Real Time Systems Design

Lecture (4): Systems Specifications (cont.)

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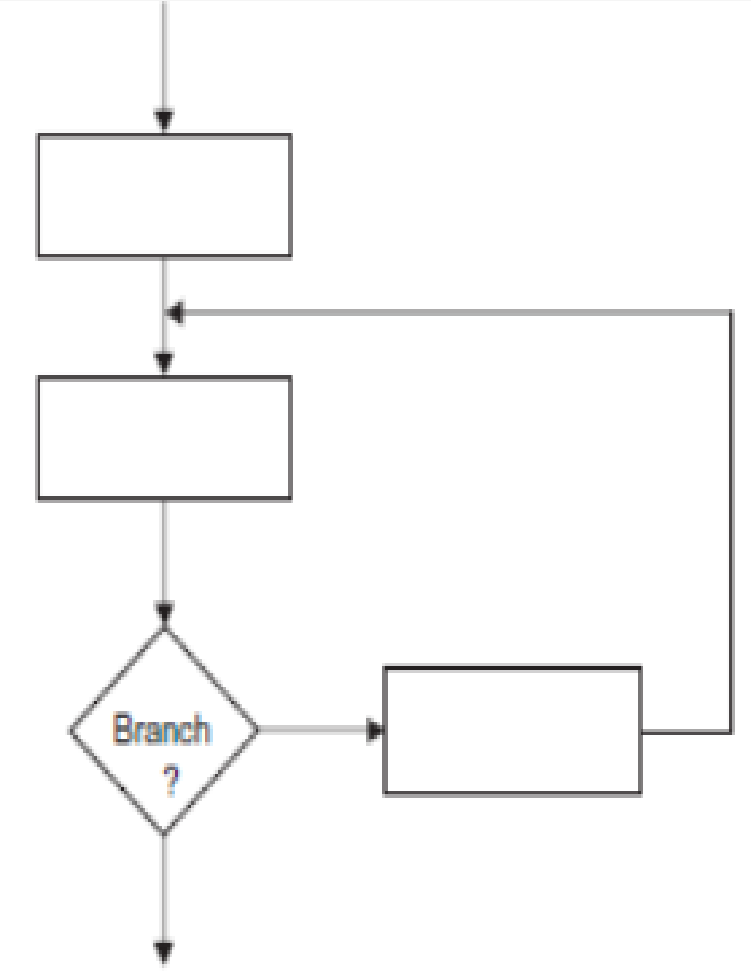
Event



In software systems, a change in state results in a change in the flow - of – control of the computer program. Consider the flowchart in Figure below. The decision block represented by the diamond suggests that the stream of program instructions can take one of two alternative paths, depending on the response in question. case , if - then , and while statements in any programming language represent a possible change in flow - of - control. Invocation of procedures in Ada and C represent changes in flow - of - control. In object – oriented languages, instantiation of an object or the invocation of a method causes the change in sequential flow - of - control. In general, consider the following definition.

Definition: Event

Any occurrence that causes the program counter to change non-sequentially is considered a change of flow - of - control

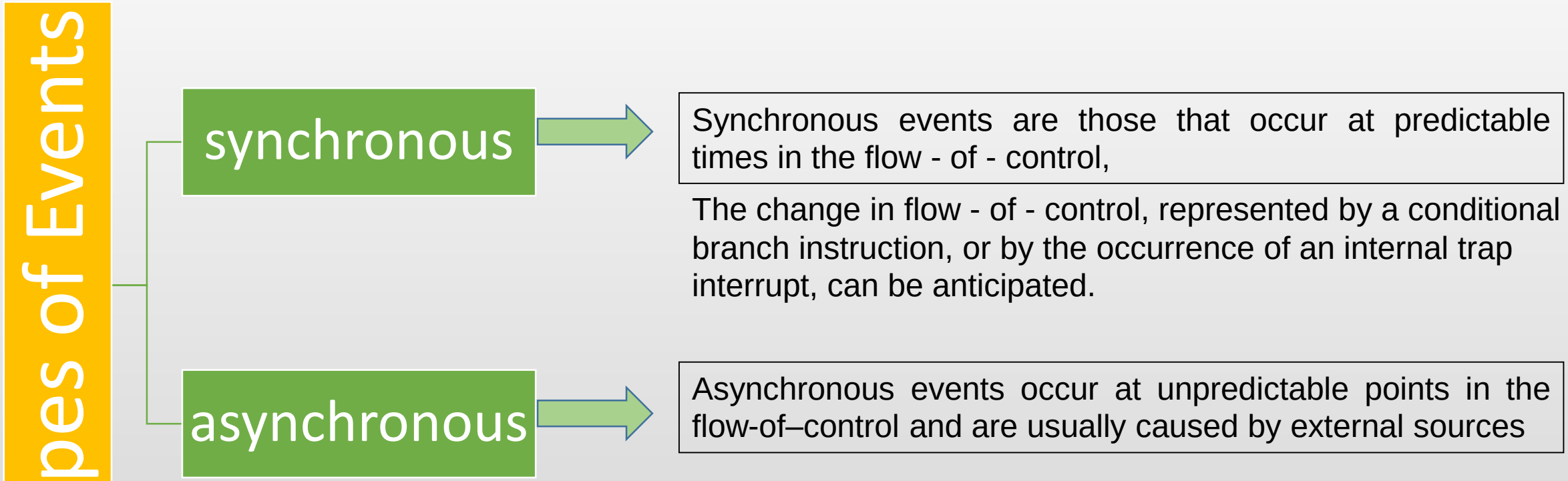
Definition: Release Time

The release time is the time at which an instance of a scheduled task is ready to run, and is generally associated with an interrupt.

Note

Events are slightly different from jobs in that events can be caused by interrupts, as well as branches.

Types of events



A real - time clock that pulses regularly at 5 ms is not a synchronous event. While it represents a periodic event, even if the clock were able to tick at a perfect 5 ms without drift, the point where the tick occurs with the flow - of - control is subject to many factors. These factors include the time at which the clock starts relative to the program and propagation delays in the computer system itself. An engineer can never count on a clock ticking exactly at the rate specified, and so any clock - driven event must be treated as asynchronous.

Events that do not occur at regular periods are called aperiodic. Furthermore, aperiodic events that tend to occur very infrequently are called sporadic.

Taxonomy of Events and Some Typical Examples

	Periodic	Aperiodic	Sporadic
Synchronous	Cyclic code	Conditional branch	Divide-by-zero (trap) interrupt
Asynchronous	Clock interrupt	Regular, but not fixed-period interrupt	Power-loss alarm

Examples

- An interrupt generated by a periodic external clock represents a periodic but asynchronous event.
- A periodic but synchronous event is one represented by a sequence of invocation of software tasks in a repeated, circular fashion.
- A typical branch instruction that is not part of a code block and that runs repeatedly at a regular rate represents a synchronous but aperiodic event.

Examples

- A branch instruction that happens infrequently, say, on the detection of some exceptional condition, is both sporadic and synchronous.
- Interrupts that are generated irregularly by an external device are classified as either asynchronous aperiodic or sporadic, depending on whether the interrupt is generated frequently or not with respect to the system clock.

Overall Control of Real-Time System

- In every system, and particularly in an embedded real - time system, maintaining overall control is extremely important. For any physical system, certain states exist under which the system is considered to be out of control; the software controlling such a system must therefore avoid these states.

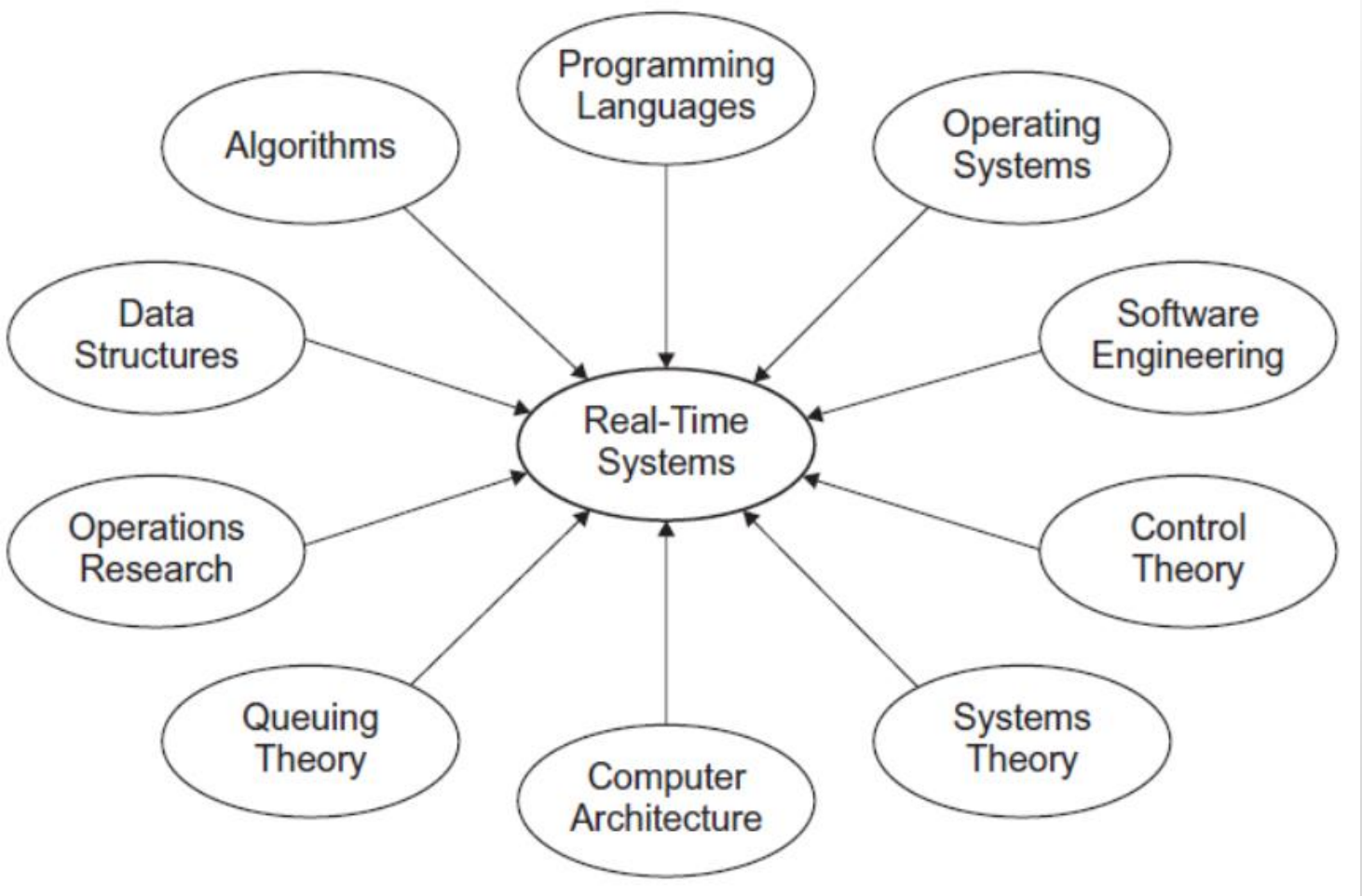
Definition: Deterministic System

A system is deterministic, if for each possible state and each set of inputs, a unique set of outputs and next state of the system can be determined.

Usual Misconceptions

1. Real - time systems are synonymous with “ fast ” systems.
2. Rate - monotonic analysis has solved “ the real - time problem. ”
3. There are universal, widely accepted methodologies for real - time systems specification and design.
4. There is no more a need to build a real - time operating system, because many commercial products exist.
5. The study of real - time systems is mostly about scheduling theory.

MULTIDISCIPLINARY DESIGN CHALLENGES



A variety of disciplines that affect real - time systems engineering.

Summary

- ✓ Explanation of Event
- ✓ Definition of Event
- ✓ Definition of Release Time
- ✓ Types of Events and Examples
- ✓ Overall Control of Real-Time systems
- ✓ Definition of Deterministic System
- ✓ Usual Misconceptions
- ✓ Design Challenges