Faculty of Engineering & Technology Ramaiah University of Applied Sciences	
Laboratory Examination Report – M. Tech.	
Department	Electronic and Communication Engineering
Course	MTech in Machine learning and intelligent systems
Batch	Full Time 2017
Module Code	MIS503
Module Title	Probalistic Graphical models
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Q 1
a)Perform suitable text pre-processing and POS tagging

Pre-processing

- The given text is tokenised into words and sentences for the further processing tasks.

Sentence Tokenisation Output

['A strike by farmers in Maharashtra continues to affect normal life, despite the State governmentís announcement of an end to the strike last week.', 'The farmers, whose demands include full waiver of farm loans, hikes in the minimum support price for agricultural produce and writing off of pending electricity bills, have been on an indefinite strike since June 1.', 'As the strike nears the end of its first week, prices of essential goods such as milk, fruits and vegetables have risen steeply, causing distress to consumers.', 'Some farmer groups agreed to call off their strike after Chief Minister Devendra Fadnavis promised that his government would waive farm loans of small and marginal farmers worth about ?30,000 crore, increase power subsidies, hike the price for milk procurement, and also set up a State commission to look into the matter of raising the MSP for crops.', 'He also promised that buying agricultural produce below their MSP would soon be made a criminal offence.', 'Other farmer groups, meanwhile, have stuck to their demand for a complete farm loan waiver and continued with their protest.', 'It is notable that the protests have come soon after the Uttar Pradesh government waived farm loans earlier this year, setting off similar demands in other States.', 'Yet, while Maharashtraís farmers have caught the attention of the government, the focus on quick fixes has pushed aside the real structural issues behind the crisis.', 'At the root of the crisis is the steep fall in the prices of agricultural goods.', 'The price slump, significantly, has come against the backdrop of a good monsoon that led to a bumper crop.', 'The production of tur dal, for instance, increased five-fold from last year to over 20 lakh tonnes in 2016-17.', 'Irrespective of price fluctuations, MSPs are supposed to enable farmers to sell their produce at remunerative prices.', 'But procurement of crops at MSP by the government has traditionally been low for most crops, except a few

staples such as rice and wheat.', 'This has forced distressed farmers to sell their produce at much lower prices, adding to their debt burden.', 'Not surprisingly, the whole system of agricultural marketing has led farmers to feel cheated, and it was only a matter of time before they organised themselves to protest.', 'Going forward, any long-term, wide-scale procurement of crops at MSPs looks unlikely; even a one-time full loan waiver is considered unrealistic by the Chief Minister, given the Stateís finances.', 'The possible ban on buying produce below the MSP would just worsen the crisis by making it hard for farmers to sell their produce even at the market price.', 'The only long-term solution is to gradually align crop production with genuine price signals, while moving ahead with reforms to de-risk agriculture, especially by increasing the crop insurance cover.', 'Expediting steps to reform the Agricultural Produce Market Committee system and introduce the model contract farming law would go a long way to free farmers from MSP-driven crop planning.']

Word Tokenisation Output

['A', 'strike', 'by', 'farmers', 'in', 'Maharashtra', 'continues', 'to', 'affect', 'normal', 'life', ',', 'despite', 'the', 'State', 'governmentís', 'announcement', 'of', 'an', 'end', 'to', 'the', 'strike', 'last', 'week', '.', 'The', 'farmers', ',', 'whose', 'demands', 'include', 'full', 'waiver', 'of', 'farm', 'loans', ',', 'hikes', 'in', 'the', 'minimum', 'support', 'price', 'for', 'agricultural', 'produce', 'and', 'writing', 'off', 'of', 'pending', 'electricity', 'bills', ',', 'have', 'been', 'on', 'an', 'indefinite', 'strike', 'since', 'June', '1', '.', 'As', 'the', 'strike', 'nears', 'the', 'end', 'of', 'its', 'first', 'week', ',', 'prices', 'of', 'essential', 'goods', 'such', 'as', 'milk', ',', 'fruits', 'and', 'vegetables', 'have', 'risen', 'steeply', ',', 'causing', 'distress', 'to', 'consumers', '.', 'Some', 'farmer', 'groups', 'agreed', 'to', 'call', 'off', 'their', 'strike', 'after', 'Chief', 'Minister', 'Devendra', 'Fadnavis', 'promised', 'that', 'his', 'government', 'would', 'waive', 'farm', 'loans', 'of', 'small', 'and', 'marginal', 'farmers', 'worth', 'about', '?', '30,000', 'crore', ',', 'increase', 'power', 'subsidies', ',', 'hike', 'the', 'price', 'for', 'milk', 'procurement', ',', 'and', 'also', 'set', 'up', 'a', 'State', 'commission', 'to', 'look', 'into', 'the', 'matter', 'of', 'raising', 'the', 'MSP', 'for', 'crops', '.', 'He', 'also', 'promised', 'that', 'buying', 'agricultural', 'produce', 'below', 'their', 'MSP', 'would', 'soon', 'be', 'made', 'a', 'criminal', 'offence', '.', 'Other', 'farmer', 'groups', ',', 'meanwhile', ',', 'have', 'stuck', 'to', 'their', 'demand', 'for', 'a', 'complete', 'farm', 'loan', 'waiver', 'and', 'continued', 'with', 'their', 'protest', '.', 'It', 'is', 'notable', 'that', 'the', 'protests', 'have', 'come', 'soon', 'after', 'the', 'Uttar', 'Pradesh', 'government', 'waived', 'farm', 'loans', 'earlier', 'this', 'year', ',', 'setting', 'off', 'similar', 'demands', 'in', 'other', 'States', '.', 'Yet', ',', 'while', 'Maharashtraís', 'farmers', 'have', 'caught', 'the', 'attention', 'of', 'the', 'government', ',', 'the', 'focus', 'on', 'quick', 'fixes', 'has', 'pushed', 'aside', 'the', 'real', 'structural', 'issues', 'behind', 'the', 'crisis', '.', 'At', 'the', 'root', 'of', 'the', 'crisis', 'is', 'the', 'steep', 'fall', 'in', 'the', 'prices', 'of', 'agricultural', 'goods', '.', 'The', 'price', 'slump', ',', 'significantly', ',', 'has', 'come', 'against', 'the', 'backdrop', 'of', 'a', 'good', 'monsoon', 'that', 'led', 'to', 'a', 'bumper', 'crop', '.', 'The', 'production', 'of', 'tur', 'dal', ',', 'for', 'instance', ',', 'increased', 'five-fold', 'from', 'last', 'year', 'to', 'over', '20', 'lakh', 'tonnes', 'in', '2016-17', '.', 'Irrespective', 'of', 'price', 'fluctuations', ',', 'MSPs', 'are', 'supposed', 'to', 'enable', 'farmers', 'to', 'sell', 'their', 'produce', 'at', 'remunerative', 'prices', '.', 'But', 'procurement', 'of', 'crops', 'at', 'MSP', 'by', 'the', 'government', 'has', 'traditionally', 'been', 'low', 'for', 'most', 'crops', ',', 'except', 'a', 'few', 'staples', 'such', 'as', 'rice', 'and', 'wheat', '.', 'This', 'has', 'forced', 'distressed', 'farmers', 'to', 'sell', 'their', 'produce', 'at', 'much', 'lower', 'prices', ',', 'adding', 'to', 'their', 'debt',

'burden', '.', 'Not', 'surprisingly', ',', 'the', 'whole', 'system', 'of', 'agricultural', 'marketing', 'has', 'led', 'farmers', 'to', 'feel', 'cheated', ',', 'and', 'it', 'was', 'only', 'a', 'matter', 'of', 'time', 'before', 'they', 'organised', 'themselves', 'to', 'protest', '.', 'Going', 'forward', ',', 'any', 'long-term', ',', 'wide-scale', 'procurement', 'of', 'crops', 'at', 'MSPs', 'looks', 'unlikely', ';', 'even', 'a', 'one-time', 'full', 'loan', 'waiver', 'is', 'considered', 'unrealistic', 'by', 'the', 'Chief', 'Minister', ',', 'given', 'the', 'Stateís', 'finances', '.', 'The', 'possible', 'ban', 'on', 'buying', 'produce', 'below', 'the', 'MSP', 'would', 'just', 'worsen', 'the', 'crisis', 'by', 'making', 'it', 'hard', 'for', 'farmers', 'to', 'sell', 'their', 'produce', 'even', 'at', 'the', 'market', 'price', '.', 'The', 'only', 'long-term', 'solution', 'is', 'to', 'gradually', 'align', 'crop', 'production', 'with', 'genuine', 'price', 'signals', ',', 'while', 'moving', 'ahead', 'with', 'reforms', 'to', 'de-risk', 'agriculture', ',', 'especially', 'by', 'increasing', 'the', 'crop', 'insurance', 'cover', '.', 'Expediting', 'steps', 'to', 'reform', 'the', 'Agricultural', 'Produce', 'Market', 'Committee', 'system', 'and', 'introduce', 'the', 'model', 'contract', 'farming', 'law', 'would', 'go', 'a', 'long', 'way', 'to', 'free', 'farmers', 'from', 'MSP-driven', 'crop', 'planning', '.']

- Before the POS tagging all the stop words like 'the', 'is', 'are' are eliminated.
- The POS tagger is run over the cleaned words.

POS tagger Output

[('A', 'DT'), ('strike', 'NN'), ('farmers', 'NNS'), ('Maharashtra', 'NNP'), ('continues', 'VBZ'), ('affect', 'VB'), ('normal', 'JJ'), ('life', 'NN'), (',', ','), ('despite', 'IN'), ('State', 'NNP'), ('governmentís', 'VBD'), ('announcement', 'NN'), ('end', 'NN'), ('strike', 'NN'), ('last', 'JJ'), ('week', 'NN'), ('.', '.')]
[('The', 'DT'), ('farmers', 'NNS'), (',', ','), ('whose', 'WP\$'), ('demands', 'NNS'), ('include', 'VBP'), ('full', 'JJ'), ('waiver', 'NN'), ('farm', 'NN'), ('loans', 'NNS'), (',', ','), ('hikes', 'NNS'), ('minimum', 'JJ'), ('support', 'NN'), ('price', 'NN'), ('agricultural', 'JJ'), ('produce', 'NN'), ('writing', 'VBG'), ('pending', 'VBG'), ('electricity', 'NN'), ('bills', 'NNS'), (',', ','), ('indefinite', 'RB'), ('strike', 'NN'), ('since', 'IN'), ('June', 'NNP'), ('1', 'CD'), ('.', '.')]
[('As', 'IN'), ('strike', 'NN'), ('nears', 'NNS'), ('end', 'VBP'), ('first', 'JJ'), ('week', 'NN'), (',', ','), ('prices', 'NNS'), ('essential', 'JJ'), ('goods', 'NNS'), ('milk', 'NN'), (',', ','), ('fruits', 'NNS'), ('vegetables', 'NNS'), ('risen', 'VBP'), ('steeply', 'RB'), (',', ','), ('causing', 'VBG'), ('distress', 'NN'), ('consumers', 'NNS'), ('.', '.')]
[('Some', 'DT'), ('farmer', 'NN'), ('groups', 'NNS'), ('agreed', 'VBD'), ('call', 'NN'), ('strike', 'NN'), ('Chief', 'NNP'), ('Minister', 'NNP'), ('Devendra', 'NNP'), ('Fadnavis', 'NNP'), ('promised', 'VBD'), ('government', 'NN'), ('would', 'MD'), ('waive', 'VB'), ('farm', 'NN'), ('loans', 'NNS'), ('small', 'JJ'), ('marginal', 'JJ'), ('farmers', 'NNS'), ('worth', 'IN'), ('?', '.'), ('30,000', 'CD'), ('crore', 'NN'), (',', ','), ('increase', 'VB'), ('power', 'NN'), ('subsidies', 'NNS'), (',', ','), ('hike', 'JJ'), ('price', 'NN'), ('milk', 'NN'), ('procurement', 'NN'), (',', ','), ('also', 'RB'), ('set', 'VBN'), ('State', 'NNP'), ('commission', 'NN'), ('look', 'NN'), ('matter', 'NN'), ('raising', 'VBG'), ('MSP', 'NNP'), ('crops', 'NNS'), ('.', '.')]
[('He', 'PRP'), ('also', 'RB'), ('promised', 'VBD'), ('buying', 'VBG'), ('agricultural', 'JJ'), ('produce', 'NN'), ('MSP', 'NNP'), ('would', 'MD'), ('soon', 'RB'), ('made', 'VB'), ('criminal', 'JJ'), ('offence', 'NN'), ('.', '.')]

[('Other', 'JJ'), ('farmer', 'NN'), ('groups', 'NNS'), (',', ','), ('meanwhile', 'RB'), (',', ','), ('stuck', 'JJ'), ('demand', 'NN'), ('complete', 'JJ'), ('farm', 'NN'), ('loan', 'NN'), ('waiver', 'WDT'), ('continued', 'VBD'), ('protest', 'JJS'), ('.', '.')]

[('It', 'PRP'), ('notable', 'JJ'), ('protests', 'NNS'), ('come', 'VBP'), ('soon', 'RB'), ('Uttar', 'NNP'), ('Pradesh', 'NNP'), ('government', 'NN'), ('waived', 'VBD'), ('farm', 'NN'), ('loans', 'NNS'), ('earlier', 'RBR'), ('year', 'NN'), (',', ','), ('setting', 'VBG'), ('similar', 'JJ'), ('demands', 'NNS'), ('States', 'NNPS'), ('.', '.')]

[('Yet', 'RB'), (',', ','), ('Maharashtraís', 'NNP'), ('farmers', 'NNS'), ('caught', 'VBD'), ('attention', 'NN'), ('government', 'NN'), (',', ','), ('focus', 'VB'), ('quick', 'JJ'), ('fixes', 'NNS'), ('pushed', 'VBD'), ('aside', 'RB'), ('real', 'JJ'), ('structural', 'JJ'), ('issues', 'NNS'), ('behind', 'IN'), ('crisis', 'NN'), ('.', '.')]

[('At', 'IN'), ('root', 'NN'), ('crisis', 'NN'), ('steep', 'JJ'), ('fall', 'NN'), ('prices', 'NNS'), ('agricultural', 'JJ'), ('goods', 'NNS'), ('.', '.')]

[('The', 'DT'), ('price', 'NN'), ('slump', 'NN'), (',', ','), ('significantly', 'RB'), (',', ','), ('come', 'VB'), ('backdrop', 'NN'), ('good', 'JJ'), ('monsoon', 'NN'), ('led', 'VBD'), ('bumper', 'JJR'), ('crop', 'NN'), ('.', '.')]

[('The', 'DT'), ('production', 'NN'), ('tur', 'NN'), ('dal', 'NN'), (',', ','), ('instance', 'NN'), (',', ','), ('increased', 'VBD'), ('five-fold', 'NN'), ('last', 'JJ'), ('year', 'NN'), ('20', 'CD'), ('lakh', 'NN'), ('tonnes', 'NNS'), ('2016-17', 'CD'), ('.', '.')]

[('Irrespective', 'JJ'), ('price', 'NN'), ('fluctuations', 'NNS'), (',', ','), ('MSPs', 'NNP'), ('supposed', 'VBD'), ('enable', 'JJ'), ('farmers', 'NNS'), ('sell', 'VBP'), ('produce', 'VBP'), ('remunerative', 'JJ'), ('prices', 'NNS'), ('.', '.')]

[('But', 'CC'), ('procurement', 'JJ'), ('crops', 'NNS'), ('MSP', 'JJ'), ('government', 'NN'), ('traditionally', 'RB'), ('low', 'JJ'), ('crops', 'NNS'), (',', ','), ('except', 'IN'), ('staples', 'NNS'), ('rice', 'RB'), ('wheat', 'NN'), ('.', '.')]

[('This', 'DT'), ('forced', 'VBD'), ('distressed', 'JJ'), ('farmers', 'NNS'), ('sell', 'VBP'), ('produce', 'RB'), ('much', 'JJ'), ('lower', 'JJR'), ('prices', 'NNS'), (',', ','), ('adding', 'VBG'), ('debt', 'NN'), ('burden', 'NN'), ('.', '.')]

[('Not', 'RB'), ('surprisingly', 'RB'), (',', ','), ('whole', 'JJ'), ('system', 'NN'), ('agricultural', 'JJ'), ('marketing', 'NN'), ('led', 'VBD'), ('farmers', 'NNS'), ('feel', 'VBP'), ('cheated', 'VBN'), (',', ','), ('matter', 'NN'), ('time', 'NN'), ('organised', 'VBN'), ('protest', 'NN'), ('.', '.')]

[('Going', 'VBG'), ('forward', 'RB'), (',', ','), ('long-term', 'JJ'), (',', ','), ('wide-scale', 'JJ'), ('procurement', 'NN'), ('crops', 'NNS'), ('MSPs', 'NNP'), ('looks', 'VBZ'), ('unlikely', 'JJ'), (';', ':'), ('even', 'RB'), ('one-time', 'VBP'), ('full', 'JJ'), ('loan', 'NN'), ('waiver', 'NN'), ('considered', 'VBN'), ('unrealistic', 'JJ'), ('Chief', 'NNP'), ('Minister', 'NNP'), (',', ','), ('given', 'VBN'), ('Stateís', 'NNP'), ('finances', 'NNS'), ('.', '.')]

[('The', 'DT'), ('possible', 'JJ'), ('ban', 'NN'), ('buying', 'NN'), ('produce', 'NN'), ('MSP', 'NNP'), ('would', 'MD'), ('worsen', 'VB'), ('crisis', 'NN'), ('making', 'VBG'), ('hard', 'JJ'), ('farmers', 'NNS'), ('sell', 'VBP'), ('produce', 'VB'), ('even', 'RB'), ('market', 'NN'), ('price', 'NN'), ('.', '.')]

[('The', 'DT'), ('long-term', 'JJ'), ('solution', 'NN'), ('gradually', 'RB'), ('align', 'JJ'), ('crop', 'NN'), ('production', 'NN'), ('genuine', 'JJ'), ('price', 'NN'), ('signals', 'NNS'), (',', ','), ('moving', 'VBG'), ('ahead', 'RB'), ('reforms', 'NNS'), ('de-risk', 'JJ'), ('agriculture', 'NN'), (',', ','), ('especially', 'RB'), ('increasing', 'VBG'), ('crop', 'NN'), ('insurance', 'NN'), ('cover', 'NN'), ('.', '.')]

[('Expediting', 'VBG'), ('steps', 'NNS'), ('reform', 'RB'), ('Agricultural', 'NNP'), ('Produce', 'NNP'), ('Market', 'NNP'), ('Committee', 'NNP'), ('system', 'NN'), ('introduce', 'VBP'), ('model', 'NN'), ('contract', 'NN'), ('farming', 'JJ'), ('law', 'NN'), ('would', 'MD'), ('go', 'VB'), ('long', 'JJ'),

('way', 'NN'), ('free', 'JJ'), ('farmers', 'NNS'), ('MSP-driven', 'JJ'), ('crop', 'NN'), ('planning', 'NN'), ('.', '.')]

b)Noun to noun mapping

In the noun to noun mapping the action perform is of, if a word in the sentence starts with the noun and is connected with in/of/etc... and connected to another noun in the same sentence those two words are given as an output this is achieved by the grammar that is fed to the regex parser
This tells us the relation of all the relation of nouns Ex:relation of person and the place in the sentence.

strike
farmer
maharashtra
life
state
governmentí
announc
end
strike
week
farmer
demand
waiver
farm
loan
hike
support
price
produc
electr
bill
indefinit
strike
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strike
end
week
price
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milk
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chief
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fadnavi
govern
farm
loan
farmer
crore
power
subsidi
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milk
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state
commiss
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govern
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price
slump
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crop
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produc
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debt
burden
system
market
farmer
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time
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msp

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waiver
chief
minist
stateí
financ
ban
produc
msp
crisi
farmer
produc
market
price
solut
crop
product
price
signal
reform
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crop
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cover
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agricultur
produc
market
committe
system
model
contract
law
way
farmer
msp-driven
crop
plan

c)Noun to verb mapping

This tells us the relation of all the action taken by a noun Ex:relation of person(Noun) protesting(Verb) in the sentence.

strike
farmer

maharashtra
affect
life
state
governmentí
announc
end
strike
week
farmer
demand
waiver
farm
loan
hike
support
price
produc
electr
bill
indefinit
strike
june
strike
end
week
price
good
milk
fruit
veget
distress
consum
farmer
group
call
strike
chief
minist
devendra
fadnavi
govern
waiv
farm
loan
farmer
crore

increas
power
subsidi
hike
price
milk
procur
state
commiss
look
matter
msp
crop
produc
msp
offenc
farmer
group
demand
farm
loan
waiver
protest
protest
uttar
pradesh
govern
farm
loan
year
demand
state
maharashtraí
farmer
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root
crisi
fall
price
good
price
slump

backdrop
monsoon
bumper
crop
product
tur
dal
instanc
five-fold
year
tonn
irrespect
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fluctuat
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farmer
sell
produc
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msp
govern
crop
stapl
rice
wheat
farmer
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minist
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product
price
signal
reform
agricultur
crop
insur
cover
step
reform
agricultur
produc
market
committe
system
introduc
model
contract
law
go
way
farmer
msp-driven
crop
plan

d)Develop a Bayesian network

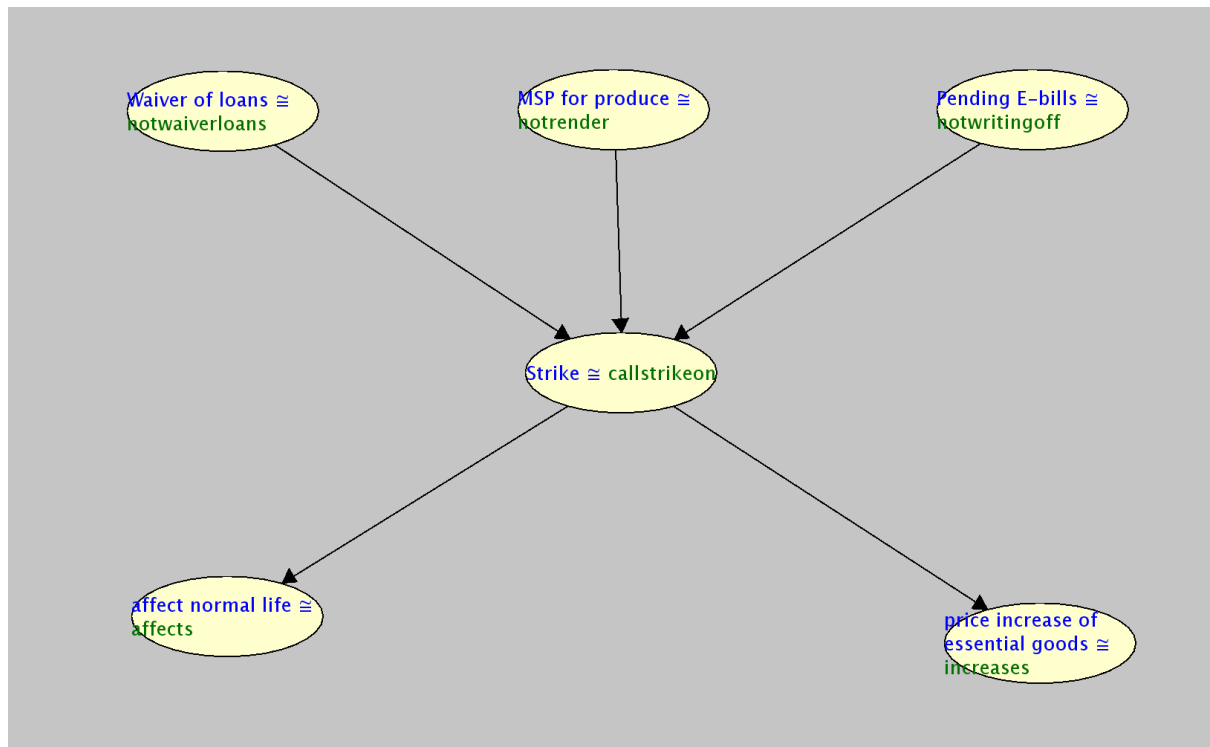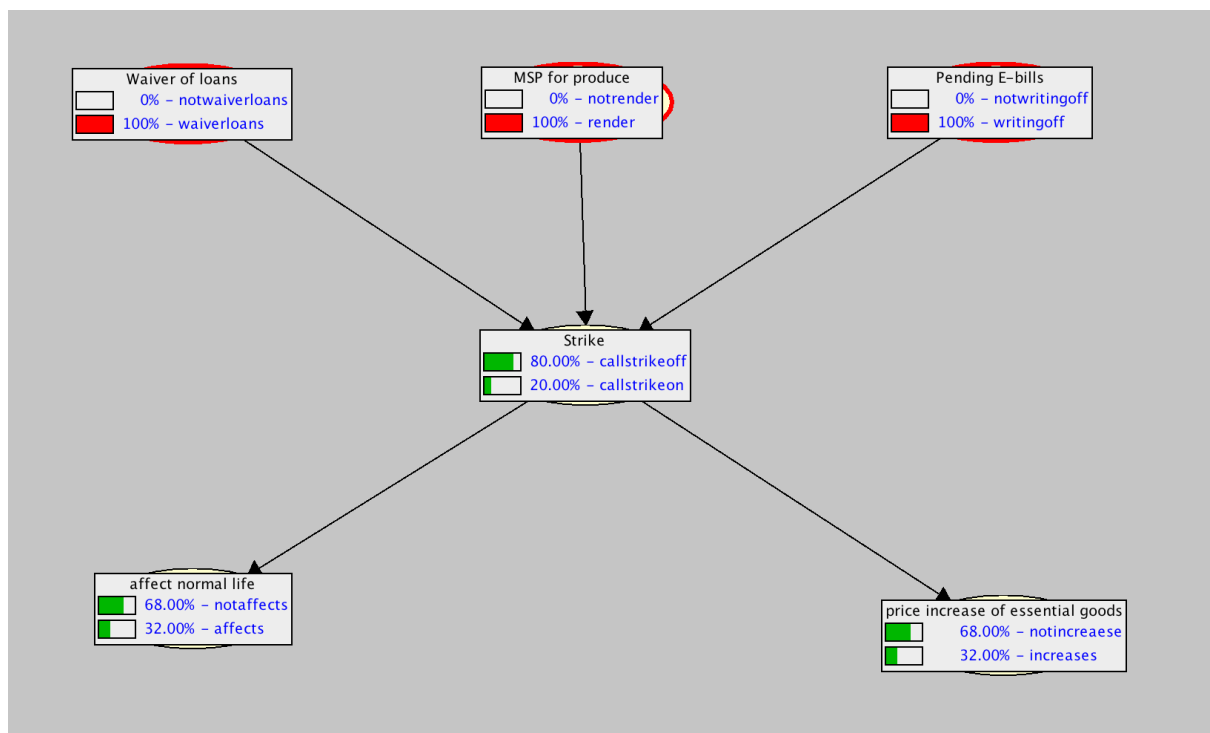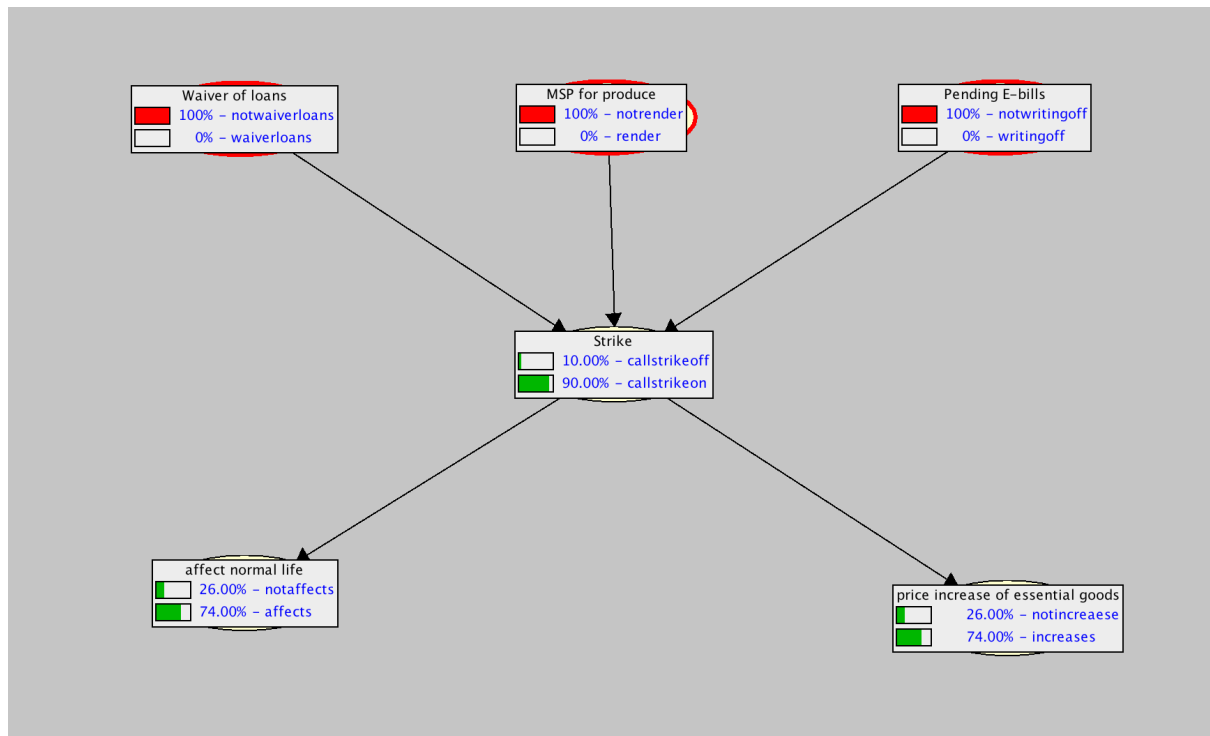Here the Bayesian network is developed for the first paragraph.

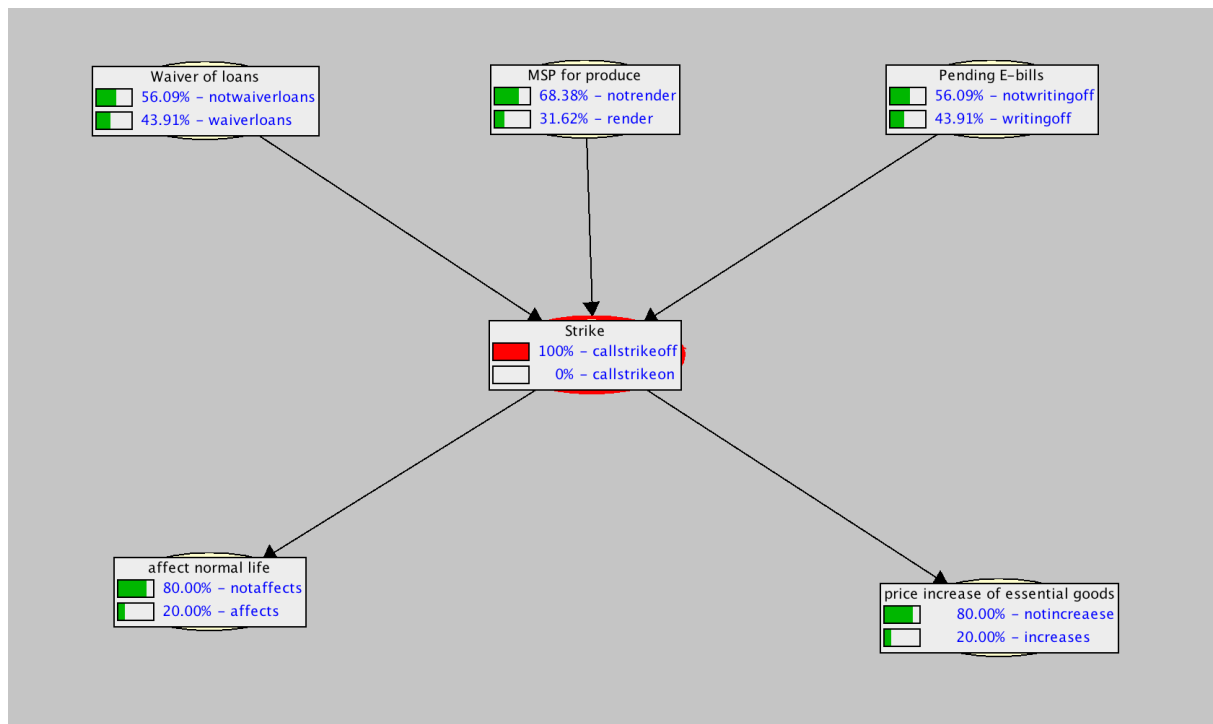*Figure1-1:Bayesian network of the first paragraph*

d) Analyse the conditional probability distribution for any two nodes.

- Analysis with respect to the cause for the strike

- Analysis with respect to the affects of the strike

s

Waiver of loans
73.20% – notwaiverloans
26.80% – waiverloans

MSP for produce
82.68% – notrender
17.32% – render

Pending E-bills
73.20% – notwritingoff
26.80% – writingoff

Strike
0% – callstrikeoff
100% – callstrikeon

affect normal life
20.00% – notaffects
80.00% – affects

price increase of essential goods
20.00% – notincreaese
80.00% – increases