**Grammar**

Miniature grammar for English (based on Jurafsky & Martin 2000, chapter 10)

|  |  |
| --- | --- |
| **S**  → NP VP | Det → that | this | a |
| S → Aux NP VP | Noun → book | flight | meal | money |
| S → VP | Verb → book | include | prefer |
| NP → Det Nominal | Aux→ does |
| Nominal → Noun |  |
| Nominal → Noun Nominal | Prep → from | to | on |
| NP → PN | PN → Houston | TWA |
| VP → Verb |  |
| VP → Verb NP |  |

**Start Symbol** = S

Full Chart for *book that flight* given this grammar:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | C | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | C | S17 / S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | C | S15 / S19 |
| S22 | VP → Verb NP \* | [0,3] | [S8,S21] | Completer | C | S11 / S21 |
| S23 | S → VP \* | [0,3] | [S22] | Completer | C | S5 / S22 |
| S27 | γ → S \* | [0,3] | [S23] | Completer | C | S0 / S23 |

Incremental build up of the Chart and Agenda

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
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| S5 | S → \* VP | [0,0] | [] | Predictor | A | S0 |

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| S3 | NP → \* PN | [0,0] | [] | Predictor | A | S1 |
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| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | A | S5 |

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| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | **C** | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | A | S5 |
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| S8 | Verb → *book* \* | [0,1] | [] | Scanner | A |  |

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| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
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| S8 | Verb → *book* \* | [0,1] | [] | Scanner | **C** |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | A | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | A | S7 / S8 |

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| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
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| S26 | γ → S \* | [0,1] | [S10] | Completer | A | S0 / S10 |

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| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | A |  |

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|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | **C** |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | A | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | A | S17 / S18 |

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| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | **C** | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | A | S17 / S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | A | S15 / S19 |

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| --- | --- | --- | --- | --- | --- | --- |
| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | C | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | **C** | S17 /S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | A | S15 / S19 |
| S24 | Nominal → \* Noun | [3,3] | [] | Predictor | A | S20 |
| S25 | Nominal → \* Noun Nominal | [3.3] | [] | Predictor | A | S20 |

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| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | C | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | C | S17 / S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | **C** | S15 / S19 |
| S24 | Nominal → \* Noun | [3,3] | [] | Predictor | A | S20 |
| S25 | Nominal → \* Noun Nominal | [3.3] | [] | Predictor | A | S20 |
| S22 | VP → Verb NP \* | [0,3] | [S8,S21] | Completer | A | S11 / S21 |

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| --- | --- | --- | --- | --- | --- | --- |
| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | C | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | C | S17 / S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | **C** | S15 / S19 |
| S24 | Nominal → \* Noun | [3,3] | [] | Predictor | **C** | S20 |
| S25 | Nominal → \* Noun Nominal | [3.3] | [] | Predictor | **C** | S20 |
| S22 | VP → Verb NP \* | [0,3] | [S8,S21] | Completer | A | S11 / S21 |

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| --- | --- | --- | --- | --- | --- | --- |
| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | C | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | C | S17 / S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | C | S15 / S19 |
| S24 | Nominal → \* Noun | [3,3] | [] | Predictor | C | S20 |
| S25 | Nominal → \* Noun Nominal | [3.3] | [] | Predictor | C | S20 |
| S22 | VP → Verb NP \* | [0,3] | [S8,S21] | Completer | **C** | S11 / S21 |
| S23 | S → VP \* | [0,3] | [S22] | Completer | A | S5 / S22 |

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| --- | --- | --- | --- | --- | --- | --- |
| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | C | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | C | S17 / S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | C | S15 / S19 |
| S24 | Nominal → \* Noun | [3,3] | [] | Predictor | C | S20 |
| S25 | Nominal → \* Noun Nominal | [3.3] | [] | Predictor | C | S20 |
| S22 | VP → Verb NP \* | [0,3] | [S8,S21] | Completer | C | S11 / S21 |
| S23 | S → VP \* | [0,3] | [S22] | Completer | **C** | S5 / S22 |
| S27 | γ → S \* | [0,3] | [S23] | Completer | A | S0 / S23 |

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| **Id** | **Item** | **From-To** | **Previous States** | **Rule** | **Agenda /**  **Chart** | **Applied to** |
| S0 | γ → \* S | [0,0] | [] | Dummy Start State | C |  |
| S1 | S → \* NP VP | [0.0] | [] | Predictor | C | S0 |
| S4 | S → \* Aux NP VP | [0,0] | [] | Predictor | C | S0 |
| S5 | S → \* VP | [0,0] | [] | Predictor | C | S0 |
| S2 | NP → \* Det Nominal | [0.0] | [] | Predictor | C | S1 |
| S3 | NP → \* PN | [0,0] | [] | Predictor | C | S1 |
| S6 | VP → \* Verb | [0,0] | [] | Predictor | C | S5 |
| S7 | VP → \* Verb NP | [0,0] | [] | Predictor | C | S5 |
|  |  |  |  |  |  |  |
| S8 | Verb → *book* \* | [0,1] | [] | Scanner | C |  |
| S9 | VP → Verb \* | [0,1] | [S8] | Completer | C | S6 / S8 |
| S11 | VP → Verb \* NP | [0,1] | [S8] | Completer | C | S7 / S8 |
| S10 | S → VP \* | [0,1] | [S9] | Completer | C | S5 / S9 |
| S12 | NP → \* Det Nominal | [1,1] | [] | Predictor | C | S11 |
| S13 | NP → \* PN | [1,1] | [] | Predictor | C | S11 |
| S26 | γ → S \* | [0,1] | [S10] | Completer | C | S0 / S10 |
|  |  |  |  |  |  |  |
| S14 | Det → *that* \* | [1,2] | [] | Scanner | C |  |
| S15 | NP → Det \* Nominal | [1,2] | [S14] | Completer | C | S12 / S14 |
| S16 | Nominal → \* Noun | [2,2] | [] | Predictor | C | S15 |
| S17 | Nominal → \* Noun Nominal | [2,2] | [] | Predictor | C | S15 |
|  |  |  |  |  |  |  |
| S18 | Noun → *flight* \* | [2,3] | [] | Scanner | C |  |
| S19 | Nominal → Noun \* | [2,3] | [S18] | Completer | C | S16 / S18 |
| S20 | Nominal → Noun \* Nominal | [2,3] | [S18] | Completer | C | S17 / S18 |
| S21 | NP → Det Nominal \* | [1,3] | [S14,S19] | Completer | C | S15 / S19 |
| S24 | Nominal → \* Noun | [3,3] | [] | Predictor | C | S20 |
| S25 | Nominal → \* Noun Nominal | [3.3] | [] | Predictor | C | S20 |
| S22 | VP → Verb NP \* | [0,3] | [S8,S21] | Completer | C | S11 / S21 |
| S23 | S → VP \* | [0,3] | [S22] | Completer | C | S5 / S22 |
| S27 | γ → S \* | [0,3] | [S23] | Completer | **C** | S0/ S23 |