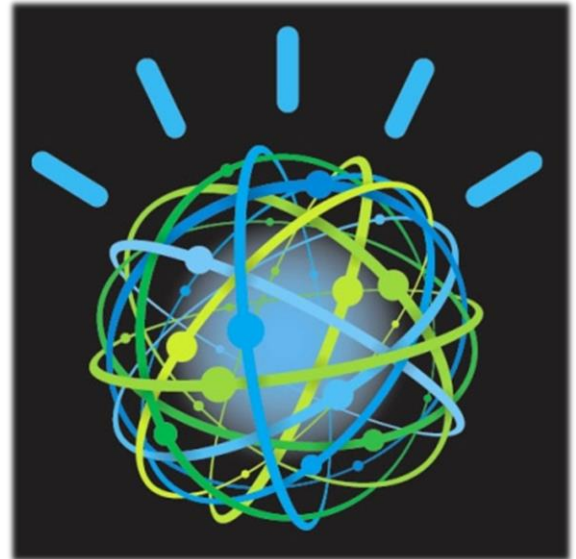


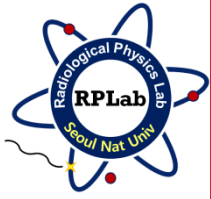
# IBM WATSON FOR ONCOLOGY

**2016. 10. 31.**

**JIMIN LEE**



# CONTENTS



## 1. IBM Watson

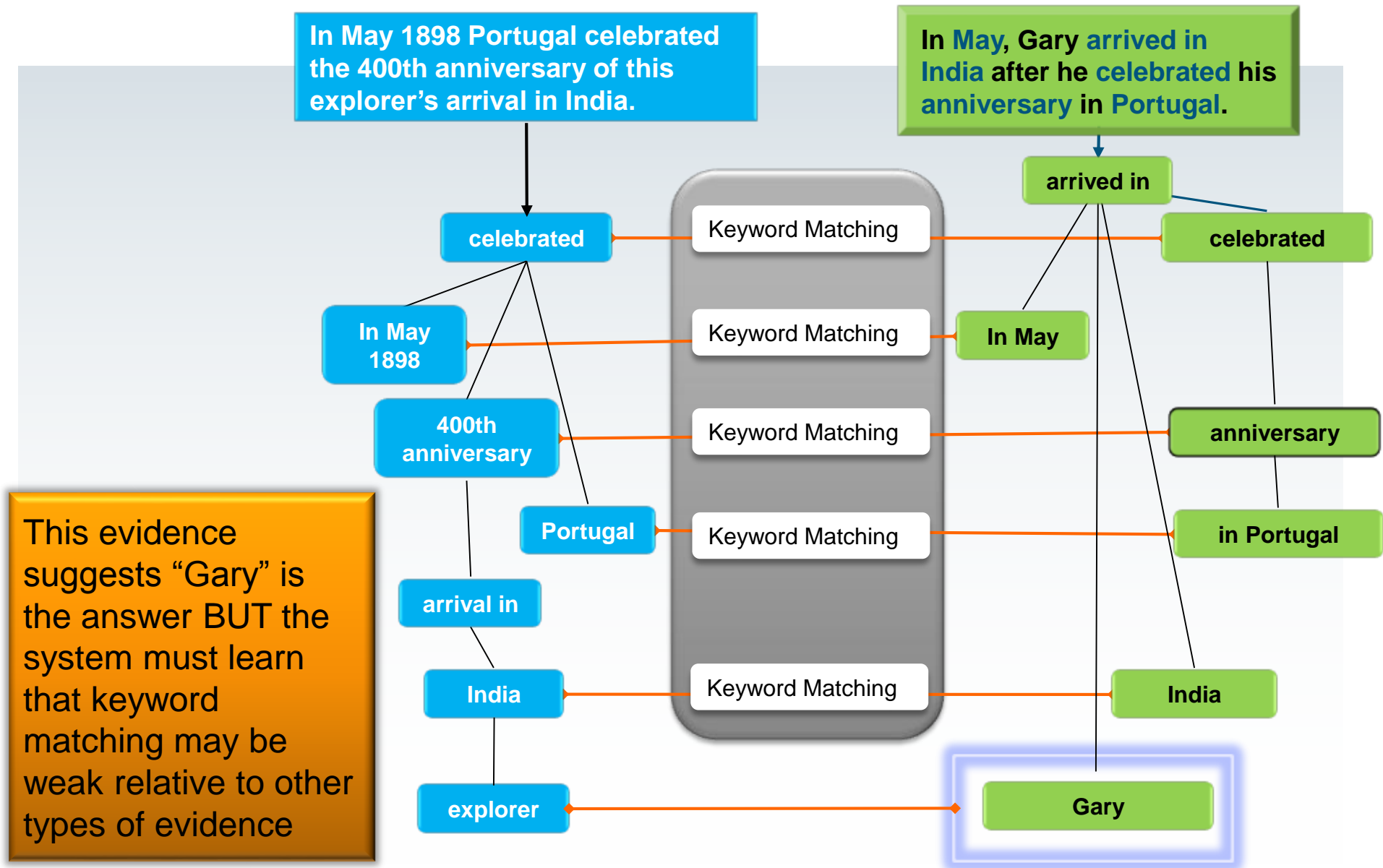
## 2. IBM Watson for Oncology

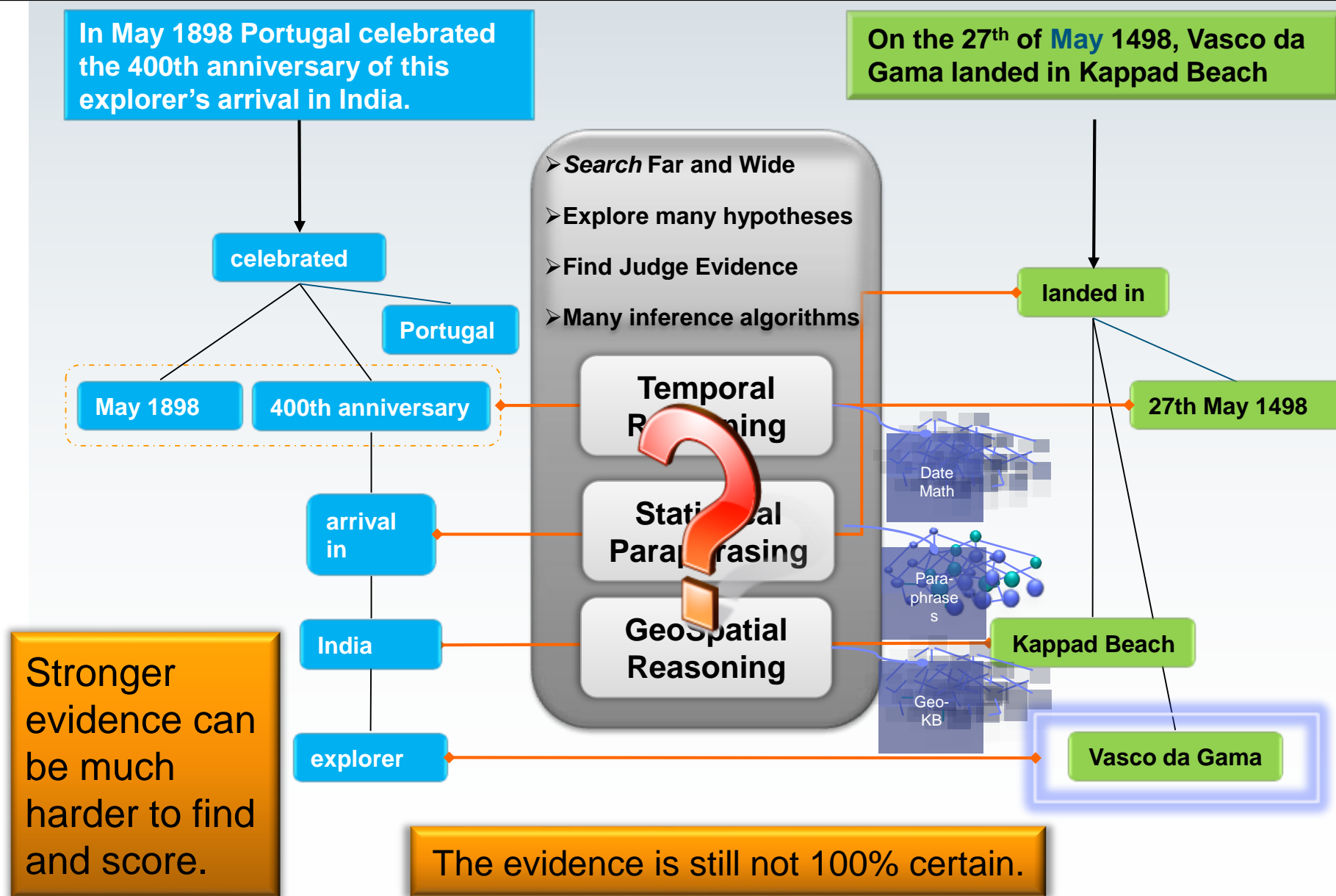
# IBM WATSON

## ■ Jeopardy! (퀴즈쇼)

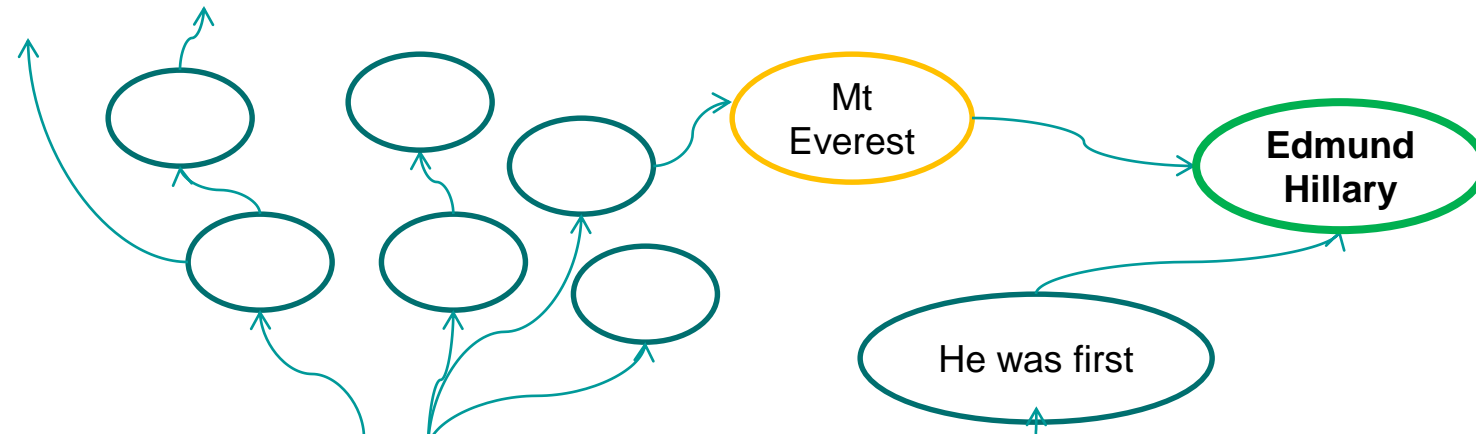
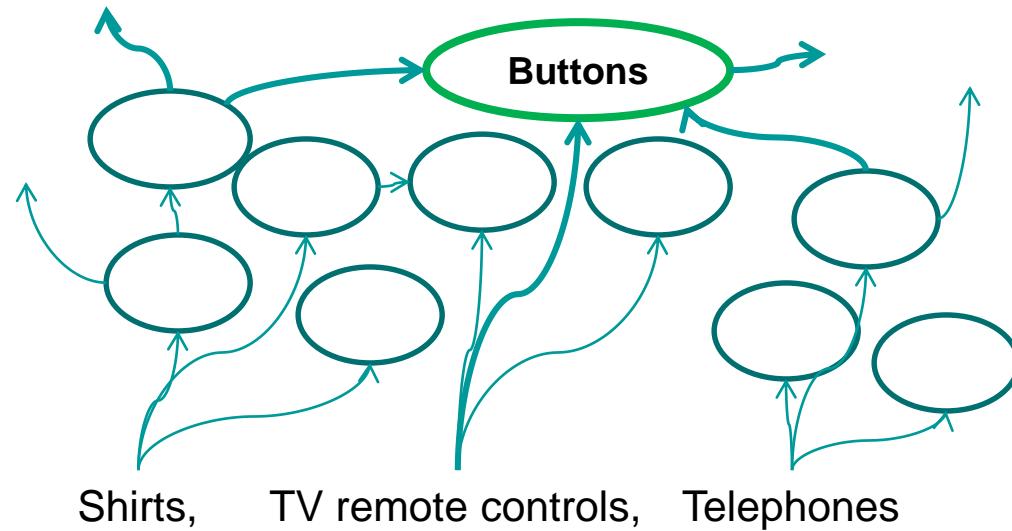
- 문제가 자연어로 출제
- 문제를 두 명의 챔피언과 동시에 텍스트 파일로 제공 받음
- 하드디스크에 저장되어 있는 자료 만을 검색해서 문제 풀이 (인터넷 연결 X)
- <https://www.youtube.com/watch?v=P0Obm0DBvwl>







# The Missing Link



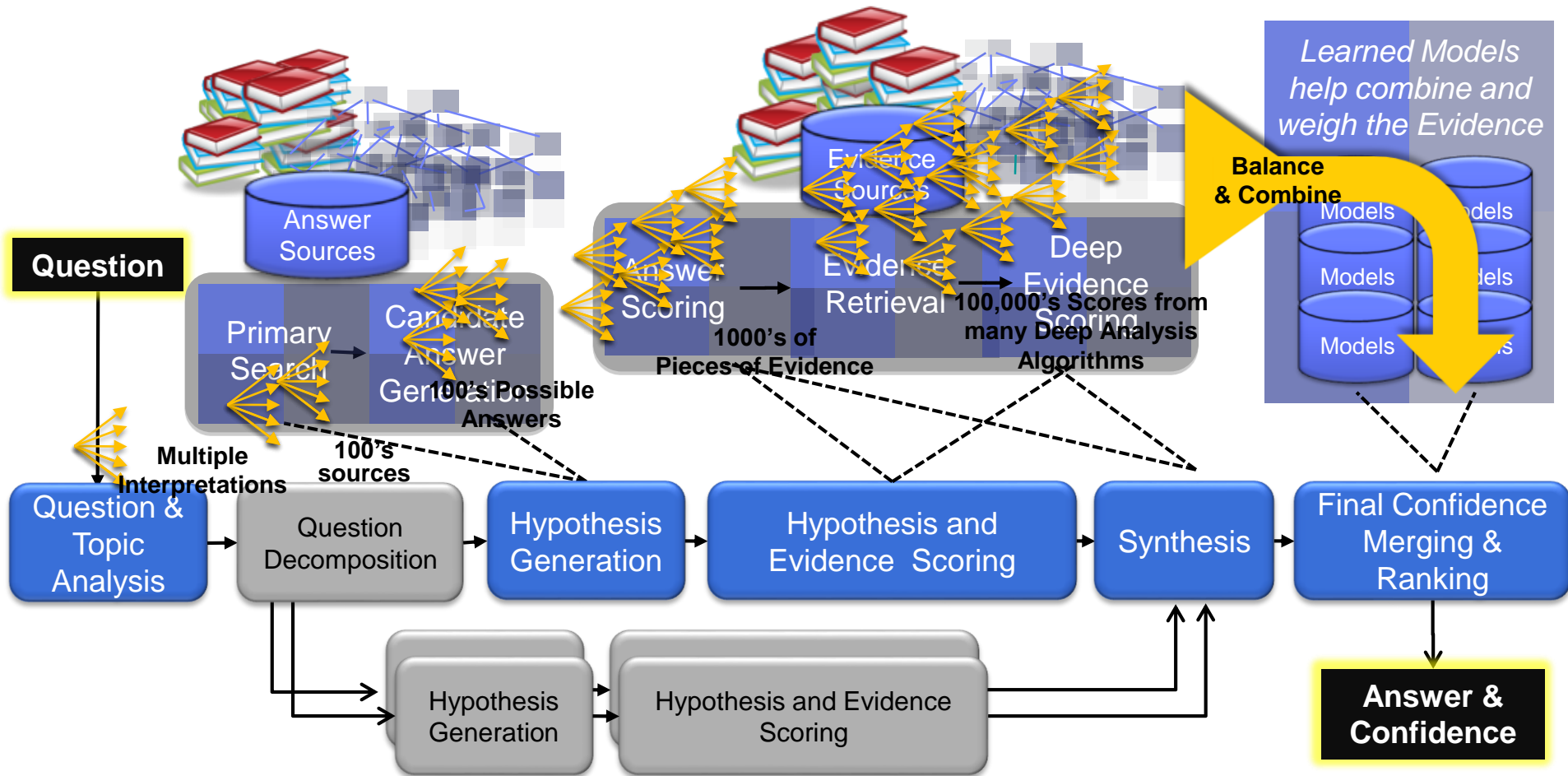
On hearing of the discovery of George Mallory's body, he told reporters he still thinks he was first.

# DeepQA: The Technology Behind Watson

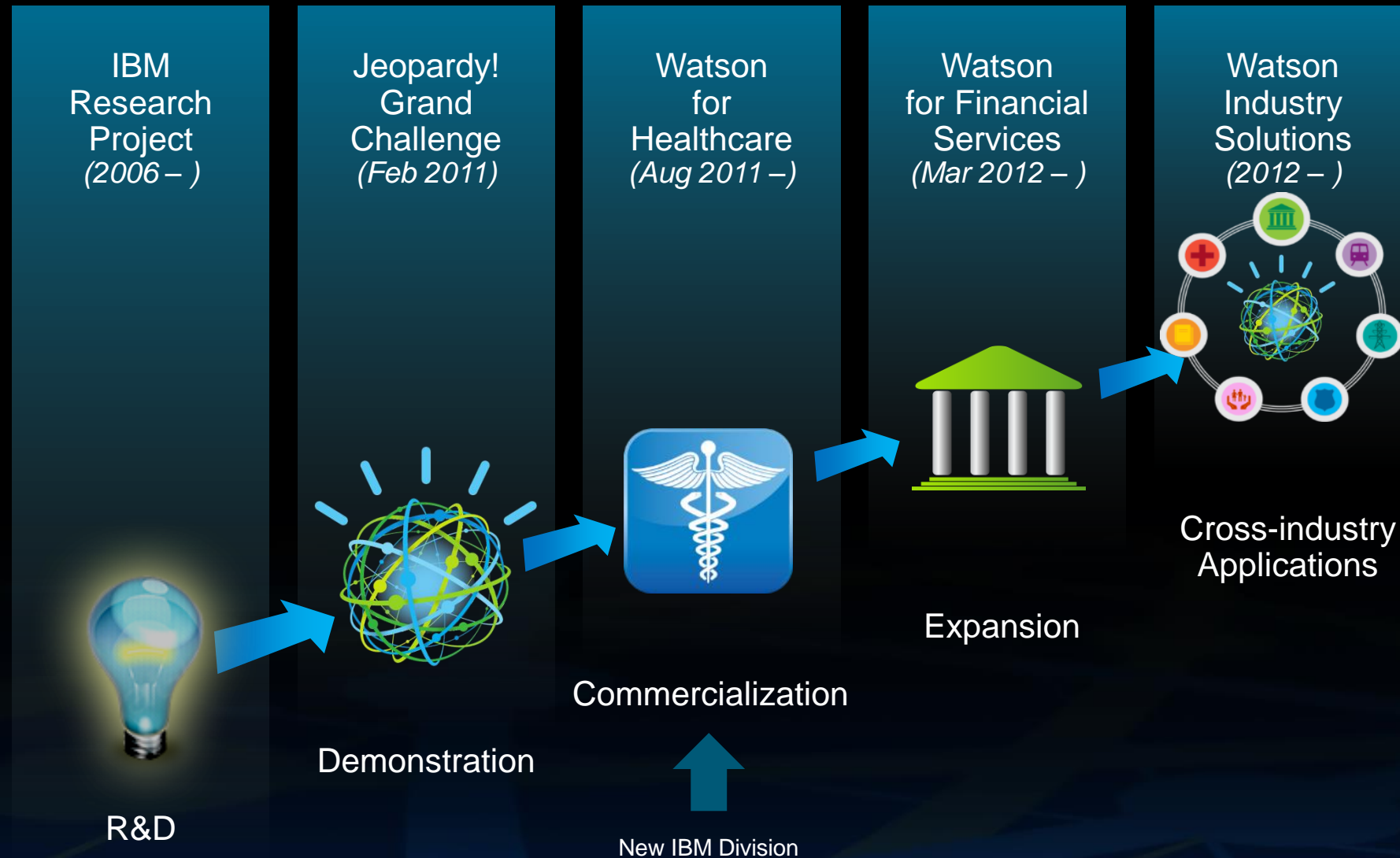
## Massively Parallel Probabilistic Evidence-Based Architecture

Generates and scores many hypotheses using a combination of 1000's **Natural Language Processing, Information Retrieval, Machine Learning** and **Reasoning Algorithms**.

These gather, evaluate, weigh and balance different types of **evidence** to deliver the answer with the best support it can find.

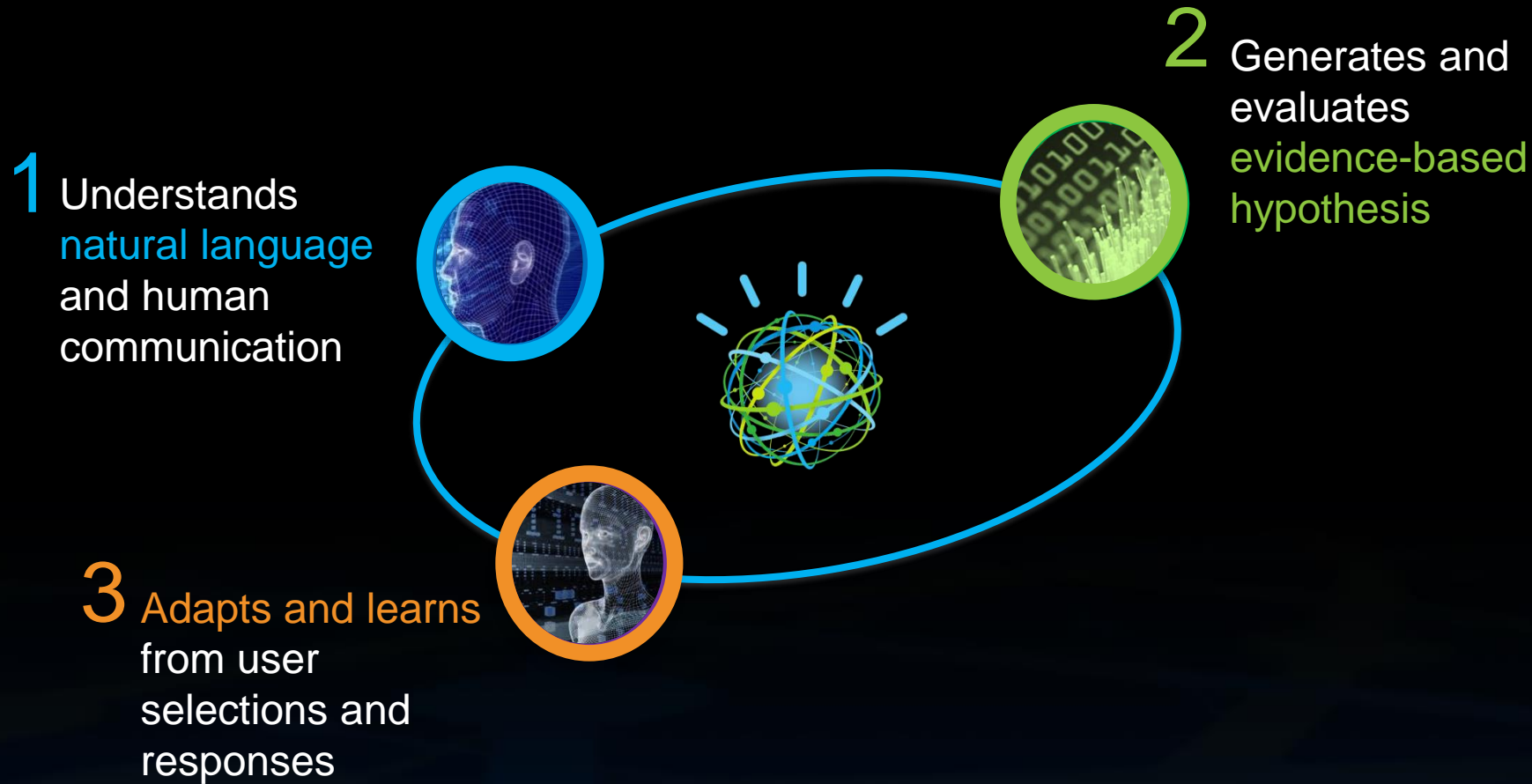


# Brief History of IBM Watson





# IBM Watson combines transformational technologies



*...built on a massively parallel architecture optimized for IBM POWER7*

# Watson Healthcare Products – 1H 2013

## Watson Clinical Insights Advisor



Therapy  
Designer

Assists with efficient trials and reduces time to market with new cancer therapies

Accelerate Research  
and Insights

## Watson Diagnosis & Treatment Advisor



Oncologists

Assists in identifying individualized treatment options for patients diagnosed with cancer

Improve Diagnosis  
and Treatments

## Watson Care Review and Authorization Advisor



Nurses

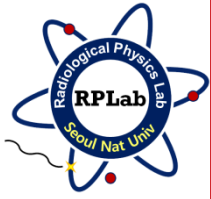
Streamlines manual review processes between a physician and health plans

Improve Decisions  
and Outcomes

# Watson Products and Infrastructure



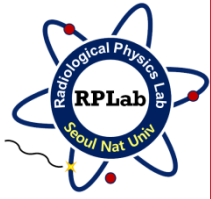
# IBM WATSON HEALTHCARE



- **Beyond Jeopardy**

- Medical Assistant: Memorial Sloan Kettering Cancer Center Partnership  
(March 2012)
- Clinicians “taught” Watson to review oncological case histories and come up with best diagnosis and treatment.
- **Advantages** : Immediate answers, Diagnosis, Efficiency, and Organization
- **Disadvantages** : Cannot read PET and CT scans to identify tumors  
Questions asked must be in text.  
Limits understanding and reasoning behind decisions

# IBM WATSON HEALTHCARE



- **Watson has analyzed: (2013/02/08)**
  - 3469 Textbooks
  - 69 Guidelines
  - 274,460 Journal articles
  - 31,540 Clinical trials
  - 106,054 Other clinical documents
- 600,000 건의 의학적 근거 (medical evidences)
- 42개 의학 저널과 임상 시험 데이터 / 1,500 개의 실제 폐암 치료 사례
- 전문의들의 노트, 환자 기록 등 ‘자연어 형태로 되어 있는’ 데이터 모두 학습



# Medical journal concept annotations

Diseases

Symptoms

Relations  
causeOf  
modifierOf  
negationOf  
partOf  
remedyOf  
resultOf

1 Chamarthi, Bindu; Morris, Charles A.; Kaiser, Ursula B.; Katz, Joel T.; Loscalzo, Joseph

2 Stalking the Diagnosis

3 362/9/834

4 <http://content.nejm.org/cgi/content/full/362/9/834></citation\_fulltext\_html\_url>

5 A 58-year-old woman presented to her primary care physician after several days of dizziness, anorexia, dry mouth, increased thirst, and frequent urination. She had also had a fever and reported that food would "get stuck" when she was swallowing. She reported no pain in her abdomen, back, or flank and no cough, shortness of breath, diarrhea, or dysuria. Her history was notable for cutaneous lupus, hyperlipidemia, osteoporosis, frequent urinary tract infections, three uncomplicated cesarean sections, a left oophorectomy for a benign cyst, and primary hypothyroidism, which had been diagnosed a year earlier. Her medications were levothyroxine, hydroxychloroquine, pravastatin, and alendronate. She lived with her husband and had three healthy adult children. She had a 20-pack-year history of smoking but had quit 3 weeks before presentation. She reported no alcohol or drug abuse and no exposure to tuberculosis. Her family history included oral and bladder cancer in her mother, Graves' disease in two sisters, hemochromatosis in one sister, and idiopathic thrombocytopenic purpura in one sister.

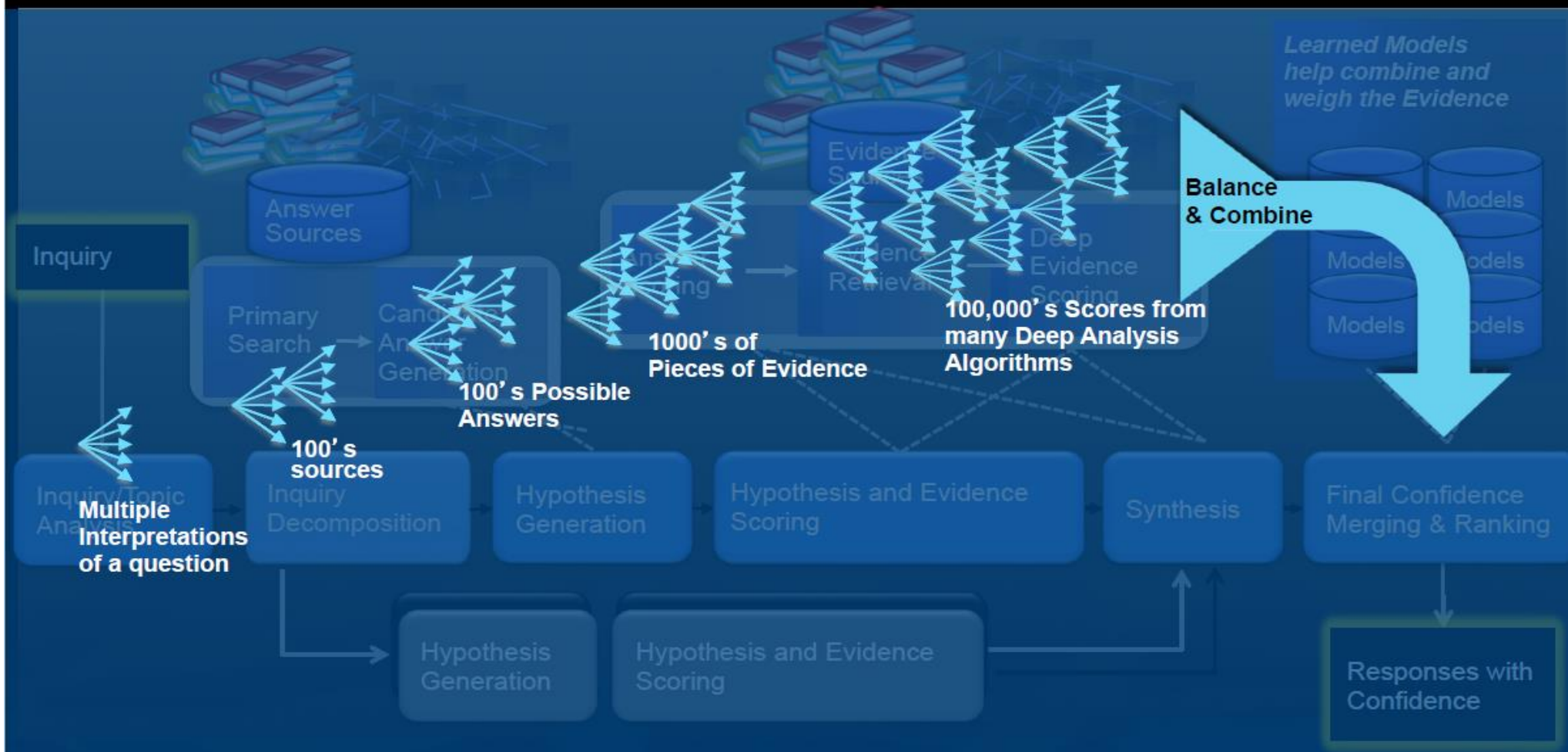
Entity Types / Roles

FAMILY-DISEASE  
FAMILY-SUBSTANCE-ABUSE  
FINDING-BLOODPRESSURE  
FINDING-GENERIC  
FINDING-HEARTRATE  
FINDING-HEIGHT  
FINDING-OXYGEN-SATURATIO  
FINDING-RESPIRATORYRATE  
FINDING-TEMPERATURE  
FINDING-WEIGHT  
MODIFIER-ANATOMY  
MODIFIER-GENERIC  
MODIFIER-NEGATION  
MODIFIER-TIME  
PATIENT-ACTIVITY-EVENT  
PATIENT-AGE  
PATIENT-ALLERGY  
PATIENT-FEMALE  
PATIENT-HAZARD-EXPOSURE  
PATIENT-HEALTHSTATE  
PATIENT-LOCATION  
PATIENT-MALE  
PATIENT-NAME  
PATIENT-OCCUPATION

Medications

Modifiers

## How Watson works: DeepQA Architecture

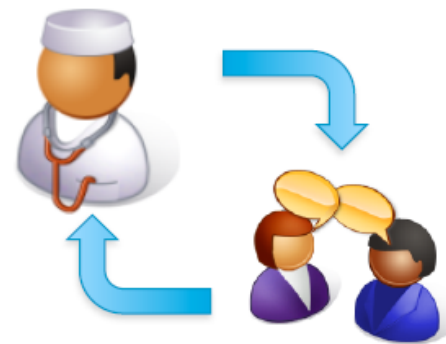




# IBM Watson goes to work in healthcare

## Use Case: Oncology Diagnosis & Treatment (ODT)

Assisting physicians with the diagnosis and treatment of cancer



### Solution

- Clinical support for patient assessment based on objective evidence – patient data, medical info, research, studies, articles, best practices, guidelines, etc.
- Evidence panel identifying key information used to support diagnosis, recommendations (e.g. suggested tests) and treatment options
- Systematic applied learning based on action taken and outcome derived
- Initial focus on lung, breast, prostate and colorectal cancers

### Goal

- Create individualized cancer diagnostic and treatment plans
- Enhance clinical confidence with greater access and understanding of information
- Speed time to evidence-based treatment
- Reduce diagnostic and administrative errors
- Accelerate the dissemination of practice-changing research



# IBM WATSON FOR ONCOLOGY

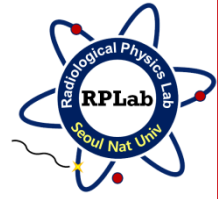
## ■ Watson for Oncology

- Extract **key attributes** from a patient's case
- Use those attributes to find **candidate treatment options** as determined by consulting NCCN (National Comprehensive Cancer Network) Guidelines
- Search a corpus of **evidence data** to find supporting evidence for each option
- Use Watson's analytic algorithms to **prioritize treatment options based on best evidence**

## ■ Watson for Oncology Demo

- <https://www.youtube.com/watch?v=WVQ7MguHjWE>

# IBM WATSON FOR ONCOLOGY



## ■ IBM Watson의 진료 정확도

- 2014 ASCO (American Society of Clinical Oncology, 미국임상암학회)  
Annual Meeting, General Poster Session

### Precision

$$= \frac{\text{correct preferred treatments}}{\text{correct preferred treatments} + \text{false positive (incorrect preferred treatments)} + \text{false negatives (missing preferred treatments)}}$$

Average precision (%) by disease site.			
	First run	Middle run	Latest run
Colon 대장암	68	81	98
Rectal 직장암	61	88	96
Bladder 방광암	24	75	91
Pancreatic 췌장암	5	91	94
Kidney 신장암	12	87	91
Ovarian 난소암	41	97	95
Cervical 자궁경부암	6	100	100
Endometrial 자궁내막암	12	83	89

# IBM WATSON FOR ONCOLOGY

- 길병원, IBM Watson 도입
  - 수도권 Big5 종합병원의 경우 굳이 Watson을 도입할 동인이 크지 않았음
  - 많은 수의 암환자, ROI (Return on Investment) 가 낮음
  - 길병원의 경우, 혁신적인 솔루션의 도입에 대한 비용이 상대적으로 큼 (대외적인 이미지 개선)
  - 이길여 총장의 강력한 리더십 및 의사 결정 체계



# IBM WATSON FOR ONCOLOGY

- 길병원 안성민 교수, IBM Watson 이용 사례 소개

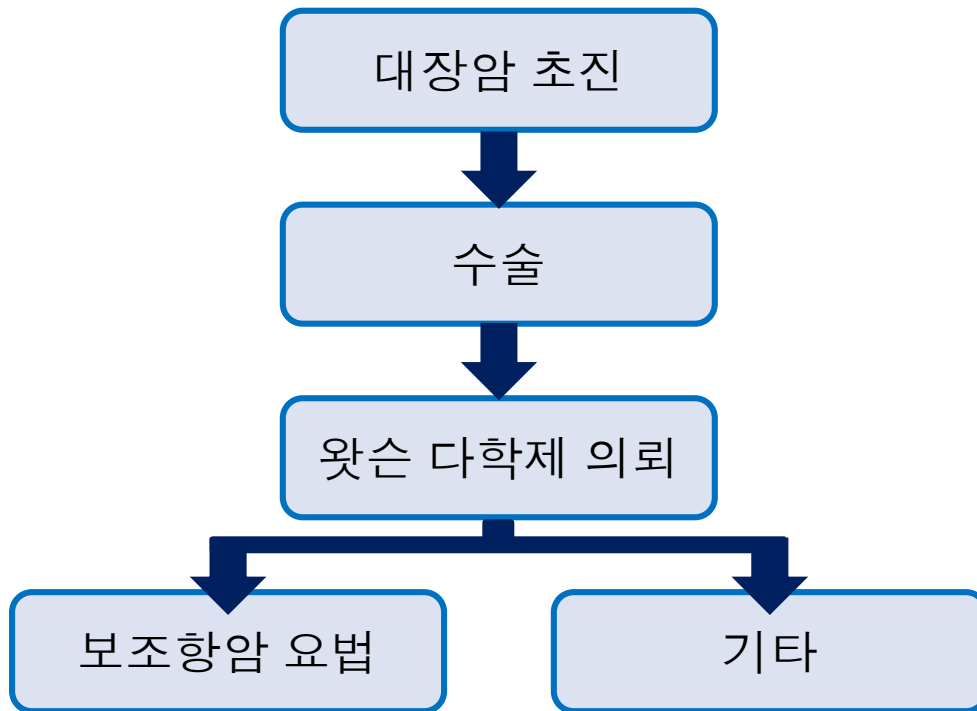


# IBM WATSON FOR ONCOLOGY

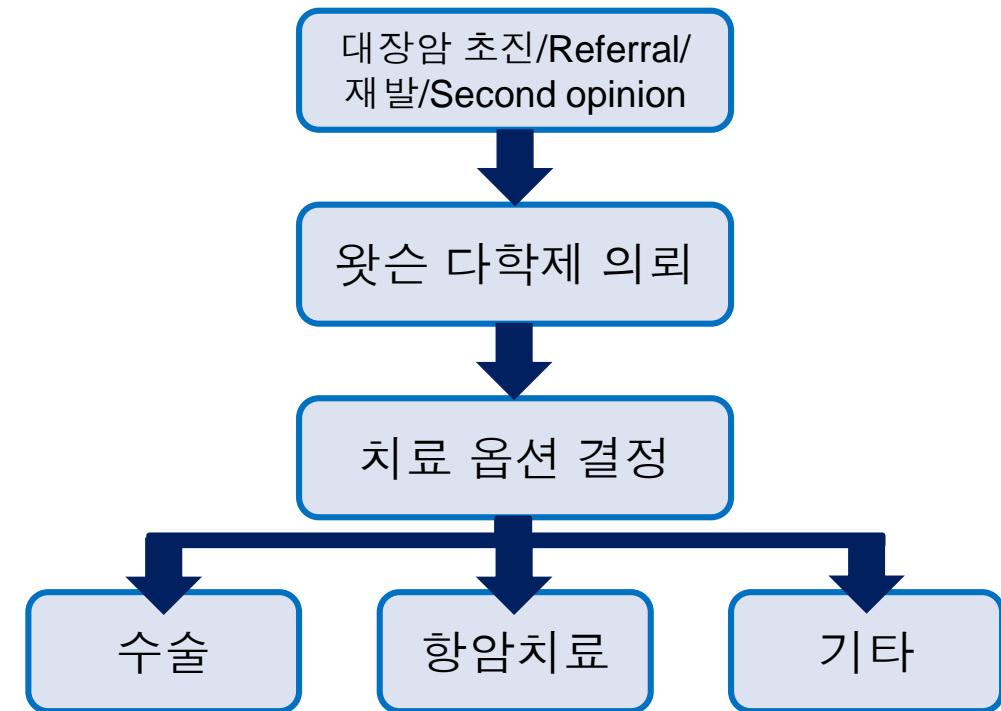
## ■ 길병원 안성민 교수, IBM Watson 이용 사례 소개

### - Workflow (예: 대장암)

소화기 내과/일반외과



예약/소화기 내과/일반외과/종양내과



# IBM WATSON FOR ONCOLOGY

- 길병원 안성민 교수, IBM Watson 이용 사례 소개
  - Key Decisions for Clinical Adoption of IBM Watson for Oncology

Questions	GMC Answer
Will you use this for primary consultation?	가능한 모든 초진 환자 (다학제 진료 통해)
Will you use this for follow-up consultation?	재발 등 새로운 치료 결정이 필요한 모든 상황 (다학제 또는 개별 진료)
Will you use this for second opinion service?	수가 인정 추진, 왓슨 의견만을 구하는 환자 등도 있음
Will you use this for Tumor Board?	적극 활용, 팀별 논의 필요
Will it be mandatory for all eligible cases be entered?	가능한 모든 초진 환자에게 의무적으로 적용
Will the physicians enter attributes in the system?	의사가 직접 입력하지 않음

# IBM WATSON FOR ONCOLOGY

## ■ 길병원 안성민 교수, IBM Watson 이용 사례 소개

### – 외국인 환자에게 적용

- 1) 태국 범룽랏 병원의 모델
- 2) 영문으로 치료에 관한 상세한 설명 및 교육자료 제공 가능

### – 다학제 진료에 활용

- 1) 다학제 진료의 backbone
- 2) 인공지능 의사를 다학제 의사 중 한 명으로 포지셔닝
- 3) 의사 간의 consensus 구축 및 환자에게 종합적인 뷰 제공
- 4) 환자의 방향이 필요 없는 베스트 옵션 제공

### – 연구 및 교육에 활용

- 1) Tumor Board / 후향적 DB 구축 가능





**THANK YOU FOR YOUR ATTENTION**