Large Scale Search Improvement Needs Large Scale Knowledge

Michael Witbrock

Cycorp Europe

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June 2nd 2008

Intelligent Search

Valve Surgery

Search

Semantic Search Results

Intelligent Search

heart valve repair Search

Semantic Search Results

A. Marc Gillinov, M.D.
A. Marc Gillinov, M.D. Specialties: Minimally invasive mitral valve, aortic valve, and tricuspid valve surgery; mitral valve repair, surgical... Gillinov, M.D. has performed 125 heart-valve repair operations at
http://tomcat/html-content/gillinov_GillinovHeartValveRepair.html (cached)

Valve Disease
AV Repair or Replace + Other AV Repair o
Replacements AV = Aortic
http://tomcat/html-content/Valve_Disease_

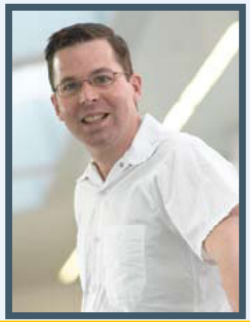
Nicholas G. Smedira, M.D.
Nicholas G. Smedira, M.D. Specialties: He
replacement, off-pump coronary artery byp
http://tomcat/html-content/smedira_.html (

Joseph F. Sabik III, M.D.
Joseph F. Sabik III, M.D. Specialties: Adult
surgery, off-pump coronary artery bypass s
http://tomcat/html-content/sabik_.html (cac

Eric E. Roselli, M.D.
Eric E. Roselli, M.D. Specialties: Adult card
and replacement, high-risk valve surger
http://tomcat/html-content/roselli_.html (a

Gosta B. Pettersson, M.D., Ph.
aortic and mitral valve repair/replaceme
http://tomcat/html-content/pettersson_.h

A. Marc Gillinov, M.D.



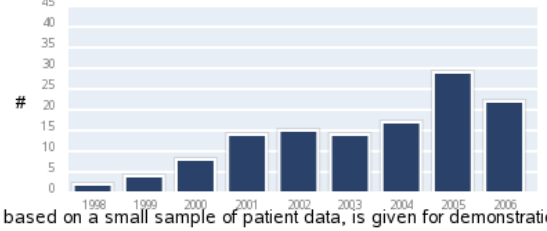
Specialties: Minimally invasive mitral valve, aortic valve, and tricuspid valve surgery; mitral valve repair, surgical treatment and minimally invasive surgery for atrial fibrillation; off-pump coronary artery bypass surgery; and high-risk mitral valve surgery.

Medical Degree: Johns Hopkins University School of Medicine, Baltimore, Maryland

Special Training: Johns Hopkins University School of Medicine, Baltimore, Maryland

A native Clevelander, Dr. Gillinov spent the summers of 1978 to 1980 dividing his time between working at Cleveland Clinic and playing tennis. He still enjoys both activities.

Gillinov, M.D. has performed 125 heart-valve repair operations at the Cleveland Clinic Foundation since 1998.



This graph, based on a small sample of patient data, is given for demonstration purposes only.

Content adaptation: heart valve repair

Intelligent Search

coronary artery Search

Semantic Search Results

A. Marc Gillinov, M.D.
Gillinov, M.D. has performed 316 coronary artery operations at the Cleveland Clinic... invasive mitral valve, aortic valve, and tricuspid valve surgery repair, surgical treatment and minimally invasive surgery for atrial fibrillation; off-pump coronary artery bypass surgery
http://tomcat/html-content/gillinov_GillinovCoronaryArtery.html (cached)

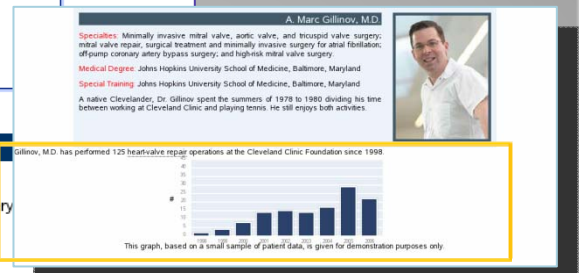
Nicholas G. Smedira, M.D.
and heart-lung transplantation, ventric
grafting, myectomy, reoperations, an
http://tomcat/html-content/smedira_.h

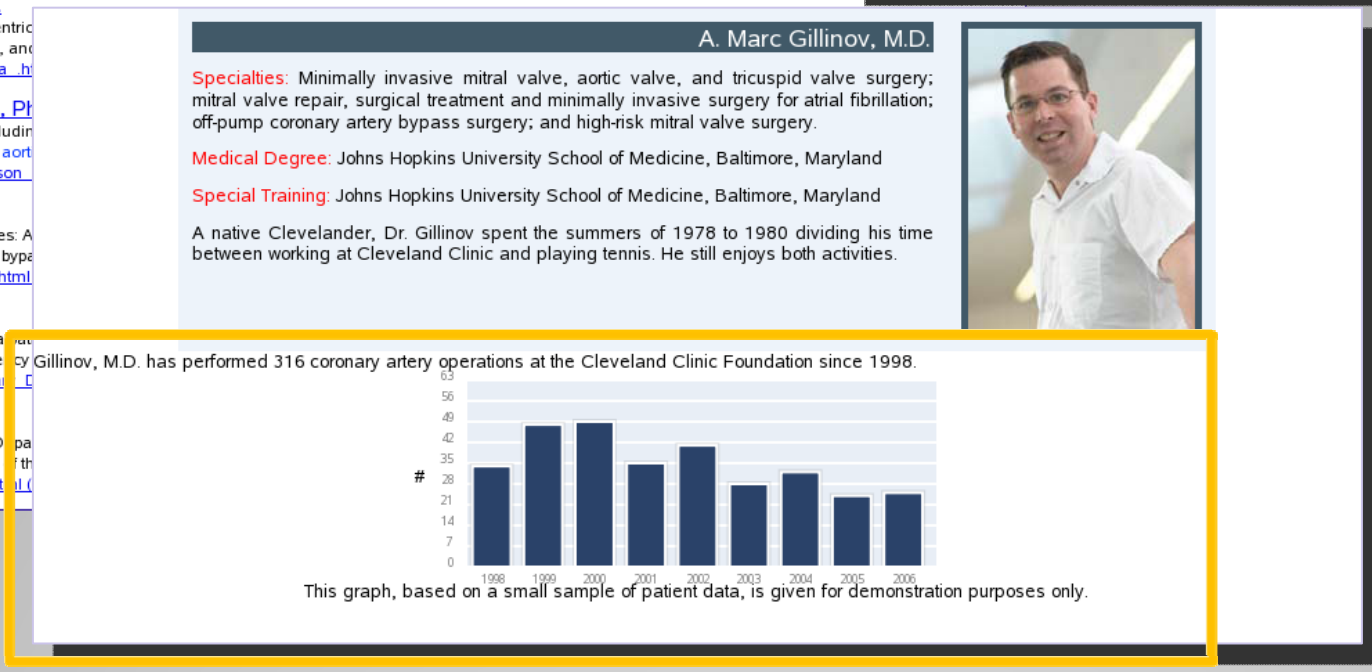
Gosta B. Pettersson, M.D., Ph
Adult acquired heart disease (includin
complex coronary artery surgery; aort
http://tomcat/html-content/pettersson_

Joseph F. Sabik III, M.D.
Joseph F. Sabik III, M.D. Specialties: A
surgery, off-pump coronary artery bypa
http://tomcat/html-content/sabik_.html

Coronary Disease
Primary isolated CABG refers to a
images... excellent long-term pate
http://tomcat/html-content/Coronar

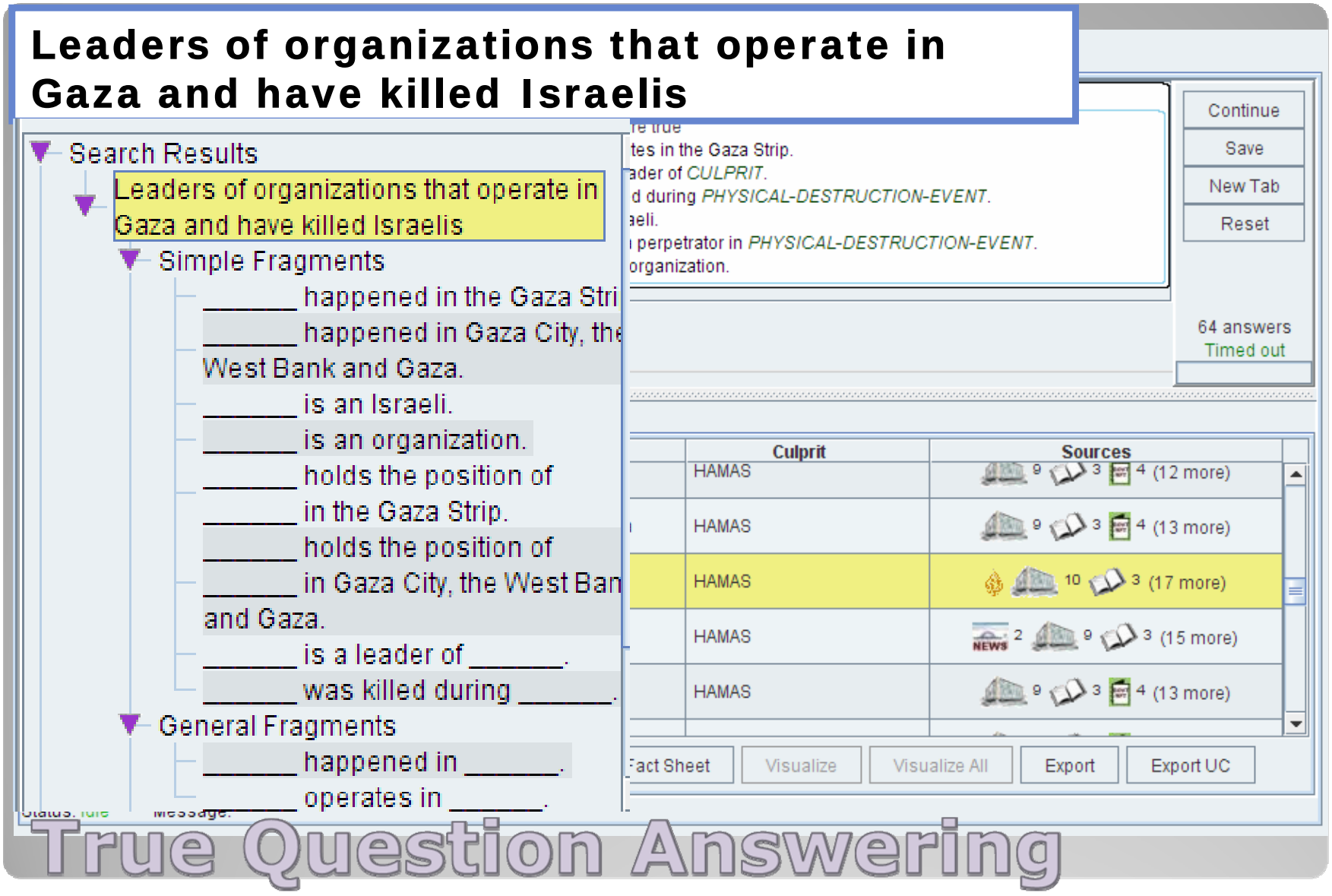
Bruce W. Lytle, M.D.
Bruce W. Lytle, M.D. Chairman, D
diseases, reoperations, diseases
http://tomcat/html-content/lytle_.ht



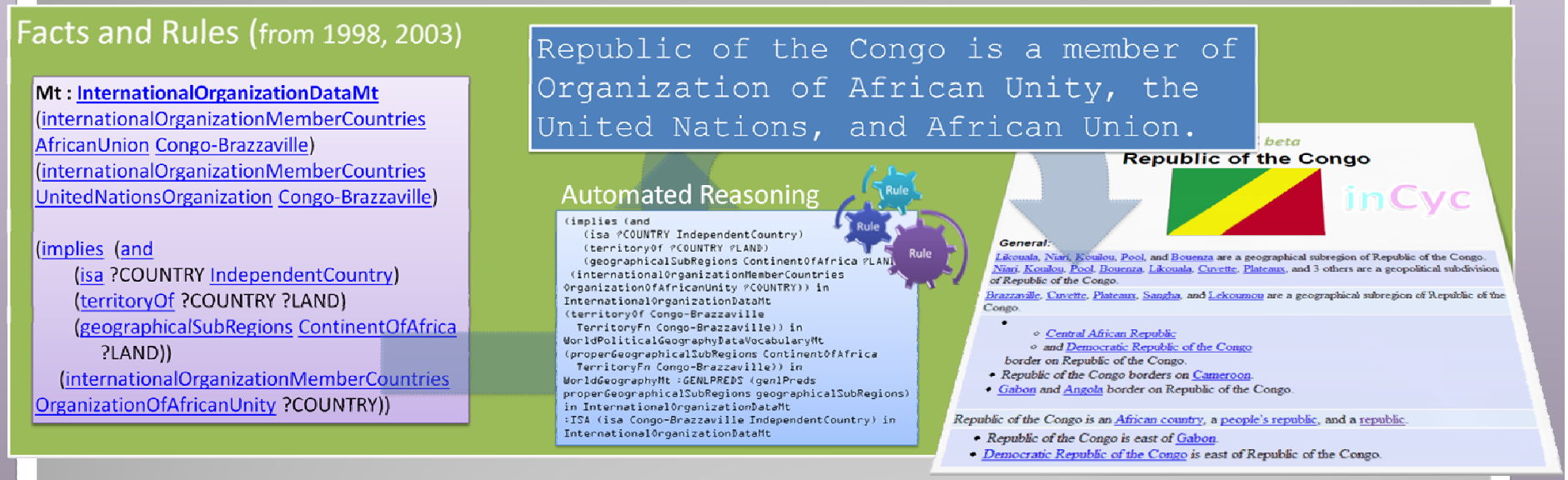


Content adaptation: coronary artery

Leaders of organizations that operate in Gaza and have killed Israelis



True Question Answering



Knowledge for People

www.cyc.com/doc/inCyc

Classification is not enough!

The Economist, Dec 13th 2007,
http://www.economist.com/world/international/displaystory.cfm?story_id=10286811

Gulliver's Travels in Basic English

For my own Part, I swam as Fortune directed me, and was pushed forward by Wind and Tide. I often let my Legs drop, and could feel no Bottom: but when I was almost gone, and able to struggle no longer, I found myself within my Depth; and by this Time the Storm was much abated. The Declivity was so small, that I walked near a Mile before I got to the Shore, which I conjectur'd was about eight a-clock in the Evening. I then advanced forward near half a Mile, but could not discover any sign of Houses or Inhabitants; at least I was in so weak a Condition, that I did not observe them. I was extremely tired, and with that, and the Heat of the Weather, and about half a Pint of Brandy that I drank as I left the Ship, I found myself much inclined to sleep. I lay down on the Grass, which was very short and soft, where I slept sounder than ever I remember to have done in my Life, and, as I reckoned, above Nine Hours; for when I awakened, it was just Day-light.

http://www.jaffebros.com/lee/gulliver/bk1/chap1-1.html

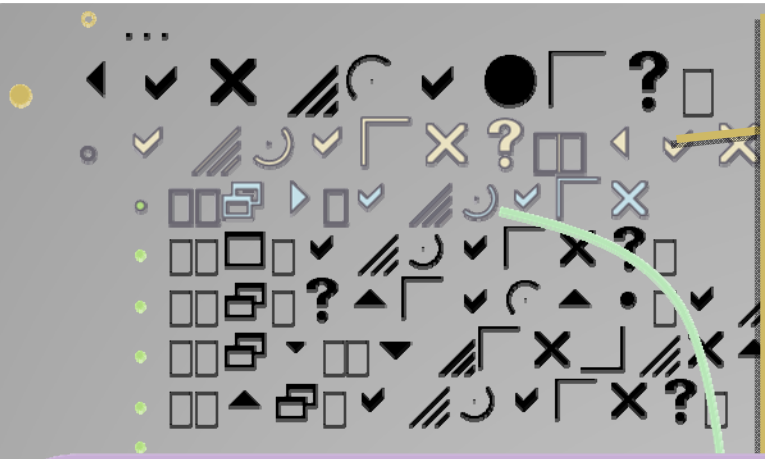
I swam, pushed forward by time and current, and when I was almost put to an end, I saw land, and discovered myself in water that was not deep. At about eight o'clock in the nightfall, I got to the edge of the sea and walked for nearly half a mile without seeing any houses. Too tired to go father, I got down on my back in the grass, which was very short and soft. There I slept soundly till morning.

Put into Basic English by the Basic English Institute
http://ogden.basic-english.org/lilliput.html

850 words: 600 nouns, 150 adjectives, 100 syntactic operators

Travels into Several Remote Nations of the World, in Four Parts. By Lemuel Gulliver, First a Surgeon, and then a Captain of several Ships, Jonathan Swift, London, Benj. Motte, 1726

Basic English: A General Introduction with Rules and Grammar.
Ogden, Charles Kay. Small format, hardcover.
Publisher: Paul Treber & Co., Ltd. London, 1930.



Mt : (ContextOfPCWFn MilitaryThingTaxonomy)
broaderThan : Warplane

Mt : TaxonomyMt
nodeInSystem : MilitaryThingTaxonomy WeaponTaxonomy

Mt: EnglishMt
(multiWordString
(TheList "bomber") Aircraft-TheWord CountNoun BomberPlane)

Mt: GeneralEnglishMt
M(denotation Bomber-TheWord CountNoun 0 BomberPlane)
(genStringAssertion BomberPlane
M(denotation Bomber-TheWord CountNoun 0 BomberPlane))

As of Feb. 24, Air Force (#$UnitedStatesAirForce) officials reported that personnel in the area numbered close to 8,000. The 100 aircraft based in Saudi Arabia for patrols over southern Iraq has seen the addition of two dozen F-15 (#$FighterPlane-F15) and F-16 fighter jets (#$FighterPlane-F16) to Bahrain. The Air Force (#$UnitedStatesAirForce) has also authorized the dispatch of 12 F-117 (#$FighterPlane-F117) stealth fighter jets to Kuwait, three B-1 bombers (#$B-1-Bomber) to Bahrain and 14 B-52 (#$B-52-Bomber) bombers (#$BomberPlane) to the island of Diego Garcia. It also has diverted dozens of support aircraft to the region for refueling, surveillance, electronic jamming and search-and-rescue missions.

Mt : TaxonomyMt
nodeInSystem : MilitaryThingTaxonomy WeaponTaxonomy
nodesForConceptFilter : (ConceptNodesForTaxonFn MilitaryThingTaxonomy)

Military Taxonomy

Document Tagging

U.S. Air Force:

As of Feb. 24, Air Force officials reported that personnel in the area numbered close to 8,000. The 100 aircraft based in Saudi Arabia for patrols over southern Iraq has seen the addition of two dozen F-15 and F-16 fighter jets to Bahrain. The Air Force has also authorized the dispatch of 12 F-117 stealth fighter jets to Kuwait, three B-1 bombers to Bahrain and 14 B-52 bombers to the island of Diego Garcia. It also has diverted dozens of support aircraft to the region for refueling, surveillance, electronic jamming and search-and-rescue missions.

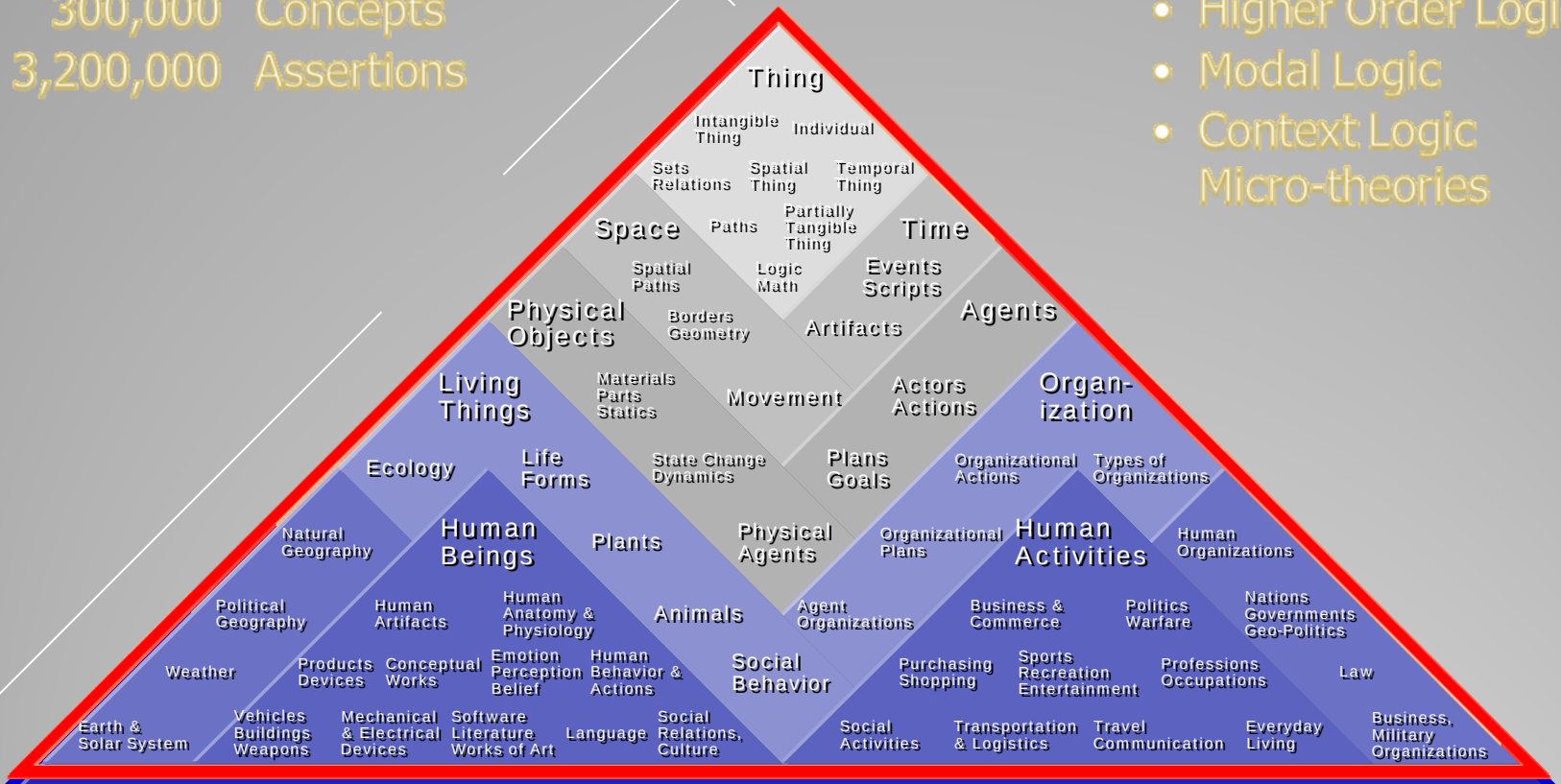
patrols over southern Iraq has seen the addition of two dozen F-15 and F-16 fighter jets to Bahrain. The Air Force has also authorized the dispatch of 12 F-117 stealth fighter jets to Kuwait, three B-1 bombers to Bahrain and 14 B-52 bombers to the island of Diego Garcia. It also has diverted dozens of support aircraft to the region for refueling, surveillance, electronic jamming and search-and-rescue missions.

Cyc contains:

15,000 Predicates
300,000 Concepts
3,200,000 Assertions

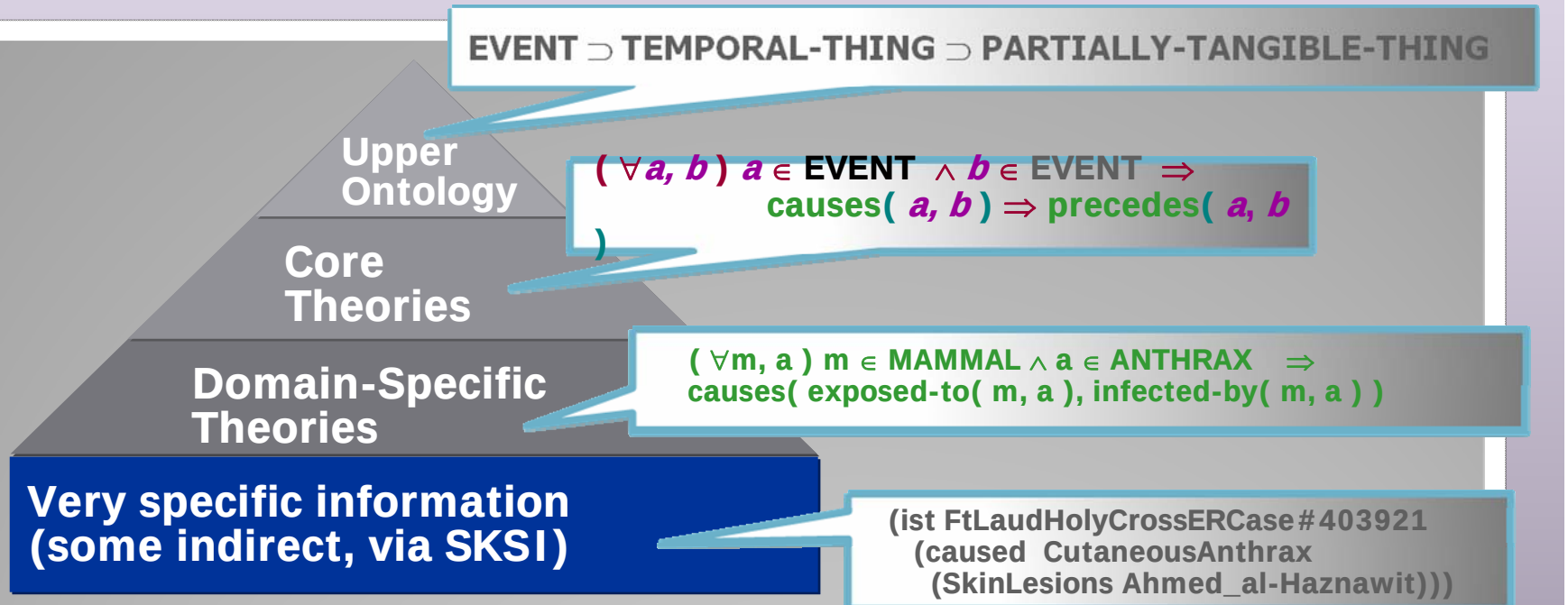
Represented in:

- First Order Logic
- Higher Order Logic
- Modal Logic
- Context Logic
  Micro-theories



General Knowledge about Various Domains

Specific data, facts, and observations



First Order Predicate Calculus: unambiguous; enable mechanical reasoning

Every American has a president.
Every American has a mother.

$\exists y.\forall x.\ Amer(x) \Rightarrow president(x,y)$
$\forall x.\exists y.\ Amer(x) \Rightarrow mother(x,y)$

Higher Order Logic: contexts, predicates as variables, nested modals, reflection,...

Formal Representation for Reasoning

Cycorp © 2008

First Order

- (isa ASBFinancialCorp PubliclyHeldCorporation)
- (corporateOfficers ASBFinancialCorp GeraldRJenkins)

With Context

- In Mt : FinancialTransactionMt
  (relationAllExists performedBy RepurchaseProgram PubliclyHeldCorporation)

Rule

- In Mt: FinancialTransactionMt
  (forAll ?X (implies
  (isa ?X RepurchaseProgram)
  (thereExists ?Y (and (isa ?Y PublicallyHeldCorporation) (performedBy ?X ?Y)))))

Second Order

- (implies
  (and (isa ?SET Set-Mathematical) (cardinality ?SET 1) (elementOf ?THING ?SET))
  (equals ?SET (TheSet ?THING)))

Modal

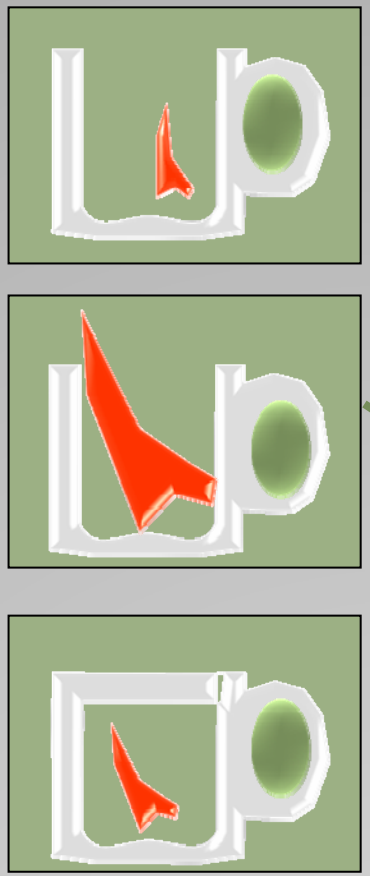
- (beliefs Israel (relationInstanceExists possesses Syria ClusterBomb))

Meta

- (opaqueArgument beliefs 2)

Syntactic Power

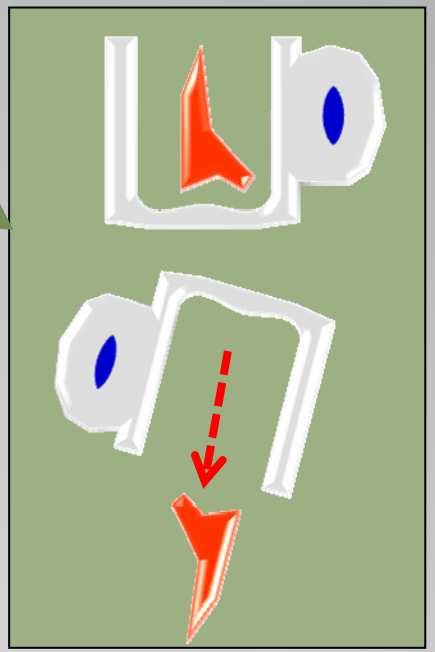
- Does part of the inner object stick out of the container?
  - None of it.
    #$in-ContCompletely
  - Yes
    #$in-ContPartially
  - No
    #$in-ContClosed



- If the container were turned around could the contained object fall out?

  Yes

  #$in-ContOpen



For Inference:

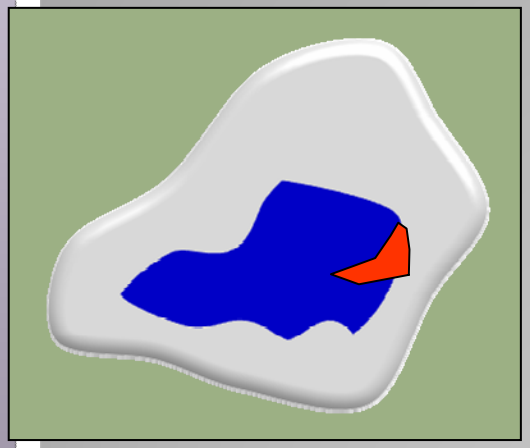
Senses of 'In'

Cycorp © 2008

Senses of 'In'

Is it attached to the inside of the outer object?

– Yes -- Try #$connectedToInside

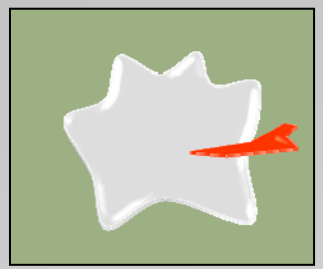


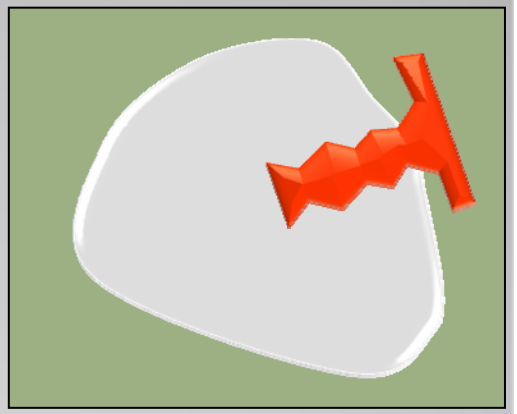
Can it be removed by pulling, if enough force is used, without damaging either object?

– No -- Try #$in-Snugly or #$screwedIn

Does the inner object stick into the outer object?

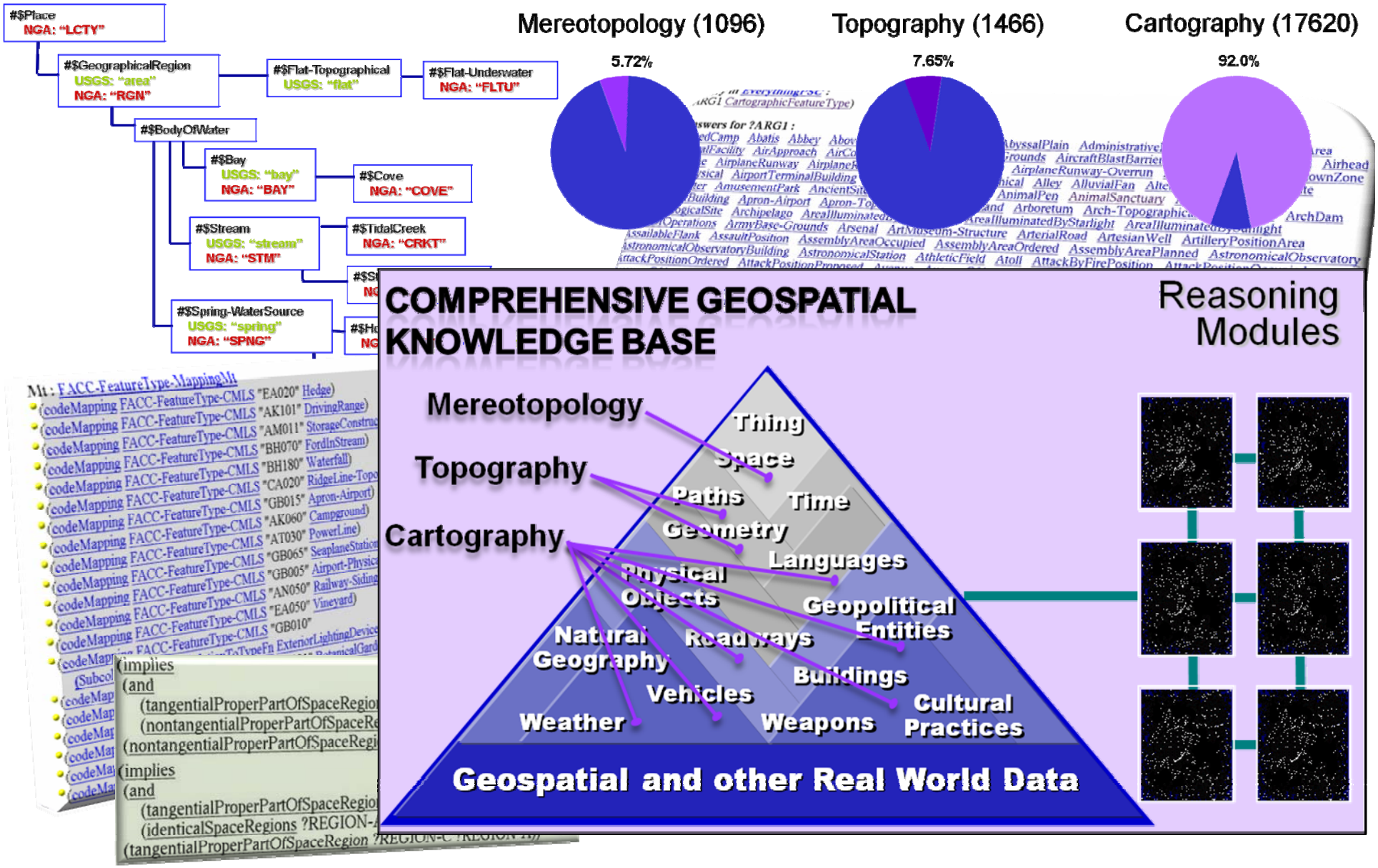
–Yes – Try #$sticksInto





Cycorp © 2007

Geospatial Knowledge



- #$TransportationEvent
- #$ControllingATransportationDevice
- #$TransportWithMotorizedLandVehicle
- (#$SteeringFn #$RoadVehicle)
- #$TransporterCrashEvent
- #$VehicleAccident
- #$CarAccident
- #$Colliding
- #$IncurringDamage
- #$TippingOver
- #$Navigating
- #$EnteringAVehicle ...

Some Transportation Event Types

- #$performedBy
- #$causes-EventEvent
- #$objectPlaced
- #$objectOfStateChange
- #$outputsCreated
- #$inputsDestroyed
- #$assistingAgent
- #$beneficiary
- #$fromLocation
- #$toLocation
- #$deviceUsed
- #$driverActor
- #$damages
- #$vehicle
- #$providerOfMotiveForce
- #$transportees ...

Over 400 more.

Relating Events and Participants

- PhysicalStateChangeEvent
- TemperatureChangingProcess
- BiologicalDevelopmentEvent
- ShapeChangeEvent
- MovementEvent
- ChangingDeviceState
- GivingSomething
- DiscoveryEvent
- Cracking
- Carving
- Buying
- Thinking
- Mixing
- Singing
- CuttingNails
- PumpingFluid

- **over 11,000 more**

- governingBody
- WholeOrganizationFn
- parentCompany
- subOrgs-Command
- subOrgs-Permanent
- subOrgs-Temporary
- subOrgs-OnlyDuringOperation
- physicalQuarters
- hasHeadquartersInCountry
- officeInCountry
- memberTypes
- organizationHead
- PolicyFn

- **Types of Emotions:**

- Adulation
- Abhorrence
- Relaxed-Feeling
- Gratitude
- Anticipation-Feeling

- Over 120 of these

- **Predicates for Defining and Attributing Emotions:**

- contraryFeelings
- appropriateEmotion
- actionExpressesFeeling
- feelsTowardsObject
- feelsTowardsPersonType

Relations between Agents and Propositions

- goals
- intends
- desires
- hopes
- expects
- beliefs
- opinions
- knows
- rememberedProp
- perceivesThat
- seesThat
- tastesThat

Propositional Attitudes

- **Organisms classified by:**
- Taxon
- Habitat
- Source of Nutrients

- **Organism Anatomy**
- Gross Anatomy
- Cell biology
- Physiological Processes

- **Common Substances**
- **Attributes of Materials**
- **States Of Matter**
- SolidStateOfMatter
- LiquidStateOfMatter
- GaseousStateOfMatter
- **Solutions**
- **Electrical Conductivity**
- **Thermal Conductivity**
- **Structural Attributes**
- **Tangible Attributes**
- SolidTangibleThing
- LiquidTangibleThing
- GaseousTangibleThing

- **Over 4000 Specializations of PhysicalDevice**
  - ClothesWasher
  - NuclearAircraftCarrier
- **Vocabulary for Describing device functions**
- primaryFunction-DeviceType

- Device Specific Predicates
  - gunCaliber
  - maximumSpeedOf
- Device States (40+)
  - DeviceOn
  - CockedState

- Weather Objects
  - CloudInSky
  - SnowMob
- Weather Events
  - TornadoAsEvent
  - SnowProcess

- **Weather Attributes**
- ClearWeather
- (LowAmountFn Raininess)

As of Feb (#$February). 24 (24), Air Force (#$UnitedStatesAirForce) officials (#$PublicOfficial #$OrganizationRepresentative) reported (#$RegisteringAComplaint #$Reporting) that personnel (#$Employee) in the area (#$Area 0 #$FieldOfStudy #$Region-Underspecified) numbered (#$Counting) close to 8,000 (8000). The 100 (100) aircraft (#$AirTransportationDevice) based (#$Base-Support #$MilitaryBase-Grounds #$BaseOfLandProtrusion #$NitrogenBase #$ChemicallyBasicSubstance) in Saudi Arabia (#$SaudiArabia) for patrols (#$Patrolling) over southern Iraq ((#$SouthernRegionFn #$Iraq)) has (#$possesses) seen (#$VisualPerception #$MeetingSomeone #$sees) the addition (#$DoingAddition) of two (2) dozen (12) F-15 (#$FighterPlane-F15) and F-16 fighter jets (#$FighterPlane-F16) to Bahrain (#$Bahrain-TheIsland #$Bahrain (#$CityNamedFn Bahrain #$Bahrain)). The Air Force (#$UnitedStatesAirForce) has (#$possesses) also authorized (#$GrantingPermission) the dispatch (#$SendingSomething) of 12 (12) F-117 (#$FighterPlane-F117) stealth (#$DodgeStealthCar) fighter jets (#$JetOfFluid #$JetPropelledAircraft) to Kuwait (#$CityOfKuwaitKuwait (#$ProperSubcollectionNamedFn-Ternary kuwait #$Individual 34057665-f4ed-11d9-9bea-0002b3a85b0b) #$Kuwait), three (3) B-1 bombers (#$B-1-Bomber) to Bahrain (#$Bahrain-TheIsland #$Bahrain (#$CityNamedFn Bahrain #$Bahrain)) and 14 (14) B-52 (#$B-52-Bomber) bombers (#$SubmarineSandwich #$BomberPlane #$Bomber) to the island (#$Island) of Diego Garcia. It also has (#$possesses) diverted (#$AmusingSomeone #$DivertingSomething) dozens (#$Dozens-Quant 12) of support (#$SupportingSomething #$ShowingSupportForSomeone (#$SubcollectionOfWithRelationFromTypeFn #$PartiallyTangible #$supportingObject #$SupportingSomething)) aircraft (#$AirTransportationDevice) to the region (#$TheRegion) for refueling (#$Refueling (#$MakingAvailableFn #$CombustibleFuelSubstance)),

Entire Cyc KB

WEEK 11

For Revis, a Different Sort of Homecoming

Published: *11-15-07*

By John Beattie

Reporter

JetOfFluid ?

The black and gold ensemble of Sunday's enemy spark some memories for one Jets rookie.

JetPropelledAircraft?

The Pittsburgh Steele… Revis' hometown of Aliquippa, Pa., — a precarious town located 30 minutes northwest of Heinz Field.

"We are definitely a football town," Revis said of his old stomping grounds.

NewYorkJets ?

Jets 24/7 Featuring Darrelle Revis

SNY Jets Nation Featuring Darrelle Revis

MULTIMEDIA HOME

view football as not just a sport but a way of life. And the deity was and will always be Steelers football.

Default: JetPropelledAircraft

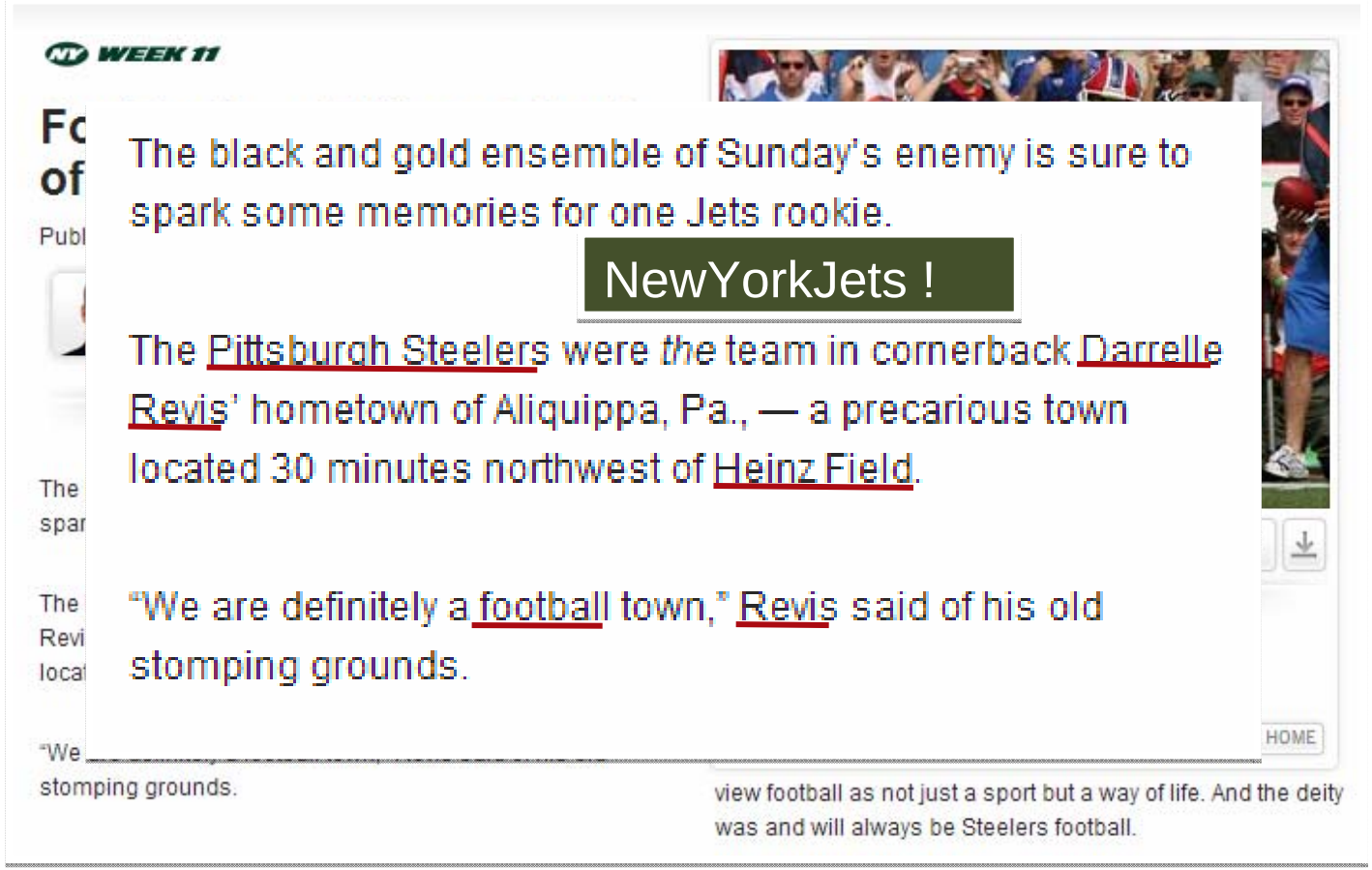
JetOfFluid *only if*

- *X within sentence such that*
  (genls *X* LiquidTangibleThing)

NewYorkJets *only if*

- FootBall-American, *or*
- (isa *X* FootballTeam), *or*
- (isa *X* FootballPlayer-American), *or*
- (isa *X* Stadium) *within document*

Disambiguation Rules: 'Jet'


WEEK 11
The black and gold ensemble of Sunday's enemy is sure to spark some memories for one Jets rookie.
NewYorkJets !
The Pittsburgh Steelers were *the* team in cornerback Darrelle Revis' hometown of Aliquippa, Pa., — a precarious town located 30 minutes northwest of Heinz Field.
"We are definitely a football town," Revis said of his old stomping grounds.
HOME
view football as not just a sport but a way of life. And the deity was and will always be Steelers football.

Mt: WordSenseDisambiguationMt
((isa ?CITY City)
∧(geographicalSubRegionsOfCountry ?COUNTRY ?CITY))
→(isLicensedBy ?CITY ?COUNTRY)

(isLicensedBy CityOfBirminghamAlabama UnitedStates)
(isLicensedBy CityOfBirminghamUK UnitedKingdom)
(isLicensedBy CityOfBirminghamUK England)
(isLicensedBy CityOfChristchurchNZ NewZealand)
(isLicensedBy CityOfChristchurchUK England)
(isLicensedBy CityOfParisTexas UnitedStates)
Etc etc....

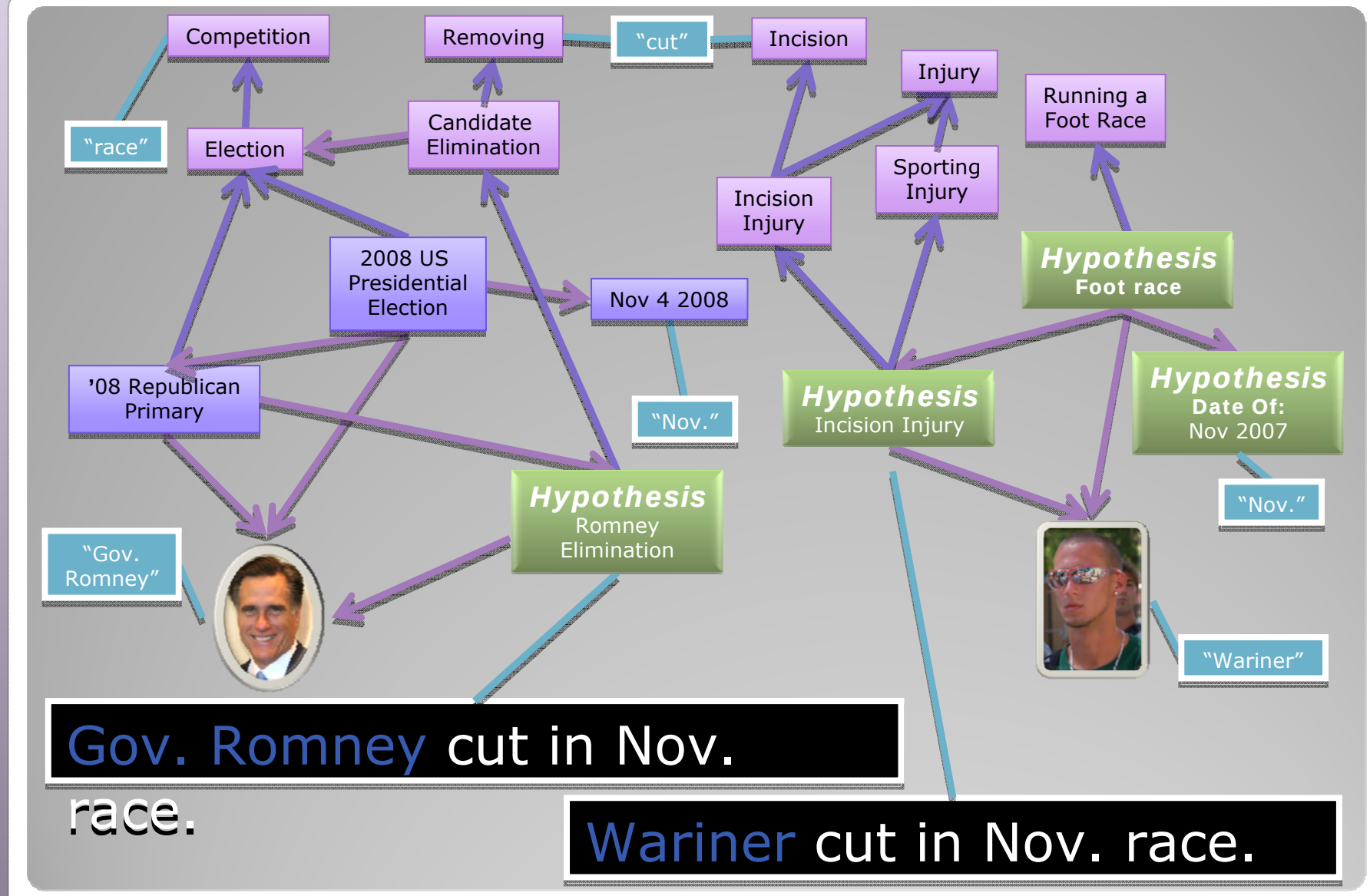
Manchester City:
City?
Football Team?

EXPRESSIVE LANGUAGE EXPRESSES RULES COMPACTLY

Mt: WordSenseDisambiguationMt

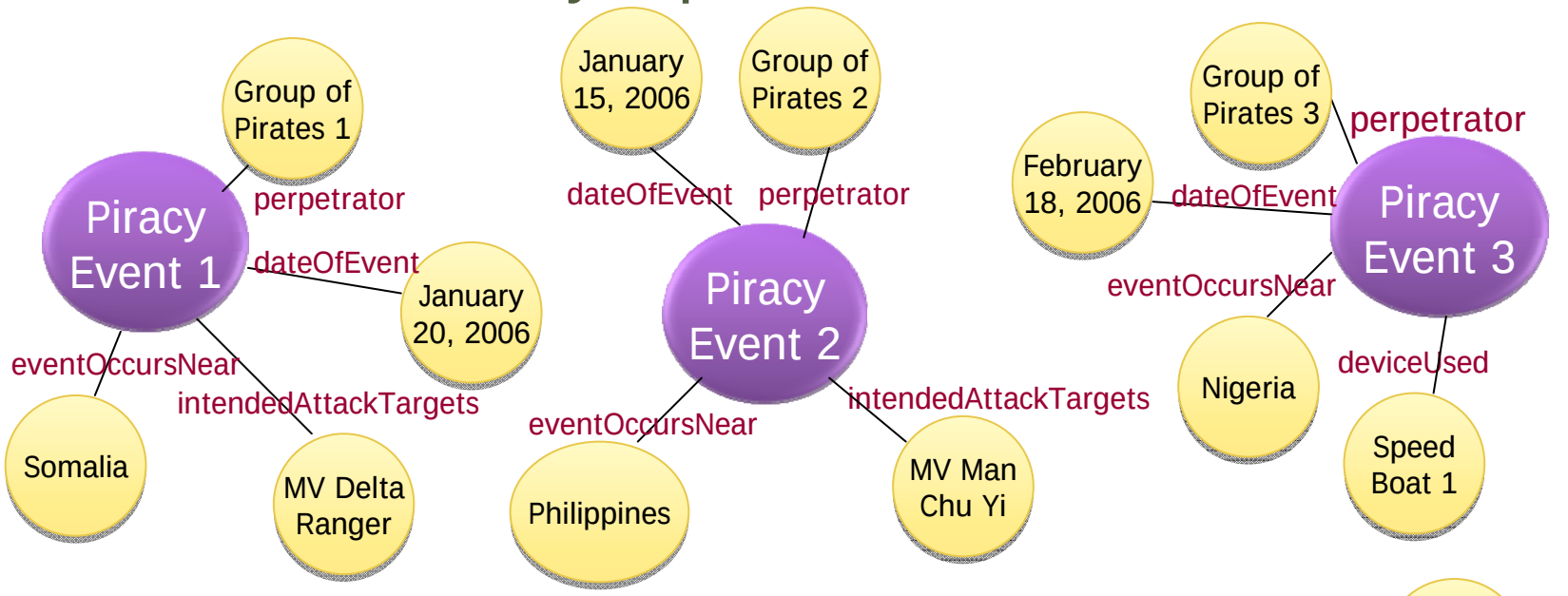
((isa ?TEAM SportsTeam)
∧(focalActivityType ?TEAM ?GAME)
∧(eventTypeUsesDeviceType ?GAME ?EQUIPMENT))
→(isLicensedBy ?TEAM ?EQUIPMENT)

(isLicensedBy ManchesterUnitedFootballTeam SoccerBall)
(isLicensedBy ManchesterUnitedFootballTeam Cleats)
(isLicensedBy NewYorkJets GoalPosts)
(isLicensedBy NewYorkJets FootballHelmet)
etc etc....



Willard Romney Picture by Ann Marie Curling http://blog.electromneyin2008.com/; Jeremy Wariner Picture is public domain

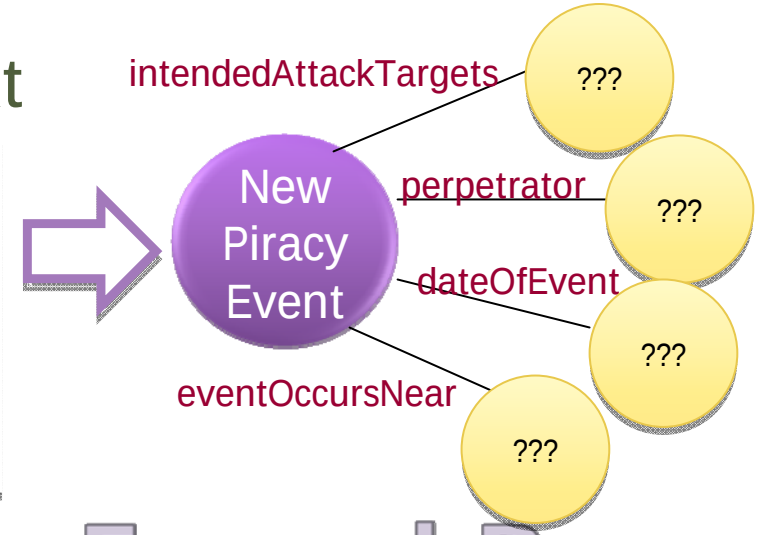
Given a set of formally represented events...



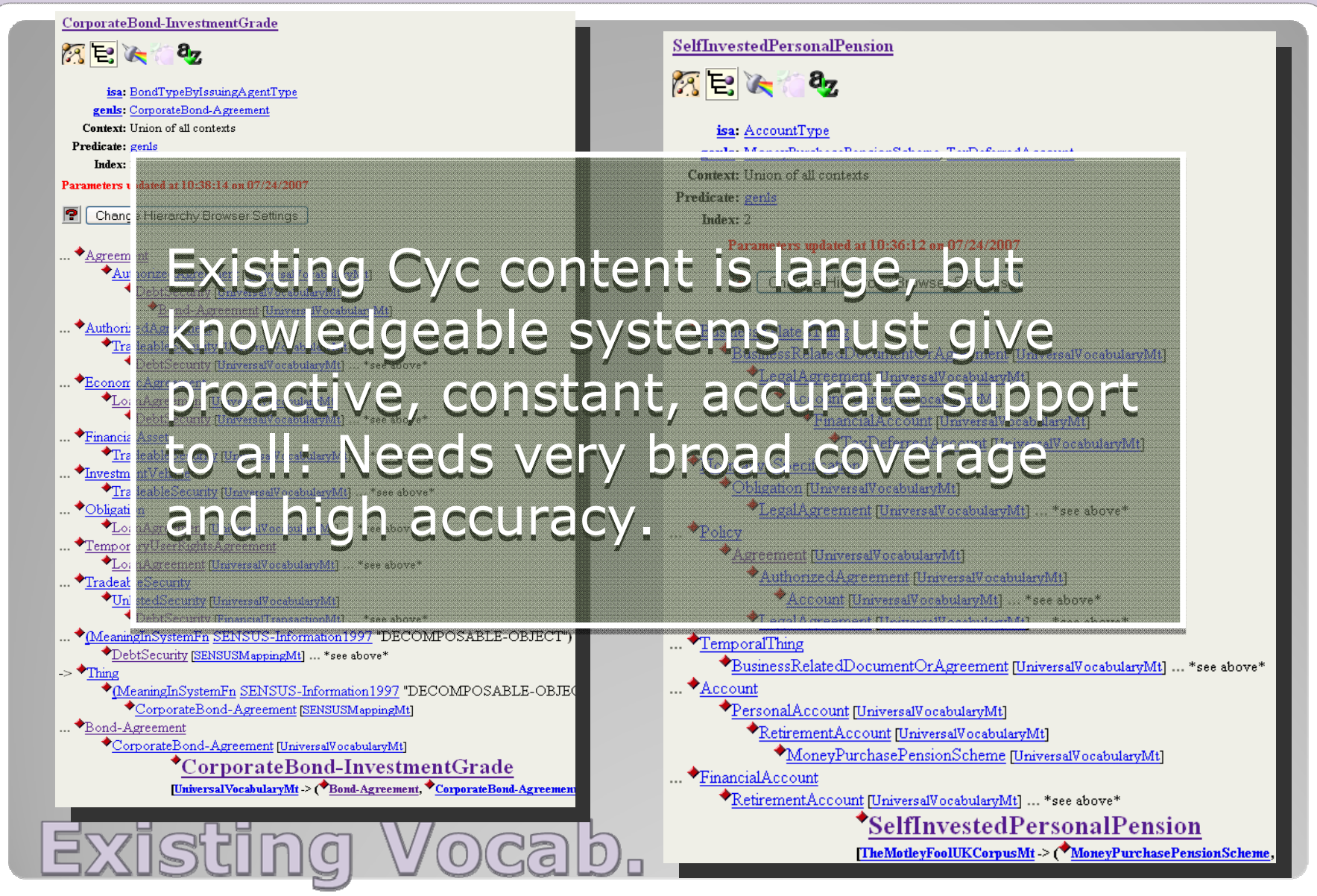
...recognize new instances in text

Malacca Straits:

On 17 April 2006, a Malaysian fishing vessel was attacked by armed pirates at approximately nine nautical miles off Parit Haji Baki coast in the Malacca Straits at about 0200 Hrs LT. Six pirates armed with guns in a speedboat closed in rapidly and opened fire at the fishing vessel underway. Several shots hit the side of the vessel but the crew escaped injuries. The fishing vessel crew lodged a police report.



Use of Probabilistic Formal Rep.


CorporateBond-InvestmentGrade
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genls: CorporateBond-Agreement
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Predicate: genls
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isa: AccountType
Context: Union of all contexts
Predicate: genls
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Existing Vocab.

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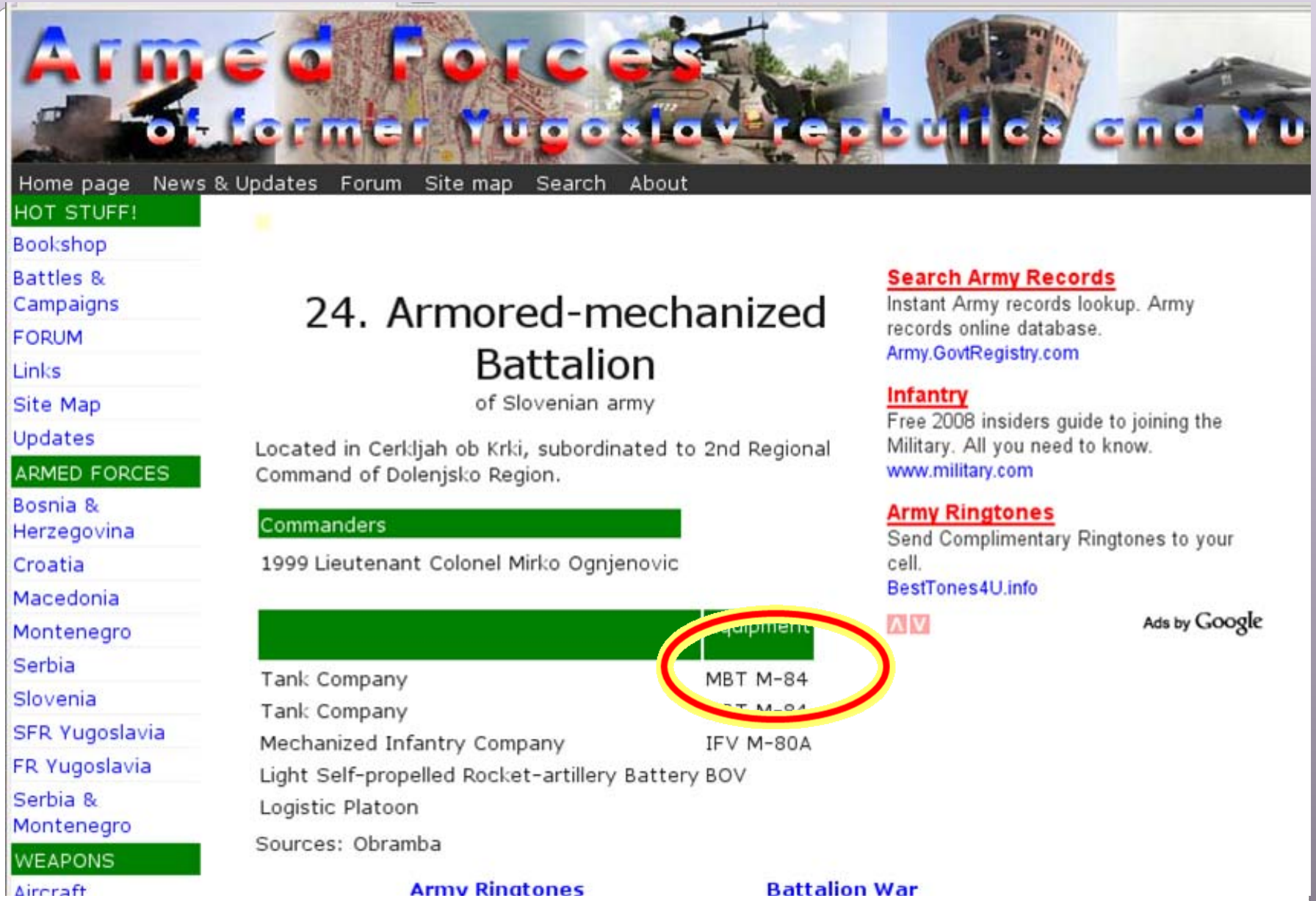
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Serbia & Montenegro
WEAPONS
Aircraft
24. Armored-mechanized Battalion
of Slovenian army
Located in Cerkljah ob Krki, subordinated to 2nd Regional Command of Dolenjsko Region.
Commanders
1999 Lieutenant Colonel Mirko Ognjenovic
Tank Company MBT M-84
Tank Company
Mechanized Infantry Company IFV M-80A
Light Self-propelled Rocket-artillery Battery BOV
Logistic Platoon
Sources: Obramba
Search Army Records
Instant Army records lookup. Army records online database.
Army.GovtRegistry.com
Infantry
Free 2008 insiders guide to joining the Military. All you need to know.
www.military.com
Army Ringtones
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M-84

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This article is about the Yugoslav tank. For other uses, see M84.

Not to be confused with T-84, a Ukrainian main battle tank.

"main battle tank" could mean:
tank (aka: main battle tank) More...

The **M-84** is a modern 2nd generation main battle tank manufactured by the Socialist Federal Republic of Yugoslavia. The M84 is in service with the Armed Forces of Bosnia and Herzegovina, Croatian Ground Army, Kuwaiti Army, Slovenian Armed Forces and Armed Forces of Serbia.

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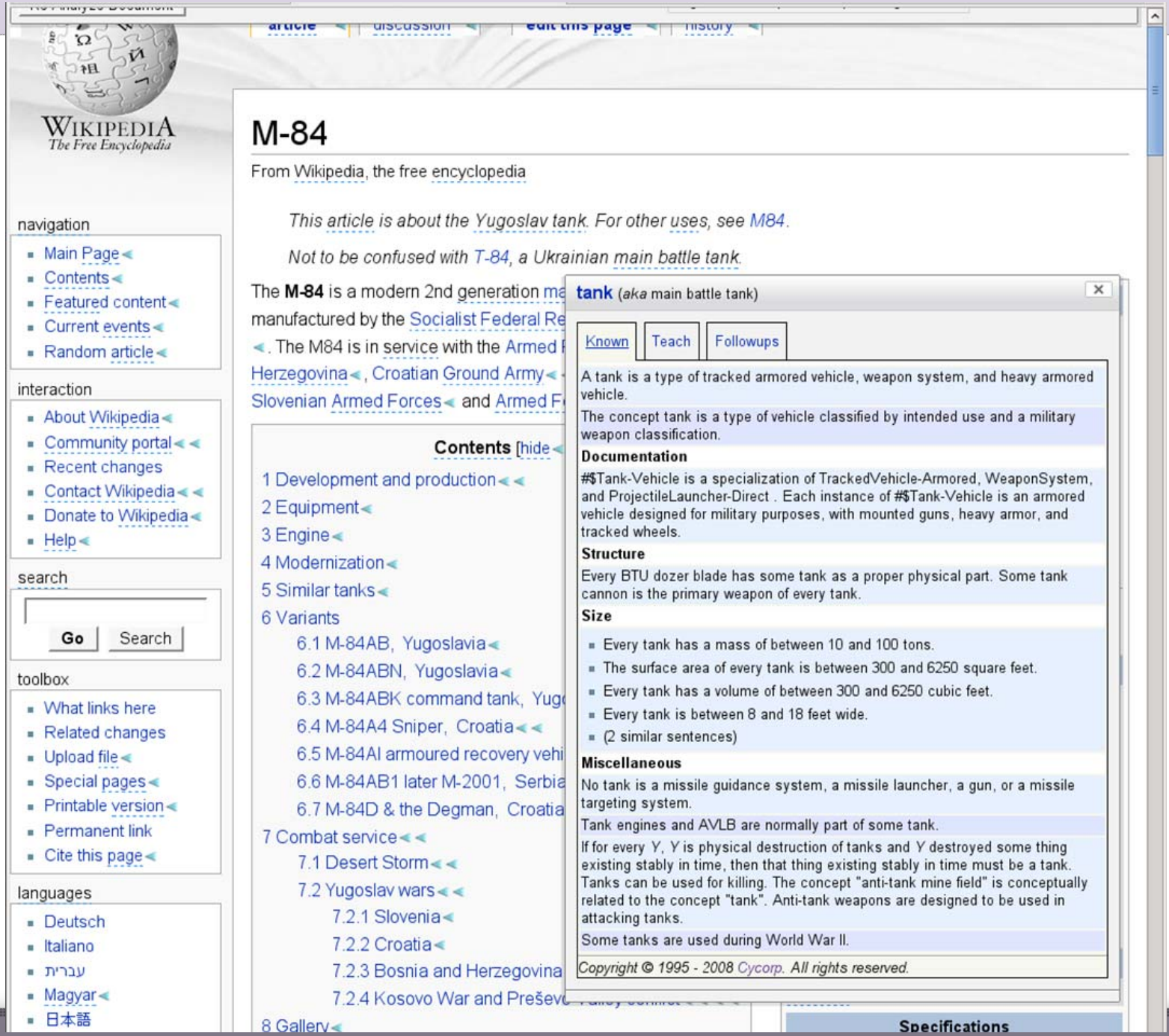
Serbian Army **M-84** MBT

Type	Main battle tank
Place of origin	Yugoslavia
Service history	
In service	1985–
Used by	Serbia, Kuwait, Croatia, Bosnia and Herzegovina, Slovenia
Wars	Gulf war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tank (aka main battle tank)
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A tank is a type of tracked armored vehicle, weapon system, and heavy armored vehicle.
The concept tank is a type of vehicle classified by intended use and a military weapon classification.
Documentation
#$Tank-Vehicle is a specialization of TrackedVehicle-Armored, WeaponSystem, and ProjectileLauncher-Direct . Each instance of #$Tank-Vehicle is an armored vehicle designed for military purposes, with mounted guns, heavy armor, and tracked wheels.
Structure
Every BTU dozer blade has some tank as a proper physical part. Some tank cannon is the primary weapon of every tank.
Size
Every tank has a mass of between 10 and 100 tons.
The surface area of every tank is between 300 and 6250 square feet.
Every tank has a volume of between 300 and 6250 cubic feet.
Every tank is between 8 and 18 feet wide.
(2 similar sentences)
Miscellaneous
No tank is a missile guidance system, a missile launcher, a gun, or a missile targeting system.
Tank engines and AVLB are normally part of some tank.
If for every Y, Y is physical destruction of tanks and Y destroyed some thing existing stably in time, then that thing existing stably in time must be a tank. Tanks can be used for killing. The concept "anti-tank mine field" is conceptually related to the concept "tank". Anti-tank weapons are designed to be used in attacking tanks.
Some tanks are used during World War II.
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tank (aka main battle tank)
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A tank is a type of:
heavy armored vehicle
tracked armored vehicle
weapon system
Click to suggest something else
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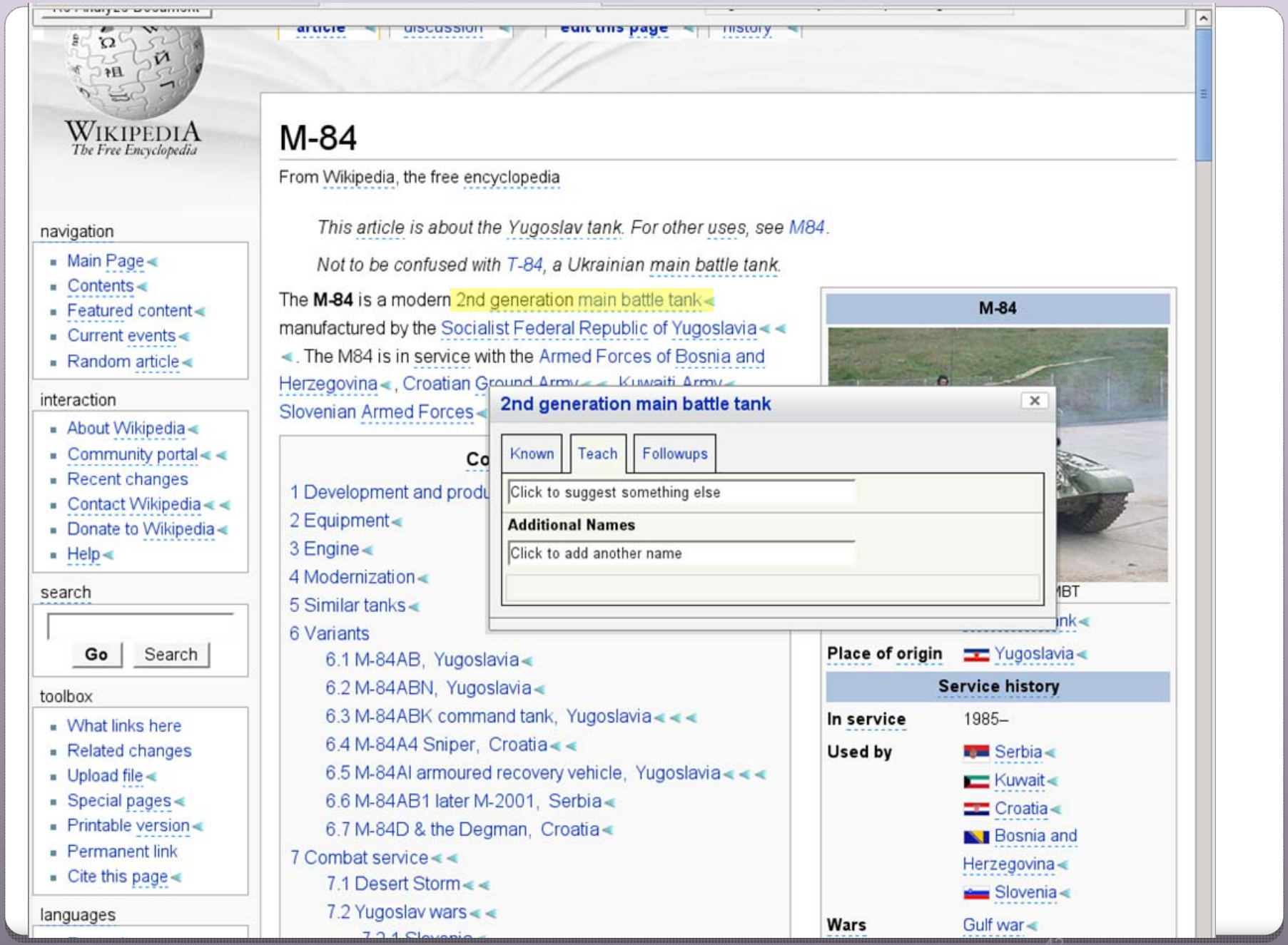
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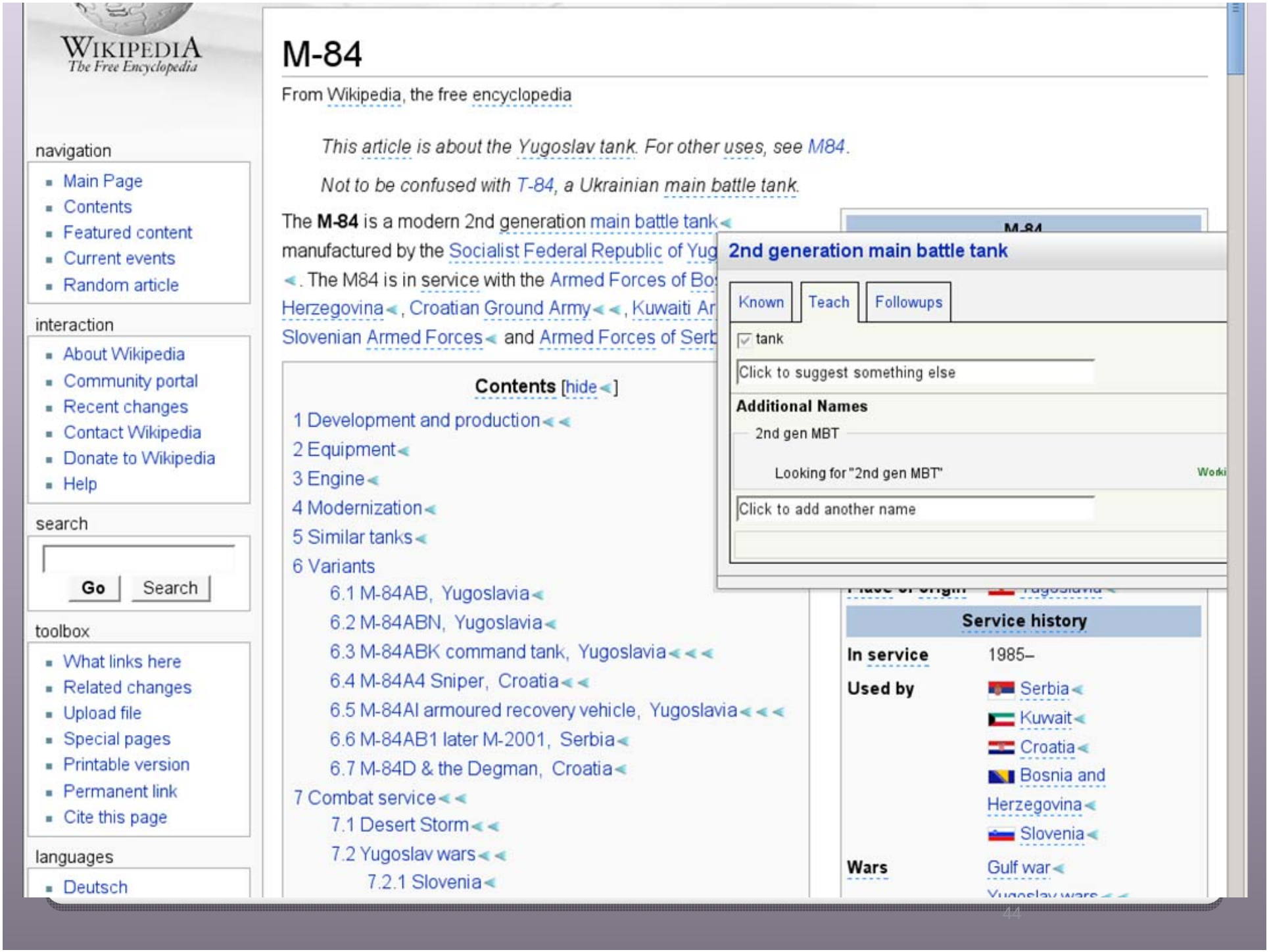
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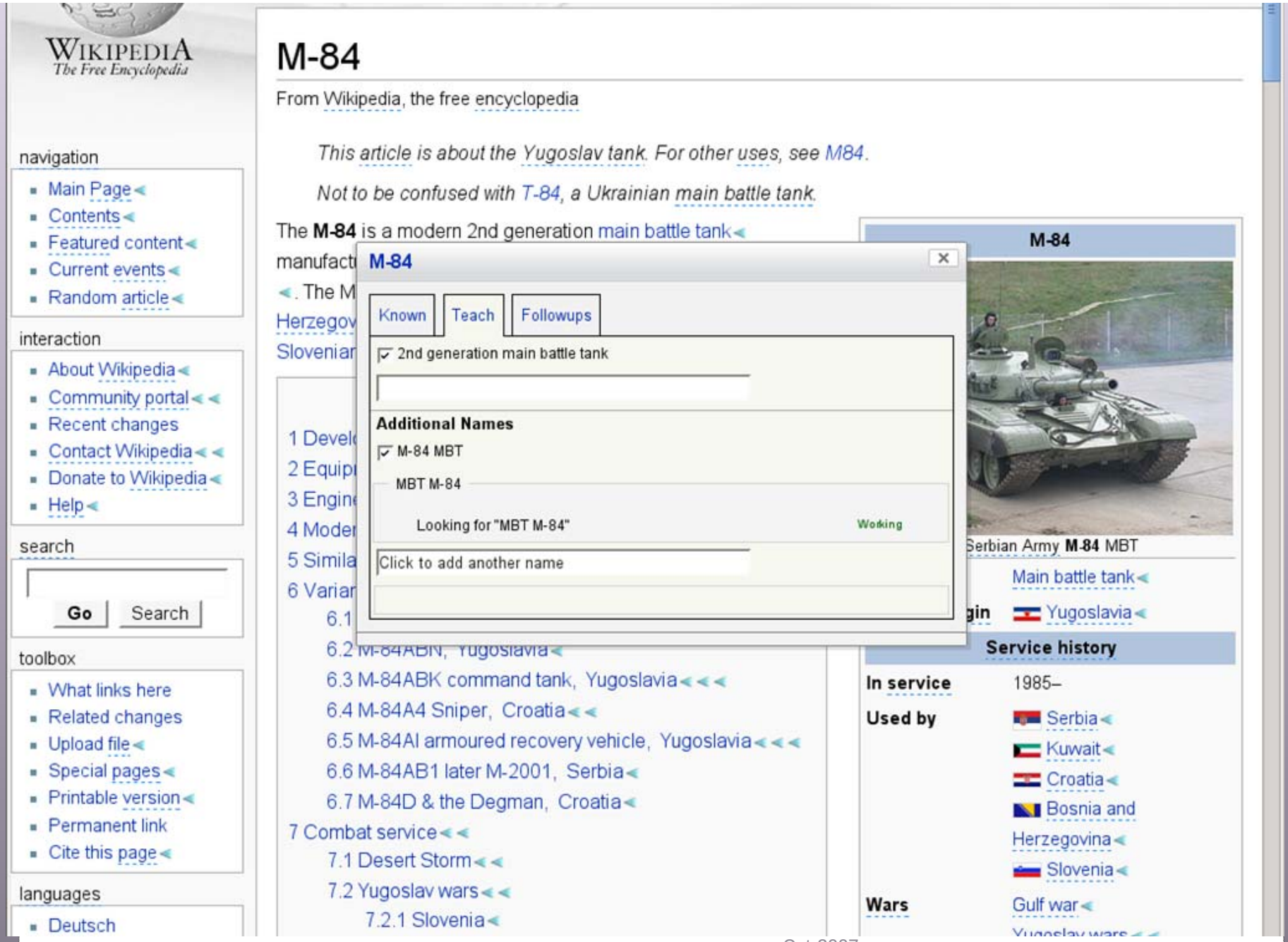
Serbian Army **M-84** MBT

	Main battle tank
Place of origin	Yugoslavia
Service history	
In service	1985–
Used by	Serbia Kuwait Croatia Bosnia and Herzegovina Slovenia
Wars	Gulf war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M-84 is a type of 2nd generation main battle tank.

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Type	Main battle tank
Place of origin	Yugoslavia
Service history	
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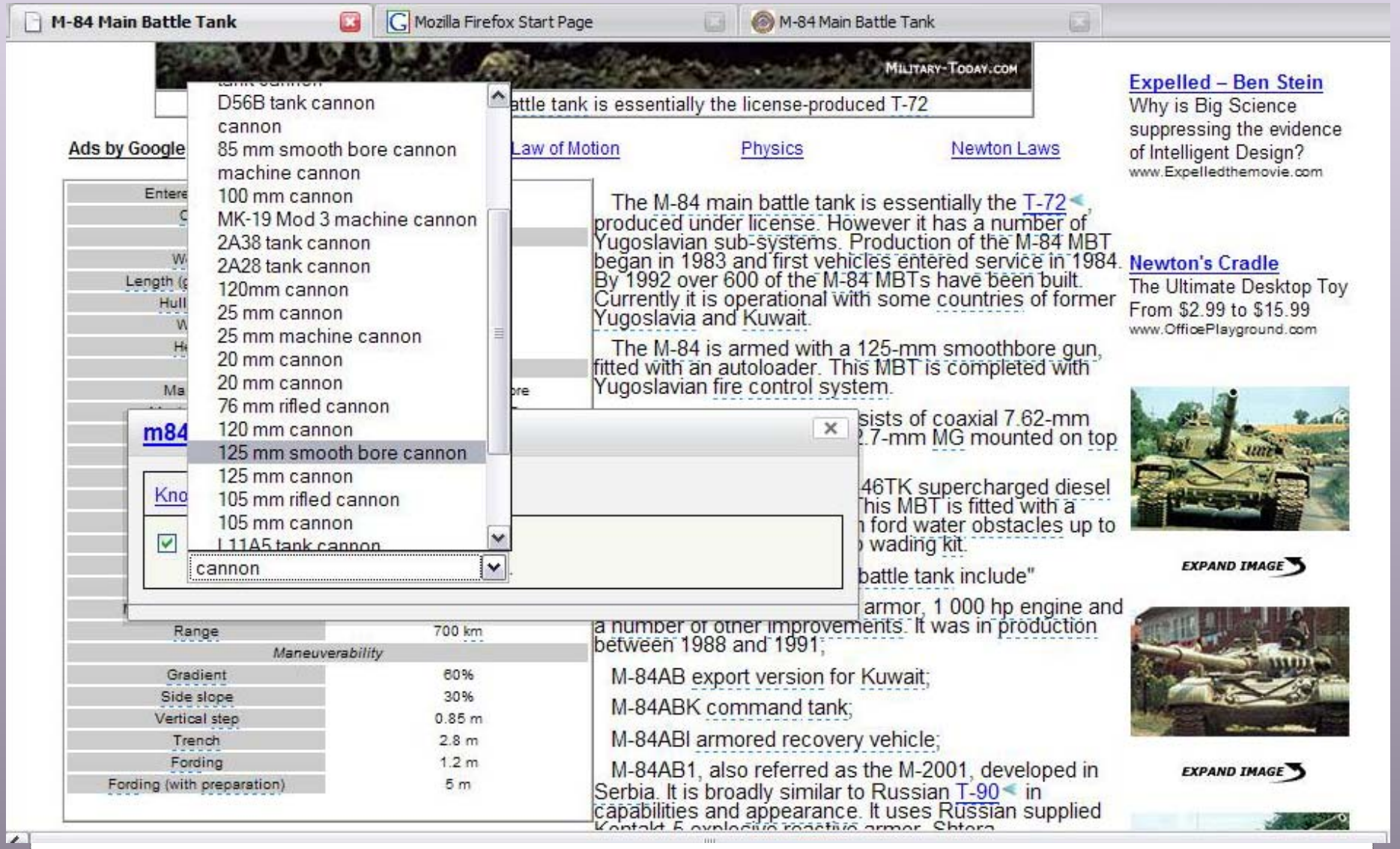
Used by	Serbia, Kuwait, Croatia, Bosnia and Herzegovina, Slovenia
Wars	Gulf war



If something is a weapons platform, what is its armament?

Fact Sheet for M-84

Recently Added

The main armament on a M-84 is a 125 mm smooth bore cannon.

M-84 is a type of 2nd generation main battle tank.

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(myCreator M-84 CycAdministrator) in BookkeepingMt
(myCreationTime M-84 20080403) in BookkeepingMt
(myCreationSecond M-84 132248) in BookkeepingMt

GAF Arg : 1

Mt : UniversalVocabularyMt
isa : Collection

Mt : DocumentReaderFollowupSuggestionMt
quotedIsa : TermAcceptableForQuerySearch-InstantiationOnly

Mt : (ContextOfPCWInterpretationFn CWSentence--170 CycAdministrator (DayFn 3 (MonthFn April (YearFn 2008))))
genls : M2ndGenerationMainBattleTank-7
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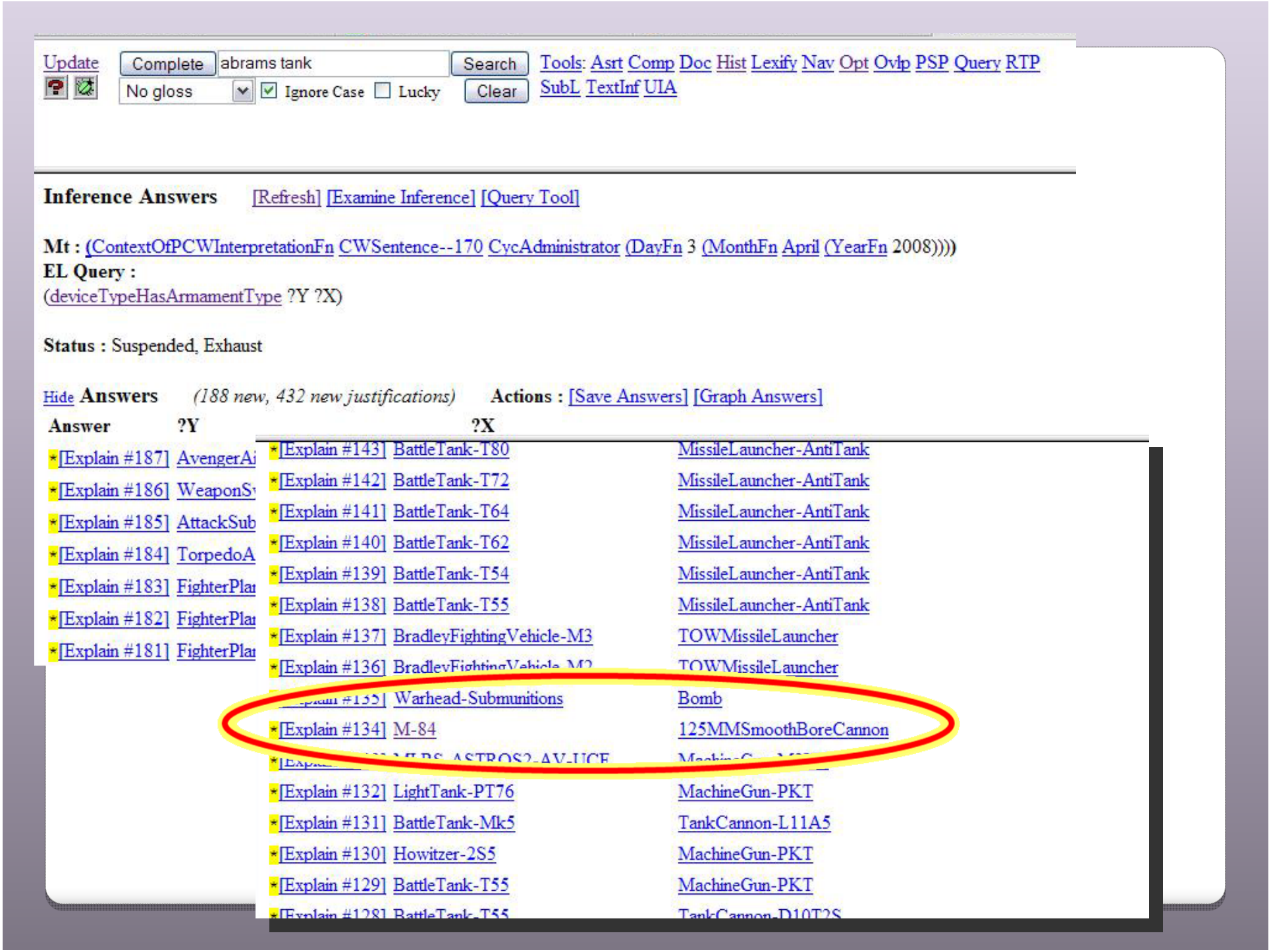
Mt : EnglishMt
nameString : "m84" "MBT M-84" "M-84 MBT" M"M-84"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Ignore Case
Lucky
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Inference Answers [Refresh] [Examine Inference] [Query Tool]
Mt : (ContextOfPCWInterpretationFn CWSentence--170 CycAdministrator (DayFn 3 (MonthFn April (YearFn 2008))))
EL Query :
(deviceTypeHasArmamentType ?Y ?X)
Status : Suspended, Exhaust
Hide Answers (188 new, 432 new justifications) Actions : [Save Answers] [Graph Answers]
Answer ?Y ?X
*[Explain #187] AvengerAi
*[Explain #186] WeaponS
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Hamas Leader's Son Among 19 Killed in Israeli-Palestinian Conflicts

Tuesday, January 15, 2008

Associated Press

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GAZA CITY, Gaza Strip — Israeli troops killed a son of Gaza's most powerful leader along with 18 other Palestinians on Tuesday in the bloodiest day of fighting in the coastal area since Hamas militants seized control last summer.

As fighting raged in Gaza, a Hamas sniper shot and killed an Ecuadorean volunteer working in the potato fields of an Israeli border farm. That killing, and Tuesday's high death toll, stoked the flames of violence at a time when Israel and Palestinian moderates are making halting attempts to talk peace.

• **Click here to view photos.**

Tuesday's bloodshed began before dawn when Israeli infantry, tanks and helicopters pushed into northern Gaza in what the military said was a routine operation aimed at Palestinian militants who launch rocket barrages at Israeli towns near Gaza almost every day.

Three Palestinian civilians were killed in the ensuing fighting, along with 14 armed militants — one of them Hussam Zahar, 24, the son of hard-line Hamas leader Mahmoud Zahar. The Israelis pulled out Tuesday with no casualties. A later airstrike on militants firing rockets into Israel killed two more Hamas men.

http://www.foxnews.com/story/0,2933,322785,00.html

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GAZA CITY, Gaza Strip — Israeli troops killed a son of Gaza's most powerful leader along with 18 other Palestinians on Tuesday in the bloodiest day of fighting in the coastal area since Hamas militants seized control last summer.

As cuadorean volunteer working in the pot 's high death toll, stoked the flames of viol making halting attempts to talk peace.

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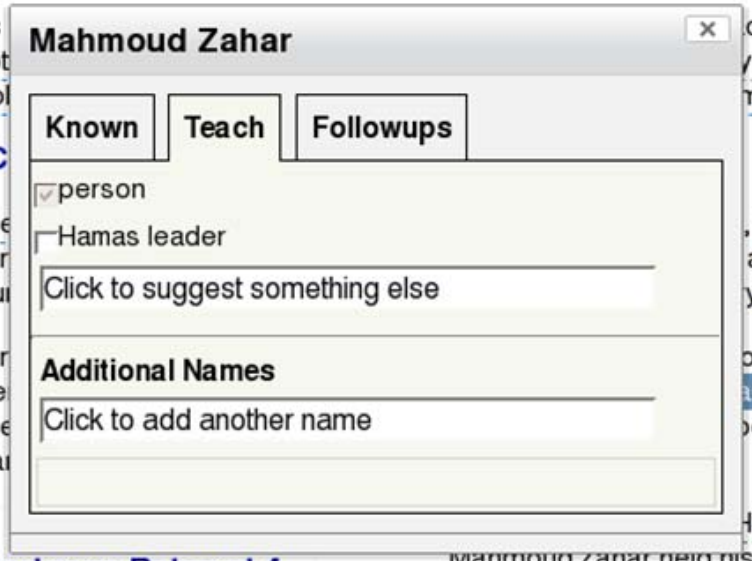
Tue , tanks and helicopters pushed into nor aimed at Palestinian militants who lau y day.

Thr ong with 14 armed militants — one of the ahmoud Zahar. The Israelis pulled out Tue ckets into Israel killed two more Har

Hospital in Gaza City, a weeping Mahmoud Zahar held his lifeless son's bloodied head in his

Mortgage Rates at 4



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Hamas Leader's Son Among 19 Killed in Israeli-Palestinian Conflicts

Tuesday, January 15, 2008

Associated Press

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Mortgage Rates at 4

Mahmoud Zahar

Known | Teach | Followups

person

Hamas leader

Click to suggest something else

Additional Names

Click to add another name

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Hamas Leader's Son Among 19 Killed in Is

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them Hussam Zahar, 24, the son of hard-line Hamas leader Mahmoud Zahar. The Israelis pulled out Tuesday with no casualties. A later airstrike on militants firing rockets into Israel killed two more Hamas men.

Individual : MahmoudZahar

Bookkeeping Assertions :

(myCreator MahmoudZahar CycAdministrator) in BookkeepingMt
(myCreationTime MahmoudZahar 20080118) in BookkeepingMt
(myCreationSecond MahmoudZahar 165058) in BookkeepingMt

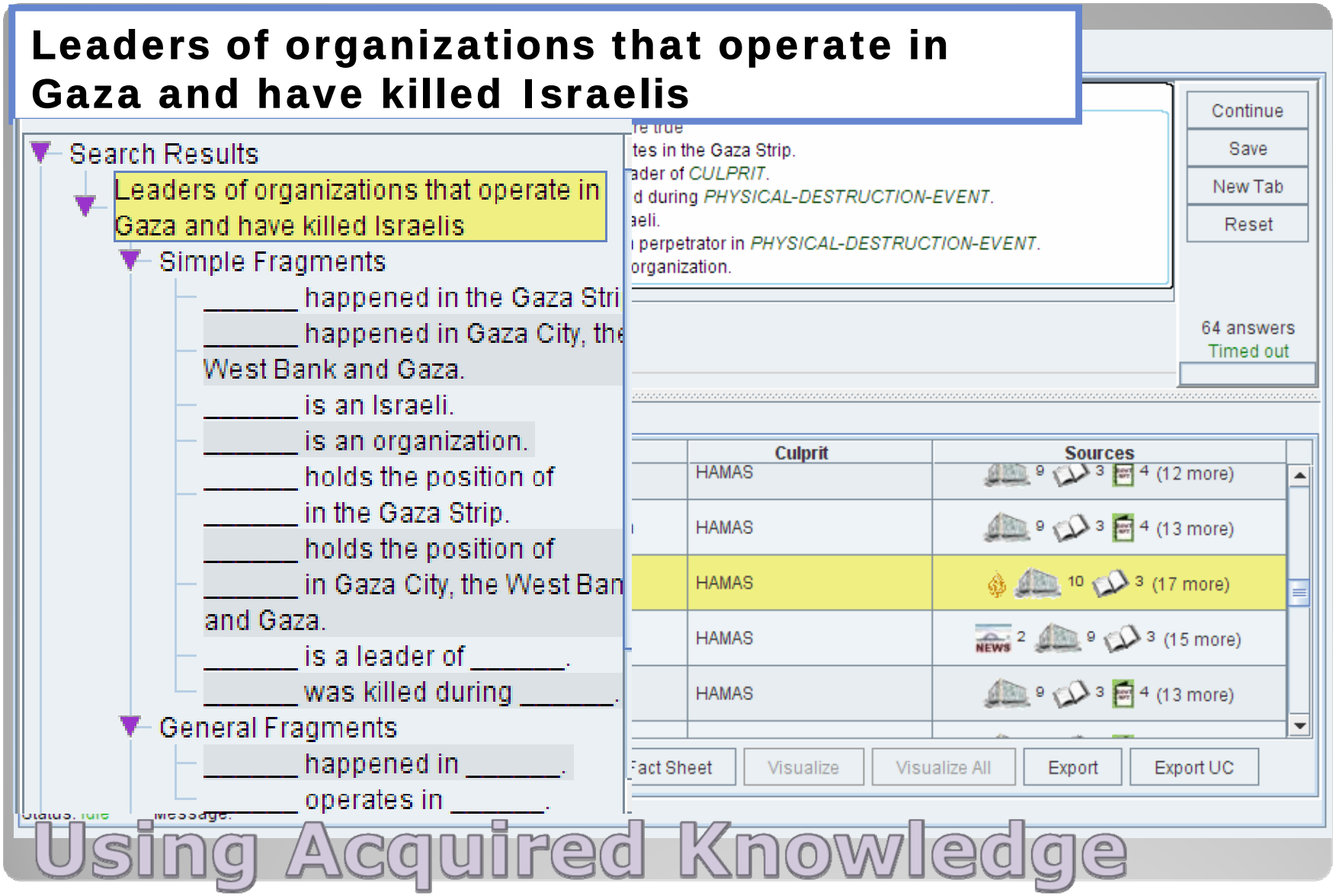
GAF Arg : 1

Mt : UniversalVocabularyMt
isa : Individual

Mt : (ContextOfPCWInterpretationFn CWSentence--7 CycAdministrator (DayFn 18 (MonthFn January (YearFn 2008))))
isa : (SubcollectionOfWithRelationToFn Person hasLeaders Organization-Hamas)

Mt : UniversalVocabularyMt
(inProgressTerm MahmoudZahar)

Leaders of organizations that operate in Gaza and have killed Israelis



Using Acquired Knowledge

Justified and Sourced Answers

Query

"What are symptoms of Whooping Cough?"

→

(symptomOfAilment WhoopingCough *?SYMP*

)

NL Generation

Partial English sentences

"A symptom of whooping cough is ___"

"Whooping cough can cause ___"

"A symptom of Pertussis Bordetella is ___"

"Symptoms (such as ____) of whooping cough"

Learning Facts by Search

Michael Witbrock © Cycorp 2008

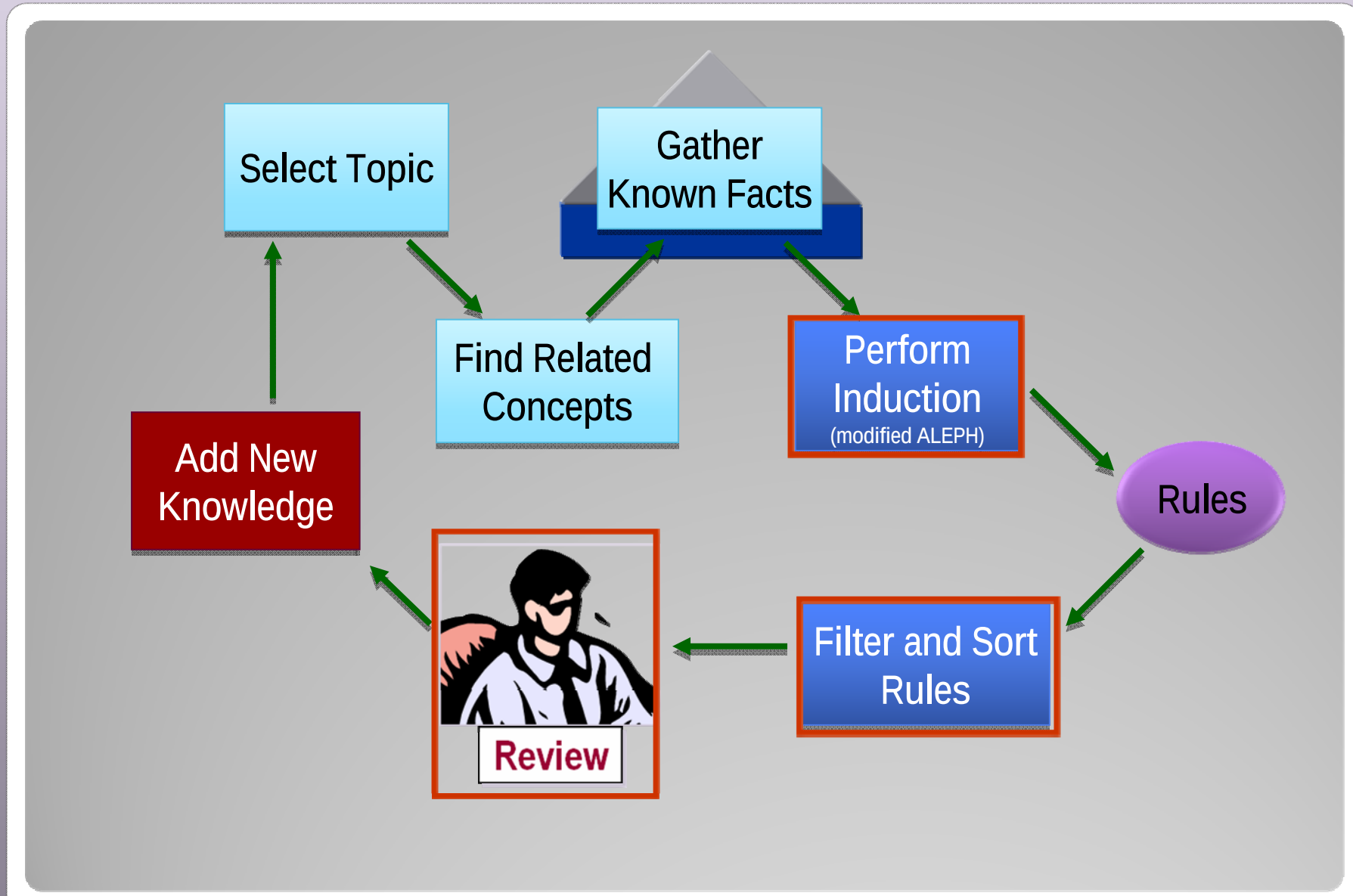
Looking for something that matches the argument constraints on the predicate…

"… symptoms of pertussis such as fever and a dry cough …"

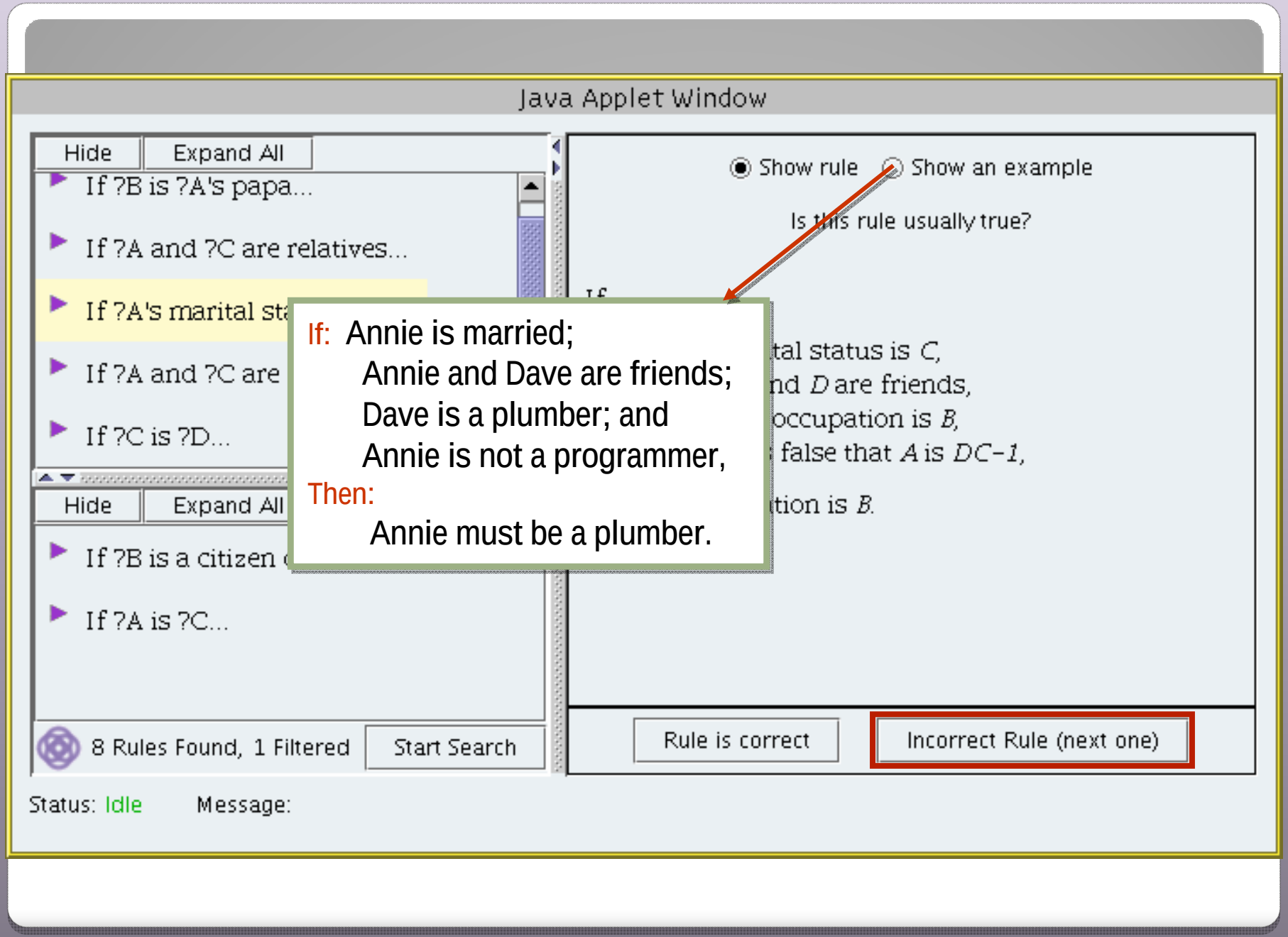
Parse back into existing CycL concepts

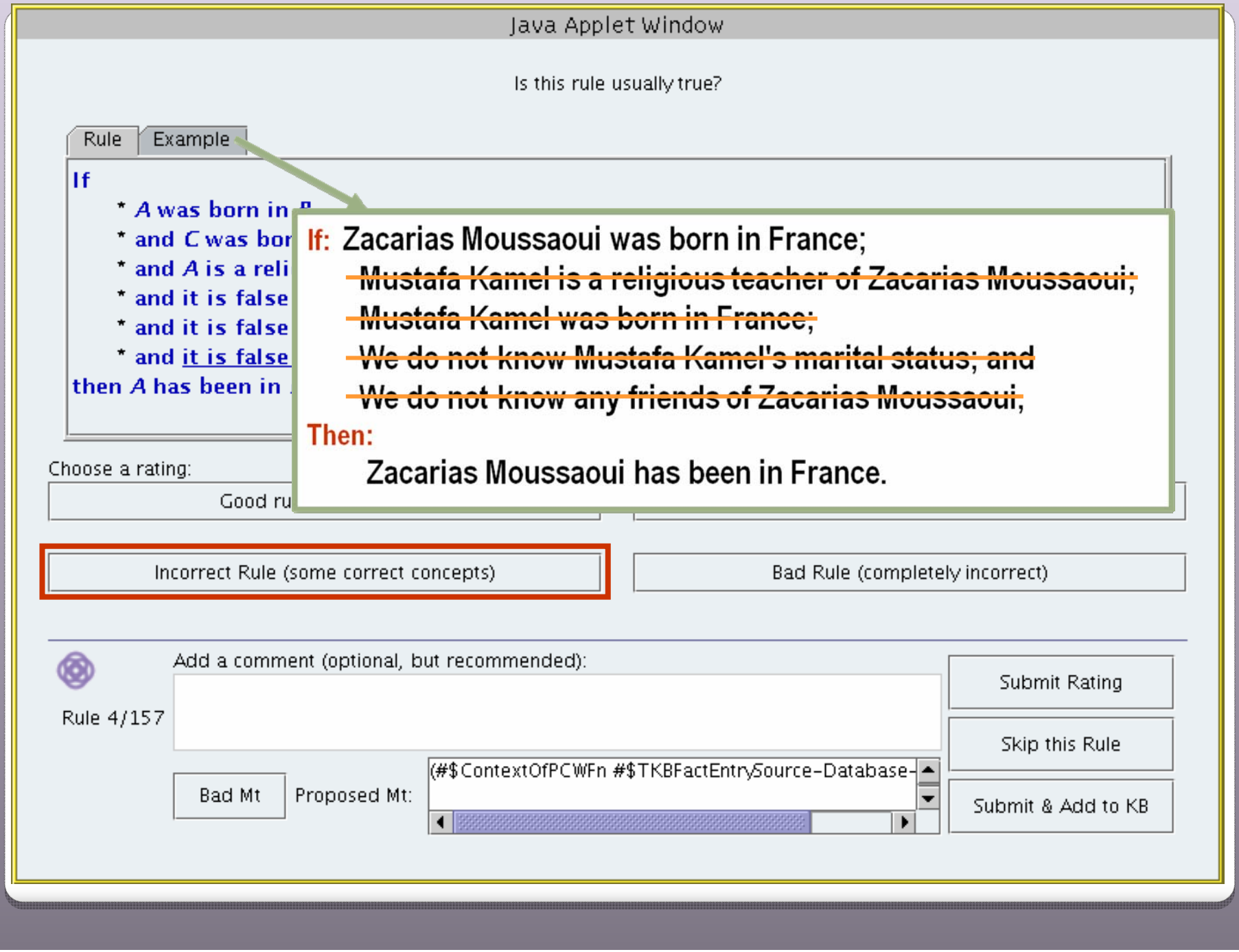
(symptomOfAilment WhoopingCough Fever)
(symptomOfAilment WhoopingCough Coughing-AilmentCondition)

Parsing Results



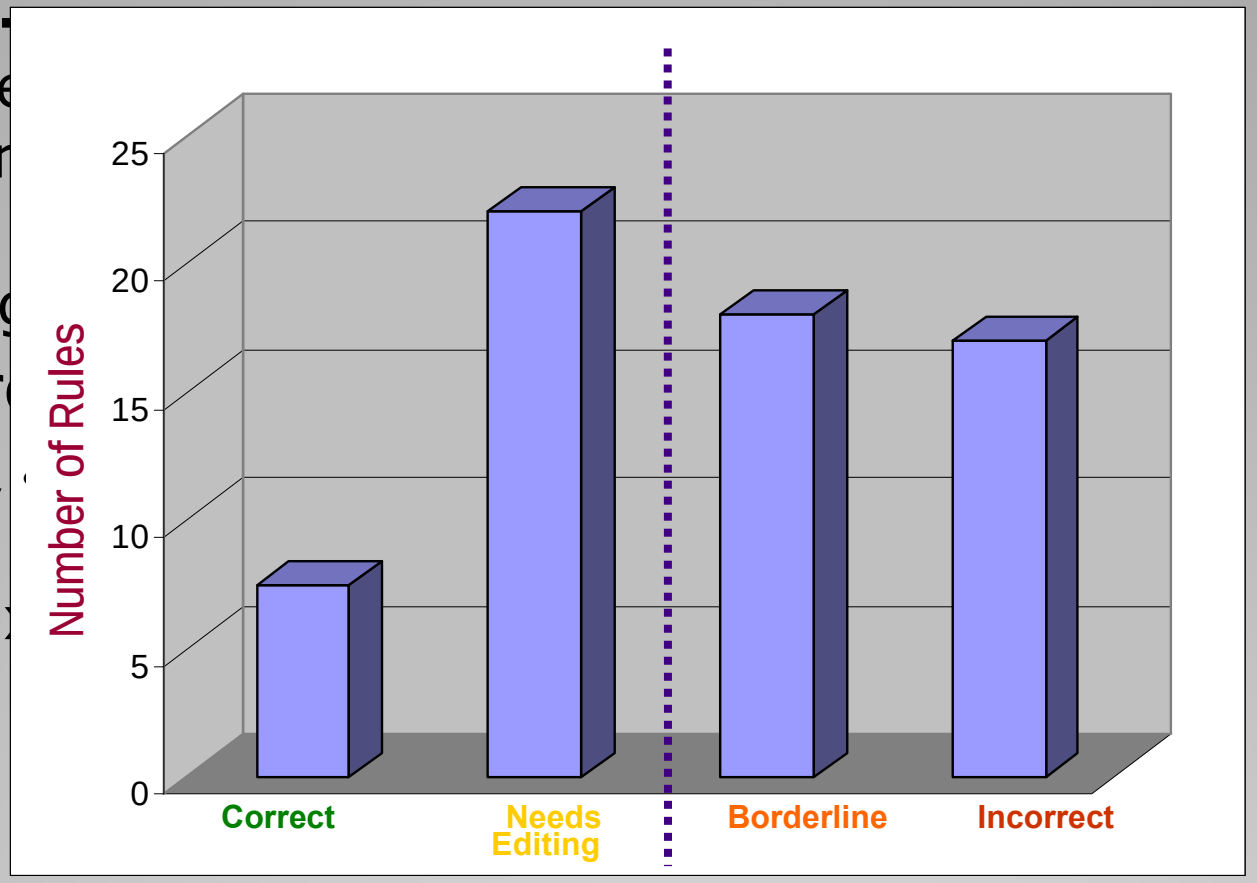
The Rule Induction Pipeline


Java Applet Window
Hide
Expand All
If ?B is ?A's papa...
If ?A and ?C are relatives...
If ?A's marital sta
If ?A and ?C are
If ?C is ?D...
Hide
Expand All
If ?B is a citizen
If ?A is ?C...
8 Rules Found, 1 Filtered
Start Search
Show rule
Show an example
Is this rule usually true?
If: Annie is married;
Annie and Dave are friends;
Dave is a plumber; and
Annie is not a programmer,
Then:
Annie must be a plumber.
tal status is C,
nd D are friends,
occupation is B,
false that A is DC-1,
tion is B.
Rule is correct
Incorrect Rule (next one)
Status: Idle
Message:


Java Applet Window
Is this rule usually true?
Rule
Example
If
* A was born in B
* and C was bor
* and A is a reli
* and it is false
* and it is false
* and it is false
then A has been in
If: Zacarias Moussaoui was born in France;
Mustafa Kamel is a religious teacher of Zacarias Moussaoui;
Mustafa Kamel was born in France;
We do not know Mustafa Kamel's marital status; and
We do not know any friends of Zacarias Moussaoui;
Then:
Zacarias Moussaoui has been in France.
Choose a rating:
Good ru
Incorrect Rule (some correct concepts)
Bad Rule (completely incorrect)
Add a comment (optional, but recommended):
Rule 4/157
Submit Rating
Skip this Rule
Bad Mt
Proposed Mt:
(#$ContextOfPCWFn #$TKBFactEntrySource-Database-
Submit & Add to KB

Early Results

- ~150 rules created in a variety of domains:
  - Family re
    affiliation
    …
  - Changing
- Results r
  - Overall,
    into KB;
    (by an ex



Sample Rules Produced

- If someone's time has been requested for a task by that person's primary project, the time will be assigned.

```
(implies
      (and
         (cyclistPrimaryProject ?KE ?PROJECT)
         (projectTasks ?PROJECT ?TASK)
         (requestedEffortPercent ?TASK ?KE ?X))
      (assignedEffortPercent ?TASK ?KE ?X))
```

- People participate in the projects they manage.

```
(implies
      (and
         (projectManagers ?PROJECT ?AGENT))
      (projectParticipants ?PROJECT ?AGENT))
```

- People are assigned to tasks requested of them for projects managed by that person's direct supervisor.

```
(implies
      (and
         (primarySupervisor ?AGENT AGENT-1)
         (requestedEffortPercent ?TASK ?AGENT ?X)
         (projectManagers ?PROJECT ?AGENT-1)
         (projectTasks ?PROJECT ?TASK))
      (assignedEffortPercent ?TASK ?AGENT ?X))
```

Summary

- Semantic Search depends on precise, detailed analysis
- Large Vocabularies
- Detailed KBs interconnecting them
- Bad News: There's a lot to learn
- Good News: Knowledge helps learning

- Semantic Search needs Web3.0 approach:
  - Collaborative Knowledge Construction and use by people and machines

- Air Force Rome Labs
- ANSER Inc.
- Austin Info Systems
- Claraview, Inc.
- Conceptual Modeling Group
- Daxtron Laboratories, Inc.
- Defense Information Systems Agency (DISA)
- Eclectic Systems, LLC
- Federal University of Bahia
- Fraunhofer Institute
- Free University of Bolzano
- Galileo Company
- Gavin Matthews, Individual
- Genomic Center of the University of Liege
- Georgia State University
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- Harvard University
- Hitachi Systems & Services
- Houston VA Medical Center
- Hybrid Systems
- IBM Research
- Image Matters LLC
- IMISE, Leipzig University
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- Intelligent Automation, Inc.
- Intelligent Autonomous System Group, University of Munchen
- Internet Technology School
- ISTC-CNR
- Jagiellonian University
- Jennifer Sullivan, Individual
- Jozef Stefan Institute
- Justsystem Corporation
- Karin Kipper Schuler, Individual
- Knowledge Media Institute, Open University
- Korea Institute of Science and Technology
- Language Computer Corporation
- LBJ School of Public Affairs
- Linkoping UniversityLockheed Martin Advanced Technology Labs
- Locomedia, LLC
- Louisiana Tech University ltu
- Marc Skowron, Individual
- Middlesex University
- MIT Media Lab
- Monmouth University
- NASA Ames Research Center
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- Northwestern University
- New Mexico Highlands University
- Norwegian University of Science and Technology (NTNU)
- NTT Communications Science Laboratories
- Oakland University
- Ohio State University, Computational Linguistics and Language Technology Lab

Reaching Web 3.0 is a collaborative, Europe-wide and world-wide effort.

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Research Cyc Licensees

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- Radboud University
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- Sunny Fugate, JTF-GNO
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- USC Information Sciences Institute
- USC-IRIS
- Utah State University, Computer Science Department
- VTT Technical Research Centre of Finland
- Xerox PARC

Reaching Web 3.0 is a collaborative, Europe-wide and world-wide effort.

CYC

Train

```
 +-------------------------------------------Xp-------------------------------------------+
 +------------Wd------------+           +--------------------MVp---------------------+    |
 |        +--------A--------+           |         +------Jp-----+----Mp----+         |    |
 |        |      +--G--+--G-+--Ss--+---Os---+--Mp-+    +--Dmcn--+     +N Sa+    +-Js-+    |
 |        |      |     |    |      |        |     |    |        |     |    |    |    |    |
LEFT   Royal.a Dutch Shell Plc halted.v output.n of 455,000 barrels.n a  day.p in Nigeria .
```

```
(#$and (#$isa (#$TheFn #$DecreaseEvent)
            (#$DecreaseInValueReturnedByFn (#$ExportRateOfByFn #$Petroleum-CrudeOil) #$Nigeria))
        (#$doneBy (#$TheFn #$DecreaseEvent) #$RoyalDutchShell)
        (#$quantityChangeAmount (#$TheFn #$DecreaseEvent) (#$BarrelsPerDay 455000)))
```

Template

```
 +-------------------------------------------Xp-------------------------------------------+
 +------------Wd------------+           +--------------------MVp---------------------+    |
 |                          +           |         +------Jp-----+                    |    |
 |              +-----------+--Ss--+---Os---+--Mp-+             +               +-Js-+    |
 |              |                  |        |     |             |               |    |    |
LEFT        [Agent]            halted.v output.n of         [Quantity]         in  [Locn] .
```

```
(#$and (#$isa (#$TheFn #$DecreaseEvent)
            (#$DecreaseInValueReturnedByFn (#$ExportRateOfByFn #$Petroleum-CrudeOil) [Locn]))
        (#$doneBy (#$TheFn #$DecreaseEvent) [Agent])
        (#$quantityChangeAmount (#$TheFn #$DecreaseEvent) [Quantity]))
```

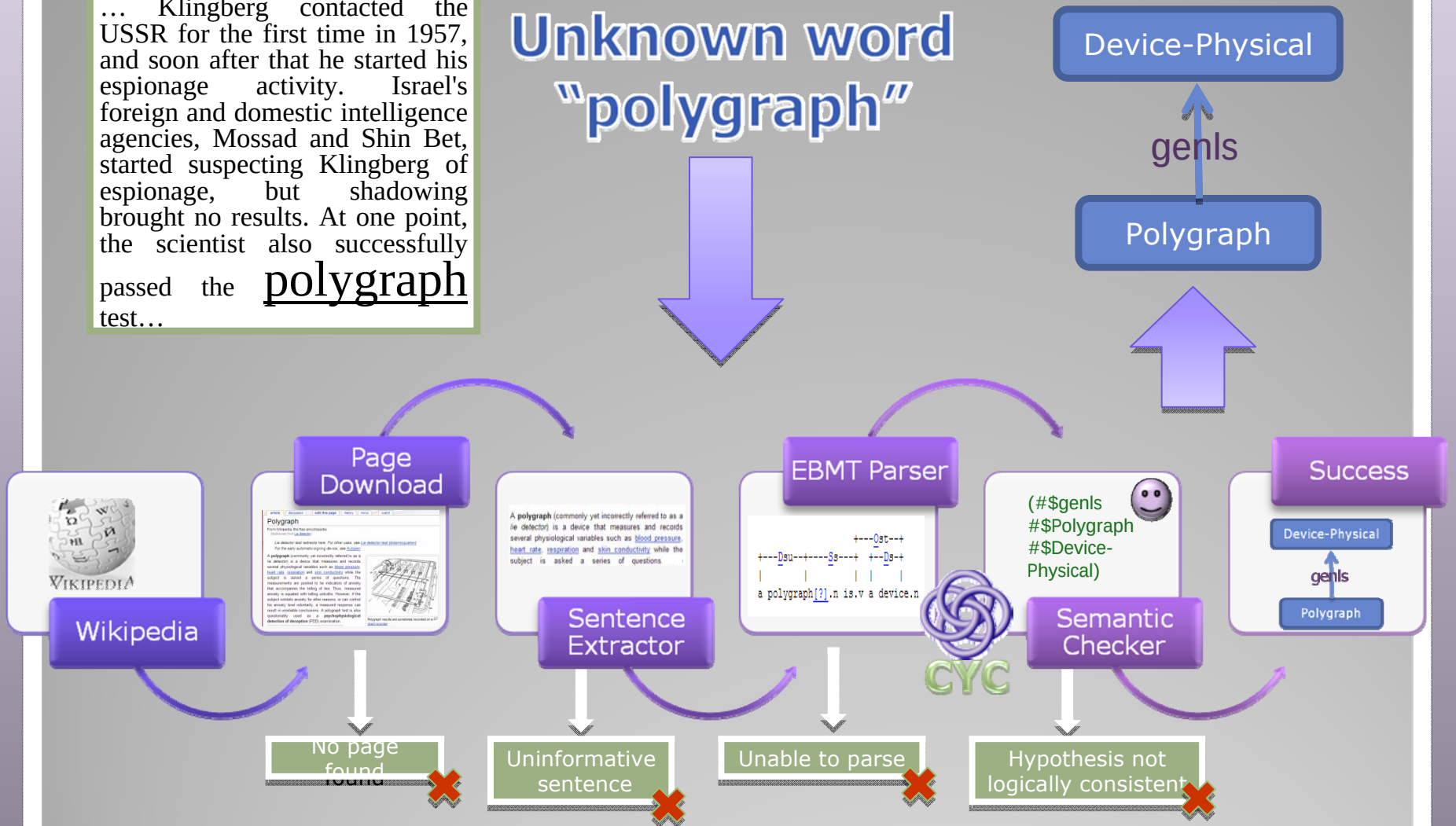
Use

Petróleos de Venezuela S.A. halted output of 760 000 barrels a week in Maracaibo.

```
(#$and (#$isa (#$TheFn #$DecreaseEvent)
            (#$DecreaseInValueReturnedByFn (#$ExportRateOfByFn #$Petroleum-CrudeOil)
                                                    #$CityOfMaracaiboVenezuela))
        (#$doneBy (#$TheFn #$DecreaseEvent) #$PetroleosdeVenezuelaSA
        (#$quantityChangeAmount (#$TheFn #$DecreaseEvent) (#$BarrelsPerWeek 760000)))
```

… Klingberg contacted the USSR for the first time in 1957, and soon after that he started his espionage activity. Israel's foreign and domestic intelligence agencies, Mossad and Shin Bet, started suspecting Klingberg of espionage, but shadowing brought no results. At one point, the scientist also successfully passed the polygraph test…

Unknown word "polygraph"



Automatically Adding to Knowledge

Getting Ground Facts

KB Knowledge as a basis for Generalization; Reading, Abduction

Fact Gathering & Verification

Query

Google

Search

"George Washington, cofounder of the United States…"

→

(foundingAgent GeorgeWashington UnitedStatesOfAmerica)

Parse

Cyc KB

Inference

Review

+ Google

Consistency & Verification

Query

"What are symptoms of Whooping Cough?"

→

(symptomOfAilment WhoopingCough *?SYMP*

)

NL Generation

Partial English sentences

"A symptom of whooping cough is ___"

"Whooping cough can cause ___"

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Michael Witbrock © Cycorp 2007

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(symptomOfAilment WhoopingCough Coughing-AilmentCondition)

Parsing Results

- Explicitly: perform one step of inference to throw out facts inconsistent with KB
- Implicitly: don't even look at things that don't match argument constraints

Throw out **provably wrong** answers

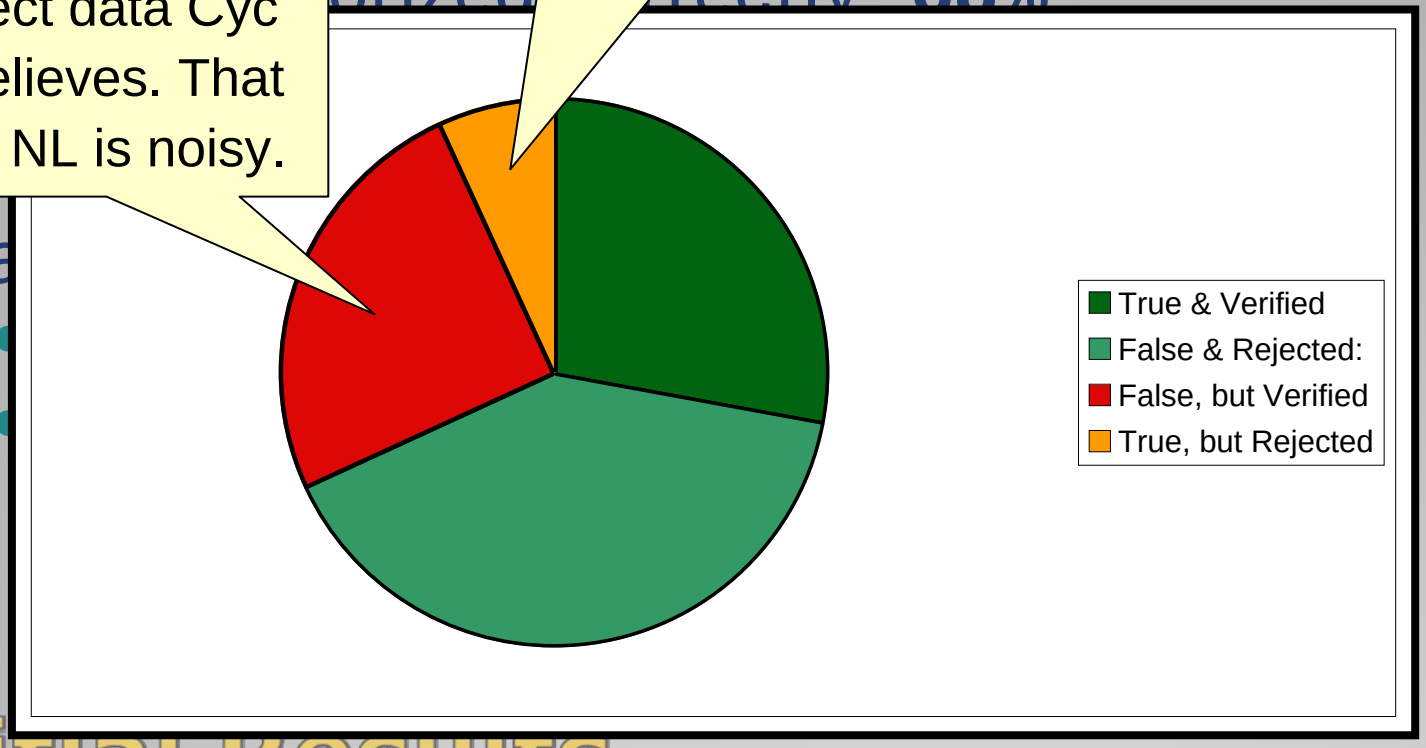
Skip already known (**provably right**) knowledge

KB Consistency Check

- On Review of 114 results
  - 61 “verified” s
  - 53 “rejected” omly chosen)
  - orized rectly 68%

Data Cyc could have got but didn’t—not so bad.

Incorrect data Cyc now believes. That *is* bad. NL is noisy.



- Fa

Initial Results

The Economist, Dec 13th 2007,
http://www.economist.com/world/international/displaystory.cfm?story_id=10286811