Conceptional Model of Computer Architecture

- The architectural description of a computer particularly should express the capabilities of its programmable interface as
  - computer instruction set,
  - register structure,
  - addressing modes,
  - handling of exceptional conditions and I/O by the programmer,

  → today mostly named as Instruction Set Architecture (ISA).

- Today a modern definition of computer architecture comprises
  - analysis,
  - evaluation,
  - design,
  - synthesis,

  of computers and computer components.

  →Hence it is simultaneously comprehensive/interdisciplinary.

Aspects of Computer Architecture

- Following aspects have to be regarded:
  - structure,
  - organization,
  - technical implementation.
- These aspects are to analyze on
  - global system level,
  - instruction set level,
  - micro architecture level.
- Among the partial aspects/levels exist feedbacks and wide-ranged interactions as well as with other disciplines of informatics, natural sciences and mathematics.

Advantages of this Approach

- A conceptional model is structured into partitions and description levels.
- It could be mapped on existing computer architectures or on architectures which have to be developed.
- It is easy to designate subproblems which are to be solved with comparison or investigation of available computers and with the design of new computers or computer components.
- The model permits to assign the necessary know-how, the required techniques of analysis and design and the available tools to the subproblems that have to be solved.

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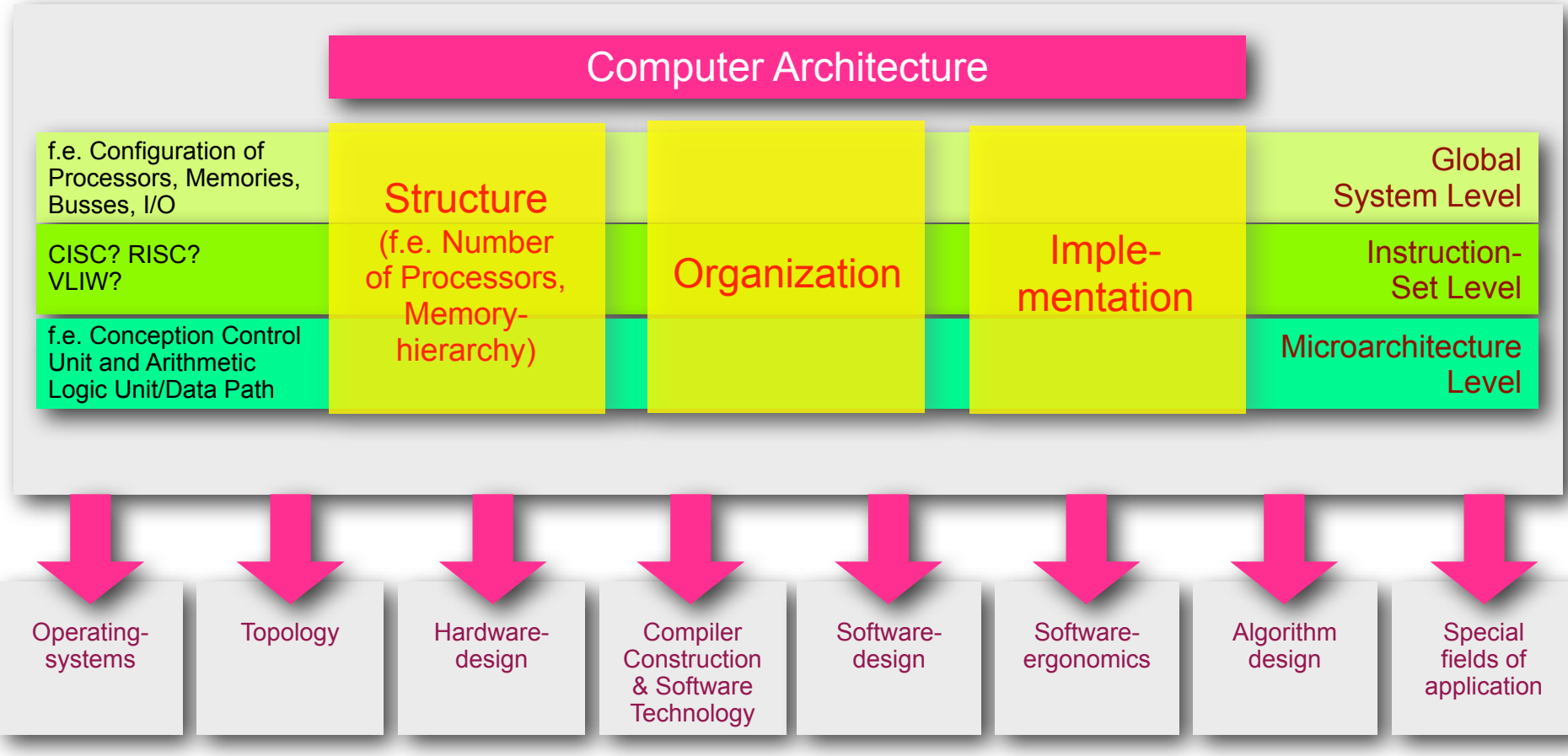


Tasks of the Field of Activity (Selection)

- Analysis of architectures of existing computer systems and computer components, i.e. processors, memories, logic components, interconnection structures, i/o-subsystems, periphery controllers.
- Classification of computer architectures.
- Observation of evolution of computer families and architectural classes.
- Early recognition of promising innovative problem solution approaches and processing principles and checking their practicability.
- Derivation and recognition of available and future trends.
- Design and synthesis of efficient computer systems from new or existing standards or special components, thereby using efficient EDA tools.
- Implementation of performance requirements which today widely are predetermined by the software and the fields of application into appropriate structures and organization forms for computers and their components (SoC).

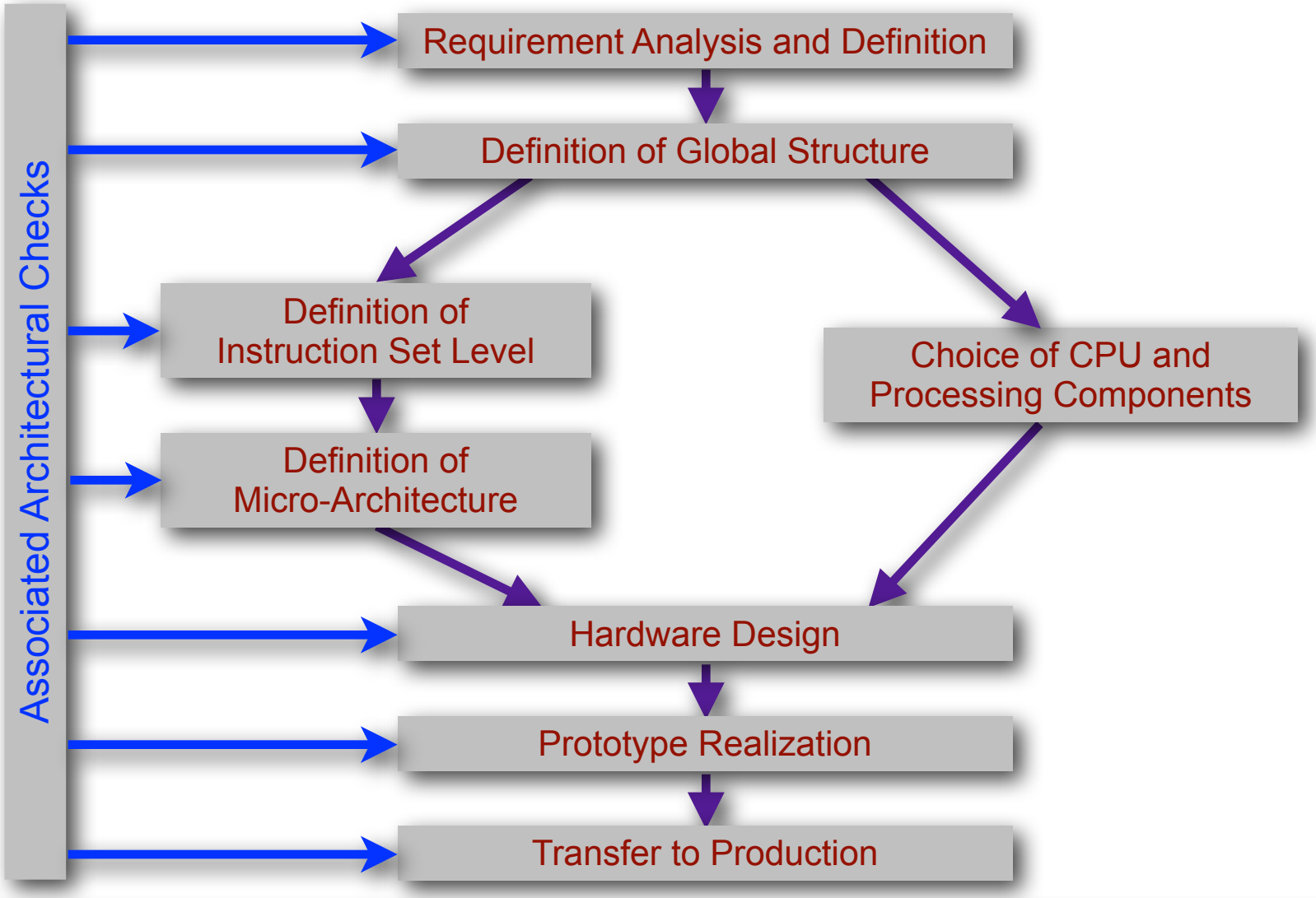
Aims for the Field of Activity (Selection)

- Further increase in performance by improving architecture.
- Observance of established quality criteria for design and realization.
- Increase of usability by f.e. hardware components for human machine communication (user interfaces, media such as voice, animation, audio, video, virtual reality).
- Design of evolutionary architectural concepts, expandable in functionality and performance, innovative ideas) → competitive implementations for a long time → reducing the average development costs.
- Promotion of useful and future-proof industry standards (not to disadvantage of design goals and design quality).
- Aspiration for balanced (hardware and software) systems.
- Utilization of synergy-effects with application fields → for achieving even more effective solutions.
- Intensive interoperation/co-operation of users and developers.

Methods

- Design of computers is realized corresponding to the description levels of a hierarchical strategy.
- Two ways:
  - Top/down design:
    designing the global structure → design of instruction set and micro architecture level → definition of the logic level → the necessary technology.
  - Bottom/up design:
    available circuit technology and respectively components build the basis for realizing computer components → object of design is the overall structure.
- In practice real system designs only could be reached with mixed top-down/bottom-up strategies = meet in the middle.
- Instead of a pure sequential process flow multiple design phases can be processed concurrent.

Phases


Associated Architectural Checks
Requirement Analysis and Definition
Definition of Global Structure
Definition of Instruction Set Level
Choice of CPU and Processing Components
Definition of Micro-Architecture
Hardware Design
Prototype Realization
Transfer to Production