FROM TEXT TO SPEECH
THE MITALK SYSTEM

Presented by
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INTRODUCTION

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- In order to get a view of the spectrum of speech synthesis approaches it is useful to consider them as the result of four different constraints which determine a design space for all possible speech output schemes

CONSTRAINTS ON SPEECH SYNTHESIS

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  - Recorded speech can be used for fixed small number of utterances
  - If the task is to simulate the human cognitive process of reading aloud, then an entirely different range of techniques is required

CONSTRAINTS ON SPEECH SYNTHESIS

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  - All systems must produce as output a speech waveform, but it is not an arbitrary signal
  - Efficient and insightful representation of the speech signal as the result of a signal source in the vocal tract exciting the vocal tract system function
  - The human vocal tract is responsible for much of the co-articulatory smoothing or encoding that makes the relation between the underlying phonetic transcription and the speech waveform so difficult to characterize

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  - The basic phonological laws, stress rules, morphological and syntactic structures and phono-tactic constraints all find their use in determining the speech output

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  - Speech science has profited greatly from variety of technologies including x-rays, motion pictures, the sonograph modern filter and sampled data theory and the modern computer

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  - Since memory size is a major limitation of these schemes, efforts have been made to cut down the number of bits per sample used for digital storage while still retaining good quality of speech
  - If messages must be concatenated, then it is extremely difficult to produce good quality speech because of problems at boundaries

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  - Parametric Representation uses the a knowledge of the human production of speech but little (if any) use is made of the linguistic structure of the language

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  - Synthesis by rule techniques can utilize a very low bit rate message description (<100bits/sec)
  - The synthesis by rule is well suited to the needs of converting unrestricted text to speech

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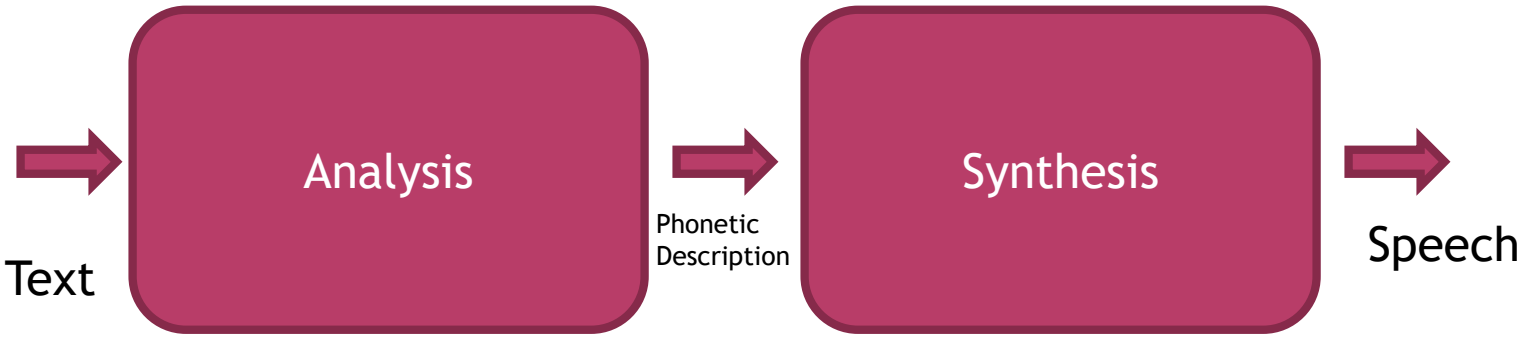
- The first step is to analyze the text to obtain a phonetic transcription
- The phonetic transcription is subjected to a synthesis procedure to yield the output speech waveform
- The analysis of the text is heavily linguistic in nature, involving a determination of the underlying phonemic, syllabic, morphemic, syntactic form of the message plus whatever semantic information can be obtained

FUNCTIONAL OUTLINE OF MITALK



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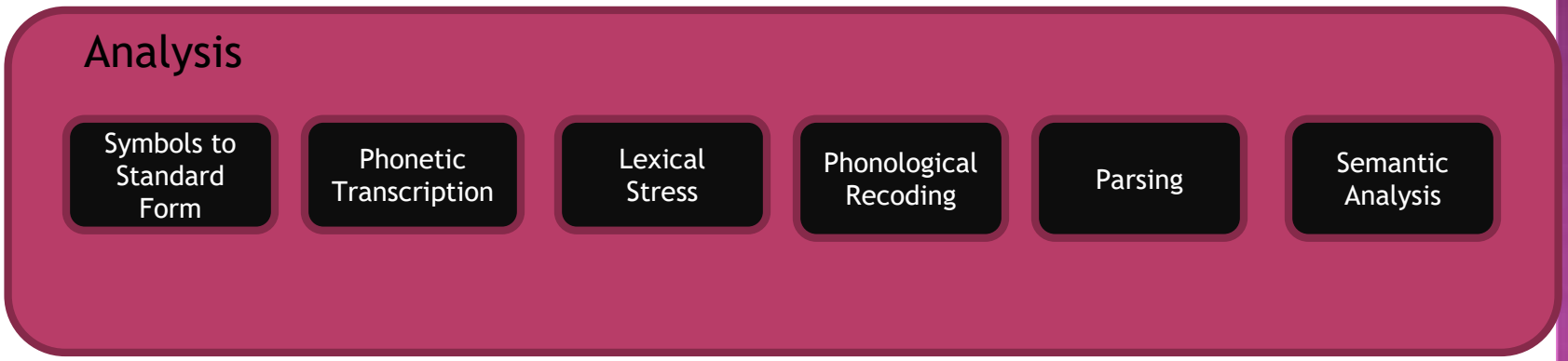

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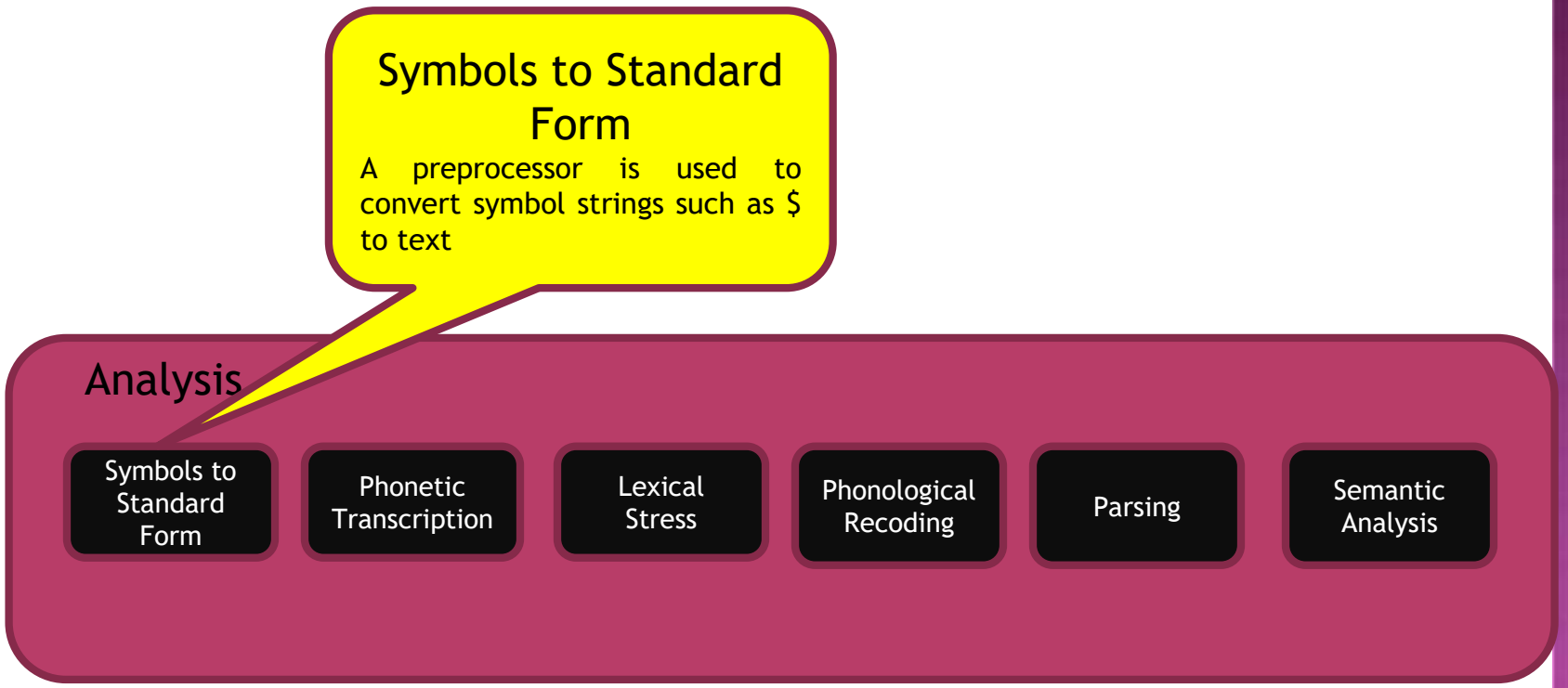

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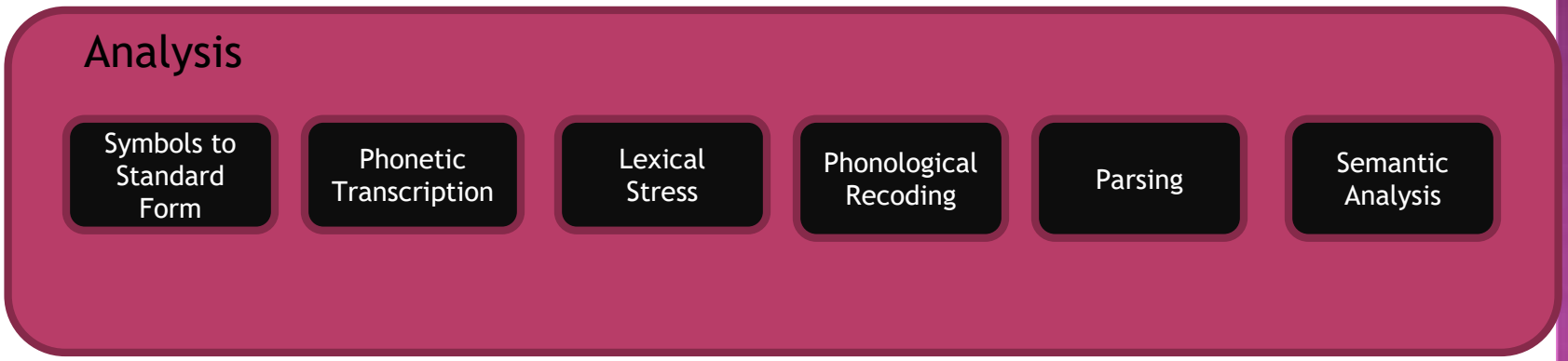

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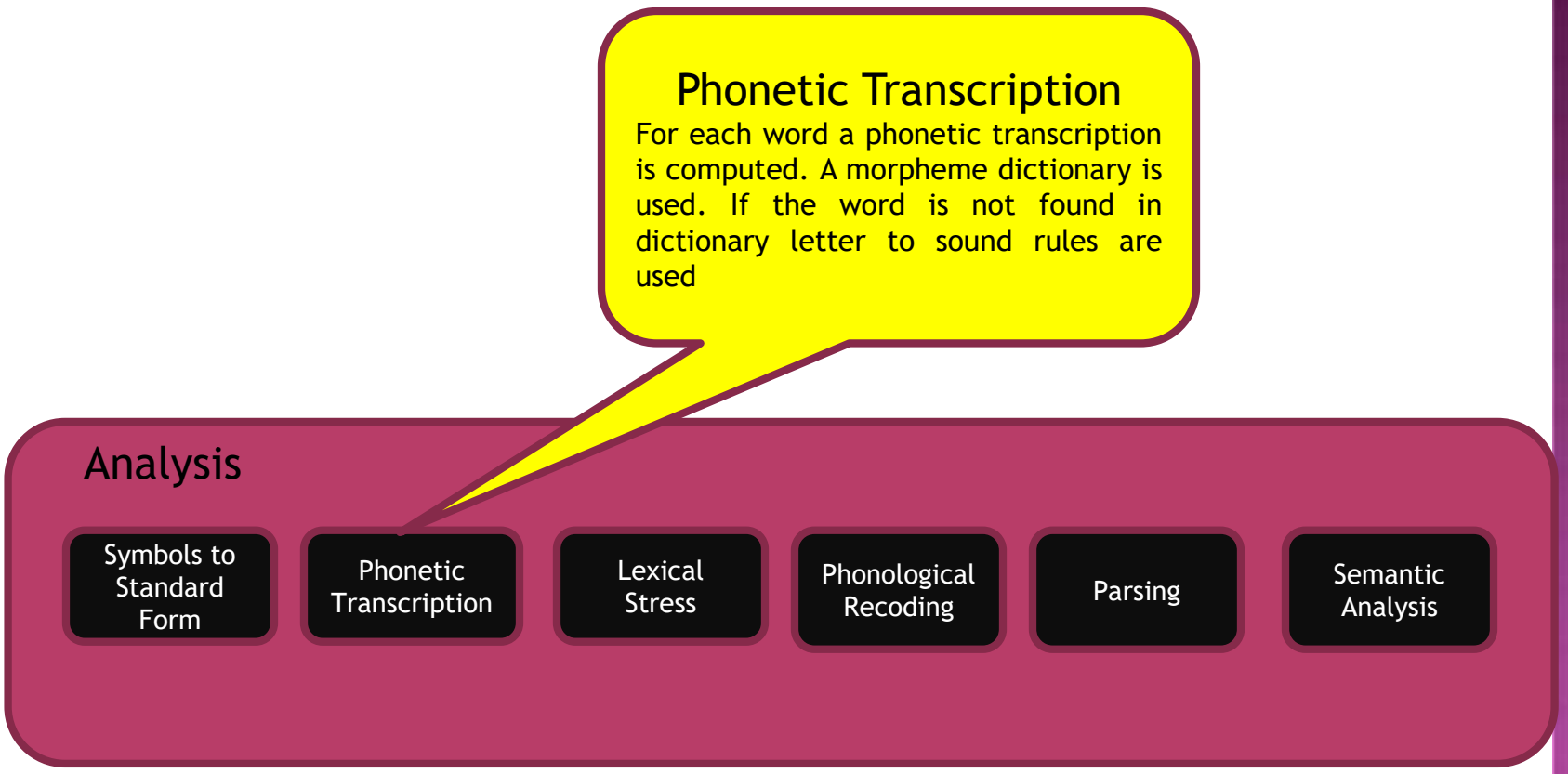

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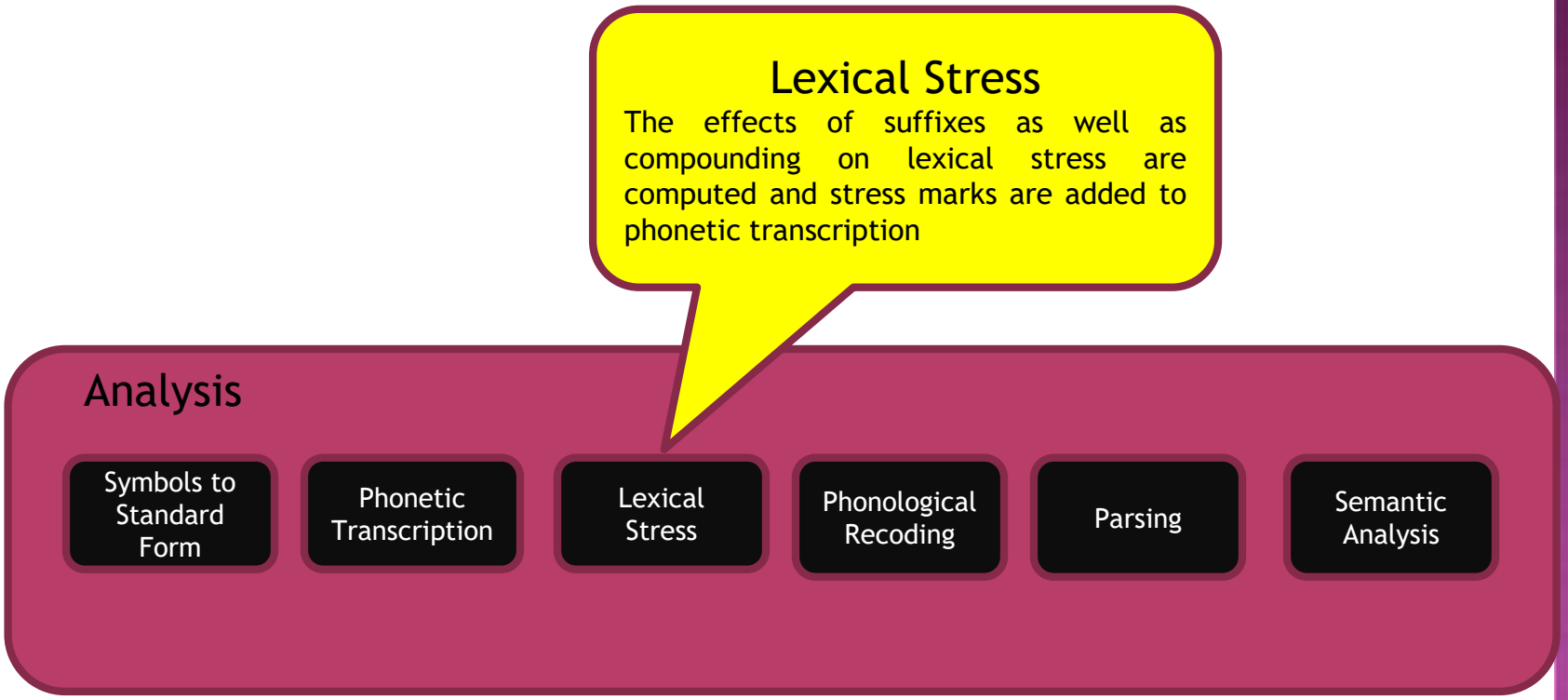

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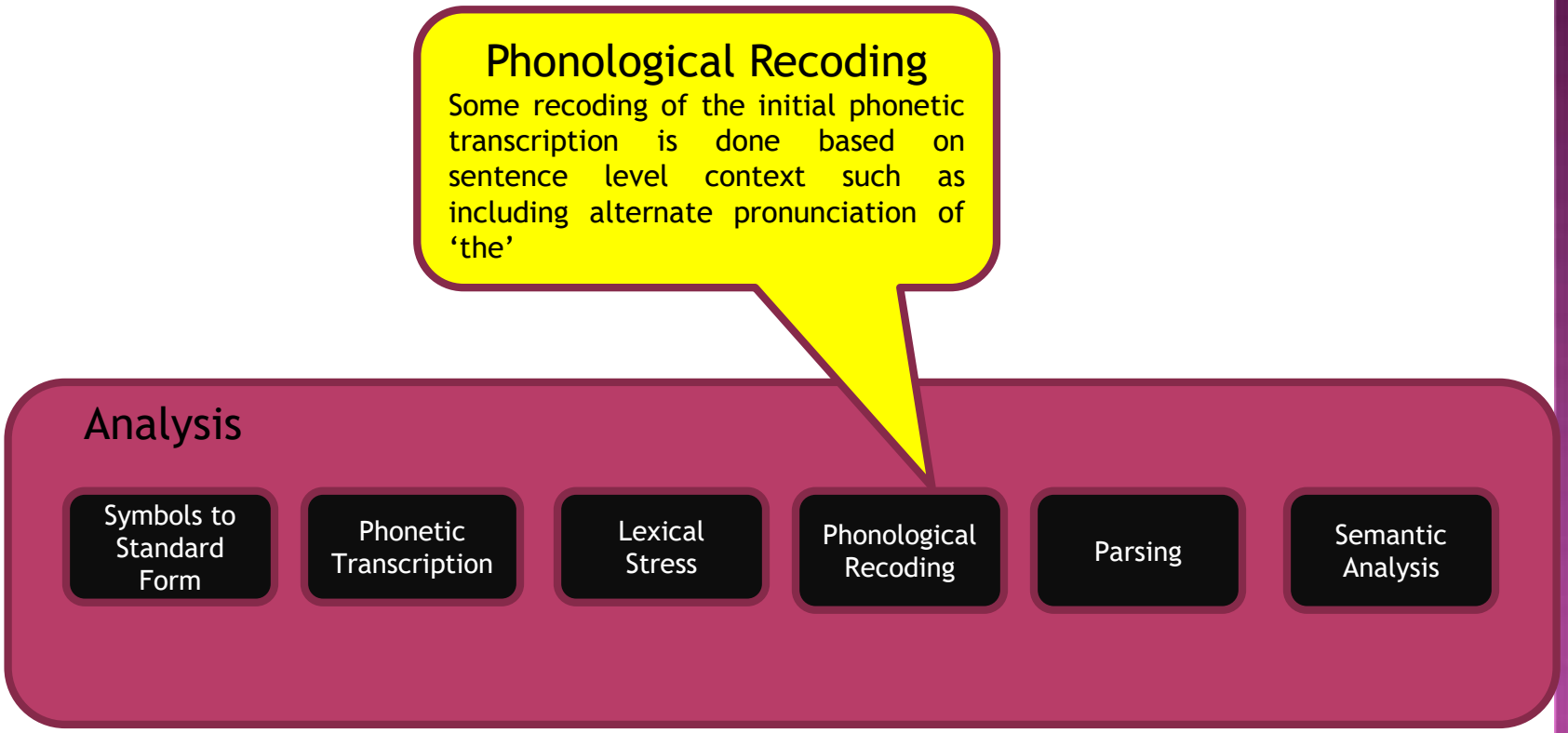

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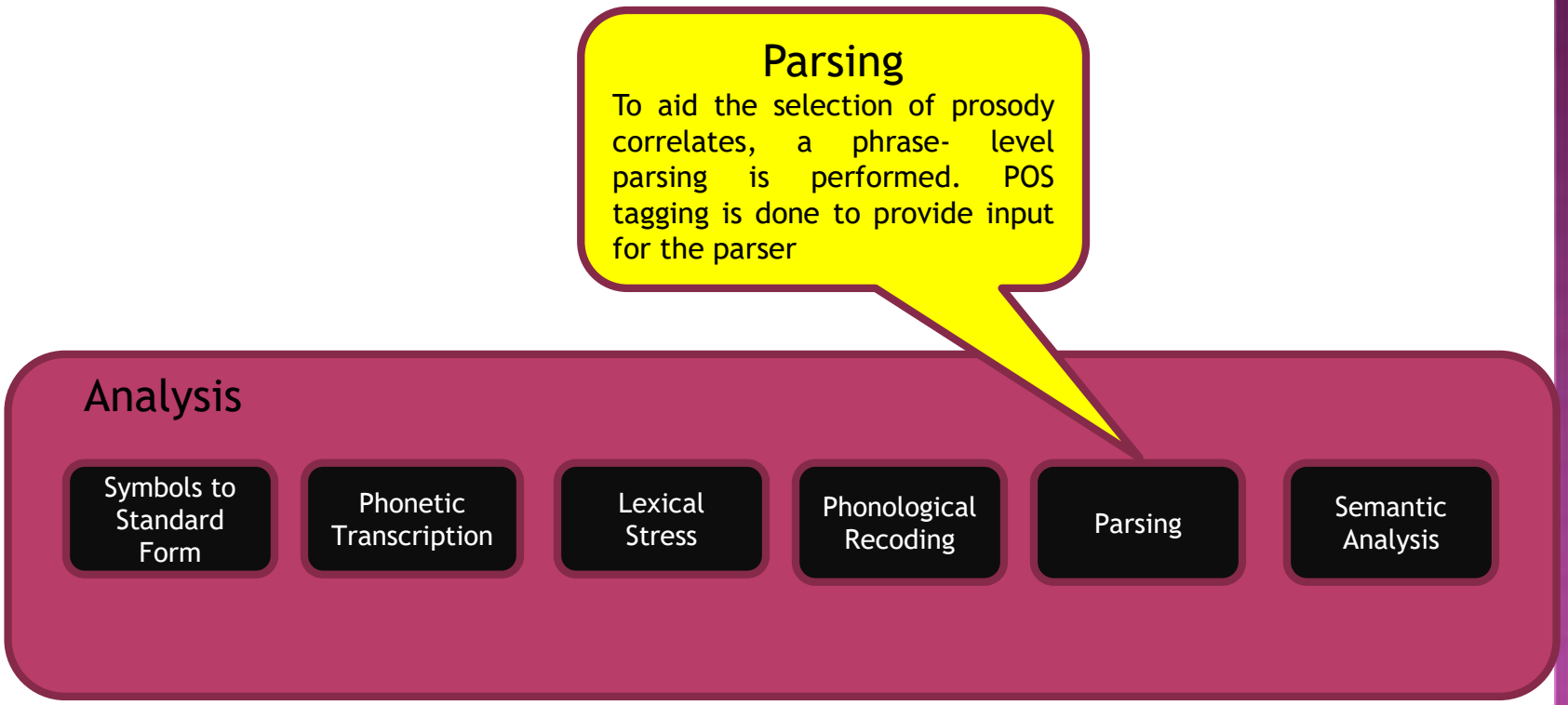

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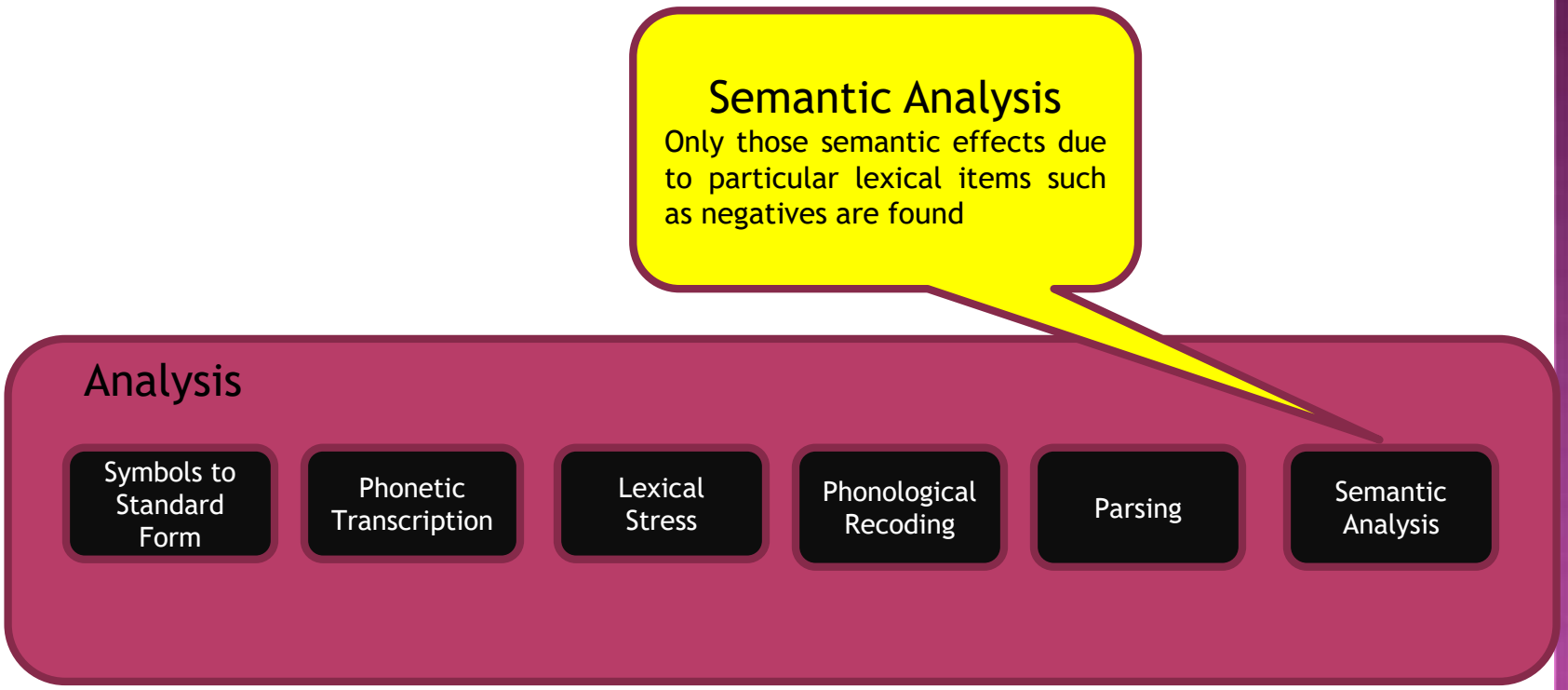

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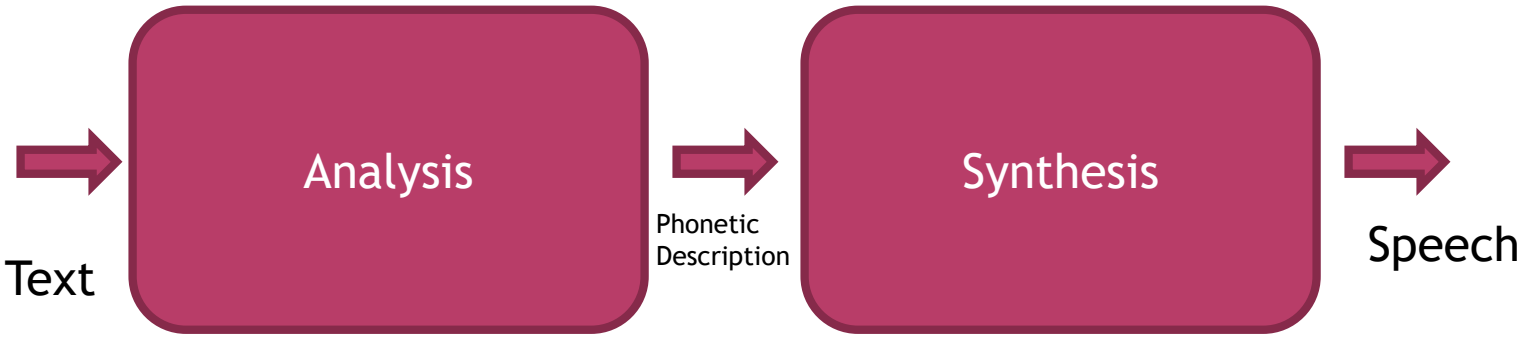

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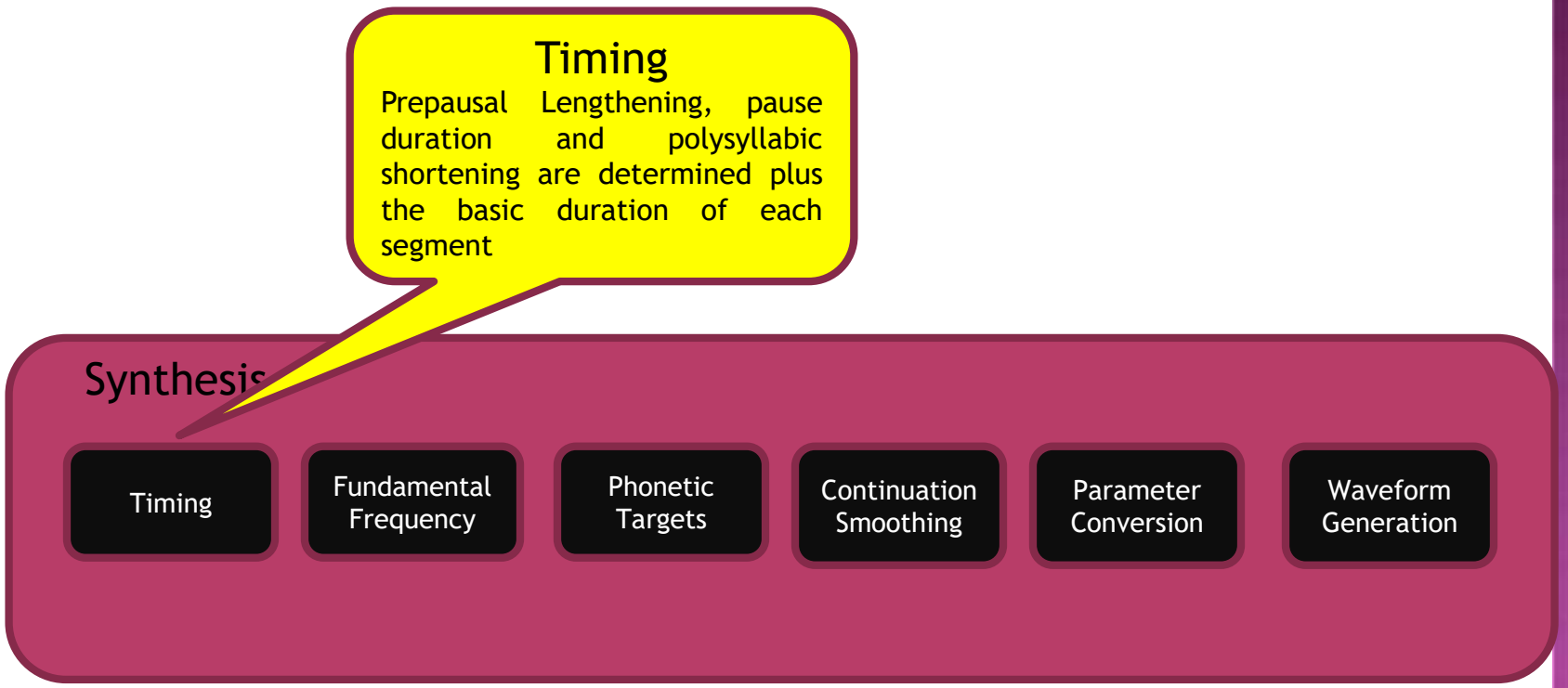

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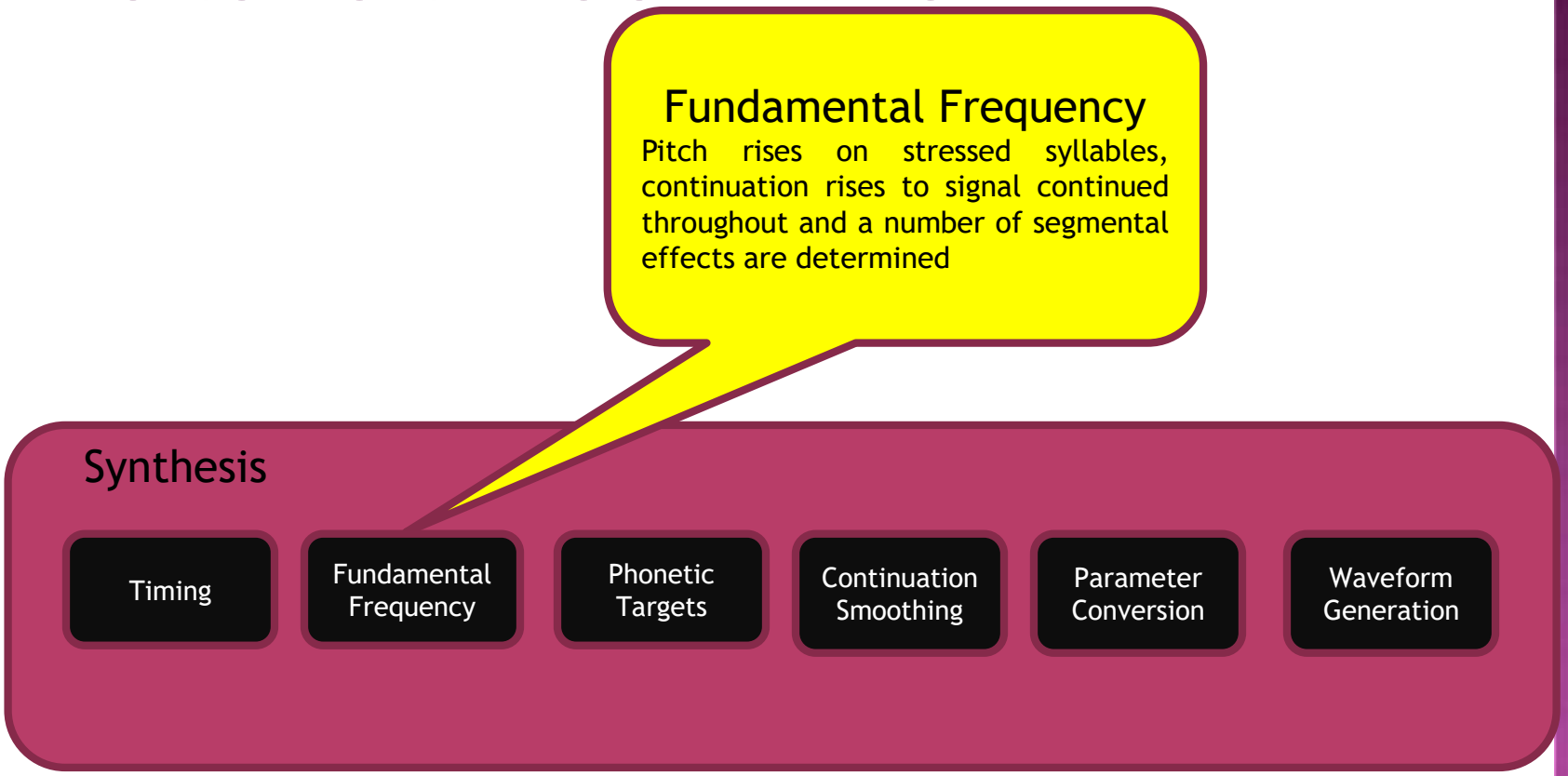

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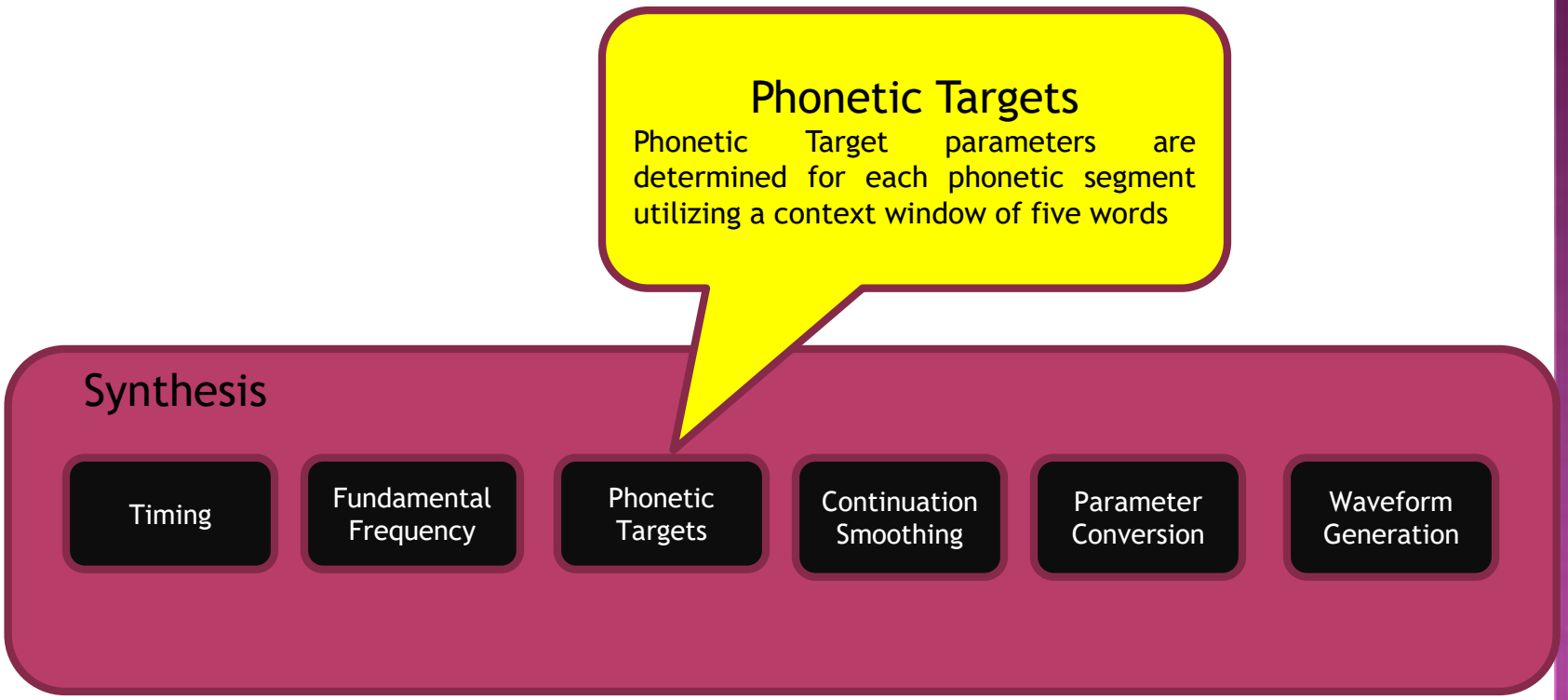

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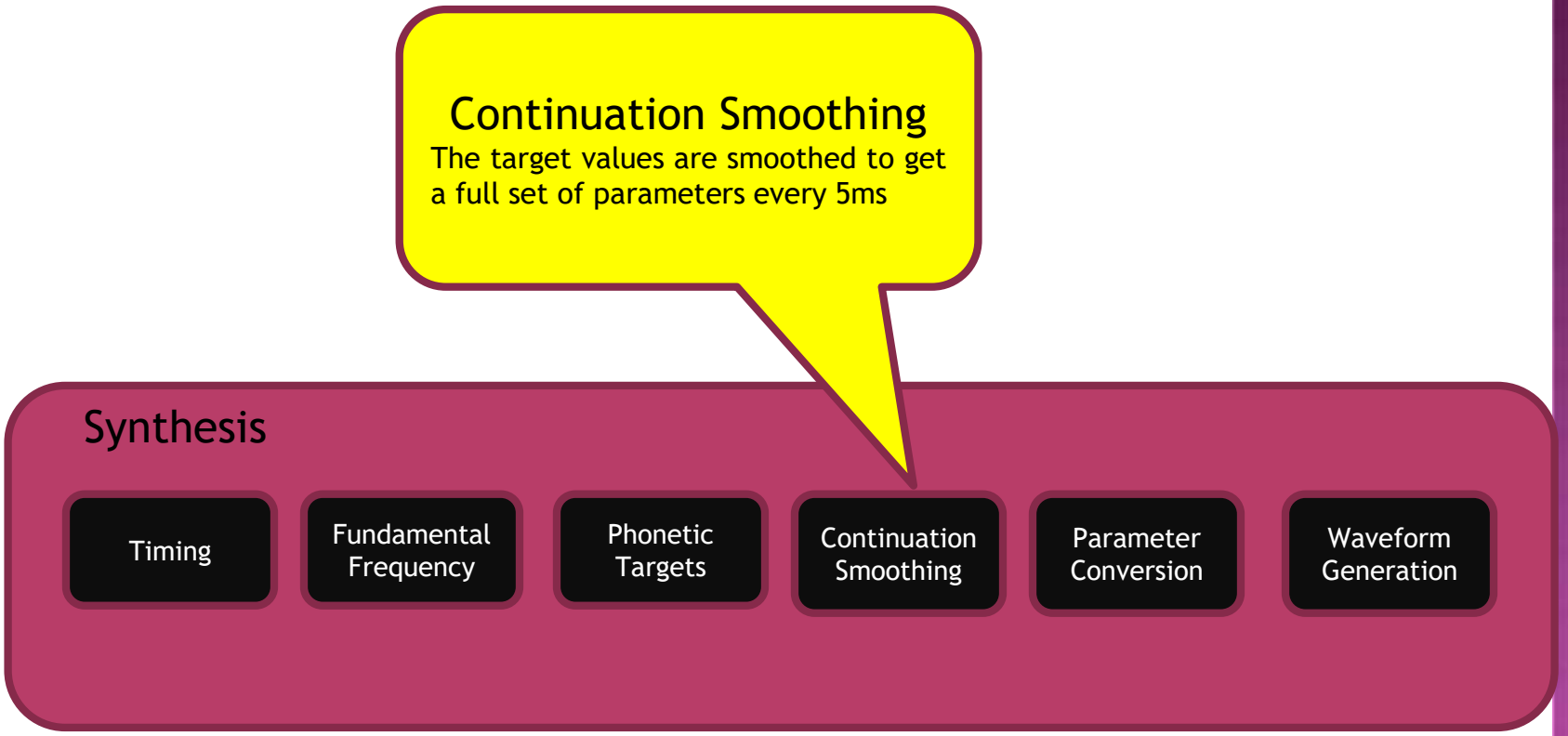

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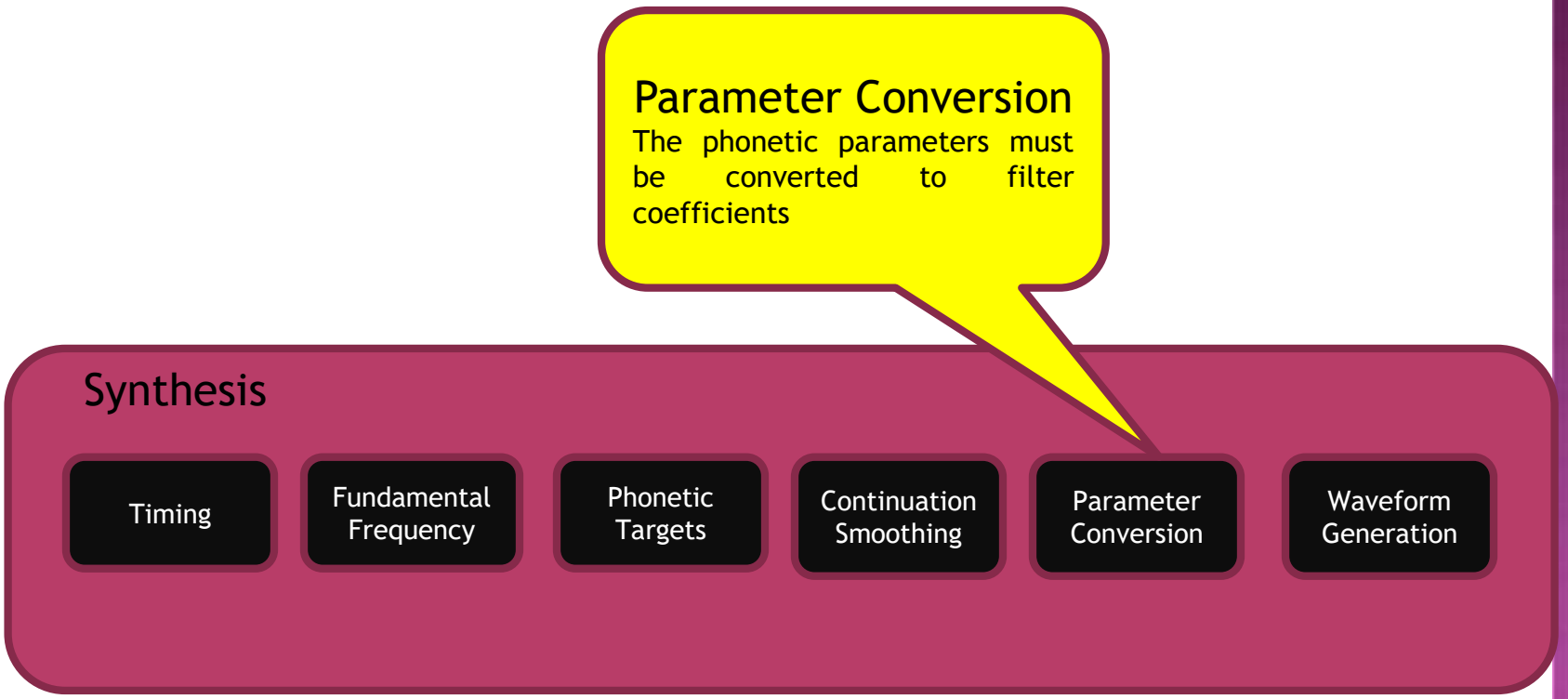

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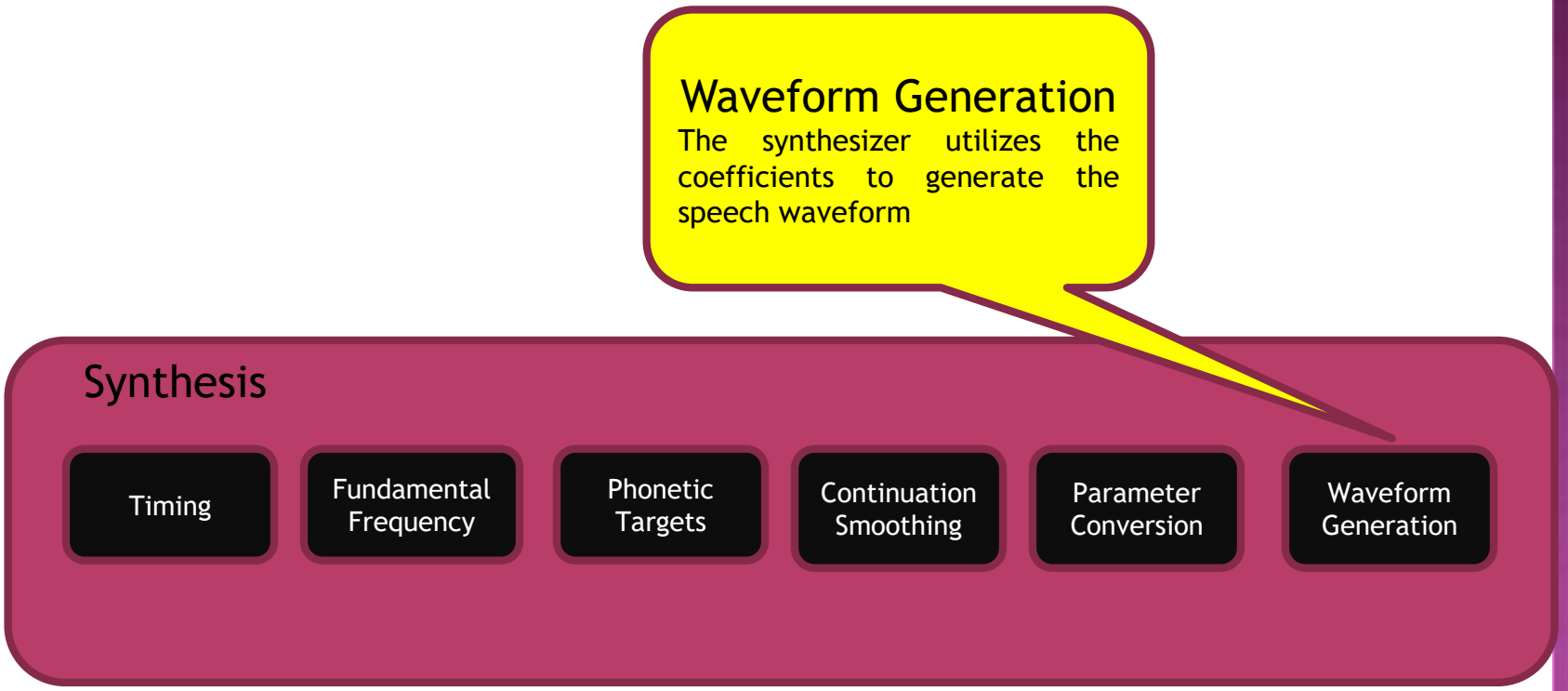

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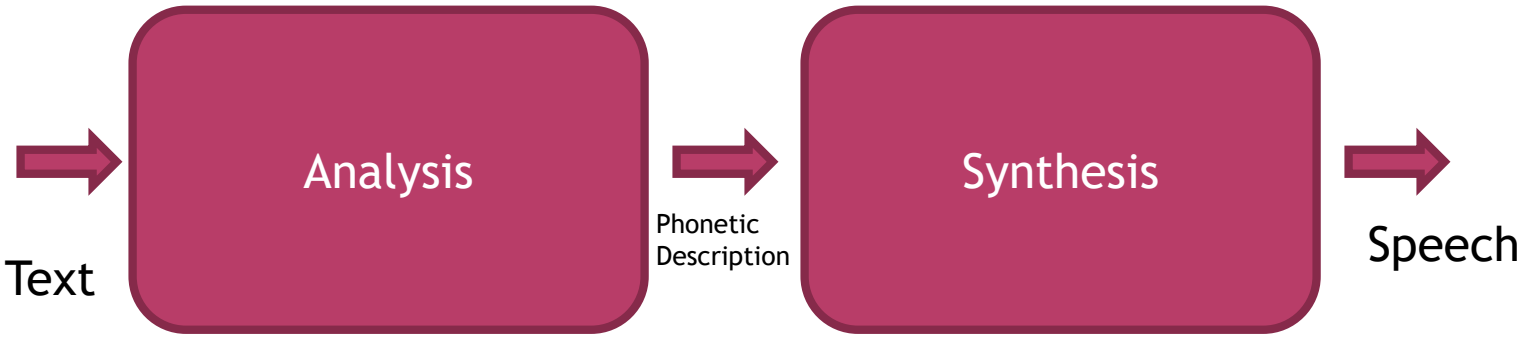

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- FORMAT module of the MITalk system performs the conversion of unrestricted text to a sequence of words and punctuation recognizable by the latter modules

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  - Words are allowed 40 characters each and the maximum number of words per sentence is 200

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  - FORMAT scans each input from left to right and converts each recognized construct (word, number, symbol etc.) into an appropriate word or sequence of words

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```
Mr. Jones gets 35.3%.
  FORMAT:  MISTER
  FORMAT:  JONES
  FORMAT:  GETS
  FORMAT:  THIRTY
  FORMAT:  FIVE
  FORMAT:  POINT
  FORMAT:  THREE
  FORMAT:  PERCENT
  FORMAT:   .
  FORMAT:   .
```

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Ms	→	MIZ
Mr	→	MISTER
Mrs	→	MIZZES
Dr	→	DOCTOR
Num	→	NUMBER
Jan	→	JANUARY
Feb	→	FEBRUARY
Mar	→	MARCH
Apr	→	APRIL
Aug	→	AUGUST
Sept	→	SEPTEMBER
Oct	→	OCTOBER
Nov	→	NOVEMBER
Dec	→	DECEMBER
etc	→	ET CETERA
Jr	→	JUNIOR
Prof	→	PROFESSOR

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    - If a word is followed by a period, then FORMAT looks in a table of abbreviations to see if a translation is specified for that word
    - A word that is in capital letters or which contains digits as well as letters is considered to be a symbol and is translated by pronouncing each character

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  - Years and Comma less Numbers

- 0159 → OH ONE FIVE NINE
- 1590 → FIFTEEN NINETY
- 7150 → SEVEN ONE FIVE OH
- 1906 → NINETEEN OH SIX
- 1800 → EIGHTEEN HUNDRED

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  - Use a complete word dictionary: this is not feasible because of the new words added every day and the size of the lexicon is too large
  - Letter to Sound rules that would convert the input letter strings to phonetic segments through some sort of phonetic and transformation process

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- This problem arise in part due to the fact that there is an internal structure in words that must be realized to derive the correct pronunciation

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- ‘Snowplows’, ‘antidisestablishmentarianism’

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- When morphs are joined together they often change pronunciation depending on the nature of the morphs involved

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- ‘th’ in ‘this’ and ‘hothouse’ , ‘sch’ in ‘school’ and ‘discharge’ can be pronounced correctly using morpheme decomposition
- Morphs leads to an efficient and productive lexicon and provides for important pronunciation effects

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- ‘Walked’ has two morphs ‘walk’ and ‘ed’
- ‘went’ has two morphemes ‘go’ and ‘PAST’ but direct segmentation to morphs is not possible

MORPHOLOGICAL ANALYSIS

- Morpheme is not a segment of the word and it has no position in a word, it is an abstract unit arising from linguistic distributional analysis
- 'Walked' has two morphs 'walk' and 'ed'
- 'went' has two morphemes 'go' and 'PAST' but direct segmentation to morphs is not possible
- A special morph type STRONG is defined in MITalk to indicate the two underlying morphemes

MORPHOLOGICAL ANALYSIS

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- Input

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- Input
  - The morphological analysis is provided by the DECOMP module in MITalk

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MORPHOLOGICAL ANALYSIS

- Input
  - The morphological analysis is provided by the DECOMP module in MITalk
  - The output of the FORMAT is the input to the DECOMP
  - Each record in the data stream contains either a word or a punctuation mark
  - DECOMP also accesses a compiled binary format morph lexicon

MORPHOLOGICAL ANALYSIS

- Output

MORPHOLOGICAL ANALYSIS

- Output
  - The output data stream consists of decomposed word records

MORPHOLOGICAL ANALYSIS

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  - The output data stream consists of decomposed word records
  - The following information is contained in each record

MORPHOLOGICAL ANALYSIS

- Output
  - The output data stream consists of decomposed word records
  - The following information is contained in each record

1. Word spelling
2. Word part of speech (possibly more than one)
3. For each part of speech, an optional list of part-of-speech *features*
4. The series of morphs obtained by decomposition
5. For each morph, the following information:
   a. Morph spelling
   b. Morph type
   c. One or two homographs
   d. For each homograph, a pronunciation and part(s) of speech