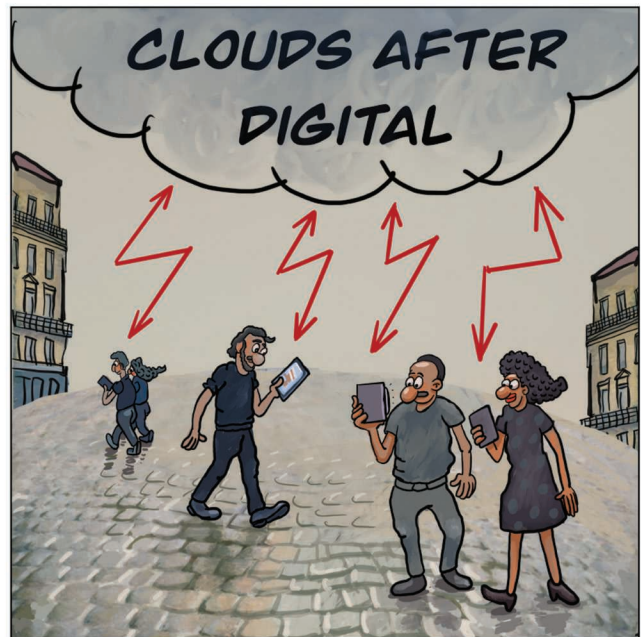
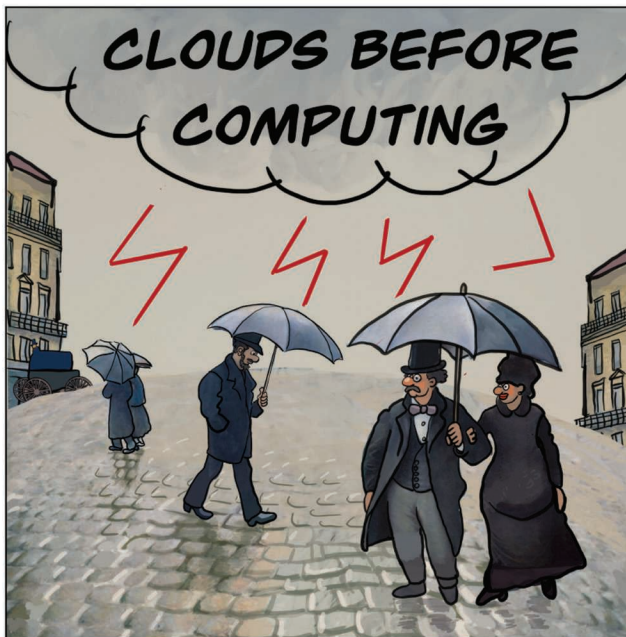


# COMPUTING THROUGH TIME

ERGUN  
AKLEMAN



THIS IS AN HOMAGE TO AN 1877 PAINTING OF IMPRESSIONIST PAINTER GUSTAVE CAILLEBOTTE, CALLED "PARIS STREET; RAINY DAY." IN THIS PAINTING, THE MOST IMPORTANT CONTRIBUTION OF THE ARTIST IS THE FEELING OF RAIN WITHOUT DRAWING RAIN DROPLETS AND CLOUDS. WE KNOW IT IS RAINING BECAUSE OF THE UMBRELLAS AND REFLECTIONS ON THE GROUND. VIRTUAL COMPUTER CLOUDS ARE CONCEPTUALLY SIMILAR. WE DO NOT DIRECTLY OBSERVE THEM BUT WE KNOW THAT THEY ARE EVER PRESENT FROM INDIRECT EVIDENCE.

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very fast." [Editor's note: I believe the case studied—user interface improvements—is a typical one where alternatives can easily be tested in parallel and the results then integrated into the "final" design. Unfortunately, only usability improvements have been evaluated and not the time saved, as was the original claim.]

## Role-Based Access Control Models; Ravi S. Sandhu et al.

(p. 38) "A family of increasingly sophisticated models shows how RBAC works. ... A role can represent specific task competency, such as that of a physician or a pharmacist. A role can embody the authority and responsibility of, say, a project supervisor. Authority and responsibility are distinct from competency." (p. 40) "To explore RBAC's various dimensions, we have defined a family of four conceptual models. Figure 1a shows the model relationships and Figure 1b portrays their essential characteristics.  $RBAC_0$ , as the base model at the bottom, is the minimum requirement for an RBAC system. Advanced models  $RBAC_1$  and  $RBAC_2$  include  $RBAC_0$ , but  $RBAC_1$  adds role hierarchies (situations where roles can inherit permissions from other roles), whereas  $RBAC_2$

adds constraints (which impose restrictions on acceptable configurations of the different components of RBAC).  $RBAC_1$  and  $RBAC_2$  are incomparable to one another. The consolidated model,  $RBAC_3$ , includes  $RBAC_1$  and  $RBAC_2$  and, by transitivity,  $RBAC_0$ ." [Editor's note: The model includes many aspects of access control but stays on a rather abstract level. It would have been helpful if a sample case had been included.]

## Logical Time: Capturing Causality in Distributed Systems; Michel Raynal et al.

(p. 49) "Causality—determining which event happens before what others—is vital in distributed computations. Distributed systems can determine causality using logical clocks. ... The notion of time is basic to capturing the causality between events. However, distributed systems have no built-in physical time and can only approximate it. Even the Internet's Network Time Protocols,<sup>1</sup> which maintain a time accurate to a few tens of milliseconds, are not adequate for capturing causality in distributed systems. ... This article presents a general framework of a system of logical clocks in distributed systems and discusses three