

The Student, the Night Nurse, and the Threat at the Watercooler (An Example Cascaded-Game Analysis)

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In this short note, we shall analyse the co-regulation between two actors covered by fire-safety regulations in a work place: the actual **workers** and the safety officer, who controls the evacuation **alarm**. Seen in isolation, a worker is guided by his or her sense of **duty** while the safety officer is influenced by clear and present danger, e.g., a **fire**. The **alarm** can be **on** or **off**. A worker can be outside work, say at **home**, or in the **general** area of the work facility, or **busy** in the actual work area. Concretely, we could be talking about a hospital with nurses either being at the nurses' station or with patients, or about a graduate school with students either being in the coffee lounge or at their desk. **Workers'** sense of **duty** (or, e.g., desire for a diploma) will make them come into work (through the **general** area) and, e.g., a call from a patient will leave them **busy**. When **busy**, their only option is to return to the **general** area at some point. If a threatening **fire** is discovered, the **alarm** must be raised. Seeing that the safety officer is personally responsible for the well-being of the **workers**, we may want to consider the possibility of letting him raise the **alarm** by his own initiative, i.e., without a clear and present danger. However, if we do that, the **workers** will probably want a system in place by which they can petition for a raised **alarm** to be lowered again (e.g., to help evacuate immobile patients or to go grab the only copy of a nearly completed thesis). Needless to say, the safety officer will only be allowed to grant such a petition if there is no threatening **fire**. Questions: are these regulations safe? do they impede work?

The narrative given above translates into the *prioritised influence graph*, below left. The first block declares entities, (ordered) states, and the default states in which an entity may influence others. The second block lists influences on the safety officer/**alarm**. We see, e.g., that a **fire** unconditionally should lead to the **alarm** being raised, +, and that **fire** can prevent a **worker** from having the **alarm** lowered, -. The third block lists the narrated influences on a **worker**, with auto-inhibition only when **busy**. The last block is commented out for now. Following conversion into our ARS formalism (e.g., Alarm.off^{Fire.yes} → Alarm.on),

the cascaded-game prediction (right) is that, on any given day, we expect to find people evacuated as a result of a raised **alarm** (top box) or working normally (lower box), i.e., we can seemingly answer the above questions with ‘yes’, ‘no’.

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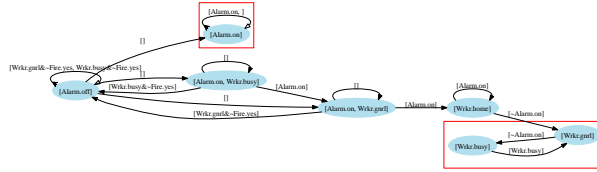
"Wrkr" | "home", "gnrl", "busy" | "gnrl", "busy" | |
"Alarm" | "off", "on" | "on" | | |
"Fire" | "no", "yes" | "yes" | | |
"Duty" | "no", "yes" | "yes" | | |

"Fire" | "Alarm" | + | | |
"Wrkr" | "Alarm" | - | - | "Fire"
"Alarm" | "Alarm" | + | + | |

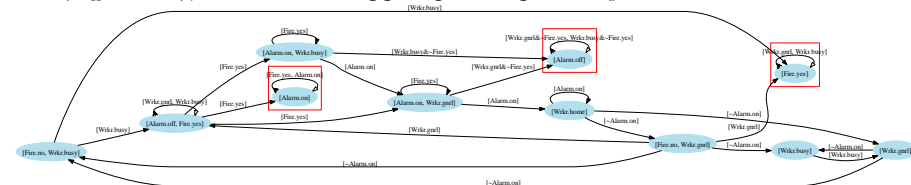
"Wrkr" | "Wrkr" | - | - | "busy" |
"Alarm" | "Wrkr" | - | - | |
"Duty" | "Wrkr" | + | + | | "Alarm"

; "Wrkr" | "Fire" | + | + | |

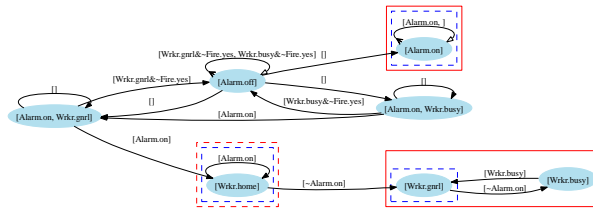
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If we include the last line, i.e., allow for the typically overlooked “threat at the watercooler”/internal threats in the form of torching by a worker (who is at work), the predictions change (below). Specifically, we see that the safety officer can still have people evacuated (left box) but, now, normal work with no **alarm** can only proceed as long as no **worker** sets a **fire** (middle box), and we can no longer guarantee that everybody will be told to evacuate in case of a **fire** (right box), even if the trapped person probably is the arsonist.



Commenting back out the “threat at the watercooler”, we see that our game-theoretic formalism allows for more detailed analysis (below) than first considered. In particular, we see that some sub-graphs are able to temporarily behave like a change-of-mind equilibrium provided all steps out of them involve inhibitors (red/outer dashed boxes). (This would be done by attempting to keep a stock of those inhibitors at the ready.) Similarly, we can imagine a sort of maximally inhibited instance of the cascaded game corresponding to the subgraph of arrows that list no inhibitors and this version can, of course, be subjected to an equilibrium analysis in its own right (blue/inner dashed boxes).



The left-most dashed box(es) corresponds, e.g., to the student who is staying at home in bed on the off chance that the evacuation **alarm** is being tested on that particular day, at least until the supervisor calls and tells him the test is next week. The blue/inner dashed box in the lower-right red box corresponds to the night nurse who is waiting at the nurses’ station in case some patient wakes up and needs help. In either case, it is a **worker** waiting for a call to **duty**.