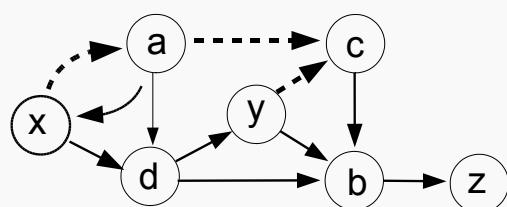


# Variations of the Game

## Variation 1: Boolean Trigger = Unnamed Rooms

Maze  $G_c$

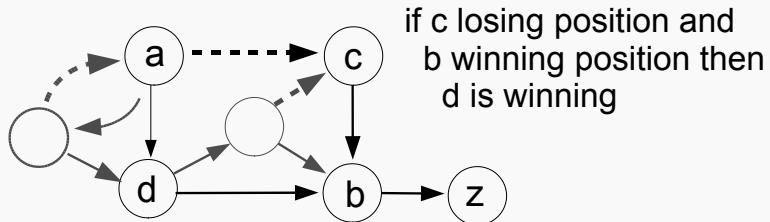


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel \neg d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 1: Boolean Trigger = Unnamed Rooms

Maze  $G_c$

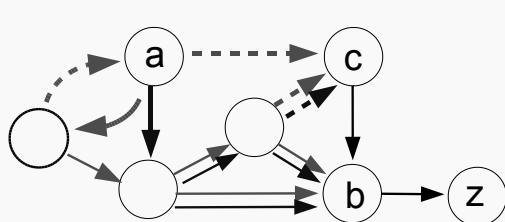


Configuration C

$c/a \parallel \neg a, d/a \parallel \neg d/a \parallel \neg b/c, d \parallel \neg c, b/d \parallel /b$

## Variation 1: Boolean Trigger = Unnamed Rooms

Maze  $G_c$

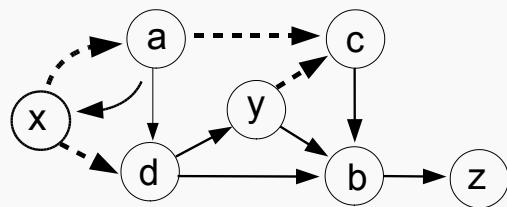


Configuration C

$c/a \parallel \neg a, \neg b \text{ or } (\neg c \text{ and } b)/a \parallel b \text{ and } (c \text{ or } \neg b)/a \parallel \neg b/c \parallel /b$

## Variation 2: Sequencing = Levelling the Game

Maze  $G_c$

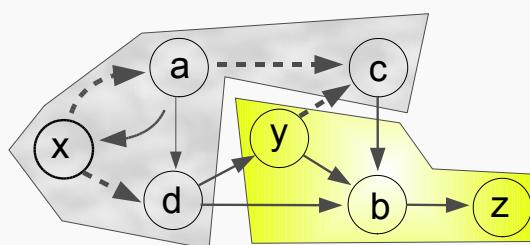


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

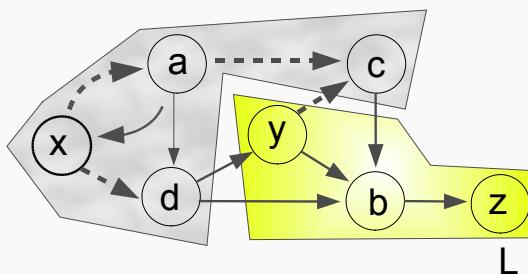


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

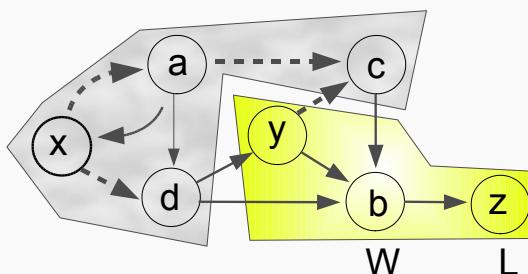


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \quad || \quad \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

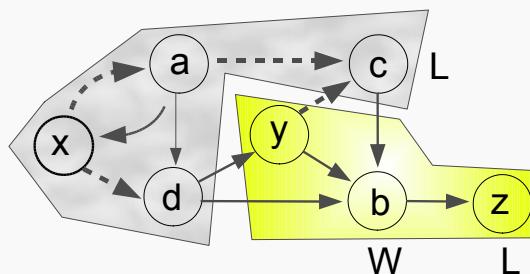


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \quad || \quad \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

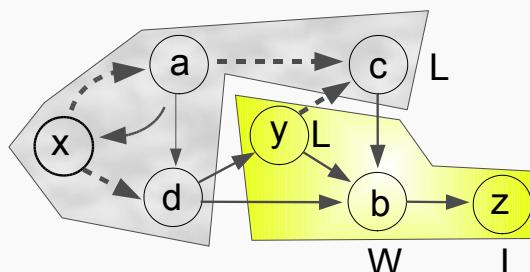


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$



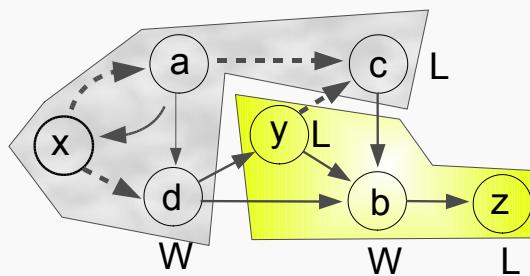
Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

Absent

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

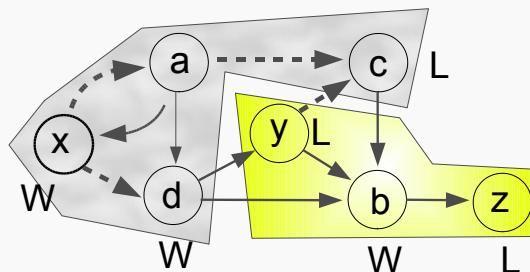


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

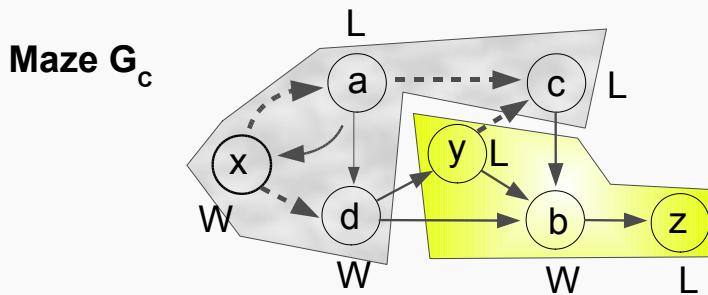


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

Present

## Variation 2: Sequencing = Levelling Game

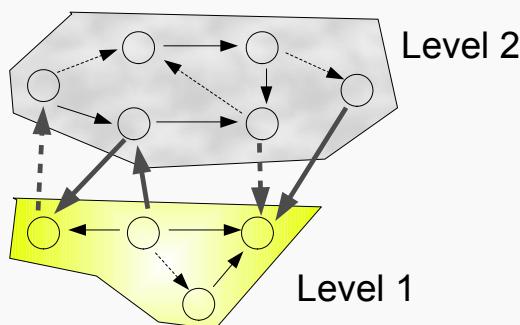


Configuration C

$c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg y/d \parallel c/y \parallel \neg b/c \parallel \neg b/y \parallel \neg b/d \parallel \neg z/b$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

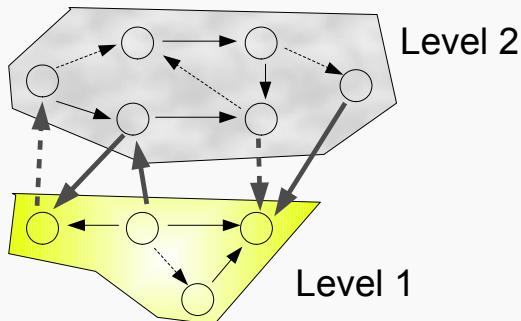


Configuration C

Level 1 || Level 2

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$



Configuration C

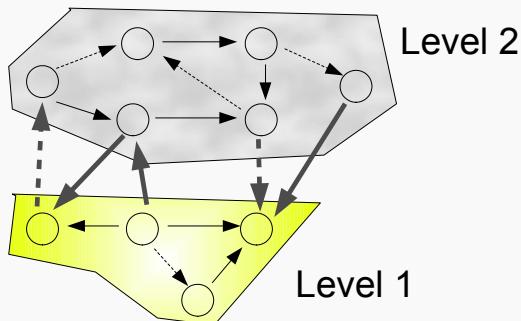


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## Variation 2: Sequencing = Levelling Game

Maze  $G_c$



Configuration C

Restrict Information flow ?

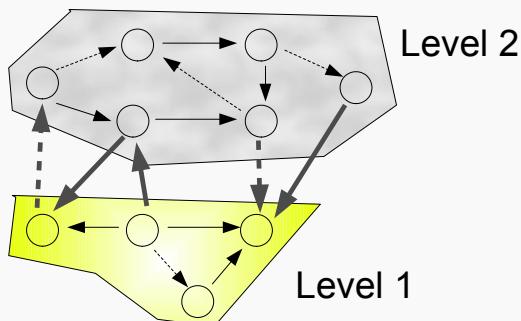


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## Variation 2: Sequencing = Levelling Game

Maze  $G_c$



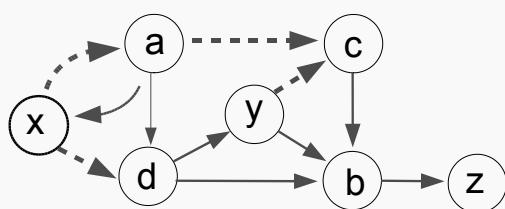
Configuration C



New Winning Condition: A room is a winning position for player A iff A never goes up from Level 1 to Level 2.

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

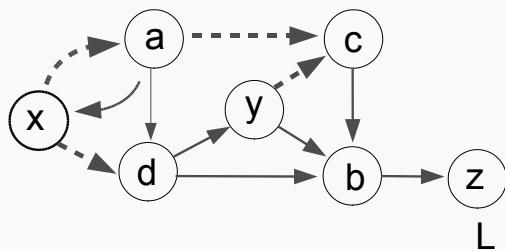


Configuration C

$\neg y/d \parallel c/y \parallel \neg z/b ; c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg b/y \parallel \neg b/c \parallel \neg b/d$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

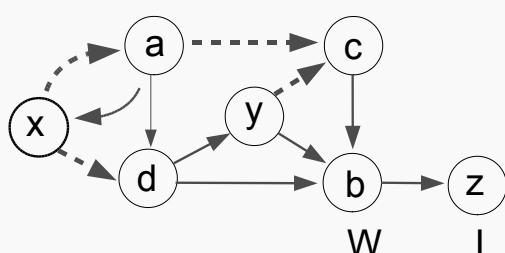


Configuration C

$\neg y/d \parallel c/y \parallel \neg z/b ; c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg b/y \parallel \neg b/c \parallel \neg b/d$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

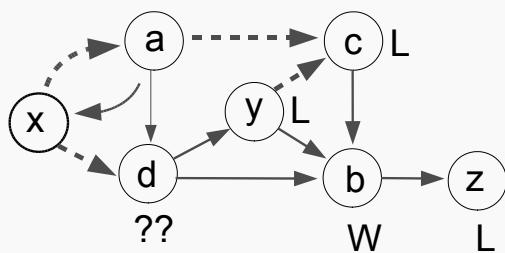


Configuration C

$\neg y/d \parallel c/y \parallel \neg z/b ; c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg b/y \parallel \neg b/c \parallel \neg b/d$

## Variation 2: Sequencing = Levelling Game

Maze  $G_c$

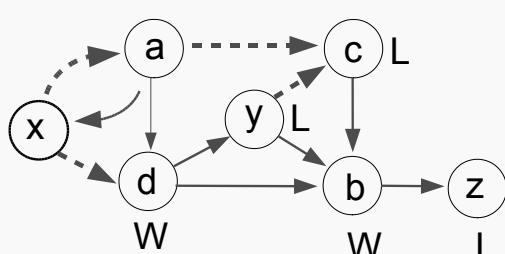


Configuration C

$\neg y/d \parallel c/y \parallel \neg z/b ; c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg b/y \parallel \neg b/c \parallel \neg b/d$

## Variation 2: Sequencing = Levelling Game

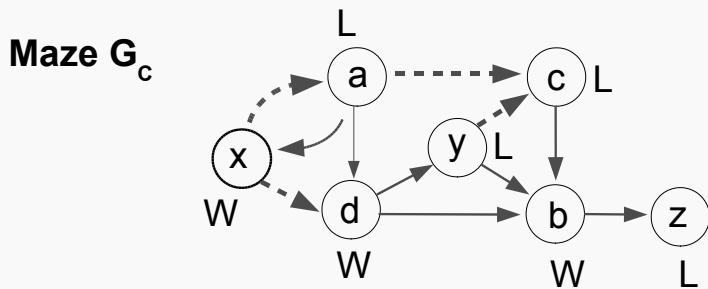
Maze  $G_c$



Configuration C

$\neg y/d \parallel c/y \parallel \neg z/b ; c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg b/y \parallel \neg b/c \parallel \neg b/d$

## Variation 2: Sequencing = Levelling Game



Configuration C

$\neg y/d \parallel c/y \parallel \neg z/b ; c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg b/y \parallel \neg b/c \parallel \neg b/d$

$\neg y/d \parallel c/y \parallel \neg z/b \parallel c/a \parallel a/x \parallel \neg x/a \parallel \neg d/a \parallel d/x \parallel \neg b/y \parallel \neg b/c \parallel \neg b/d$

## Variation 2: Sequencing = Levelling Game

- P;Q lazy sequential composition
- If  $P \parallel Q = P ; Q$  then Information flow directed  $P \rightarrow Q$
- If  $P \parallel Q = Q ; P$  then information flow is directed  $P \leftarrow Q$
- If  $P \parallel Q \neq P ; Q$  and  $P \parallel Q \neq Q ; P$  then information flows both ways
- If  $P \parallel Q = \text{present } c$  then  $P ; Q$  else  $Q ; P$  (combinational cycle)

# Summary

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My work is a game, a very serious game  
*M.C. Escher*

## Conclusions

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- Game theory is a constructive approach to handle co-contravariant fixed point problem in synchronous languages
- Must/Cannot analysis of combinational Esterel corresponds to computation of winning strategies
- Translation Esterel → Games
  - has didactic value
  - can be optimised
  - so far covers kernel language (incl. parallel, sequential) without signal hiding