
- Object Relational Database Repository Requirements
- Repository Architecture
- Summary & Conclusions



National Medical Knowledge Bank

An Advanced Technology Program Joint Venture

Allegheny-Singer Research Institute, Pittsburgh PA

Millennium Healthcare Solutions, Edison NJ

NCR Corporation, Dayton OH

MCP Hahnemann University, Philadelphia PA

AT&T Government Markets, McLeansville NC

Sponsored by:

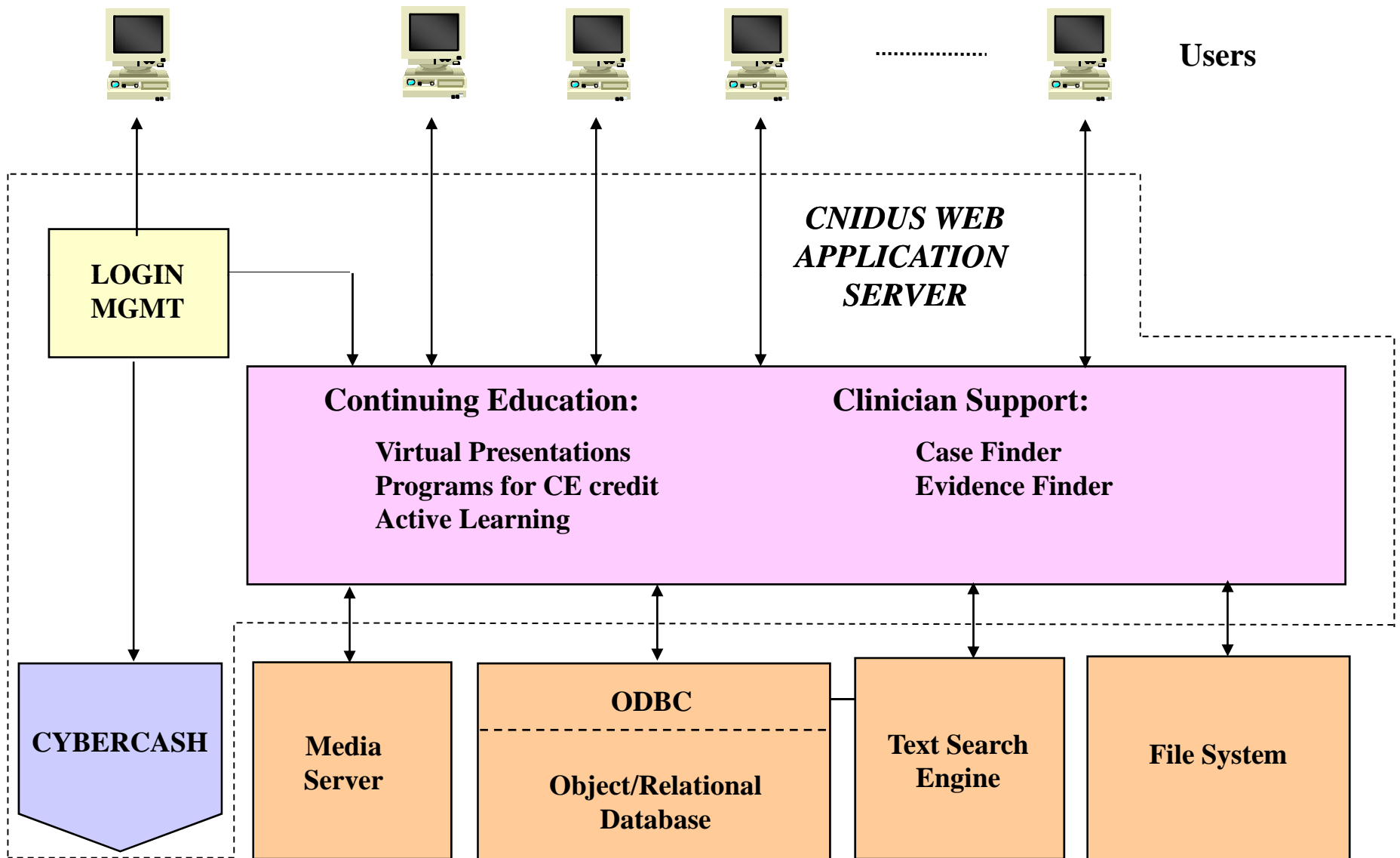
The United States Department of Commerce

National Institute of Standards and Technology

National Medical Knowledge Bank Features

- Web-based Architecture
- Targeted to healthcare practitioners
- Integrated applications
 - Virtual Medical Conferences
 - Nursing Training
 - Case-Based Retrieval for Diagnosis/Treatment Determination
 - Disease Domain-specific Literature Search
- Offers Continuing Education credits
- Designed to use an object relational database as a scalable, parallel data warehouse

NMKB Web Architecture





Virtual Conferences

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Brain Attack Conference - Video with Slide Indexing

The screenshot displays the BrainAttack Virtual Conference interface. At the top left, it says "BrainAttack VIRTUAL CONFERENCE" and "General Public". A "Help" button with a question mark icon is visible. To the right is a "Show Navigator" button. The main content area is split into two panels. The left panel shows a "Coronal View" of a brain with labels: "Blood in Subarachnoid Space" (top right) and "Blood in Subarachnoid Space Around Spinal Cord" (bottom right). A copyright notice "© 1997 NPKB" is in the bottom left of this panel. The right panel features a video player with a portrait of a man, a play/pause button, a progress bar showing "00:11.5 / 14:55.3", and two buttons: "Show me the Article" and "Show me the Video". Below the main content is a slide indexing bar with icons for "Title", "Presentation", "Facts", and "Presentation", with a red arrow pointing to the current slide.

- Asynchronous, discretionary viewing
- Lower cost option (travel, time)
- Concept searching
- CME credit, including JE/JIT
- Indexed presentation outlines for fast navigation
- Streaming video/audio with synchronized slides



Intelligent Agent-based Active Learning Framework

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Case Studies





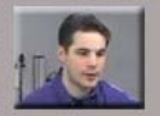

http://brainattack.ncrhitc.com/alf/CaseSelection.asp - Microsoft Internet Explorer provided by NCR Corpora...

File Edit View Favorites Tools Help

Continuing Education

Case Studies in Fatigue

Primary Care Providers
Catalogue of Case Studies in Fatigue
click on any of the pictures below to select case studies

 <p>Patient M.J. 32 year old female Native of India Married, 2 children homemaker</p>	 <p>Patient H.G. 32 year old female African-American Single, 3 children Unemployed</p>	 <p>Patient K.M. 23 year old male Caucasian Single Farm Foreman</p>
 <p>Patient R.T. 49 year old female African-American Single, 4 children Unemployed</p>	 <p>Patient H.R. 20 year old male Caucasian Single Student, pt time job</p>	 <p>Patient P.M. 40 year old female African-American Single, 4 children</p>

Patient M.J.
Patient H.G.
Patient K.M.
Patient R.T.
Patient H.R.
Patient P.M.

An ambiguous, elusive and time consuming complaint to unravel, fatigue is often unwelcome by the busy health care provider and may be either over-looked or dismissed.

This set of interactive case studies is designed to challenge your diagnostic thinking, enhance your clinical work-ups and increase your working knowledge of the causes and treatments of fatigue.

Author: Debra McGrath, RN, MSN,CRNP

- Delivers personalized, active education experience
- Problem-based learning
- At convenience of student schedule; can complete in multiple sessions
- Certified CNE credit
- Reusable framework; lowers production cost
- Agent technology - lesson planning; student model; tutor; ontology
- Applicable to other domains

Internet

Activity Menu

Lesson Plan - Microsoft Internet Explorer provided by NCR Corporation

File Edit View Favorites Tools Help

Continuing Education Case Catalogue

Case Studies in Fatigue

Activity Menu
Click on an activity to begin.

Develop plan-of-care

Perform physical exam

Conduct ROS Interview

Conduct HPI interview

Review case scenario

Review patient chart

Mouse over activity titles for descriptions

Mastery Level: 0%

Patient M.J.
32 year old female
Native of India
Married, 2 children
homemaker

Applet started Internet

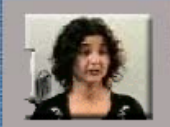
HPI Interview

History of Present Illness - Microsoft Internet Explorer provided by NCR Corporation

File Edit View Favorites Tools Help

Continuing Education

Case Studies in Fatigue



Case Catalogue

[Back to Activity Menu](#)

Conduct HPI Interview

Decide which are the 10 most pertinent interview questions.

Instructions: Drag and drop 10 questions from the list into the spaces provided on the interview form. To play the video for an interview question, click on the video button. Drag questions back to the list that you do not wish to view. Your score is determined by the first 10 questions you view and these interview findings will be automatically recorded in the chart. After that, the remaining questions will be available for viewing.

HPI questions

On a scale of one to ten, how would you rate your fatigue? Do you feel so tired that you cannot keep up with your daily responsibilities?

How much sleep do you get per night?

Do you have difficulty falling asleep?

When you fall asleep do you awake in the middle of the night and have difficulty falling back to sleep?

Is there anything that you are doing that makes you feel less tired? More tired?

How much weight have you gained

Interview Form

1. Do you have difficulty falling asleep?
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

[Back to Activity Menu](#)

CHART

Click to View

Done Internet

Intelligent Agent-based Continuing Education - HPI Video Interview

History of Present Illness - Microsoft Internet Explorer provided by NCR Corporation

File Edit View Favorites Tools Help

Continuing Education Case Catalogue

Case Studies in Fatigue [Back to Activity Menu](#)

Conduct HPI Interview

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Interview Form

1. Do you have difficulty falling asleep?

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

CHART
Click to View

Done Internet

- Patient interview video vignettes (streaming video)
- Student selects questions and orders them
- Student evaluated on question choice

Intelligent Agent-based Continuing Education – Review Patient Chart


http://brainattack.ncrhitc.com/alf/Chart.asp?LESSONID=104&NF=LESSONPLAN&NFID=-1 - Microsoft Internet...

File Edit View Favorites » Address http://brainattack.ncrhitc.com/alf/Chart.asp?LESSONID=104&NF=LESSONPLAN&NFID=-1 Go

Continuing Education

[Case Catalogue](#)

Case Studies
in Fatigue



[Back to Activity Menu](#)

Patient Chart

The patient chart contains the information available to you at the initial patient visit. Information is added to the chart as you obtain additional information about the patient during this lesson.

Name: M.J. **Gender:** **Birthdate:** 1/2/67 **Allergies:** NKDA

Patient Problems
Past Medical
Current Health
Family History
Psychosocial

CC & HPI
Review of Systems
Physical Exam
Labs
Assessment and Plan

LAB RESULTS [Scroll to view more data](#)

Test	Result	Normal range	Finding
CBC with differentials and platelets			
■ WBC	9.3	(4.5-11.0)	Normal
- Neutrophils	56%		
- Bands	3%		
- Lymphocytes	34%		
- Monocytes	4%		
- Eosinophils	3%		
- Basophils	0.3%		
■ RBC	4.5	(4.2-5.4)	Normal
■ MCV	88	(82-98)	Normal
■ MCHC	36%	(32%-36%)	Normal
■ MCH	29%	(27%-31%)	Normal

[Back to Activity Menu](#)



Case Finder (Case-based Reasoning)

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Target Selector

Target Selector - Microsoft Internet Explorer provided by NCR Corporation

File Edit View Favorites Tools Help

Case Finder Target Selector

Neurology Cases

Find Matching Cases

First Previous Target Case: 5 of 23

Patient Information: 50 year old white male

Problem: Onset: acute (hours), Duration: hours, Temporal Pattern: improving

Findings:

CT Scan: brain Normal

Signs and Symptoms:

frontal headache
vomiting
hemiparesis
slurred speech
nausea

Past Medical History: ulcer

Social History: tobacco use, Drug Abuse

Family History:

Internet

- Uses **Case-Based Reasoning** to Find “Similar” Cases
- Eases clinician’s burden of reading and recalling cases
- Saves clinician time
- Web-based; works with any ODBC database
- Matches complex data

Neurology Cases #5

Case Matcher - Microsoft Internet Explorer provided by NCR Corporation

File Edit View Favorites Tools Help

	Target Case 5	Case 40 88%	Case 39 58%	Case 12 58%
Problem:	Onset: acute (hours) Duration: hours Temporal Pattern: improving	Onset: subacute (days-weeks) Duration: days Temporal Pattern: constant Subarachnoid Hemorrhage caused by basilar apex aneurysm	Onset: acute (hours) Duration: hours Temporal Pattern: constant Subarachnoid Hemorrhage caused by left side carotid artery aneurysm	Onset: acute (hours) Duration: days Temporal Pattern: constant Subarachnoid Hemorrhage caused by micro middle cerebral artery aneurysm
Findings:	CT Scan: brain Normal	CT Scan: brain Normal Lumbar Puncture: spinal fluid blood Angiography: basilar artery aneurysm (1 cm)	CT: brain subarachnoid hemorrhage CT: brain subarachnoid hemorrhage CT: 3rd cerebral ventricles blood CT: brain hydrocephalus Angiography: carotid artery aneurysm Angiography: internal carotid artery aneurysm	CT: brain subarachnoid hemorrhage
Signs and Symptoms:	frontal headache vomiting hemiparesis slurred speech nausea	severe headache nausea vomiting	worst in life headache lethargy right hemiparesis dysphasic	severe headache stiff neck vomiting
Past Medical History:	ulcer	hypertension		hypertension
Social:	tobacco use Drug Abuse			

Internet

Medical Ontology

Case Finder uses the Unified Medical Language System (UMLS) with >700K concepts and 1.5M concept names

- allows matching at the concept level
 - stroke = brain attack
- identifies relationships between concepts
 - embolic stroke is a kind of stroke

What the Warehouse Holds

- NMKB Content Index for all current and potential content for all applications - based on Dublin Core
- Evidence-based medicine abstracts and “pearls”
- All exemplar cases for CaseFinder application
- Digital video and slides/images for all virtual events
- All content for Active Learning Framework training modules
- Unified Medical Language System ontology
- Student history
- User data
- Potential content for the NMKB

Repository (Database) Requirements

- Store standard datatypes, medical imagery, video, text - up to 2 Gbyte objects
- Support application-specific User Defined Functions for:
 - image analysis and image manipulation
 - cbr similarity metrics calculation
- Support DICOM3 datatype
- Support high concurrent usage
- Support terabyte-size databases
- Support scalability

What is an Object Relational Database?

Traditional Data

Alphanumeric

- Integer
- Character
- Date
- Float

New Data

System Defined Types (SDTs)

- Audio
- Image
- Video
- Geospatial
- Document/Text

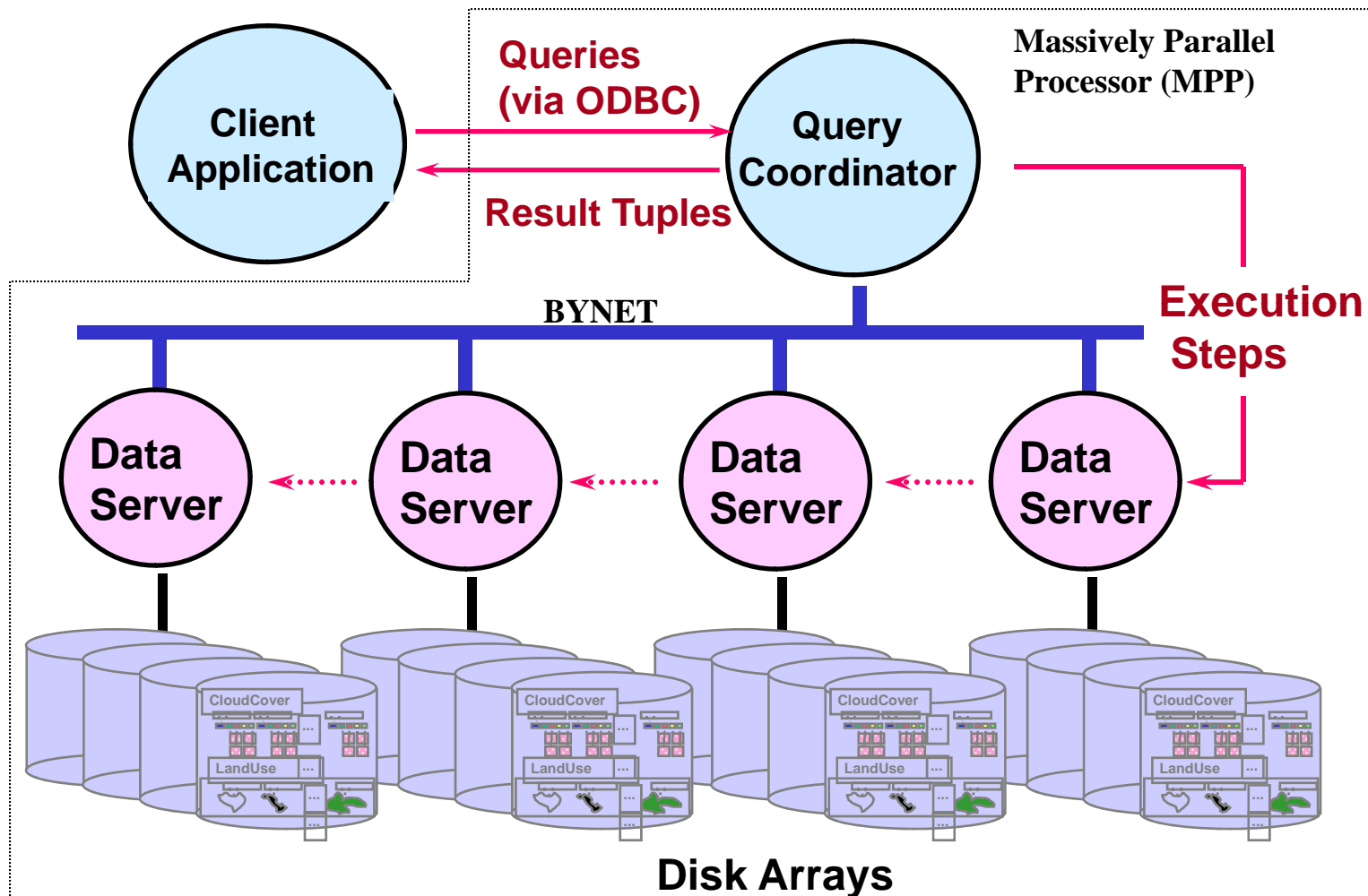
System/User Defined Functions (SDFs/UDFs)

- Word Spotting; Voice Recognition for Identification
- Tumor Classification in MRI Scans; Color Histogram
- Extraction of Video Segment (start and end points)
- Map/Image Overlay; Distance Between Points; Polygon Overlap
- Language translation; Word/Phase Matching and Counting

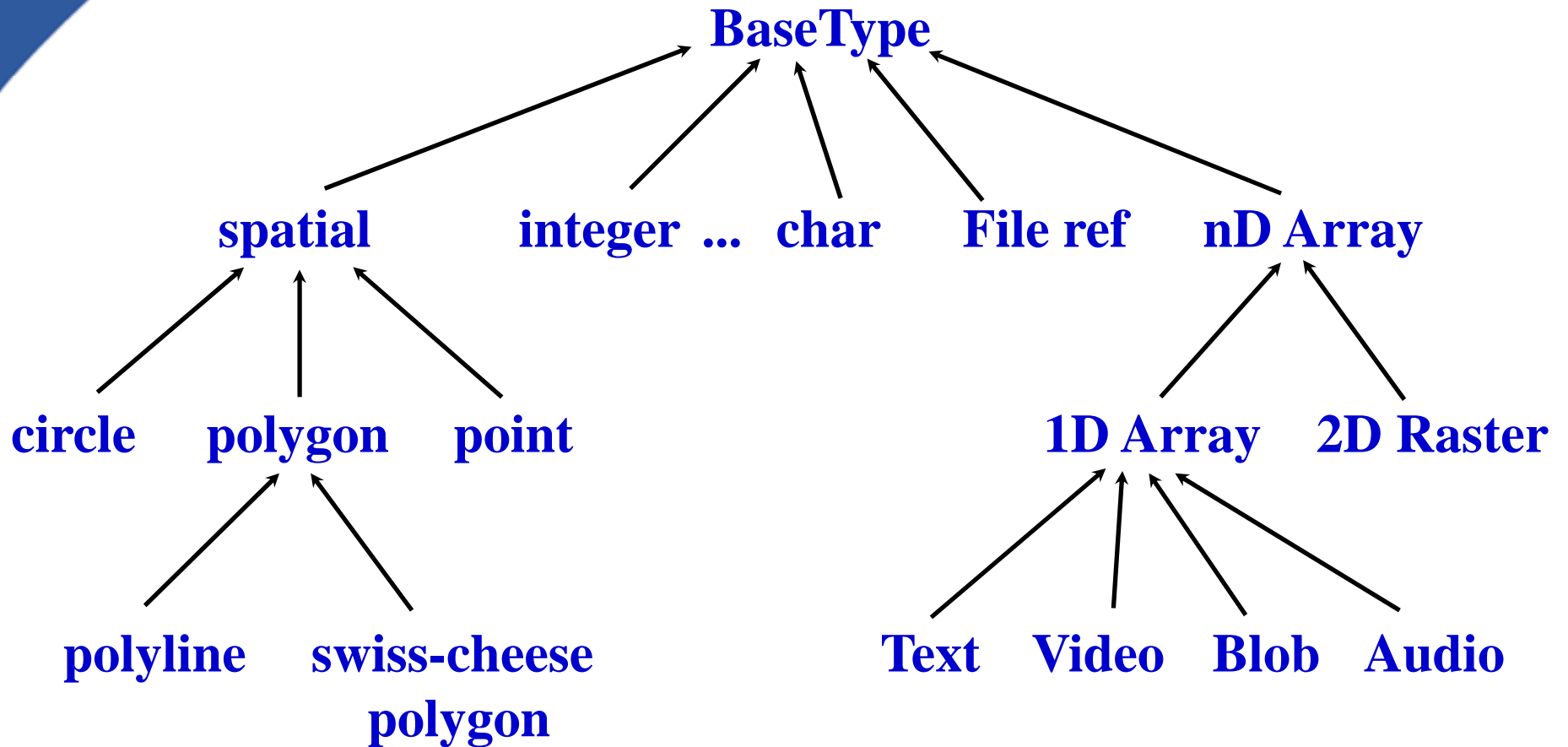
Object Relational Database Table Row

Alphanumeric Attributes			"Object" Columns (SDTs)				
Char (n)	Integer	Float	Image	Audio	Video	Point	Text
Patient Name	Patient Age	Account Balance	MRI Scans	Doctor Comm.	Angio-gram	Work Location	Transcribed Dr. Comm

Parallel Architecture

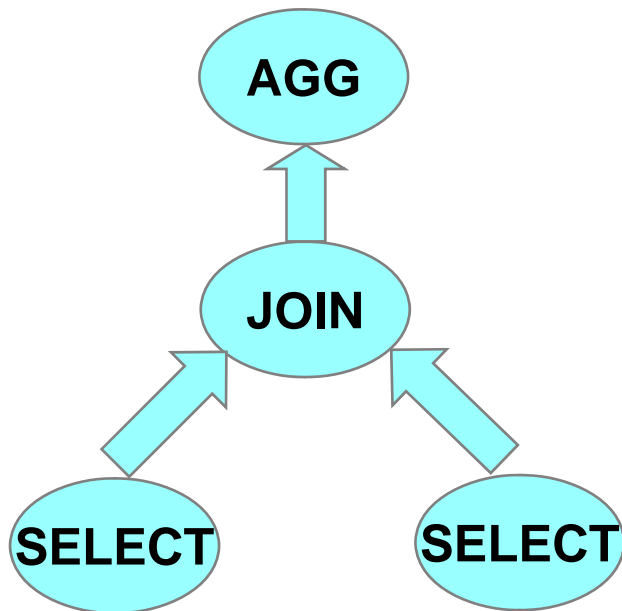


Type Hierarchy

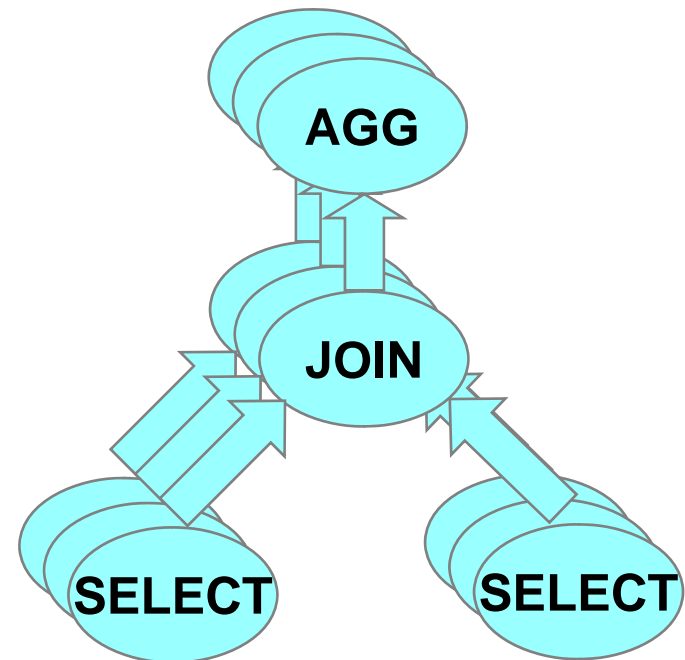


Parallel Execution

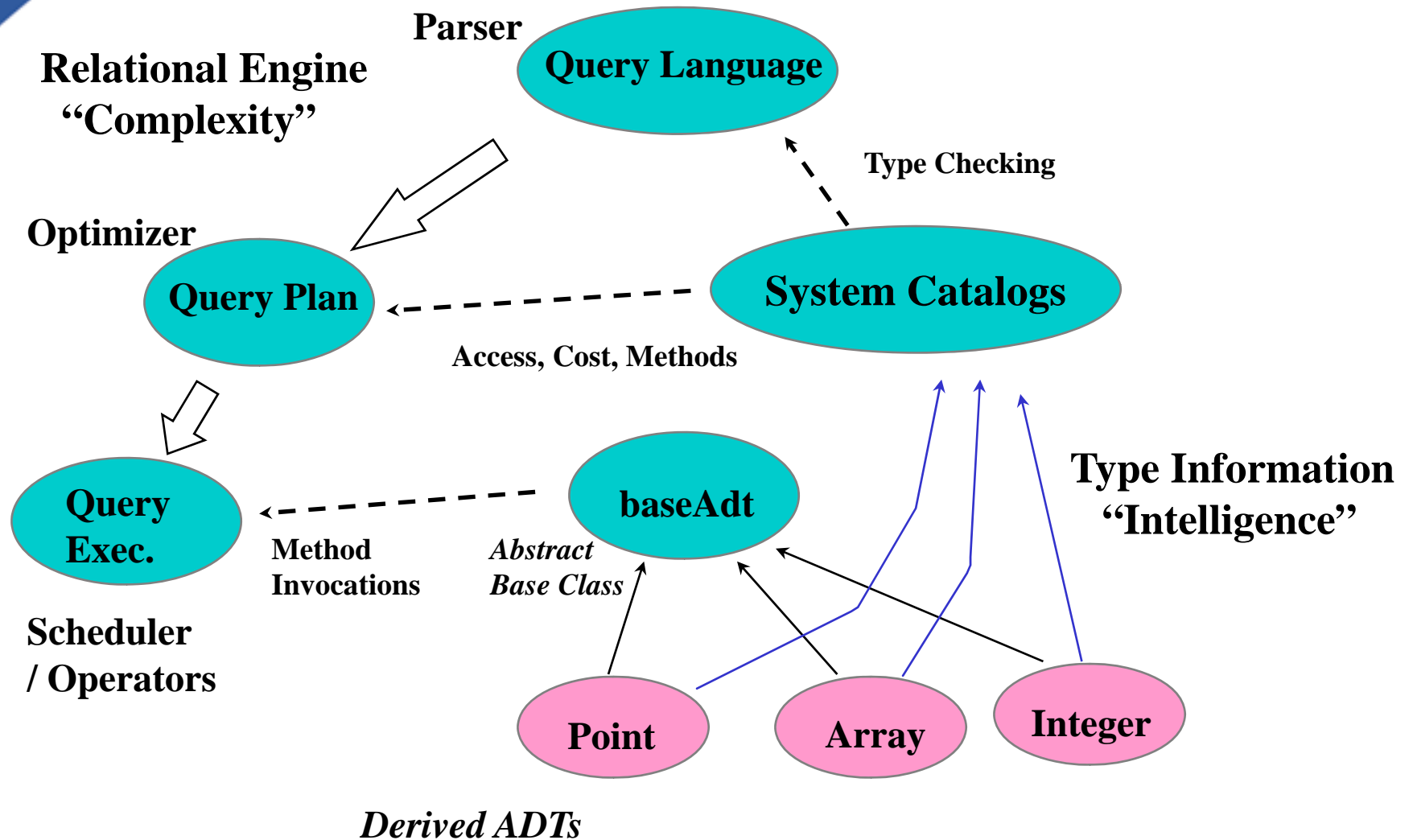
Pipelined Execution



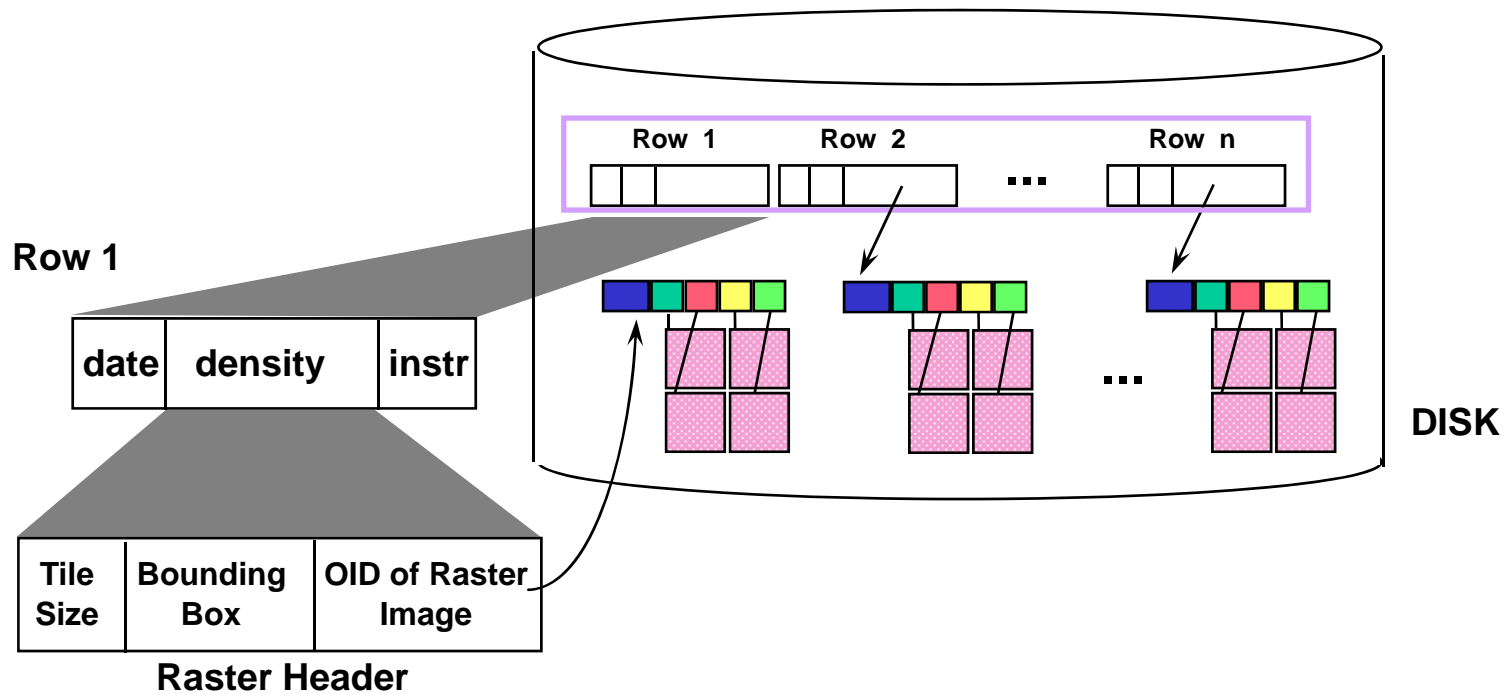
Partitioned Execution



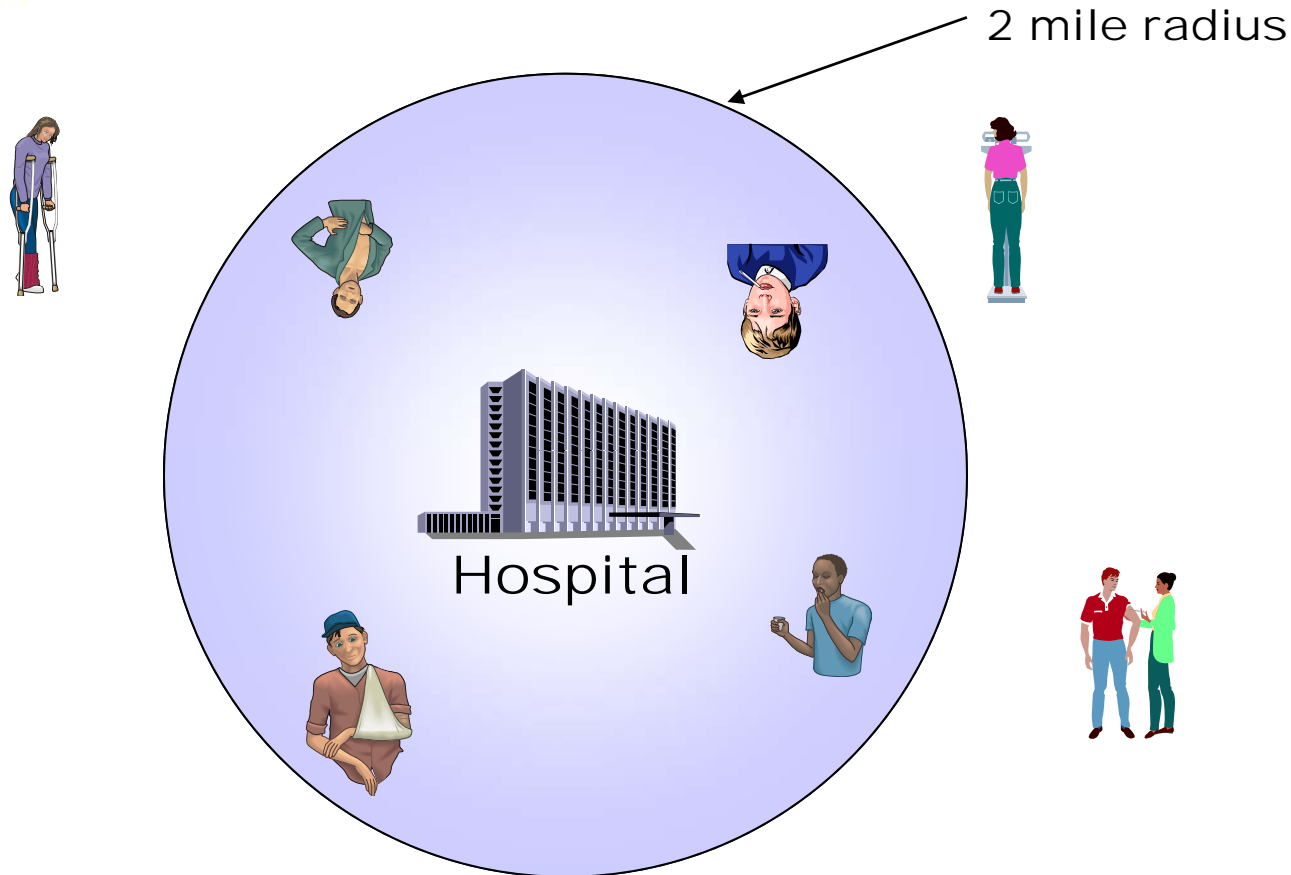
Execution Architecture



CloudCover (date: date, density: 2Draster, instr: string)



Sample Spatial Query

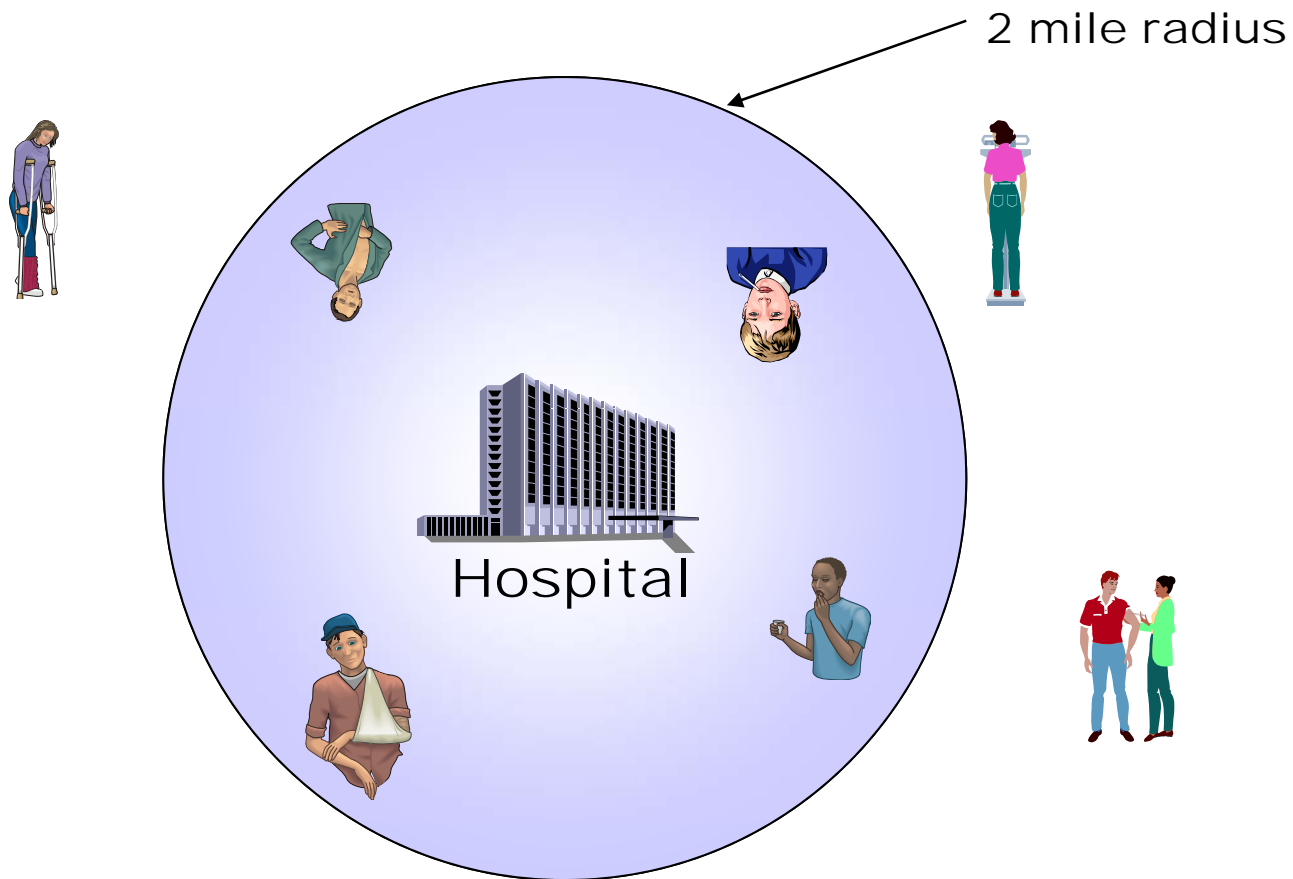


Query: Find all patients that live within a 2 mile radius of Greenwich Hospital.

Tables: Patients (name:string, home:point)

Hospitals (name:string, location:point)

Sample Spatial Query



Select patients.name from patients, hospitals
where circle (hospitals.location, 2)

contains patients.home and hospitals.name = "Greenwich"

Summary and Conclusions

- The NMKB project sponsored by NIST ATP was successfully completed
- The NMKB will support innovative interactive multimedia-enabled medical applications.
- Goal is to commercialize the NMKB or pieces of it.
- The data warehouse of a commercial NMKB must be supported by object relational database technology
- Scalable growth is required as content base grows.
- Parallel database operation is required for sophisticated CBR searching and concurrent access by large numbers of users.