

**automata**

algorithmic  
logic

databases

mathematics

topology

descriptive set theory

linear algebra

group theory

probabilities

word

combinatorics

language  
theory

linguistic

WQO's

verification

model-checking

game  
theory

complexity

boolean  
circuits

algebraic  
circuits

CSP's

logic  
(model theory)

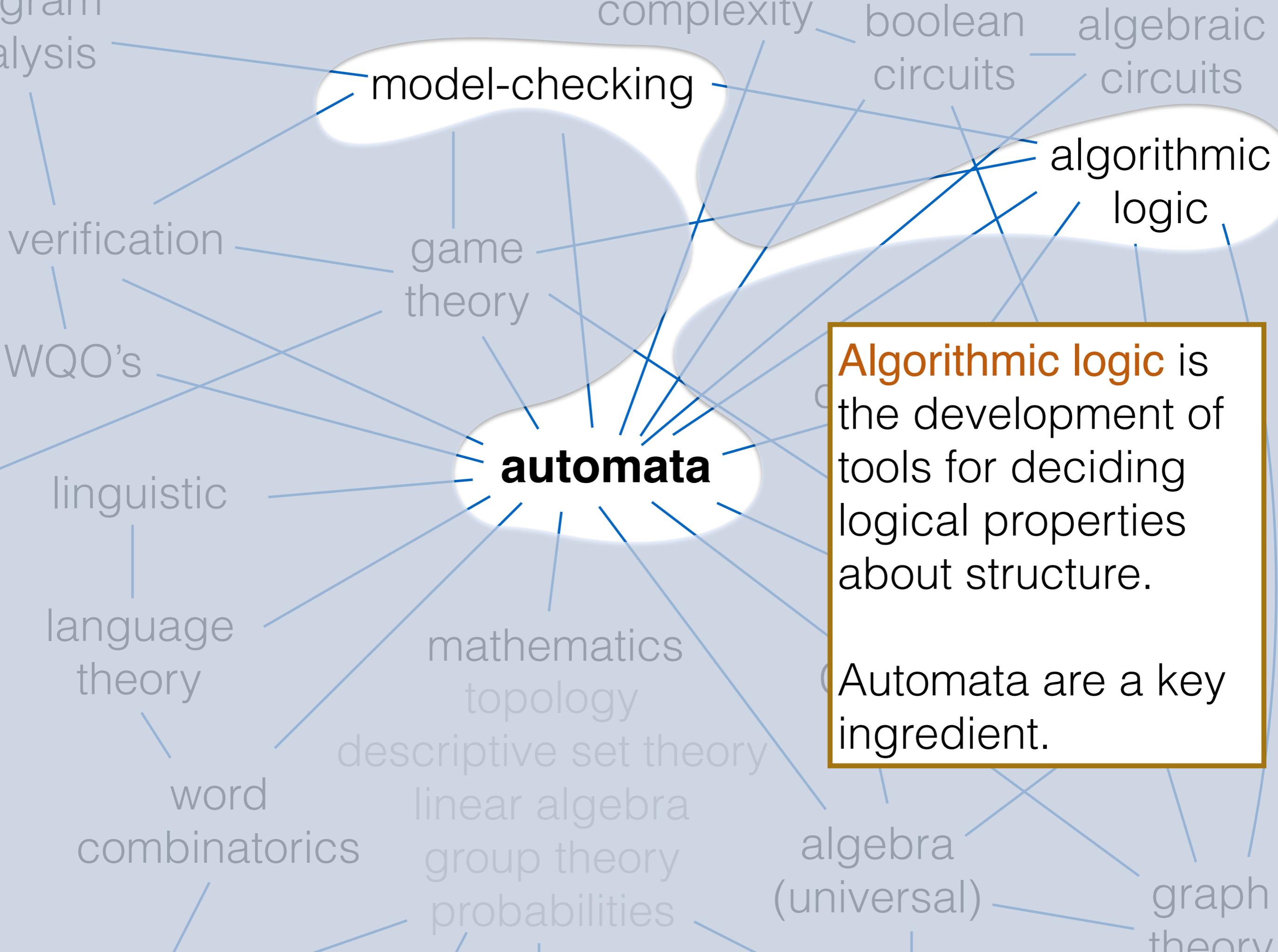
algebra  
(universal)

graph  
theory

**automata**

**Algorithmic logic** is the development of tools for deciding logical properties about structure.

Automata are a key ingredient.



model-checking

algorithmic logic

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model-checking

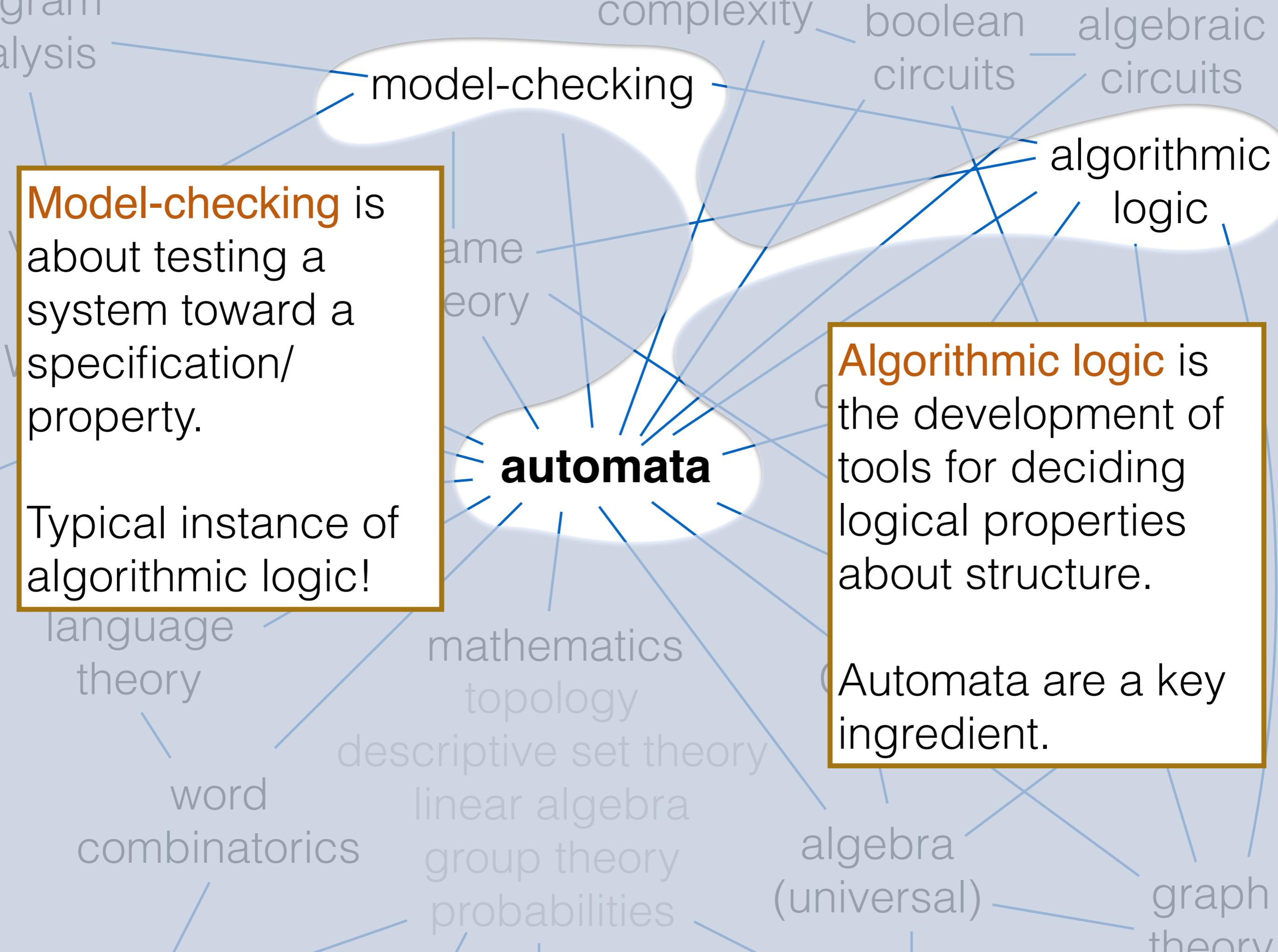
**Model-checking** is about testing a system toward a specification/property.

Typical instance of algorithmic logic!

**automata**

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model-checking

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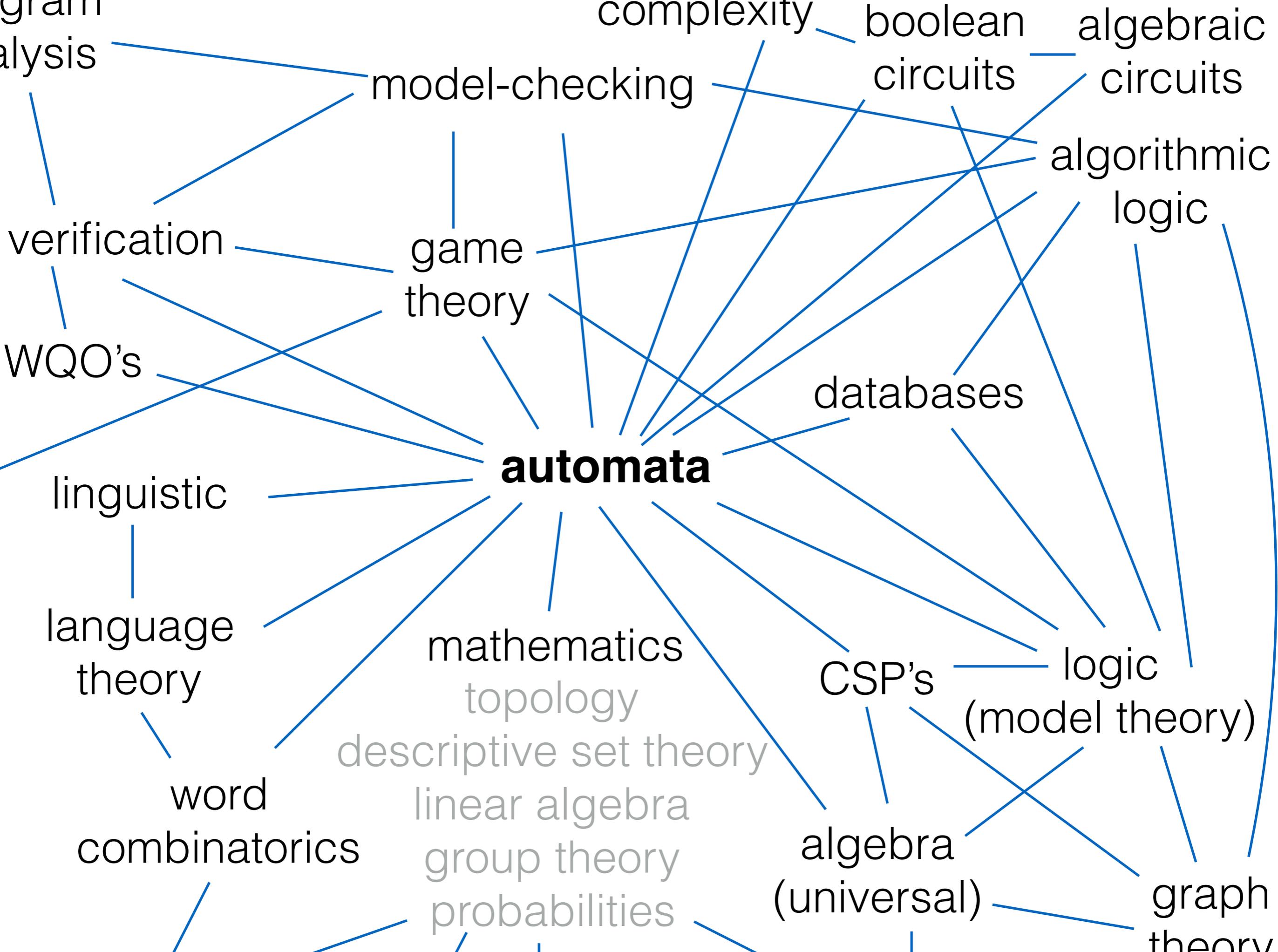
**automata**

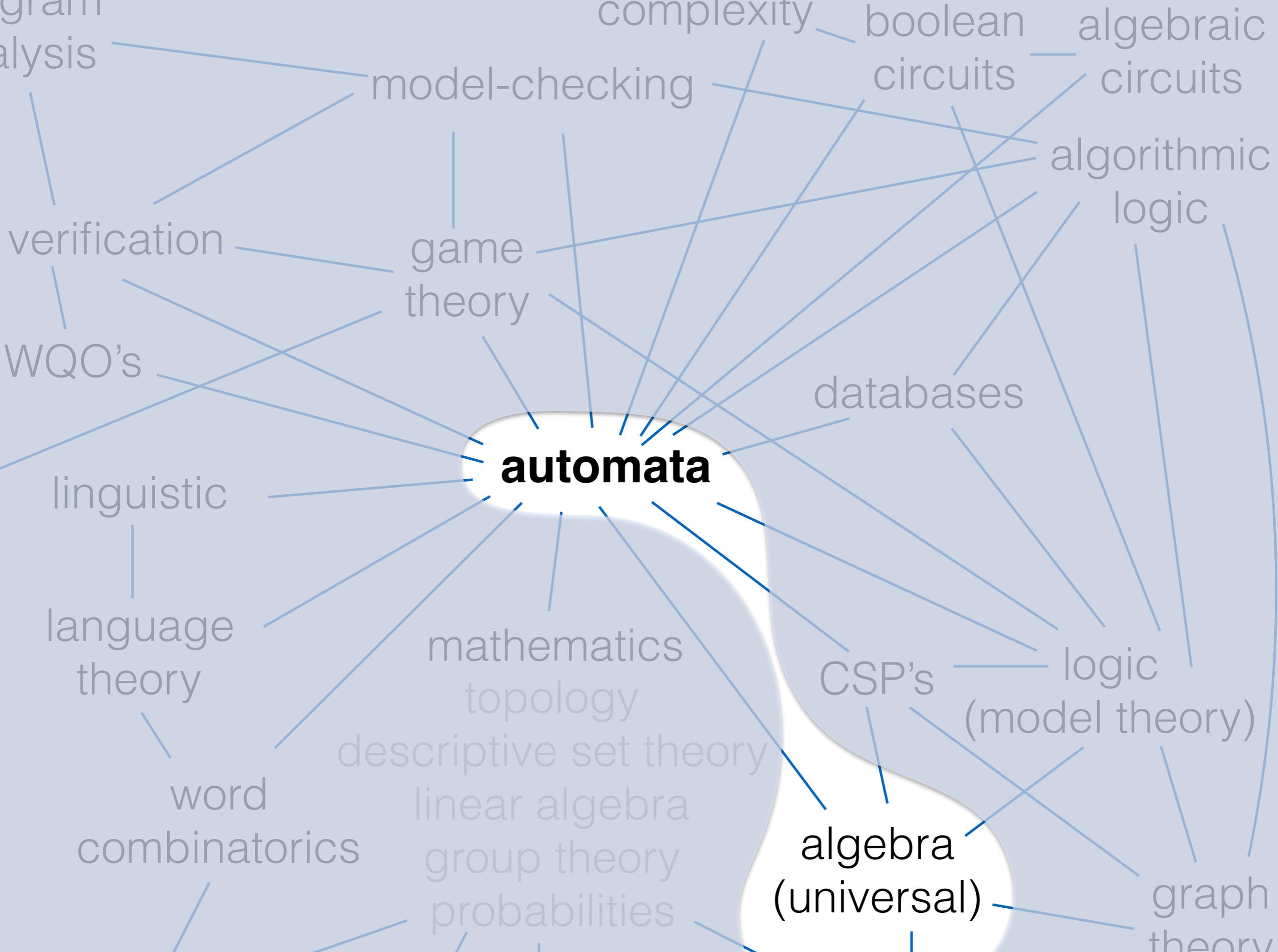
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2.9.1 Well-Quasi-Orders for Algorithms

2.9.2 Algorithmic verification of programs





**automata**

model-checking

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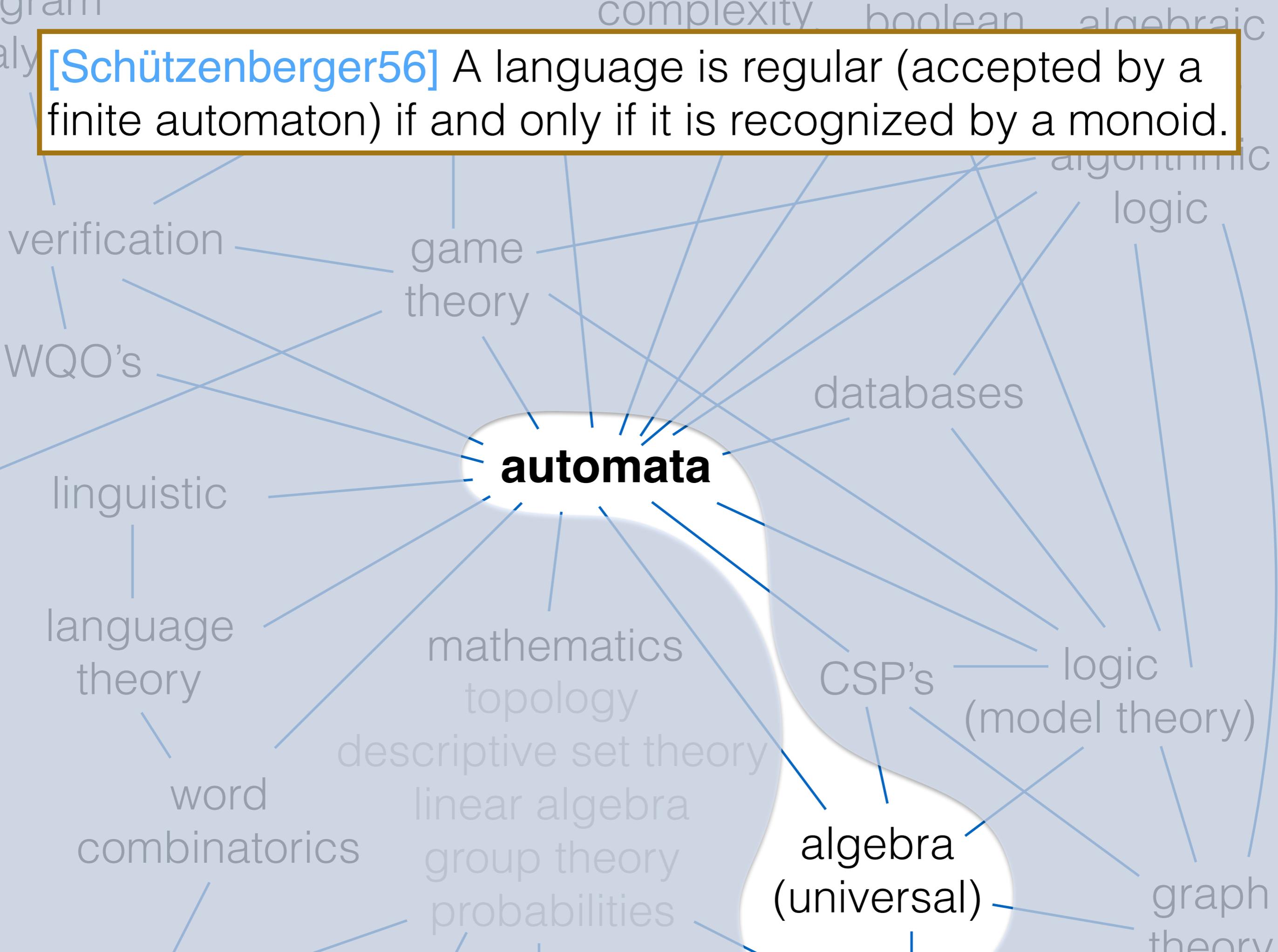
CSP's

word combinatorics

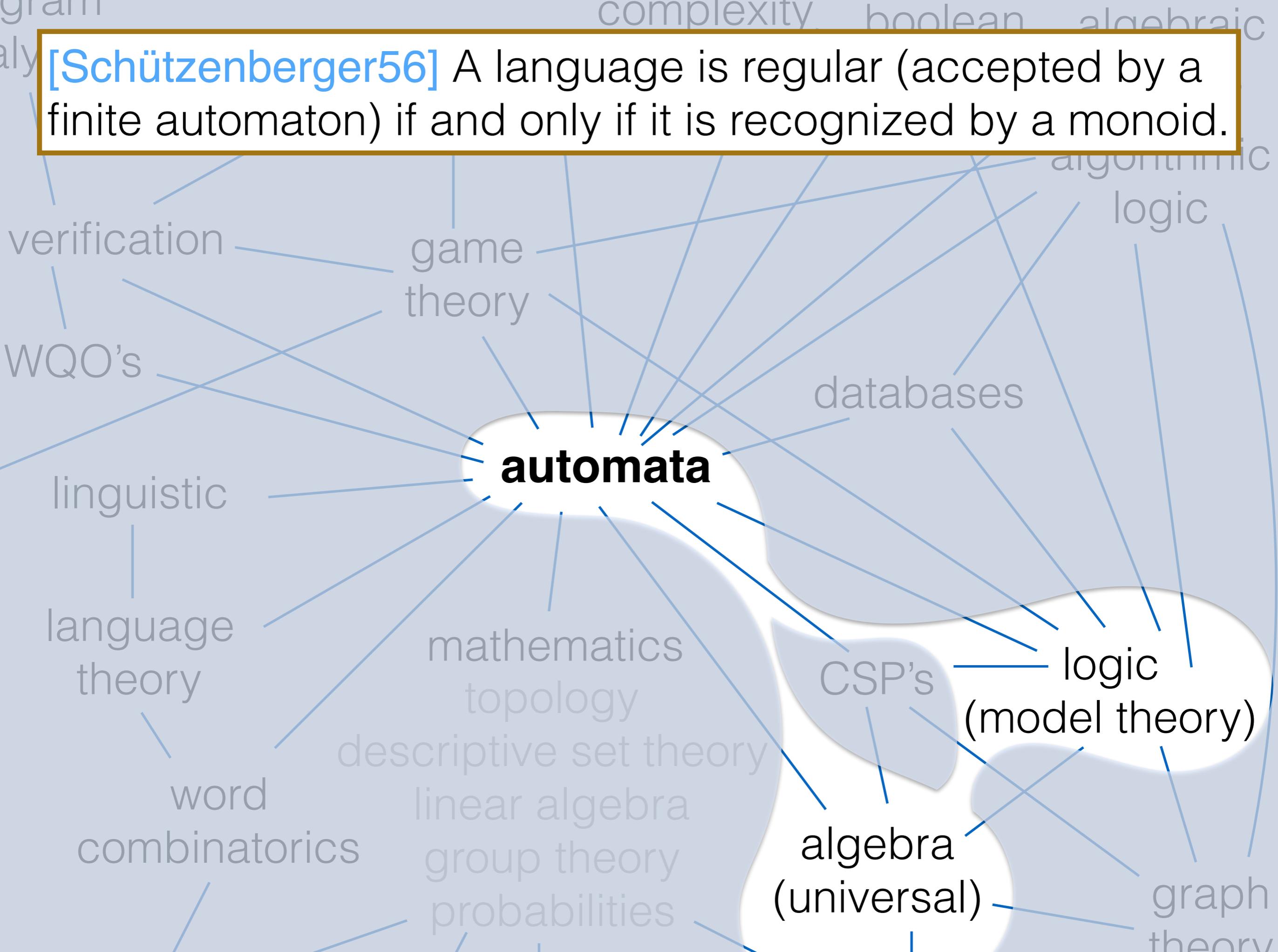
combinatorics

**[Schützenberger56]** A language is regular (accepted by a finite automaton) if and only if it is recognized by a monoid.

**automata**



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**[Elgott,Büchi,Trakhtenbrot 61]** A language is regular if and only if it definable in monadic second-order logic.

**[Schützenberger56]** A language is first-order definable if and only if it is recognized by an aperiodic monoid.

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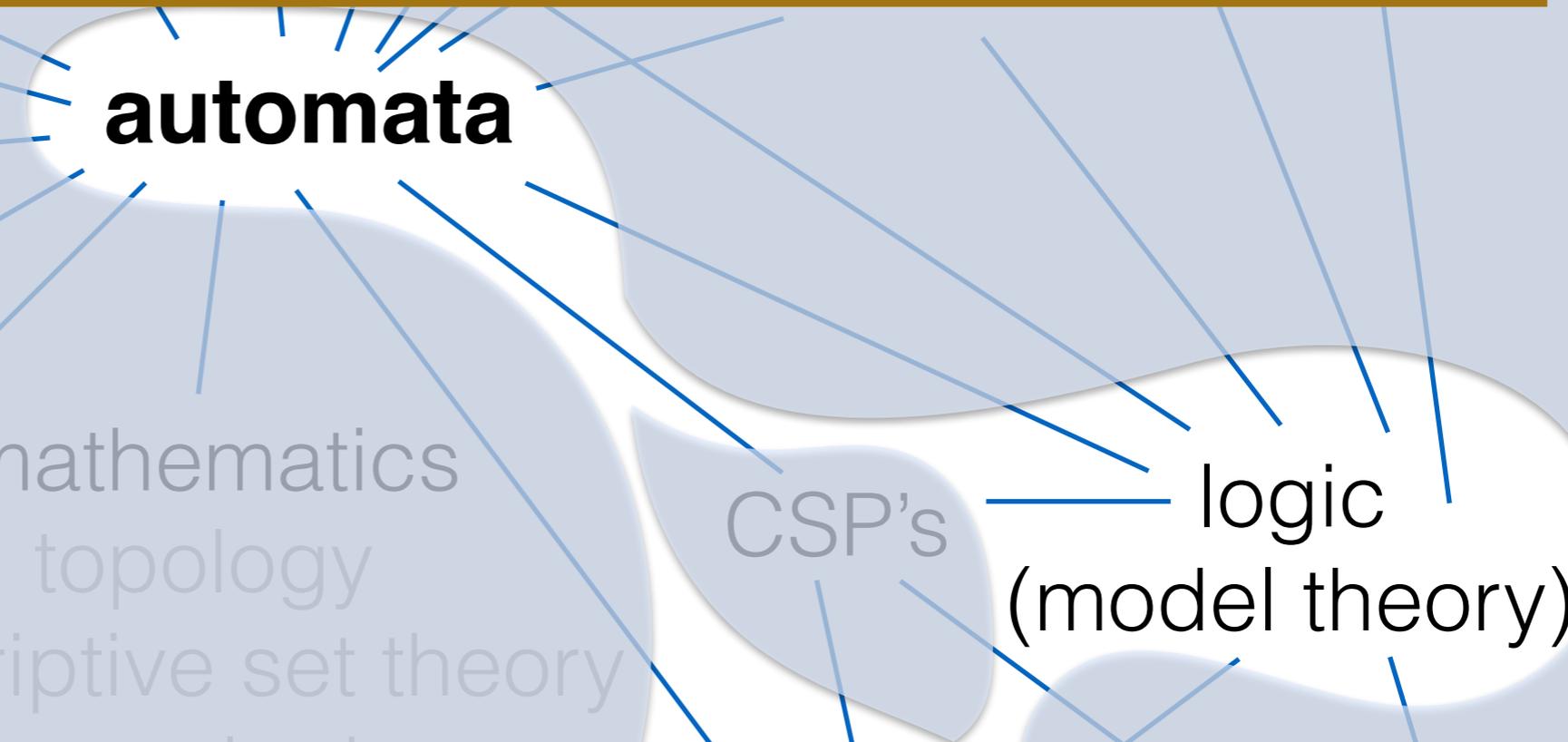
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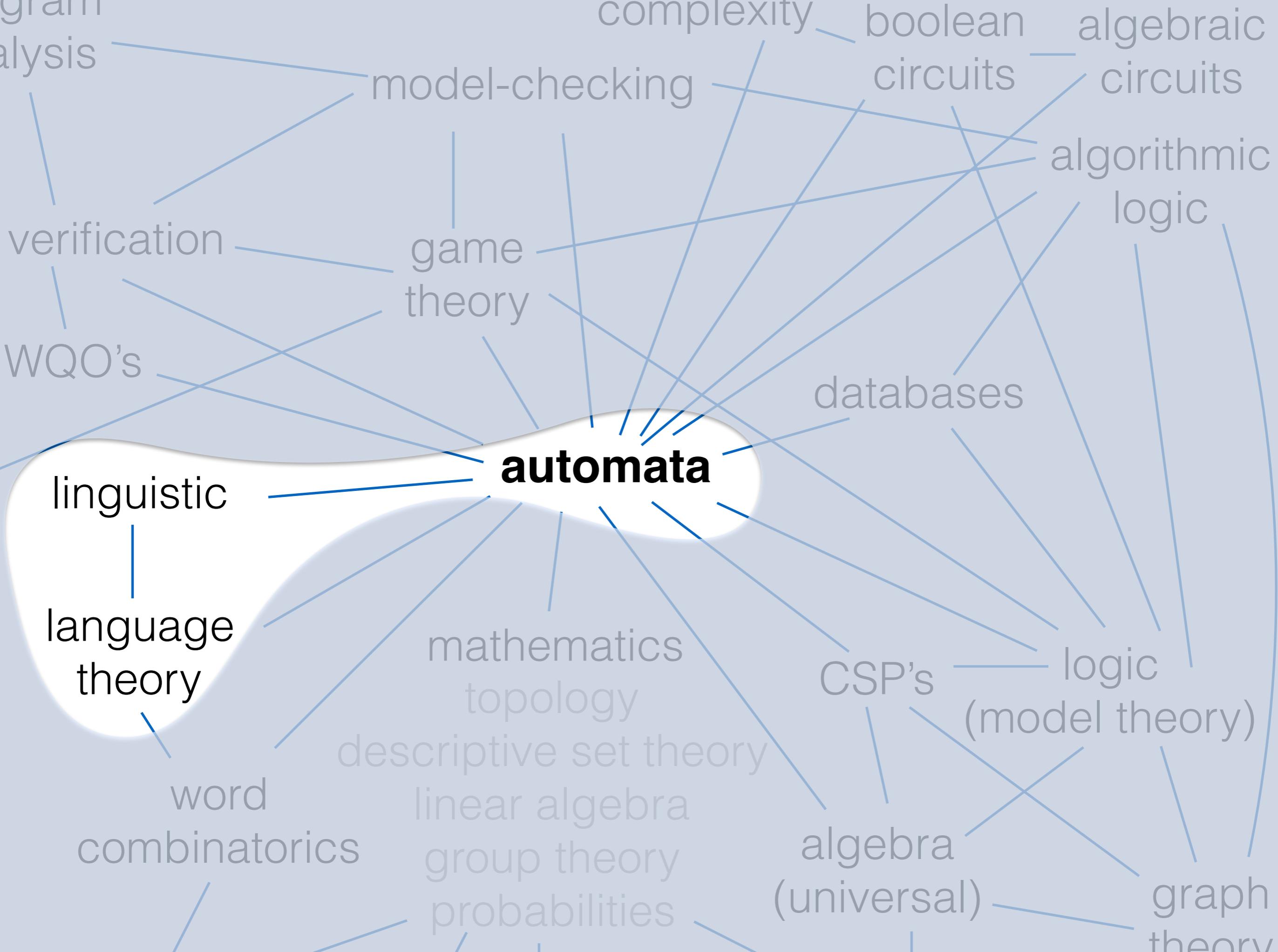
CSP's

logic  
(model theory)

2.20.3 Mathematical foundations of automata theory

2.26.1 Logic, descriptive complexity and database theory





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**Automata** are  
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representations of  
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at the heart of  
parsing techniques  
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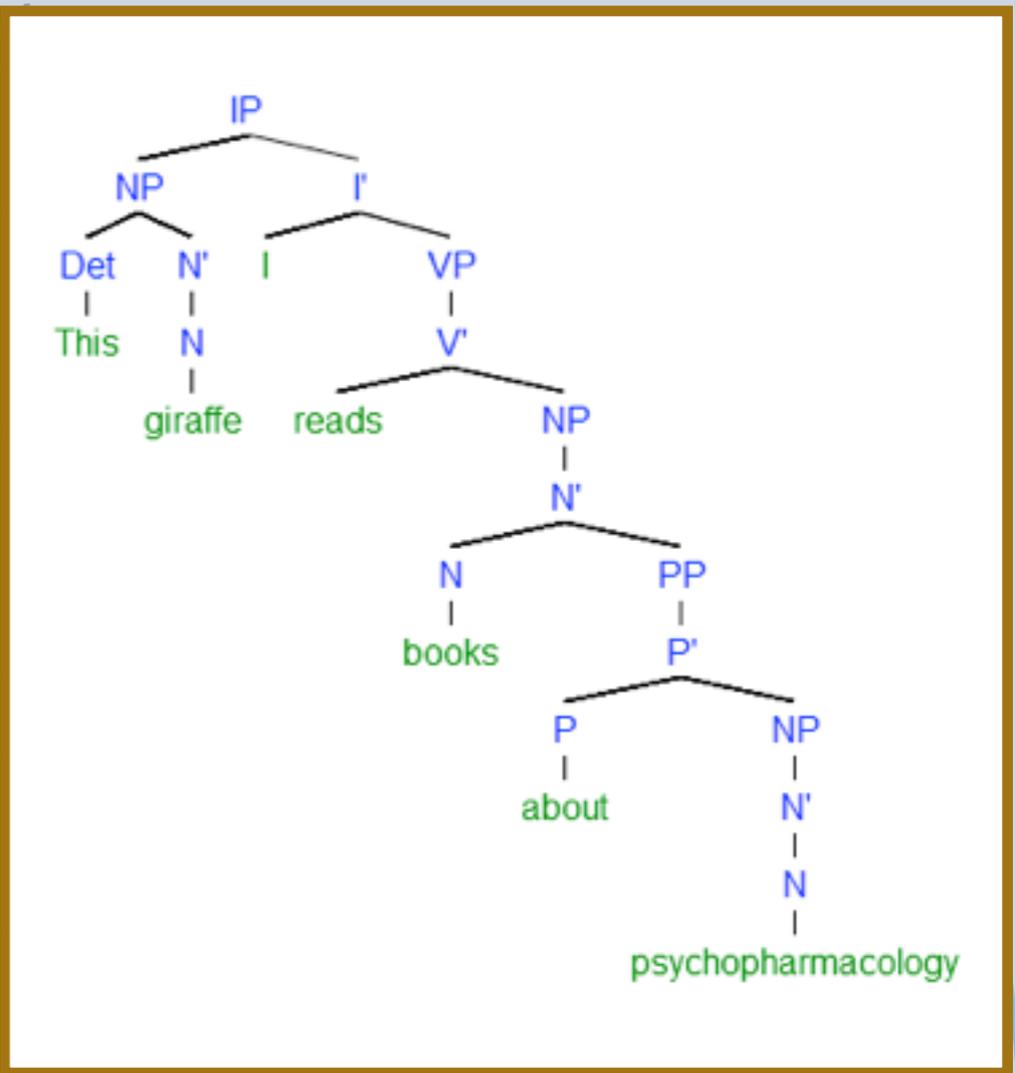
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# automata

linguistic

language  
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combinatorics

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probabilities

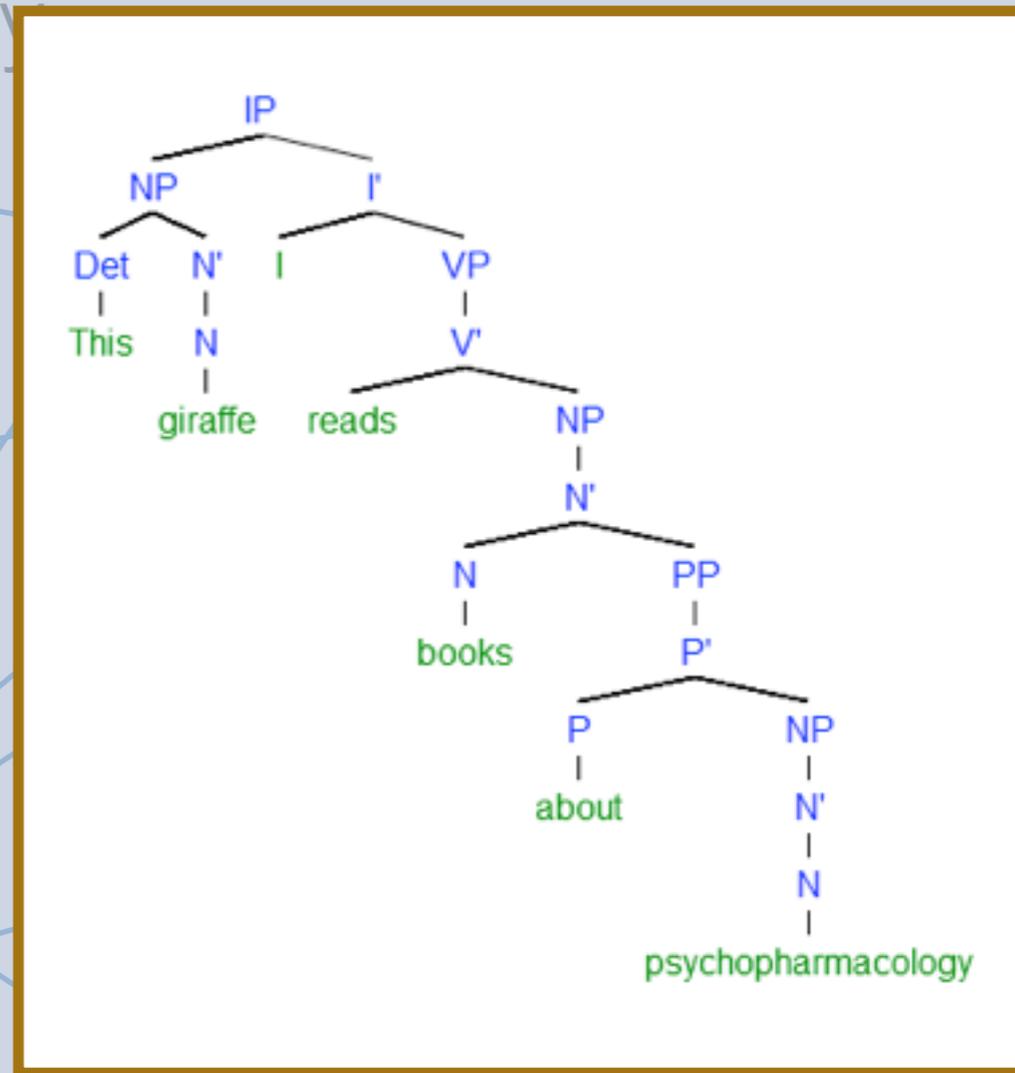
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algebra  
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**automata**

linguistic

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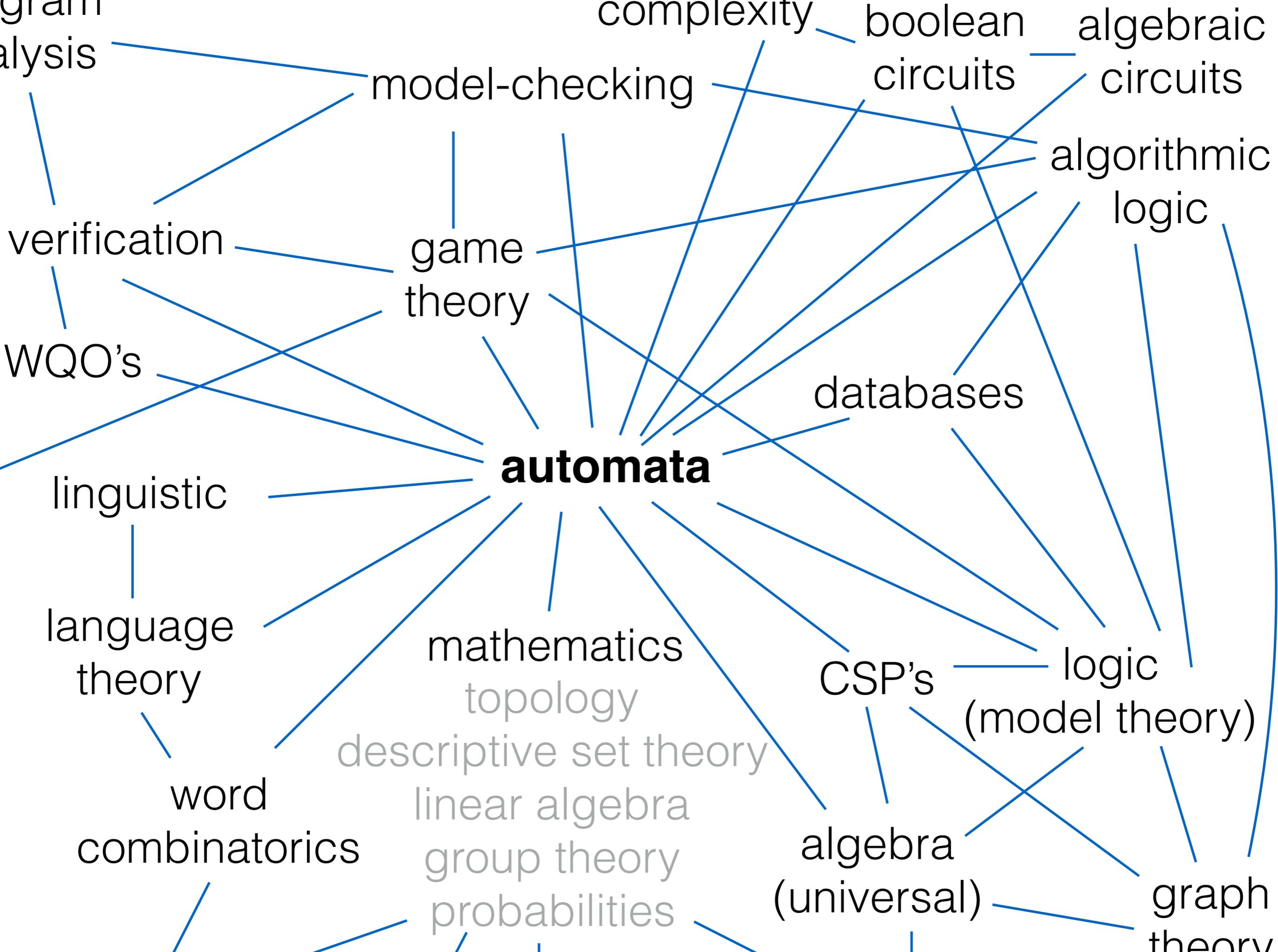
mathematics  
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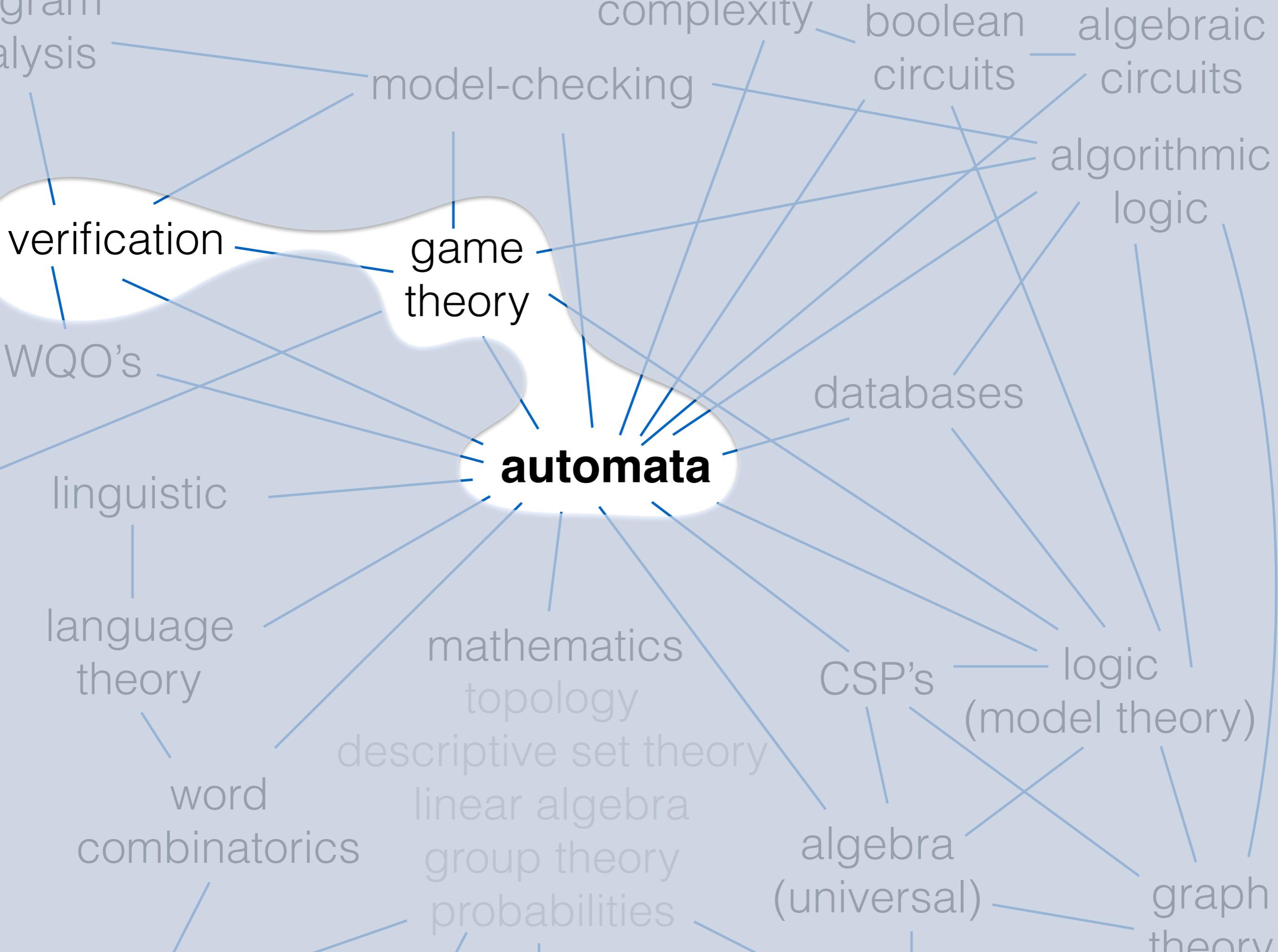
descriptive set theory

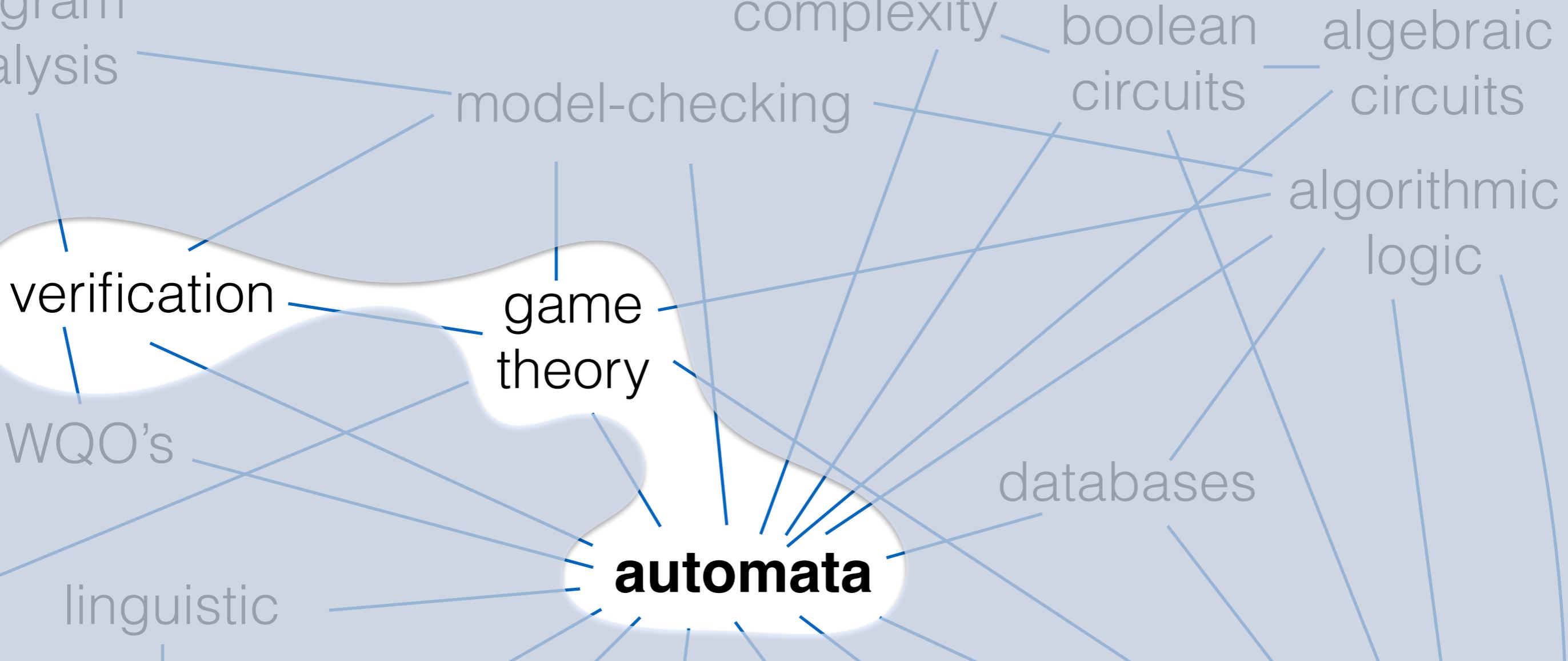
CSP's

logic  
(model theory)

**2.27.1 Logical and Computational Structures for Linguistic Modeling**



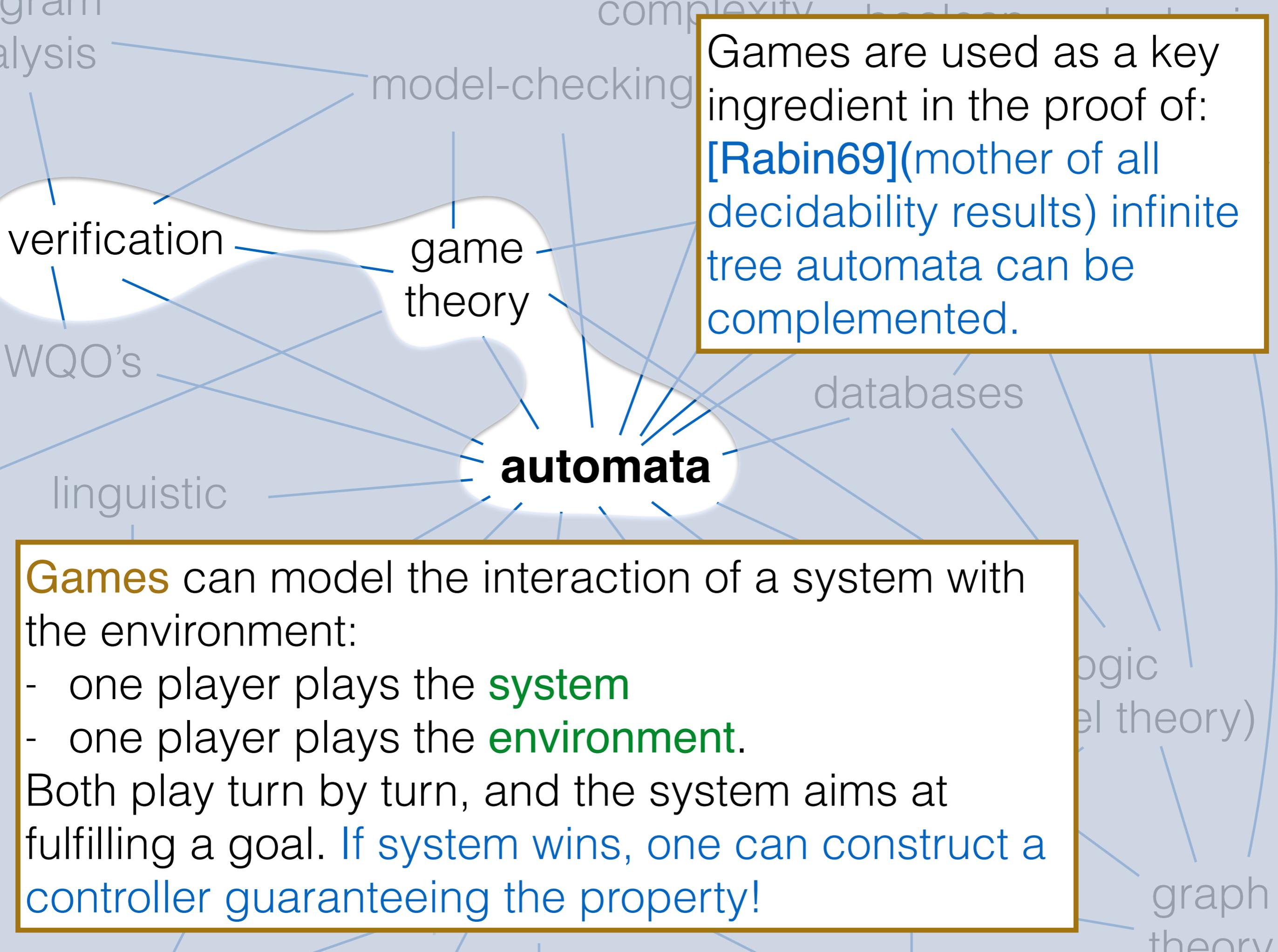




**Games** can model the interaction of a system with the environment:

- one player plays the **system**
- one player plays the **environment**.

Both play turn by turn, and the system aims at fulfilling a goal. **If system wins, one can construct a controller guaranteeing the property!**



Games are used as a key ingredient in the proof of: **[Rabin69]**(mother of all decidability results) infinite tree automata can be complemented.

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## 2.20.1 Game theory techniques in computer science

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verification

game theory

**automata**

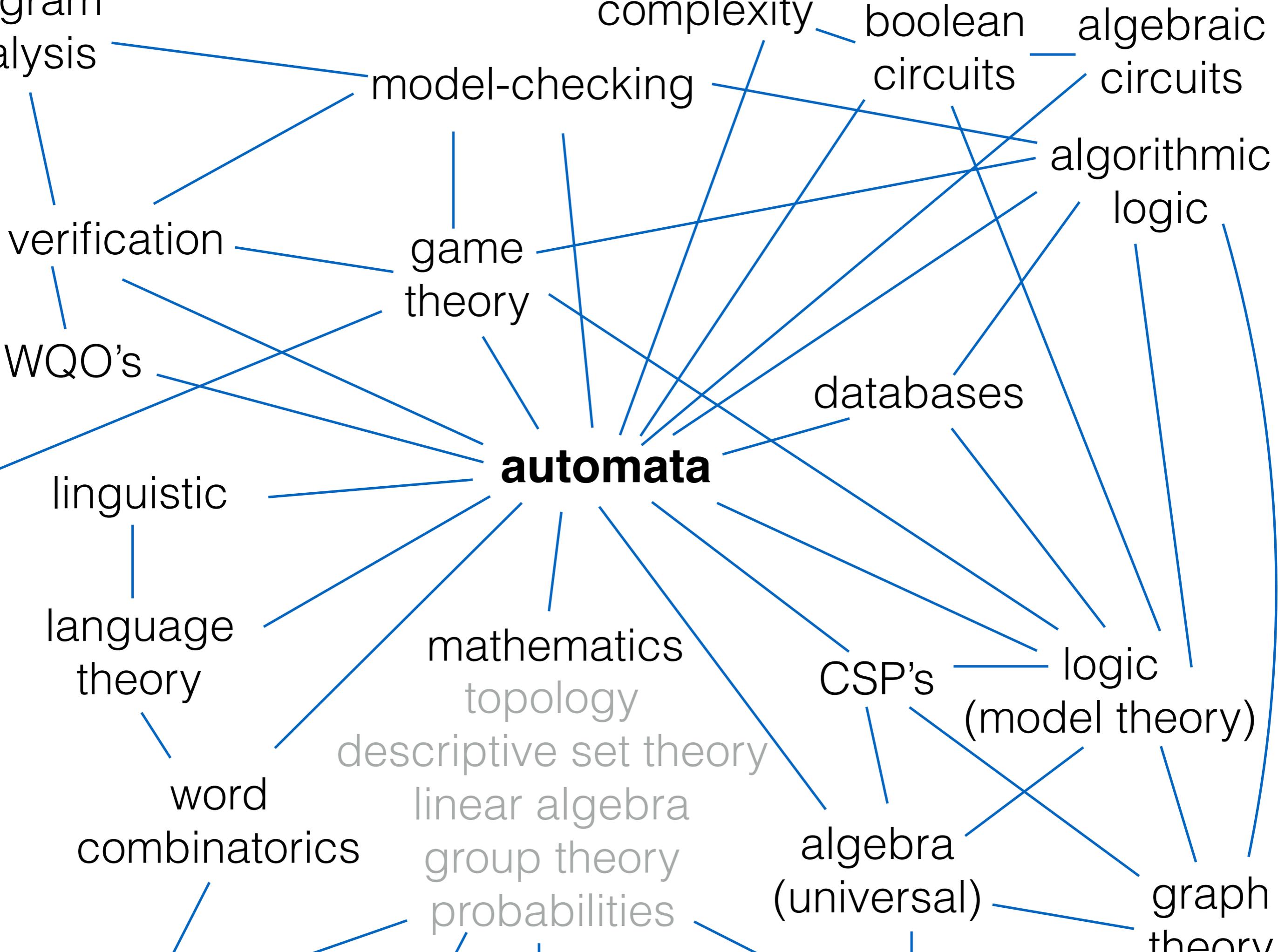
databases

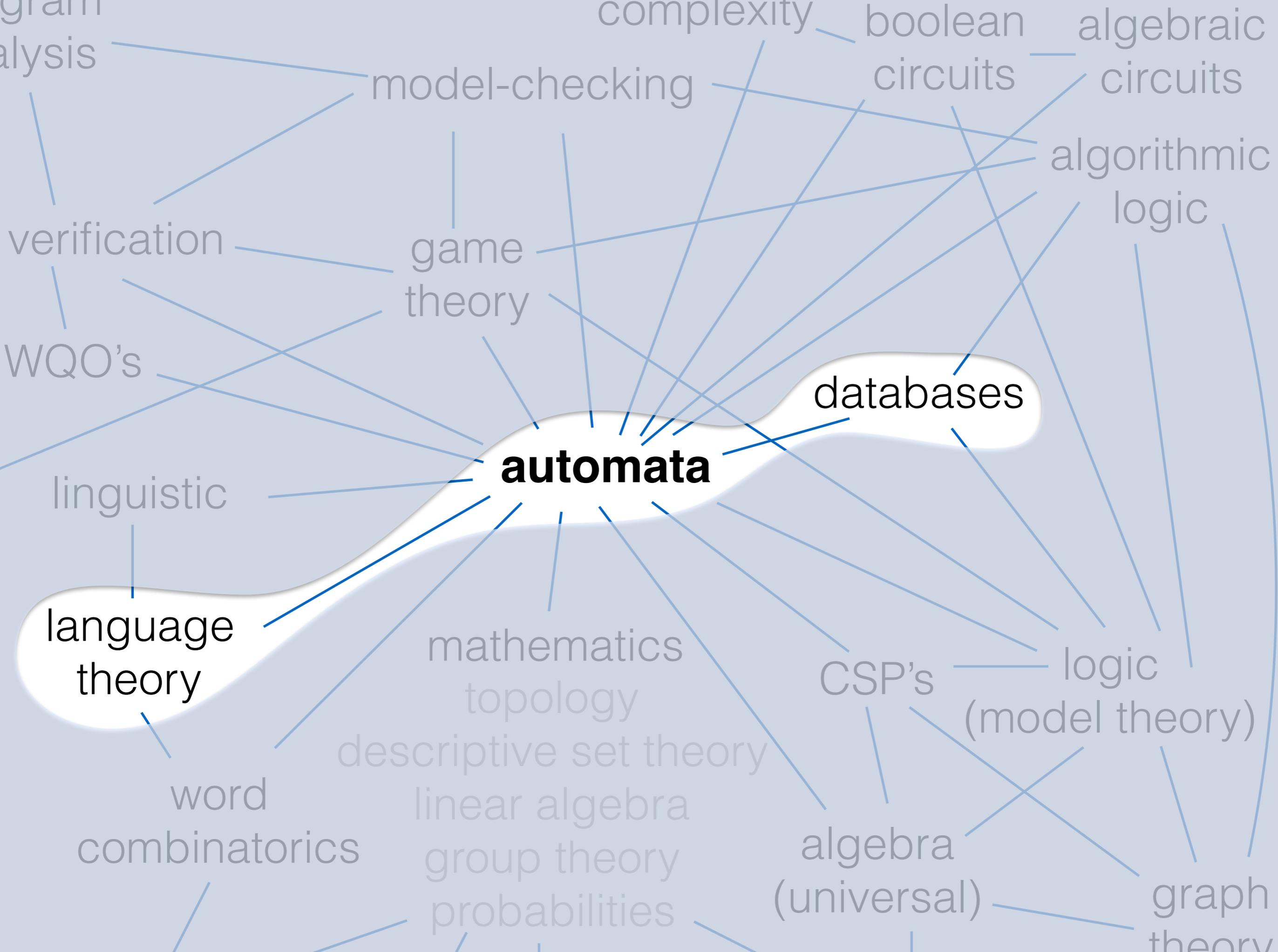
linguistic

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**automata**

databases

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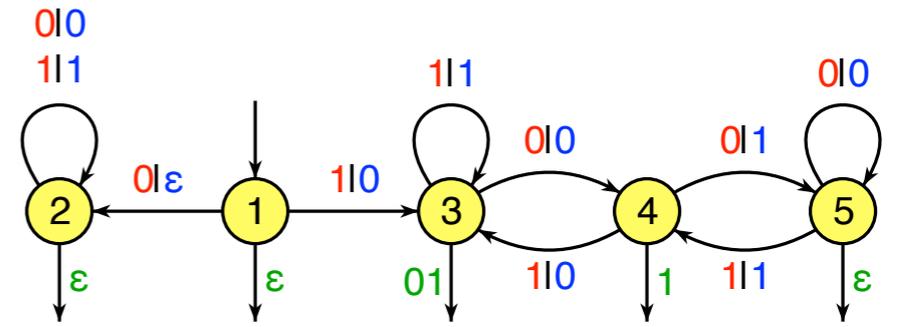
CSP's

logic (model theory)

algebra (universal)

graph theory

Some databases are linear or tree like structures (XML for instance). Transforming them consists in applying transducers; finite automata that transform the input.



**automata**

databases

language theory

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topology

CSP's

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word  
combinatorics

descriptive set theory

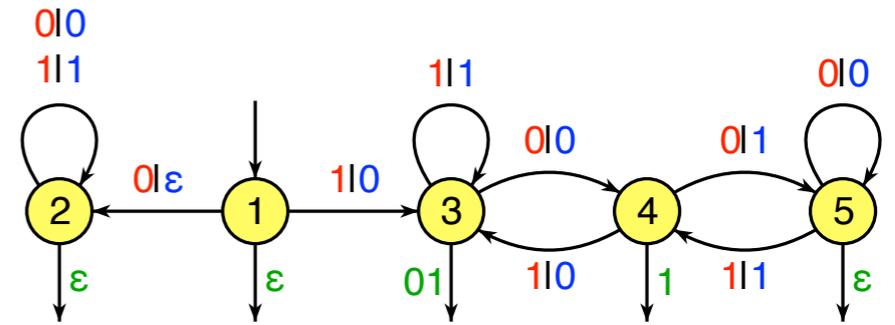
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**automata**

databases

What is the theory of transducers ?

language theory

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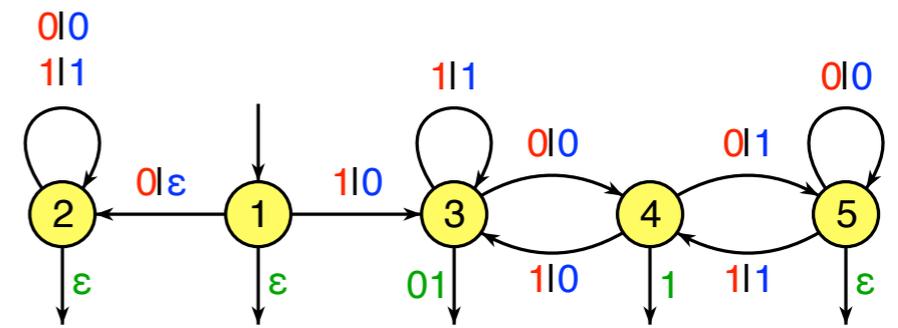
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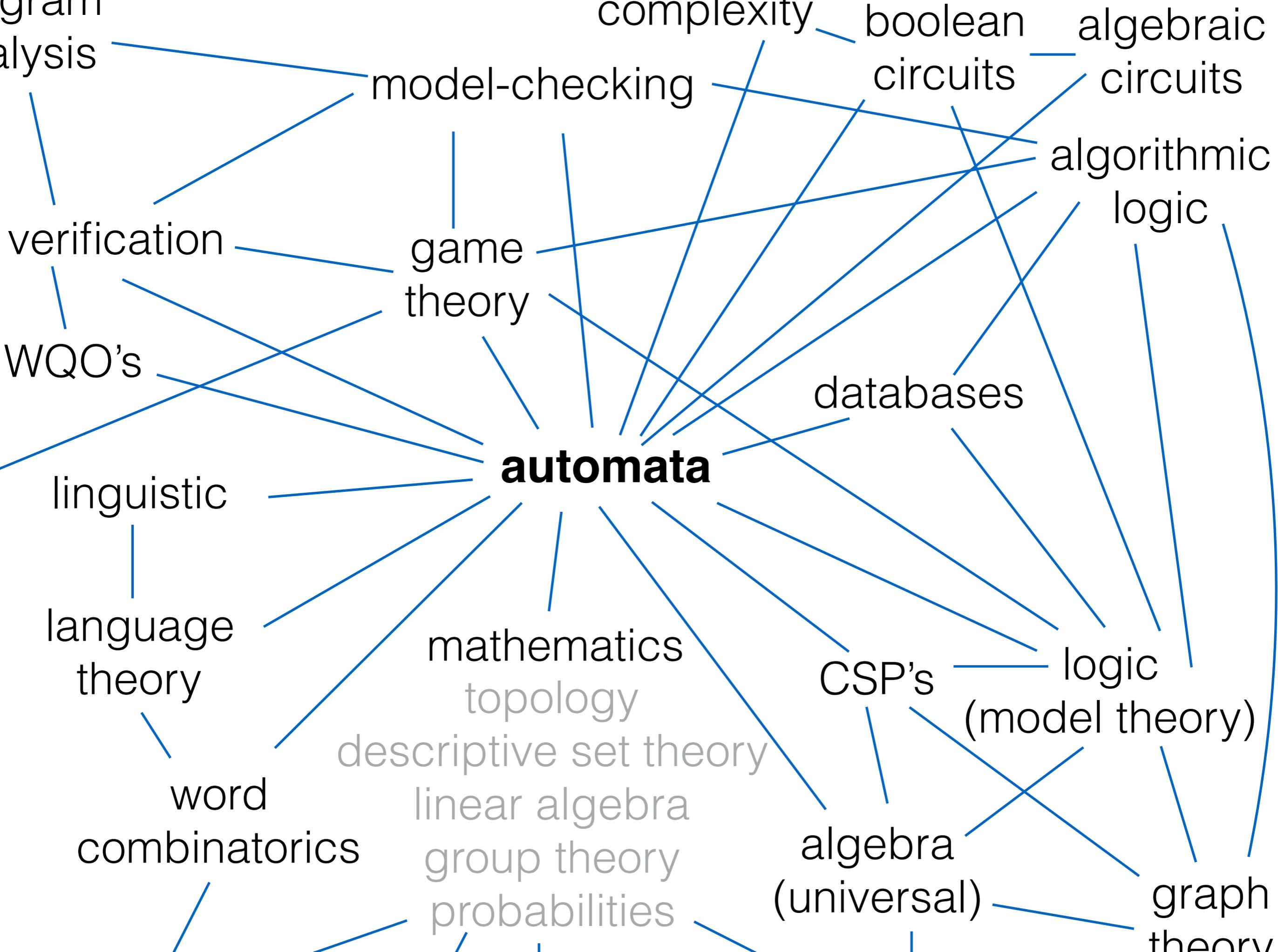
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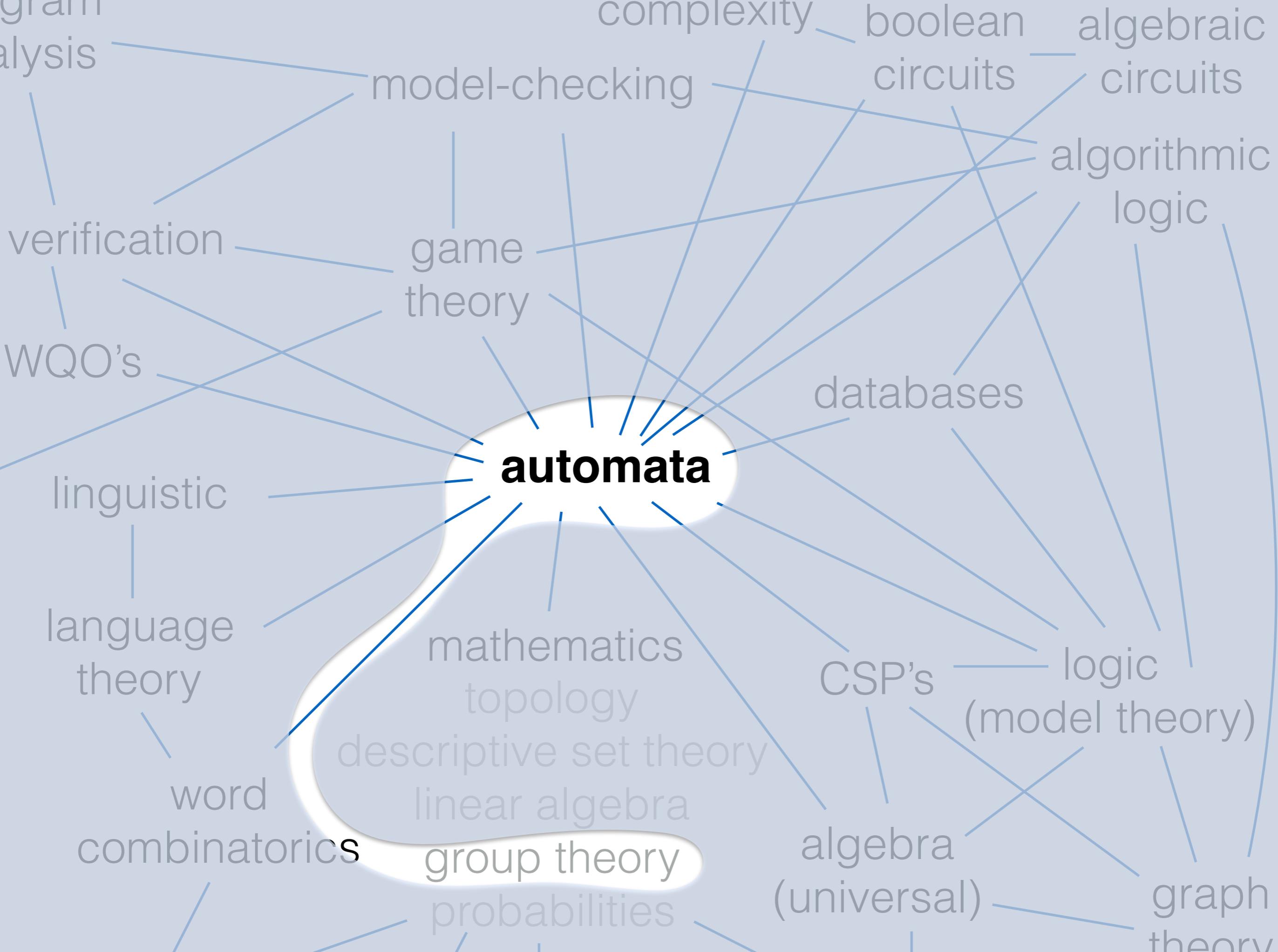
What is the theory of transducers ?

language theory

2.16 Computation model and automata

2.26.1 Logic, descriptive complexity and database theory





Automata can be used to represent objects (languages, relations).

This can be used to represent infinite objects such as infinite groups.

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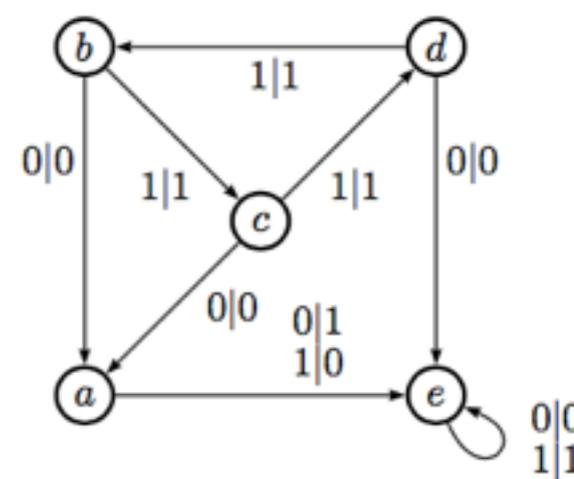
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[Aleshin — Grigorchuk]

the following automaton describes a group of intermediate growth:



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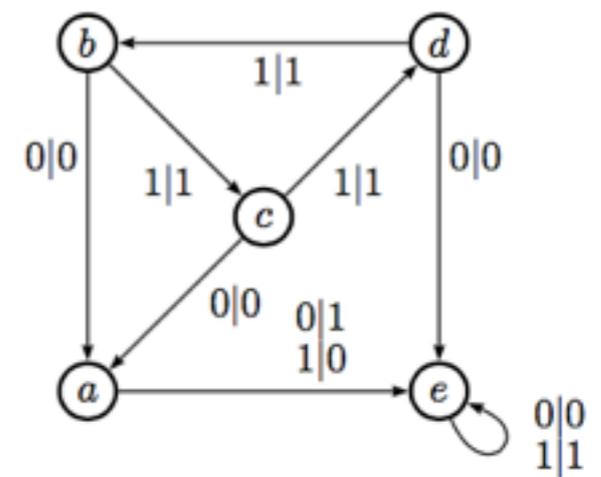
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## 2.16 Computation model and automata

# Some modules related to automata

- 1.28 Tree automata and applications
- 1.22 Basics of verification
- 2.9.1 Well-quasi-orders for algorithms  
Beaux préordres et algorithmes
- 2.9.2 Algorithmic verification of programs  
Vérification algorithmique des programmes
- 2.20.1 Games theory techniques in computer science  
Techniques de théorie des jeux en informatique
- 2.16 Computation models and  
Modèles de calcul et automates finis
- 2.20.2 Mathematical foundations of automata theory  
Fondations mathématiques de la théorie des automates
- 2.26.1 Logic, descriptive complexity and database theory  
Logique, complexité descriptive et théorie des bases de données
- 2.27.1 Computational structures and logics for natural language modeling  
Structures informatiques et logiques pour la modélisation linguistique

