COMP7503 Multimedia Technologies

Elements of Multimedia Computing

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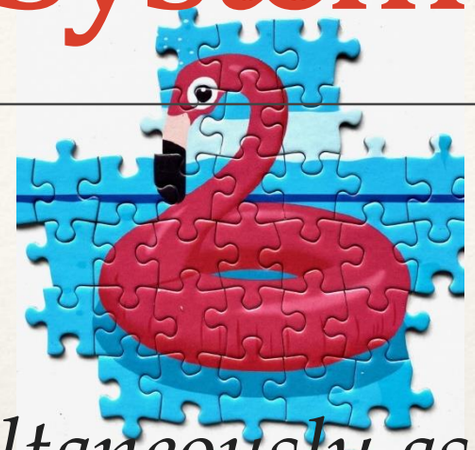
Objective of Multimedia System



https://image-republic.com/en/news/1-000-pieces-puzzles-1-000-pieces-sont-arrives-

- **Objective**
  - *Process different types of data streams simultaneously as one correlated set of streams that represent **information** and **knowledge of interest** for solving a problem*
- **Challenge**
  - *Discover correlations that exist in the set of multimedia data*
  - *Combine partial information from disparate sources to build holistic **information** in a given **context***

Experience and Information

- ***Experience*** is the direct observation of or participation in events as a basis of knowledge (*Webster's dictionary*)
  - We experience the world we live in, and learn about the world and accumulate and aggregate our experiences in the form of ***knowledge***
- ***Information*** is an efficient but abstract communication of **experience**
  - We gain knowledge through the set of experiences that make up our lives and communicate information about those experiences

Communication is the process of sharing experiences and information with others

- Allows sharing of experiences with people who may be spatially and temporally separated

Communication

- We gain knowledge through the set of experiences that make up our lives and communicate information about those experiences
  - But we don't communicate the experiences themselves
  - During the communication process, we lose the vital element of the ***act of experiencing***
- Example
  - Information: "*Wearing a mask is a powerful weapon under epidemic situation*"
  - For a man, he/she won't know how important it could be, unless he/she has been there.

Communication (Cont'd)

Communication (Cont'd)

April 16, 2003 – a main sitting on an empty MTR train. Photo: Peter Parks/AFP

Communication (Cont'd)

- Implications
  - For a man, he/she won't know how important it could be, unless he/she has been there.
  - Effective communication of information requires the support by relevant experiences

What can we do if we can not share the experience?

Communication Process

- ***Dictionary*** is one of the most important elements for communication
  - Dictionary is a shared and agreed upon collection of symbols (words) and what these symbols mean
- In language, dictionary is an exhaustive collection of a selection of words of a language
- In Computer Science, dictionaries are extended to use lists of codes, terms, and keys for use by computer programmes
  - Compress algorithms also employ dictionary concept to achieve compression
- In multimedia, instead of traditional words or codes, the basic elements in the corresponding dictionary is called ***percept***
  - Visual dictionaries
    - Curves, shapes, lines, etc.

Objects and Events

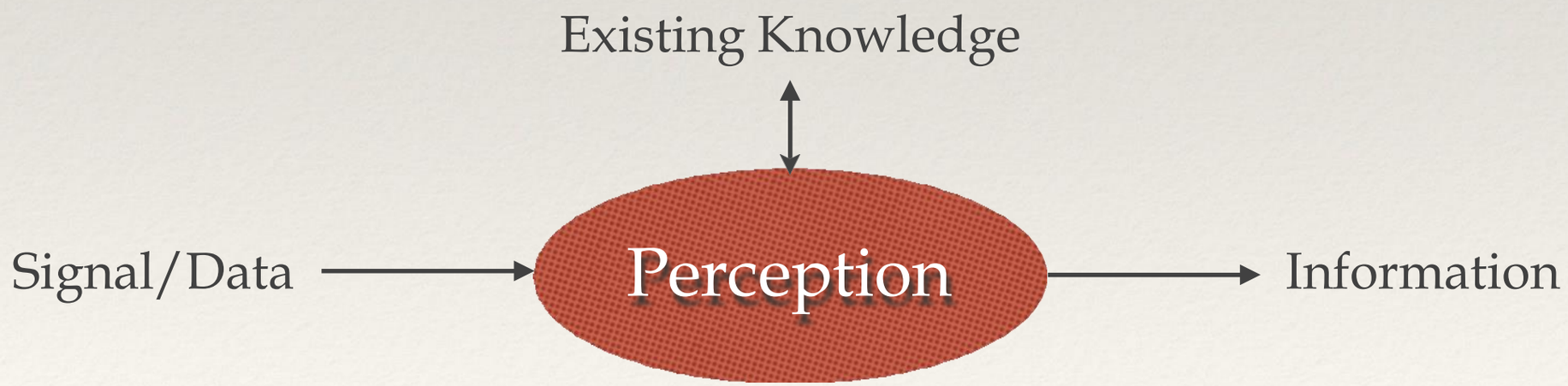
- Objects and events should be used to model a dynamic world
  - Objects are good at capturing static components of the world
  - Events represent changes in relationships among objects
- Multimedia, in particular audio and video, are fundamentally dynamic in nature
  - They capture signals that represent some attributes of the world as a function of time

Perception

- ***Perception*** is the process of understanding sensory signals to recover useful information
  - The field attracted attention from psychologists and researchers in artificial intelligence
  - Understanding perceptual processes remains a difficult problem in many disciplines like psychology, neuro-physics, computer science, and computer vision
- Understanding of sensory information is an important step in many multimedia systems
  - A perception system takes sensory signals as input and generates the information that is relevant in its application context as output

Perception (Cont'd)

- Without any knowledge, the system cannot produce any information
- Perception sometimes is considered as a controlled hallucination process
  - Given a signal, the system starts simulating and creates multiple hypotheses to find the best supported hypotheses to recover information



Perception (Cont'd)

- What can you see from the image below?

Perception (Cont'd)

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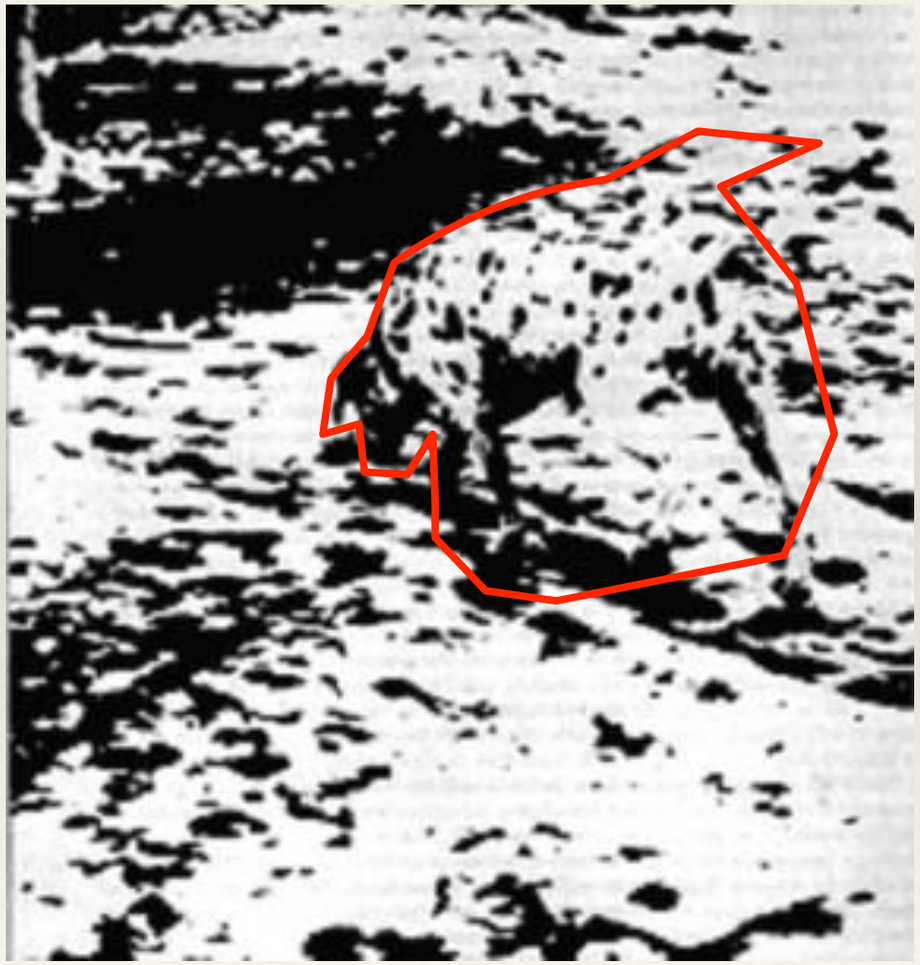
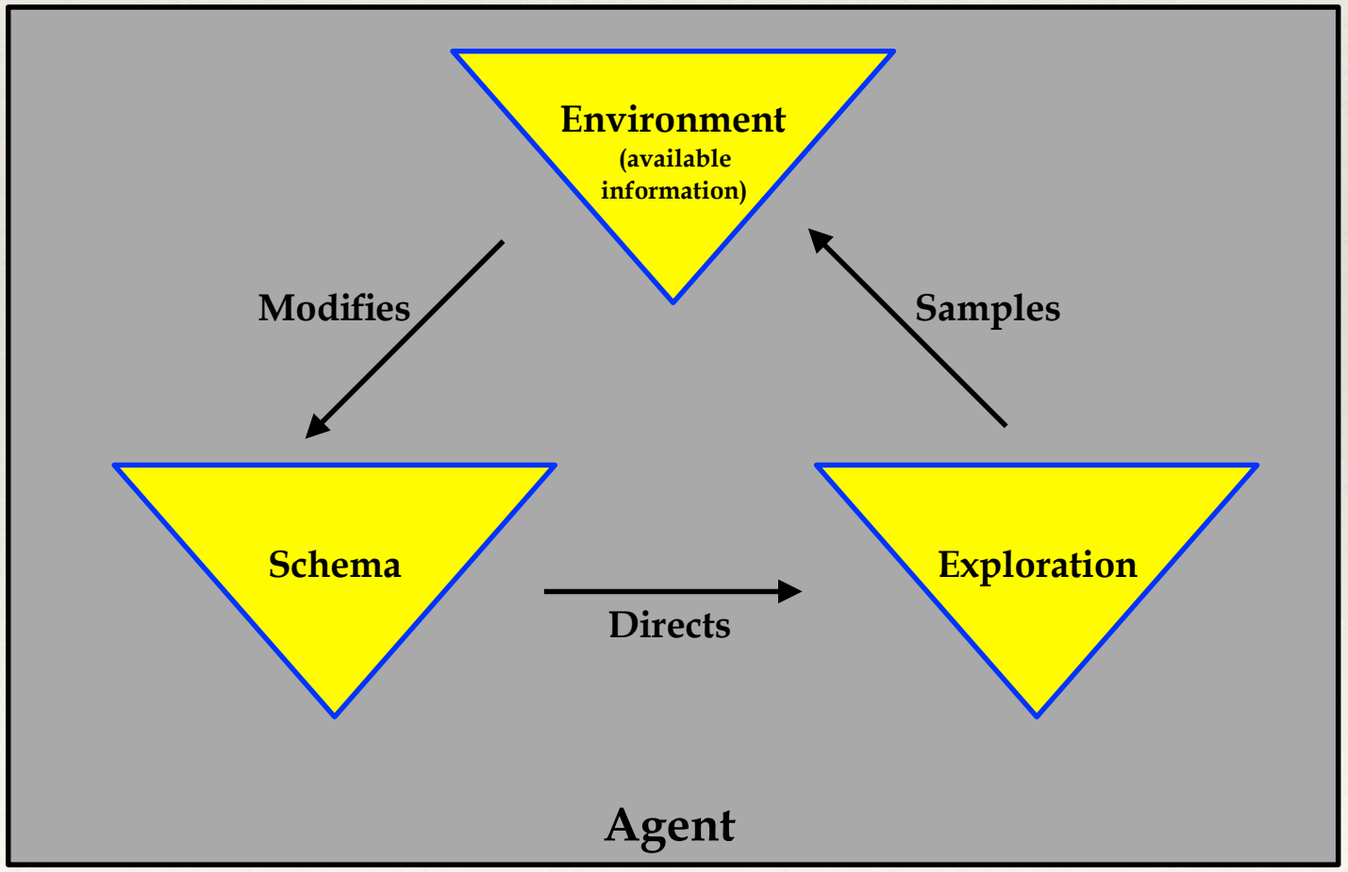


Perceptual Cycle

- Neisser's Perceptual Cycle
  - An agent is continuously interacting with the environment using its sensory mechanisms
  - Build the model (a.k.a. ***schema***) of the environment
  - The system then decides what is further required to complete the task and how that information could be acquired



Wine

or

???????

MTR
Mei Foo Station

Wine

or

Soy Sauce

Problems to Solve

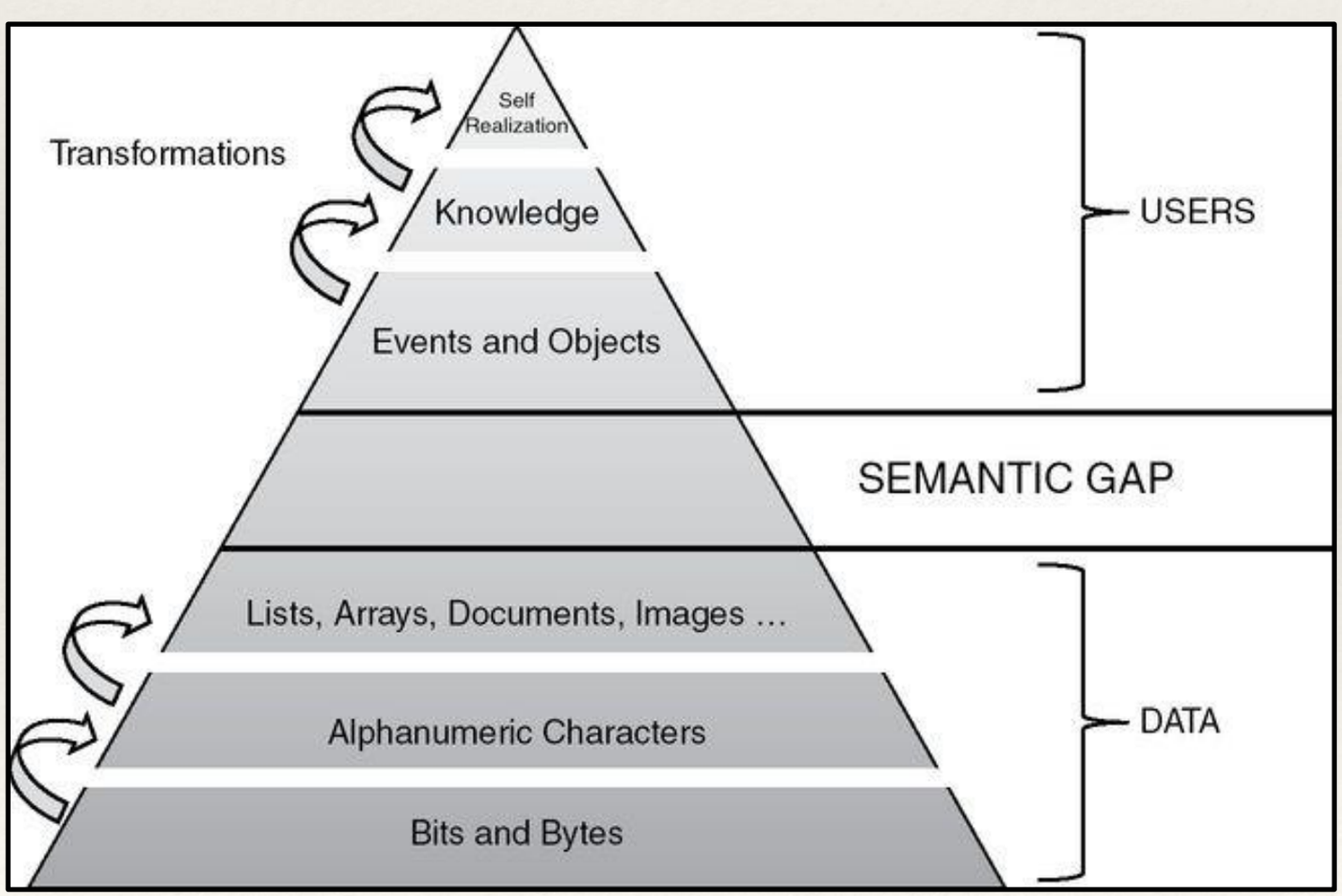
- How do we represent data in the most compact form for communication and storage?
- How do we present vast amount of data to user's computing environment to communicate intended information?
- What system issues must be solved to deal with disparate types of data and how the system handles them?
- How do we combine these data streams to obtain the information that is essential for solving the problem at hand?

Semantic Gap

- Data in computing systems
  - Represented as bits and bytes
  - More sophisticated representations
    - Lists
    - Images
    - Audio
    - Video
- Users, on the other hand, define their applications based on abstractions of objects and events
- There is a fundamental gap between different abstractions employed by computing systems and those by the users

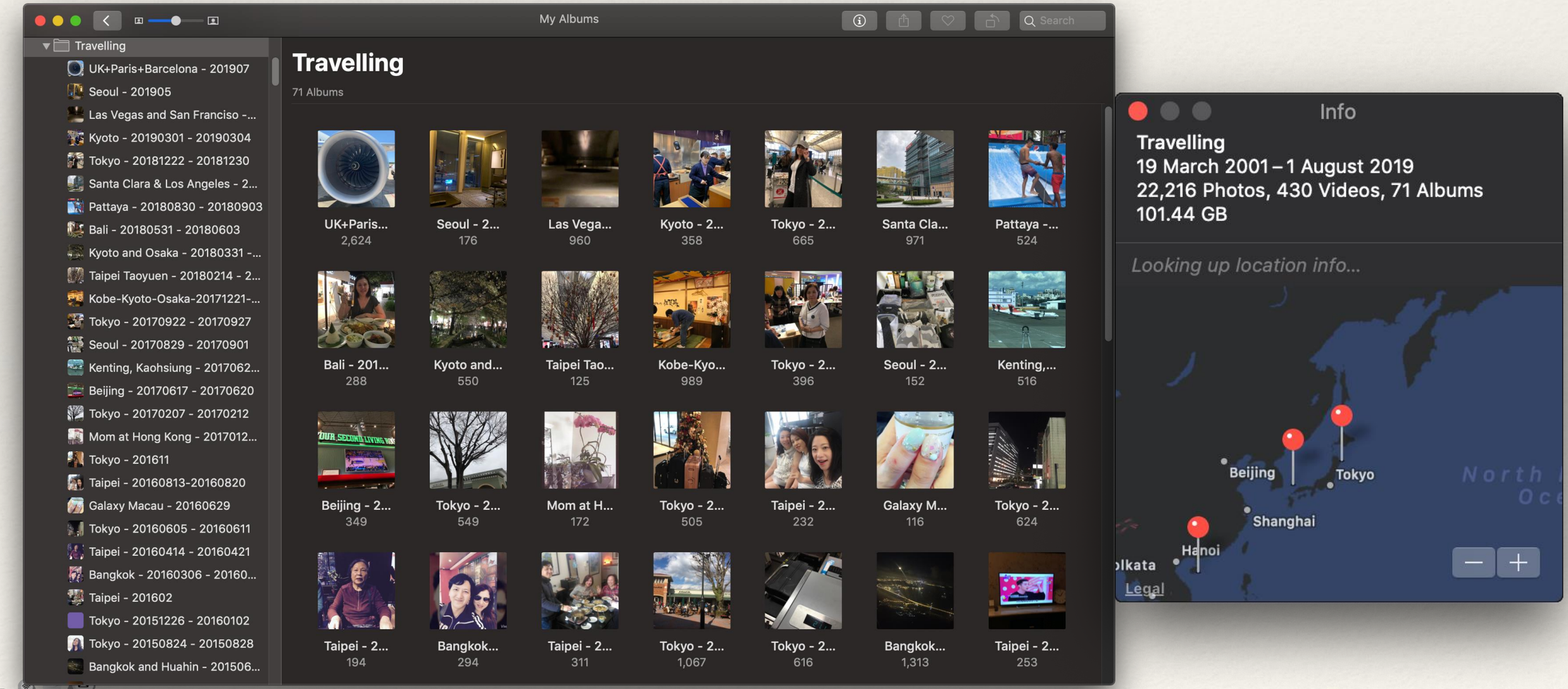
Semantic Gap (Cont'd)

- The semantic gap is the difference between the information that a machine can extract from (perceptual) data and the interpretation that a user in a given situation has for the same data
- Multimedia computing needs to bridge the semantic gap between human and computer



Context and Content

- Context is the interrelated conditions in which some data (the content) is acquired
  - Exchangeable image file format (Exif) metadata for the photo



Context and Content (Cont'd)

- Metadata can be regarded as "Data about data"
- Metadata can provide context parameters that may help in understanding the content
- The importance of context is becoming increasing clear
  - Content and context should be combined and should be viewed as all information that must be used for understanding multimedia

Components of a Multimedia System

- Capture Devices
  - Video Camera
  - Video Recorder
  - Microphone
  - Keyboards
  - Mouse
  - Touch Screen
  - Pressure sensor
  - etc.
- Storage Devices
  - Hard disks, Flash Drive, Optical Disc, etc.
- Communication Networks
  - Local network, 4G/5G connection, bluetooth, RF, etc.
- Computer Systems
  - Workstations, Servers, DSP
- Output Devices
  - LCD Display, Speakers, Vibration Motor, Haptic Feedback, etc.