A. Submission Instructions:
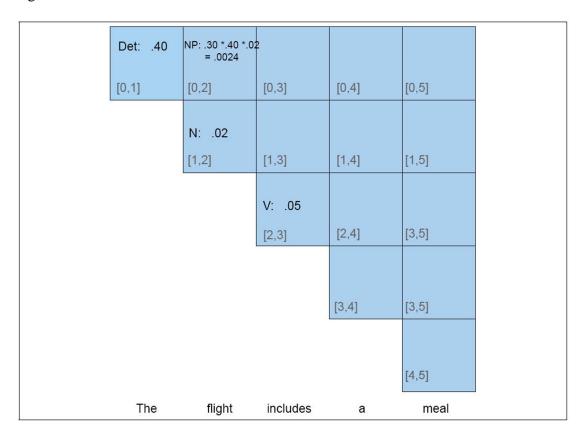
- Submit your solutions via eLearning.
- Please submit a single zip file with the following files:
    - For programming questions:
        - Source code file(s) in C/C++, Java, or Python. For using any other programming language, please get prior approval from the TA.
        - A ReadMe file with instructions on how to compile/run the code.
    - For all other questions, a PDF/Doc/PS/Image file with the solutions.
- Late Submission Penalty:
    - up to 2 hours late — 10% deduction
    - 2 - 4 hours late — 20% deduction
    - 4 - 12 hours late — 35% deduction
    - 12 - 24 hours late — 50% deduction
    - 24 - 48 hours late — 75% deduction
    - more than 48 hours late — 100% deduction (zero credit)

B. Problems:

1. Statistical Parsing (25 points)

S	$\rightarrow$ $NP\ VP$	.80	Det	$\rightarrow$ the	.40
NP	$\rightarrow$ $Det\ N$	.30	Det	$\rightarrow$ a	.40
VP	$\rightarrow$ $V\ NP$	.20	N	$\rightarrow$ $meal$	.01
V	$\rightarrow$ $includes$	.05	N	$\rightarrow$ $flight$	.02

Using the above grammar rules, fill out the rest of the probabilistic CKY chart in the figure below:

Det: .40	NP: .30 *.40 *.02 = .0024				
[0,1]	[0,2]	[0,3]	[0,4]	[0,5]	
	N: .02				
	[1,2]	[1,3]	[1,4]	[1,5]	
		V: .05			
		[2,3]	[2,4]	[3,5]	
			[3,4]	[3,5]	
				[4,5]	
The	flight	includes	a	meal	

2. Thematic Roles (25 points)

Thematic Role	Definition / Example
Agent	The volitional causer of an event *The waiter* spilled the soup.
Experiencer	The experiencer of and event *John* has a headache.
Force	The non-volitional causer of the event *The wind* blows debris from the mall into our yards.
Theme	The participant most directly affected by an event Only after Benjamin Franklin broke *the ice...*
Result	The end product of an event The French government has built a *regular-size baseball diamond...*
Content	The proposition or content of a propositional event Mona asked *"You met Mary Ann at a super market?"*
Instrument	An instrument used in an event He turned to poaching catfish, stunning them *with a shocking device...*
Beneficiary	The beneficiary of an event Whenever Ann Callahan makes hotel reservations *for her boss...*
Source	The origin of the object of a transfer event I flew in *from Boston.*
Goal	The destination of an object of a transfer event I drove *to Portland.*

Using the thematic role definitions from the above table, assign the various verb arguments in the following WSJ examples to their appropriate thematic roles:

1. The intense heat buckled the highway about three feet.

2. He melted her reserve with a husky-voiced paean to her eyes.

3. But Mingo, a major Union Pacific shipping center in the 1890s, has melted away to little more than the grain elevator now.

3. Word Sense Disambiguation (50 points):

```
function SIMPLIFIED LESK(word, sentence) returns best sense of word

    best-sense ← most frequent sense for word
    max-overlap ← 0
    context ← set of words in sentence
    for each sense in senses of word do
        signature ← set of words in the gloss and examples of sense
        overlap ← COMPUTEOVERLAP(signature, context)
        if overlap > max-overlap then
            max-overlap ← overlap
            best-sense ← sense
    end
    return(best-sense)
```

Using WordNet as the dictionary, implement the SIMPLIFIED LESK algorithm to disambiguate the word *bank* in the sentence. Your output should show the word overlap for each sense of the word *bank* in WordNet and the final chosen sense.

The bank can guarantee deposits will eventually cover future tuition costs because it invests in adjustable-rate mortgage securities.