Week 8-3
Cognition

SFWRENG 4HC3/6HC3 Human Computer Interfaces

** Slides adapted from previous instructors of COMPSCI/SFWRENG 4HC3/6HC3*

McMaster University

Memory Summary

Sensory memory
- High capacity
- Short duration

Short-term memory
- Low-capacity
- Fast access
- Less short duration

Long-term memory
- Slow access
- Large capacity
- Long duration

Reducing Memory Load

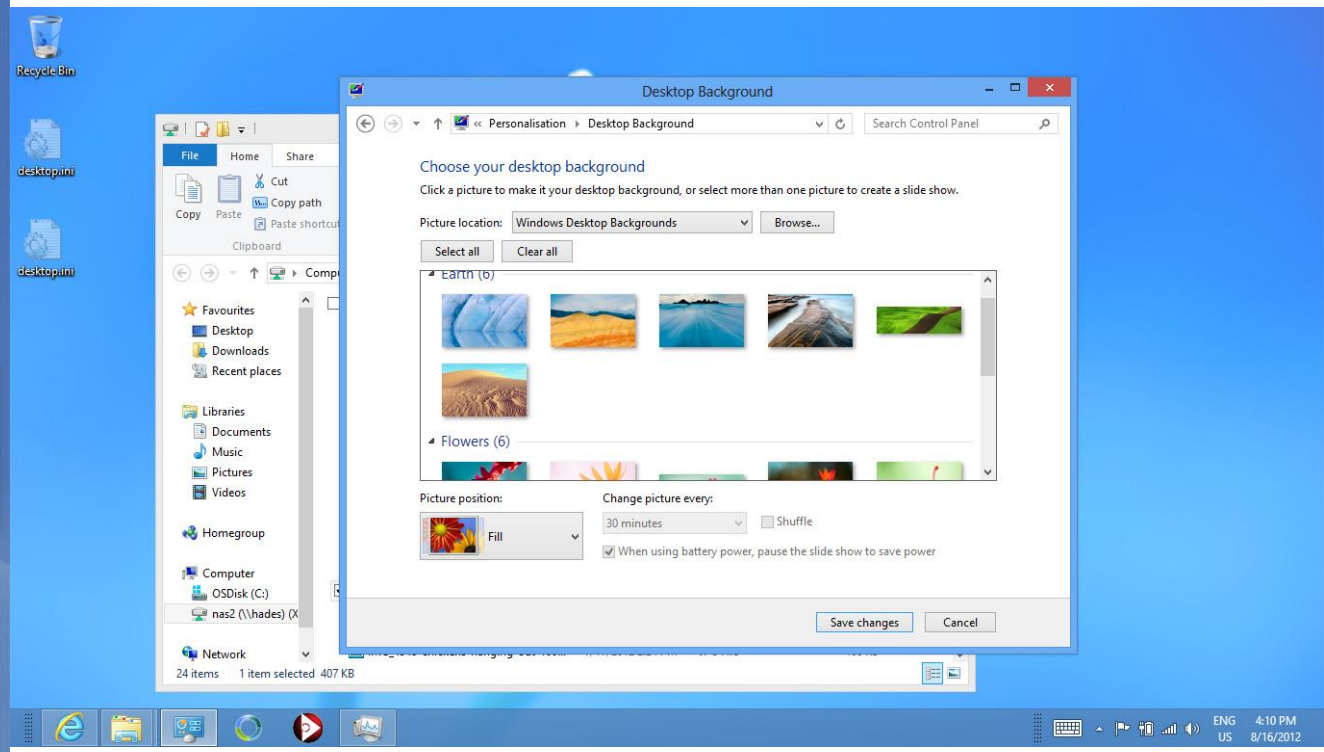
Don’t reinvent the wheel!

- **Leverage existing memories** to your own benefit – **stick to the norms**
- **Don’t change** hotkeys, keywords, etc. between versions
- Use **metaphors** to piggyback on existing memories

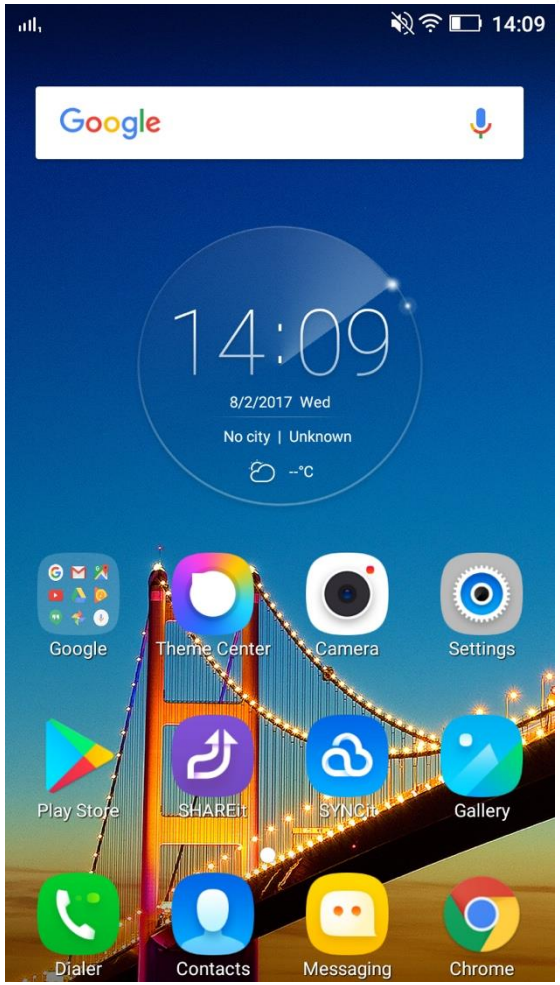
Make things memorable

- Use visual memory / icons
- Make new items unique to avoid interference / overlap

Example: Desktop Metaphor



Example: App Model



Use Metaphor

A way to bring the outside world into your interface so the user has less to learn.

Take a look at all the interfaces around you:

- Any good/bad usage of metaphor in the interface design?

Desktop metaphor

Not a perfect attempt to simulate a real desktop

But it leverages knowledge of files, folders, trash

Explains why some windows can be overlapping each other

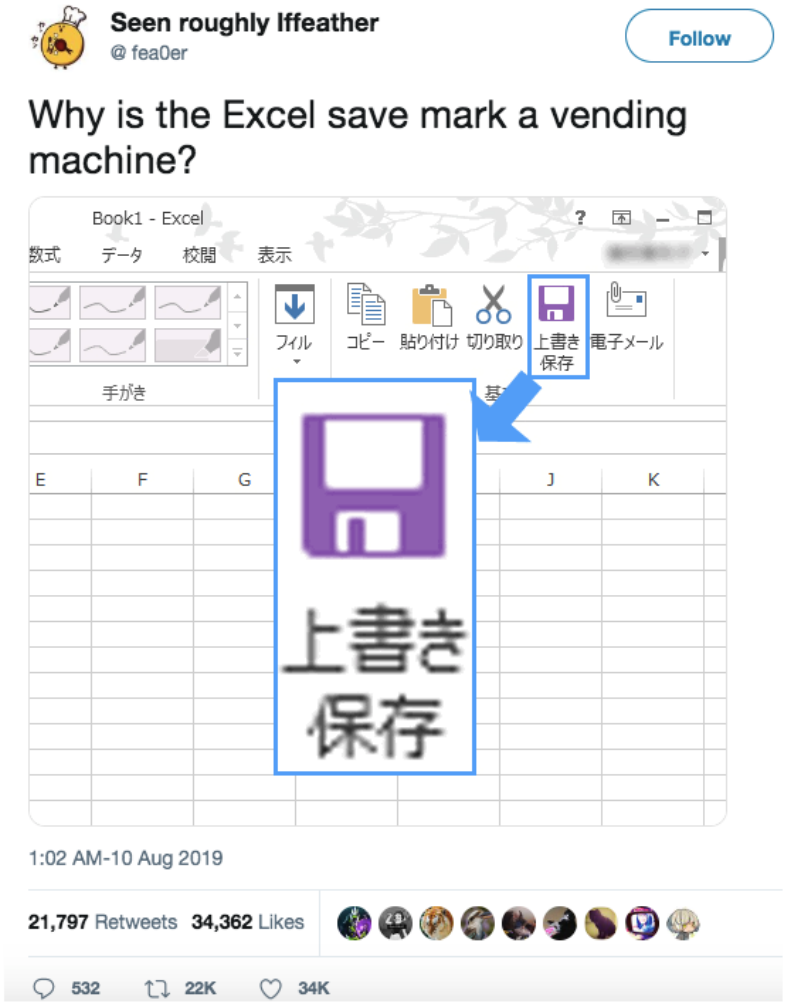
Use Metaphor

Advantages

- Highly learnable when appropriate
- Hooks into a user's existing mental model easily

Dangers

- May be constraining
- Metaphors always break down at some point
- Metaphors can be not useful
- **Metaphors can die**



The Human

A **simplified view** of “the human” involves:

- **Input/output** (vision, auditory, haptic; movement, voice)
- **Memory** (short term, long term, sensory)
- **Processing** (cognition, problem solving, learning, etc…)

Each person is **different** in these aspects!

Week 8 Overview

- **Monday**
  - ~~Perceptions: Gestalt~~
- **Wednesday**
  - ~~Memory~~
- **Friday**
  - **Cognition**

Cognition

Cognition: "cognitive mental processes"

- **Cognitive:** "of, relating to, being, or involving conscious intellectual activity (as thinking, reasoning, or remembering)"

Interacting with technology is cognitive

- Need to take into account cognitive abilities and limitations of users
- Provides insight into what users can and cannot be expected to do
- Helps identify and explain the nature and causes of problems users encounter

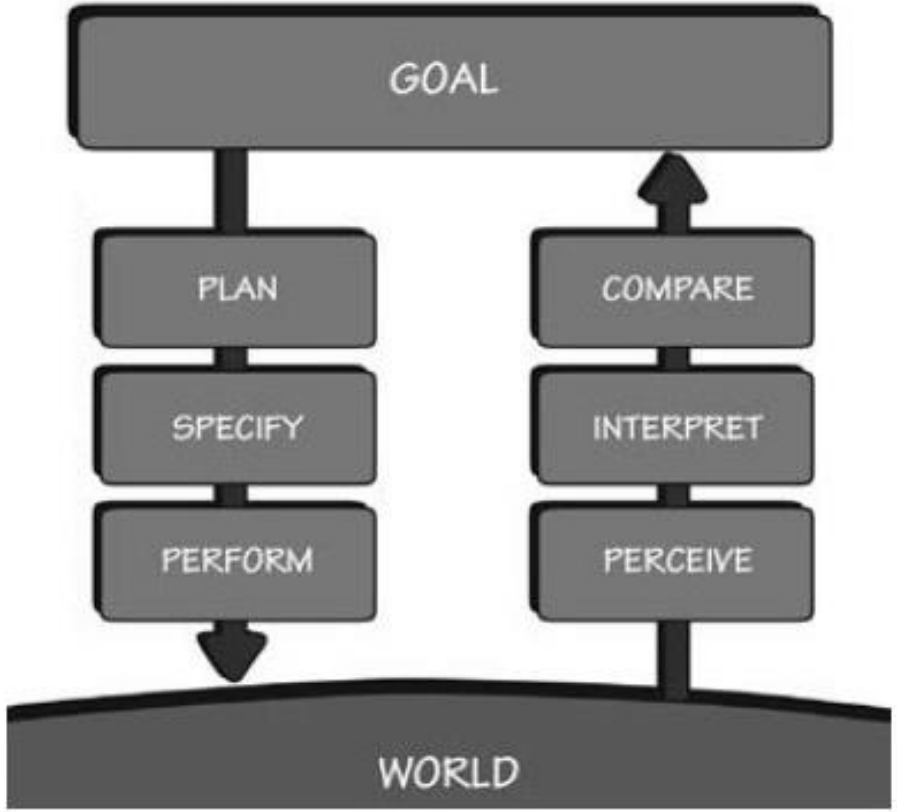
Cognition: Goal Model

People have goals

- Form plans on how to meet those goals
- Rely on cognitive resources (including memory)

Cognition occurs at various levels:

- Conscious cognition
- Unconscious cognition



Conscious Cognition

- Our **focus of attention**
- **Serial processor** - can attend to only one thing at a time
- **Short-term memory**
- **Low bandwidth**
  - Limited amount of information that can be processed at a time

Unconscious Cognition

- **Parallel processing**
  - **Ability to do many things simultaneously**
  - “walk and chew gum” at same time
- **Higher bandwidth**
  - Can process **lots of information** at same time
  - Think about all the information processed when walking
- Long-term memory
- **Lots of resources** to draw upon

Cognition

Property	Conscious	Unconscious
Engaged by	Novelty, emergencies, high-level planning	Repetition, expected events, safety
Used in	New circumstances	Routine situations
Can handle	Decisions	Non-branching tasks
Accepts	Logical propositions	Logic or inconsistencies
Operates	Sequentially	Simultaneously
Controls	Volition/will	Habits
Capacity	Tiny	Huge
Persists for	Tenths of seconds	Decades (lifelong)

Learning

- Learning is the process of moving things from **conscious to unconscious** cognition
- Enables us to perform increasingly complex tasks
- Things become “automatic”

Learning: Example #1

Driving a car

- Initially difficult to coordinate both hands and feet
- Difficult to control pressure of feet/speed of turning
- Many things require full cognitive attention
- As you learn, more things become automatic
- Smooth proportional braking and acceleration, signal changes, shifting, etc.

Learning: Example #2

Writing an essay on a computer

- Initially, typing requires full cognitive attention (and visual)
- Over time, “pushed down” the stack to unconscious levels of cognition, **enables you to focus on words and organization, not on typing**

Learning

Novel actions must be **explicitly guided by conscious effort and feedback**

- Slow and requires a lot of effort
- Hinders other tasks

Over time, **actions become automatic**, “ballistic”
Once you start an action, it executes to completion

- Not under conscious control
- Not as much feedback required by interface

Practice: Write a Computer Program

- What is the process?
- What aspects of it:
  - are under conscious control?
  - are under unconscious control?

Practice: Write a Computer Program

1. Understand the problem to be solved - Conscious
2. Plan an approach to organization / data model / etc – Conscious
3. Use common programming items like variables, for loops, if statements, basic logic, etc - More unconscious
4. Use mouse, keyboard to navigate and use programming software - Motor actions are ballistic

Implications for Design

When people do things, learning is automatic

- **We cannot stop habits from forming**

What are implications for interface design?

- Leverage **unconscious cognition** as much as possible!

Implications for Design

Need to be careful what habits we encourage

- Lack of explicit design does **NOT** stop learning

Consistency and congruency in interfaces help draw upon **unconscious cognition** (**repetition**)

- Help reduce cognitive effort required for learning

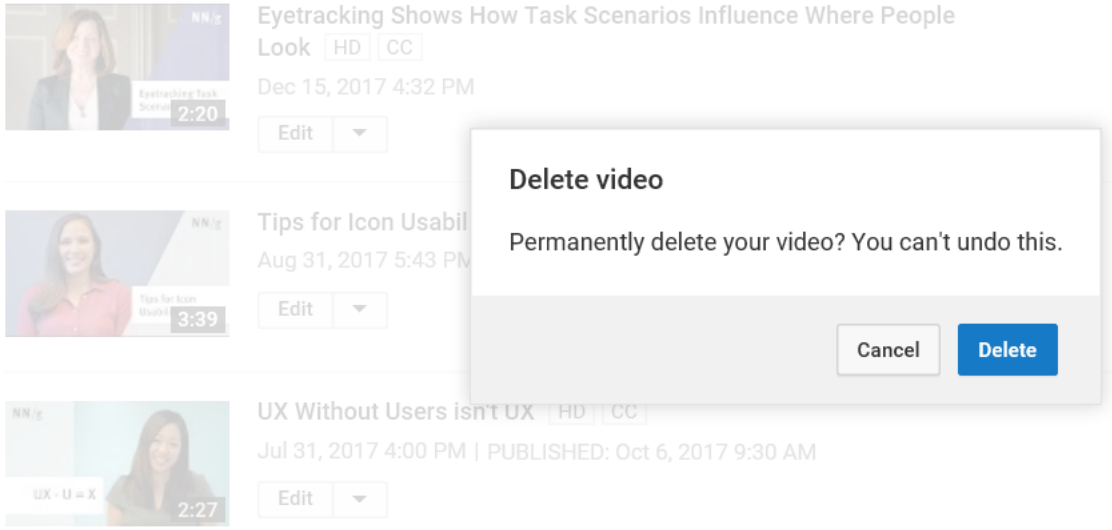
Example: Confirmation Dialog

Too many confirmation dialogs

- people don’t read, just click **OK**

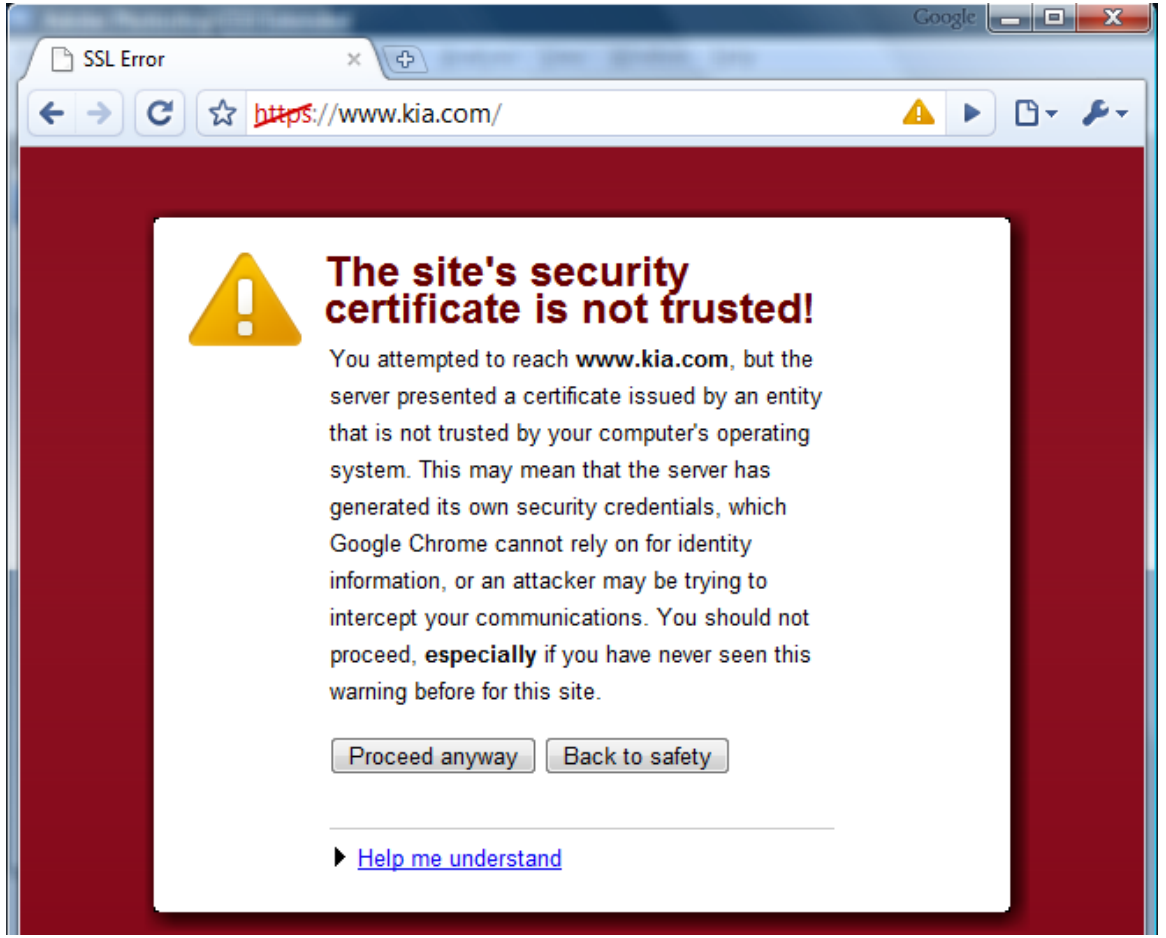
But what if it’s serious?

- **Change the interaction** to bypass the learning



Example: Confirmation Dialog

Unfamiliar, weird,
gets your attention



Memory and Cognition

Processes that transfer information between stores:

- Sensory → short-term: attention
- Short-term → long-term: rehearsal, encoding
- Long-term → short-term: recall

Forms of cognition

- Unconscious
- Conscious

Advanced: Distributed Cognition

"How cognitive activity is distributed across internal human minds, external cognitive artifacts **[off-loading]**, and groups of people **[shared cognition],** and how it is distributed across space and time"

- **Off-loading** is the use of external artifacts to extend the mental processes
  - Data sharing
- **Shared cognition** is distributing cognition across individuals, where people working together to solve a problem
  - Collective intelligence (Wikipedia)

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