COAL WORKER'S PNEUMOCONIOSIS X-ray DIAGNOSIS EXPERT SYSTEM:

PXDES

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This system was based both on production system
of artificial intelligence and on approximate
reasoning. The Pneumoconiosis X-ray Diagnosis Expert
System (which shorts for PXDES) was implemented with
micro-PROLOG for the IBM PC-XT machine. The system
consists of the knowledge-base, the inference engine,
the explanation interface and the knowledge
acquisition module. PXDES can diagnose various
pneumoconiosis. Plenty of Clinical diagnosis shows
that PXDES can model the decision processes of the
medical experts. The average rate of coincidence
is as many as 95%.


Keywords: PXDES, approximate reasoning, degree of
          belief, pneumoconiosis.

## 1. PXDES Overview

PXDES (which stands for Pneumoconiosis X-ray Diagnosis
Expert System) is an evolving computer program that has been
developed with the micro-PROLOG V3.1 to assist medical men
who are not experts in the field of the pneumociosis. The
system consists of four modules: the knowledge-base module,
the inference engine (the approximate reasoning) module,
the explanation interface module and the knowledge acquisi-
tion module. Figure 1 is an overview of the four modules.

Figure 1: PXDES Overview
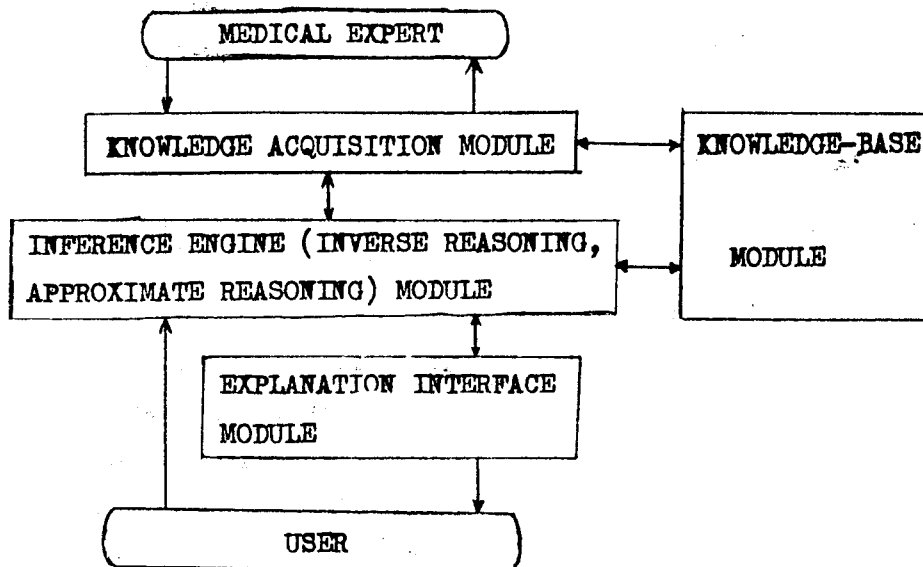


## 2. Explanation Interface

The Explanation interface of PXDES that answers questions from the user and attempts to explain its diagnosis result. It offers several options to the user:

1) how (result): How do the system obtain the diagnosis result?

2) why (question): Why do the system ask the question?

3) Whynot (result): Why don't the system obtain the result?

## 3. Model of Approximate Reasoning in PXDES

The section introduces our quantification scheme for approximate medical reasoning. In the question of pneumoconiosis X-ray diagnosis X-ray representions of any patient may be expressed by n number of the diagnosis factor. A diagnosis factor is a set of the different degree symptoms. Such set will be denoted as

$$Xi = \{ x_{i1}, x_{i2}, \ldots, x_{iw} \}$$

Hence any patient's X-ray representions is indicated as a vector

$$x = (x_{1p}, x_{2q}, ..., x_{nr})$$

in n-dimensional vector space $X = X_1 \times X_2 \times ... \times X_n$ . Every different grade pneumoconiosis is a fuzzy subset $P_i$ of $X$, i = 1, 2, ..., m.

The notation will be as follows:

$B_i (X_i, x) = \lambda \in [0, 1]$ (which shorts for $B_i$ ) means "The Degree of Belief in the diagnosis factor $X_i$ , based on the symptom x, is $\lambda$ ."

$F(X_i)$ denotes the set of all Fuzzy subsets $B_i$ in $X_i$ .

$F(X)$ denotes the set of all differe grade pneumoconiosis $P_i$ in $X$.

An approximate medical reasoning system consists of a group of n-ple imlication proposition:

"If $B_j^{(1)}$ and $B_j^{(2)}$ and ... and $B_j^{(n)}$ then $P_j$ "

where $B_j^{(i)} \in F(X_i)$ and $P_j \in F(X)$, j = 1, 2, ..., m, i = 1, 2, ..., n.

1) When i = 1 and j = 1, if $B^*$ is known, $B^* \in F(X)$, then reasoning result $P^*$ is

$$P^* = B^* \circ (B \times P) = aP \in F(X)$$

where $a = \underset{u \in X_1}{Sup} [ B^*(u) \wedge B(u) ]$ and

$$(aP)(u) \triangleq a \wedge P(u).$$

2) When i = 1, and j = 1, 2, ..., m, if $B^*$ is known, $B^* \in F(X_1)$ then approximate reasoning result $P^*$ is

$$P^* = B^* \circ \overset{m}{\underset{j=1}{\cup}} (B_j \times P_j)$$

$$= \overset{m}{\underset{j=1}{\cup}} a_j P_j \in F(X)$$

where $a_j = \underset{u \in X_1}{Sup} [ B^*(u) \wedge B_j(u) ]$ and

$$(a_j P_j)(u) \triangleq a_j \wedge P_j(u),$$

3) When i = 1, 2, ..., n, j = 1, 2, ..., m, if $B^{1*}$, $B^{2*}$, ..., $B^{n*}$ are known, $B^{i*} \in F(X_i)$, then reasoning result $P^*$ is

$$P^* = \bigcup_{j=1}^{m} (\bigwedge_{i=1}^{n} a_j^{(i)}) P_j$$

where $a_j^{(i)} = \sup_{u \in X_i} [ B^{i*}(u) \wedge B_j^{(i)}(u) ].$

## 4. Knowledge Acquisition Module

This module permits experts to teach PXDES new decision rules or to alter pre-existing rules that are judged to be inadequate or incorrect.

## 5. Knowledge-Base

PXDES must accordingly follow each of these steps when giving advice to a physician. To reiterate, diagnosis rules have been sought that allow the program to do the following:

1) decide whether the patient has certain grade pneumoconiosis;

2) decide what drugs are apt to be effective against this grade pneumoconiosis;

3) choose the drug that is most appropriate given the patient's clinical condition;

Approximately 500 such decision rules have been identified. This corpus of rules is termed the "Knowledge-Base" of the PXDES.

## 6. Conclusion

The PXDES is offered as a solution to the problems, i.e, it can model the dicision procosses of the medical experts. Plenty of clinical diagnosis shows that the average rate of coincidence of diagnosis is as many as 95%.

References

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