Pengenalan Obyek

Kuliah ke-11
Program Studi S1 Reguler
Departemen Teknik Elektro, FTUI

What's up now?

- Lecture:
  - Recognition Methodology
  - Pattern recognition (pengenalan pola)
  - Elemen Kerja Pengembangan Sistem PR
  - OCR (Optical Character Reader)
  - Model sistem pengenalan pola
    - Geometric/Statistical Approach
    - Structural/Syntactic Approach
    - Computational Intelligence Approach:
      - Fuzzy Logic Approach
      - Neural Network Approach
- Video: Face recognition
- MATLAB®: Mengenali obyek melingkar

Recognition Methodology (Weng & Stockman, CPS803, MSU, 1990)

- Conditioning (Pengondisian)
- Labeling (Pelabelan)
- Grouping (Pengelompokan)
- Extracting (Ekstraksi)
- Matching (Pencocokan)

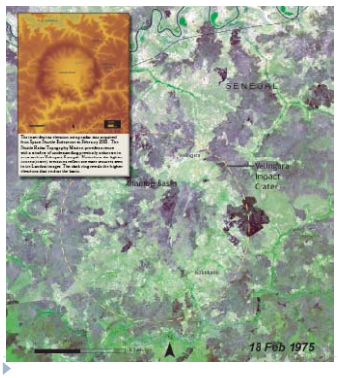
Conditioning

- Memperbaiki kondisi citra untuk proses interpretasi:
  - Geometric correction
    - Different sensor system
    - Image registration
  - Radiometric correction
    - Uninteresting variation disebut juga noise, bisa bersifat additive (+) atau multiplicative (*)
    - Image filtering

Labeling

- Memberikan label pada wilayah-wilayah yang ada pada citra
  - Memberikan label pada wilayah yang homogen berdasarkan ciri tonal dan warna (disebut *primary features*)
  - Memberikan label pada wilayah bertekstur berdasarkan ciri tekstur (disebut *secondary features*)
    - Contoh: citra sensor optik bersifat homogeneous sedangkan citra sensor radar bersifat *textured*

Contoh: impak meteor



- Located in southern Senegal is a feature that appears to be a meteor-impact-generated structure, possibly millions of years old
- It is a circular, multiple ring structure with an overall diameter of 48 km (30 miles) and centered about 12 km (7 miles) south-southwest of the town of Velingara

Grouping & Extracting

- *Grouping*: merupakan proses pembentukan wilayah-wilayah pada citra
  - *Image segmentation/clustering*
  - *Training samples and area identification*
- *Extracting*: merupakan proses ekstraksi ukuran ciri pada piksel citra
  - Ciri primer atau sekunder
  - *Homogeneous area: tonal mean & variance*
  - *Textured area: Gray Level Co-occurrence Matrix* (GLCM)

Matching

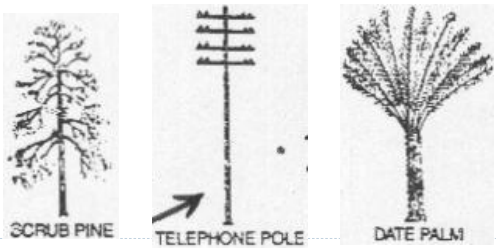
- Melakukan identifikasi obyek pada citra
  - Pengenalan obyek dilakukan dengan membandingkan ciri obyek yang diamati dengan pengetahuan yang telah dimiliki tentang obyek-obyek yang ada
  - Sistem *matching* dibangun dengan melalui proses pelatihan dan proses pengenalan
  - Pada proses pelatihan dibangun suatu aturan keputusan (*decision rules*), sedangkan pada proses pengenalan digunakan aturan keputusan tersebut

Pattern Recognition – Pengenalan Pola

- Pengertian pola (pattern):
  - Pola adalah suatu entitas yang dapat didefinisikan (mungkin secara samar) dan dapat diberi suatu identifikasi atau nama
  - Contoh: gelombang suara, sidik jari, raut wajah, penutup lahan dll.
- Pengertian object descriptors/features/ciri:
  - Suatu ukuran yang bersifat kuantitatif yang merupakan deskriptor suatu obyek tertentu pada citra
  - Merupakan kumpulan deskriptor (features/ciri) suatu obyek pada citra
- Pengertian kelas pola (kategori obyek):
  - Sekumpulan pola yang mempunyai sifat/properties/ciri yang sama
  - Contoh: pola-pola pada kelas hutan, kelas air, dst.

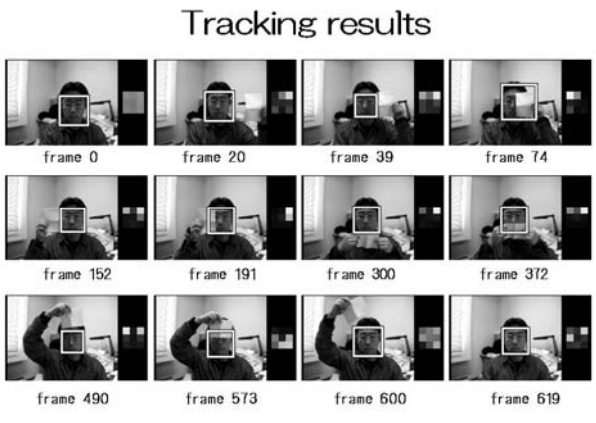
Pattern Recognition System (1)
(Sumber: Scientific American Journal, 1997)

- Bagaimana membedakan tiang telepon dari pohon? Mereka mempunyai ciri sama: ada batang dan ranting!



Pattern Recognition vs Artificial Intelligence

- Pattern Recognition:
  - Statistical Decision Theory – Computational Intelligence Approach
  - Speech recognition
  - 2-D object recognition
- Artificial Intelligence:
  - Knowledge-based system – Computational Intelligence
  - Speech understanding
  - 3-D object recognition



Beberapa Pattern Recognition Systems

- Contoh beberapa pattern recognition (PR) system:
  - Computer-based procedures for automatically classifying objects and making decisions.
  - Commercial Pattern Recognition System: blood cells, finger prints, voice and word recognition.
  - Industrial machine vision system: object identification for sorting, inspection and assemby.

- Honda's humanoid robot, Asimo, responds to machine visual information including (right hand frame) gesture and posture, through triangulation (bottom centre).
- The other three frames show Asimo's recognition of a face from a set held in memory (lower left), distinction of distance and direction for multiple moving objects (top left), and interpretation of a hand gesture.

OCR

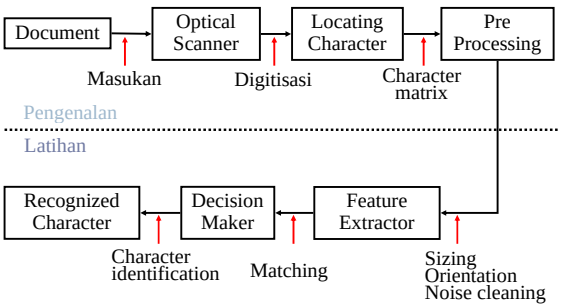
- While humanoid robots can be expensive, facial recognition difficult, and even ant tracking requires some programming effort, building a basic ANPR system is now a pattern recognition activity available to any budding monomaniac with a PC, standard software, a little ingenuity and a lab window overlooking the street.
- Here, a camera triggered via a serial connection captures the image (background) and OCR software supplied free with an inexpensive scanner (ABBYY FineReader, top right) extracts the text strings.
- For that added air of omniscience, the strings are stored in a Microsoft Access database and checked for frequency of previous occurrence (top left) by a scheduled Windows macro (recorded in Tronan MacroMachine, bottom left).

- One of the cars recorded here has been registered before, but the other (highlighted in the Access table) is new to the area.

Elemen Kerja Pengembangan Sistem PR

- Definisi Masalah
- Analisis Kebutuhan Data
- Akuisisi Data
- Pembentukan Ciri
- Pembentukan Pattern Recognition System

Optical Character Recognition (OCR) System



OCR Process

Operasi Sistem Pengenalan Pola

- Tahap Latihan: terdiri dari rancangan ekstraksi ciri, rancangan aturan keputusan, evaluasi hasil pengenalan pola, dan pembentukan data pengetahuan
- Tahap Pengenalan (Operasional): terdiri dari penentuan pola yang akan diamati, pengukuran ciri, proses pengenalan dengan memberlakukan aturan keputusan serta penggunaan data pengetahuan
- Tahap Evaluasi: apakah hasil pengenalan (dengan real –*world pattern*) sudah optimal, ataukah masih perlu untuk memperbaiki dengan mencari ciri yang lebih efektif dan aturan keputusan yang lebih akurat

Model Sistem Pengenalan Pola

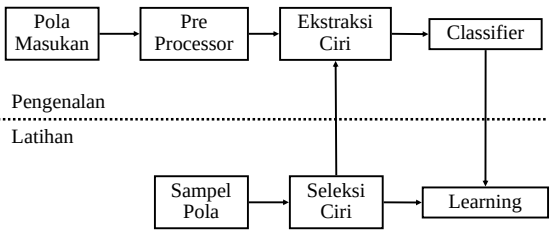
- *Geometric/Statistical Approach*
- *Structural/Syntactic Approach*

- *Computational Intelligence Approach:*
  - *Fuzzy Logic Approach*
  - *Neural Network Approach*

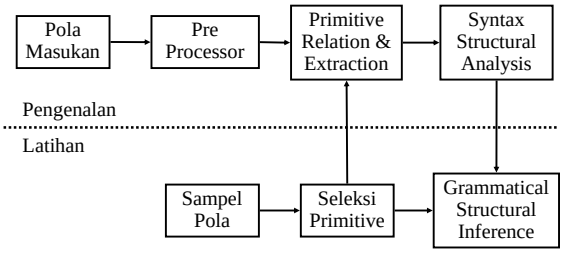
Analogi Pendekatan Statistical dan Syntactical

- Statistical
  - Ciri/Feature (warna, tekstur)
  - Density Function (probabilitas)
  - Estimation (mean, variance)
  - Classification (kategori obyek)
- Syntactical
  - Primitif (garis lurus, orientasi)
  - Grammar (natural language)
  - Inference (aplikasi primitif pada grammar)
  - Description (kategori obyek)

Geometric/Statistical Approach

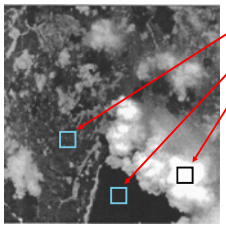


Structural/Syntactic Approach



Proses Pelatihan

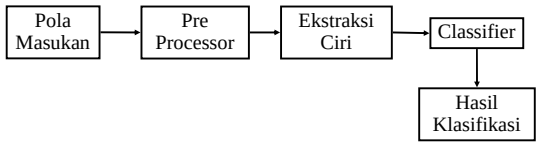
Pendekatan Geometric/Statistical



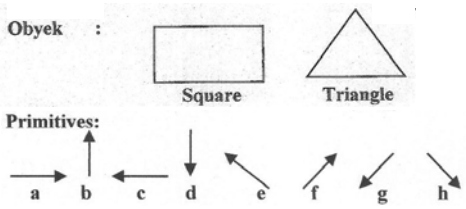
Estimator: gray-level mean value

Decision rule: minimum distance

Proses Pengenalan: pendekatan geometric/statistical



Proses Pelatihan

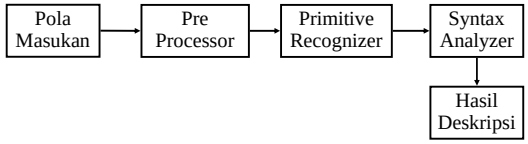


Grammar (Tata Bahasa) dinyatakan dalam bentuk aturan untuk memproduksi bentuk *square* dan *triangle*

$$Square: Ls = \{a^n b^n c^n d^n \mid n > 0\}$$

$$Triangle: Lt = \{a^n e^n g^n \cup c^n f^n h^n \mid n > 0\}$$

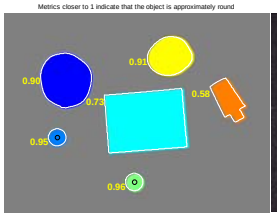
Proses pengenalan: pendekatan structural/syntactic



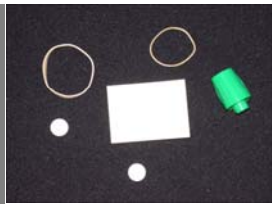
Video Time: Face Recognition

MATLAB® Time: Mengenali benda melingkar

Output



Input



Ket.: metrik mendekati 1, berarti obyek melingkar