COMPUTER BASED SYSTEM

- Software engineering occurs as a consequence of a process called *system engineering.*

- *Instead of concentrating solely on software, system engineering* focuses on a variety of elements, analyzing, designing, and organizing those elements into a system that can be a product, a service, or a technology for the transformation of information or control.

- System engineering may take on two different forms depending on the application domain
  - "Business process" engineering – conducted when the context of the work focuses on a business enterprise
  - Product engineering – conducted when the context of the work focuses on a product that is to be built
- Both forms bring order to the development of computer-based systems
- Both forms work to allocate a role for computer software and to establish the links that tie software to other elements of a computer-based system

System

- System (Webster)
  - A set or arrangement of things so related as to form a unity or organic whole
  - A set of facts, principles, rules. etc., … to show a logical plan linking the various parts
  - A method or plan of classification or arrangement
  - An established way of doing something such as a method or procedure

Computer-based System

- Defined: *A set or arrangement of elements that are organized to accomplish some predefined goal by processing information*
- The goal may be to support some business function or to develop a product that can be sold to generate business revenue
- A computer-based system makes use of system elements
- Elements constituting one system may represent one macro element of a still larger system
- Example
  - A factory automation system may consist of a numerical control machine, robots, and data entry devices; each can be its own system
  - At the next lower hierarchical level, a numerical control machine, is a computer-based system that may integrate other macro elements

- CBS - makes use of the following <u>elements</u> that combine in a variety of ways to transform information
  - **Software**: computer programs, data structures, and related work products that serve to effect the logical method, procedure, or control that is required
  - **Hardware**: electronic devices that provide computing capability, interconnectivity devices that enable flow of data, and electromechanical devices that provide external functions
  - **People**: Users and operators of hardware and software
  - **Database**: A large, organized collection of information that is accessed via software and persists over time
- The uses of these elements are described in the following:
  - **Documentation**: Descriptive information that portrays the use and operation of the system
  - **Procedures**: The steps that define the specific use of each sys element or the procedural context in which the system resides

- To summarize, the manufacturing cell and its macro elements each are composed of system elements with the generic labels: software, hardware, people, database, procedures, and documentation.

- In some cases, macro elements may share a generic element.

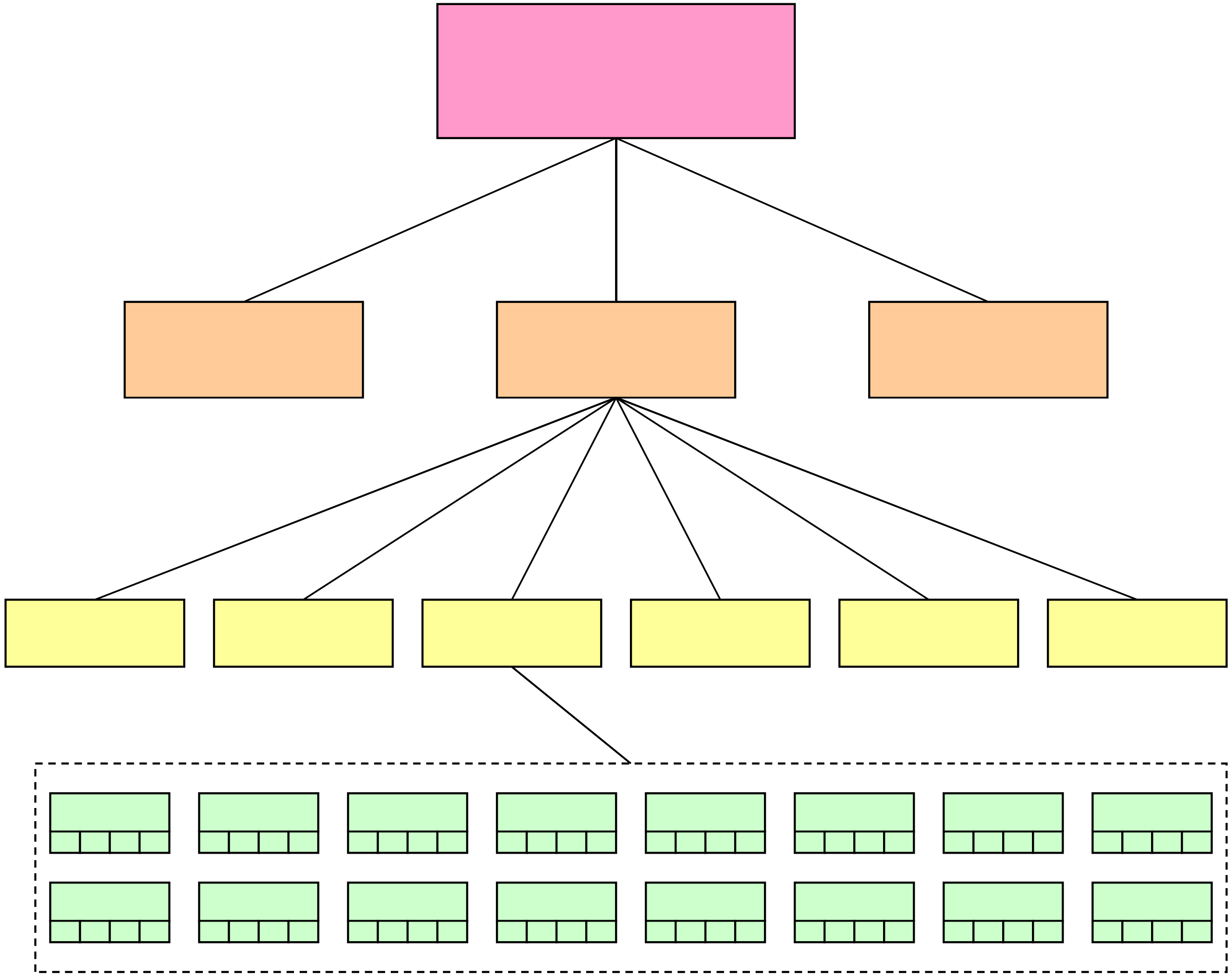
- For example, the robot and the NC machine both might be managed by a single operator (the people element).

- In other cases, generic elements are exclusive to one system.
- The role of the system engineer is to define the elements for a specific computer based system in the context of the overall hierarchy of systems (macro elements).

System Engineering Process

- The system engineering process begins with a world view;
- the business or product domain is examined to ensure that the proper business or technology -established
- The world view is refined to focus on a specific domain of interest
- Within a specific domain, the need for targeted system elements is analyzed
- Finally, the analysis, design, and construction of a targeted system element are initiated
- At the world view level, a very broad context is established
- At the bottom level, detailed technical activities are conducted by the relevant engineering discipline (e.g., software engineering)

System Engineering Hierarchy

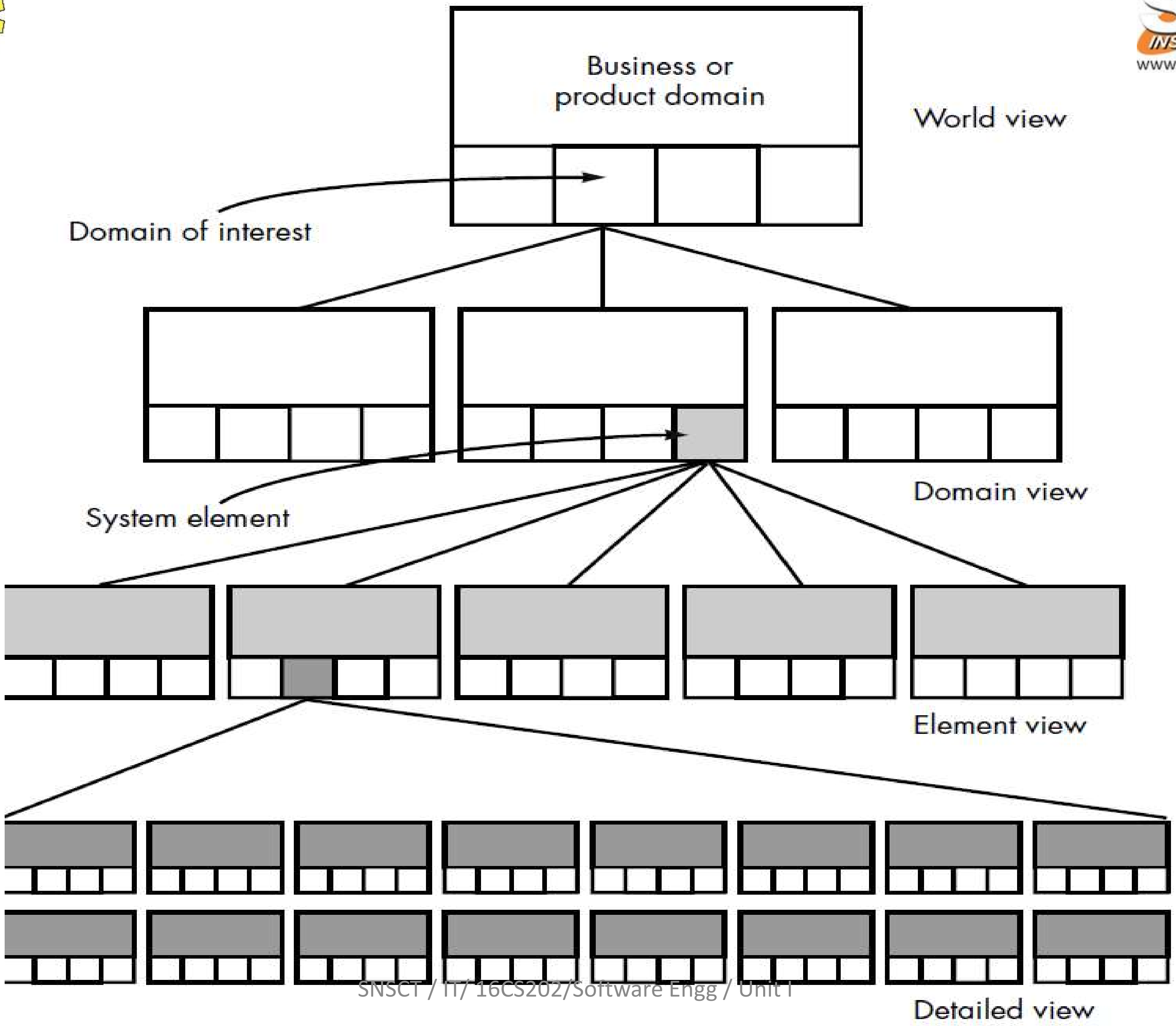


World View

Domain View

Element View

Component View


Business or product domain
World view
Domain of interest
System element
Domain view
Element view
Detailed view

Stated in a slightly more formal manner, the world view (WV) is composed of a set of domains (D_i), which can each be a system or system of systems in its own right.

$$WV = \{D_1, D_2, D_3, \ldots, D_n\}$$

Each domain is composed of specific elements (E_j) each of which serves some role in accomplishing the objective and goals of the domain or component:

$$D_i = \{E_1, E_2, E_3, \ldots, E_m\}$$

Finally, each element is implemented by specifying the technical components (C_k) that achieve the necessary function for an element:

$$E_j = \{C_1, C_2, C_3, \ldots, C_k\}$$

In the software context, a component could be a computer program, a reusable program component, a module, a class or object, or even a programming language statement.

System Modeling (at each view level)

- Defines the processes (e.g., domain classes in OO terminology) that serve the needs of the view under consideration
- Represents the behavior of the processes and the assumptions on which the behavior is based
- Explicitly defines intra-level and inter-level input that form links between entities in the model
- Represents all linkages (including output) that will enable the engineer to better understand the view
- May result in models that call for one of the following
  - Completely automated solution
  - A semi-automated solution
  - A non-automated (i.e., manual) approach

Factors -when Constructing a Model

- Assumptions
  - reduce the number of possible variations, thus enabling a model to reflect the problem in a reasonable manner
- Simplifications
  - These enable the model to be created in a timely manner
- Limitations
  - These help to bound the maximum and minimum values of the system
- Constraints
  - These guide the manner in which the model is created and the approach taken when the model is implemented
- Preferences
  - These indicate the preferred solution for all data, functions, and behavior
  - They are driven by customer requirements