Computational Complexity

Lecture 5

in which we relate space and time,

and see the essence of PSPACE (TQBF)

SPACE and TIME

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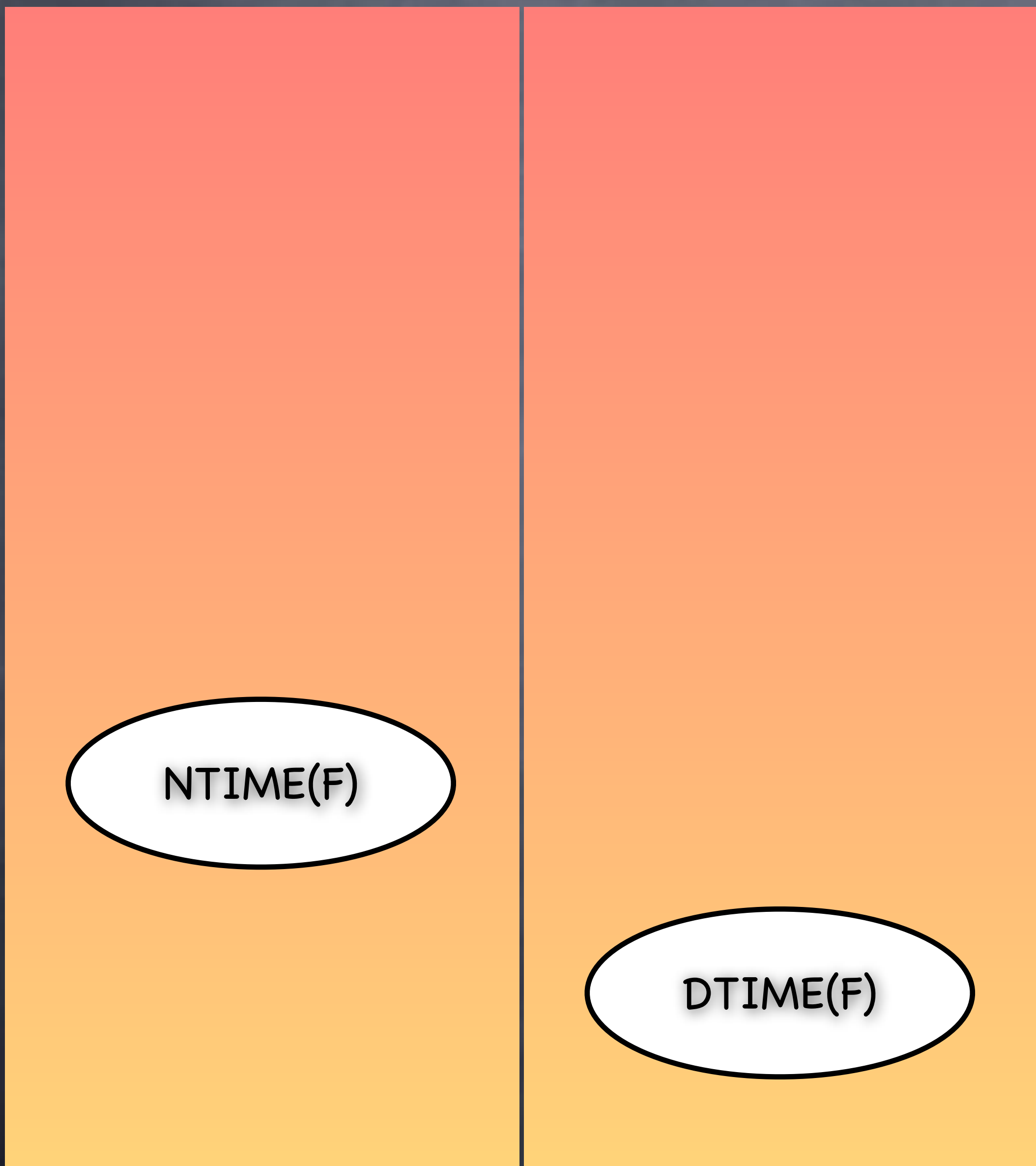

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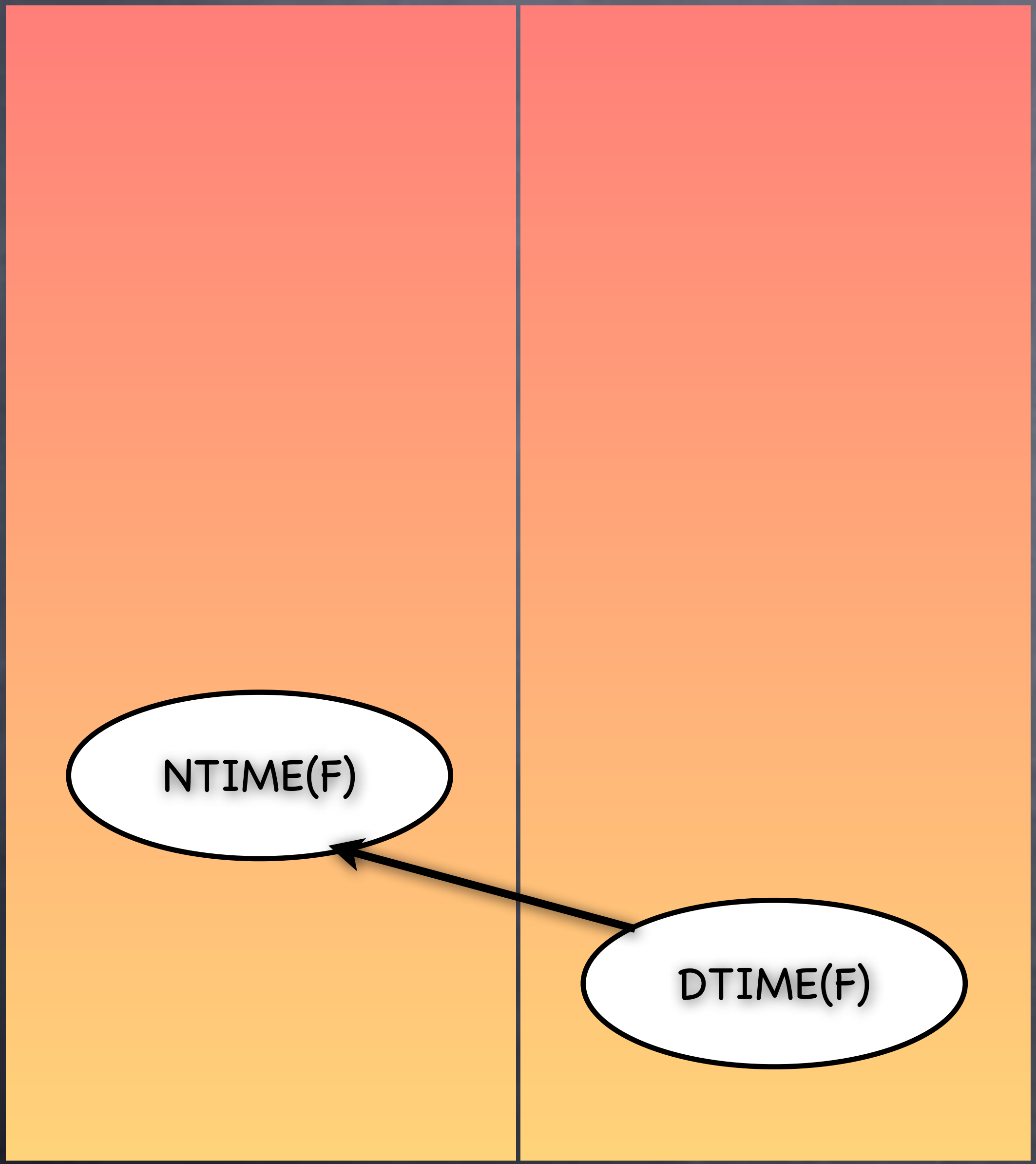

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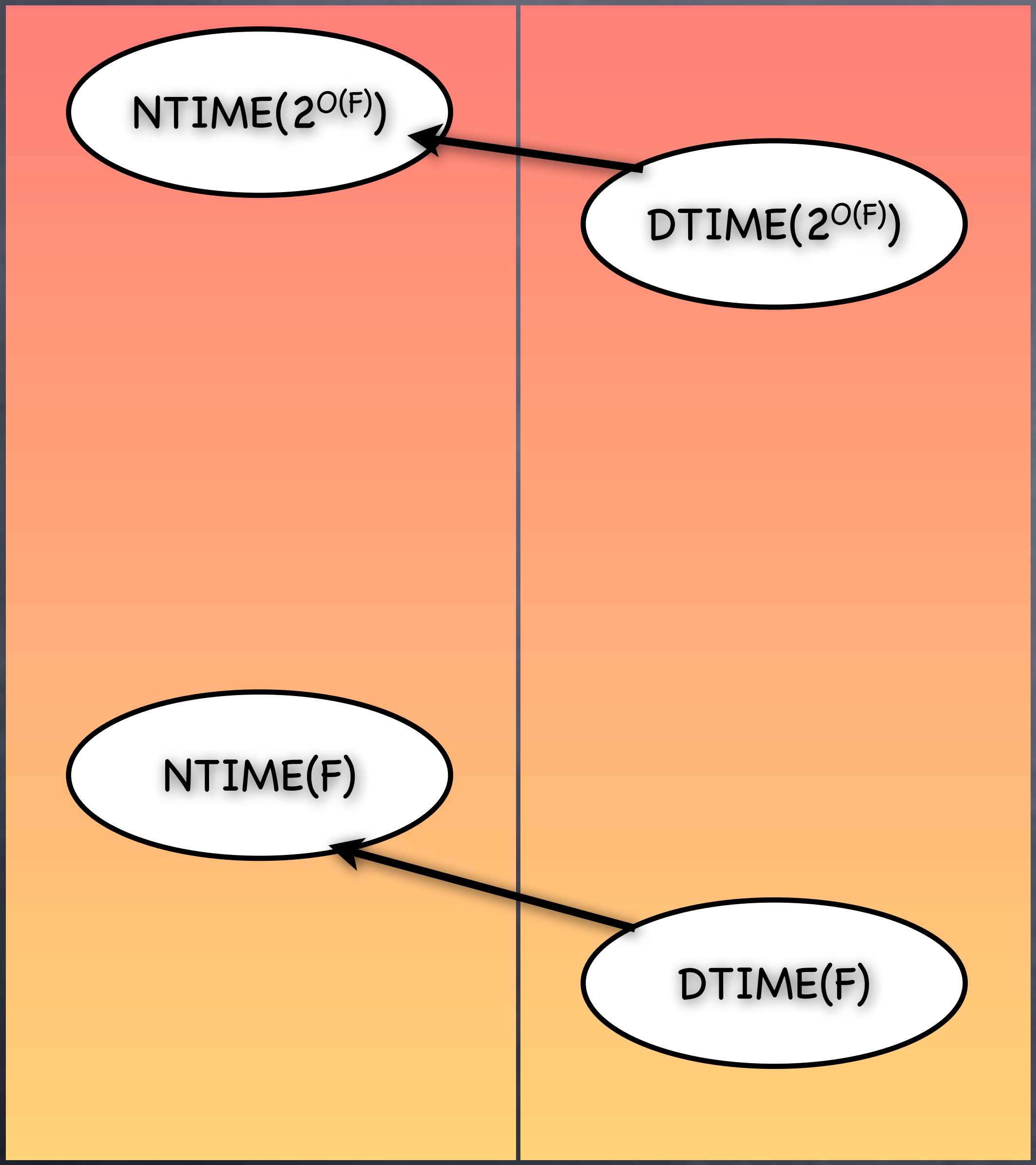

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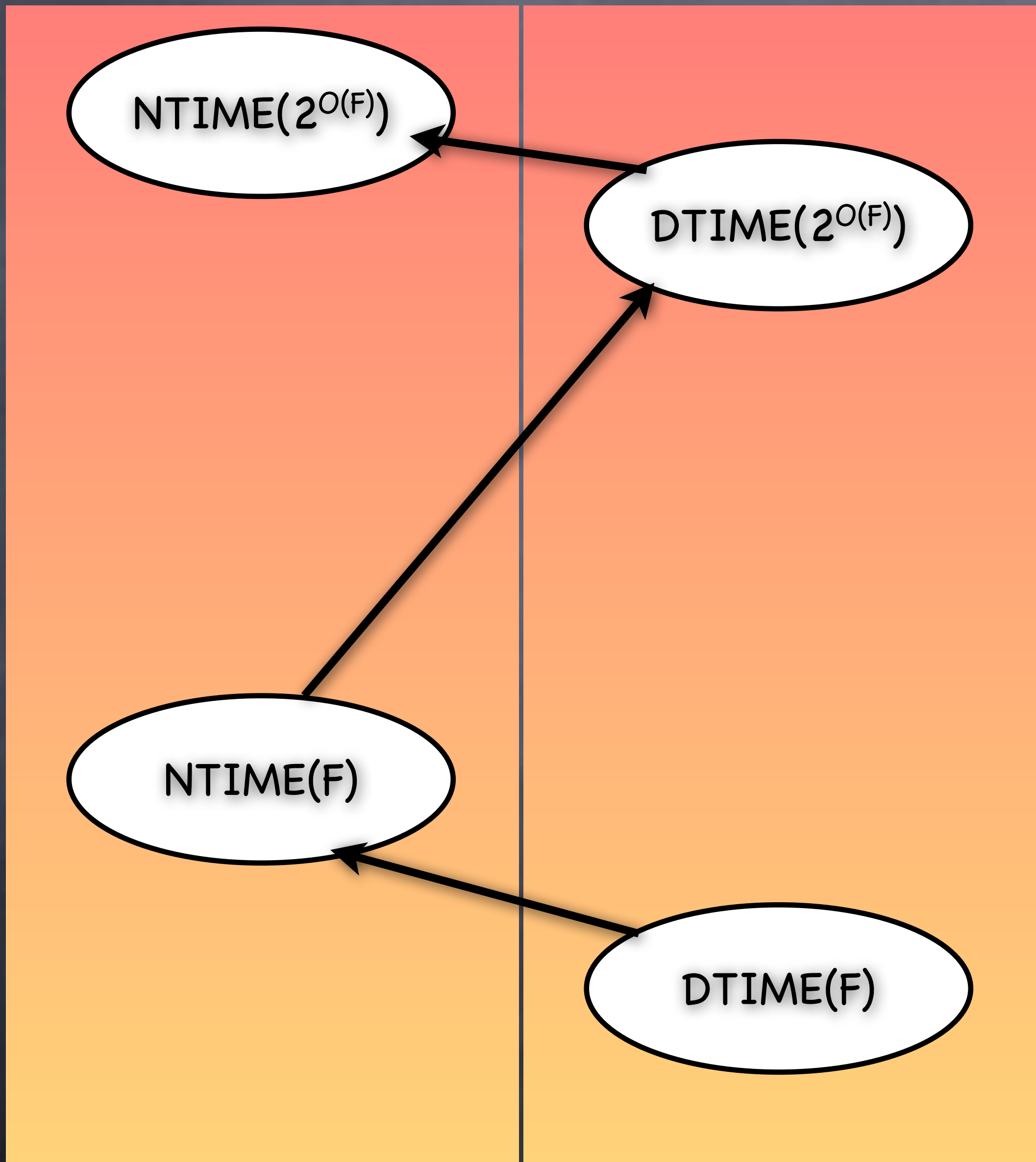

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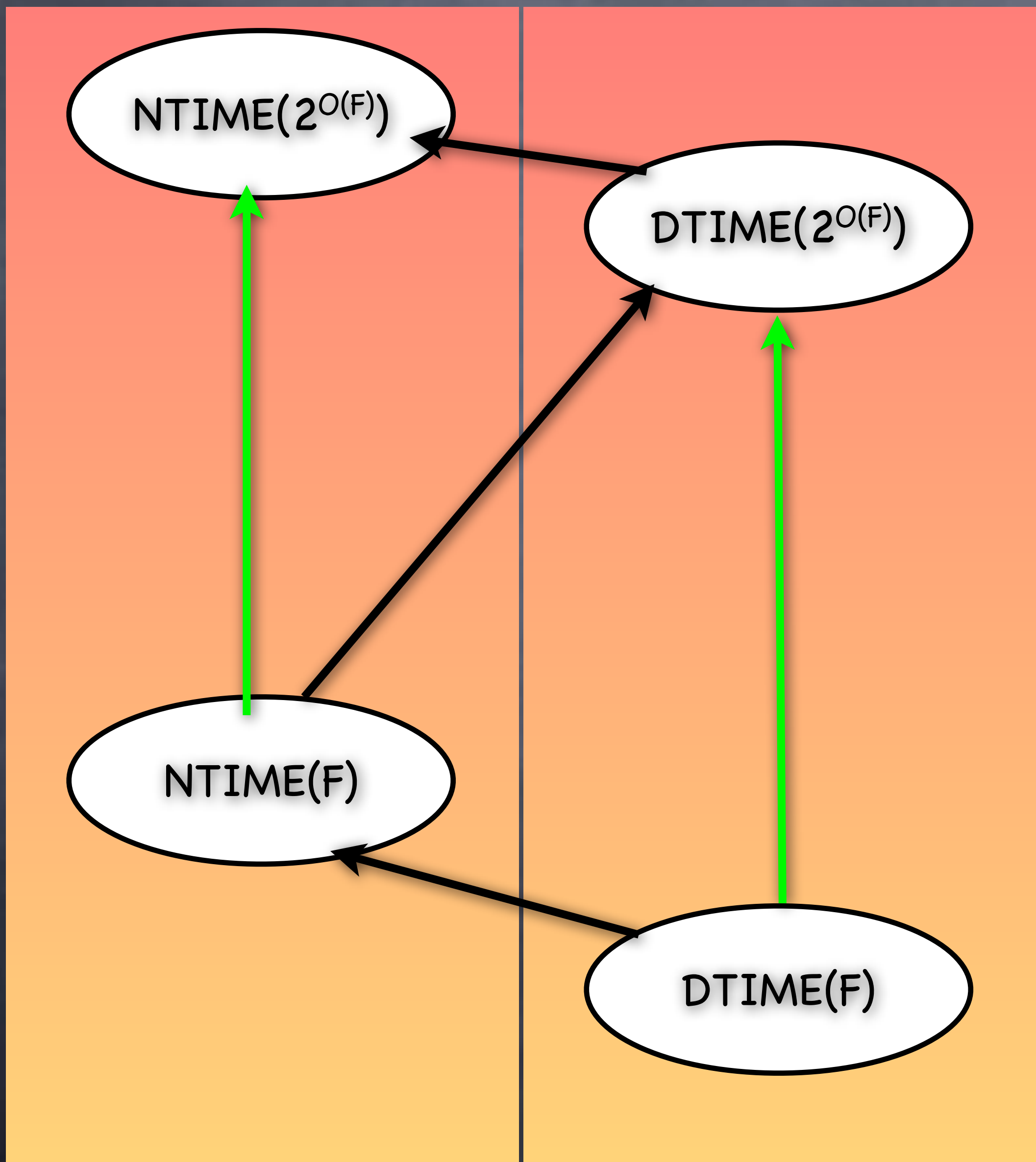

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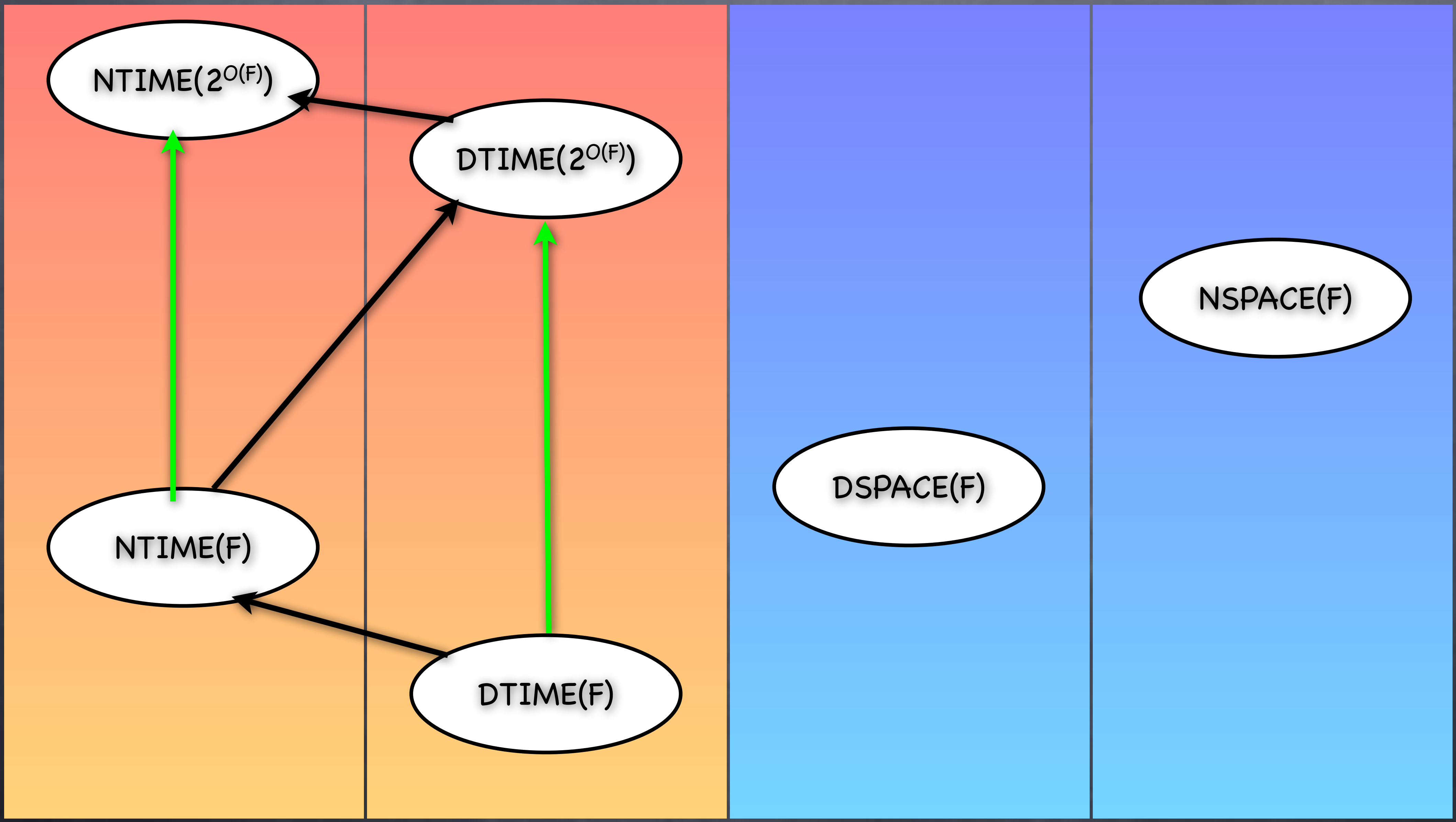

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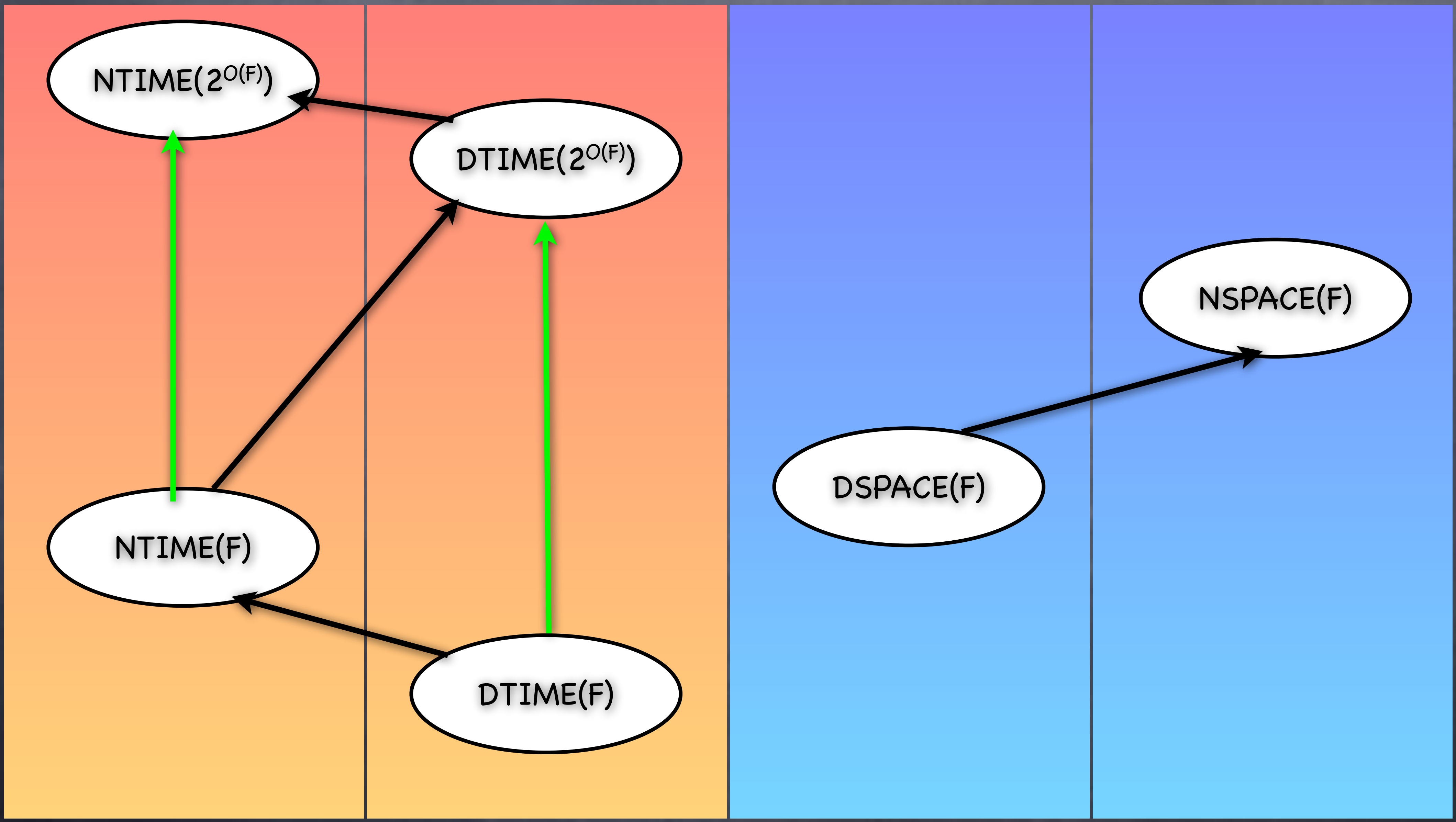

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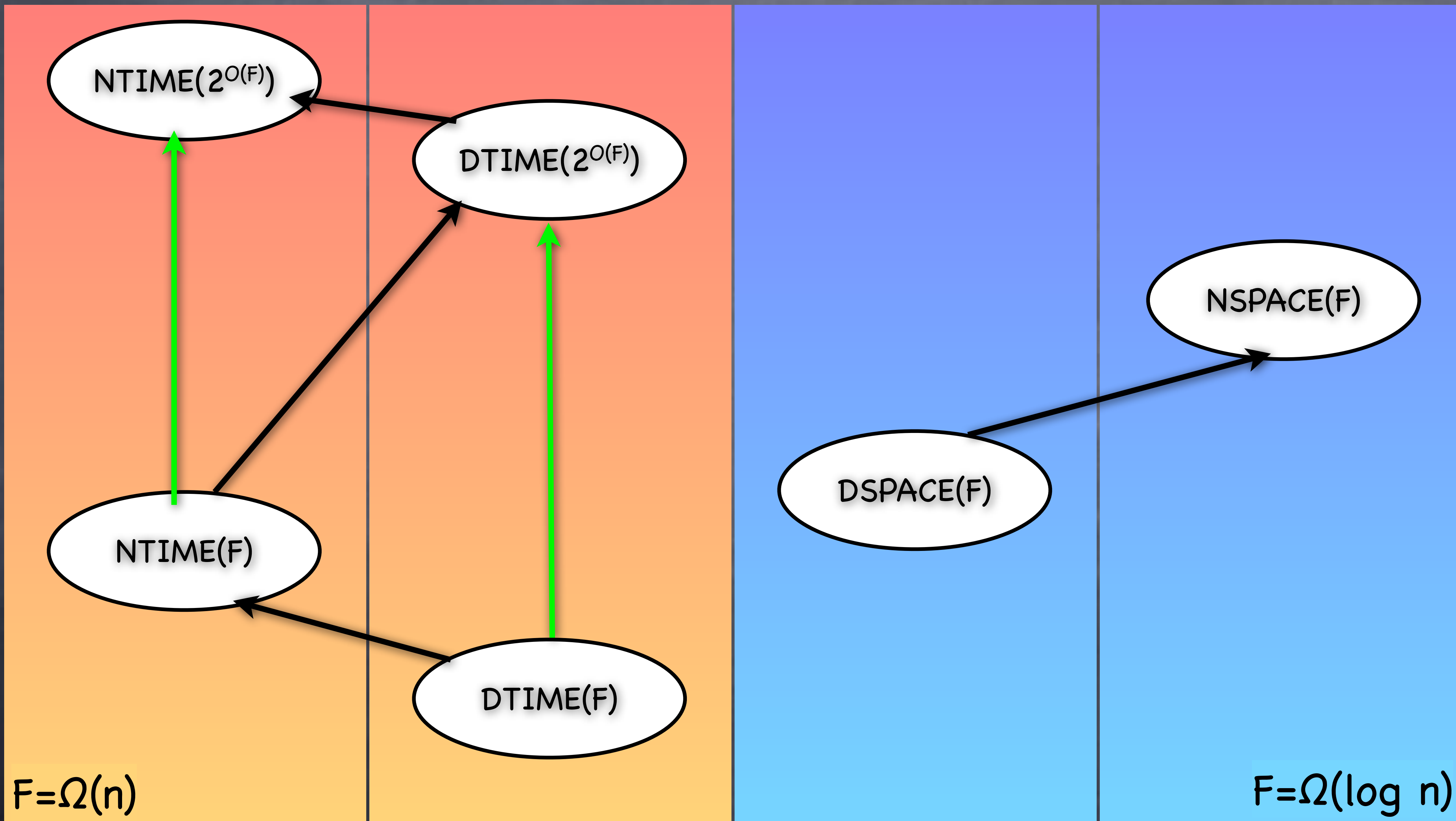

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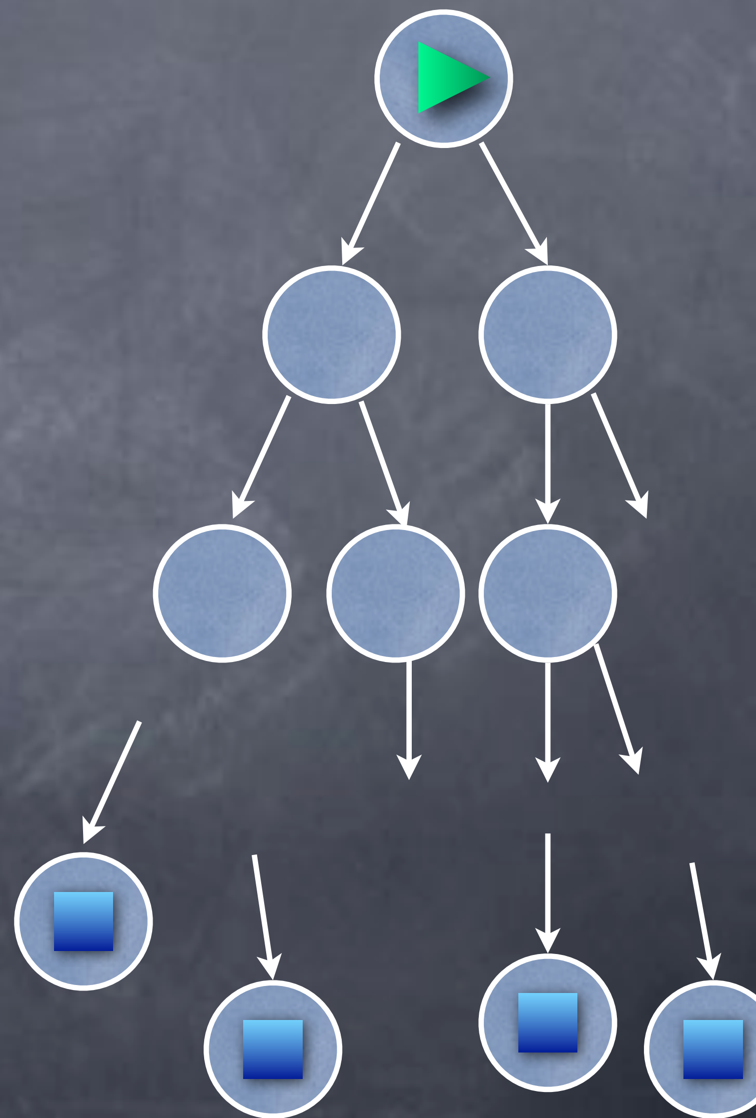

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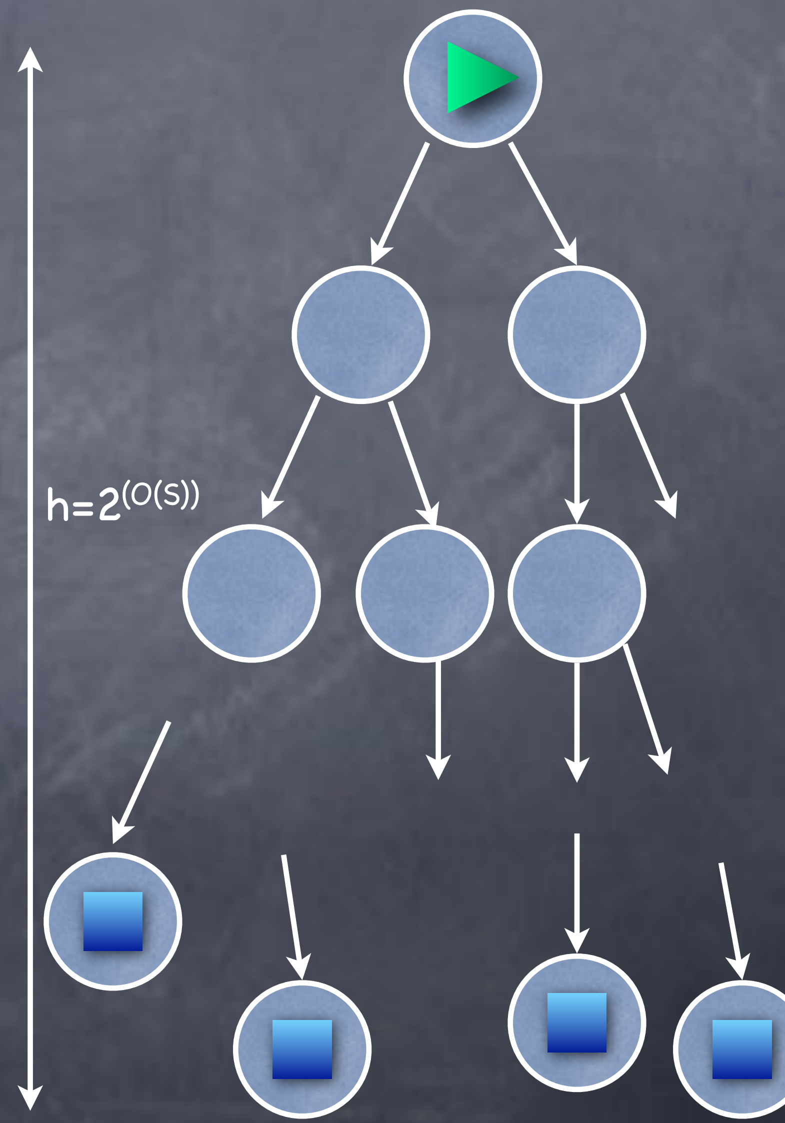

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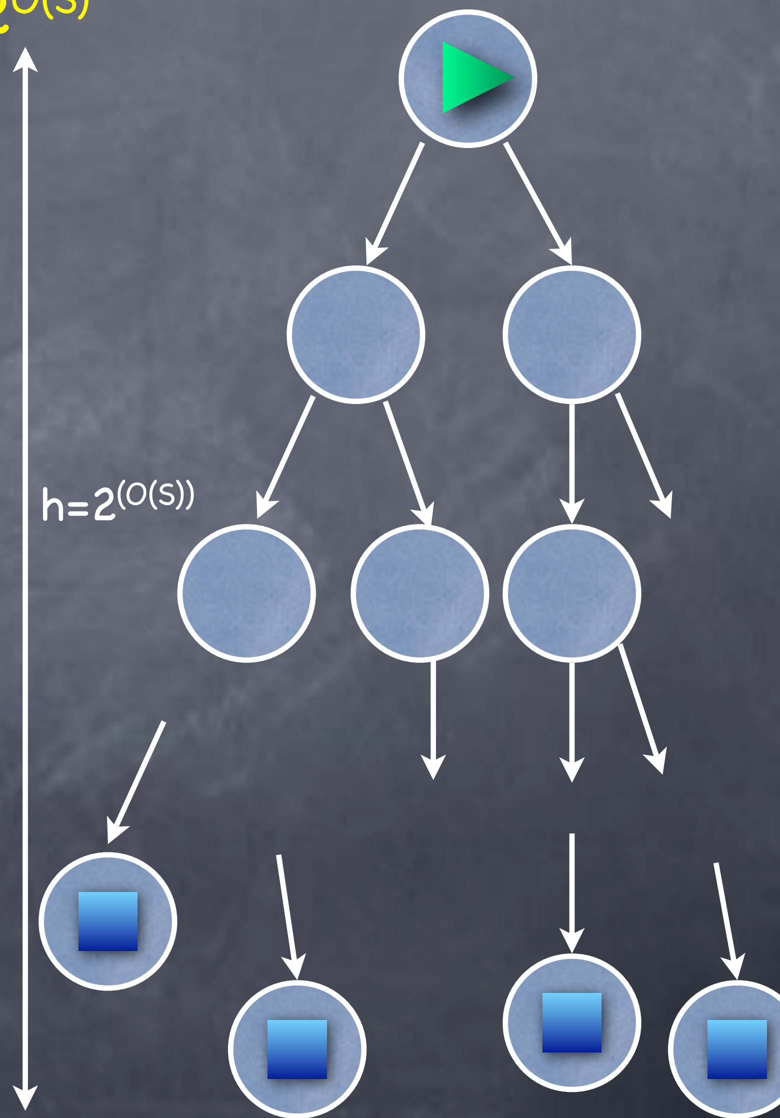

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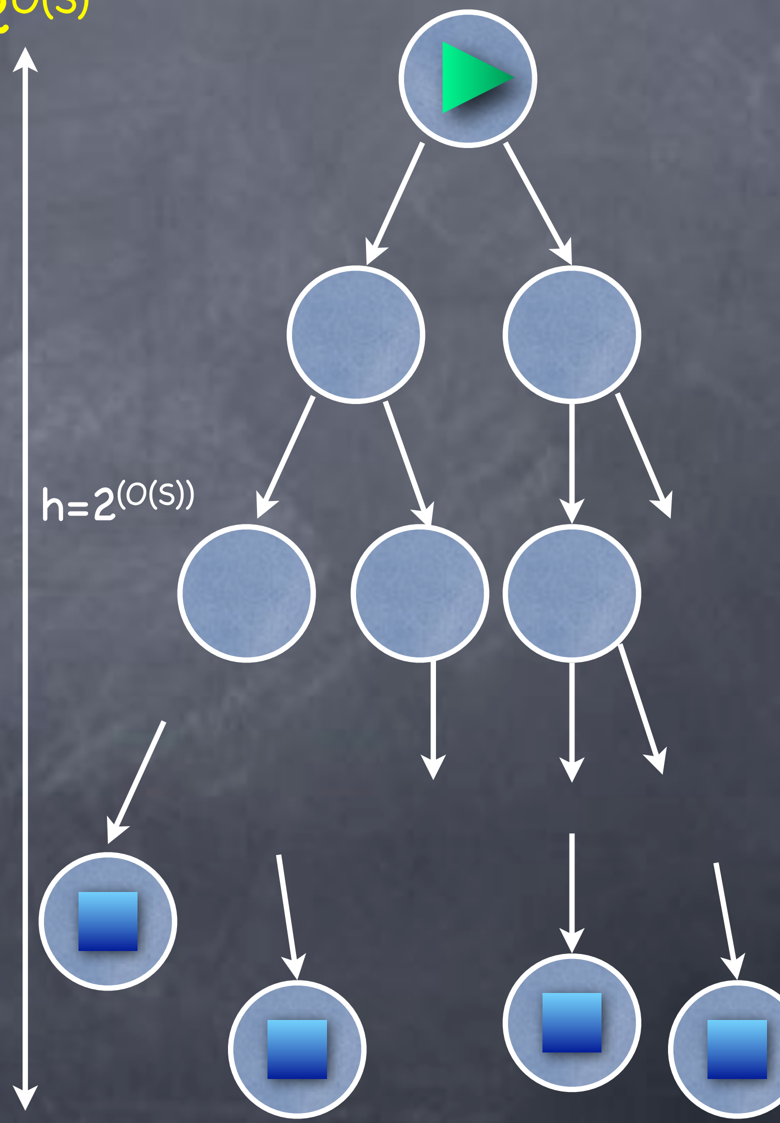

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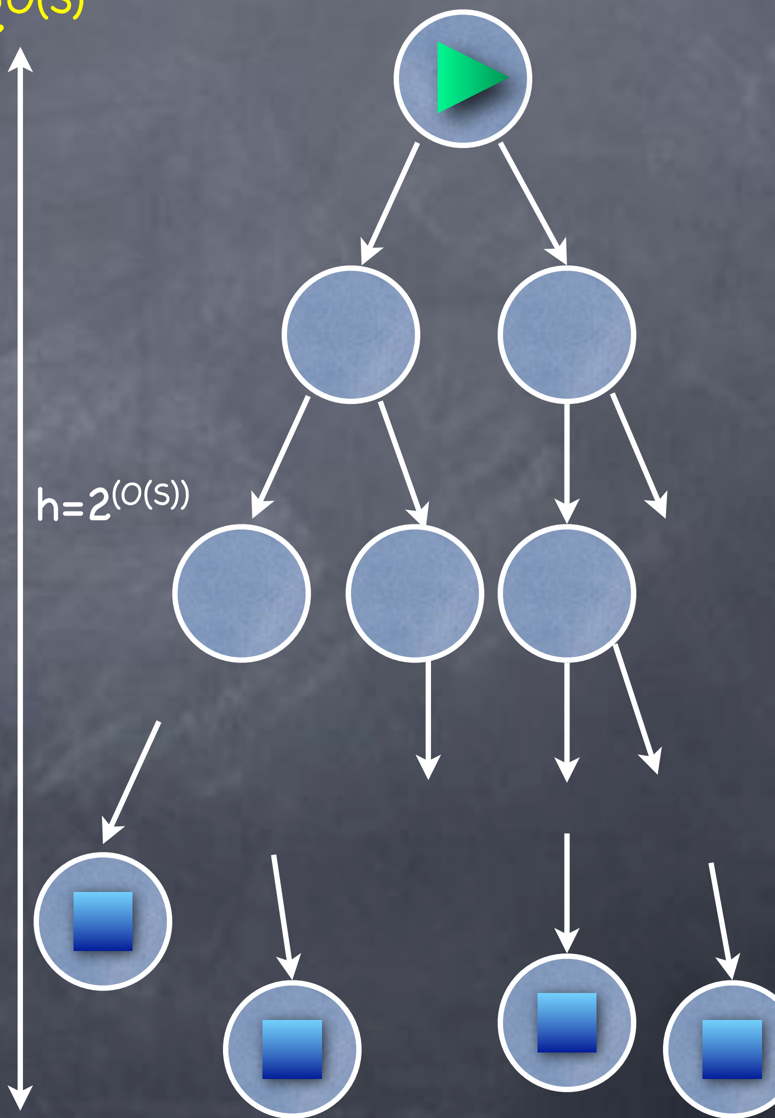

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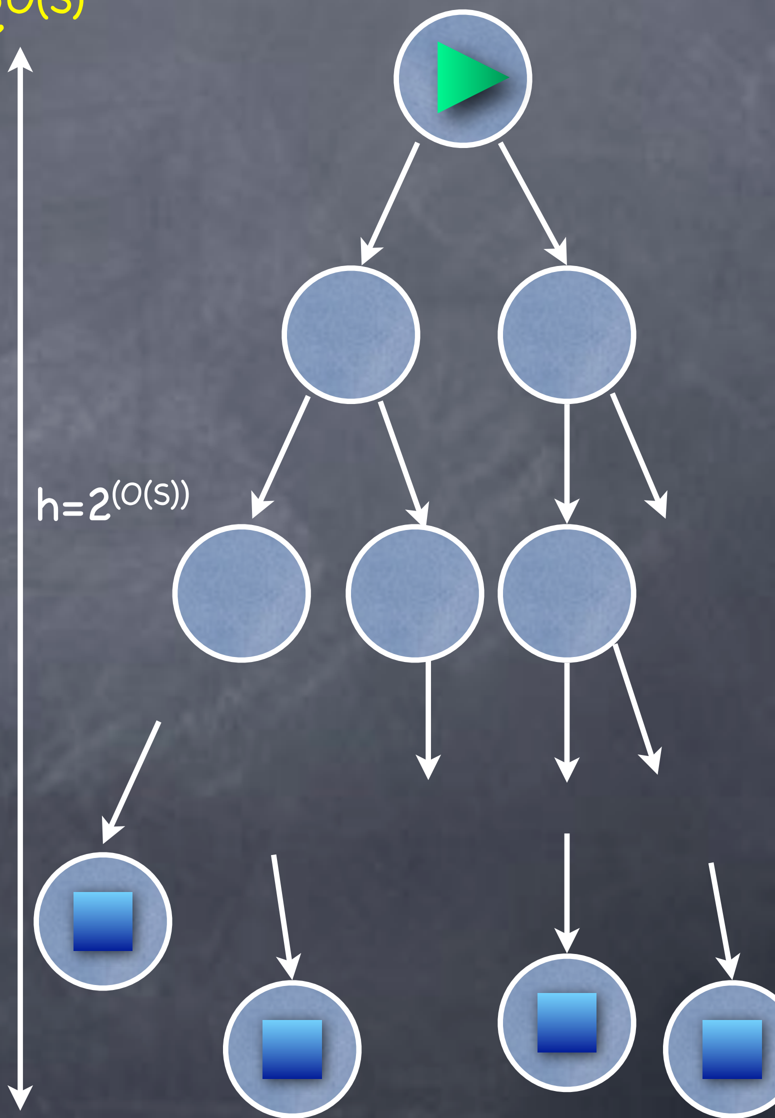

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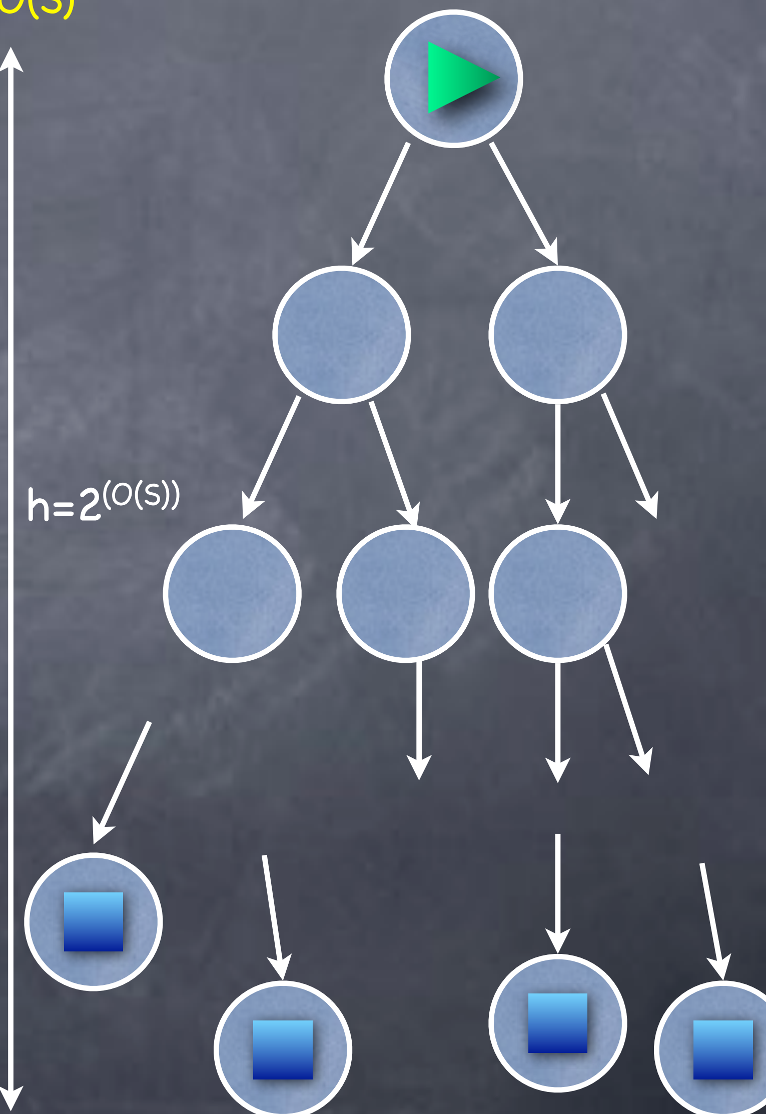
    - poly($2^{O(S)}$) = $2^{O(S)}$



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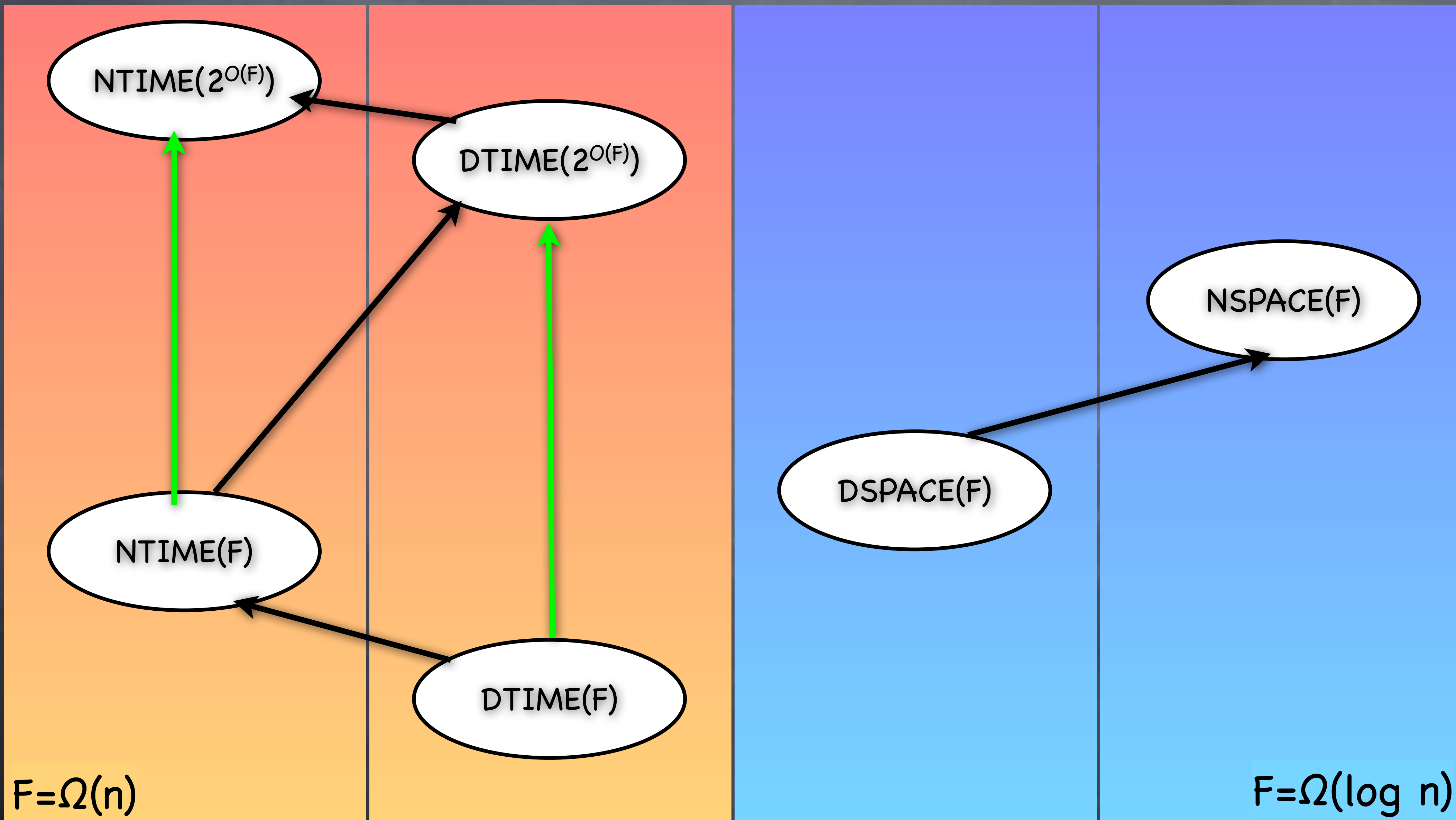

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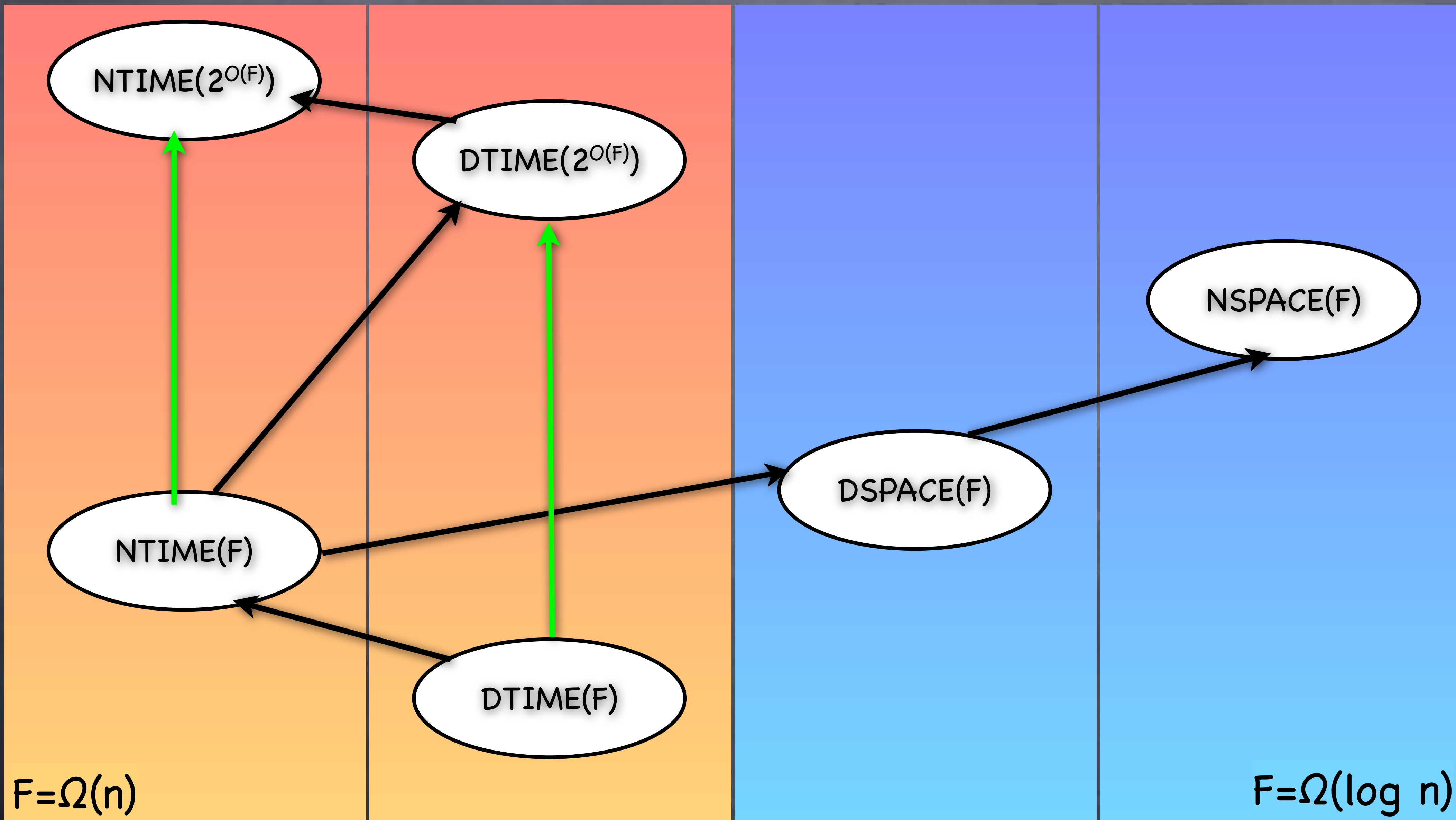

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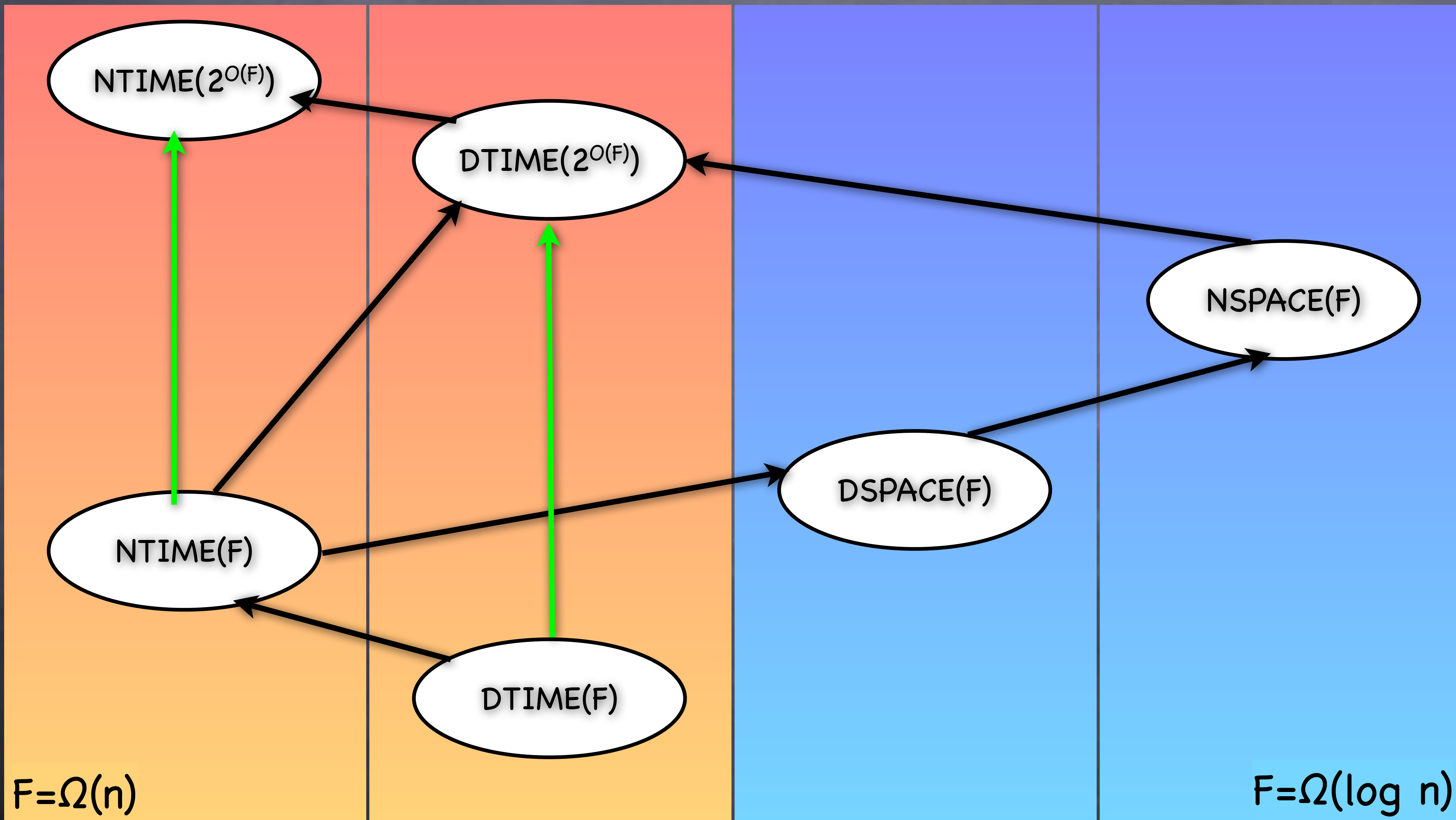

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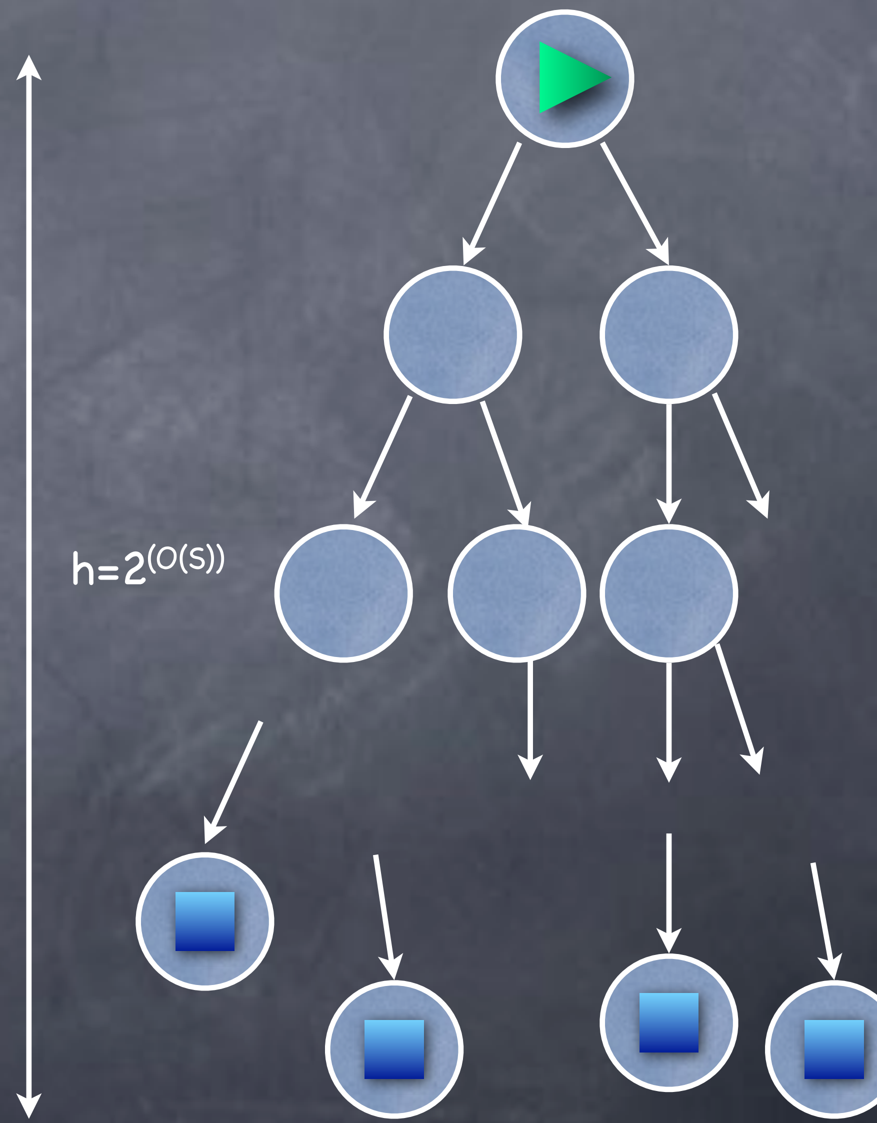

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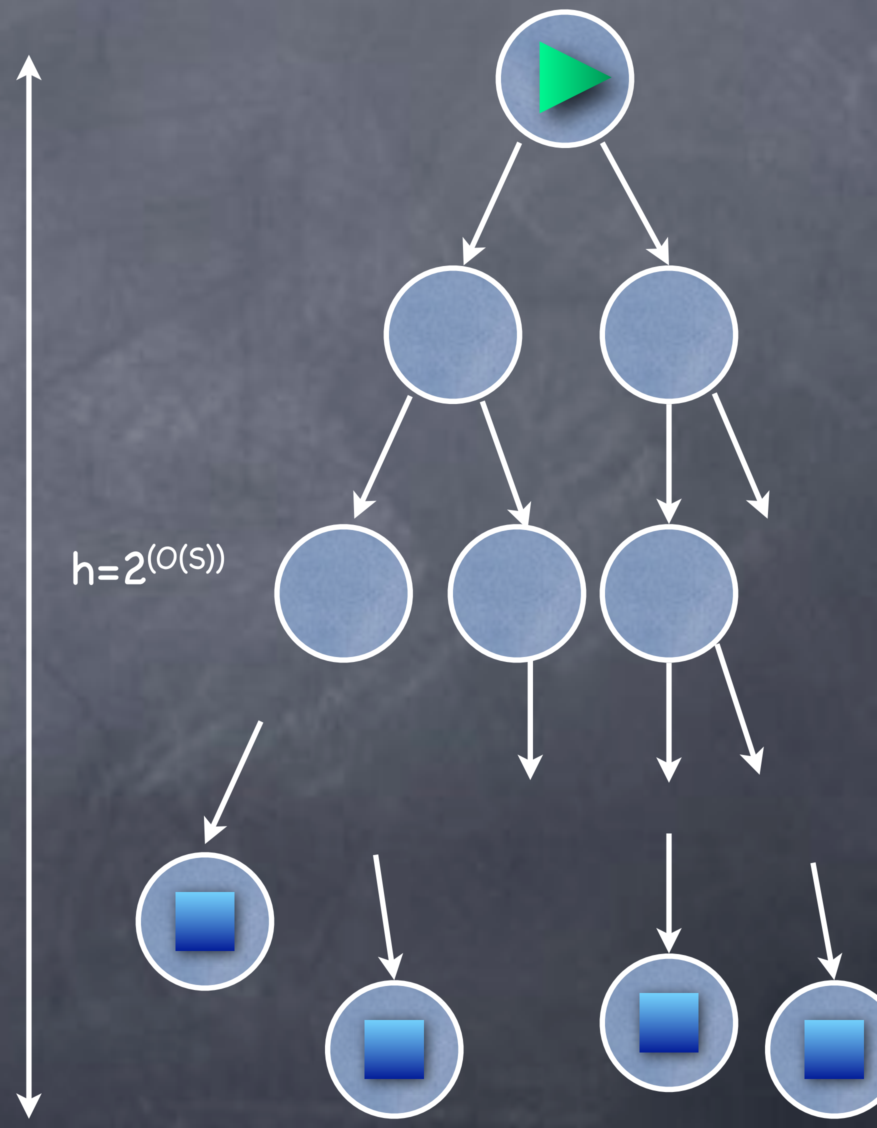

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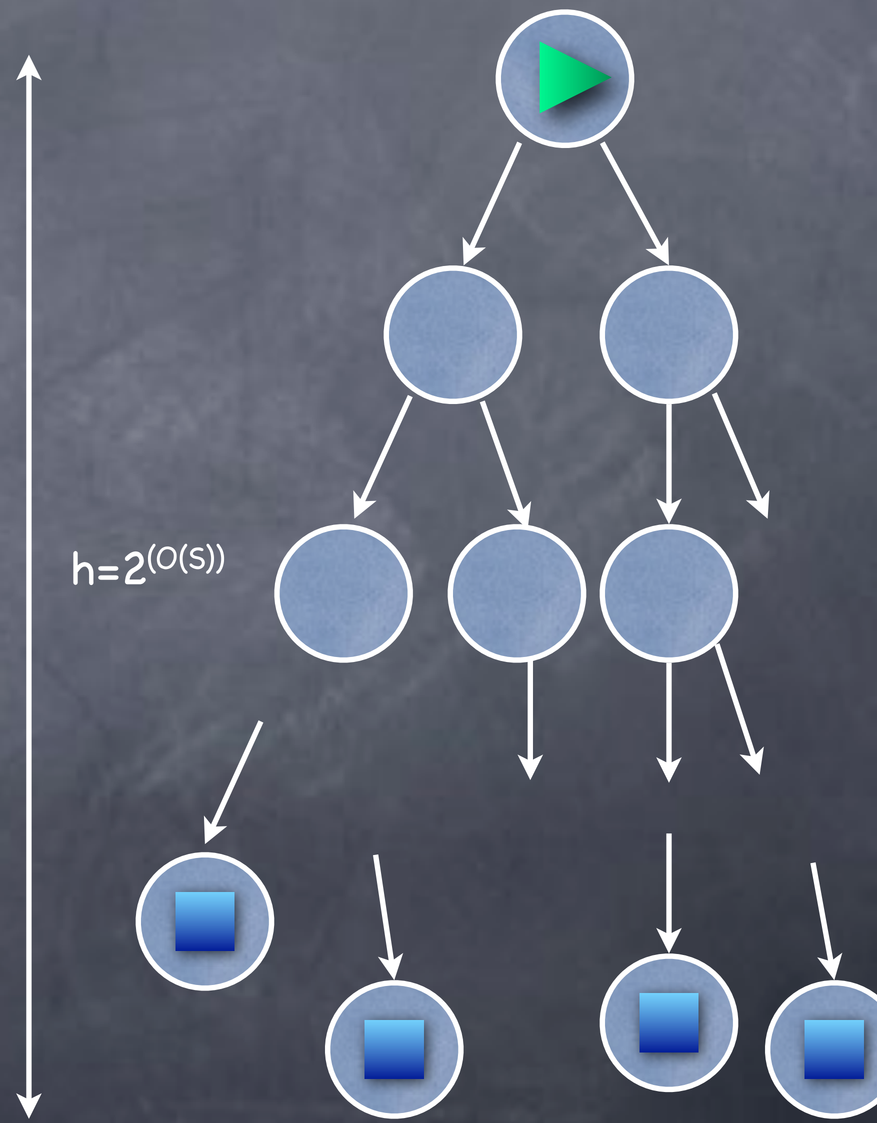

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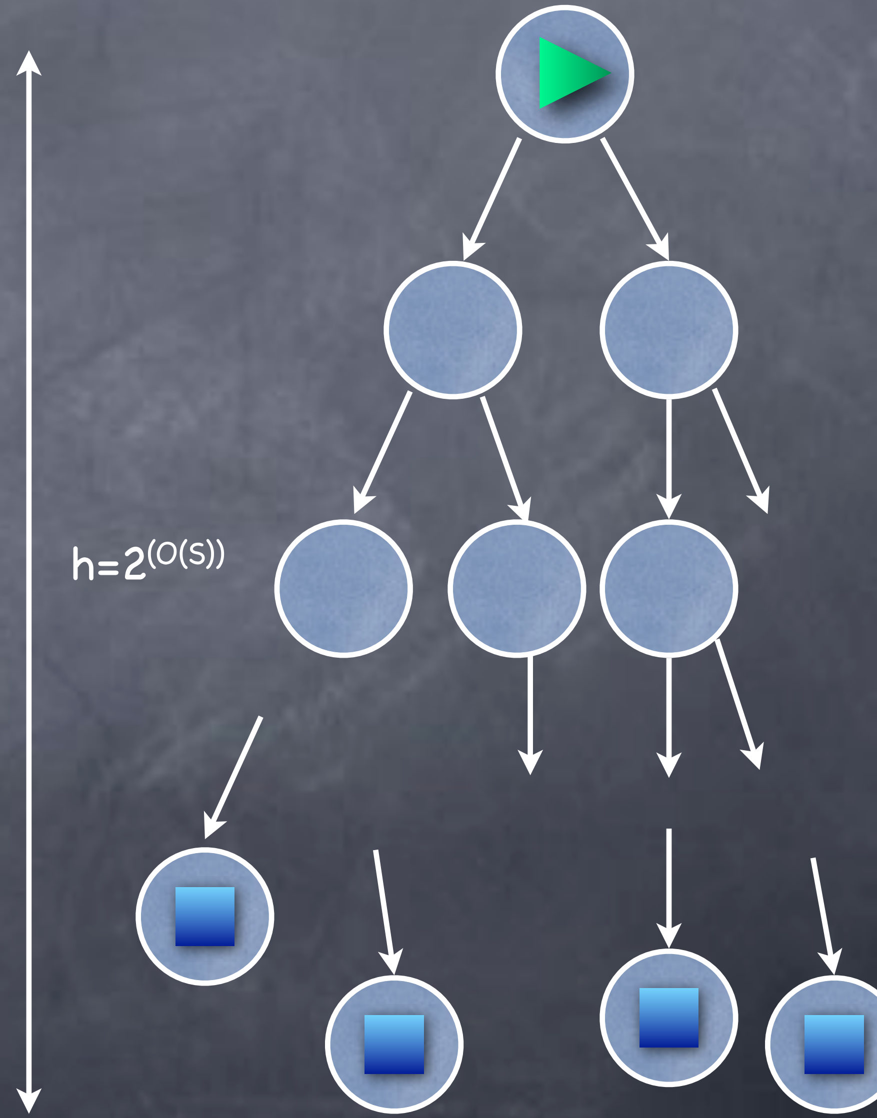

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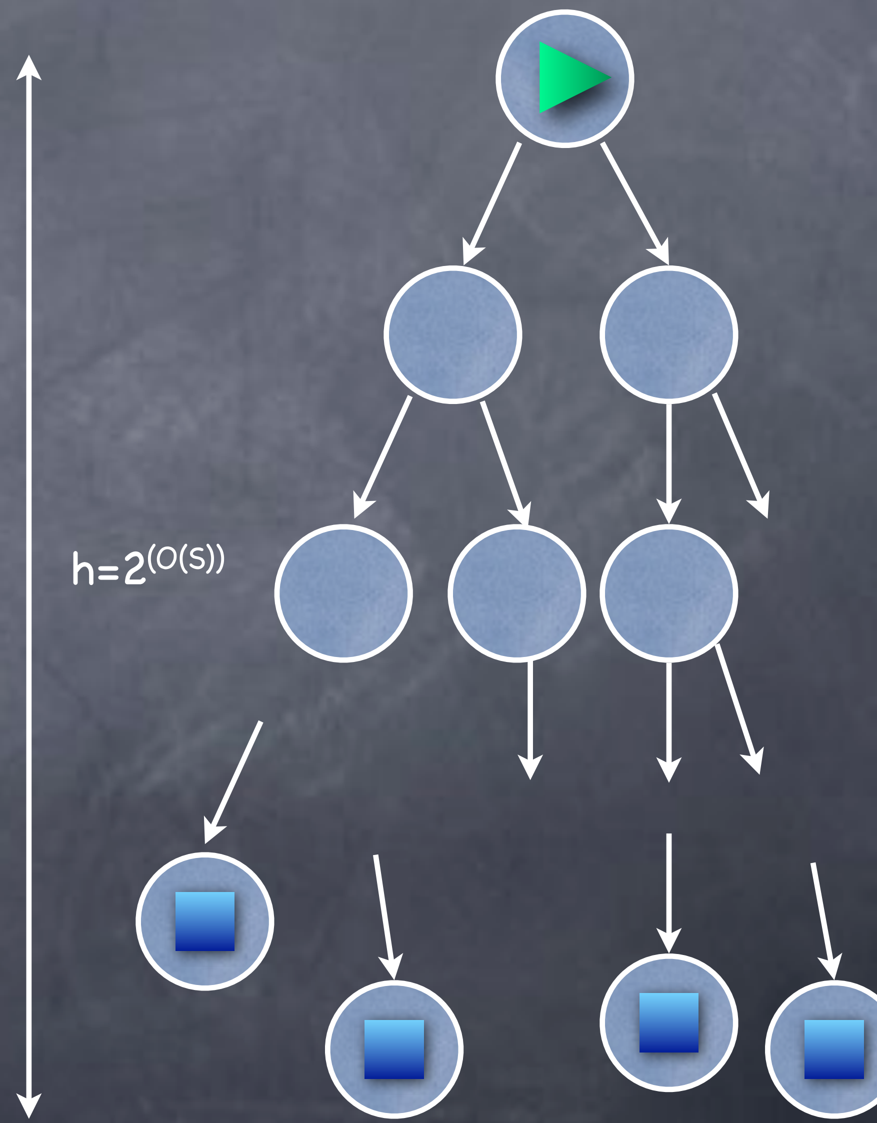
  - Space needed = O(log h)*O(S) = O(S^2)



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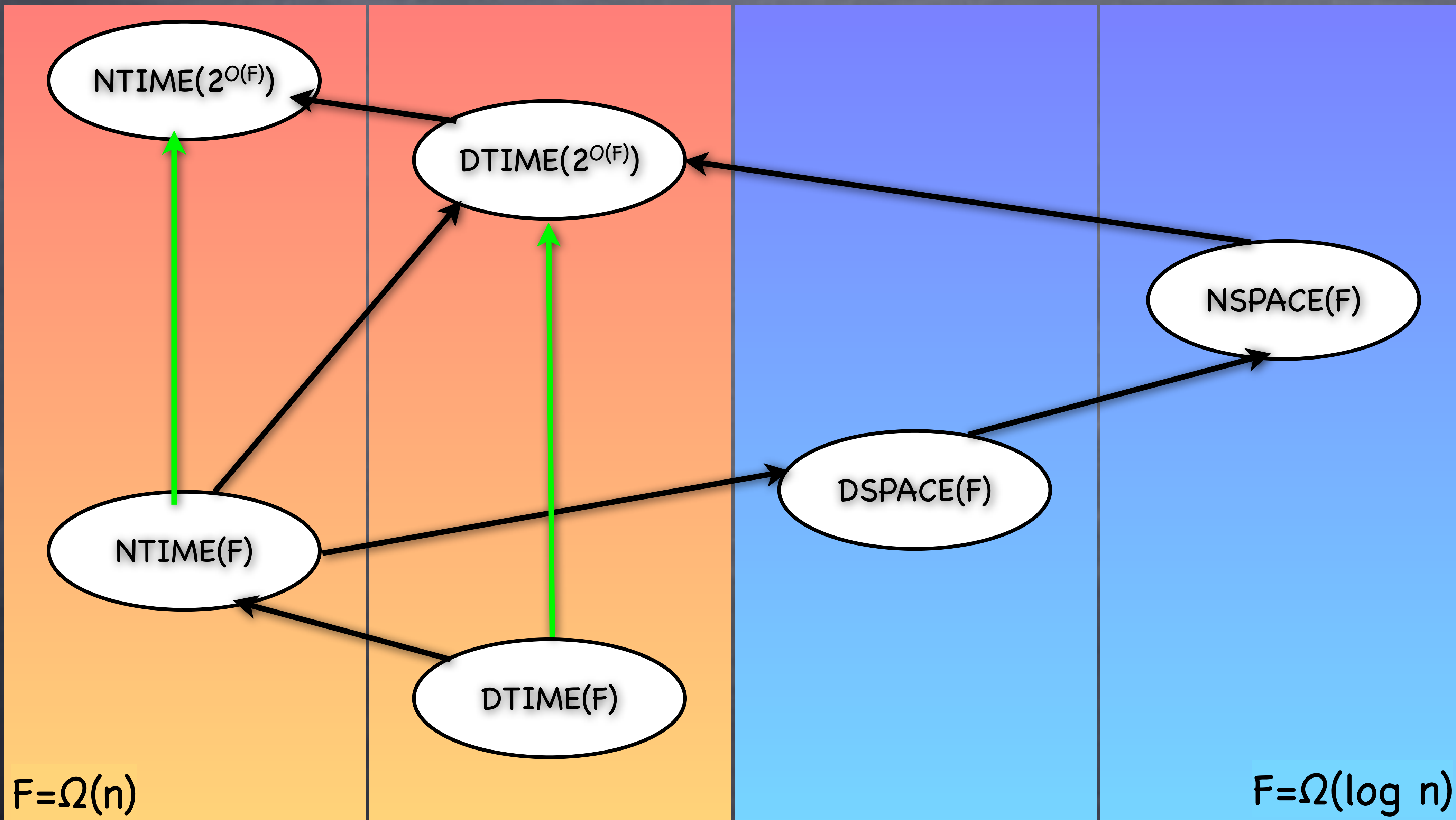

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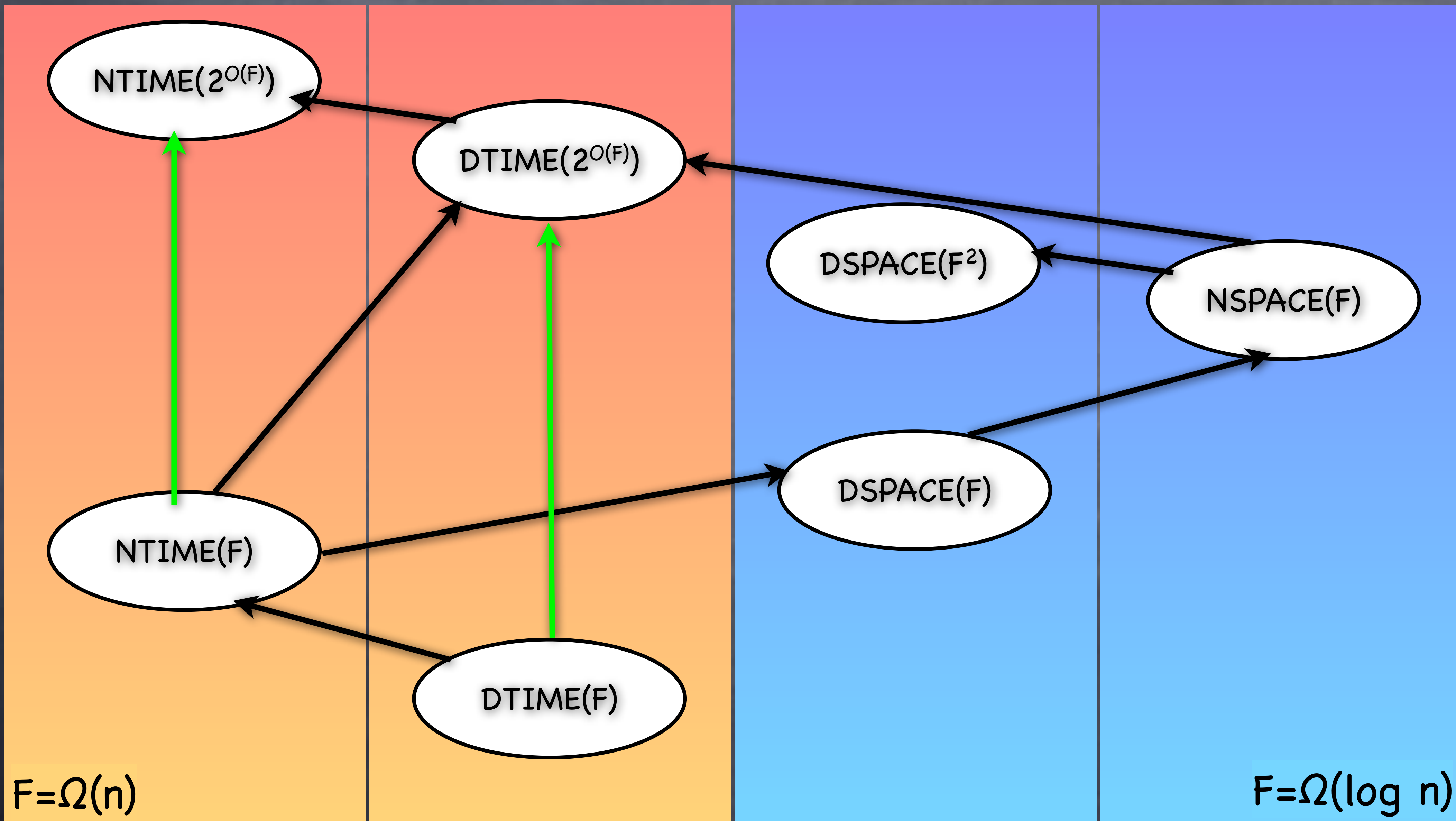

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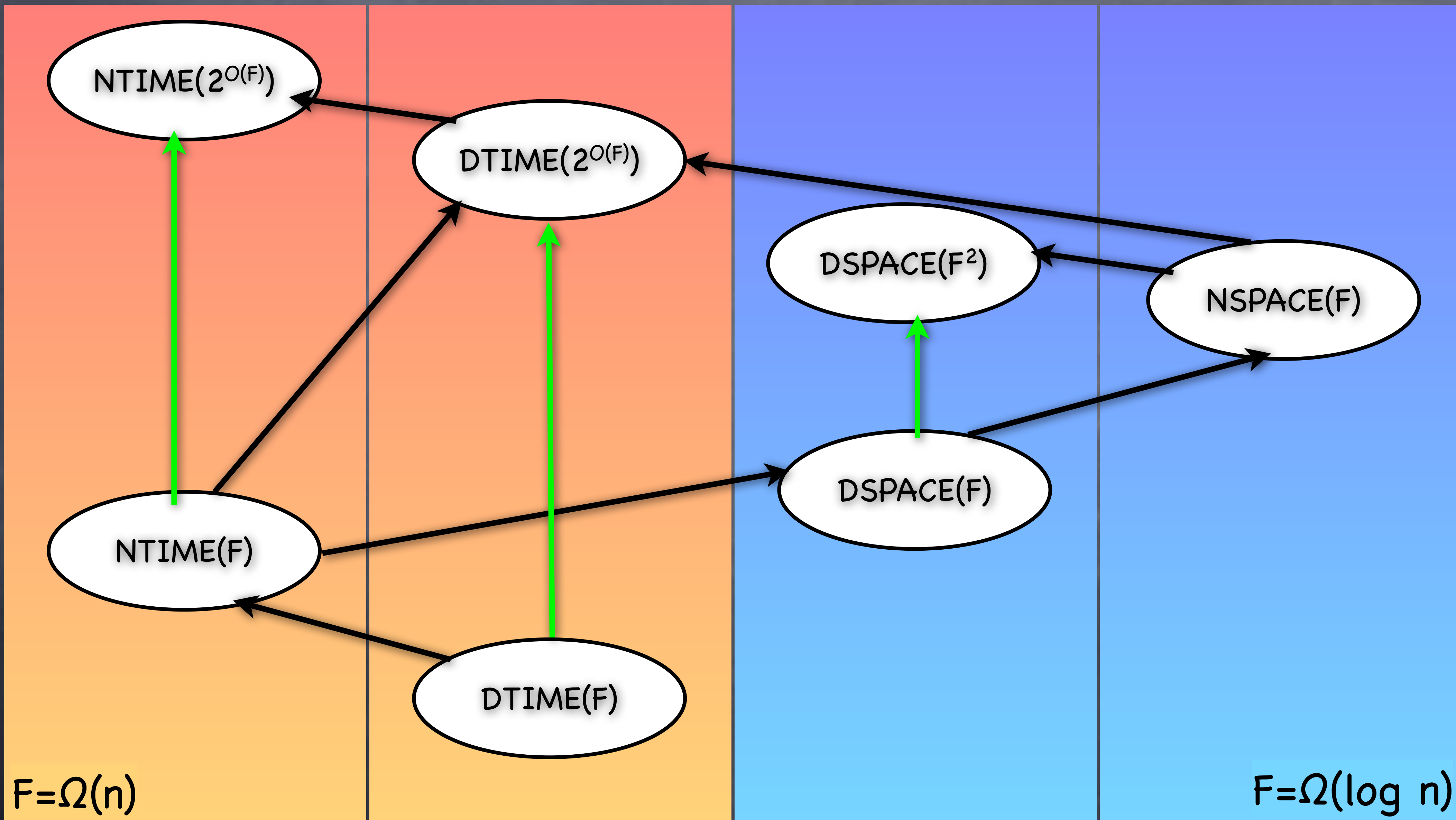

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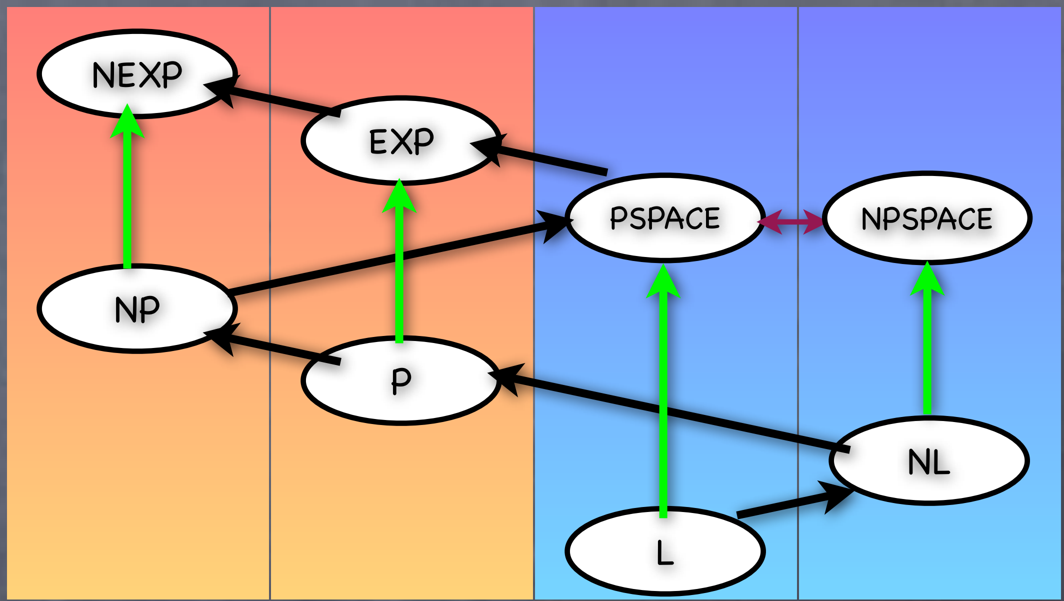

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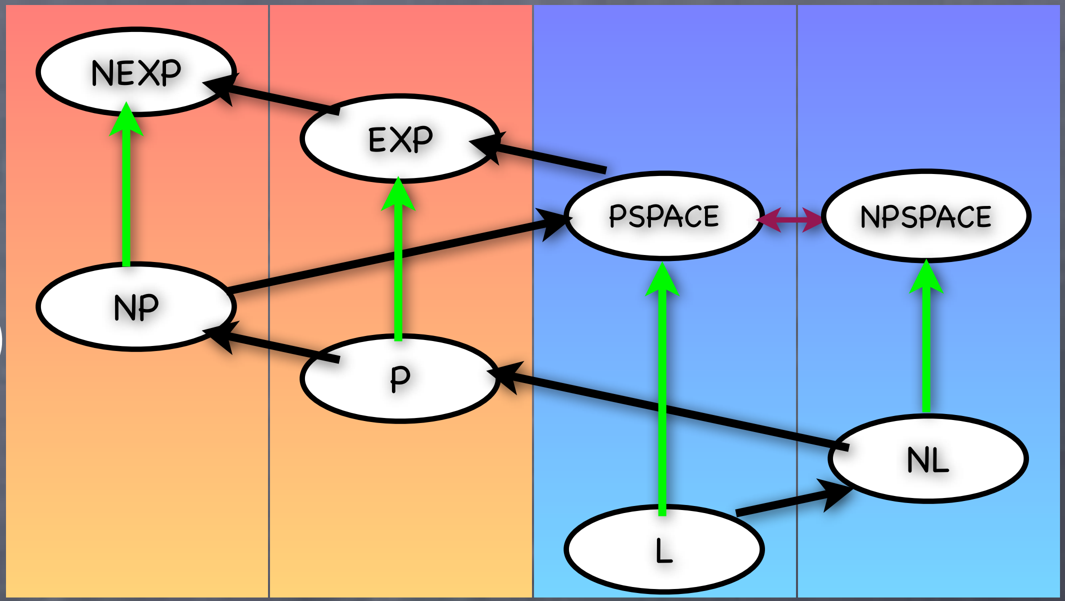

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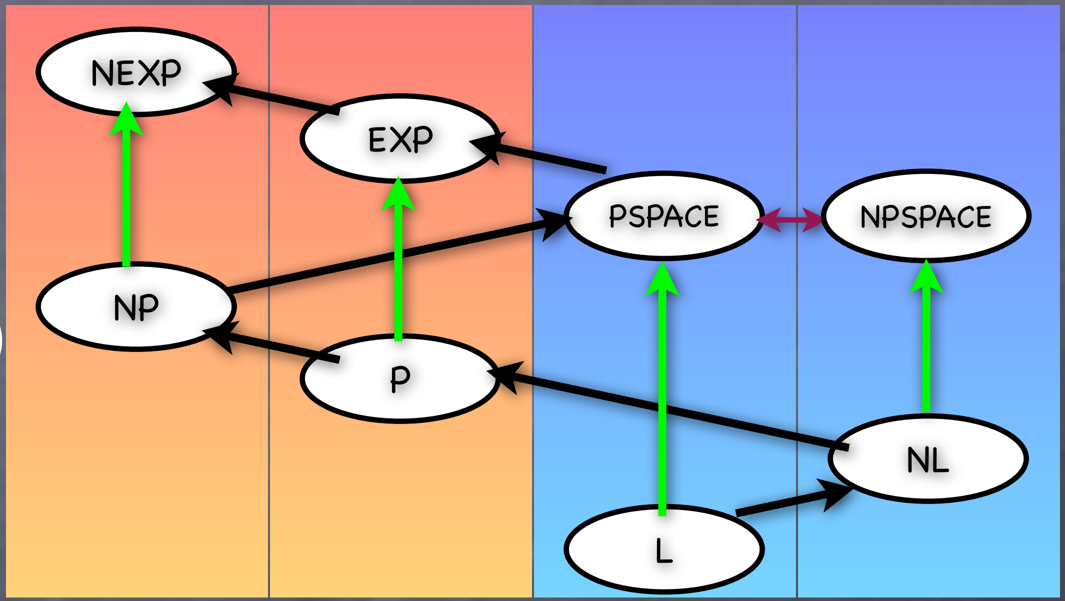
- Coming up:
  - PSPACE-completeness



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- (An) essence of PSPACE: Understanding 2-player games
  - Can the first/second player always win?

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- Given a QBF game does Alice have a sure-to-win strategy

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- e.g. ψ_1: $\exists x \forall y \ (x=y)$, ψ_2: $\forall y \exists x \ (x=y)$

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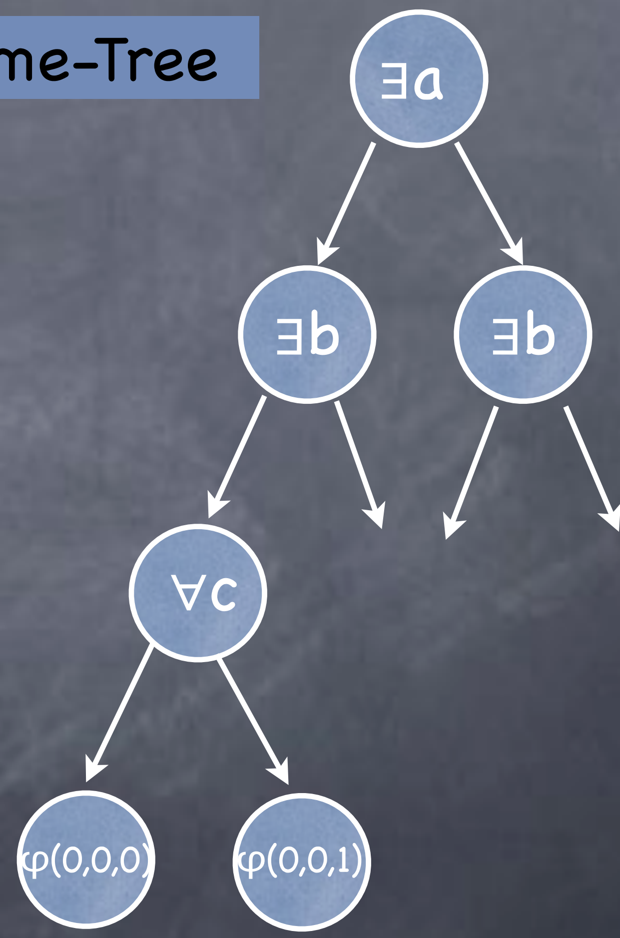

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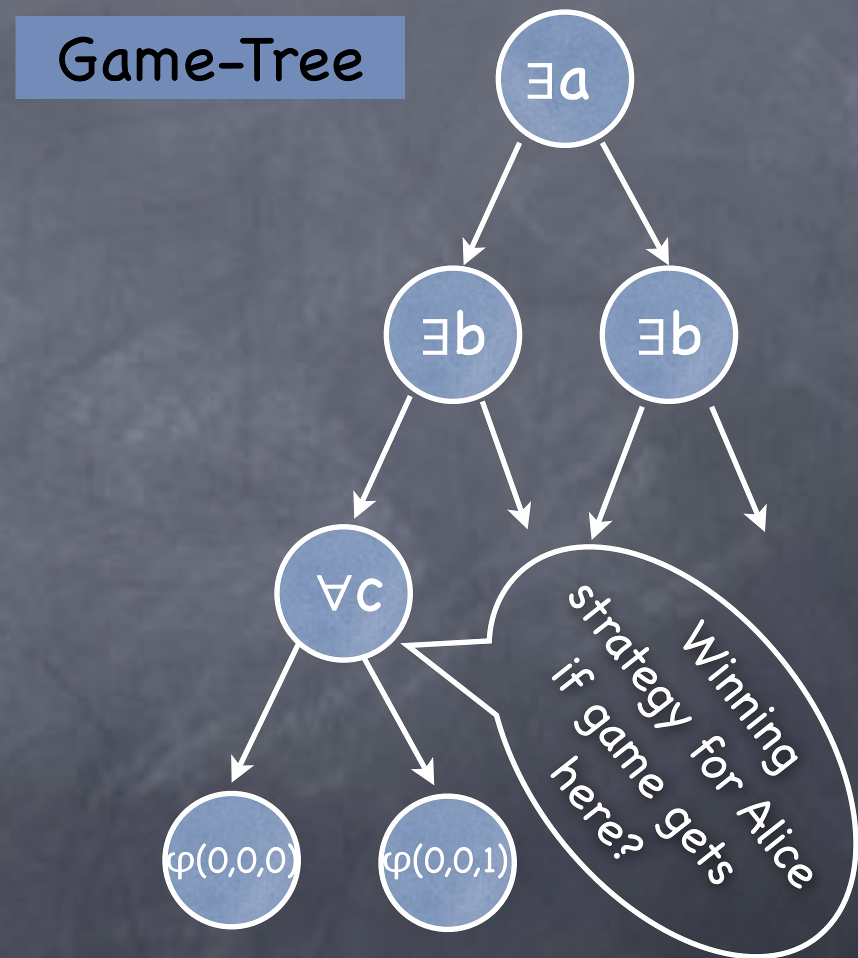

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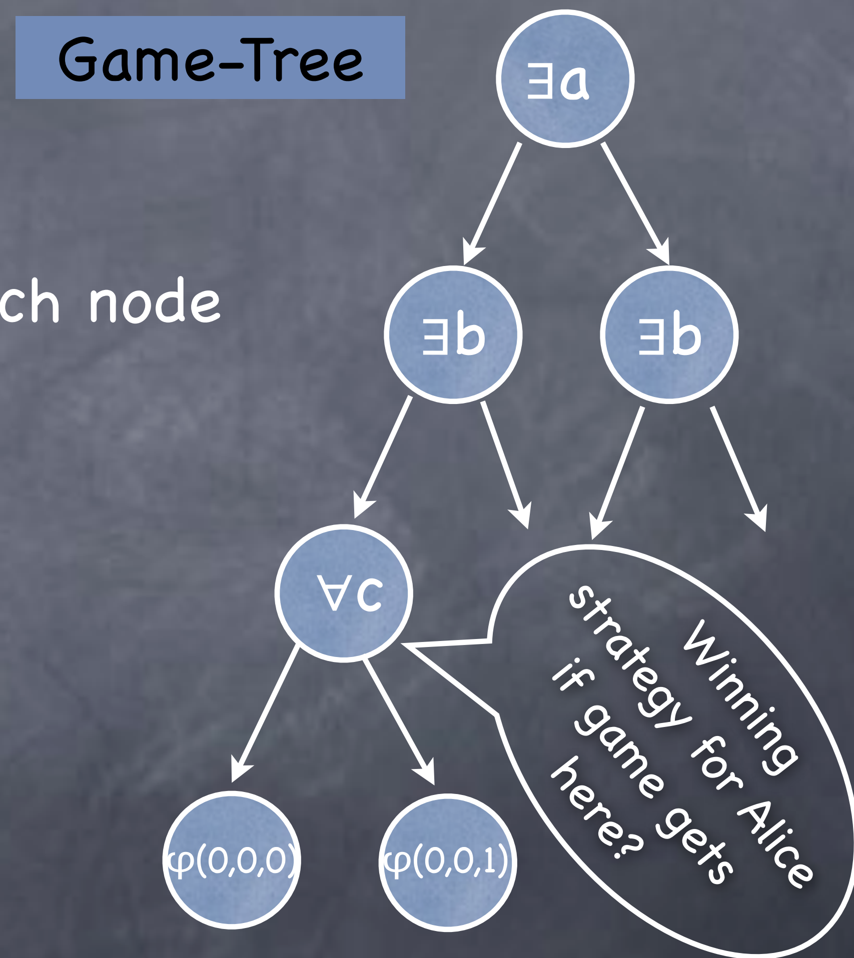
  - e.g. ∃a,b ∀c φ(a,b,c)
  - Ask if winning strategy from each node



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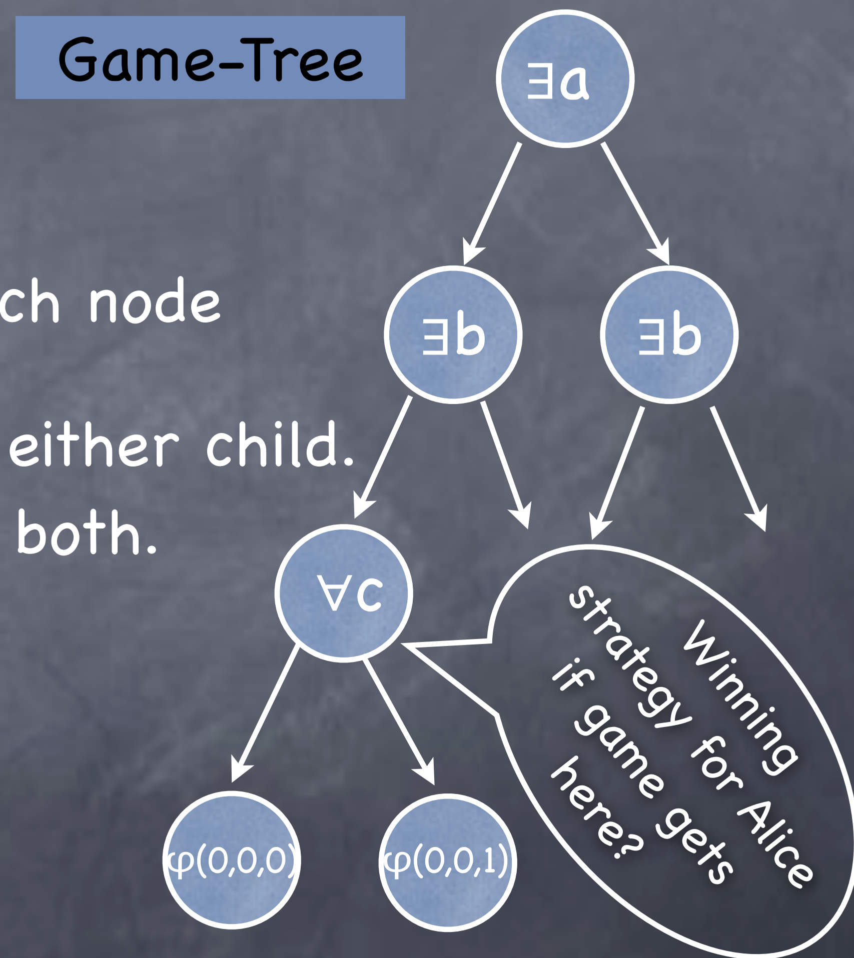

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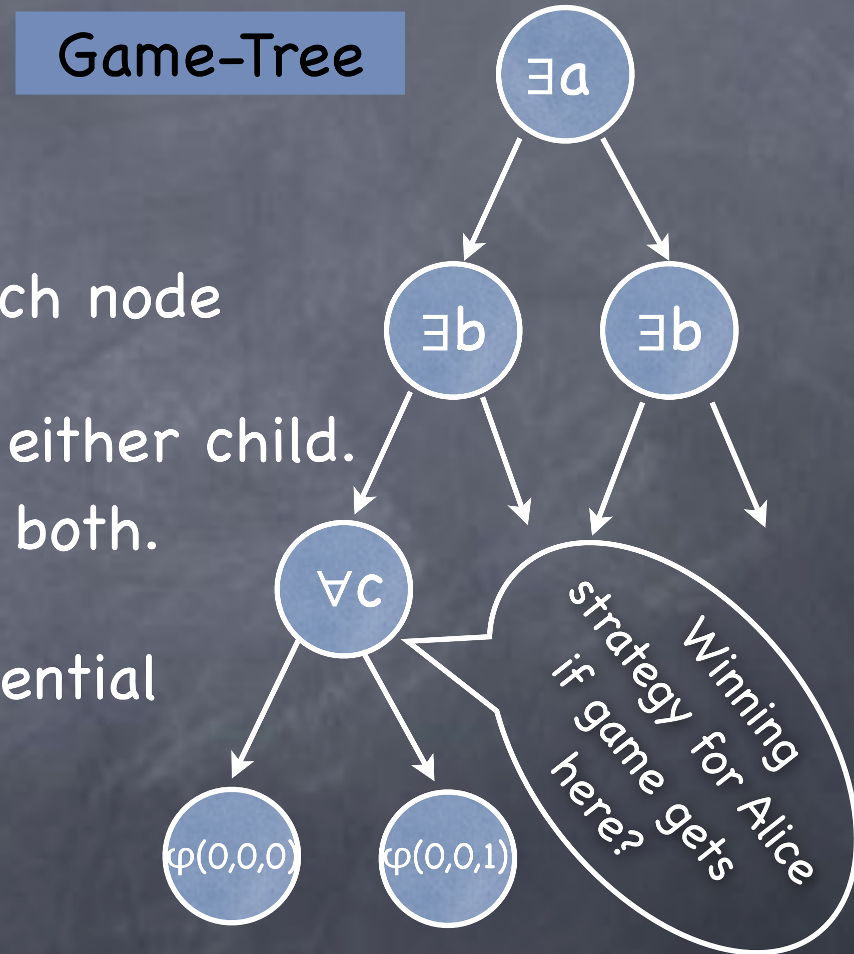

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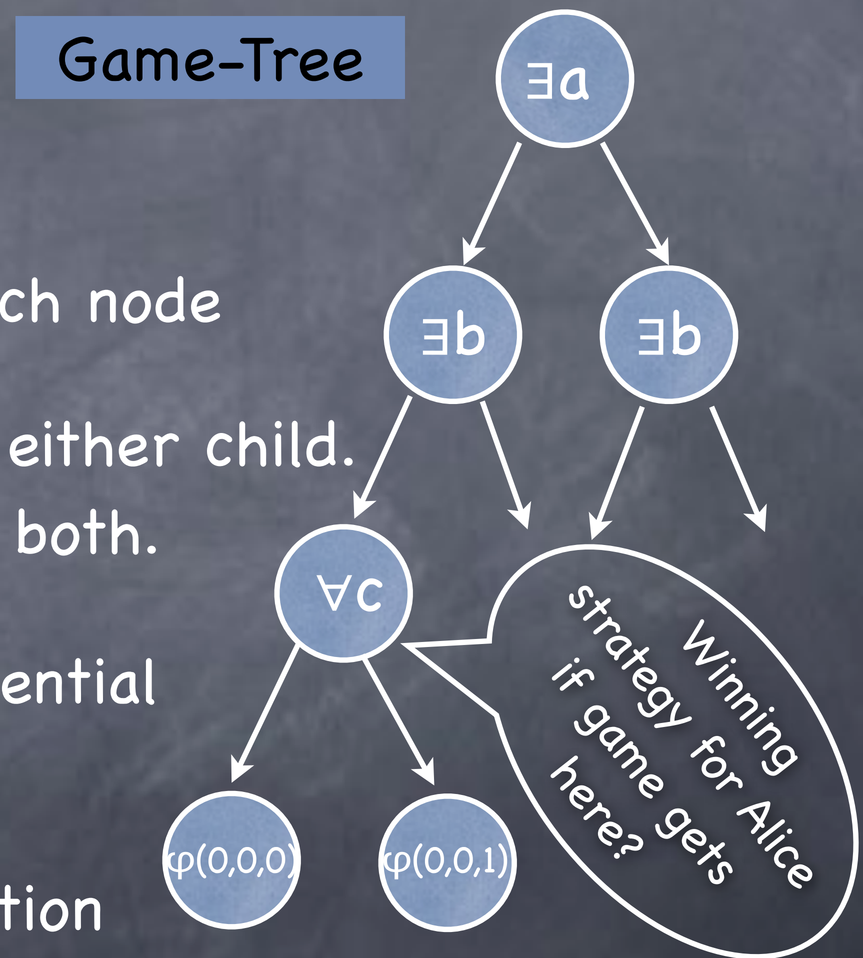

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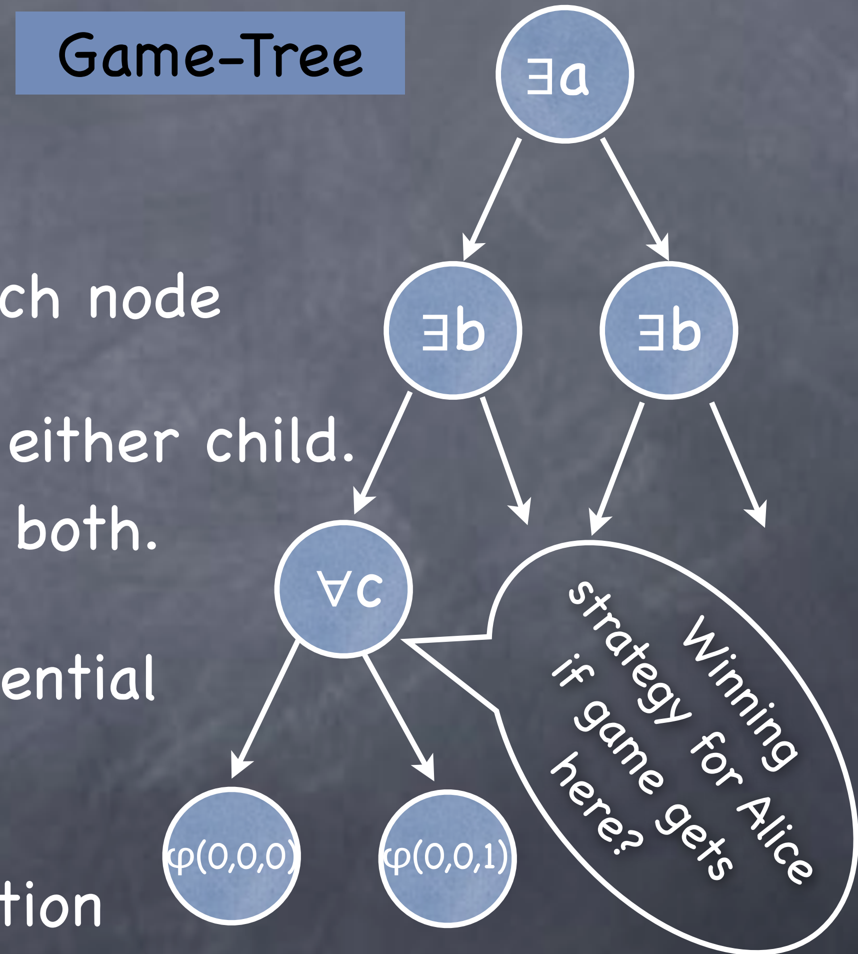
      - Space needed = O(depth) + for evaluation = poly(|QBF|)



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    - Use power of quantification to write it succinctly

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      - In fact, same as naive formula!

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- "Quantification is a powerful programming language"

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  - Coming soon!

Today

Today

- Zoo (more later)

Today

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