Kemerburgaz University
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The project topic is

An Analysis of Operating System Behavior on a Simultaneous Multithreaded (SMT) Architecture

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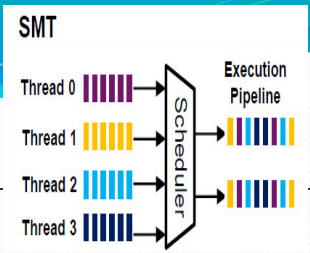
Outline



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Introduction

- Simultaneous multithreading (SMT) is a technique for improving the overall efficiency of superscalar CPUs with hardware multithreading. SMT permits multiple independent threads of execution to better utilize the resources provided by modern processor architectures.

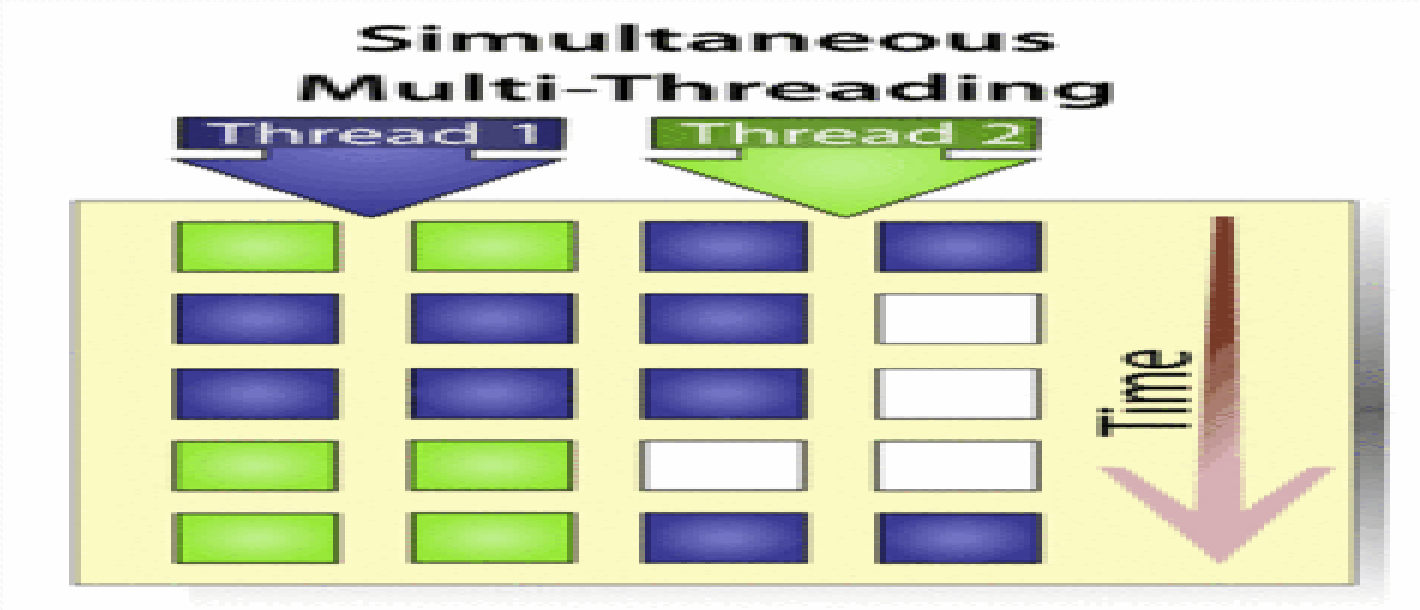


Figure 1. Simultaneous multi-threading adapted from (Haff, 2009).

Simultaneous Multithreading SMT

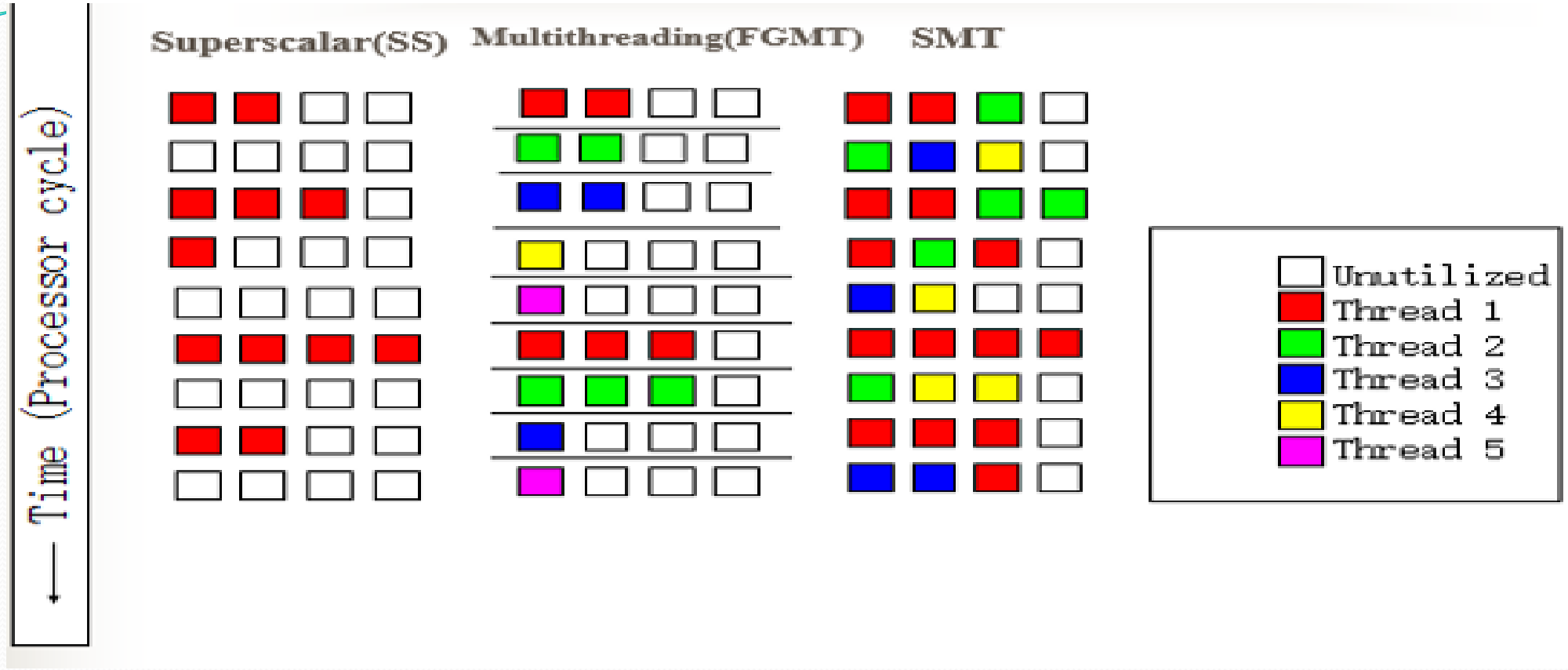


Figure 2. SMT multiprocessor

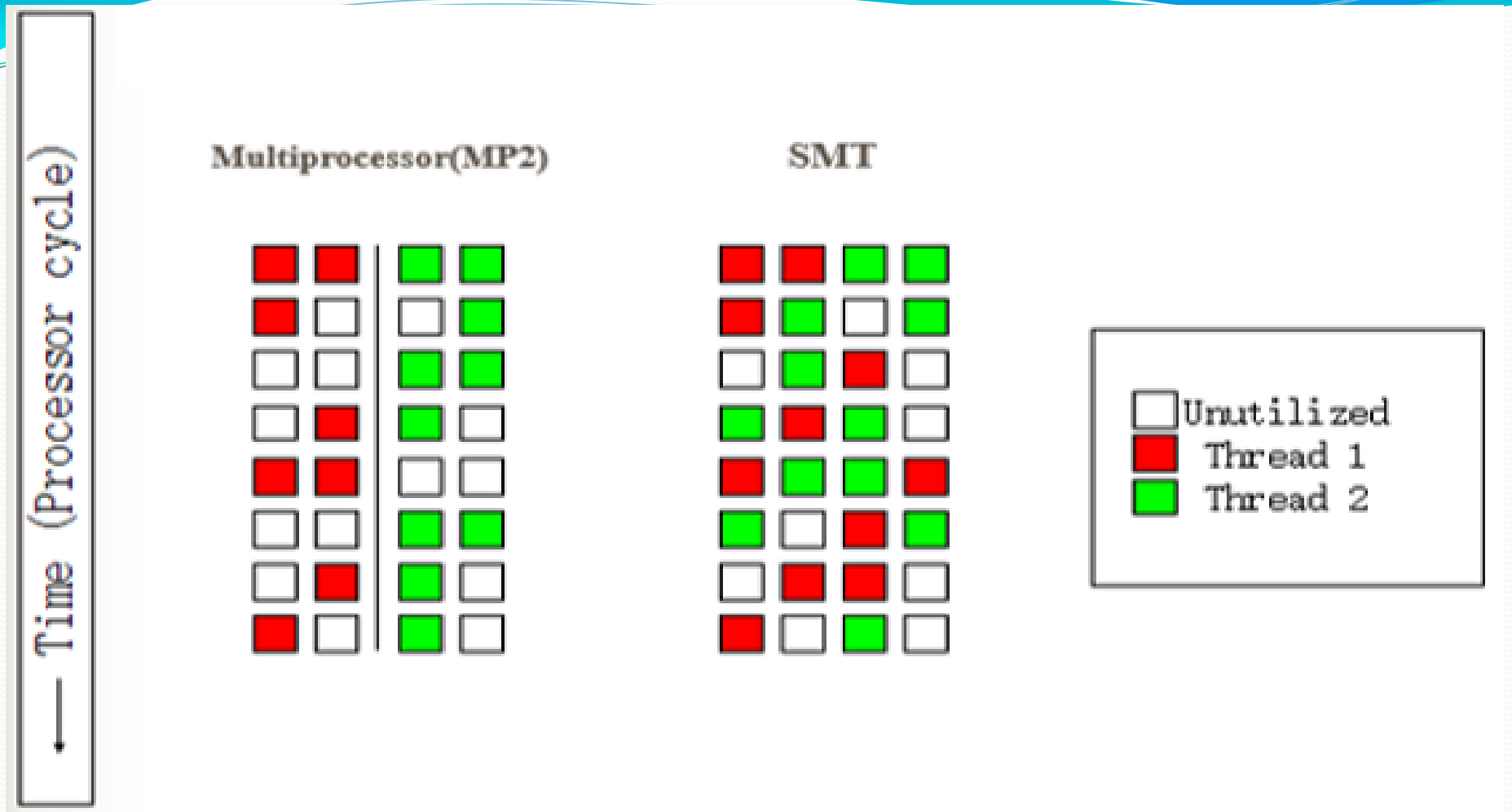


Figure.3. Multiprocessor and SMT

Related work

- Eggers et al., (1997)
- Redstone et al., (2000)
- Ruan et al., (2005)
- Marr et al., (2008)
- Pouyan et al., (2014)
- According to Ruan et al., (2005) empowering SMT on genuine hardware often delivers just slight execution picks up, and can in some cases prompt to execution misfortune. In the uniprocessor case, past reviews show up to have ignored the OS overhead in changing from a uniprocessor portion to a SMT-empowered part

SMT Architecture

- Base Processor: like out-of-order superscalar processor. [MIPS R10000]
- Changes: With N simultaneous running threads, need N PC and N subroutine return stacks and more than N*32 physical registers for register renaming in total.
- Need large register files, longer register access time, pipeline stages are added. SMT Pipeline below explain the SMT architecture.
- Share the cache hierarchy and branch prediction hardware.
- Each cycle: select up to 2 threads and each fetch up to 4 instructions.

Fetch	Decode	Renaming	Queue	Reg Read	eg Read	Exec	Reg Write	Commit

Figure.4. SMT Pipeline architecture

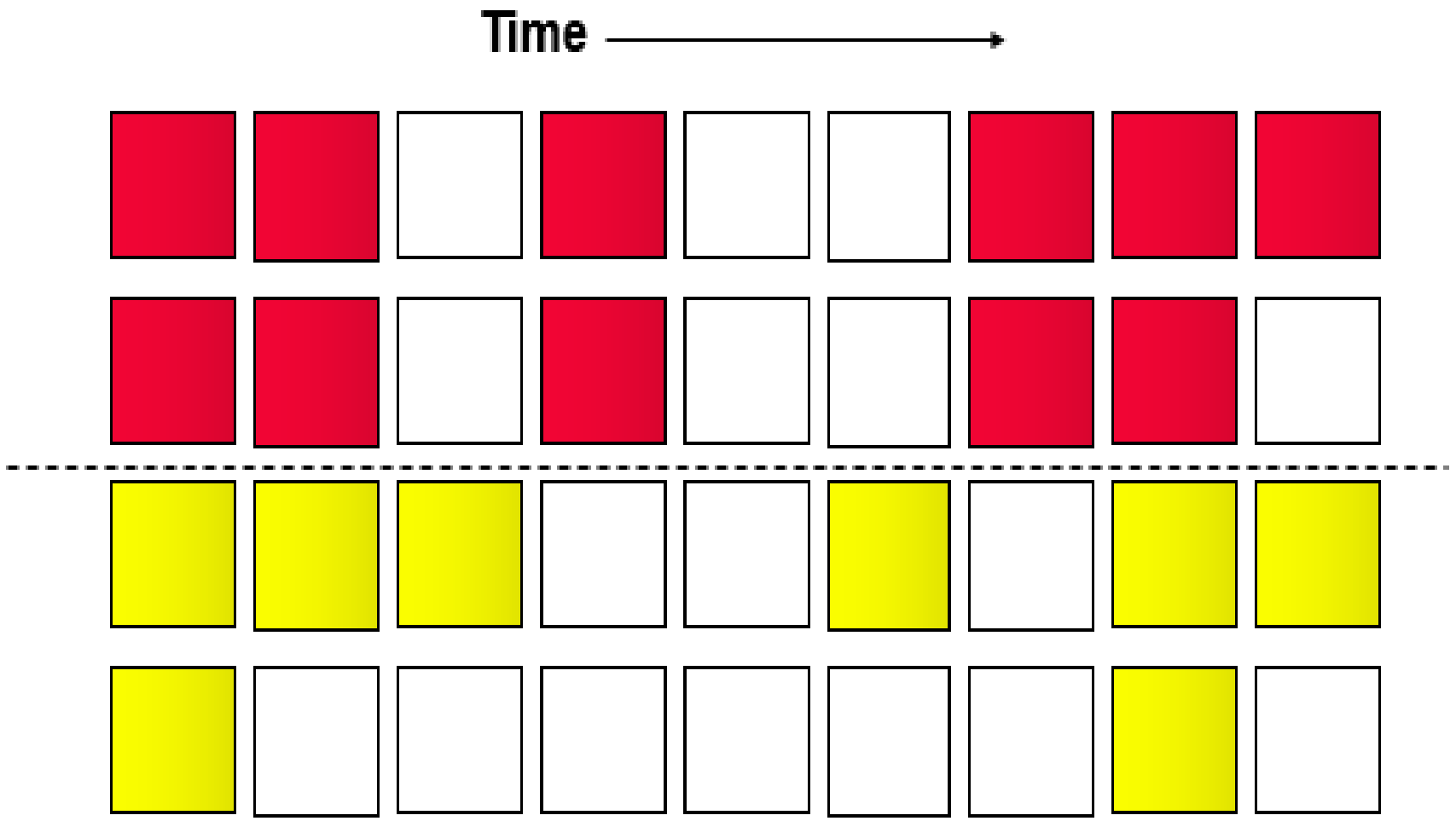


Figure.5. Chip Multiprocessor Limited utilization when only running one thread

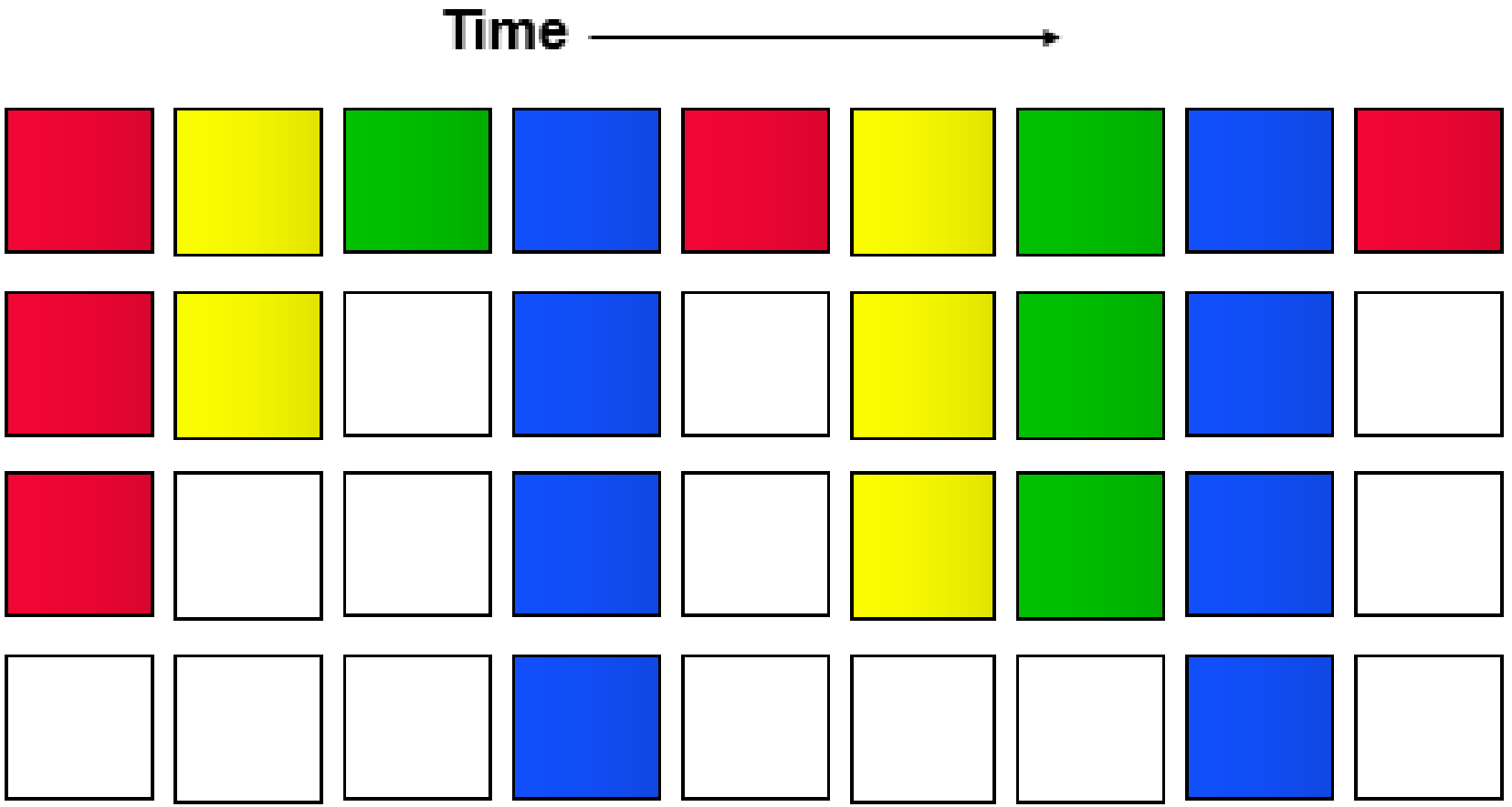


Figure.6.Fine Grained Multithreading Intra-thread dependencies still limit performance

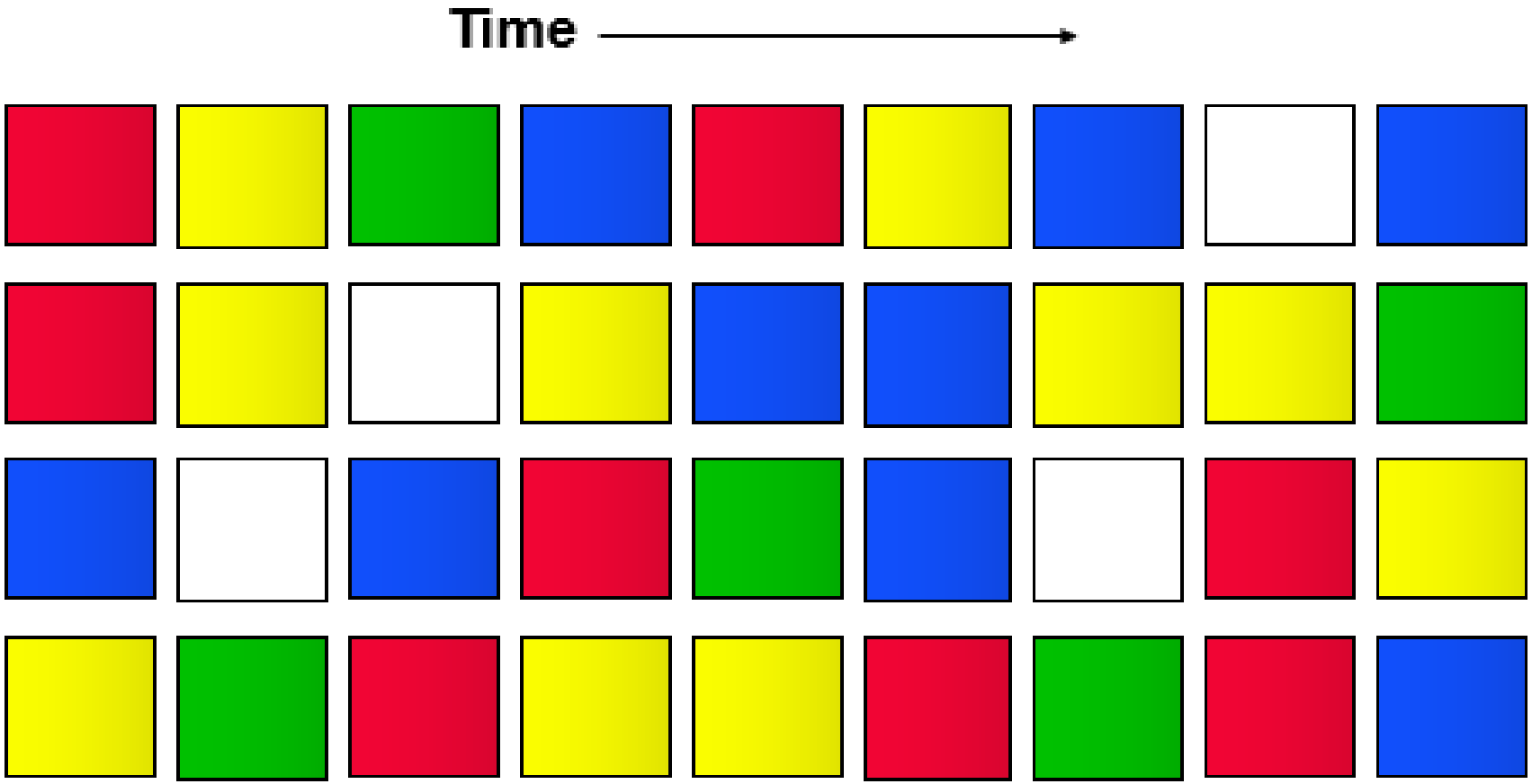


Figure.7.Simultaneous Multithreading Maximum utilization of function units by independent operations.

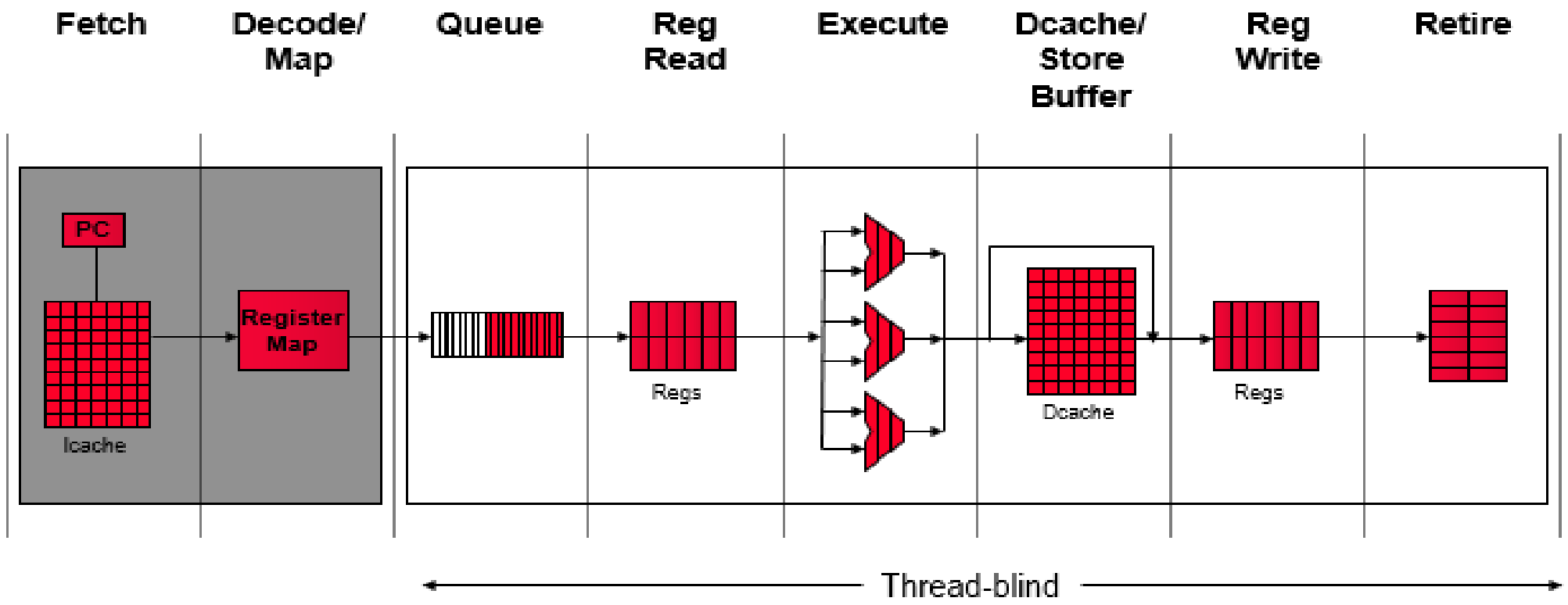


Figure.8. Basic Out-of-order Pipeline (Marr, 2008).

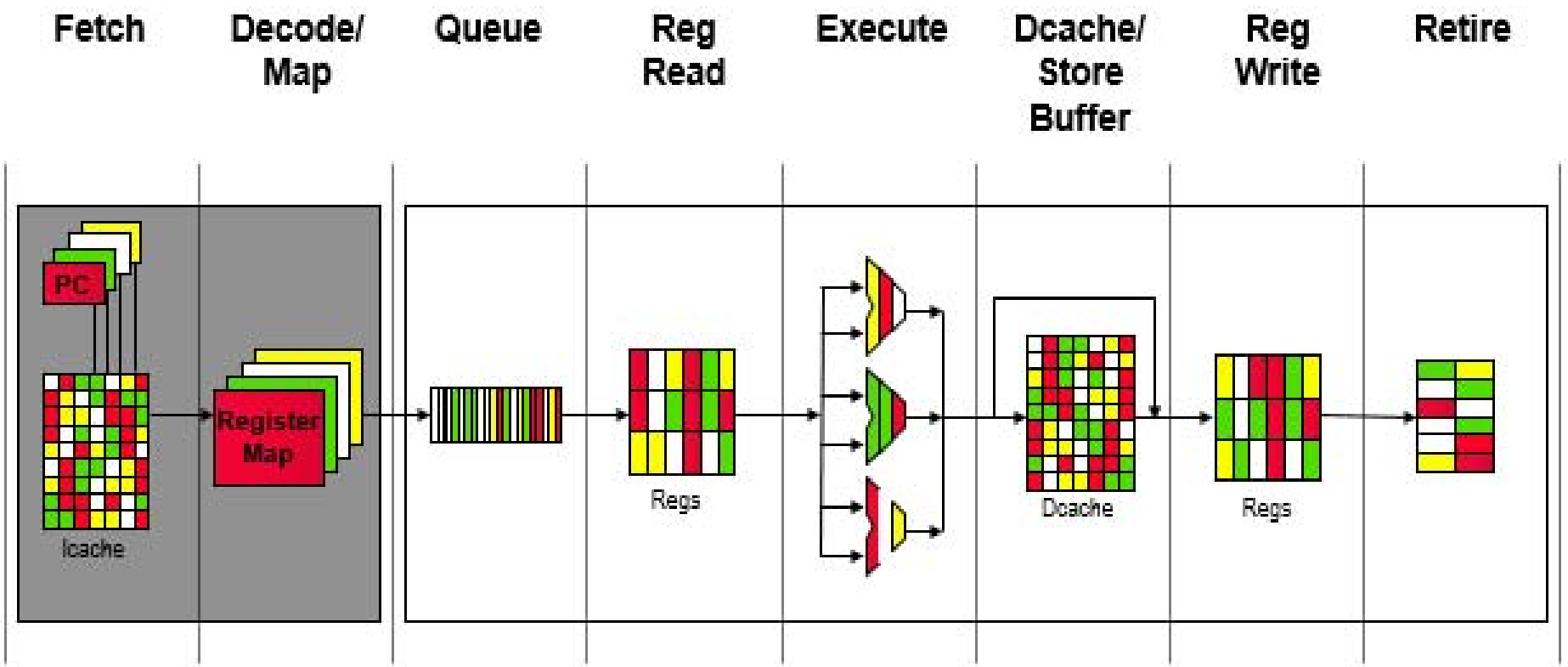
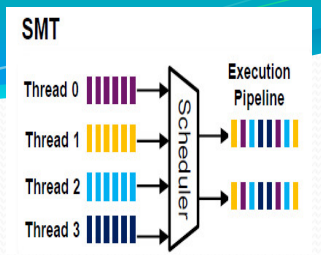


Figure.9. SMT Pipeline adapted from (Marr, 2008).

Changes for SMT



- Basic pipeline unchanged.
- Replicated resources (Program counters, Register maps).
- Shared resources (Eggers et al., 1997).
    1) (Register file (size increased).
    2) Instruction queue
    3) First and second level caches
    4) Translation buffers.
    5) Branch predictor (Haff, 2009).

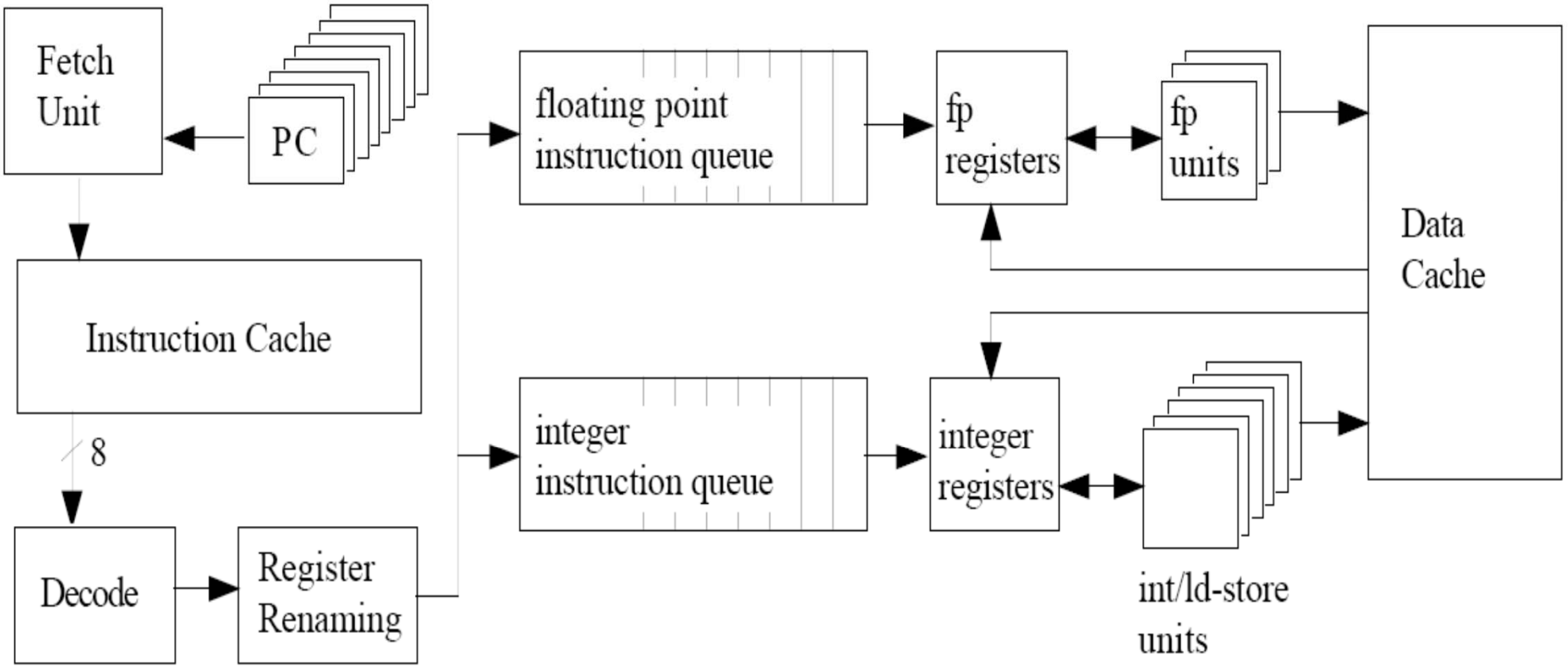
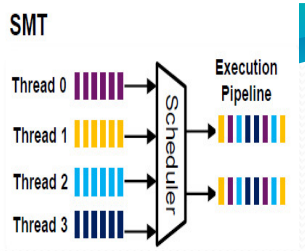


Figure.10. Simultaneous Multithreading (SMT) adapted from (Haff, 2009).

SMT advantages



- Increased throughput w/o adding much cost
- Fast response for multitasking environment (Haff, 2009).
- SMT will significantly enhance multistream performance
- Across a wide range of applications (Eggers et al., 1997).
- Without significant hardware cost, and Without major architectural changes (Reinhardt and Mukherjee, 2000).

SMT disadvantages

- Slower single processor performance (Eggers et al., 1997).
- Can decrease performance if any of the shared resources are bottlenecks for performance.

Conclusion

- In this presentation , this study of Simultaneous Multithreading can be found in screening the collected papers from the electronic databases.
- This study is essential for many of the organizations who have an interest in reaping the best benefits of using SMT.
- The main contribution of this is study the impact and the main benefit of using or misusing SMT in different type of the organizations or project domains .
- Finally, Simultaneous Multithreading (SMT) can significantly increase resource usability and enhance performance improvement. Making those threading elements busy is key to maximize processing efficiency and therefore power efficiency as well as high performance.

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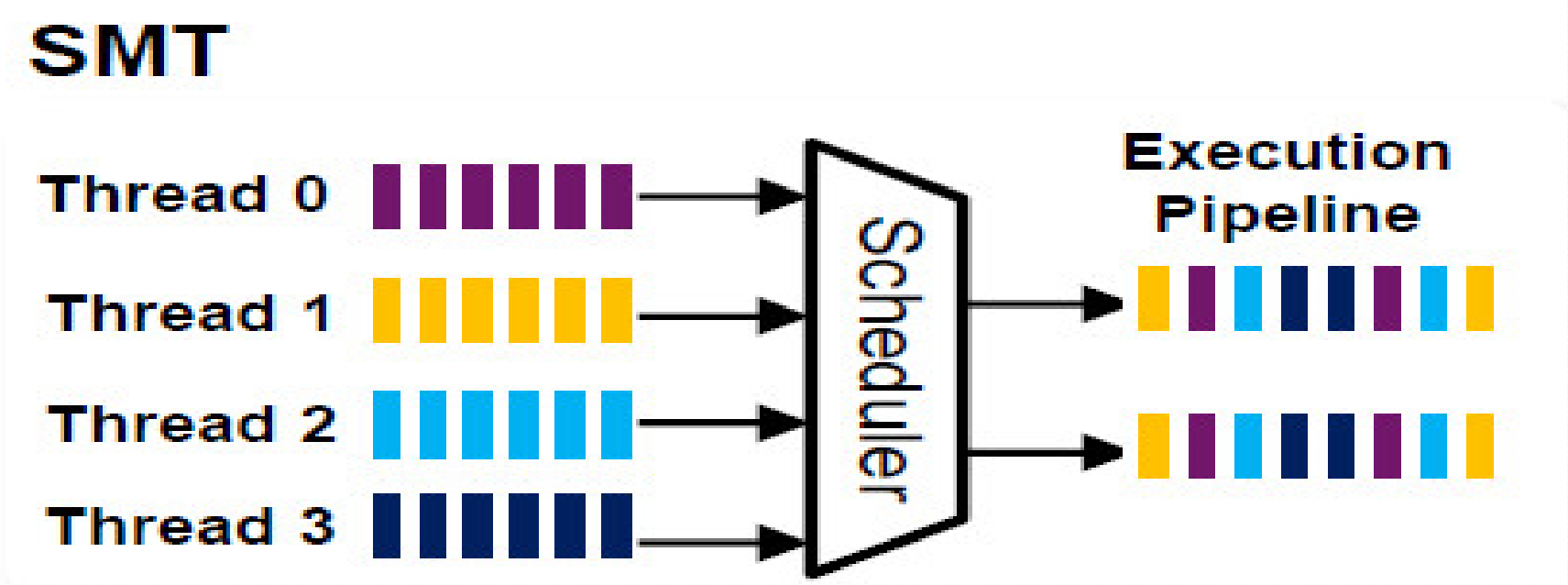
What is Simultaneous Multithreading



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