Human Computer Communication

LESSON 15

Reading

Chapter 22, 24, 25

Outline

- Communication as Action
- Introduction to Natural Language Processing
- Introduction to Perception
- Introduction to Robotics

What is NLP?

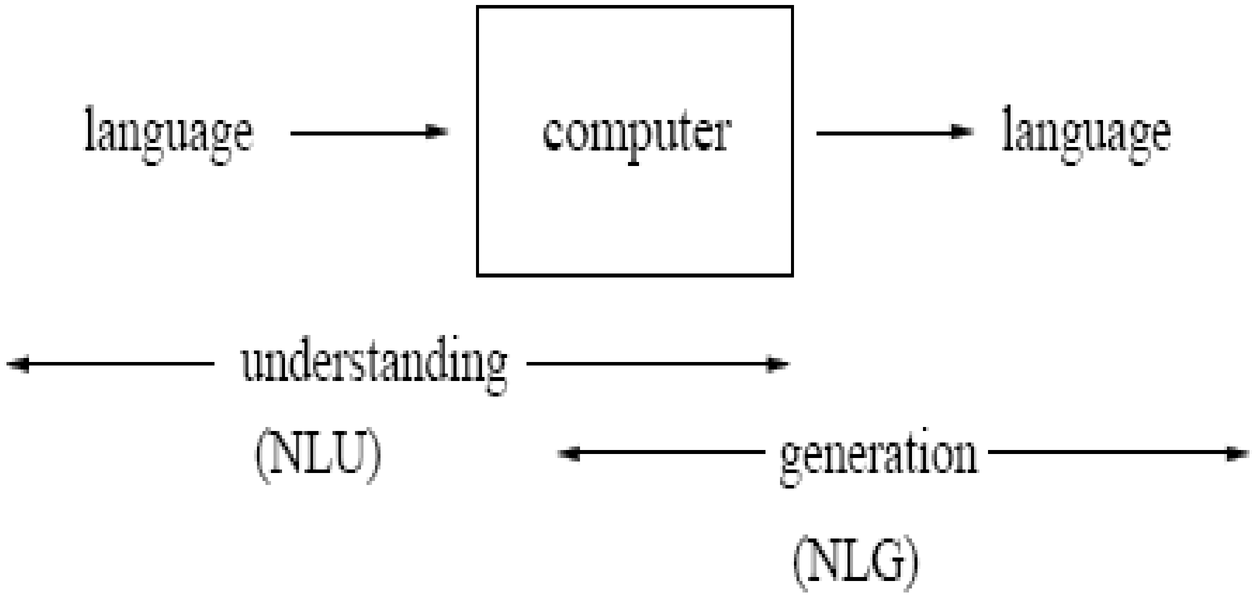
Are texts important?

- What is the purpose of IT?

NLP is the research field to doing with texts.

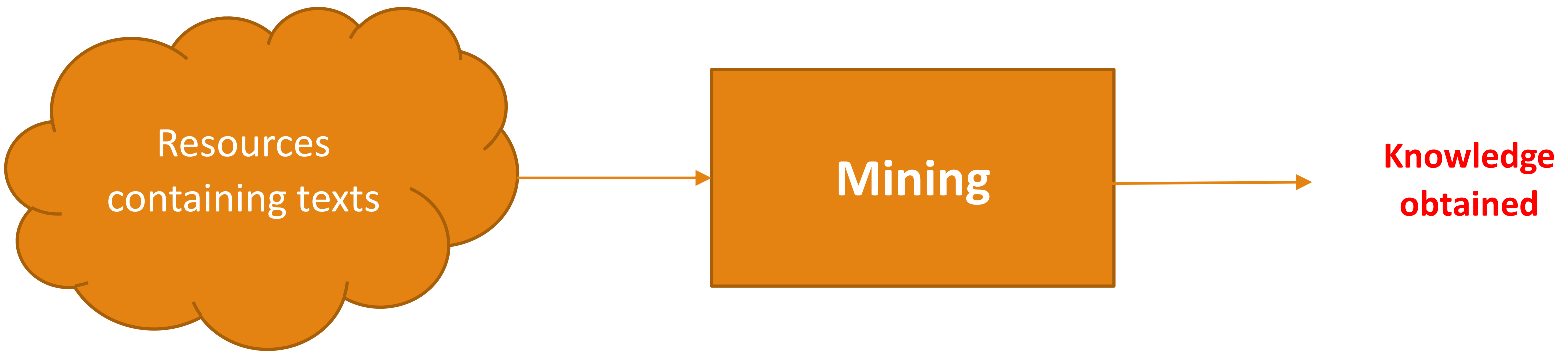
What should we research?

What is NLP?



language
computer
language
understanding
(NLU)
generation
(NLG)

What is NLP?



What is difference?

Computational Linguistics?

Natural language processing?

Basic problems and applications

Basic problems: for formulating problems to understanding language.

Applications: the usefulness of applications with the object to processing is text.

NLP Basic problems

Morphological analysis

Language modeling

Word segmentation

Syntatic parsing

Part-Of-Speech tagging

Word sense disambiguation

Name entity recognition

Natural language generation

Other: preposition attachment; coreference resolution; collocation extraction; building the WordNet dictionaries;

NLP Applications

Machine translation

Spell checking

Grammar checking

Text classification

Text summarization

Question answering systems

Information retrieval

Information extraction

Sentiment analysis

…

Perception

Perception provides an agent with information about the world they inhabit

- Provided by sensors
  - Anything that can record some aspect of the environment and pass it as input to a program
    - Simple 1 bit sensors…Complex human retina

Perception

There are basically two approaches for perception

- Feature Extraction
  - Detect some small number of features in sensory input and pass them to their agent program
  - Agent program will combine features with other information
  - “bottom up”
- Model Based
  - Sensory stimulus is used to reconstruct a model of the world
  - Start with a function that maps from a state of the world to a stimulus
  - “top down”

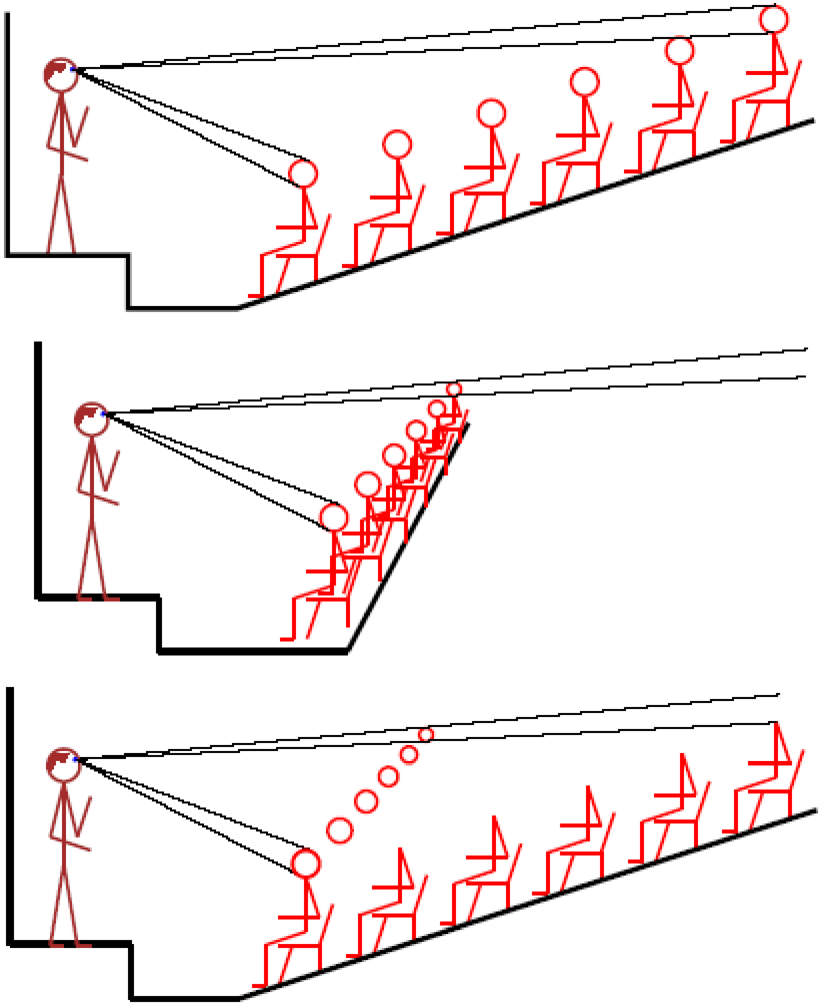
Perception

$S = g(W)$

- Generating S from g and a real or imaginary world W is accomplished by computer graphics

$W = g^{-1}(S)$

- Computer vision is in some sense the inverse of computer graphics
  - But not a proper inverse…
    - We cannot see around corners and thus we cannot recover all aspects of the world from a stimulus

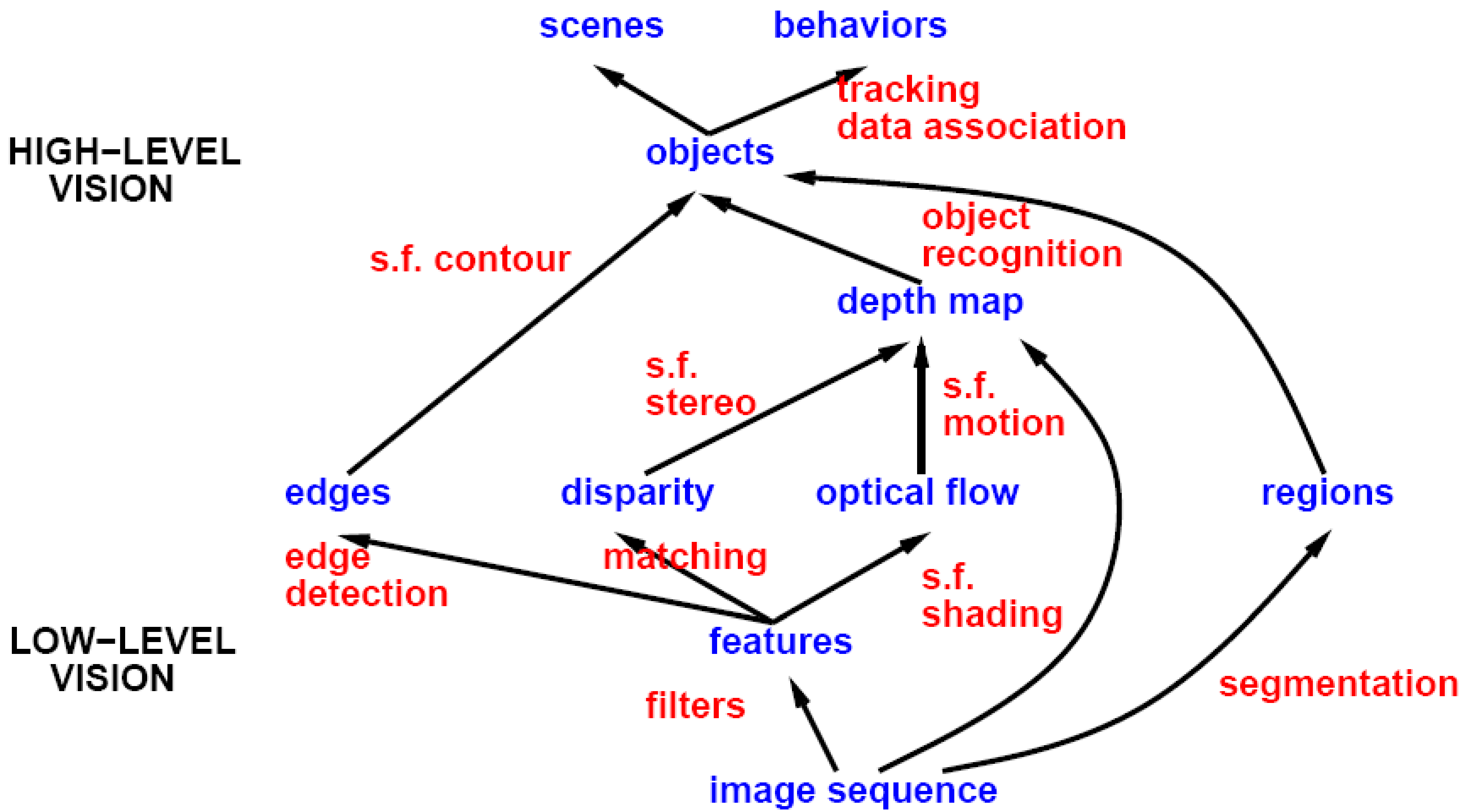


Perception

In reality, both feature extraction and model-based approaches are needed

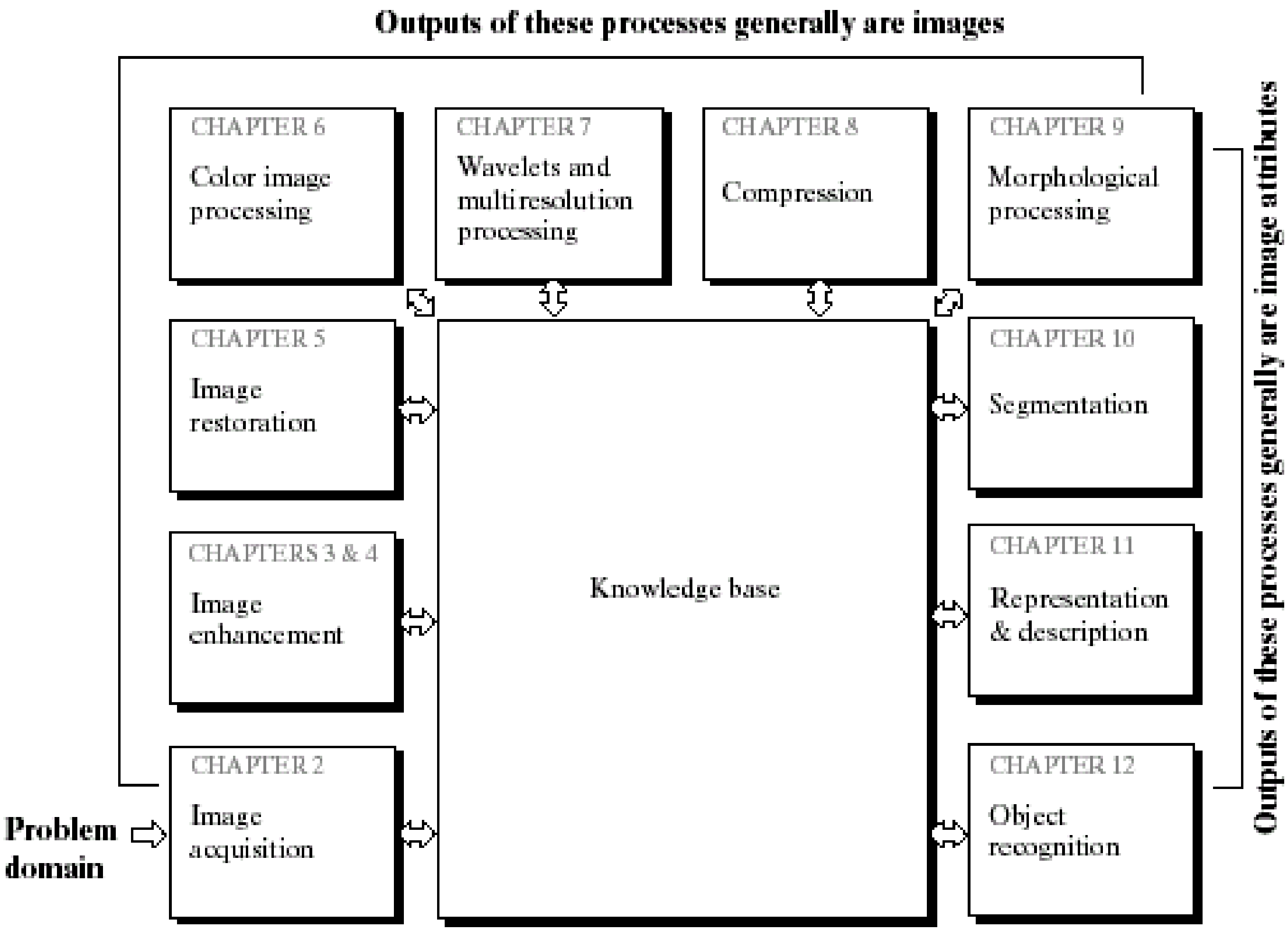
- Not well understood how to combine these approaches
- Knowledge representation of the model is the problem

A Roadmap of Computer Vision



Computer Vision Systems

FIGURE 1.23
Fundamental steps in digital image processing.

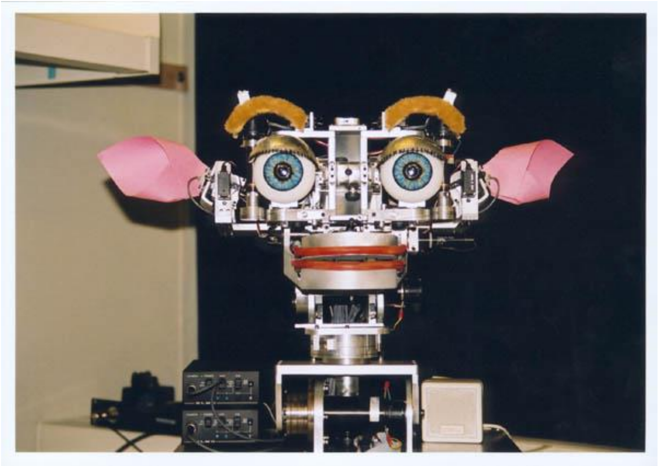


Robotics

Alternate definition:

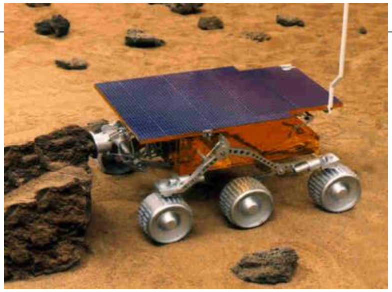
"A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks." (Robot Institute of America)

"A robot is a one-armed, blind idiot with limited memory and which cannot speak, see, or hear."



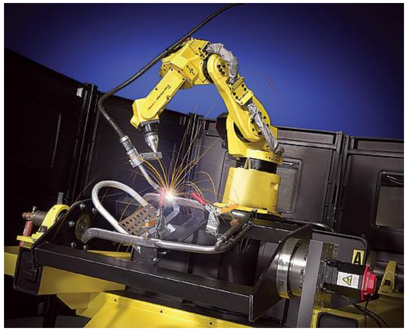
MIT's Kismet: a robot which exhibits expressions, e.g., happy, sad, surprise, disgust.

Ideal Tasks



Tasks which are:

- Dangerous
  - Space exploration
  - chemical spill cleanup
  - disarming bombs
  - disaster cleanup
- Boring and/or repetitive
  - Welding car frames
  - part pick and place
  - manufacturing parts.
- High precision or high speed
  - Electronics testing
  - Surgery
  - precision machining.



Automation vs. robots

Automation –Machinery designed to carry out a spe

(These are always better than robots, because they can be optimally designed for a particular task).

- Bottling machine
- Dishwasher
- Paint sprayer

Robots – machinery designed

to carry out a variety of tasks

- Pick and place arms
- Mobile robots
- Computer Numerical Control machines

Types of robots

A SCARA robot (Selective Compliant Articulated Robot Arm): A pick-and-place robot with angular
x-y-z positioning (Adept Technology)

Pick and place
- Moves items between points

Continuous path control
- Moves along a programmable path

A six-axis industrial robot ($60K)(Fanuc Robotics), but an additional $200K is often spent for tooling and programming.

Sensory
- Employs sensors for feedback

Pick and Place

Moves items from one point to another

Does not need to follow a specific path between points

Uses include loading and unloading machines, placing components on circuit boards, and moving parts off conveyor belts.

A cartesian robot for picking and placing circuits on circuit-boards

Continuous path control

Moves along a specific path

Uses include welding, cutting, machining parts.

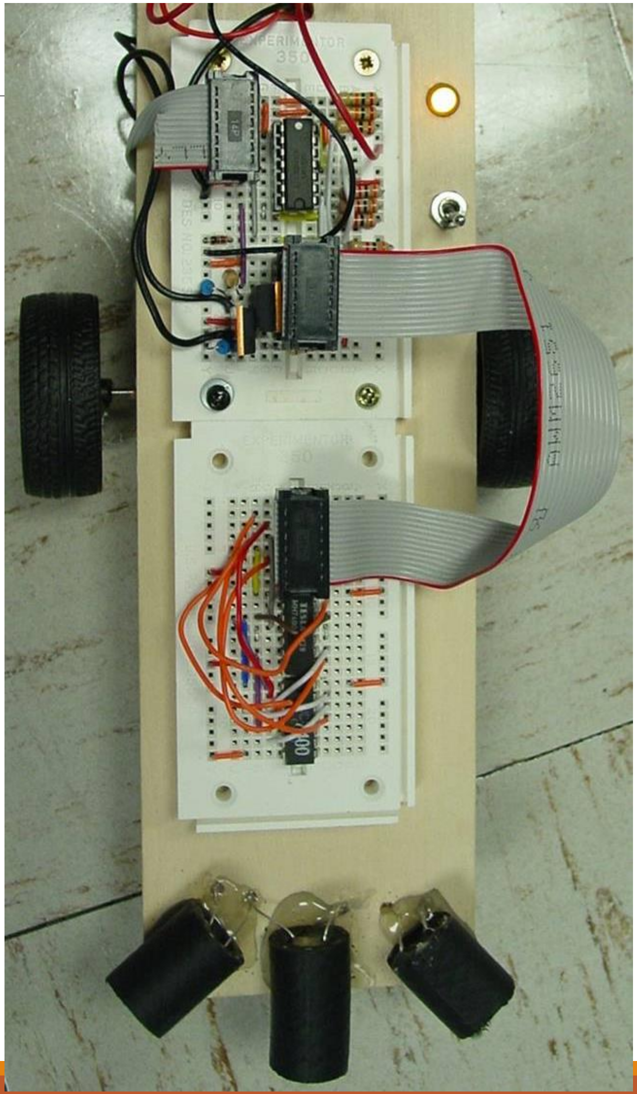
Robotic seam welding

Sensory

Uses sensors for feedback.

Closed-loop robots use sensors in conjunction with actuators to gain higher accuracy – servo motors.

Uses include mobile robotics, telepresence, search and rescue, pick and place with machine vision.



Measures of performance

Working volume

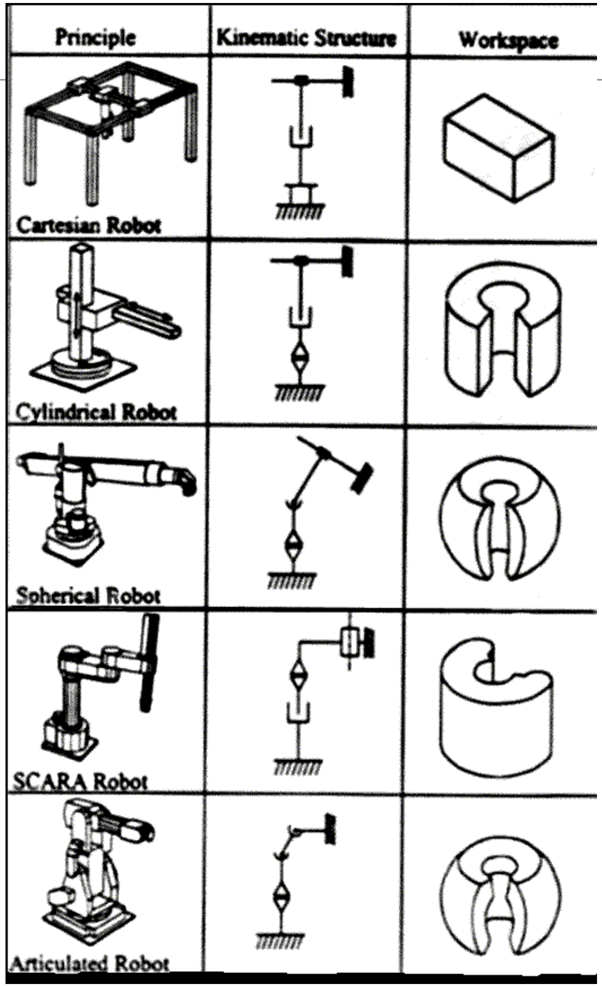
- The space within which the robot operates.
- Larger volume costs more but can increase the capabilities of a robot

Speed and acceleration

- Faster speed often reduces resolution or increases cost
- Varies depending on position, load.
- Speed can be limited by the task the robot performs (welding, cutting)

Resolution

- Often a speed tradeoff
- The smallest step the robot can take



Performance (cont.)

- Accuracy
  - –The difference between the actual position of the robot and the programmed position
- Repeatability

  Will the robot always return to the same point under the same control conditions?

  Increased cost

  Varies depending on position, load