5 Formal Models of Language (pjb48)

An intrepid linguist encounters an alien while exploring a remote planet, she documents an alien language that has four sounds, $\Sigma = \{a, e, f, m\}$. The following are examples of the alien’s speech and a translation:

- $e \ amaf$ nice spaceship
- $e \ faem$ nice spaceboots
- $e \ e \ amaf$ very nice spaceship
- $e \ e \ e \ faem$ extremely nice spaceboots

The linguist hypothesizes that Expression 1 matches sound sequences in the alien language.

Expression 1: $e^*(a|e|f|m)(a|e|f|m)^*$

(a) Describe the strings that are matched by Expression 1. [2 marks]

(b) Provide a Finite State Automaton that can generate the language defined by Expression 1. [2 marks]

As the linguist continues to explore, she encounters a grumpy alien and documents the following utterances:

- $fama \ e \ amaf$ not nice spaceship (unpleasant spaceship)
- $meaf \ e \ e \ faem$ very unpleasant spaceboots
- $afaf \ e \ e \ e \ fafa$ extremely unpleasant gift

The linguist hypothesizes that Expression 2 matches sound sequences in the language.

Expression 2: $w^{-1}e^*w$ where $w \in \Sigma^*$

(c) Can the linguist draw a Finite State Automaton to generate the language defined by Expression 2? Provide a proof for your answer. [5 marks]

(d) Provide a grammar that can generate the language defined by Expression 2. [5 marks]

On the far side of the planet, the linguist encounters a new dialect and documents the following utterances:

- $amaf \ e \ amaf$ unpleasant spaceship
- $faem \ e \ e \ faem$ very unpleasant spaceboots
- $mefaem \ e \ e \ e \ mefaem$ extremely unpleasant earthling

(e) Provide a general expression to match such sound sequences. [1 mark]

(f) Can you use a Context Free Grammar to generate the language defined by your expression? Provide a proof for your answer. [5 marks]