EXPERIMENT 2

IMPLEMENTATION OF CANDIDATE ELMINATION ALGORITHM

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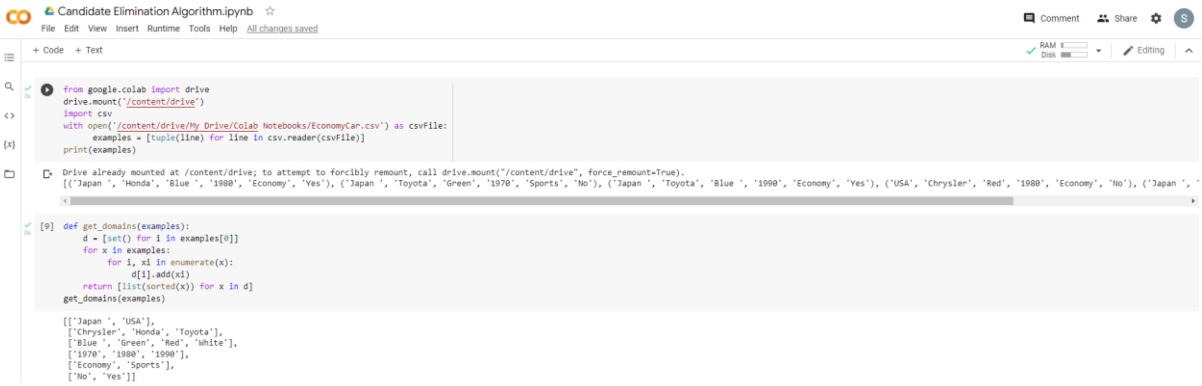
REGISTRATION NUMBER : 19BCE7230

SLOT NO: L-23+24

CODE –

```
from google.colab import drive
drive.mount('/content/drive')
import csv
with open('/content/drive/My Drive/Colab Notebooks/EconomyCar.csv') as
csvFile:
      examples = [tuple(line) for line in csv.reader(csvFile)]
print(examples)
def get_domains(examples):
    d = [set() for i in examples[0]]
    for x in examples:
         for i, xi in enumerate(x):
              d[i].add(xi)
    return [list(sorted(x)) for x in d]
get_domains(examples)
def g_0(n):
    return ('?',)*n

def s_0(n):
    return ('Phi',)*n
def more_general(h1, h2):
    more_general_parts = []
    for x, y in zip(h1, h2):
        mg = x == '?' or (x != 'Phi' and (x == y or y == 'Phi'))
        more_general_parts.append(mg)
    return all(more_general_parts)

def consistent(hypothesis,example):
    return more_general(hypothesis, example)

def min_generalizations(h, x):
    h_new = list(h)
    for i in range(len(h)):
          if not consistent(h[i:i+1],x[i:i+1]):
            if h[i] != 'Phi':
                h_new[i] = '?'
            else:
                h_new[i] = x[i]
    return [tuple(h_new)]

def generalize_S(x, G, S):
    S_prev = list(S)
    for s in S_prev:
        if s not in S:
            continue
        if not consistent(s,x):
            S.remove(s)
            Splus = min_generalizations(s, x)
            S.update([h for h in Splus if any([more_general(g,h)
                                               for g in G])])

            S.difference_update([h for h in S if
                                 any([more_general(h, h1)
                                      for h1 in S if h != h1])])
    return S
def min_specializations(h, domains, x):
    results = []
    for i in range(len(h)):
        if h[i] == '?':
            for val in domains[i]:
                if x[i] != val:
                    h_new = h[:i] + (val,) + h[i+1:]
                    results.append(h_new)
        elif h[i] != 'Phi':
            h_new = h[:i] + ('Phi',) + h[i+1:]
            results.append(h_new)
    return results

def specialize_G(x, domains, G, S):
    G_prev = list(G)
    for g in G_prev:
        if g not in G:
            continue
        if consistent(g,x):
            G.remove(g)
            Gminus = min_specializations(g, domains, x)
            G.update([h for h in Gminus if any([more_general(h, s)
for s in S])])
            G.difference_update([h for h in G if
                                 any([more_general(g1, h)
                                      for g1 in G if h != g1])])
    return G

def candidate_elimination(examples):
    domains = get_domains(examples)[:-1]
    G = set([g_0(len(domains))])
    S = set([s_0(len(domains))])
    i=0
    print('All the hypotheses in General and Specific boundary are:\n')
    print('\n G[{0}]:'.format(i),G)
    print('\n S[{0}]:'.format(i),S)
    for xcx in examples:
        i=i+1
        x, cx = xcx[:-1], xcx[-1]
        if cx=='Yes':
            G = {g for g in G if consistent(g,x)}
            S = generalize_S(x, G, S)
        else:
            S = {s for s in S if not consistent(s,x)}
            G = specialize_G(x, domains, G, S)
        print('\n G[{0}]:'.format(i),G)
        print('\n S[{0}]:'.format(i),S)
    return
candidate_elimination(examples)
```

OUTPUT –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Candidate Elimination Algorithm.ipynb
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```
from google.colab import drive
drive.mount('/content/drive')
import csv
with open('/content/drive/My Drive/Colab Notebooks/EconomyCar.csv') as csvFile:
    examples = [tuple(line) for line in csv.reader(csvFile)]
print(examples)
```

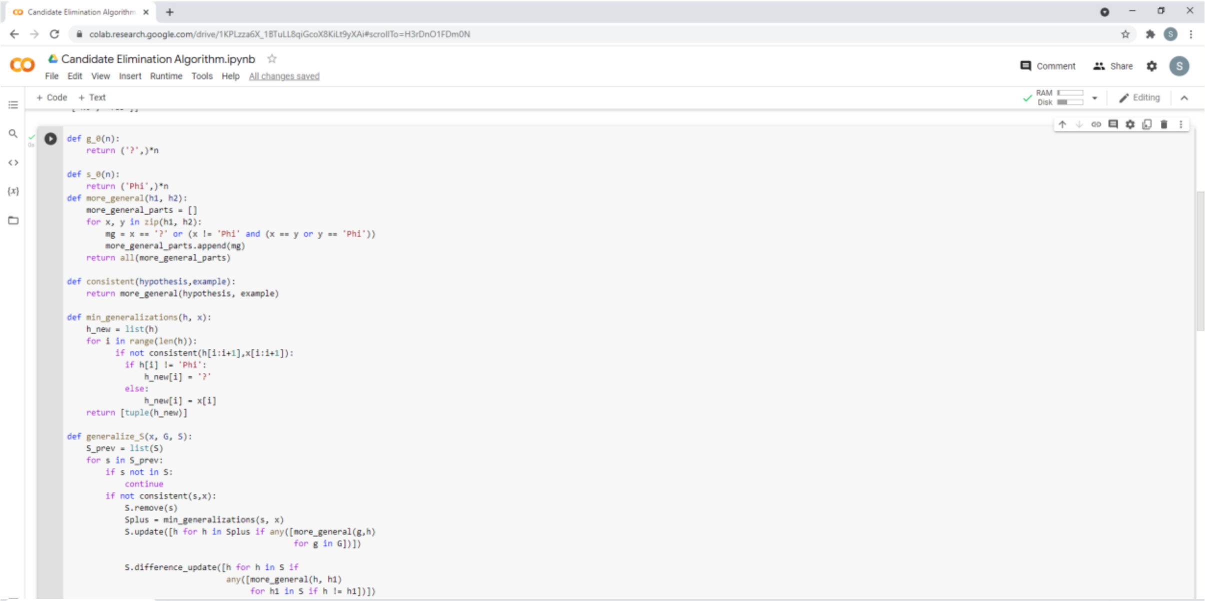
```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
[('Japan ', 'Honda', 'Blue ', '1980', 'Economy', 'Yes'), ('Japan ', 'Toyota', 'Green', '1970', 'Sports', 'No'), ('Japan ', 'Toyota', 'Blue ', '1990', 'Economy', 'Yes'), ('USA', 'Chrysler', 'Red', '1980', 'Economy', 'No'), ('Japan ', '
```

```
[9] def get_domains(examples):
        d = [set() for i in examples[0]]
        for x in examples:
            for i, xi in enumerate(x):
                d[i].add(xi)
        return [list(sorted(x)) for x in d]
    get_domains(examples)
```

```
[['Japan ', 'USA'],
 ['Chrysler', 'Honda', 'Toyota'],
 ['Blue ', 'Green', 'Red', 'White'],
 ['1970', '1980', '1990'],
 ['Economy', 'Sports'],
 ['No', 'Yes']]
```

```
Drive already mounted at /content/drive; to attempt to forcibly
remount, call drive.mount("/content/drive", force_remount=True).
[('Japan ', 'Honda', 'Blue ', '1980', 'Economy', 'Yes'), ('Japan ',
'Toyota', 'Green', '1970', 'Sports', 'No'), ('Japan ', 'Toyota', 'Blue
', '1990', 'Economy', 'Yes'), ('USA', 'Chrysler', 'Red', '1980',
'Economy', 'No'), ('Japan ', 'Honda', 'White', '1980', 'Economy',
'Yes')]

[['Japan ', 'USA'],
 ['Chrysler', 'Honda', 'Toyota'],
 ['Blue ', 'Green', 'Red', 'White'],
 ['1970', '1980', '1990'],
 ['Economy', 'Sports'],
 ['No', 'Yes']]
```


Candidate Elimination Algorithm
colab.research.google.com/drive/1KPLzza6X_1BTuLL8qiGcoX8KiLt9yXAi#scrollTo=H3rDnO1FDm0N
Candidate Elimination Algorithm.ipynb
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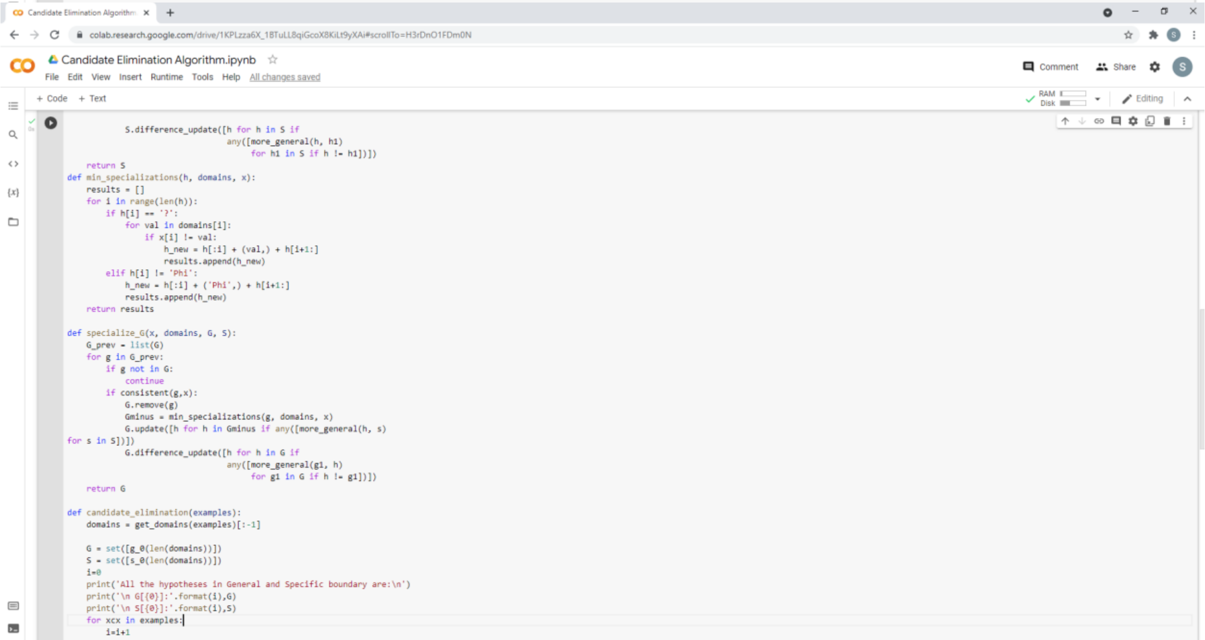
```python
def g_0(n):
    return ('?',)*n

def s_0(n):
    return ('Phi',)*n
def more_general(h1, h2):
    more_general_parts = []
    for x, y in zip(h1, h2):
        mg = x == '?' or (x != 'Phi' and (x == y or y == 'Phi'))
        more_general_parts.append(mg)
    return all(more_general_parts)

def consistent(hypothesis,example):
    return more_general(hypothesis, example)

def min_generalizations(h, x):
    h_new = list(h)
    for i in range(len(h)):
          if not consistent(h[i:i+1],x[i:i+1]):
            if h[i] != 'Phi':
                h_new[i] = '?'
            else:
                h_new[i] = x[i]
    return [tuple(h_new)]

def generalize_S(x, G, S):
    S_prev = list(S)
    for s in S_prev:
        if s not in S:
            continue
        if not consistent(s,x):
            S.remove(s)
            Splus = min_generalizations(s, x)
            S.update([h for h in Splus if any([more_general(g,h)
                                                  for g in G])])

            S.difference_update([h for h in S if
                                 any([more_general(h, h1)
                                      for h1 in S if h != h1])])
```


Candidate Elimination Algorithm
colab.research.google.com/drive/1KPLzza6X_1BTuLL8qiGcoX8KiLt9yXAi#scrollTo=H3rDnO1FDm0N
Candidate Elimination Algorithm.ipynb
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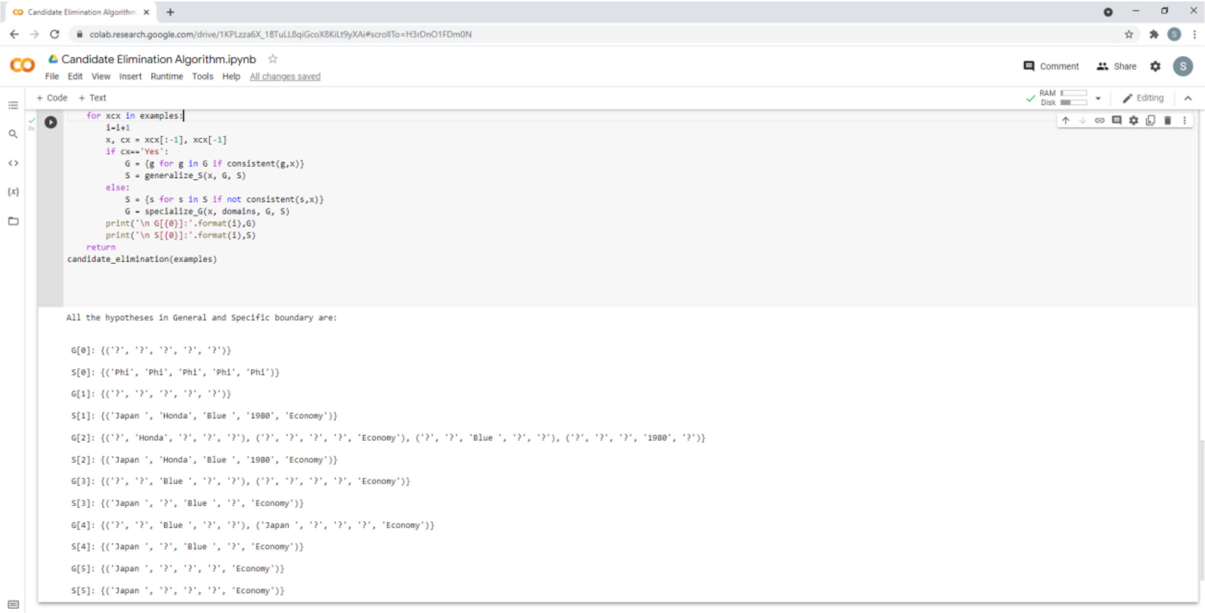
```python
            S.difference_update([h for h in S if
                                 any([more_general(h, h1)
                                      for h1 in S if h != h1])])
    return S
def min_specializations(h, domains, x):
    results = []
    for i in range(len(h)):
        if h[i] == '?':
            for val in domains[i]:
                if x[i] != val:
                    h_new = h[:i] + (val,) + h[i+1:]
                    results.append(h_new)
        elif h[i] != 'Phi':
            h_new = h[:i] + ('Phi',) + h[i+1:]
            results.append(h_new)
    return results

def specialize_G(x, domains, G, S):
    G_prev = list(G)
    for g in G_prev:
        if g not in G:
            continue
        if consistent(g,x):
            G.remove(g)
            Gminus = min_specializations(g, domains, x)
            G.update([h for h in Gminus if any([more_general(h, s)
for s in S])])
            G.difference_update([h for h in G if
                                 any([more_general(g1, h)
                                      for g1 in G if h != g1])])
    return G

def candidate_elimination(examples):
    domains = get_domains(examples)[:-1]

    G = set([g_0(len(domains))])
    S = set([s_0(len(domains))])
    i=0
    print('All the hypotheses in General and Specific boundary are:\n')
    print('\n G[{0}]:'.format(i),G)
    print('\n S[{0}]:'.format(i),S)
    for xcx in examples:
        i=i+1
```



Candidate Elimination Algorithm
colab.research.google.com/drive/1KPLzza6X_1BTuLL8qiGcoX8KiLt9yXAi#scrollTo=H3rDnO1FDm0N
Candidate Elimination Algorithm.ipynb
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```
    for xcx in examples:
        i=i+1
        x, cx = xcx[:-1], xcx[-1]
        if cx=='Yes':
            G = {g for g in G if consistent(g,x)}
            S = generalize_S(x, G, S)
        else:
            S = {s for s in S if not consistent(s,x)}
            G = specialize_G(x, domains, G, S)
        print('\n G[{0}]:'.format(i),G)
        print('\n S[{0}]:'.format(i),S)
    return
candidate_elimination(examples)
```

```
All the hypotheses in General and Specific boundary are:


 G[0]: {('?', '?', '?', '?', '?')}

 S[0]: {('Phi', 'Phi', 'Phi', 'Phi', 'Phi')}

 G[1]: {('?', '?', '?', '?', '?')}

 S[1]: {('Japan ', 'Honda', 'Blue ', '1980', 'Economy')}

 G[2]: {('?', 'Honda', '?', '?', '?'), ('?', '?', '?', '?', 'Economy'), ('?', '?', 'Blue ', '?', '?'), ('?', '?', '?', '1980', '?')}

 S[2]: {('Japan ', 'Honda', 'Blue ', '1980', 'Economy')}

 G[3]: {('?', '?', 'Blue ', '?', '?'), ('?', '?', '?', '?', 'Economy')}

 S[3]: {('Japan ', '?', 'Blue ', '?', 'Economy')}

 G[4]: {('?', '?', 'Blue ', '?', '?'), ('Japan ', '?', '?', '?', 'Economy')}

 S[4]: {('Japan ', '?', 'Blue ', '?', 'Economy')}

 G[5]: {('Japan ', '?', '?', '?', 'Economy')}

 S[5]: {('Japan ', '?', '?', '?', 'Economy')}
```

```
All the hypotheses in General and Specific boundary are:


 G[0]: {('?', '?', '?', '?', '?')}

 S[0]: {('Phi', 'Phi', 'Phi', 'Phi', 'Phi')}

 G[1]: {('?', '?', '?', '?', '?')}

 S[1]: {('Japan ', 'Honda', 'Blue ', '1980', 'Economy')}

 G[2]: {('?', 'Honda', '?', '?', '?'), ('?', '?', '?', '?', 'Economy'),
('?', '?', 'Blue ', '?', '?'), ('?', '?', '?', '1980', '?')}

 S[2]: {('Japan ', 'Honda', 'Blue ', '1980', 'Economy')}

 G[3]: {('?', '?', 'Blue ', '?', '?'), ('?', '?', '?', '?', 'Economy')}

 S[3]: {('Japan ', '?', 'Blue ', '?', 'Economy')}

 G[4]: {('?', '?', 'Blue ', '?', '?'), ('Japan ', '?', '?', '?',
'Economy')}

 S[4]: {('Japan ', '?', 'Blue ', '?', 'Economy')}

 G[5]: {('Japan ', '?', '?', '?', 'Economy')}

 S[5]: {('Japan ', '?', '?', '?', 'Economy')}
```