

# 1 List Of Models

## 1.1 Infinite Words

- DBA
- NBA
- GBA
- Rabin automaton
- Muller automaton
- Parity automaton
- E automaton
- A automaton
- coBA
- weak BA
- Staiger-Wagner automaton
- ABA
- LTL
- S1S
- $\exists$ S1S
- S1S<sub>0</sub>

## 1.2 Finite Trees

- DTA
- NTA
- $\downarrow$ DTA
- $\downarrow$ NTA
- DUTA
- NUTA
- DTD
- deterministic EDTD
- single-type EDTD

- EDTD
- Relax NG
- FO
- MSO
- Regular expressions
- DTWA
- TWA

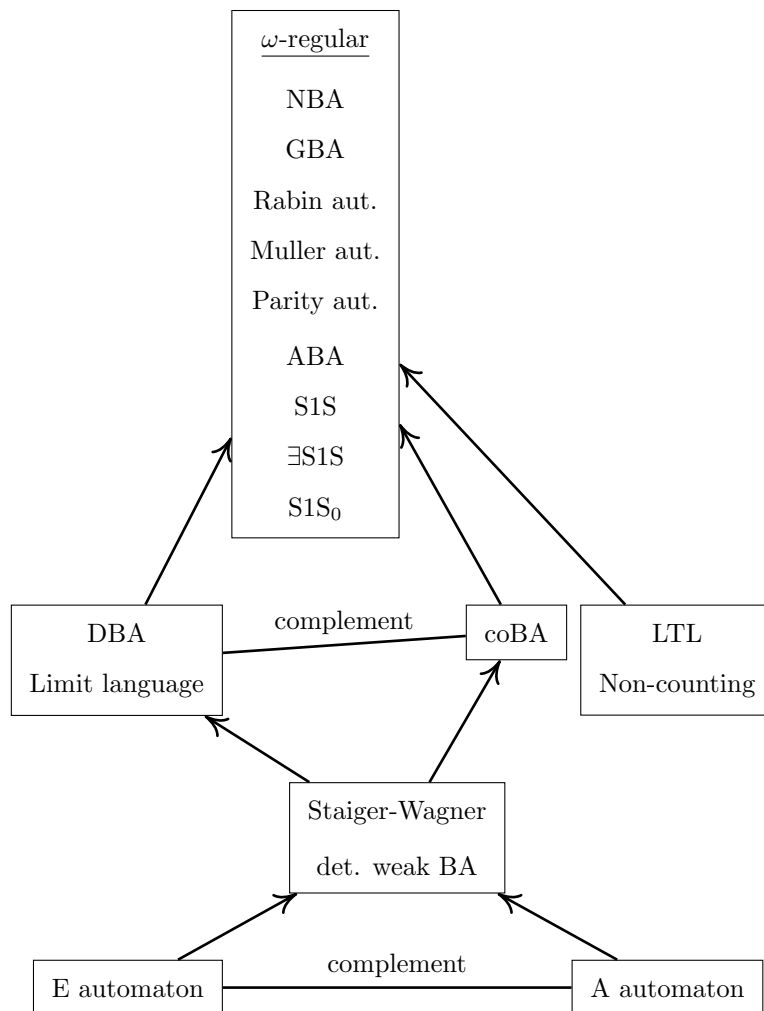
### 1.3 Infinite Trees

- BTA
- Muller TA
- Parity TA
- DMTA
- S2S (MSO / WMSO)
- S2S<sub>0</sub> (MSO / WMSO)

## 2 List Of Games

- Büchi
- Staiger-Wagner
- weak Parity
- Reachability
- Safety
- Muller
- Parity
- Rabin
- Streett
- Gale-Stewart
- Wadge

### 3 Infinite Word Models



#### 3.1 Class Inclusions

- E aut.  $\subseteq$  Staiger-Wagner  
**Proof:** SWA with  $\mathcal{F} = \{Q' \subseteq Q \mid F \cap Q' \neq \emptyset\}$ .
- A. aut.  $\subseteq$  Staiger-Wagner  
**Proof:** SW closed under complement,
- Staiger-Wagner  $\subseteq$  DBA / coBA  
**Proof:**  $\mathcal{A}$  SWA  $\Rightarrow \mathcal{A}' = (Q \times 2^Q, \Sigma, (q_0, \emptyset), \delta', F')$   
 Collect all visited states and accept if that set stays in  $\mathcal{F}$ .

- $\text{DBA} \subseteq \text{NBA}$   
trivial
- $\text{coBA} \subseteq \text{NBA}$   
**Proof:** NBA closed under complement.
- $\text{LTL} \subseteq \text{NBA}$   
**Proof:** ??
- $\text{LTL} \subseteq \text{ABA}$   
**Proof:** ??

### 3.2 Class Exclusions

- $\text{E aut.} \not\subseteq \text{A aut.}$   
**Example:**  $(a + b)^*a(a + b)^\omega$   
**Proof:** ??
- $\text{A aut.} \not\subseteq \text{E aut.}$   
**Example:**  $\{a^\omega\}$   
**Proof:** ??
- $\text{DBA} \not\subseteq \text{coBA}$   
**Example:**  $(a^*b)^\omega$   
**Proof:** ??
- $\text{coBA} \not\subseteq \text{DBA}$   
**Example:**  $(a + b)^*a^\omega$   
**Proof:** ??
- $\text{LTL} \not\subseteq \text{NBA}$   
**Example:**  $((a + b)a)^\omega$   
**Proof:** ??

### 3.3 Class Equalities

#### 3.3.1 NBA

- $\text{NBA} \Rightarrow \omega\text{-regular}$   
**Proof:** ??
- $\omega\text{-regular} \Rightarrow \text{NBA}$   
**Proof:** ??
- $\text{NBA} \Rightarrow \exists \text{S1S}$   
**Proof:** ??
- $\text{S1S} \Rightarrow \text{S1S}_0$   
**Proof:** ??

- $S1S_0 \Rightarrow NBA$

**Proof:** ??

- Det. Muller  $\Rightarrow NBA$

**Proof:** NBA with  $L(\mathcal{A}) = \bigcup_{F \in \mathcal{F}} \left( \bigcap_{q \in F} L(\mathcal{A}_q) \cap \bigcap_{q \notin F} \overline{L(\mathcal{A}_q)} \right)$  where  $\mathcal{A}_q$  is  $\mathcal{A}$  starting in  $q$ .

- $NBA \Rightarrow \text{det. Muller}$

**Proof:** ??

- (det.) Muller  $\Rightarrow$  (det.) Parity

**Proof:** ??

- $ABA \Rightarrow NBA$

**Proof:** ??

### 3.3.2 LTL

LTL  $\Leftrightarrow$  Non-counting

No proof. Remarks in F8.

### 3.3.3 SW

Staiger-Wagner  $\Leftrightarrow$  det. weak BA

**Proof:** ??

## 3.4 Closures

### 3.4.1 NBA

- Closed under union

**Proof:** ??

- Closed under intersection

**Proof:** ??

- Closed under complement

**Proof:** ??

### 3.4.2 DBA

- Not closed under complement (inf. many  $a \leftrightarrow$  fin. many  $a$ )

### 3.4.3 SW

- Closed under union

**Proof:** ??

- Closed under intersection

**Proof:** ??

- Closed under complement  
**Proof:** ??

### 3.5 Characterizations

- Parity conditions are directly convertible to Rabin chain conditions and vice-versa.  
**Proof:** Assign priorities in ascending order;  $E_k \rightarrow 0$ ,  $F_k \setminus E_k \rightarrow 1$ ,  $E_{k-1} \setminus F_k \rightarrow 2 \dots$
- $U$  is  $\omega$ -regular iff  $U$  is a Boolean combination of DBA-languages  
**Proof:** NBAs are closed under Boolean operations.
- $U$  is DBA-recog. iff  $U = \lim(L)$  for some regular  $L \subseteq \Sigma^*$ .  
**Proof:** ??
- $U$  is E-recog. iff  $U = L \cdot \Sigma^*$  for some regular  $L \subseteq \Sigma^*$ .  
**Proof:** ??
- Landweber's theorem  
**Proof:** ??
- $\text{DBA} \cap \text{coBA} \Rightarrow \text{SW}$   
**Proof:** ??

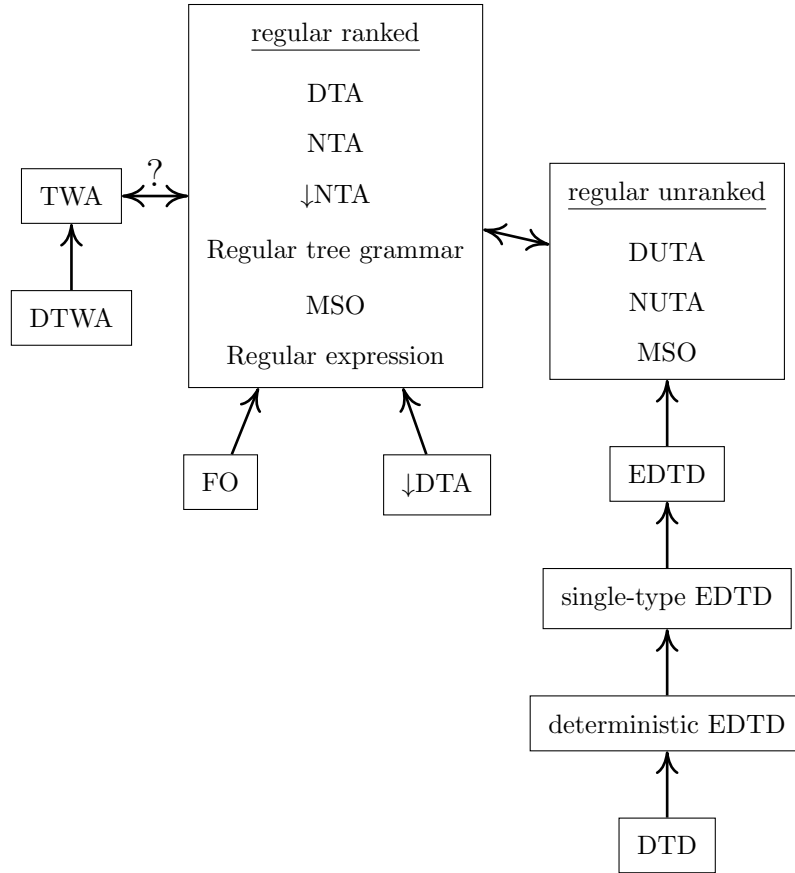
### 3.6 Duality

- $U$  is A-recog. iff  $\Sigma^\omega \setminus U$  is E-recog.  
**Proof:** ??
- $U$  is coBA-recog. iff  $\Sigma^\omega \setminus U$  is DBA-recog.  
**Proof:** ??

### 3.7 Problems / Complexity

- Emptiness problem for NBAs is decidable in poly. time.  
**Proof:** ??
- Emptiness problem for ABAs is PSPACE-complete.  
No proof. Remarks in F23.
- Membership problem for ABAs is decidable in poly. time.

## 4 Finite Tree Models



### 4.1 Class Inclusions

TODO

### 4.2 Class Exclusions

- $\downarrow\text{DTA} \not\subseteq \text{NTA}$   
**Example:**  $T = \{f(a, b), f(b, a)\}$   
**Proof:** ??

### 4.3 Class Equalities

### 4.4 Regular Ranked

- $\text{NTA} \Rightarrow \text{DTA}$   
**Proof:** Subset construction.

- $\text{NTA} \Leftrightarrow \downarrow\text{NTA}$   
**Proof:** ??

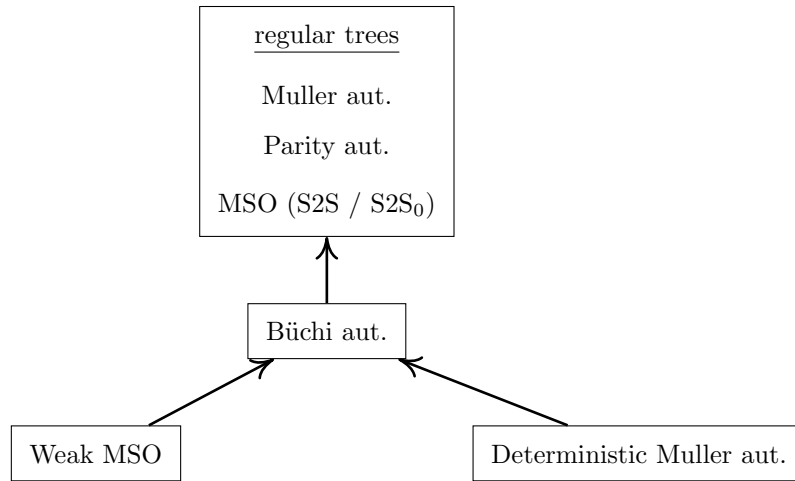
## 4.5 Closures

## 4.6 Regular Ranked

- Regular (ranked) trees are closed under complement.  
**Proof:** ??
- Regular (ranked) trees are closed under union.  
**Proof:** ??
- Regular (ranked) trees are closed under intersection.  
**Proof:** ??



## 5 Infinite Tree Models



### 5.1 Class Differences

TODO

### 5.2 Class Equalities

TODO

### 5.3 Closures

TODO