TESTING STATEFUL SYSTEMS WITH QUICKCHECK AND PROLOG

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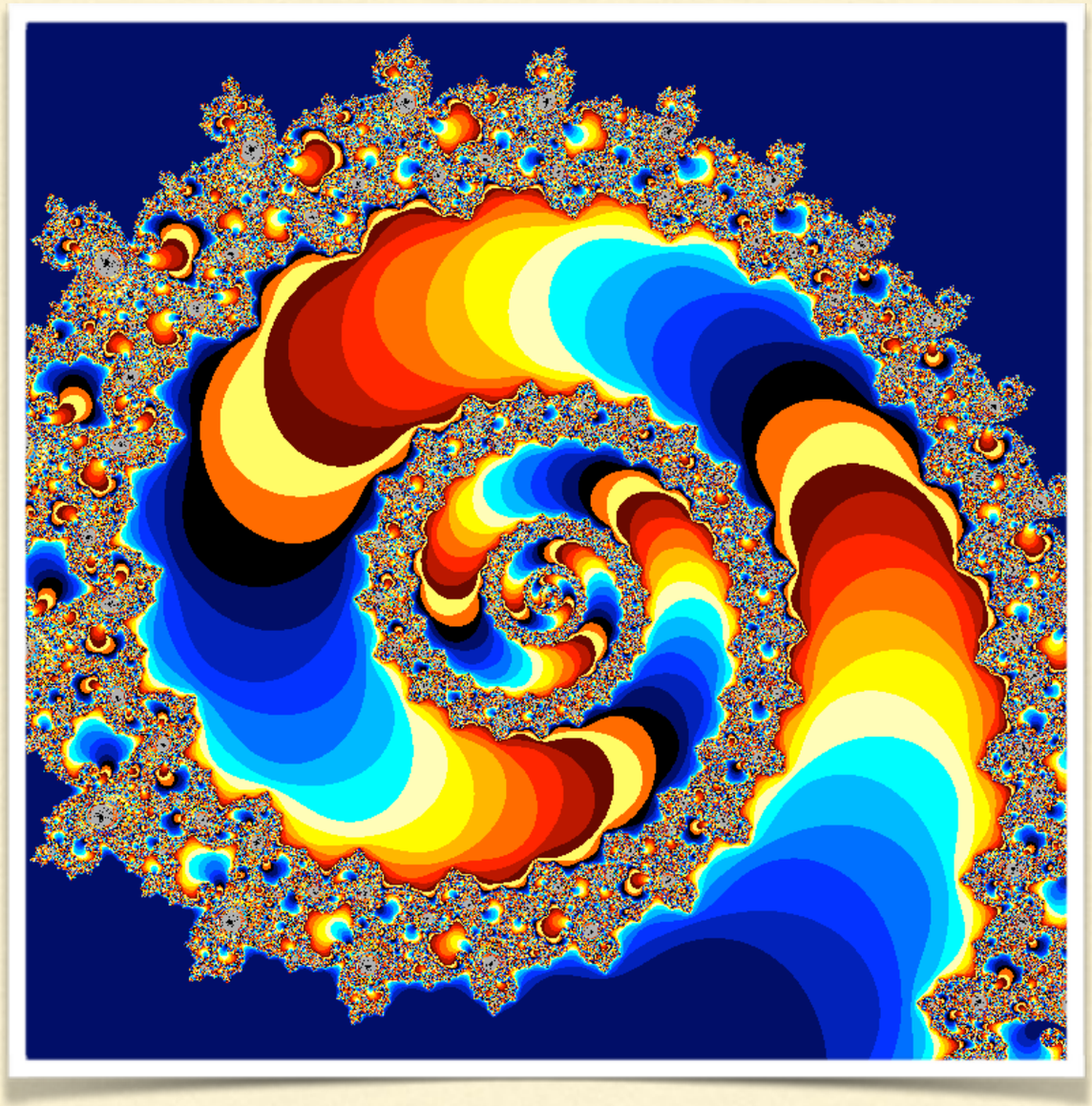
WHAT IS QUICKCHECK?

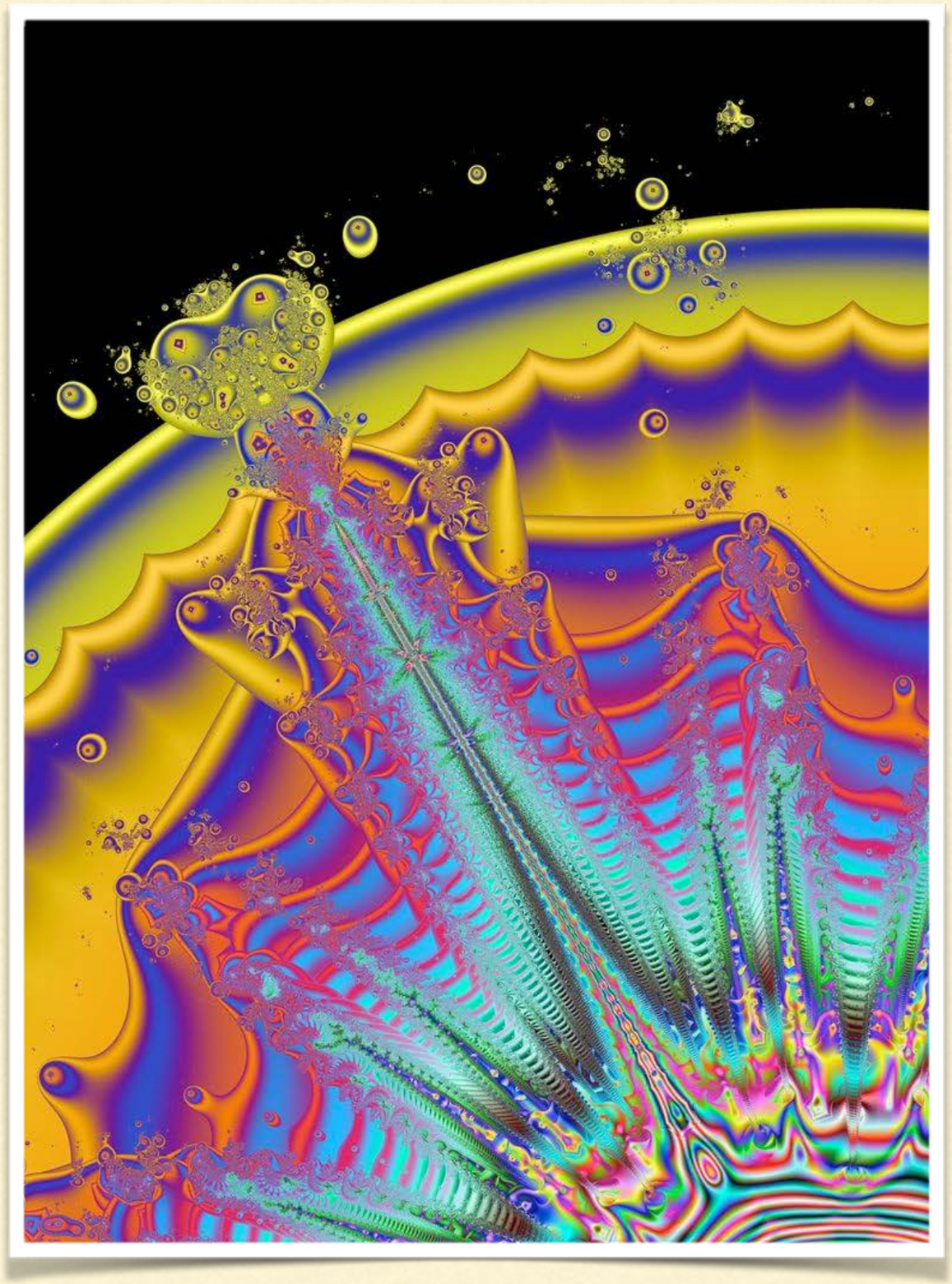
QUICKCHECK



- Don't write tests: Generate them
- Express invariance as general properties
- Run Lots of Tests
- Find Error conditions
- Shrink them to smallest cases

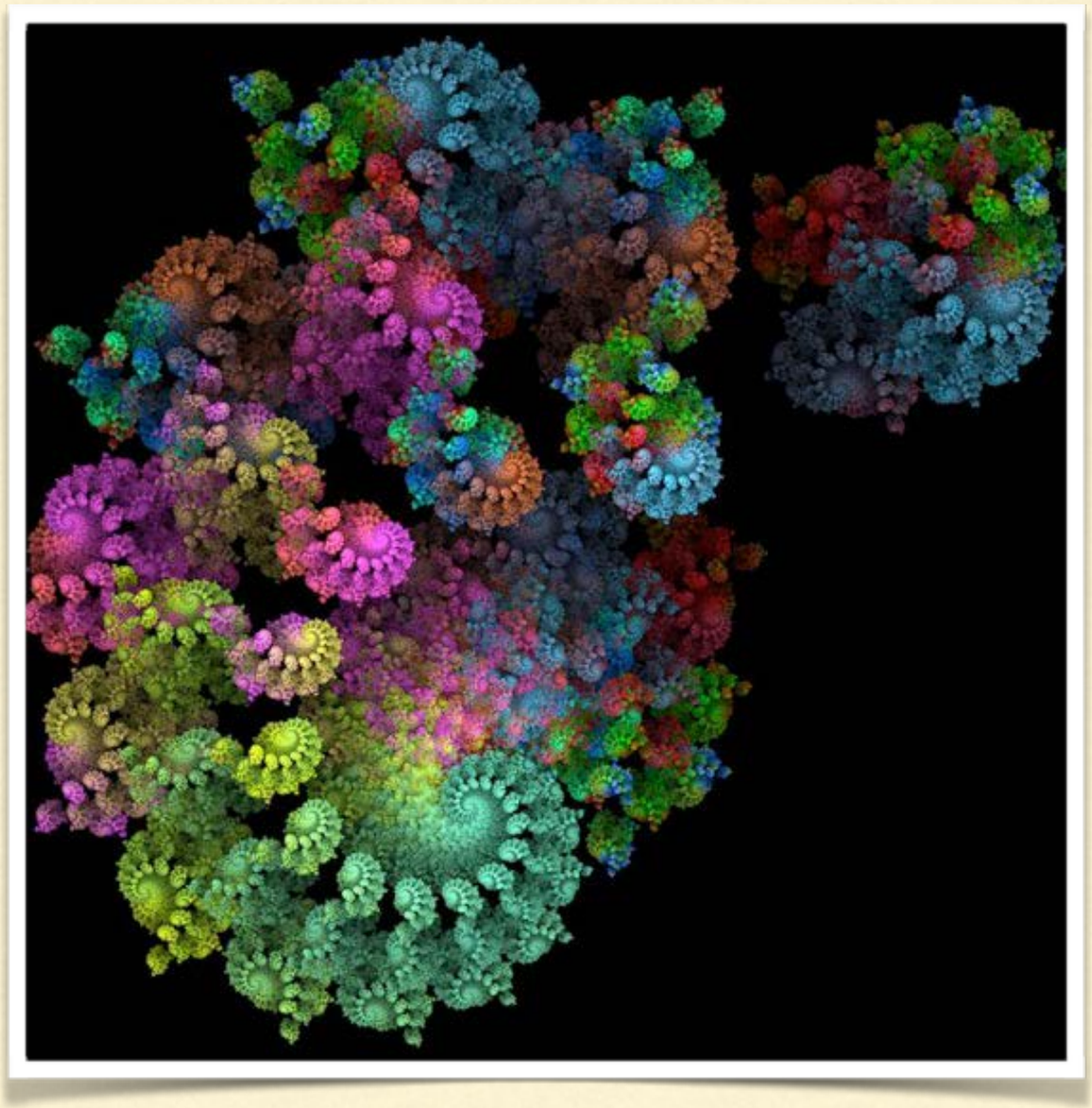
Testing systems with State

- MODEL SYSTEM
- CREATE EVENT STREAM
- VALIDATE

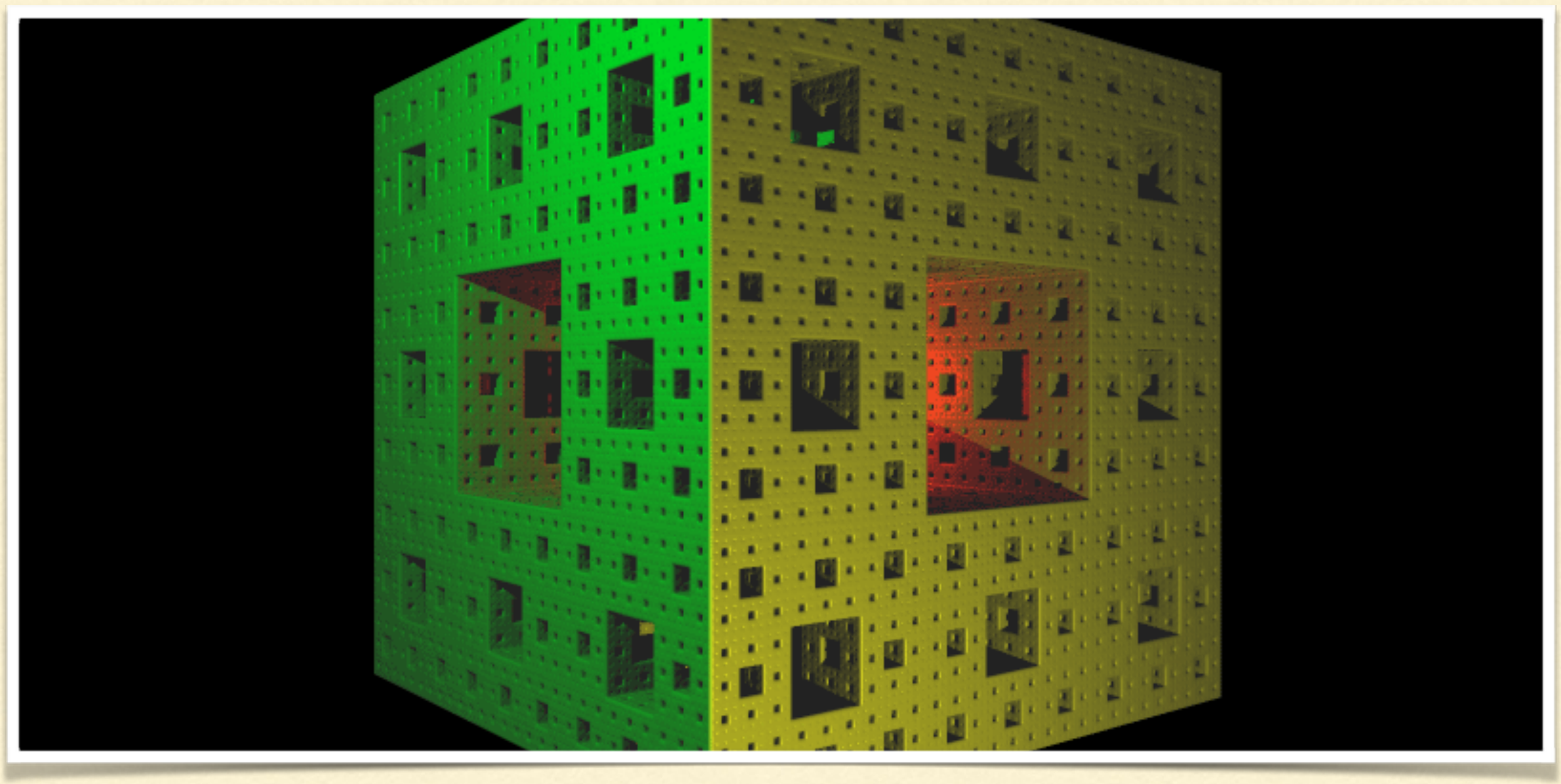


WE NEED A MODEL

CREATING A MODEL IN ERLANG



- Sometimes awkward
- You want to not reuse the code



USE AN EXTERNAL MODEL!

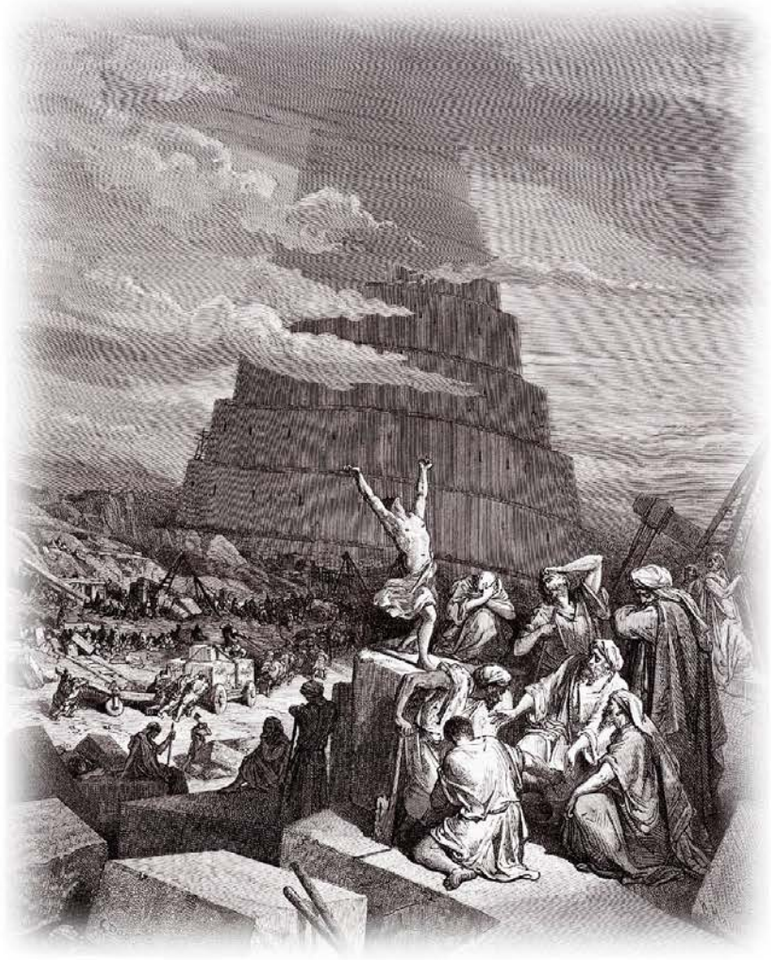
WHAT MIGHT MAKE THIS EASIER?

PROLOG?

The Pragmatic Programmers

Seven Languages in Seven Weeks

A Pragmatic Guide to Learning Programming Languages



Bruce A. Tate

Edited by Jacquelyn Carter

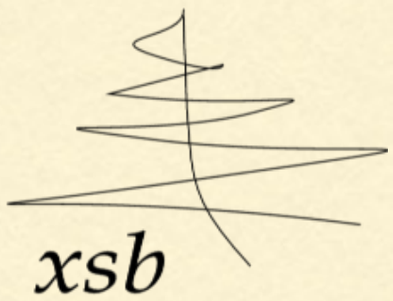
WHAT IS PROLOG?

PROGRAMMING WITH LOGIC

VERSIONS OF PROLOG

SWI Prolog

Gnu Prolog



Erlog

YAProlog

HISTORY OF PROLOG

- Invented in the Early 1970's
- Often used in AI
- Used to Develop Erlang
- What is, WATSON?

rvirding / erlog

Watch 12 | Star 94 | Fork 19

Prolog interpreter in and for Erlang

40 commits | 2 branches | 0 releases | 4 contributors

branch: master | erlog / +

Merge pull request #7 from zkessin/master ...

rvirding authored on 25 Apr — latest commit 39402c2b4d

bin	Create Erlog start file erlog	a year ago
doc	Add memberchk/2 predicate to lists library	4 months ago
ebin	Move sort/2 from erlog_int to erlog_lists	6 months ago
examples	Export consult_file/2 and reconsult_file/2 from erlog.erl.	6 years ago
src	now can supply the goal as a string	2 months ago
.gitignore	Remove .beam files from Git.	3 years ago
Emakefile	Remove .beam files from Git.	3 years ago
LICENSE	Convert to use Apache License, Version 2.0	a year ago
Makefile	Improve Makefile to do conditional compilation	9 months ago

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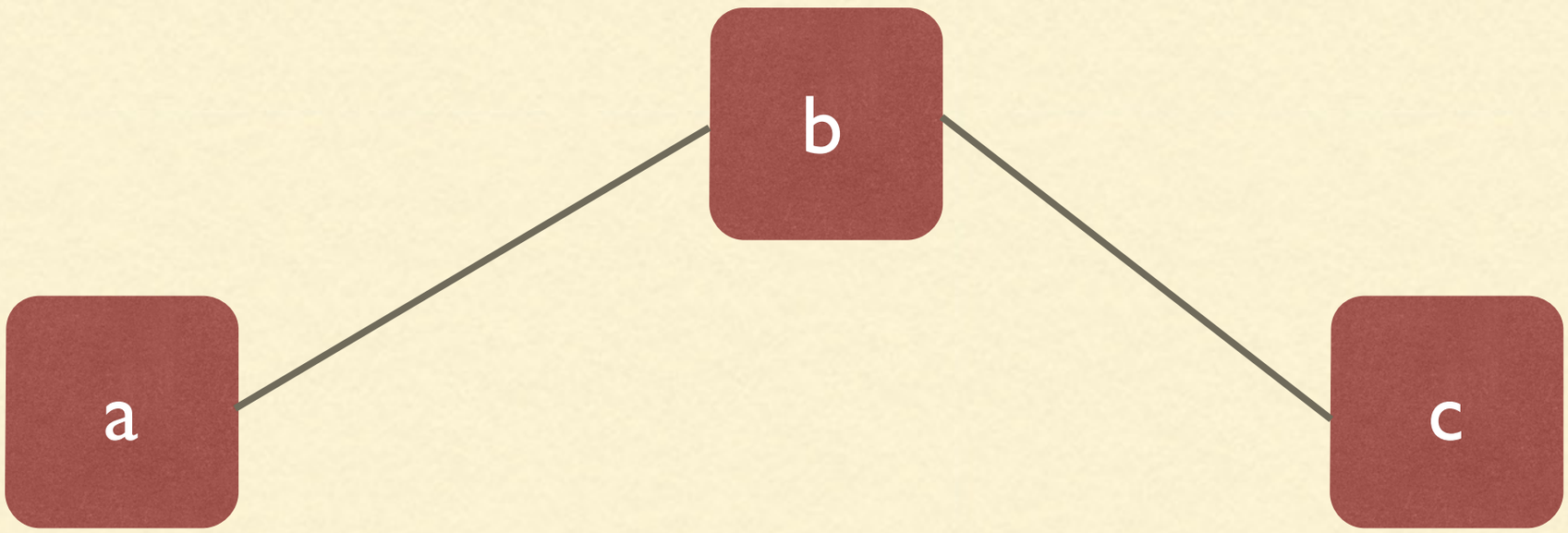
ERLOG FEATURES

- ISO Prolog
- Runs in an Erlang Process
- Can talk to ETS tables
- Understands Erlang Data

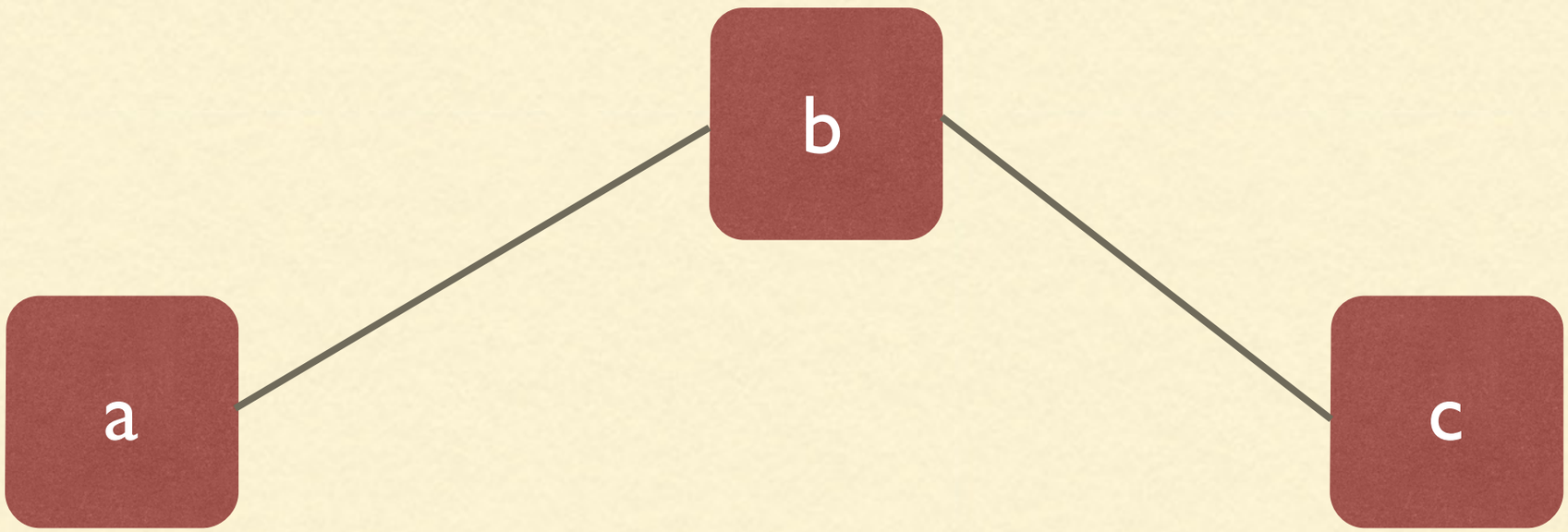
FACTS

```
1 model("KEY","value").
2 edge(a,b).
3 edge(b,c).
```



SIMPLE RULE

```
1 connected(A,B) :-
2   edge(A,B);
3   edge(B,A).
```



UNIFICATION

```
1 edge(a,b).
2 edge(a,c).
3 edge(c,d).
4 edge(e,f).
5 edge(f,b).
6
7 connected(A,B) :-
8  edge(A,B);
9  edge(B,A).
```

UNIFICATION

```
1 ?- connected(a,X).
2 X = b ;
3 X = c ;
```

REVERSIBLE

```
1 ?- connected(X,f).
2 X = e ;
3 X = b.
```

RECURSIVE RULES

```
1  path(A,B,Path) :-
2          travel(A,B,[A],Q),
3          reverse(Q,Path).
4
5  travel(A,B,P,[B|P]) :-
6          connected(A,B).
7  travel(A,B,Visited,Path) :-
8          connected(A,C),
9          C \== B,
10         \+member(C,Visited),
11         travel(C,B,[C|Visited],Path).
```

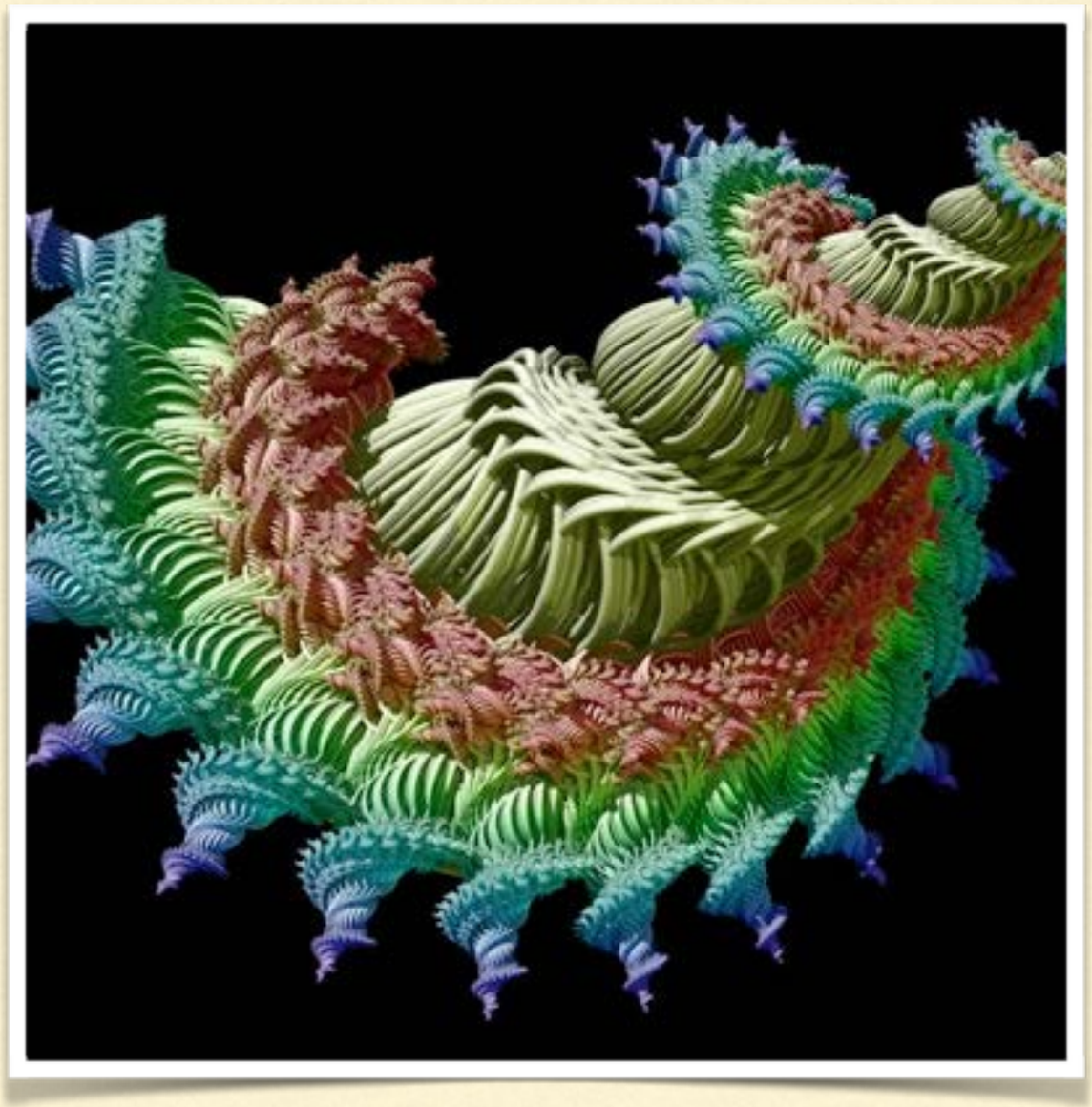
QUERIES

```
1 ?- path(a,f, Path)
2 Path = ...
```

STATE IN PROLOG

```
1 assert(FACT).
2 asserta(FACT).
3 assertz(FACT).
4 retract(FACT).
```

WHAT TYPES OF PROBLEMS?



- State Model
- Algebra
- Grammar
- FSM

MODEL: LAST VALUE CACHE

LVC MODEL IN PROLOG

```
1 add_to_model(Key, Value) :-
2     retract(model(Key, _)),
3     asserta(model(Key, Value)).
```

SETTING UP PROLOG TO RUN

```
1       {ok,Erlog} = erlog:start_link(),
2       ok         = erlog:consult(Erlog,
3          "../test/erl_cache_model.pl"),
4
5       erlog:halt(Erlog).
```

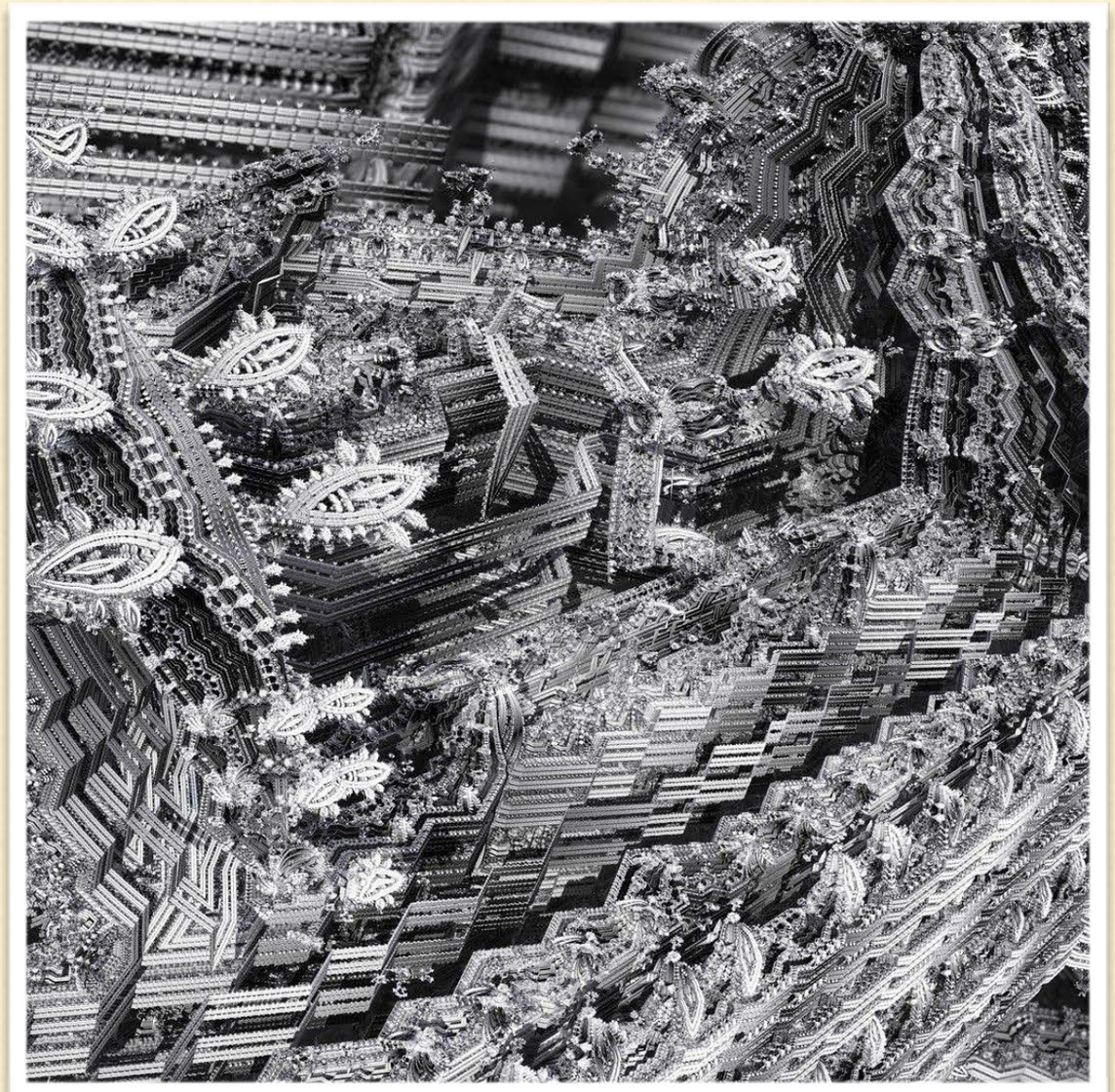
CALLING PROLOG

```
1 set(Erlog, Key, Value)  ->
2     case erlog:prove(Erlog,
3            {add_to_model,Key,Value})
4         of
5            {succeed, _} -> true;
6            _R           -> false
7     end.
```

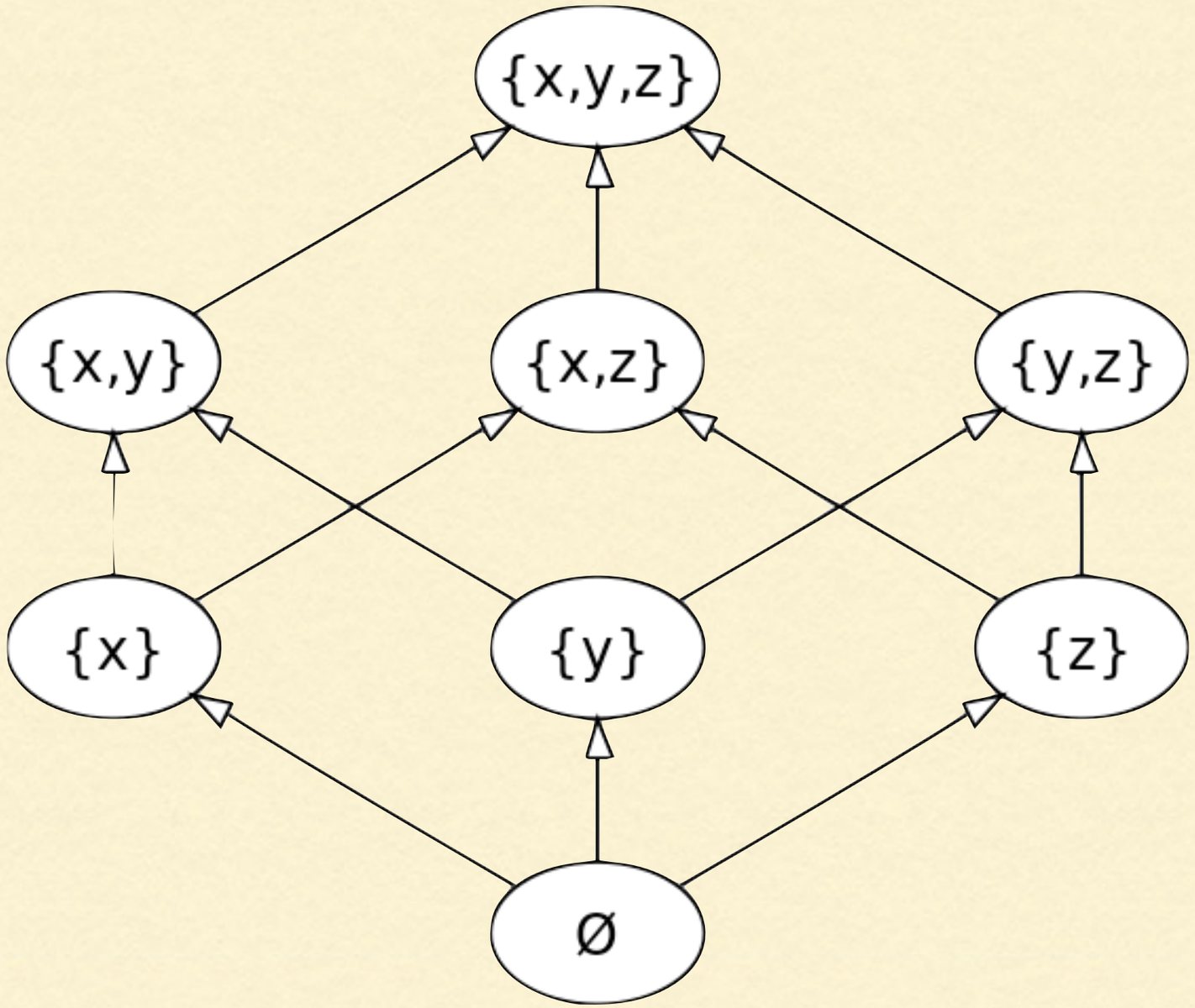
CALLING PROLOG

```
1 get(Erlog, Key) ->
2       PR = erlog:prove(Erlog,
3             {model, Key, {'Y'}}) ,
4       case  PR of
5           {succeed, [{'Y', Value}]} ->
6        {ok, Value};
7           fail                      ->
8        not_found
9       end.
```

ALGEBRA



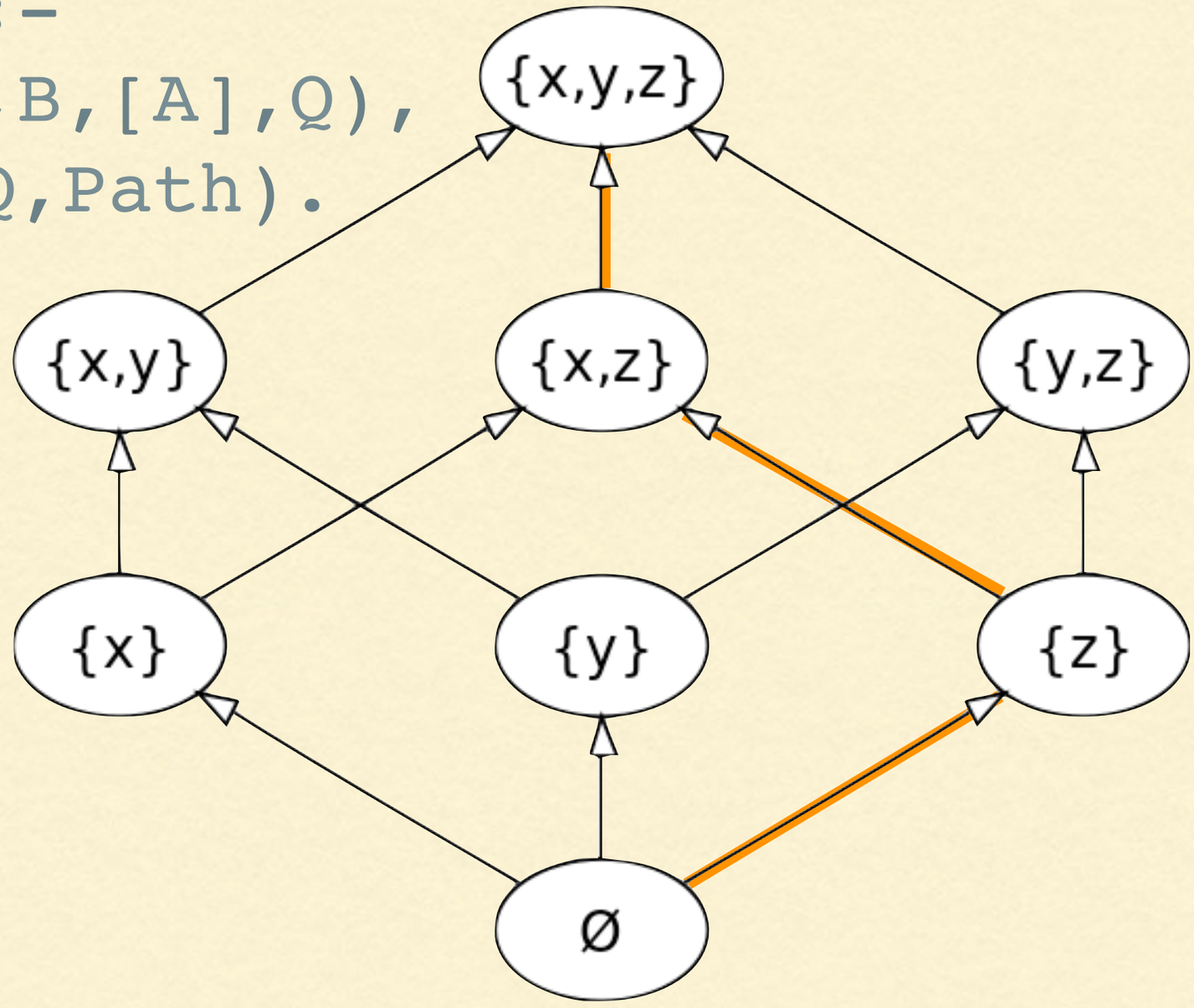
- Sets
- Graphs
- Trees
- CRDTs



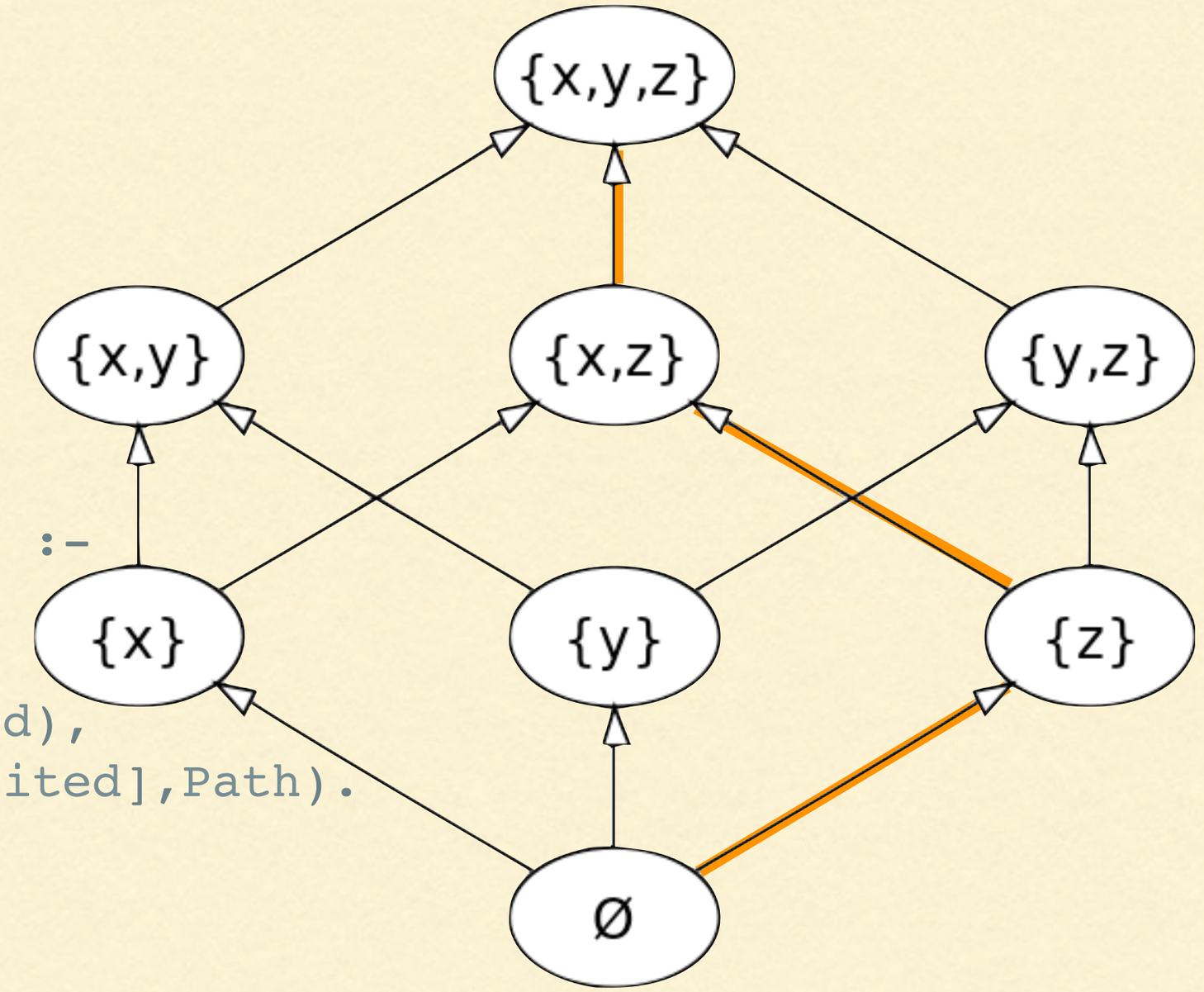
PARTIALLY ORDERED SETS

ESTABLISHING PATHS

```
1 path(A,B,Path) :-
2         travel(A,B,[A],Q),
3         reverse(Q,Path).
```



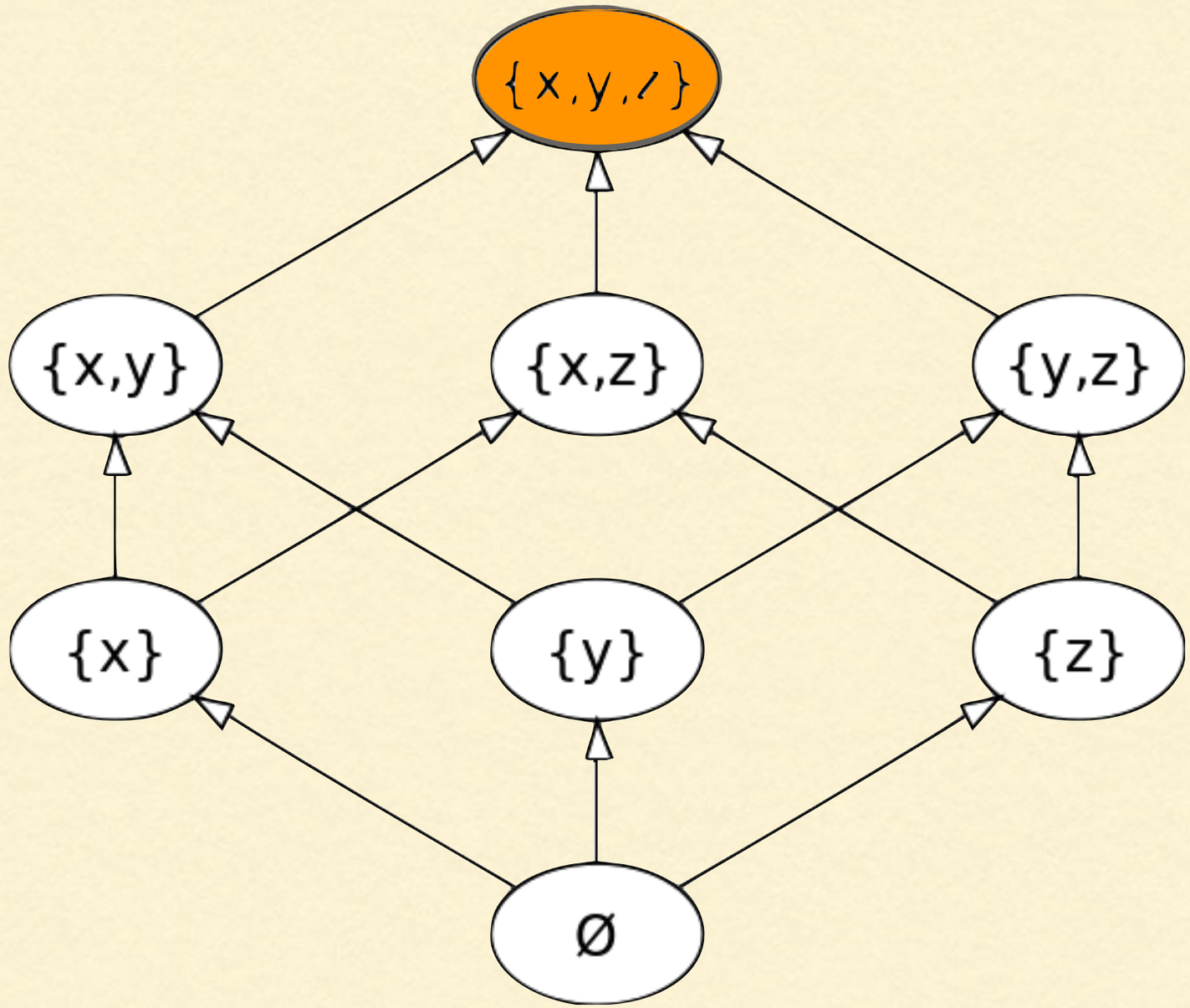
ESTABLISHING PATHS




```
1 travel(A,B,P,[B|P]) :-
2         connected(A,B).
3 travel(A,B,Visited,Path) :-
4         connected(A,C),
5         C \== B,
6         \+member(C,Visited),
7         travel(C,B,[C|Visited],Path).
```

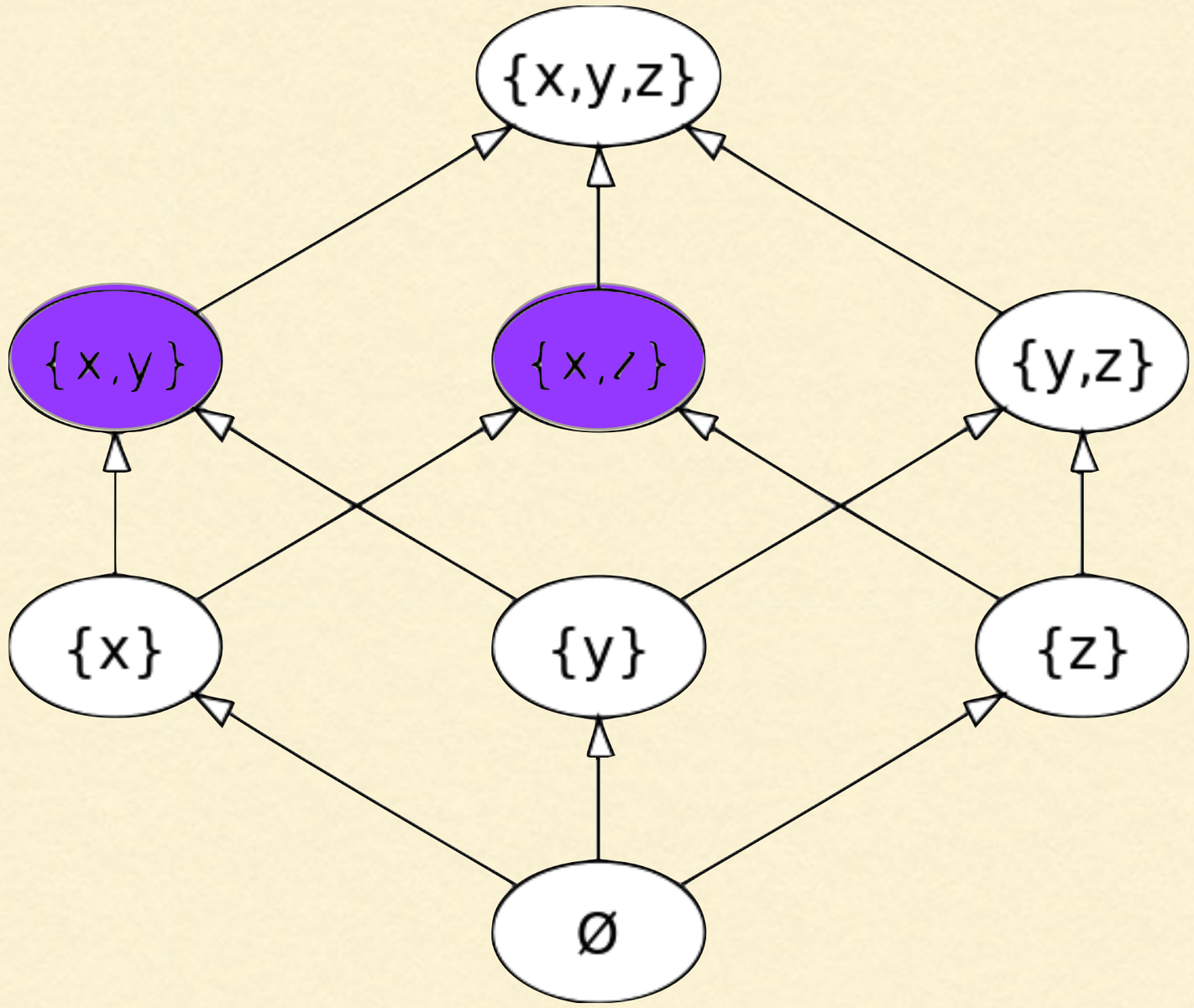
HEAD/CHILD

```
1 child(A) :-
2   \+edge(A,_).
```



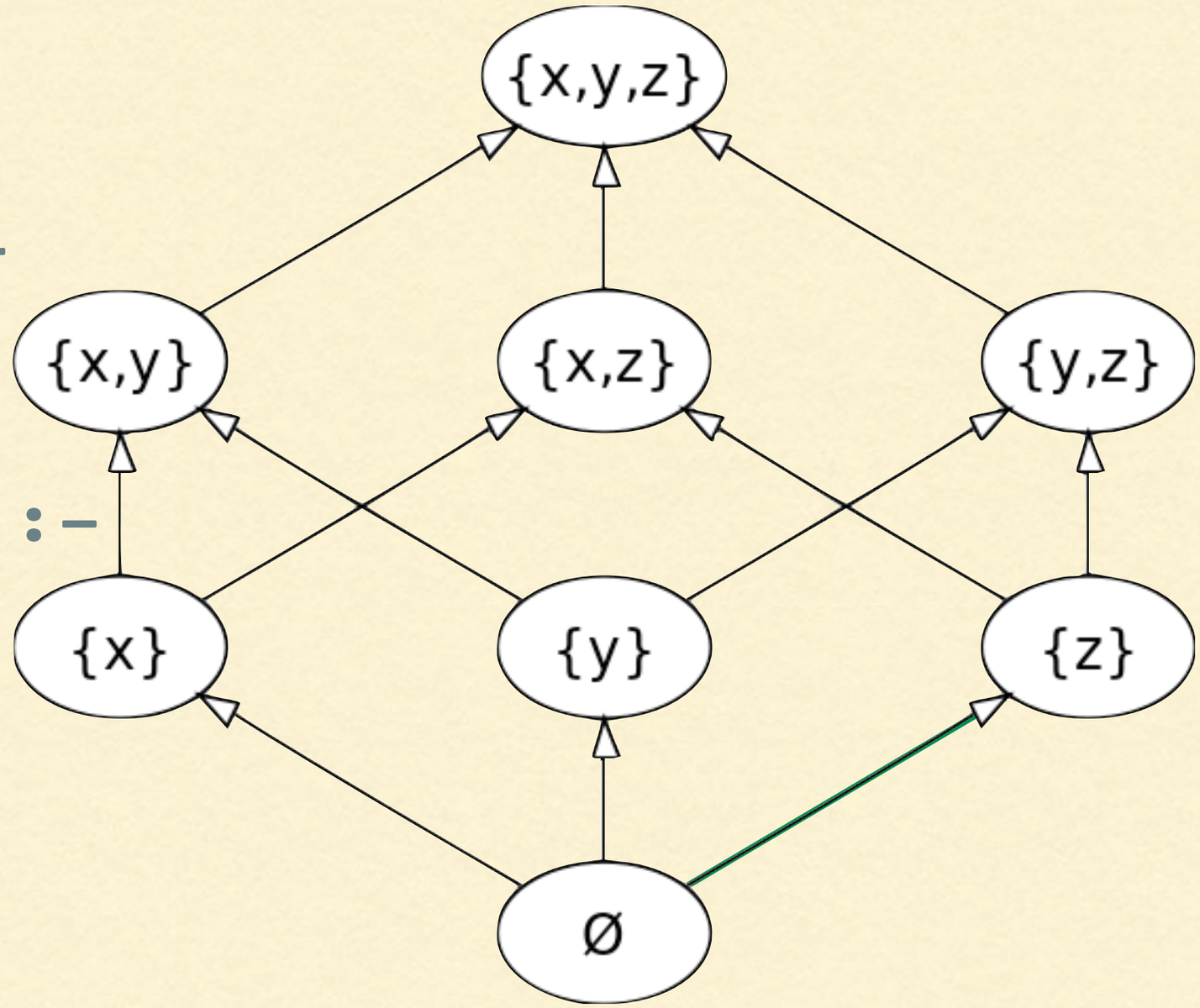
SIBLING RELATIONSHIPS

```
1 sib(A,B) :-
2   path(C,A,_),
3   path(C,B,_),
4   \+path(A,B,_),
5   \+path(B,A,_).
```

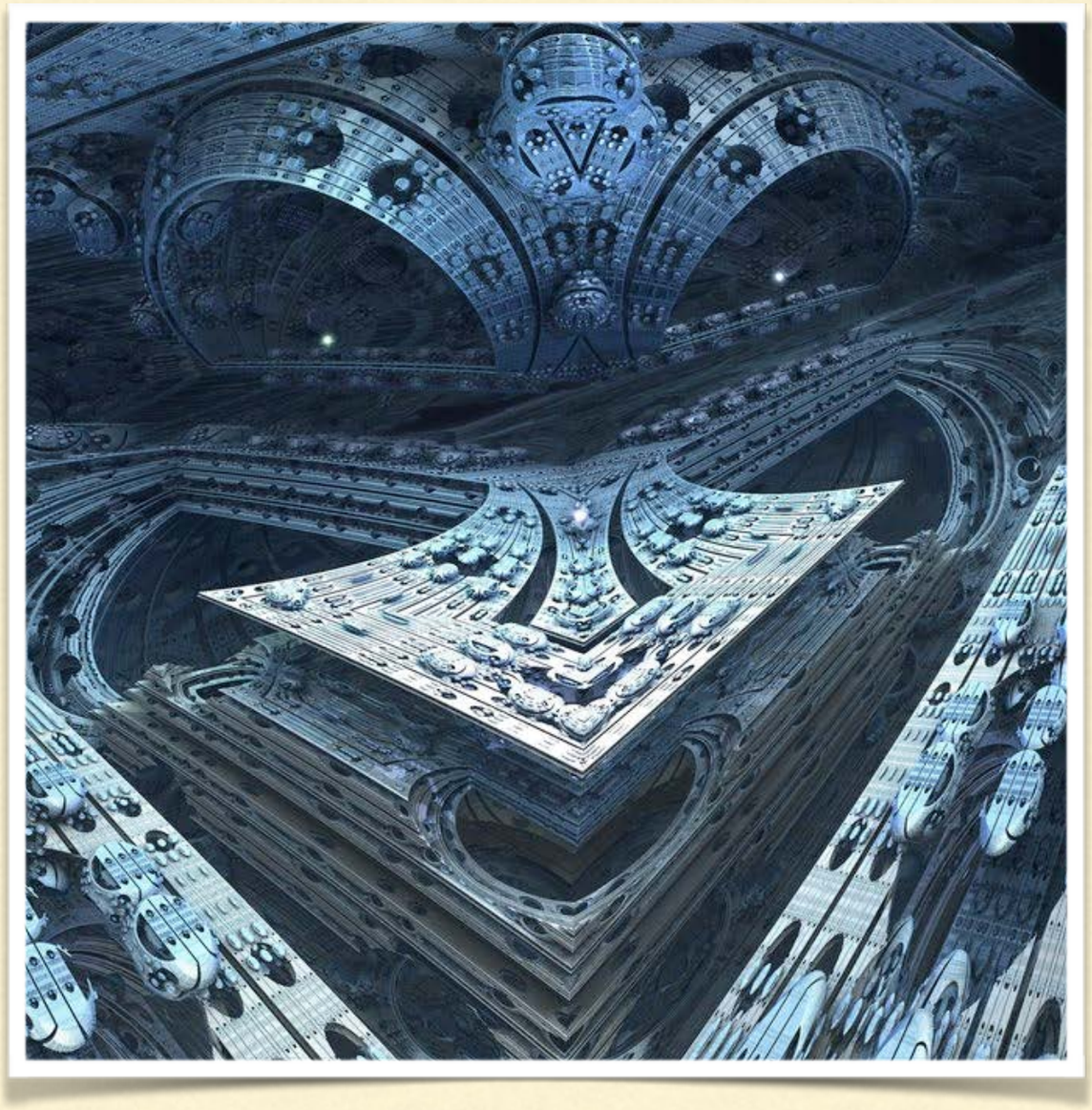


ANCESTOR / DESCENDENT

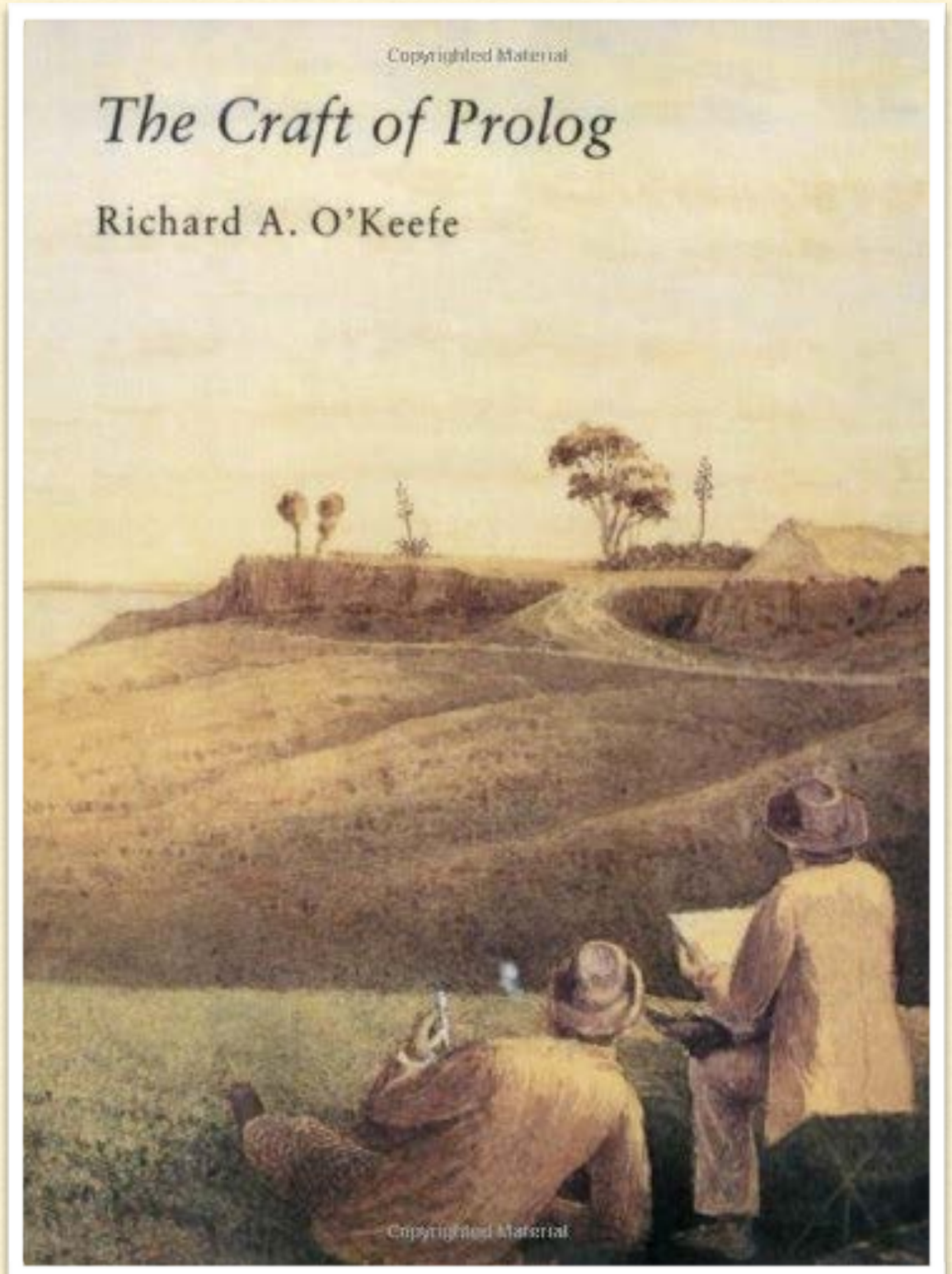
```
1 ancestor(A,B) :-
2   path(A,B,_).
3
4 descendent(A,B) :-
5   path(B,A,_).
```

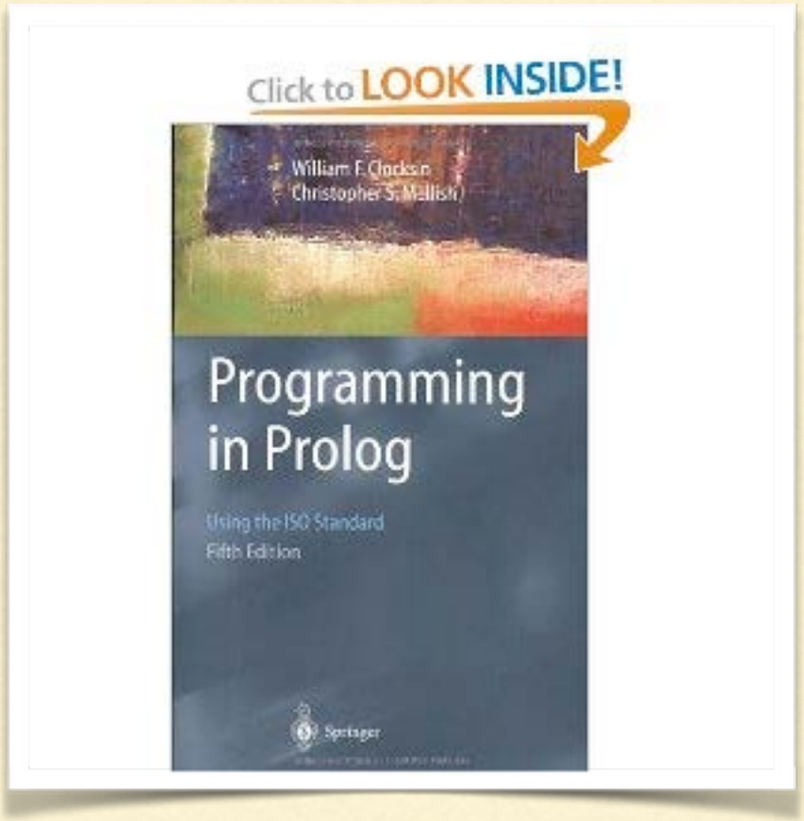


HOW TO TEST WITH IT



- Create an initial state
- Apply Event Stream
- Validate states of VC's after each step





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THANK YOU!

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