

# Techniques for AI Advances

# Rule-based Model



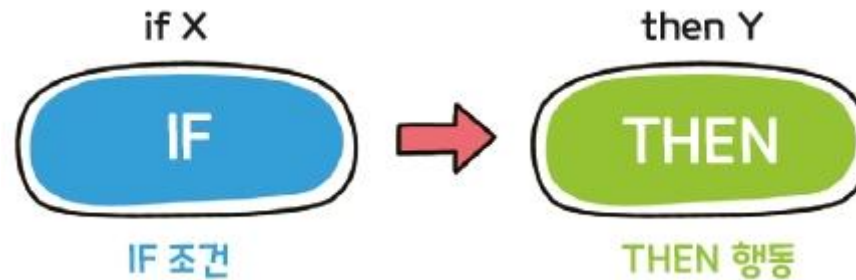
## ❖ Concept

### ■ Rule-based Model

- A model that entrusts machines with human judgment
- Programming by each person

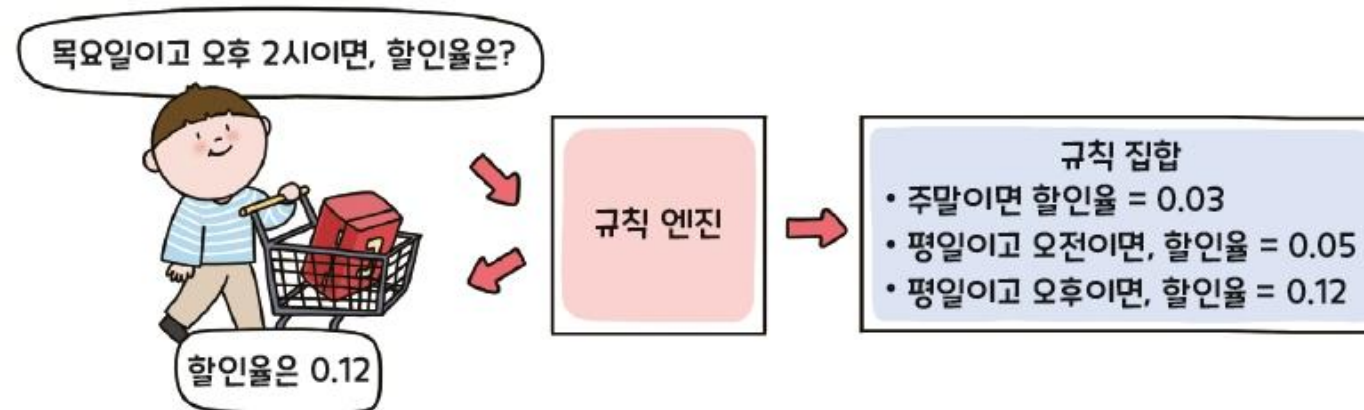
### ■ If-Then

- To compare certain conditions and divide the work to be done
- Rule-based models leverage these conditional branches to implement rules
- In general, 'If condition (X) then action (Y): If X, do Y.'



## ❖ Concept

- Assume that there are rules (conditions) for the discount rate when purchasing goods from a mart
  - If you buy something on the weekend, the discount rate is 0.03
  - If you buy something on weekdays, the discount rate is 0.05 in the morning and 0.12 in the afternoon
  - The discount rate when customer A purchases goods at 2 p.m. on Thursday is 0.12



# Rule-based Model



## ❖ Concept

- Rule engines and rule sets are required to implement rule-based models

구성 요소	설명
규칙 엔진	규칙에 대한 조건을 평가하고 행동으로 실행하는 것을 담당
규칙 집합	상황에 대한 경우의 수 모음

- Rule engines can make it easier to express solutions to complex problems
- Rule set is the number of cases for all situations, expressed as 'IF-THEN'

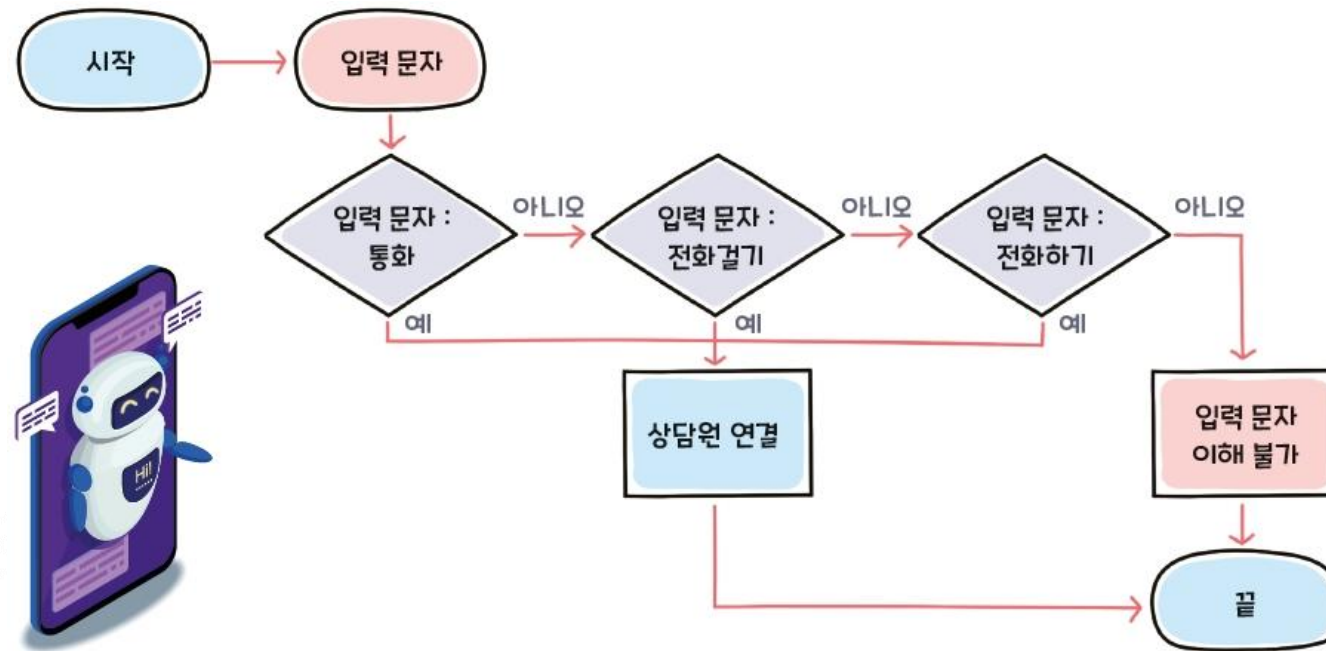
# Rule-based Model



## ❖ Applications

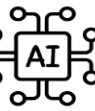
### ▪ Chatbot

- To find and answer user query keywords that match predefined keywords in the rule set (or database)





# Rule-based Model



## ❖ Applications

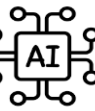
### ▪ **AI-based Chatbot**

- Using AI technology such as machine learning or natural language processing
- Interaction with users to learn queries on their own and become more intelligent
- There are no set rules, and it is characterized by learning and answering user queries on its own

### ▪ **Combined Chatbot**

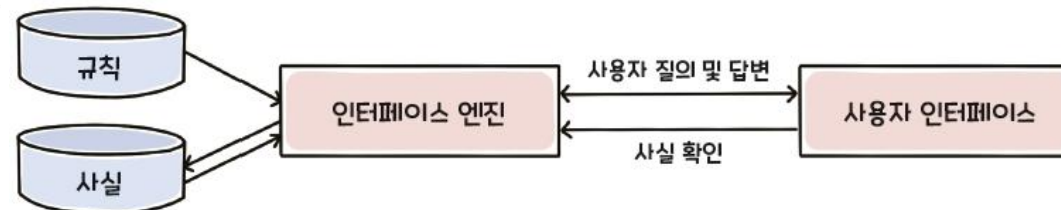
- The most common type of chatbot
- Basically, a mixture of rule-based and artificial intelligence-based chatbots
- Rules are used for simple questions from users, but when the conversation becomes deeper and the questions become more difficult, the AI answers based on what it has learned

# Rule-based Model

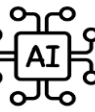


## ❖ Advantages

- A natural expression of knowledge
  - Rule-based models are described in the same way as 'A acts B in a situation', which can be expressed naturally by rules such as 'IF-THEN'
- A unified structure
  - Generated rules have a unified 'IF-THEN' structure
- The separation of knowledge and process
  - Rule-based models are separated into rules and facts, so they can be separated and recycled to different application systems

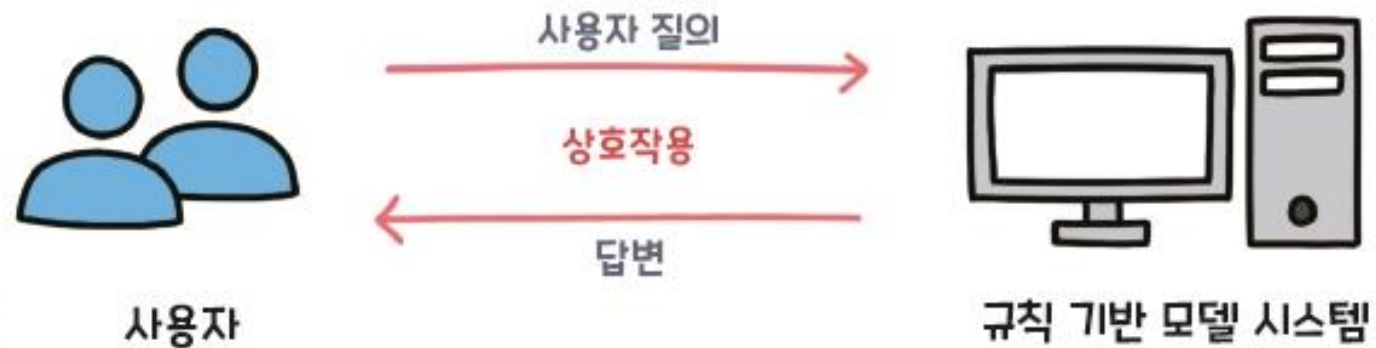


# Rule-based Model



## ❖ Advantages

- Interaction with users
  - Rule-based models can also interact with the user, and they search for rules about the user's input (question) and return appropriate answers

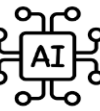




## ❖ Limitations

- An obscure relationship between rules
  - Individual rules are relatively simple and easy to understand, but within a set of many rules, the logical interrelationship of rules may not be clear
  - Difficult to observe how individual rules contribute to the overall strategy in rule-based models

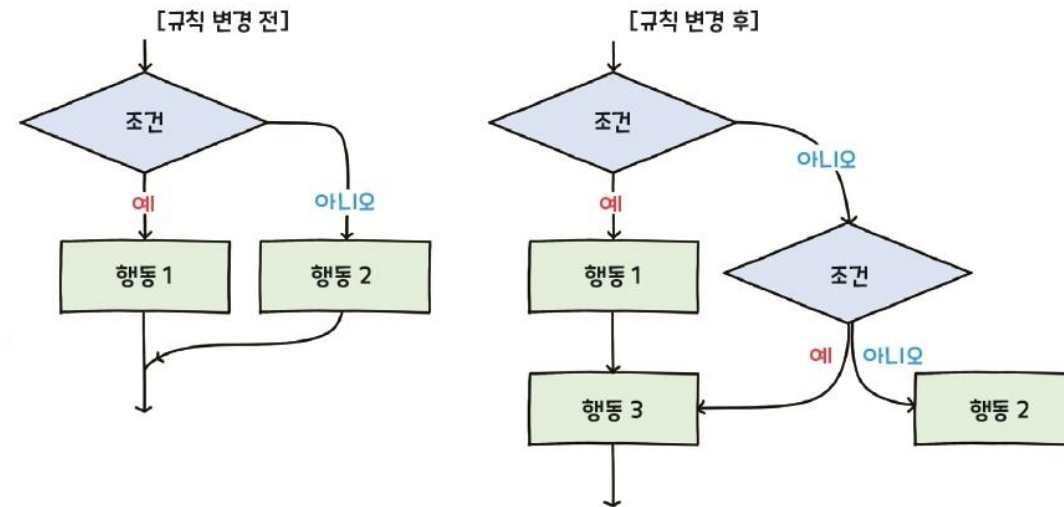
# Rule-based Model



## ❖ Limitations

### ▪ Frequent rule modifications

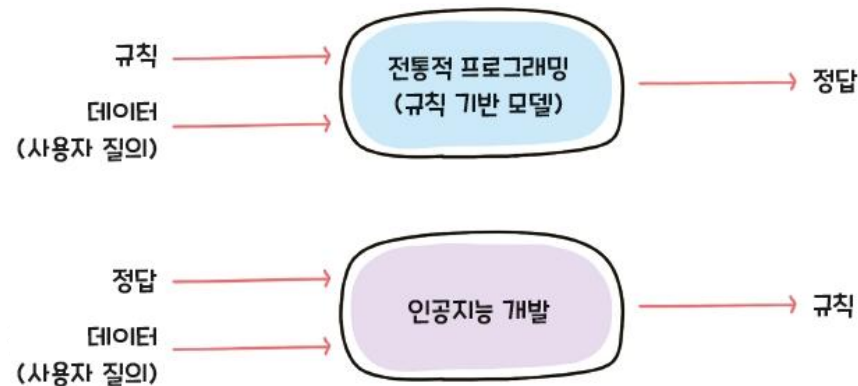
- Frequent individual rule modifications can be cumbersome to modify them one by one
- Not only is it difficult to find the rules you want to modify within a set of rules with numerous rules, but it also costs a lot to manually modify and maintain each time



## ❖ Limitations

### ▪ Impossible learning

- Rule-based models do not have the ability to learn from experience, so they print answers based on rules and user queries that have already been created
- Error occurs when user query content is outside the rules, due to inability to modify
  - Machine learning, on the other hand, allows the computer to modify rules or create new rules on its own because rules are created based on answers and user queries



## ❖ Limitations

표 2-2 전통적 프로그래밍과 인공지능 프로그래밍의 차이

구분	전통적 프로그래밍	인공지능 프로그래밍
목표	• 정해진 결과 도출	• 모델(규칙, 알고리즘) 생성
컴퓨팅 환경	• 전통적 CPU 기반의 컴퓨팅	• 슈퍼컴퓨팅(GPU를 이용한 병렬연산 처리)
목적	• 정확성	• 데이터에서 통계 패턴 채굴
행동성	• 인간이 구현한 알고리즘 그대로 행동	• 기계 스스로 학습하여 최적의 알고리즘 구현 및 행동
성능 지수	• 개발자의 능력	• 개발자 이상의 능력
불확실성 여부	• 결과가 명확함	• 모델 추정의 불확실성 • 예측의 불확실성
개발자 역할	• 소프트웨어(최종 생성물)를 위해 최적의 알고리즘 구현	• 입력을 출력에 매핑하는 수학 모델 작성 후 모델 학습
툴	• 프로그래밍 개발 툴 • 프로젝트 관리 툴	• 데이터 분석 툴 • 데이터 시각화 툴



## ❖ Limitations

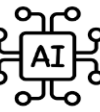
표 2-2 전통적 프로그래밍과 인공지능 프로그래밍의 차이

구분	전통적 프로그래밍	인공지능 프로그래밍
데이터	<ul style="list-style-type: none"> <li>기업 내부 자체 생산 데이터</li> </ul>	<ul style="list-style-type: none"> <li>웹, IoT 기기 등 수집 가능한 모든 데이터</li> </ul>
응용	<ul style="list-style-type: none"> <li>업무 편의성/비즈니스 이윤 창출을 위해 목적을 갖고 개발</li> </ul>	<ul style="list-style-type: none"> <li>전 산업분야 적용 가능</li> <li>인간이 풀 수 없는 난제 해결</li> </ul>
접근 방법론	<ul style="list-style-type: none"> <li>개발 방법론(폭포수, 애자일 등)</li> </ul>	<ul style="list-style-type: none"> <li>머신러닝, 딥러닝, 자연어 처리, 컴퓨터 비전 등</li> </ul>
접근 프로세스	<pre> graph TD     A[데이터] --&gt; B[정적 코드]     B --&gt; C[현실세계 결과]             </pre> <ul style="list-style-type: none"> <li>데이터가 입력되면 정해진 규칙에 의해 결괏값 출력</li> </ul>	<pre> graph TD     A[데이터] --&gt; B[알고리즘]     B --&gt; C[추정]     C --&gt; D[현실세계 결과]     D -- 피드백 --&gt; B             </pre> <ul style="list-style-type: none"> <li>데이터와 예상 출력값을 통해 모델(알고리즘)을 구현한 후 결괏값 출력</li> <li>모델(알고리즘)은 지속적 학습을 통해 개선됨</li> </ul>



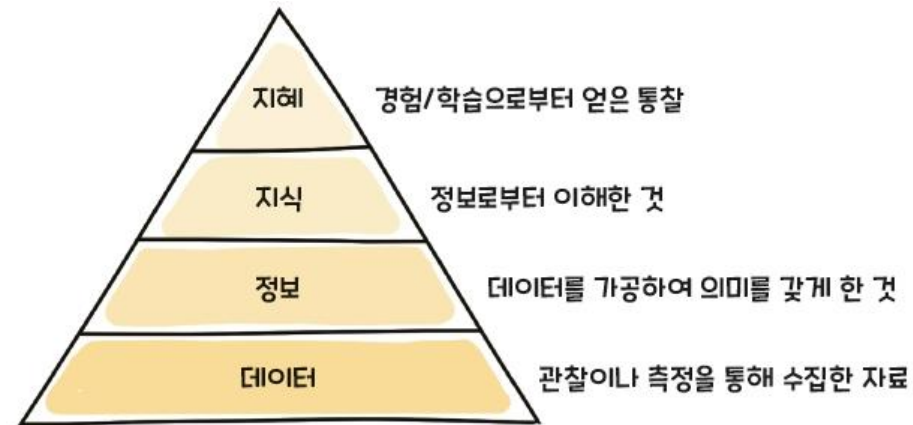


# Knowledge-based Model & Expert Systems



## ❖ Knowledge

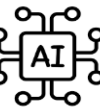
- A collection of general facts that are now known as theoretical or practical understanding of a subject or field



## ❖ Expert

- A person who has knowledge

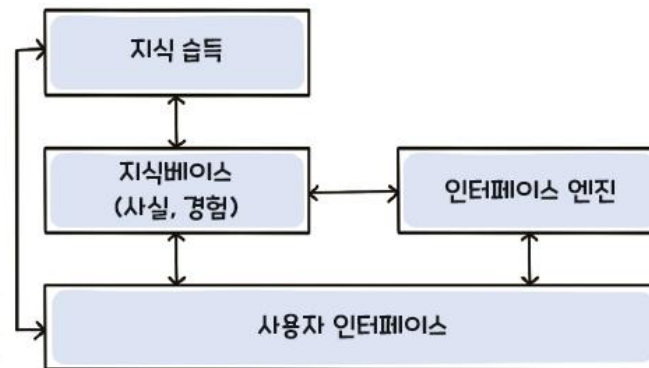
# Knowledge-based Model & Expert Systems



## ❖ Concepts

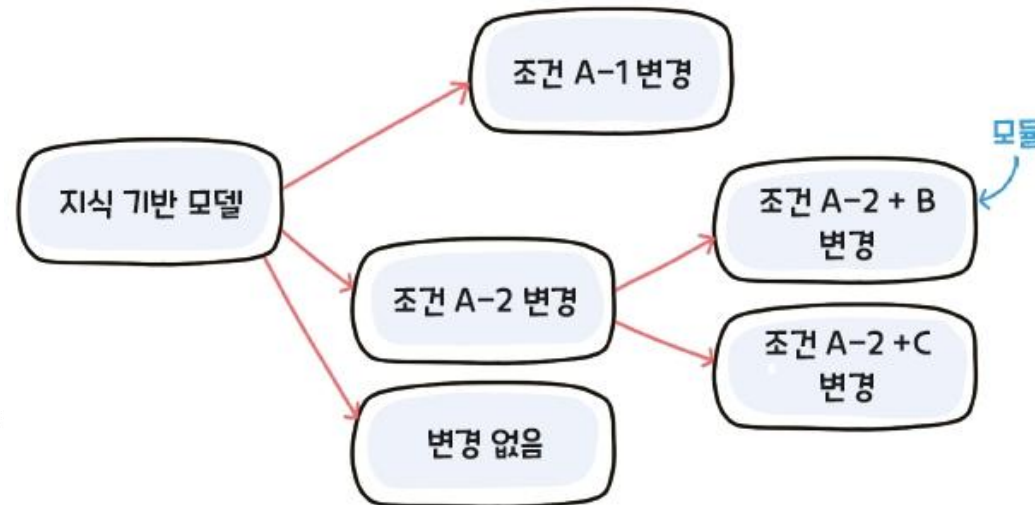
### ▪ Knowledge-based Model

- Utilizing a database containing expertise in a particular field and facts and rules needed to solve problems
- Isolated data areas that set conditions based on knowledge to reduce the inconvenience of modifying programs whenever changes are made
- It is divided into a data area and an interface engine that processes and outputs real data, where the data area is called a knowledge base

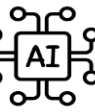


## ❖ Concepts

- Rule-based models consist of hundreds or thousands of rules in a single set, while rules in knowledge-based models have similar features divided by module
- Finding modules that contain these rules is easier to modify than rule-based models



# Knowledge-based Model & Expert Systems

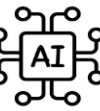


## ❖ Expert System

- A system that allows the general public to use expertise by organizing and expressing the professional knowledge that humans have about a specific field and storing it in a computer
- **Four Conditions**
  - ① Use the expertise of the problem area to infer
  - ② Knowledge gained from experts
  - ③ Targeting high-level practical issues professionally
  - ④ Competence equal to that of a professional



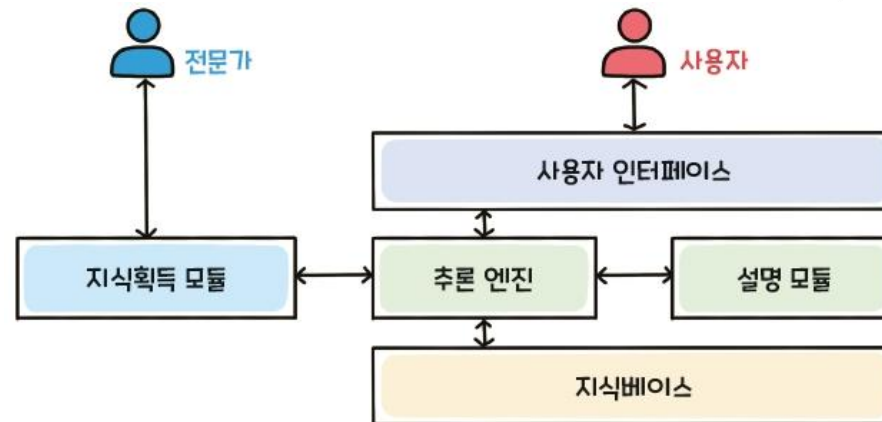
# Knowledge-based Model & Expert Systems



## ❖ Expert System

### ▪ Components and structures of expert systems

구성 요소		설명
사용자 인터페이스		사용자로부터 새로운 사실을 획득하여 결론을 제시하는 등의 사용자와의 대화 창구
추론 엔진		사실과 규칙을 사용하여 새로운 사실과 결론을 추론
설명 모듈		추론 엔진이 어떻게 결론에 도달하였는지 설명
지식획득 모듈		전문가와 인터뷰를 통해 지식을 획득
지식베이스	규칙	전문가로부터 획득된 'IF-THEN' 규칙들
	사실	전문가나 사용자로부터 획득되거나 규칙으로부터 추론된 사실들





# Recommender System

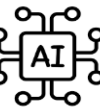


## ❖ Concepts

- A system that recommends personalized customized content based on the content of the content or after acquiring information about people's tendencies
  - (Example) YouTube video recommendations, online shopping malls or news recommendations, financial product recommendations, etc.

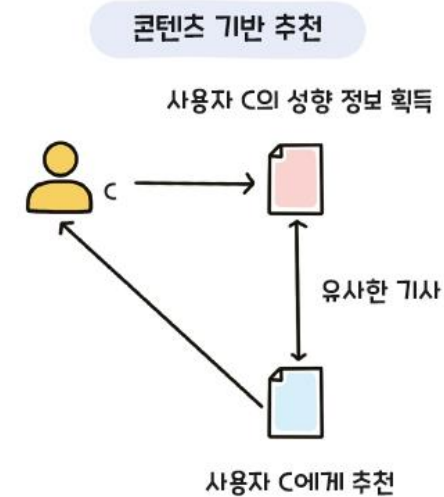
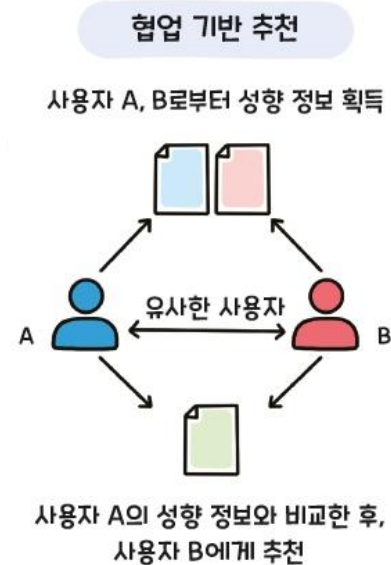


# Recommender System

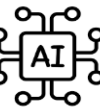


## ❖ Kinds of recommender system

- Collaboration-based recommendation
  - Types of recommendations based on user information with similar tendencies
- Content-based recommendation
  - Types of recommendations based on personal accumulated data



# Recommender System

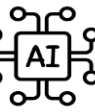


## ❖ Kinds of recommender system

- Collaboration-based recommendation
  - How to obtain similar user propensity information and recommend it



# Recommender System



## ❖ Kinds of recommender system

### ▪ Collaboration-based recommendation

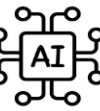
#### • **User-based Filtering**

- A method of recommending products purchased by a person based on data from users with similar tendencies to me
  - » (Example) User A buys apples, strawberries, and pizza, and User B buys apples and strawberries
- Algorithms recognize these two overlapping purchase lists as similar

Recommend Pizza to User B



# Recommender System

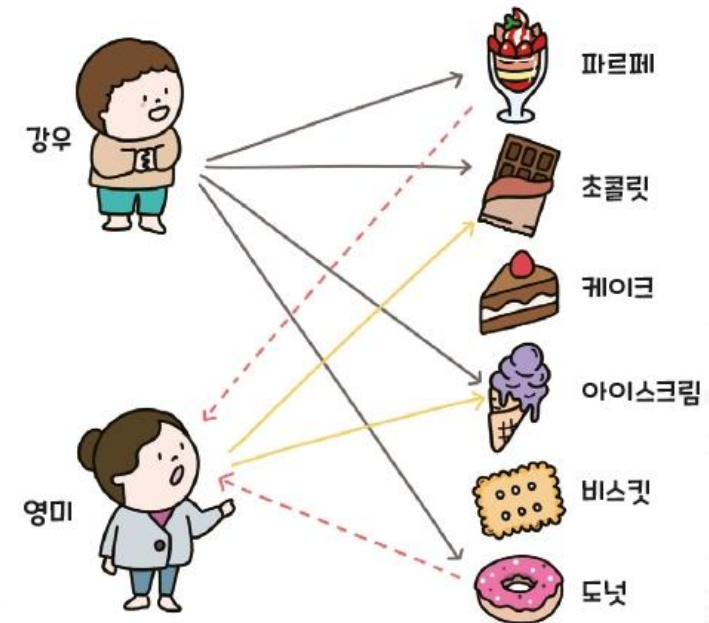


## ❖ Kinds of recommender system

### ▪ Collaboration-based recommendation

#### • User-based Filtering

- (예) 강우와 영미가 유사한 성향을 가진 사용자라고 가정
  - » 강우 : 파르페, 초콜릿, 아이스크림, 도넛 구매
  - » 영미 : 초콜릿과 아이스크림 구매
  - » 영미에게 추가로 추천할 상품은 파르페와 도넛





# Recommender System



## ❖ Kinds of recommender system

### ▪ Collaboration-based recommendation

#### • **Item-based Filtering**

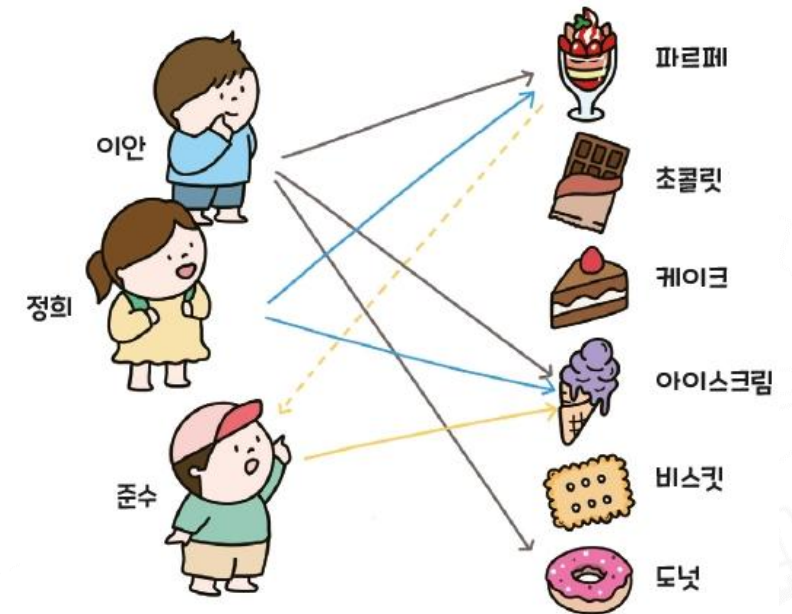
- A method of recommending another product similar to the product based on the item previously purchased
- Similarity between products is measured by analyzing the frequency of purchase together
  - » (Example) Gloves are recommended for coat buyers, highlighter recommendations for ballpoint pen buyers

## ❖ Kinds of recommender system

### ▪ Collaboration-based recommendation

#### • Item-based Filtering

- (예) 이안, 정희, 준수가 유사한 성향을 가진 사용자라고 가정
  - » 이안 : 파르페, 아이스크림, 도넛 구매
  - » 정희 : 파르페, 아이스크림 구매
  - » 파르페와 아이스크림의 유사도가 높다고 판단
  - » 준수가 아이스크림만 구매했을 때 파르페 추천

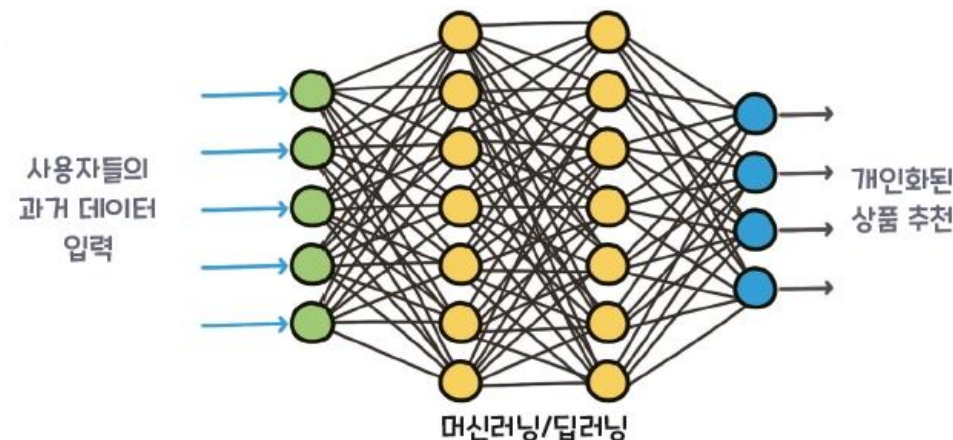


## ❖ Kinds of recommender system

### ▪ Collaboration-based recommendation

#### • **Model-based Filtering**

- Appeared to compensate for the shortcomings of the memory-based recommendation method
- How to predict ratings using machine learning
- Model-based recommendations use historical user rating data to create models, allowing users to predict their ratings for specific content without rating information



## ❖ Kinds of recommender system

- Collaboration-based recommendation

### 하나 더 알기 협업 기반 추천 시스템의 성능 평가

#### ▪ 협업 기반 추천 시스템을 평가하는 방법 :

사용자 평가, 온라인 평가, 오프라인 평가

- **사용자 평가** : 특정한 시점에 사용자를 초청해 추천 시스템의 성능을 점검
- **온라인 평가** : 추천 시스템이 실제 환경에서 활용되고 있는 상황에서 사용자가 보여주는 행위를 보고 성능을 평가



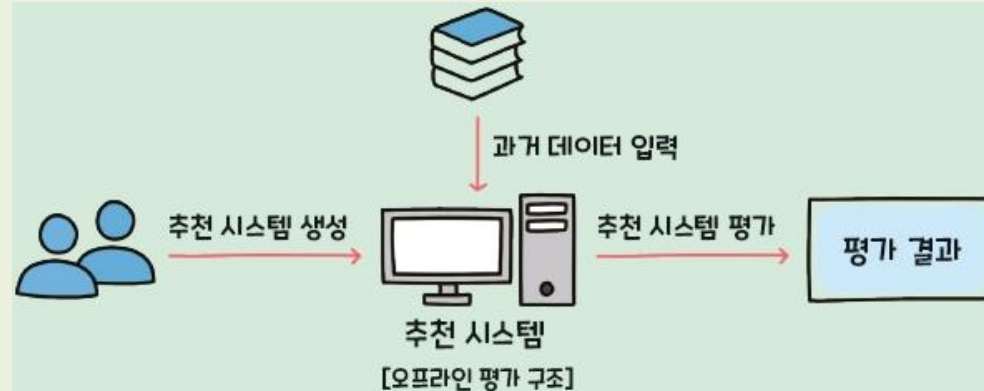


## ❖ Kinds of recommender system

- Collaboration-based recommendation

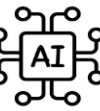
### 하나 더 알기 협업 기반 추천 시스템의 성능 평가

- 오프라인 평가 : 과거의 데이터를 이용해 평가하는 방식으로, 데이터 기반의 평가이기 때문에 사용자를 초청할 필요가 없으며 추천 시스템의 성능을 평가하기 위해 과거의 데이터를 이용





# Recommender System



## ❖ Kinds of recommender system

### ▪ Collaboration-based recommendation

#### • Disadvantages : Cold Start

- To use a collaboration-based recommendation system, no content can be recommended to new users unless some data is accumulated
- 콜드 스타트는 이러한 상황을 일컫는 말로 '새로 시작할 때의 곤란함' 의미



# Recommender System

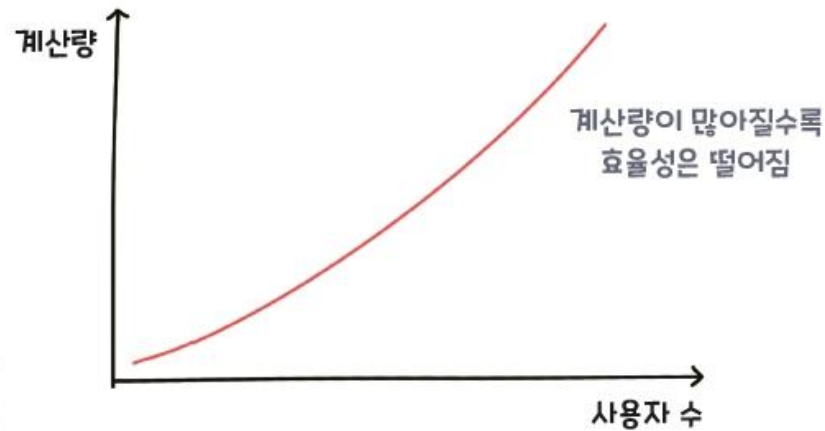


## ❖ Kinds of recommender system

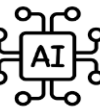
### ▪ Collaboration-based recommendation

#### • **Disadvantages : Reduced computational efficiency**

- Collaboration-based recommendations take longer to compute for recommendations with more users, resulting in less efficiency due to time consuming



# Recommender System

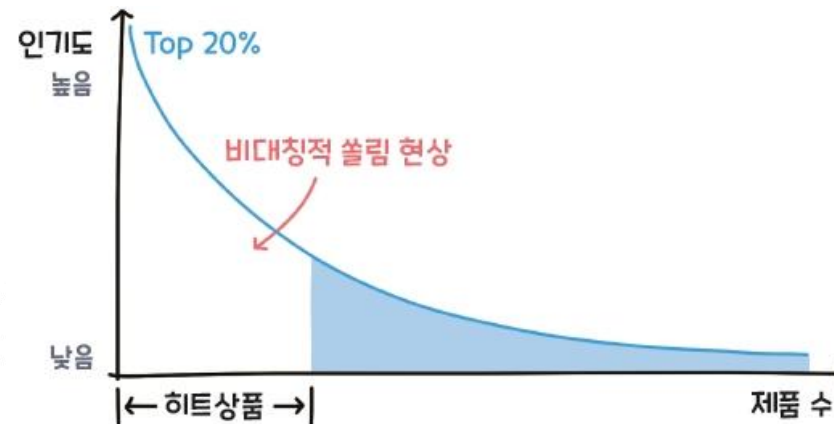


## ❖ Kinds of recommender system

### ▪ Collaboration-based recommendation

#### • Disadvantages : Long Tail problem

- Users tend to be interested in a small number of popular content
  - » Few popular content accounts for a significant percentage of all recommended content
  - » Low-interested items are not recommended due to lack of information



## ❖ Kinds of recommender system

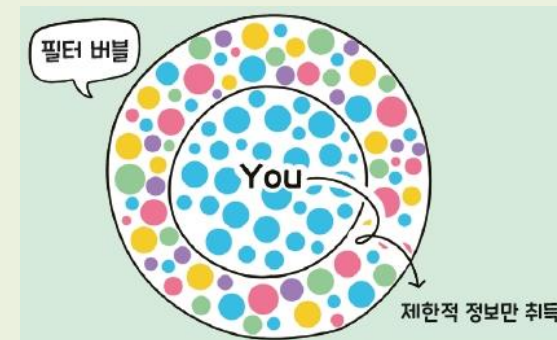
### ▪ Contents-based recommendation

- It emerged to overcome the limitations of collaboration-based recommendation, and its methods based on analysis of various contents
- How to
  - To recommend music, analyze the music itself, and to recommend a menu, analyze the menu itself → Content-based recommendations do not require large amounts of user behavior information, resulting in cold start issues
- Disadvantages
  - Limitations of analysis make it difficult to recommend items in various formats

- ❖ Kinds of recommender system
  - Contents-based recommendation

## 하나 더 알기 필터 버블

- 지금까지 살펴본 추천 시스템은 사람들의 호기심을 자극하고 필요를 충족시켜 주지만, 필터 버블(Filter Bubble) 현상에 대한 문제점을 가지고 있음
- **필터 버블 현상** : 인터넷 정보 제공자가 맞춤형 정보를 제공하기 때문에 이용자는 걸러진 정보만을 접하게 되는 현상





# Recommender System

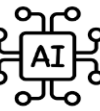


## ❖ Examples of Application

### ▪ Amazon

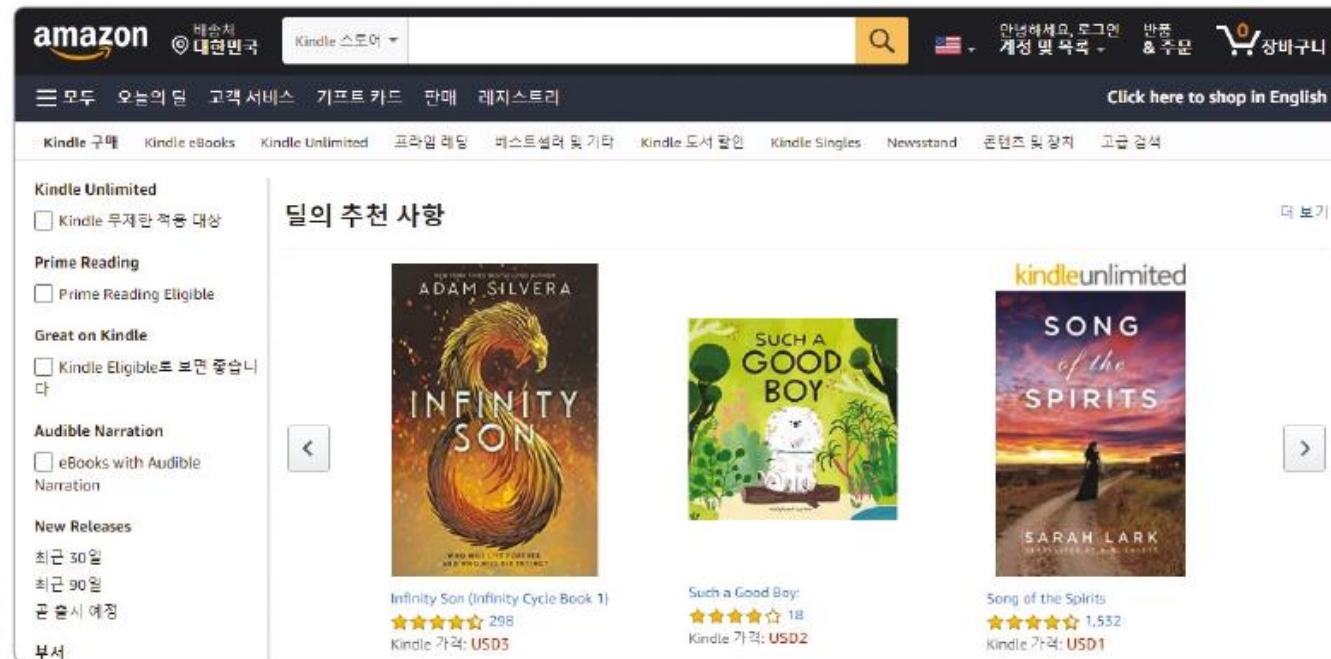
- Companies that use recommendation systems best in e-commerce
  - Recommended systems are highly utilized, with 35% of sales coming from recommendations
  - Amazon uses ratings by dividing them into explicit and implicit ratings
    - » Explicit rating : Your own rating
    - » Implicit rating : Purchasing and feedback ratings

# Recommender System

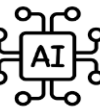


## ❖ Examples of Application

### ▪ Amazon



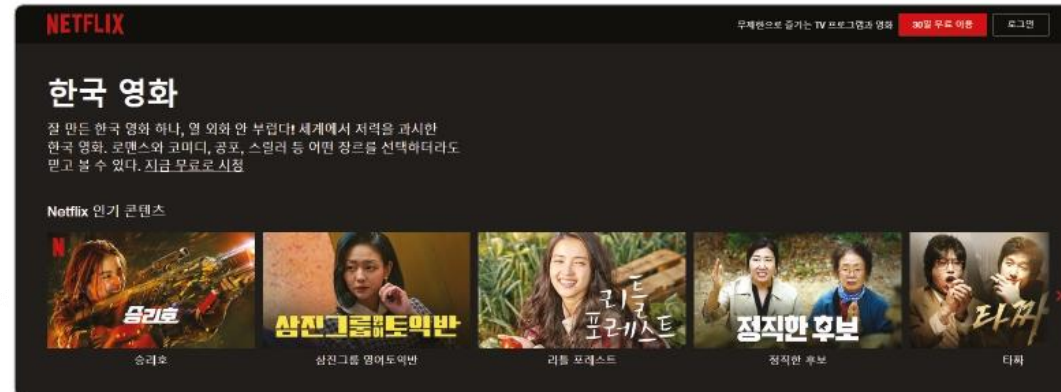
# Recommender System



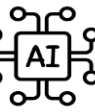
## ❖ Examples of Application

### ▪ Netflix

- Global Multimedia Entertainment Over The Top (OTT) Company
- Start with a simple system that identifies the user's propensity and recommends movies that they like
- Recently, the moment a user logs in, the entire page is organized according to their preference



# Recommender System



## ❖ Examples of Application

### ▪ Facebook by Meta

- A social network service website
- IT companies that take advantage of recommended systems
- Use the recommendation system for friend recommendations, not product or news recommendations





## ❖ Examples of Application

### 하나 더 알기 추천 시스템의 한계

표 2-4 추천 시스템의 한계

구분	한계점	세부 설명
협업 기반 추천	콜드 스타트 문제	<ul style="list-style-type: none"><li>• 새로운 항목 추천의 한계</li><li>• 초기 정보 부족 문제</li></ul>
	계산 효율 저하	<ul style="list-style-type: none"><li>• 사용자가 다수일 경우 계산 시간 비효율</li></ul>
	롱테일 문제	<ul style="list-style-type: none"><li>• 비대칭적 쏠림 현상 발생</li><li>• 관심 저조 항목의 정보 부족</li></ul>
콘텐츠 기반 추천	한정된 데이터	<ul style="list-style-type: none"><li>• 한정된 데이터에 대한 상품 추천 정확도 저하 문제</li></ul>
추천 시스템 공통	필터 버블	<ul style="list-style-type: none"><li>• 전체 정보 접근 기회 박탈</li><li>• 정보의 편향적 제공, 양극화</li></ul>

