Knowledge Based System

Informatics Engineering Study Program
School of Electrical Engineering and Informatics

Institute of Technology Bandung

Overview

- Review
- Knowledge-based System
- KBS Examples
- KBS Final Project
- Knowledge Engineering

Review

- Wumpus world:
  - Select action by infering general knowledge + current percepts
  - Knowledge: rules of environment
- Knowledge base: set of sentences
  - Each sentence is expressed in knowledge representation language (e.g. : logics)
- Knowledge base is the central component of knowledge based agent / system
  - Percepts → TELL (KB, percepts) {assert percepts}
  - Action ← ASK (KB) {reasoning}
  - Action → TELL (KB, action) {assert action}

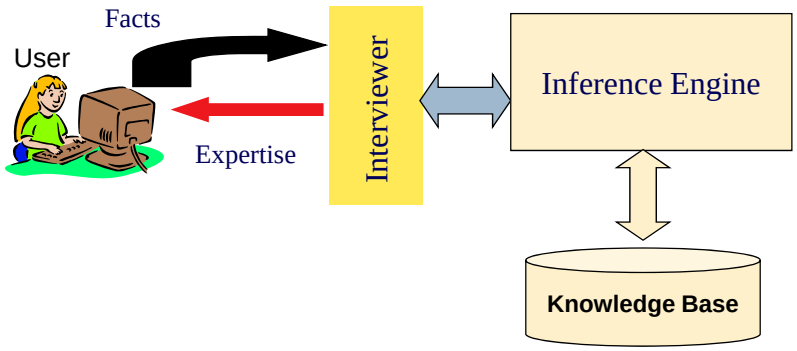
Knowledge-based System (KBS/SBP)

- Sistem yang melakukan task dengan mengaplikasikan pengetahuan dalam representasi simbolik
- SBP vs sistem pakar
- Sistem pakar:
  - sistem komputer yang meniru kemampuan pengambilan keputusan pakar pada domain tertentu
  - Sumber pengetahuan sistem pakar: pakar manusia
  - Domain sistem pakar: persoalan dunia nyata

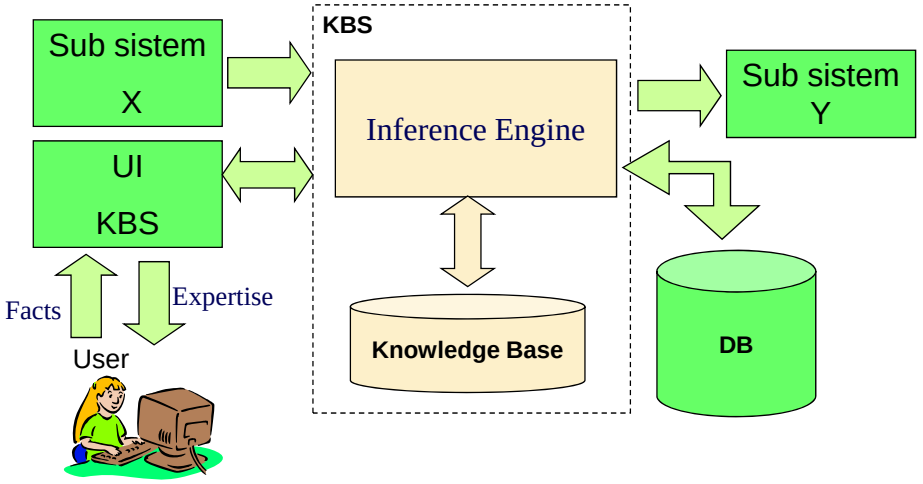
KBS vs Program Konvensional

Program Konvensional	KBS
algoritma + data Contoh: Penghitungan IPK	**metode pemecahan masalah + domain knowledge + data** Contoh: diagnosis penyakit, diagnosis kerusakan mobil
Programmer menentukan apa yang harus dilakukan dan urutan yang harus dilakukan	Pakar menentukan aksi, urutan ditentukan oleh interpreter

Interactive KBS

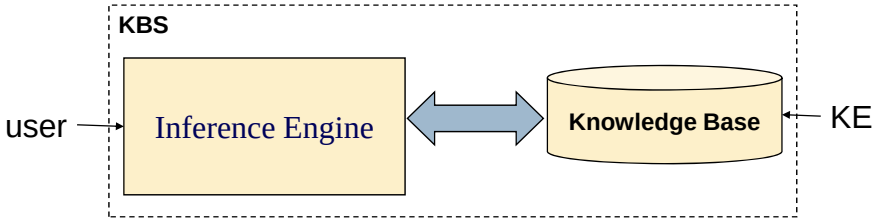


Embedded KBS

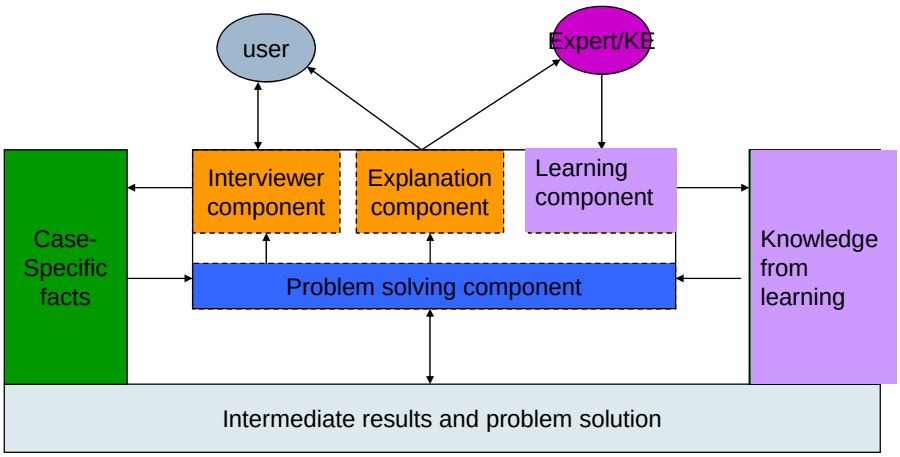


Arsitektur Dasar KBS

- Arsitektur: modul-modul program + hubungan antar modul
- Arsitektur Dasar:



Arsitektur Umum KBS



Domain KBS

- Ill-structured/ill-defined/messy problem
  - Problem: well formed vs ill-structured
  - Well formed → solusi: program konvensional
    Contoh: problem matematika/sains
  - Ill-structured → solusi: SBP
    Contoh: rencana liburan
- Domain-well bounded (terbatas dan spesifik)

Ill-structured problem: Contoh Ekstrim

Travel agent's questions	Responses
Can I help you ?	I'm thinking about going somewhere
Where do you want to go?	I'm not sure where to go
Any particular destination?	I just like to travel; destination's not important
How much can you afford ?	I don't have enough money to go
Can you get some money?	I don't know how to get the money
When do you want to go?	I must go soon.

Ill-structured problem: Karakteristik

Responses	Characteristic
I'm thinking about going somewhere	Goal not explicit
I'm not sure where to go	Solution space unbounded
I just like to travel; destination's not important	Problem states not discrete
I don't have enough money to go	Intermediate states difficult to achieve
I don't know how to get the money	State operator unknown
I must go soon.	Time constraint

Problem Characteristics

	Well-formed	Ill-structured
Goal	Explicit	Not explicit
Solution space	bounded	unbounded
Solution	Exact/certain	Uncertain
Problem states	Discrete	Not discrete
State operator	Explicit, deterministic	Unknown

Problem Category

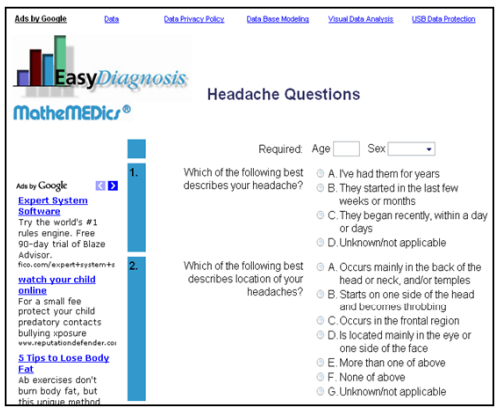
- Kelas masalah → metode pemecahan masalah → representasi dan inferensi
- Kategori metode pemecahan masalah:
  - Klasifikasi → classifier
    - Solusi dipilih dari set kelas masalah yang sudah didefinisikan
    - Pemetaan set observasi ke set solusi
  - Konstruksi
    - Solusi disusun dari elemen solusi

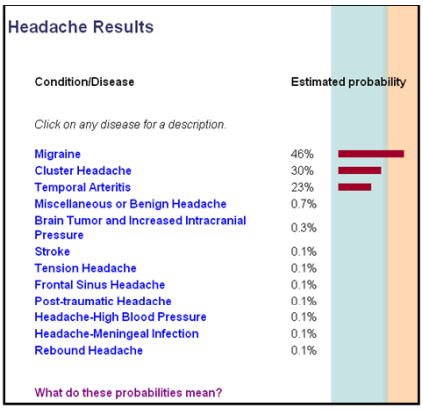
KBS Examples

Contoh Aplikasi

- **Kesehatan:** BAL2000, LISA, ISABEL, CTSHIV, DxPlain, MedWeaver, The Analyst, FuzzyFluid, Casnet, PUFF, Centaur, EasyDiagnosis, CLEM, VIE-PNN
- **Lingkungan:** ESS-WWTP, CREWS, CORMIX, HITERM, GCES, Oncologic
- **Jaringan:** NIDES, AudES, eXpert-BSM, Expert Advisor, Online ES (listrik)
- **ITS:** ActiveMath, TEST, ELM-ART, SID2002 Math ES, Chest
- **Komputer/HW:** DART, PEARL, PDAmum
- **Manajemen:** DXMAS, CESA, FINEVA
- **Permainan:** FRES, Rogomatic
- **Geologi:** PROSPECTOR II, DAS
- **Pertanian:** EXSEL, HABES, DSS4Ag
- **Biologi:** RIH, PSORTb
- **NASA:** Weather ES, SHINE
- **Lainnya:** TTA (teroris), ACAS-PRO (kartu kredit), USLIMITS 2, CATD-RT, HWYCON, SHYSTER (hukum)

EasyDiagnosis Medical Expert System



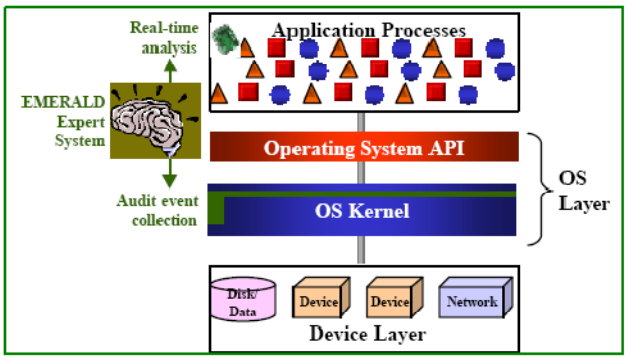


Green Chemistry Expert System (GCES)

- Developer: EPA (*Evironmental Protection Agency*) Amerika Serikat
  - MS Access, DBMS
- untuk menilai substansi yang berbahaya dalam reaksi kimia sehingga polusi dapat dicegah
- http://www.epa.gov/greenchemistry/pubs/gces.html

eXpert-BSM

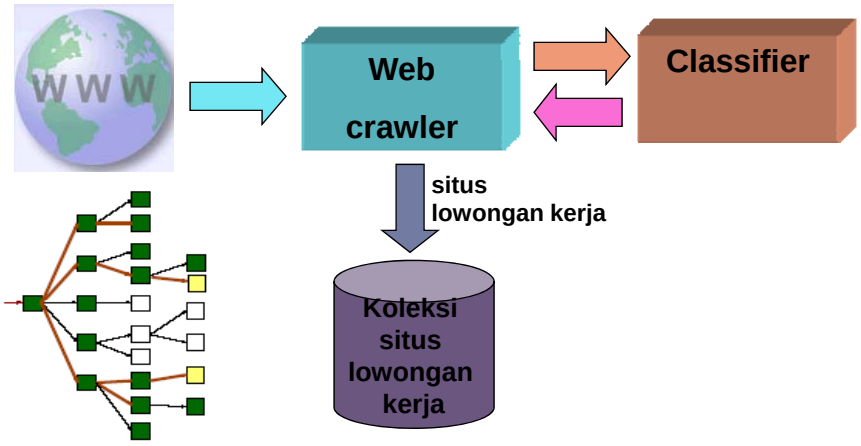
- Intrusion Detection Solution for Sun Solaris
- Output: hasil analisis dan alert adanya intrusi pada audit trail dari Sun Solaris
- Sub sistem Emerald ES



LynxTrak

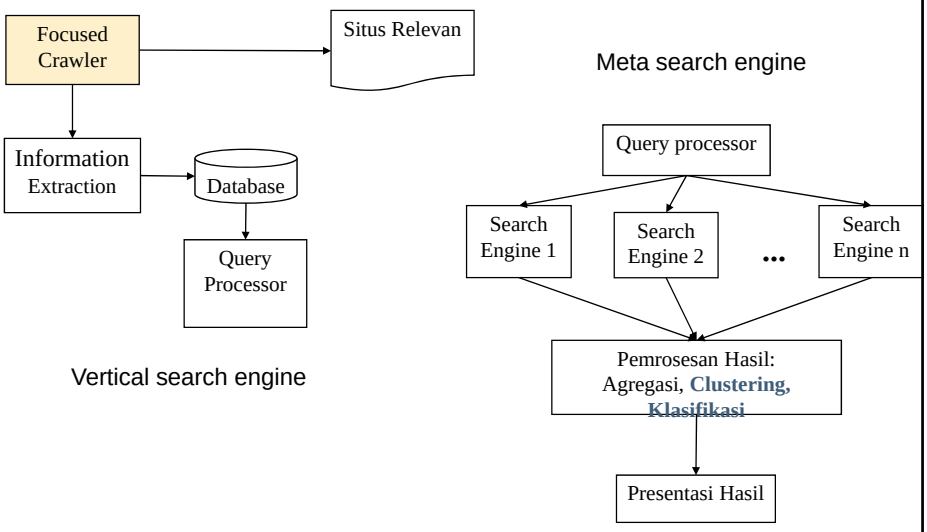
- Expert System for Lynx Harvest Management
- Latar belakang: kurangnya data jumlah populasi Linx, menjaga kesinambungan populasi Linx dan mangsanya.
- Sebagai Decision Support System(DSS) untuk *Tracking Harvest Strategy*(THS) di Alaska sejak 1999
- Membantu manajer perburuan linx dalam pengambilan keputusan manajemen dalam peraturan dan regulasi perburuan Linx di Alaska khusus area THS.
- http://www.exsys.com/apps/LynxManagement

Focused Crawler Situs Lowongan Kerja

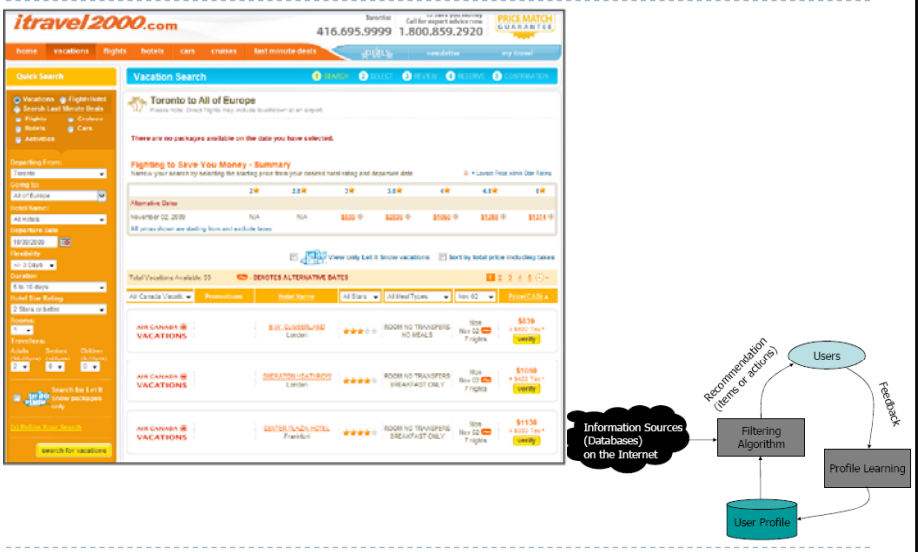


Vertical Search Engine

Search Engine: Architecture

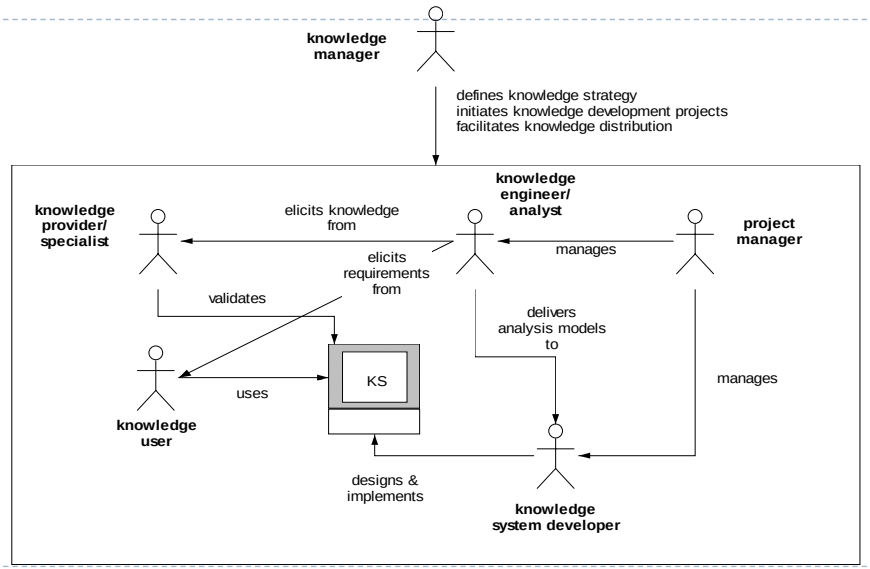


Recommender System



Knowledge Engineering

KBS Developer



Rekayasa Pengetahuan

- Akuisisi pengetahuan dalam suatu domain dari satu atau lebih sumber non-elektronik dan konversinya ke dalam suatu bentuk yang dapat digunakan oleh komputer untuk memecahkan masalahnya yang umumnya hanya dapat dipecahkan oleh pakar domain tersebut.

Akuisisi Pengetahuan (KA)

- KA=knowledge ***elicitation*** + ***representation***
- knowledge elicitation
  - Proses ekstraksi pengetahuan domain dan strategik dari pakar
  - Interview antara KE dan pakar
  - a cyclical process
- Knowledge representation
  - Proses merepresentasikan pengetahuan hasil ekstraksi ke suatu bentuk formal

Task dalam Knowledge Elicitation

- Pada setiap iterasi:
  - ***collect*** knowledge (e.g. from expert)
  - determine ***key concepts*** in problem domain
  - establish ***relationships*** between various concepts in problem domain
  - decide h***ow knowledge is represented*** in KBS
  - determine what knowledge needs to be collected in the next cycle

Tahapan Akuisisi Pengetahuan

- Identification
  - Identifikasi karakteristik masalah
- Conceptualization
  - Menemukan konsep2 untuk merepresentasikan pengetahuan
- Formalization
  - Design struktur untuk mengorganisasikan pengetahuan
- Implementation
  - Formulasi pengetahuan ke bentuk runnable program
- Testing
  - Validasi pengetahuan

Teknik Akuisisi Pengetahuan

- Manual:
  1. Interview
  2. Observasi
  3. Intuitive: tukar peran Knowledge Engineer dan pakar
- Otomatis:
  - Menggunakan tools untuk memfasilitasi akuisisi
  - Tools untuk pakar
  - Tools machine learning

Keywords

- Knowledge based system, expert system
- KBS: interactive, embedded
- Inference engine, knowledge base
- Component: Interviewer, explanation, knowledge acquisition, learning
- Classification, construction
  - Automatic text summarization: classification vs construction
- Knowledge engineering, knowledge acquisition
- Knowledge elicitation, knowledge representation