

Knowledge Based System

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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}

▶ 3

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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

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KBS vs Program Konvensional

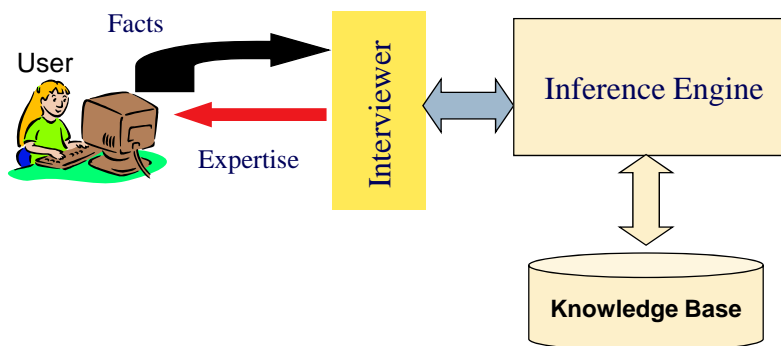
Program Konvensional	KBS
algoritma + data Contoh: Penghitungan IPK	metode pemecahan masalah + domain knowledge + data Contoh: diagnosis penyakit, diagnosis kerusakan mobil
Programmer menentukan apa yang harus dilakukan dan urutan yang harus dilakukan	Pakar menentukan aksi, urutan ditentukan oleh interpreter

▶ 5

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Interactive KBS

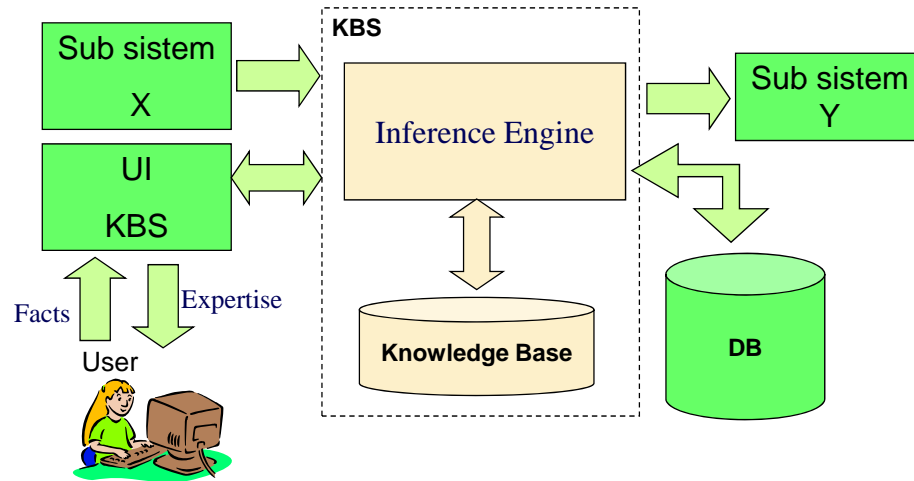


▶ 6

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Embedded KBS



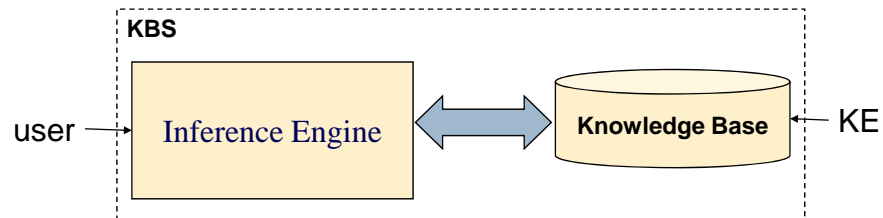
▶ 7

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Arsitektur Dasar KBS

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

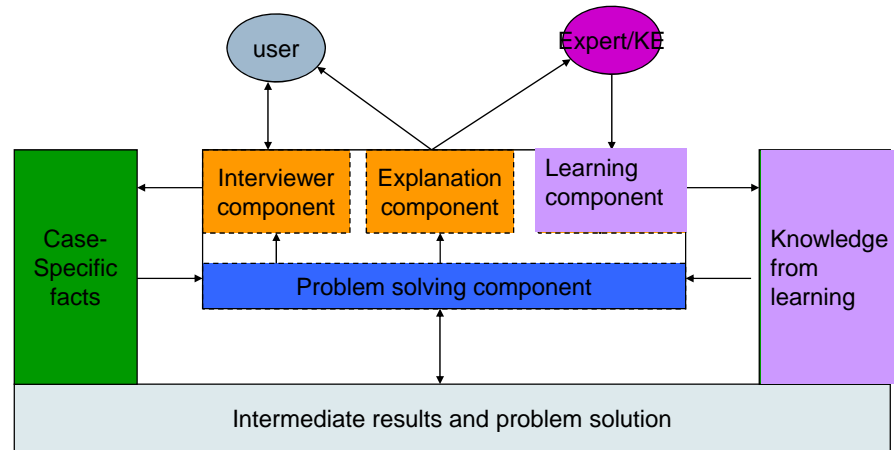


▶ 8

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Arsitektur Umum KBS



▶ 9

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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)**

▶ 10

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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

▶ 13

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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

▶ 14

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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)

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Headache Questions

Required Age Sex

1. Which of the following best describes your headache?

☐ A. I've had them for years

☐ B. They started in the last few weeks or months

☐ C. They began recently, within a day or days

☐ D. Unknown/not applicable

2. Which of the following best describes location of your headaches?

☐ A. Occurs mainly in the back of the head or neck, and/or temples

☐ B. Starts on one side of the head and becomes throbbing

☐ C. Occurs in the frontal region

☐ D. Is located mainly in the eye or one side of the face

☐ E. More than one of above

☐ F. None of above

☐ G. Unknown/not applicable

Headache Results

Condition/Disease	Estimated probability
Migraine	46%
Cluster Headache	30%
Temporal Arteritis	23%
Miscellaneous or Benign Headache	0.7%
Brain Tumor and Increased Intracranial Pressure	0.3%
Stroke	0.1%
Tension Headache	0.1%
Frontal Sinus Headache	0.1%
Post-traumatic Headache	0.1%
Headache-High Blood Pressure	0.1%
Headache-Meningeal Infection	0.1%
Rebound Headache	0.1%

Click on any disease for a description.

What do these probabilities mean?

▶ 17

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Green Chemistry Expert System (GCES)

- ▶ Developer: EPA (Environmental 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>

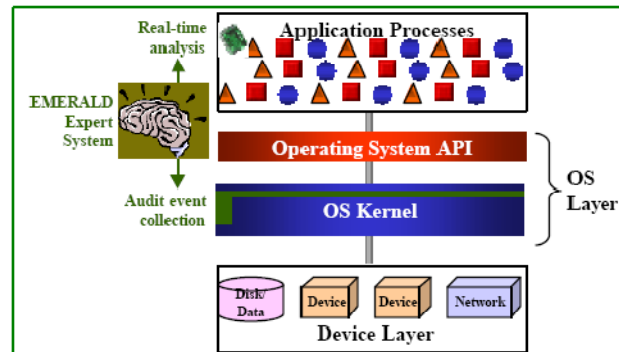
▶ 18

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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



▶ 19

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LynxTrak

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

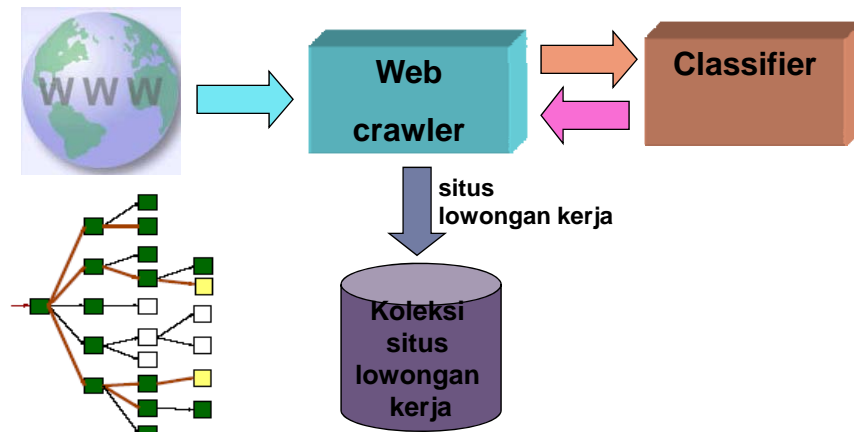


▶ 20

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Focused Crawler Situs Lowongan Kerja



21

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Vertical Search Engine

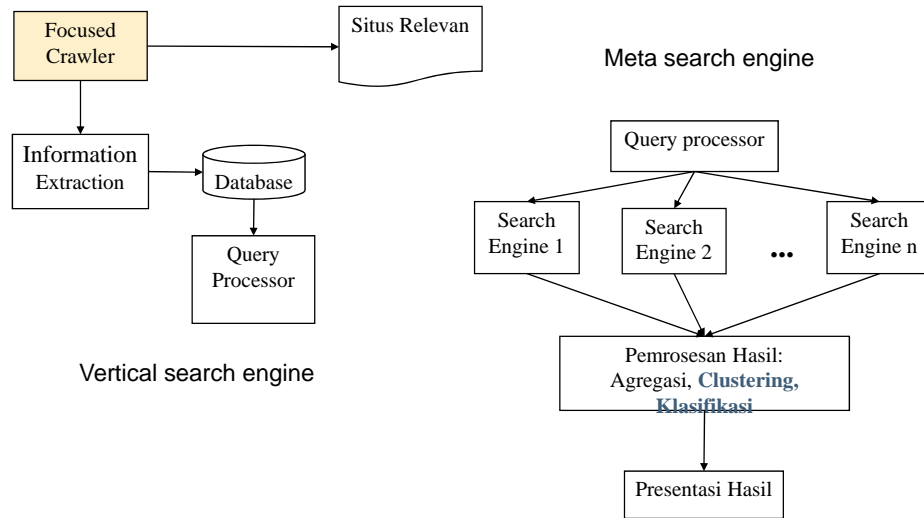


22

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Search Engine: Architecture

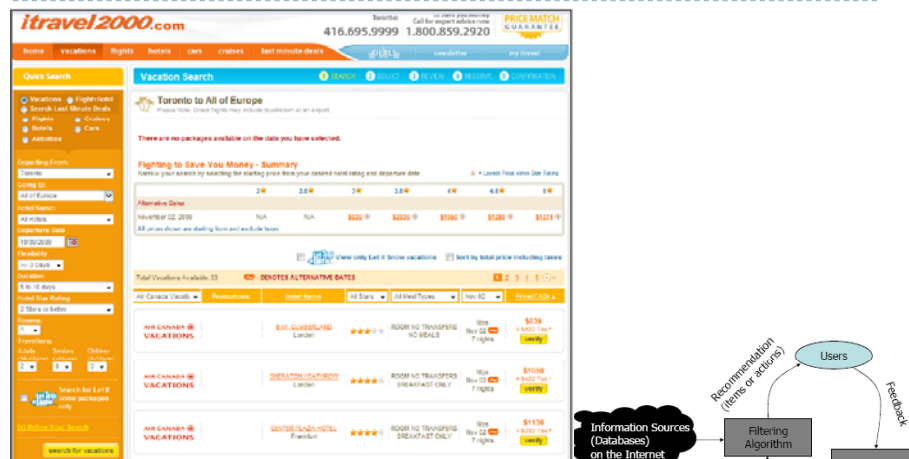


23

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Recommender System



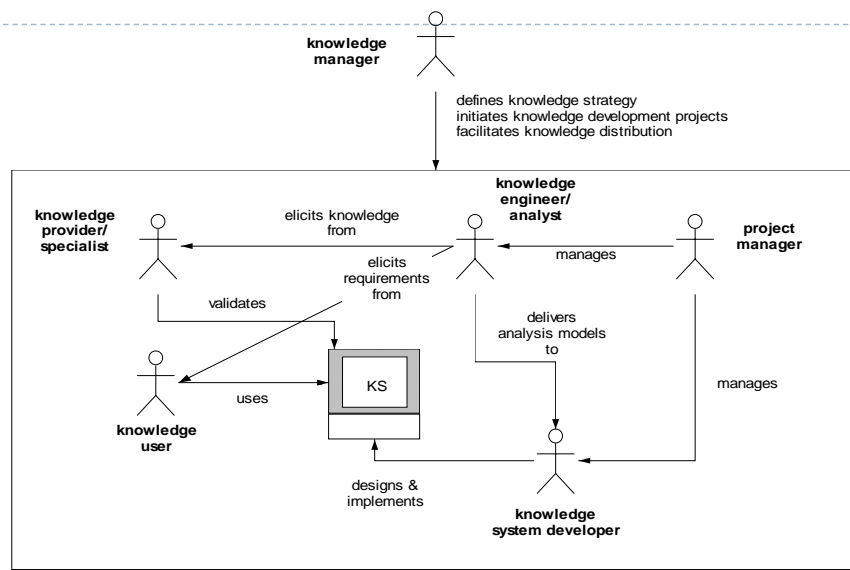
24

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Knowledge Engineering

KBS Developer



26

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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.

▶ 27

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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

▶ 28

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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 **how knowledge is represented** in KBS
 - ▶ determine what knowledge needs to be collected in the next cycle

▶ 29

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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

▶ 30

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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

▶ 31

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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

▶ 32

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