Write a concise paper that addresses the usability issues that are particular to one of the three system types given below. For all of the papers, you are expected to make effective use of the concepts learned in class to inform and enlighten your chosen topic. Are there guidelines documents that codify certain ideas explicitly? What principles or theories might come into play? Most of all, how do the issues in these topics relate to the way mental models are formed an communicated across developers and users? You are free to make a final call, but make sure to base your call on the material we have seen (and beyond! -don't hesitate to visit the library or find additional information sources for your work).

Introduction
Background
Methods
Discussion
Conclusions

Mental models, the models people have of themselves, others, the environment, and the things with which they interact. People form mental models dthrough experience, training, and instruction. The mental model of a device is formed largely by interpreting its perceived actions and its visible structure. (The Design of Everyday Things, 17)

By "mental model" is meant some kind of understanding of how the device works in terms of its internal structure and process. The emphasis has been on mental models in which the understanding of the system approaches the level of understanding that an actual expert in the relevant technical field would have. (Kieras and Bovair)

In the past decade, the main goal of the research in the field of ubiquitous computing (UC) has been the support to humans in their everyday life without upsets.

In the Weiser's vision, a great variety of heterogeneous devices with regards to their shape or use will be at the disposal of the user [1]. Such devices will be aimed either to be 'personal' or 'embedded' in the environment.

Some common UC devices are personal digital assistants (PDAs), tablet personal computer (PC), laptops and electronic dashboards. The research activity is oriented to devise more and more sophisticated objects and to their integration through unwired communication channels.

In a nutshell, HCI involves the communication between humans and computers and their abilities when using complex systems such as interface learnability and performance measures in task execution.

With an explosive growth of wireless communication devices, ad hoc and ubiquitous computing technologies have received unparallel attention from both the academia and industry. In recent years, a

number of significant advances have been made in these technologies, with the the target of offereing more exciting and efficient services for different application scenarios, at anytime and anywhere. (Encyclopedia on Ad Hoc and Ubiquitous Computing: Theor and Design of Wireless Ad Hoc, Sensor, and Mesh Networks)

We are therefore trying to conceive a new way of thinking about computers, one that takes into account the human world and allows the computers themselves to vanish into the background. All say, in essence, that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.

The idea of integrating computers seamlessly into the world at large runs counter to a number of sent-day trends. “Ubiquitous computing” in this context does not mean just computers that can be carried to the beach, jungle or airport. Hundreds of computers in a room could seem intimidating at first, just as hundreds of volts coursing through wires in the walls once did. But like the wires in the walls, these hudreds of computers will come to be invisible to common awareness. People will simply use them unconsciously to acoomplish everyday tasks.

A world in which computer interaction informally enhances every room.
The technology required for ubiquitous computing comes in three parts: cheap, low-power computers that include equally convenient displays, software for ubiquitous applications and a network that ties them all together.

Neither an explication of the principles of ubiquitous computing nor a list of the technologies involved really gives a sense of what it would be like to live in a world full of invisible widget.

Perhaps key among the social issues that embodied virtuality will engender is privacy: hundreds of computers in every room, all capable of sensing people near them and linked by high-speed networks, have the potential to make totalitarism up to now seem like sheerest anarchy.

Fortunately, cryptographic techniques already exist to secure messages from one ubiquitous computer to another and to safeguard private information stored in networked systems. By pushing computers into the background, embodied virtuality will make individuals more aware of the people on the other ends of their computer links. This development may reverse the unhealthy centripetal forces that conventional personal computers have introduced into life and the workplace.
Ubiquitous computers, in contrast, reside in the human world and pose no barrier to personal interactions. If anything, the transparent connections that they offer between different locations and times may tentd to bring communiteis closer together.

Most important, ubiquitous computers will help overcome the problem of information overload. There is more information available at our fingertips during a walk in the woods than in any computer system, yet people find a walk among tress relaxing and computers frustrating. Machines that fit the human

environment instead of forcing humans to enter theirs will make using a computer as refreshing as taking a walk in the woods.
Scientific American 1991

Some of the characteristics of mental modesls are:
-Incomplete
-Constantly evolving
-Not accurate representation (contain errors and uncertainty measures)
-Provide a simple representation of a complex phenomena
-Can be represented by aset of if-then-else rules

The theory of mental modesl was formulated in the early 1940's by Kenneth Craik. He sought to provide a genearal explanation of the human thought based on the assertion that humans represent the world they interact with through mental models.

Users form mental modesl by interacting with a certain computer system. The content and structure of mental modesl are influenced by selecting which information about a certain system is presented to the user and how it is presented. The interpretation of these models specifies how users interact with that system. Some major questions in this domain arise such as: To what extent the form of representation used in the interface affects the way the user solves a certain problem? Furhtermore, is it possible to develop interfaces that facilitate problem solving and support creativity?

Design considerations:

As stated above, systems should be designed to help users form the correct productive mental models. Common design methods include the following factors:

- **Affordance:** Clues provided by certain objects properties on how this object will be used and manipulated.
- **Simplicity:** Frequently accessed function should be easily accessible. A simple interface should be simple and transparent enough for the user to concentrate on the actual task in hand
- **Familiarity:** As mental models are built upon prior knowledge, it's important to use this fact in designing a system. Relying on the familiarity of a user with an old, frequently used system gains user trust and help accomplishing a large number of tasks. Metaphors in user interface design are an example of applying the familiarity factor within the system.
- **Availability:** Since recognition is always better than recall, an efficient interface should always provide cues and visual elements to relieve the user from the memory load necessary to recall the functionality of the system.
- **Flexibility:** The user should be able to use any object, in any sequence, at any time.
- **Feedback:** Complete and continuous feedback from the system through the course of action of the user. Fast feedback helps assessing the correctness of the sequence of actions.

(Amir Khella, Knowledge and Mental Models in HCI, September 2002, University of Maryland)

internet of things

We can portray mental models using several key parts:
1. An image (needed if the mental model is of a physical thing).
2. A script (needed if the mental model has a process).
3. A set of related metnal models.
4. A controlled vocabulary.
5. A set of assumptions.

Ubiquitous computing and tangible user interfaces depend on embedding sensing techniques into the environment. For example, active badges with Radio Frequency Identification (RFID) tags can trigger the preloading of personal files into a room's computer when users enter a room. The positioning of physical objects can specify modes or trigger actions. Ambient light, sound, or airflow can be artistic applications use video cameras or body sensors to track body positions and create enticing user experiences. Early explorations by perforamnce artist Vincent John Vincent led to a three-dimensional environment for theatical exploration such as Mandala, in which performers or amateur users touch images of harps, bells, drums, or cymbals, and the instruments respond. Myron Krueger's artificial realities contain friendly video-projected cartoon-like creatures that playfully crawl on your arm or approach your outstretched hand. Such environments invite participation, and the serious research aspects fade as joyful exploration takes over and you step inside the computer's world. StoryRoom is another such application that enables children to actively construct their own interactive environments, using props and magic wands to create stories that other chidlren are invited to experience.
(Designing the user interface, p.327)