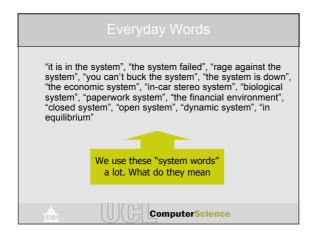
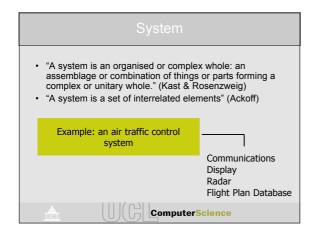
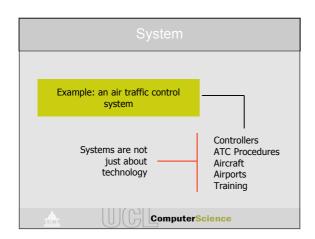
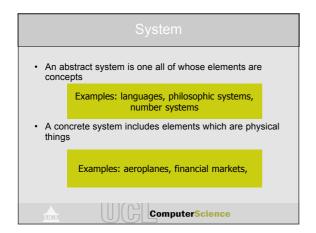


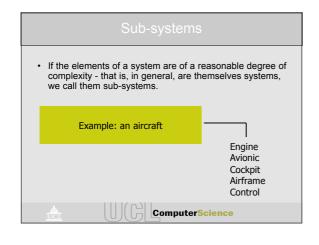
Unit 1: Software & Systems Engineering Objectives To provide an introduction to systems engineering and the embedding of software in a systems context. ComputerScience

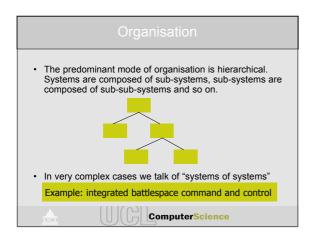


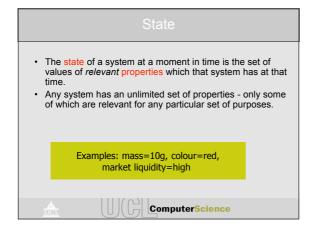






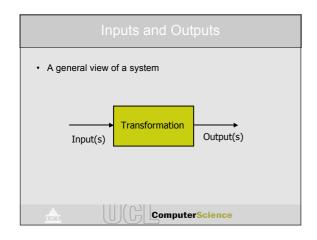


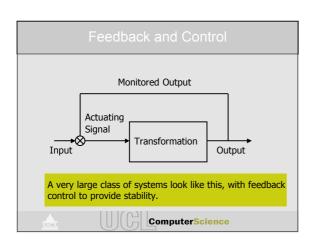




The environment of a system is the set of elements (and their relevant properties) which are NOT part of the system - but a change in any of which can produce a change in the state of the system I Environment Boundary System ComputerScience The choice of the boundary is subjective. Different people may divide a domain of discourse into different systems and environments. An architect views a house as the system comprised of mechanical, electrical, heating and water sub-systems. The electrical supply system is in the environment. The electrical may view the electrical sub-system together with the electrical supply system as the system with the house as its environment. with the house as its environment. ComputerScience Setting boundaries is very important when analysing and designing a system. It limits your investigation and problem solving "space". Example: Imagine you are designing a new electrical car. Are the repair shops, refuelling stations and parts supply part of the system you are designing or not? How much Do they affect the design of the car? Can you change them? How much would changes in them affect your design (robustness)? ComputerScience

• Systems can be considered closed or open. · Closed systems do not interact with their environment. Any closed system tends to move towards a chaotic or random state in which there is no further potential for energy transformation or work - an increase in entropy. · Open systems have a dynamic relationship with their environment, receiving inputs, transforming these inputs and exporting outputs. They adapt to their environment by changing the structure and nature of their components -they can be said to be in equilibrium. ComputerScience Systems generally have purpose (sometimes the word mission is used). Their purpose may be to maintain a particular state or to achieve a goal, that is some preferred outcome. It is not always clear what the purpose of a complex system is. Example: The National Health Service is a system. What is its purpose? Is this purpose one shared by all its sub-systems? ComputerScience In achieving their purpose systems exhibit dynamic characteristics - behaviour. It may not be easy to understand this behaviour - systems can behave counter-intuitively. Example: Arrest of dealers in hard drugs? ComputerScience





Compositionality & Emergence If you know something about the behaviour of a subsystem and you compose that sub-system with other subsystems to constitute a new system the behaviour of that sub-system may change New behaviours - desired and undesired - may arise because of the composition. These behaviours are known as emergent. Example: Feature interaction in telephone systems. Ring Back When Free and Call Divert. ComputerScience

Systems Engineering Software is an important part of many large and complex real-world systems but only a part! It is embedded in a broader systems context! This means that you have to "engineer" the system not just the software. ComputerScience Implications

This means you need to: Work with engineers from multiple disciplines Avoid "software mindset" think carefully about the different characteristics of the constituent technologies Configure a systems engineering process, approaches which work for software will not work in other settings

Partitioning Partitioning is dividing the system according to implementation technology In general delay partitioning till as late as possible Early partitioning can result in non-optimal solutions Once partitioning decisions have been made they can be very costly to change

Throughout the Units which follow you should "think systems" not just software. Very few real problems are amenable to being solved by software alone they require systems solutions. ComputerScience