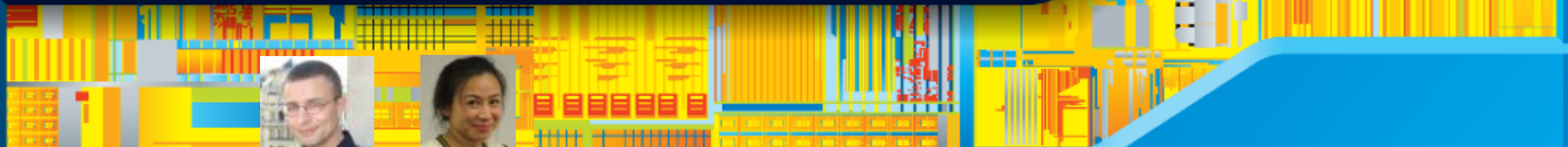




People

*inside*TM



Programmed by Thien Que Nguyen and
Pascal Van Cauwenberghe



Thien Que Nguyen

Consults
Manages projects
Analyzes business

Creates games
Teaches yoga
Organizes conferences



<http://atbru.be>



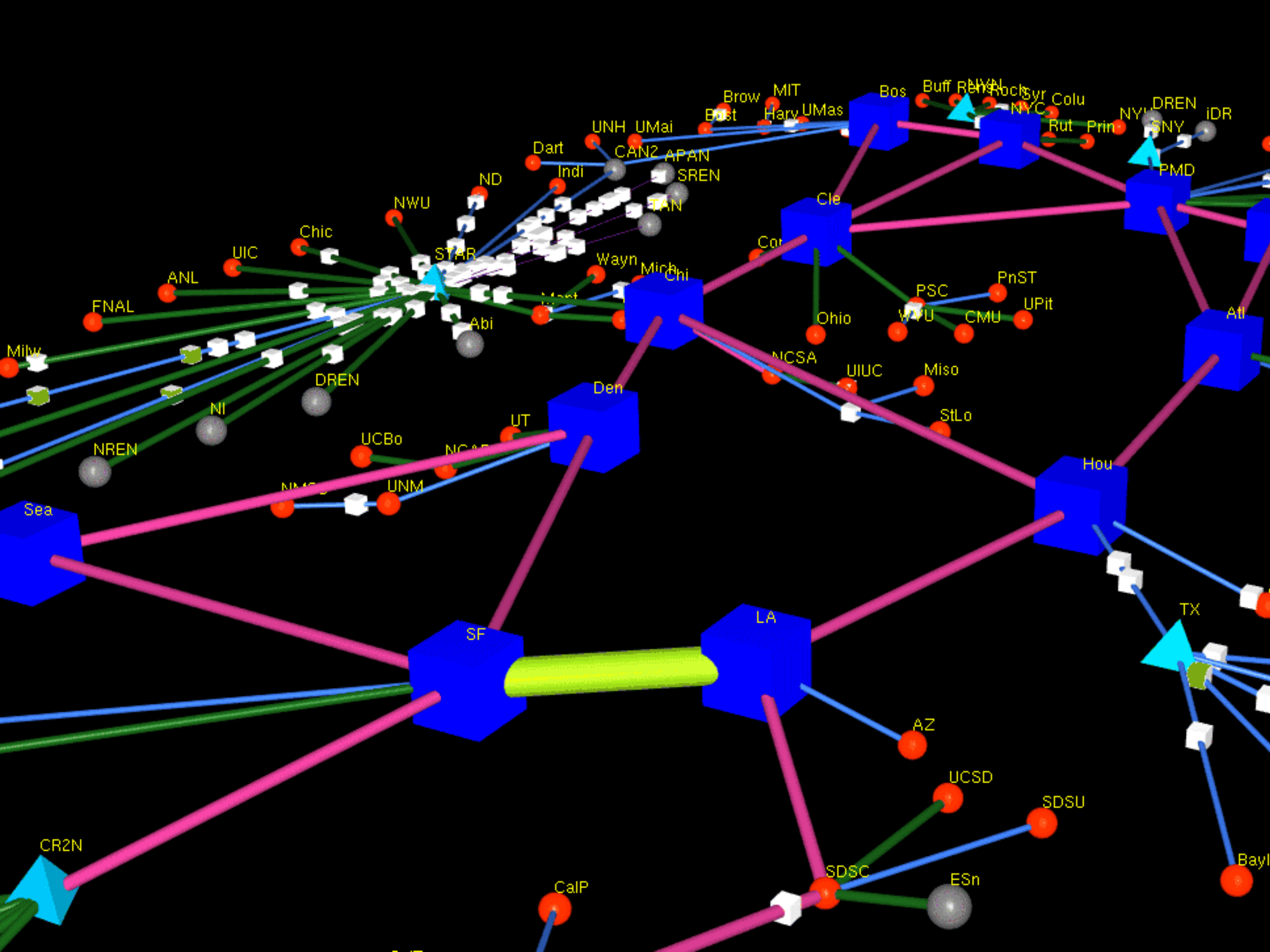
Pascal Van
Cauwenberghe

Consults
Manages projects
Tests, programs, analyzes

Creates games
Tells tall stories
Organizes conferences



<http://xpday.net>









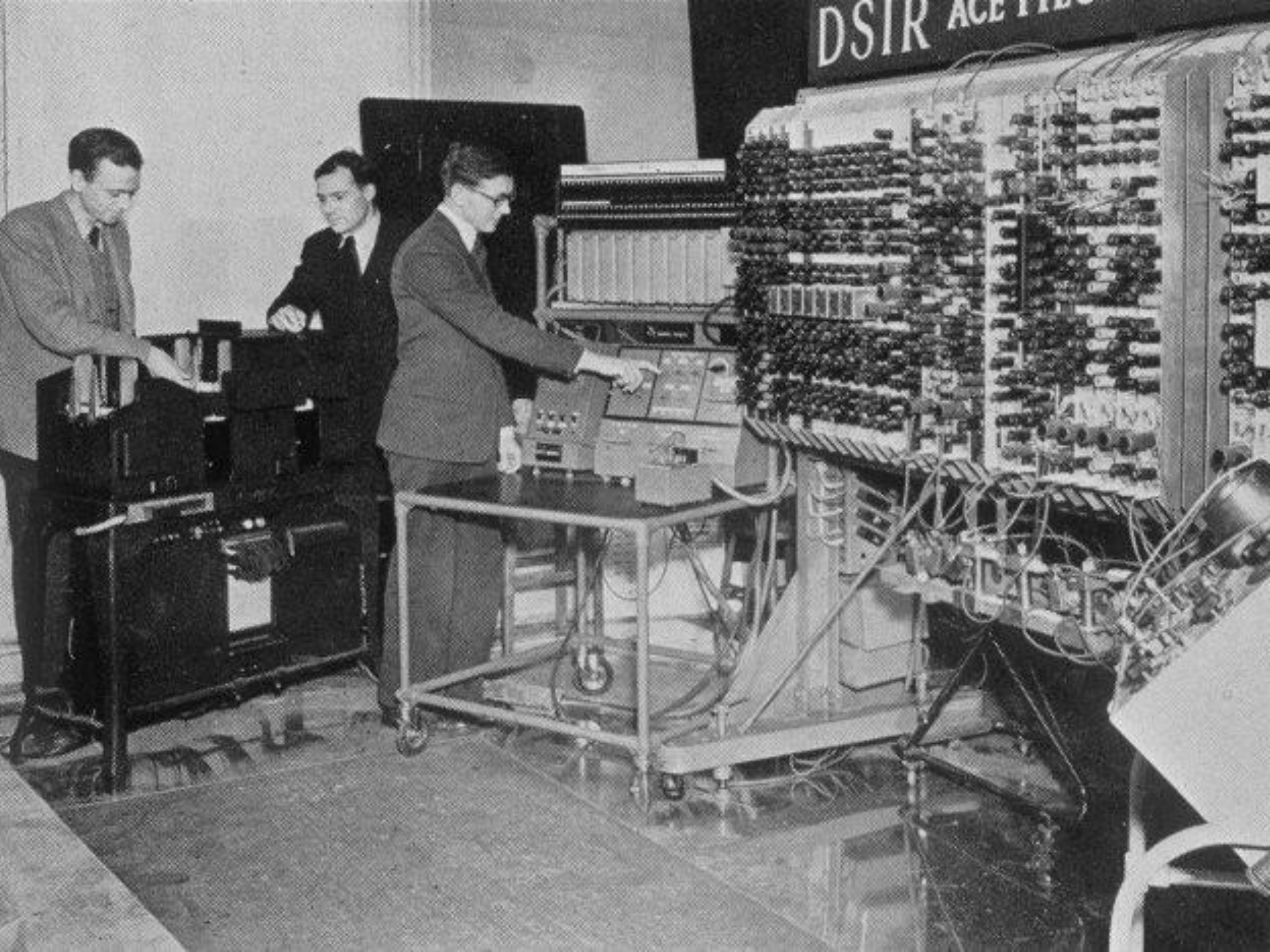


Acceptance Test

- ☐ We had fun
- ☐ We solved the puzzle
- ☐ You look at concurrent systems differently
- ☐ You've learned something you can apply
 - ☐ in your work and life
- ☐ You want to know more

BACK TO THE FUTURE™





“Computers”



MENU !

Demo: TDD Cell

Exercise 1: TDD Grid

Exercise 2: TDD Region

Theory

Human Computer Simulation

TDD Human Computer

$2 + 2 = \dots ?$

$2 + 2 = 4 ?$

Correct!

Unit Test

Program

Specification Step by step..



Cell Specification

[1][2][3][4][5][6]

- A Cell expresses which of the numbers 1..6 are possible
- By default every number is possible
- If there is more than one possible number, the value of the cell is unknown
- If exactly one number is possible, the value of the cell is known == number
- If there are no possible numbers there is a contradiction, this is impossible

Demo TDD: Cell (1)

1	2	3	4	5	6
---	---	---	---	---	---

- GIVEN a new Cell

Question	Answer
How many numbers are possible?	6
What is the value of the cell?	UNKNOWN
Is 5 a possible value?	Yes
Is 2 a possible value?	Yes

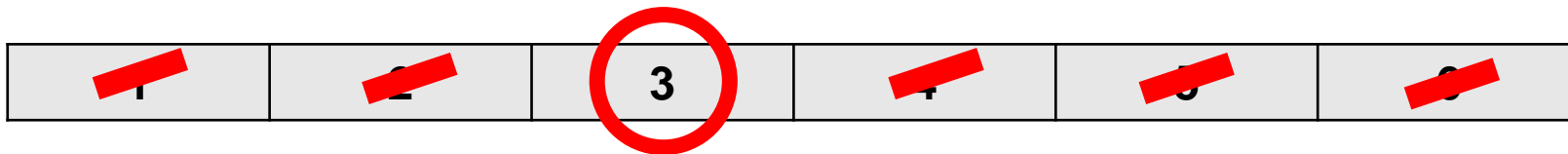
Demo TDD: Cell (2)

1	2	3	4	5	6
---	---	--------------	--------------	---	---

- GIVEN a new Cell
- When 3 is not possible
- When 4 is not possible

Question	Answer
How many numbers are possible?	4
What is the value of the cell?	UNKNOWN
Is 5 a possible value?	Yes
Is 3 a possible value?	No

Demo TDD: Cell (3)



- GIVEN a new Cell
- When the value is known to be 3

Question	Answer
How many numbers are possible?	1
What is the value of the cell?	3
Is 5 a possible value?	No
Is 2 a possible value?	No

Demo TDD: Cell (4)



- GIVEN a new Cell
- When number 1, 6, 3, 2, 5, 4 are not possible

Question	Answer
How many numbers are possible?	0
What is the value of the cell?	IMPOSSIBLE

Grid Specification (1)

A Grid has a name: A, B, C, D, E, or F

A Grid consists of 3x2 Cells

Cells are addressed as (Row, Column)

IF a Cell within a Grid has a known value¹

THEN NO other Cell can have the same value

Grid – Example (1)

Example: $\text{Cell}(2,1) = 4$

	COLUMN 1 (1,1)	COLUMN 2 (1,2)
ROW 1	1 2 3 4 5 6	1 2 3 4 5 6
ROW 2	1 2 3 4 5 6	1 2 3 4 5 6
ROW 3	1 2 3 4 5 6	1 2 3 4 5 6

Grid Specification (1)

IF a cell in a grid has a **known value**
THEN all **cells on the same row**
of all grids to the left and to the right
can not have the same value

A	B	C
D	E	F

Grid – Specification (2)

- Example: Grid E cell(2,1) = 6

A	B	C
D	E	F

Grid D

COLUMN 1

COLUMN 2

(1,1)

(1,2)

ROW 1

1	2	3	4	5	6
---	---	---	---	---	---

1	2	3	4	5	6
---	---	---	---	---	---

(2,1)

(2,2)

ROW 2

1	2	3	4	5	6
---	---	---	---	---	--------------

1	2	3	4	5	6
---	---	---	---	---	--------------

(3,1)

(3,2)

ROW 3

1	2	3	4	5	6
---	---	---	---	---	---

1	2	3	4	5	6
---	---	---	---	---	---

Grid Specification (1)

IF a cell in a grid has a **known value**
THEN all **cells on the same column**
of all grids above and below
can not have the same value

A	B	C
D	E	F

Grid – Specification (3)

- Example: Grid E, cell(2,1) = 6

A	B	C
D	E	F

Grid B

COLUMN 1

(1,1)

ROW 1

1	2	3	4	5	6
---	---	---	---	---	--------------

(2,1)

ROW 2

1	2	3	4	5	6
---	---	---	---	---	--------------

(3,1)

ROW 3

1	2	3	4	5	6
---	---	---	---	---	--------------

COLUMN 2

(1,2)

1	2	3	4	5	6
---	---	---	---	---	---

(2,2)

1	2	3	4	5	6
---	---	---	---	---	---

(3,2)

1	2	3	4	5	6
---	---	---	---	---	---

Execute Grid Tests

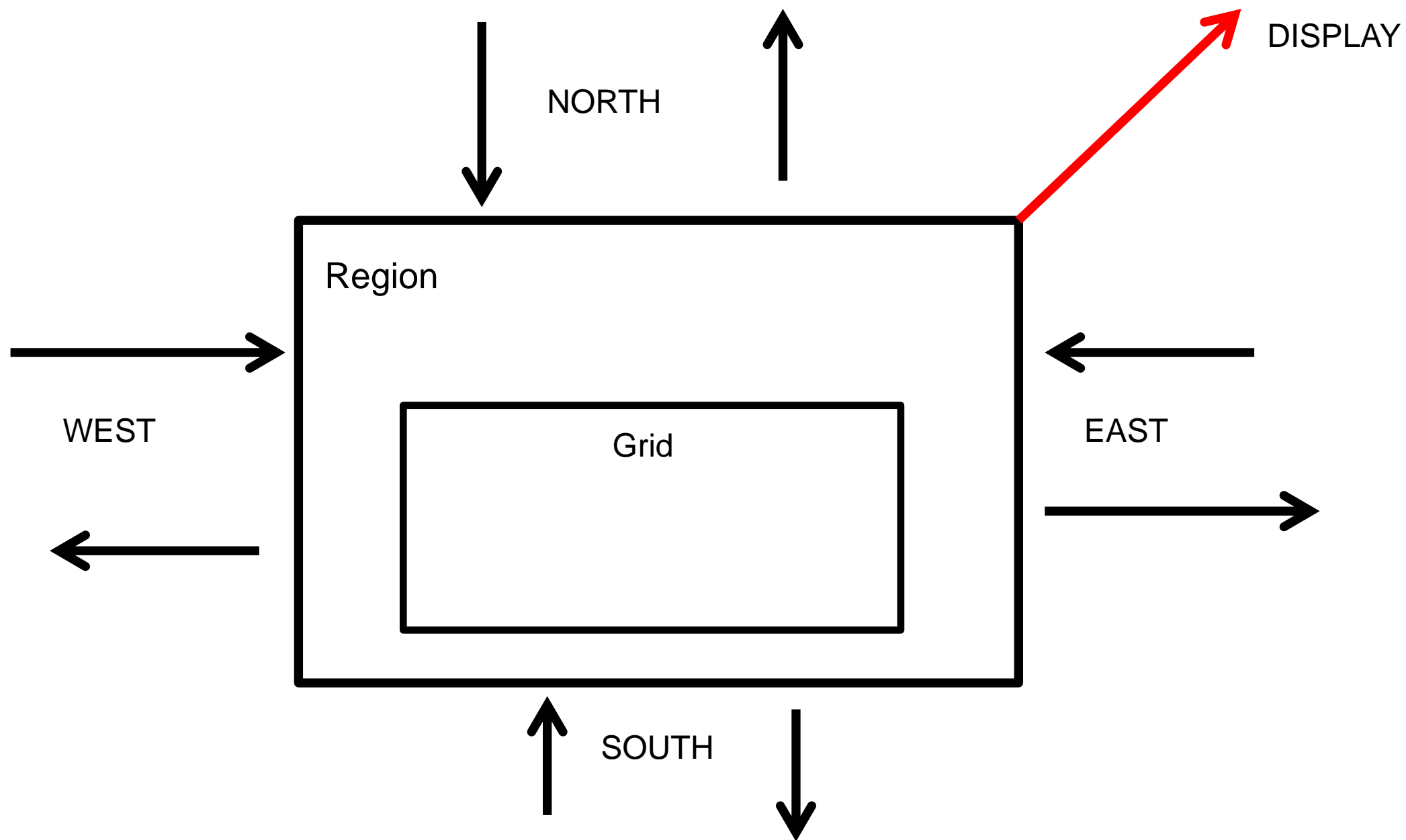


Get Ready...

Start! 10 mins execution time

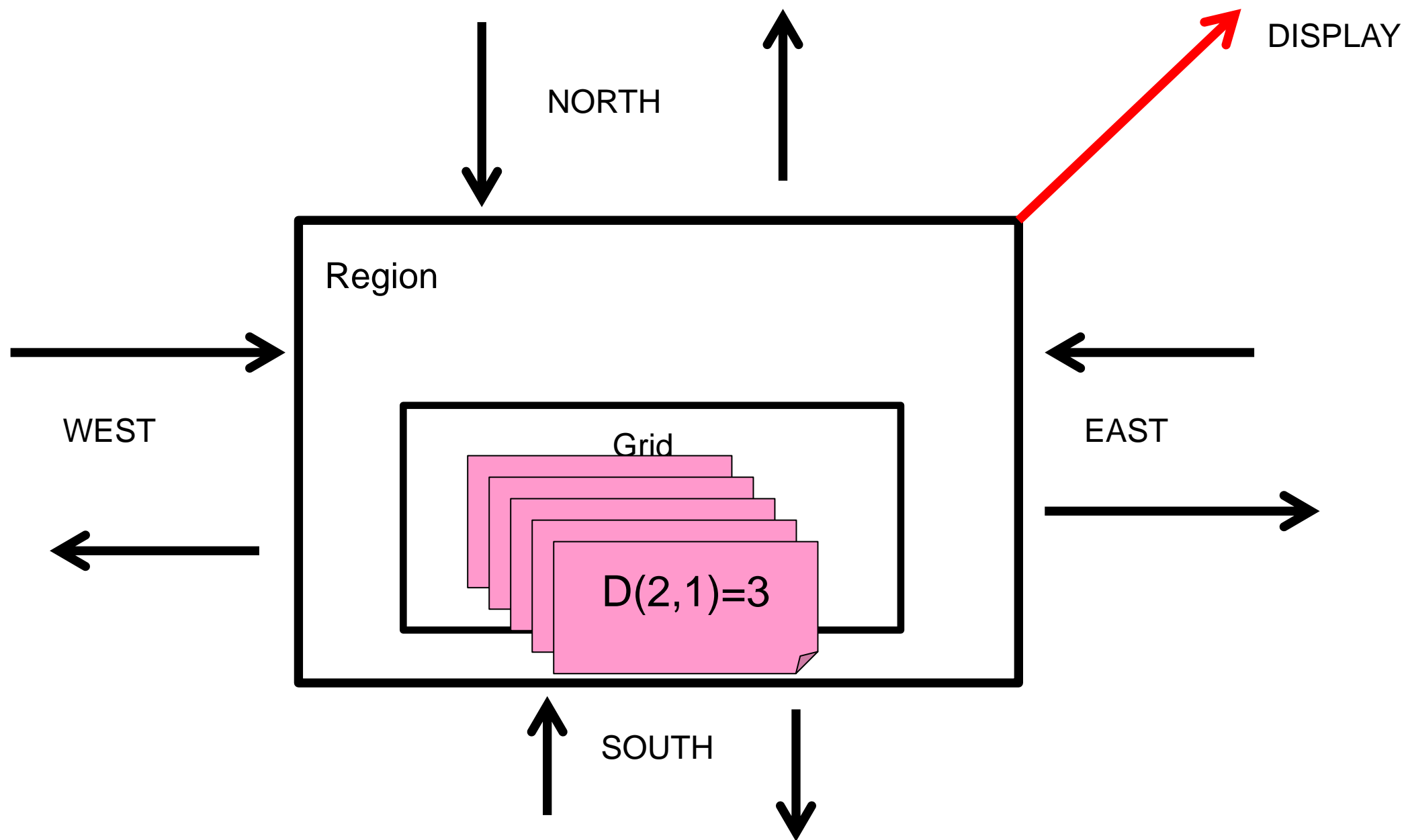
Region Specification (1)

- A Region contains a Grid
- A Region has 4 inputs: North, East, South, West
- A Region has 4 outputs: North, East, South, West
- A Region has an output Display



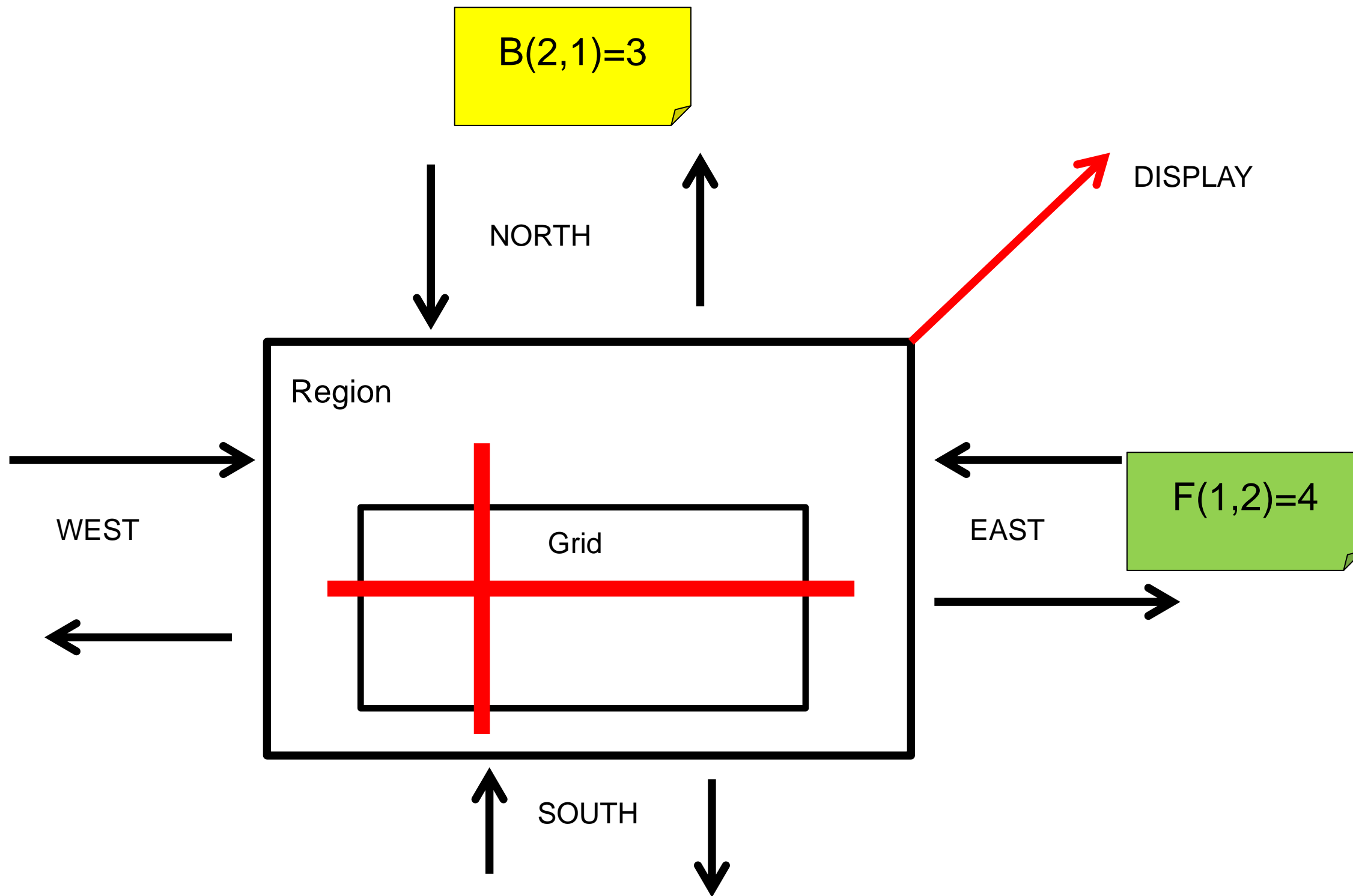
Region Specification (2)

- When you discover the value of a cell
 - Send a message `Gridname(Row,Column)=Value`
 - To the Display
 - And to all output channels
-
- You discover the starting values of a few cells.
 - You must send these values to the Display and all the output channels



Region Specification (2)

- When you receive a `GridName(Row,Column) = Value` From the North or South
 - The Grid can't have Value in that column
- When you receive a `GridName(Row,Column)` From the East or West
 - The Grid can't have Value in that row
 - And Send the message on to the other side



Execute RegionTests



Get ready...Start!
15 mins execution time

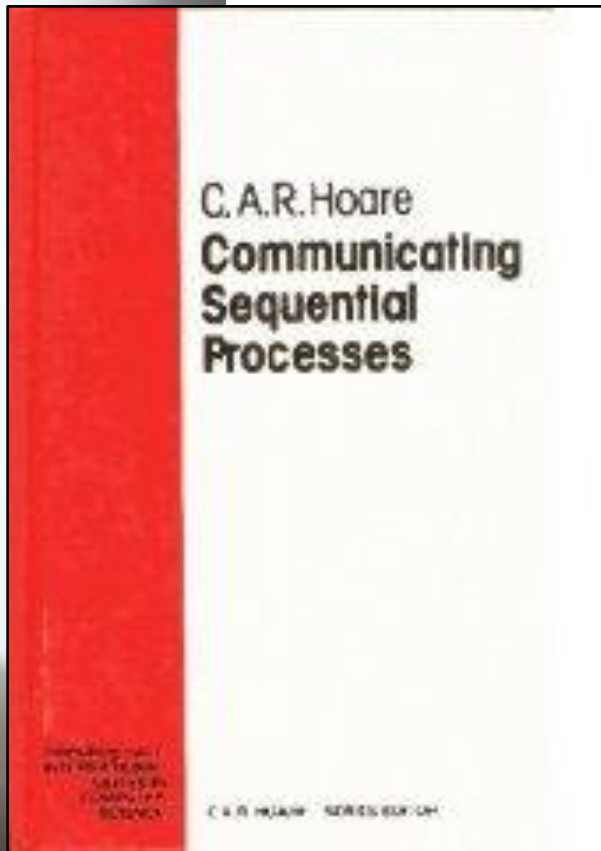
What happened?

And a smidgen of theory

CSP = Communicating Sequential Processes



QuickSort

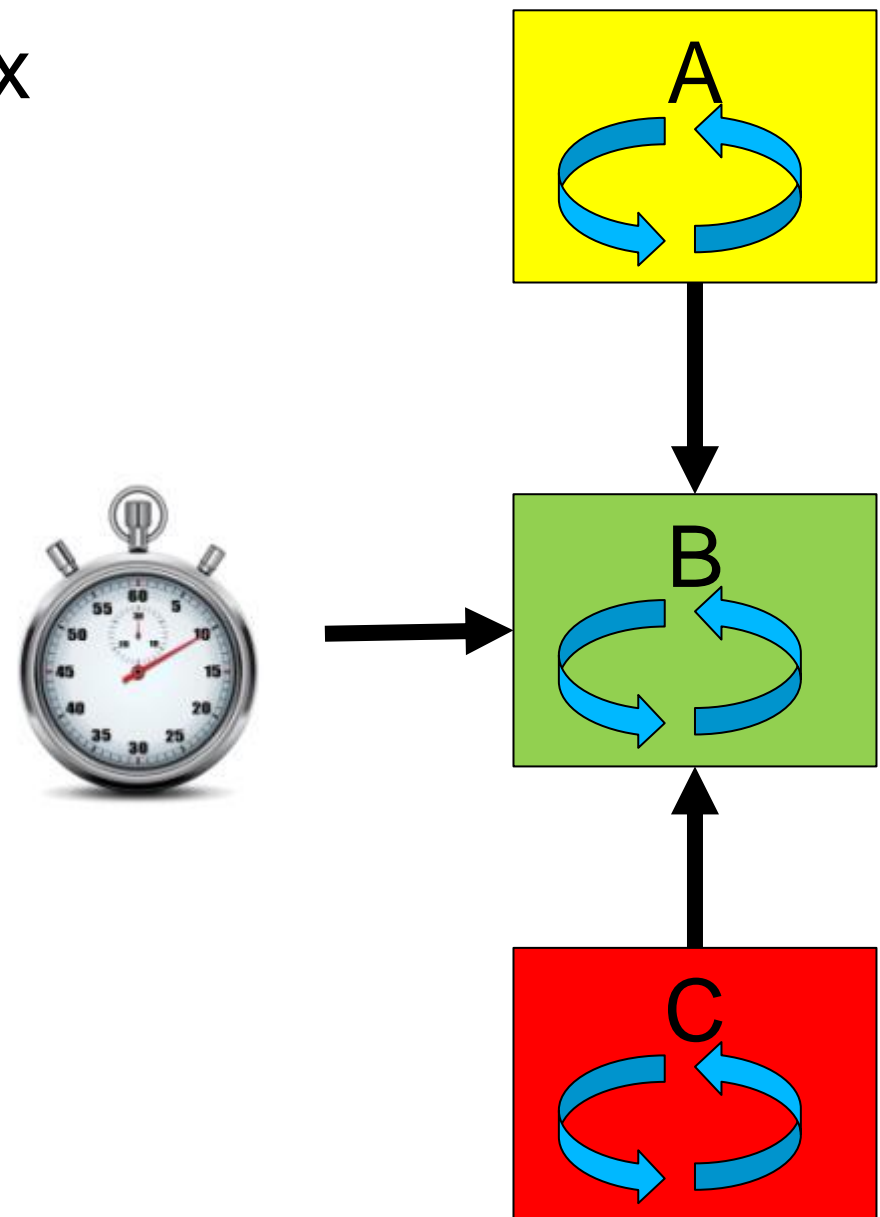


C.A.R. Hoare
**Communicating
Sequential
Processes**

Sir Prof. Tony Hoare
CSP Book (1985)
Free download (2004)

The 3 elements of CSP

- Processes
 - Independent, sequential, black box
- Channels
 - Send and receive messages
- ALT(ernating)
 - Wait for channels or timers



Back to 1985!



Back to 1985!

- Occam
- Transputer

Back to 1985!



Clojure



The
C++
Programming Language



Erlang

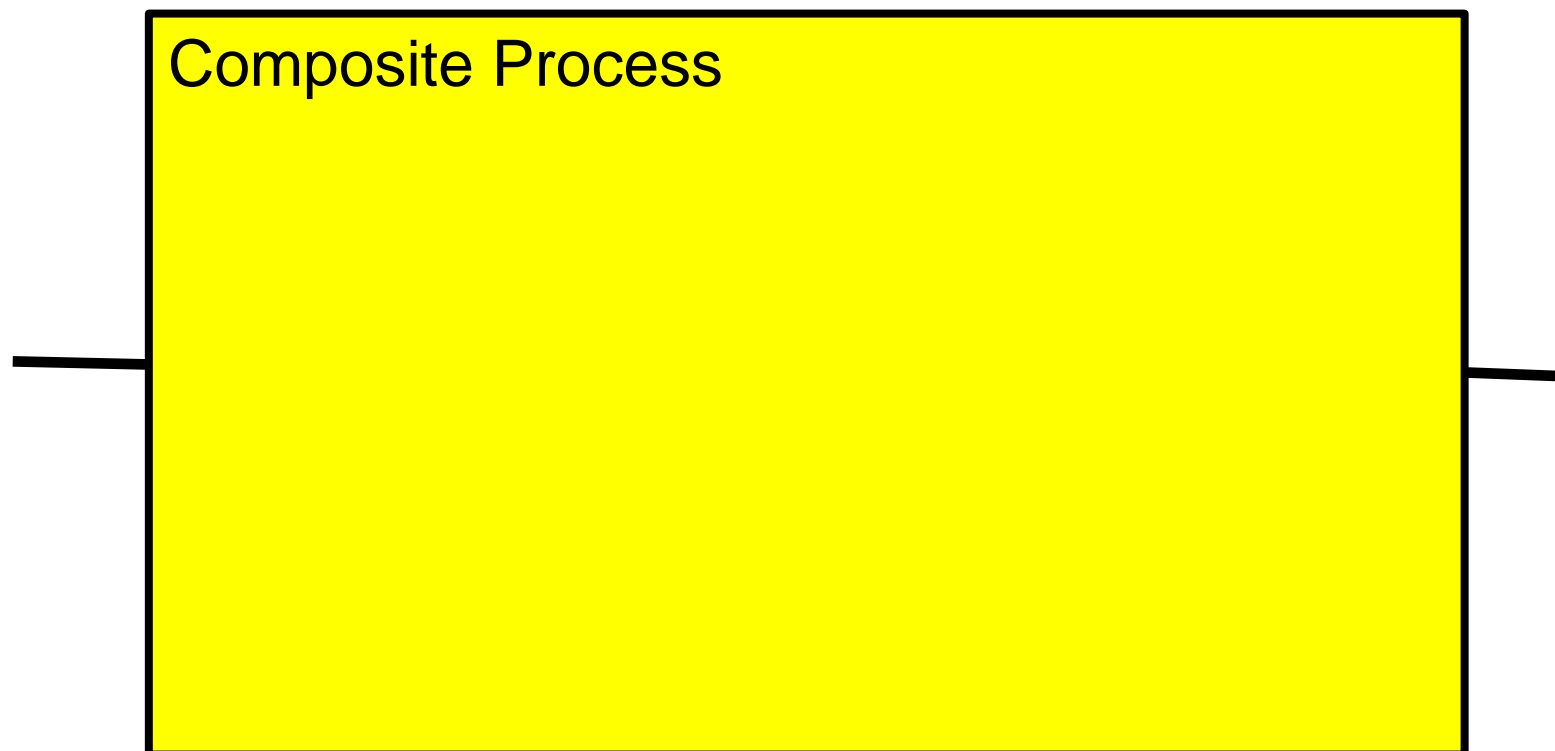


elixir

Microsoft
C#.net

Benefits of CSP

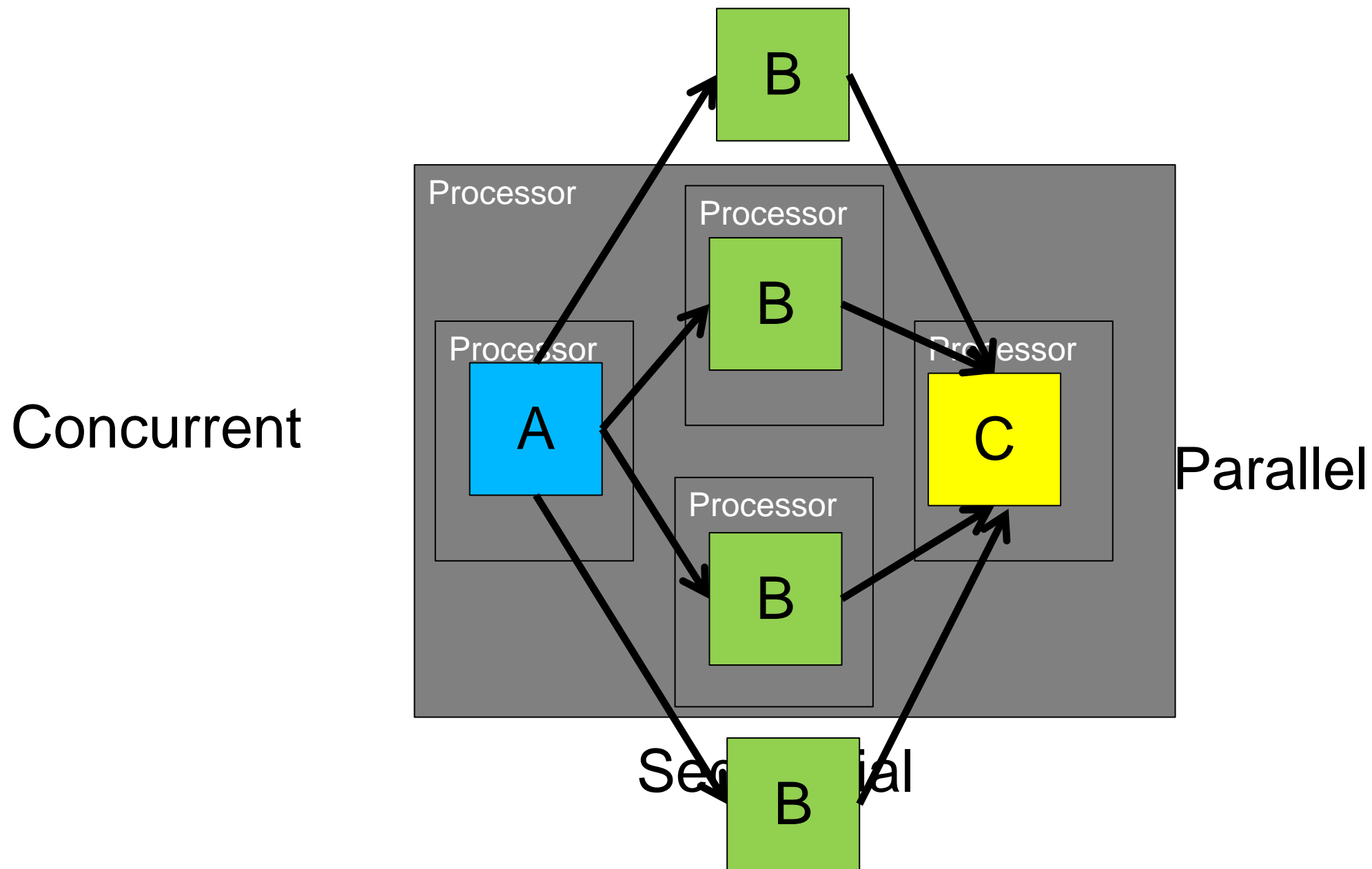
- Separation between “domain” and “collaboration”
- No shared mutable state => no locking (bugs)
- Easy and fast unit tests
- Easy to simulate edge cases
- Composable. Composite Process can be tested



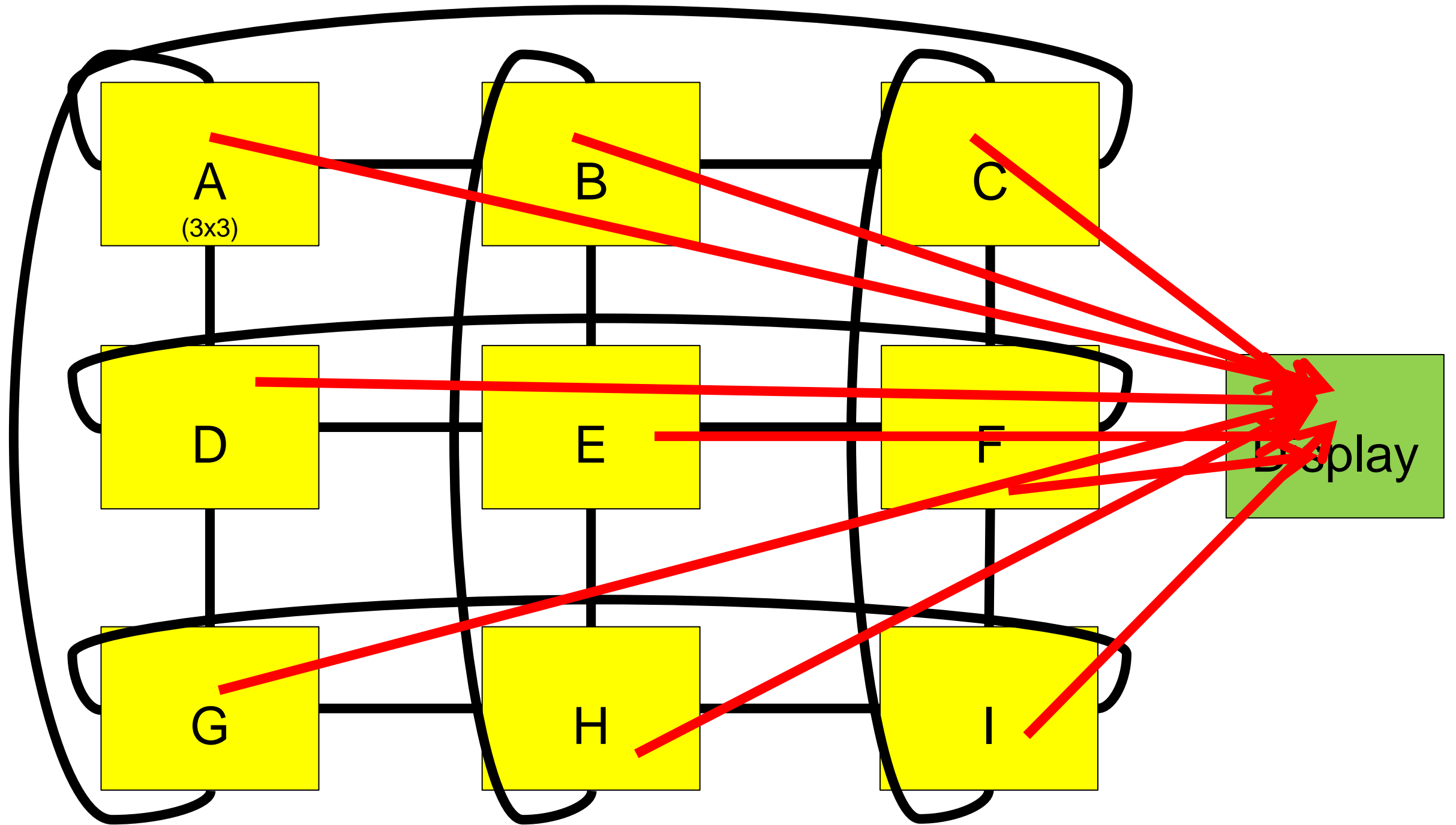
How do you test concurrent code?

1. TDD single threaded domain objects
2. Encapsulate domain objects in CSP Processes
3. TDD each Process in isolation
 - WHEN send(input,value)
 - THEN expected_value == receive(output)
 - WHEN time.advance(amount)
 - THEN expected_value == receive(output)
4. TDD composed Processes
 - TDD the inputs/outputs of ever larger ensembles

Concurrent != Parallel



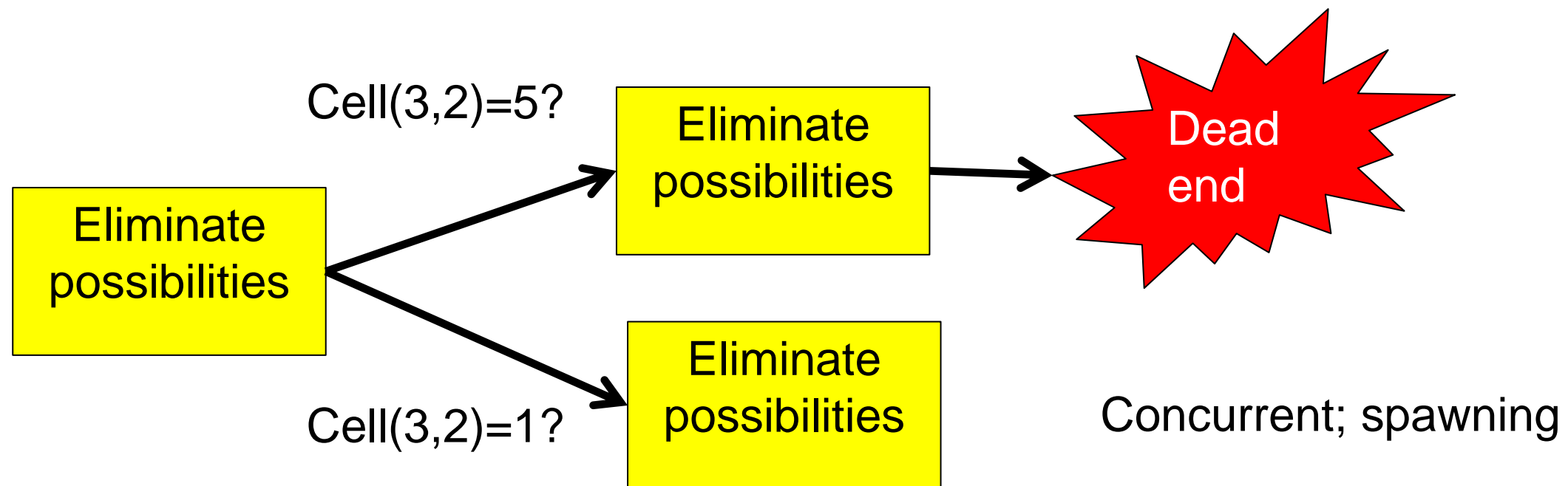
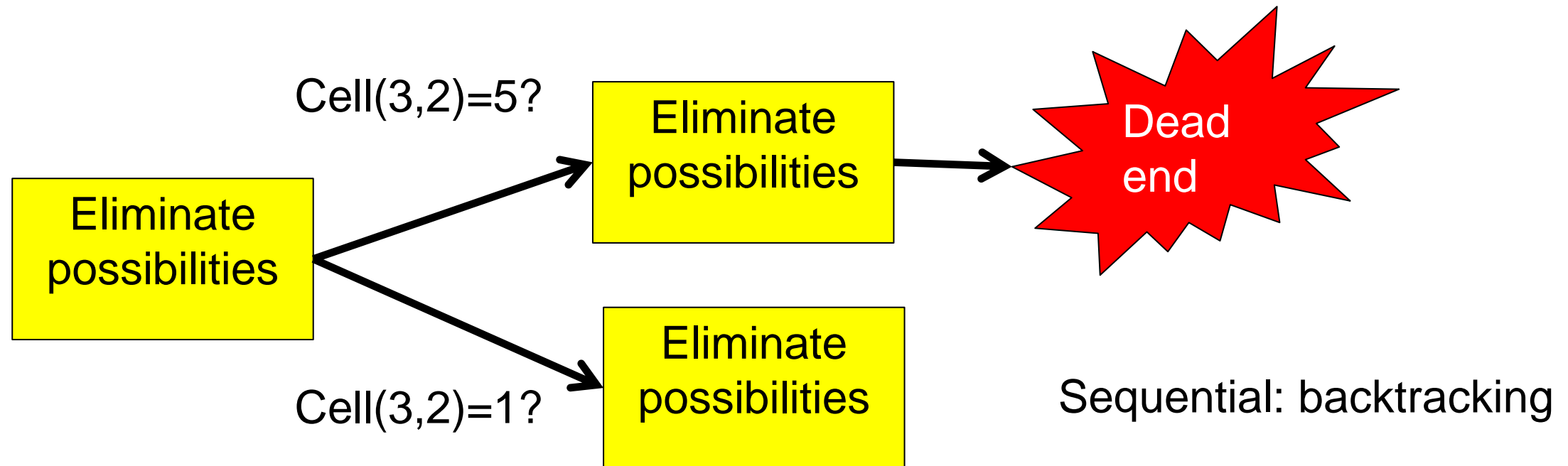
To solve a real Sudoku



Another CSP

- Constraint Satisfaction Problem
- A set of variables (81 cells)
- Each variable has a Domain of possible values (1..6)
- There are constraints between variables (e.g. All cells in a 3x3 grid must have distinct values)

Constraint satisfaction



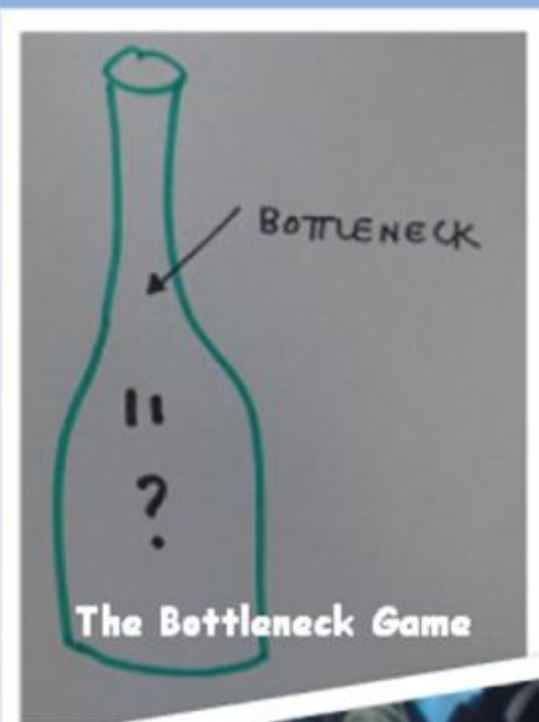
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- ☐ We solved the puzzle
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- ☐ You've learned something you can apply
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- ☐ You want to know more

If you want to know more

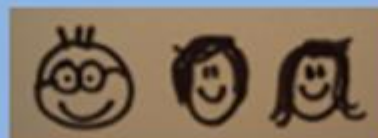
- Tony Hoare: <http://www.usingcsp.com/>
- C++: <http://www.cs.kent.ac.uk/projects/ofa/c++csp/>
- Java: <http://www.cs.kent.ac.uk/projects/ofa/jcsp/>
- Go: <http://golang.org/>
- Clojure: <http://clojure.org/>

- Download from <http://agilecoach.net>
- <https://github.com/pascalvancauwenberghe/concurrent>



	Problem	Impact	Vision
Open	1	4	7
Control	2	5	8
Confirm	3	6	9

Agile Analysis

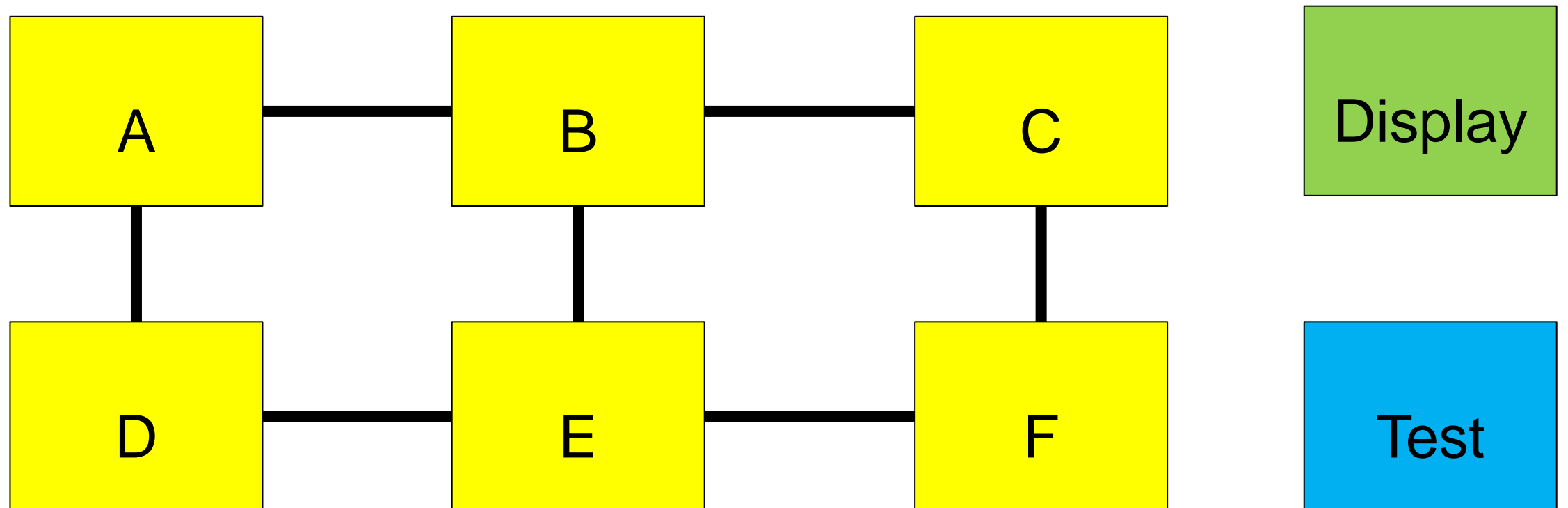


Are you ready to execute the program?

We need $(N) \times 8$ players to run the simulation

You can also observe

Assemble the Computer



Run the simulation

Pause when you've sent all messages for
known values

Check Display of known values

Process all incoming messages