

Important to exce in system:

```
$ cat results.txt |sed -e 's/]/],\\\/g' >load_results.py
```

And edit the file `load_results.py` adding: `'results = ['` at begin, and change the last `','\'` by `']'`.

Machine: Intel(R) Xeon(R) CPU E3-1241 v3 @ 3.50GHz

In [1]:

```
import load_results as lr
import pandas as pd
import markdown
from IPython.display import Markdown as md
import matplotlib.pyplot as plt
import numpy as np
```

```
/home/israel/anaconda3/envs/aing/lib/python3.5/importlib/_bootstrap.
py:222: RuntimeWarning: numpy.dtype size changed, may indicate binar
y incompatibility. Expected 96, got 88
  return f(*args, **kwds)
```

In [2]:

```
results = pd.DataFrame(lr.results)
```

In [3]:

```
results.columns=['Problem', 'Search Method', 'Heuristic', \
                 'Actions', 'Expansions', 'Goal Tests', 'New Nodes', \
                 'Plan length', 'Time (s)']
results
```

Out[3]:

	Problem	Search Method	Heuristic	Actions	Expansions	Goal Tests	New Nodes	Plan length	1
0	Air Cargo Problem 1	Breadth First Search		20	43	56	178	6	0.014
1	Air Cargo Problem 1	Depth First Graph Search		20	21	22	84	20	0.004
2	Air Cargo Problem 1	Uniform Cost Search		20	60	62	240	6	0.012
3	Air Cargo Problem 1	Greedy Best First Graph Search	Unmet Goals	20	7	9	29	6	0.001
4	Air Cargo Problem 1	Greedy Best First Graph Search	LevelSum	20	6	8	28	6	0.361
5	Air Cargo Problem 1	Greedy Best First Graph Search	MaxLevel	20	6	8	24	6	0.123
6	Air Cargo Problem 1	Greedy Best First Graph Search	SetLevel	20	6	8	28	6	0.361
7	Air Cargo Problem 1	A* Search	Unmet Goals	20	50	52	206	6	0.009
8	Air Cargo Problem 1	A* Search	LevelSum	20	28	30	122	6	0.180

	Problem	Search Method	Heuristic	Actions	Expansions	Goal Tests	New Nodes	Plan length	1
9	Air Cargo Problem 1	A* Search	MaxLevel	20	43	45	180	6	0.130
10	Air Cargo Problem 1	A* Search	SetLevel	20	33	35	138	6	0.294
11	Air Cargo Problem 2	Breadth First Search		72	3343	4609	30503	9	0.262
12	Air Cargo Problem 2	Depth First Graph Search		72	624	625	5602	619	0.371
13	Air Cargo Problem 2	Uniform Cost Search		72	5154	5156	46618	9	0.472
14	Air Cargo Problem 2	Greedy Best First Graph Search	Unmet Goals	72	17	19	170	9	0.020
15	Air Cargo Problem 2	Greedy Best First Graph Search	LevelSum	72	9	11	86	9	0.462
16	Air Cargo Problem 2	Greedy Best First Graph Search	MaxLevel	72	27	29	249	9	0.893
17	Air Cargo Problem 2	Greedy Best First Graph Search	SetLevel	72	9	11	84	9	0.952
18	Air Cargo Problem 2	A* Search	Unmet Goals	72	2467	2469	22522	9	0.483

	Problem	Search Method	Heuristic	Actions	Expansions	Goal Tests	New Nodes	Plan length	1
19	Air Cargo Problem 2	A* Search	LevelSum	72	357	359	3426	9	11.68
20	Air Cargo Problem 2	A* Search	MaxLevel	72	2887	2889	26594	9	68.58
21	Air Cargo Problem 2	A* Search	SetLevel	72	1037	1039	9605	9	74.36
22	Air Cargo Problem 3	Breadth First Search		88	14663	18098	129625	12	0.598
23	Air Cargo Problem 3	Depth First Graph Search		88	408	409	3364	392	0.122
24	Air Cargo Problem 3	Uniform Cost Search		88	18510	18512	161936	12	0.941
25	Air Cargo Problem 3	Greedy Best First Graph Search	Unmet Goals	88	25	27	230	15	0.006
26	Air Cargo Problem 3	Greedy Best First Graph Search	LevelSum	88	14	16	126	14	1.072
27	Air Cargo Problem 3	Greedy Best First Graph Search	MaxLevel	88	21	23	195	13	1.187
28	Air Cargo Problem 3	Greedy Best First Graph Search	SetLevel	88	35	37	345	17	4.498

	Problem	Search Method	Heuristic	Actions	Expansions	Goal Tests	New Nodes	Plan length	1
29	Air Cargo Problem 3	A* Search	Unmet Goals	88	7388	7390	65711	12	0.664
30	Air Cargo Problem 3	A* Search	LevelSum	88	369	371	3403	12	18.00
31	Air Cargo Problem 3	A* Search	MaxLevel	88	9580	9582	86312	12	328.8
32	Air Cargo Problem 3	A* Search	SetLevel	88	3423	3425	31596	12	399.9
33	Air Cargo Problem 4	Breadth First Search		104	99736	114953	944130	14	4.302
34	Air Cargo Problem 4	Depth First Graph Search		104	25174	25175	228849	24132	787.0
35	Air Cargo Problem 4	Uniform Cost Search		104	113339	113341	1066413	14	6.708
36	Air Cargo Problem 4	Greedy Best First Graph Search	Unmet Goals	104	29	31	280	18	0.034
37	Air Cargo Problem 4	Greedy Best First Graph Search	LevelSum	104	17	19	165	17	1.747
38	Air Cargo Problem 4	Greedy Best First Graph Search	MaxLevel	104	56	58	580	17	4.247

	Problem	Search Method	Heuristic	Actions	Expansions	Goal Tests	New Nodes	Plan length	1
39	Air Cargo Problem 4	Greedy Best First Graph Search	SetLevel	104	107	109	1164	23	20.59
40	Air Cargo Problem 4	A* Search	Unmet Goals	104	34330	34332	328509	14	3.102
41	Air Cargo Problem 4	A* Search	LevelSum	104	1208	1210	12210	15	110.6
42	Air Cargo Problem 4	A* Search	MaxLevel	104	62077	62079	599376	14	3222.
43	Air Cargo Problem 4	A* Search	SetLevel	104	22606	22608	224229	14	4182.

In [24]:

```
with open("my_table.tex", "w") as f:
    f.write(results.to_latex())
```

In [4]:

```
results['Time (log)'] = results[results.columns[-1]].apply(np.log)
```

In [25]:

```
#f = open('README.md', 'r')
#htmlmarkdown=markdown.markdown( f.read() )
#md(htmlmarkdown)
```

In [26]:

```
#f = open('examples.md', 'r')
#htmlmarkdown=markdown.markdown( f.read() )
#md(htmlmarkdown)
```

In [27]:

```
#f = open('pseudocode/heuristics.md', 'r')
#htmlmarkdown=markdown.markdown( f.read() )
#md(htmlmarkdown)
```

In [9]:

```
def only_upper(s):
    s = str(s)
    upper_chars = ""
    for char in s:
        if char.isupper():
            upper_chars += char
    return upper_chars

#print(only_upper(results_sep[i][results.columns[1]].values[0]))
```

In [10]:

```
SA = set(list(results[results.columns[1]].values))
HS = set(list(results[results.columns[2]].values))
```

In [11]:

```
results_sep = []
i=0
for search in SA:
    temp = results.loc[(results[results.columns[1]] == search) & (results[results.columns[2]] == '')]
    if len(temp)>0:
        results_sep.append(temp)

#results_sep
```

1) Use a table or chart to analyze the number of nodes expanded against number of actions in the domain

2) Use a table or chart to analyze the search time against the number of actions in the domain

In [12]:

```
#results_sep[0]
```


In [13]:

```

x = 3
yy = [4, -1]

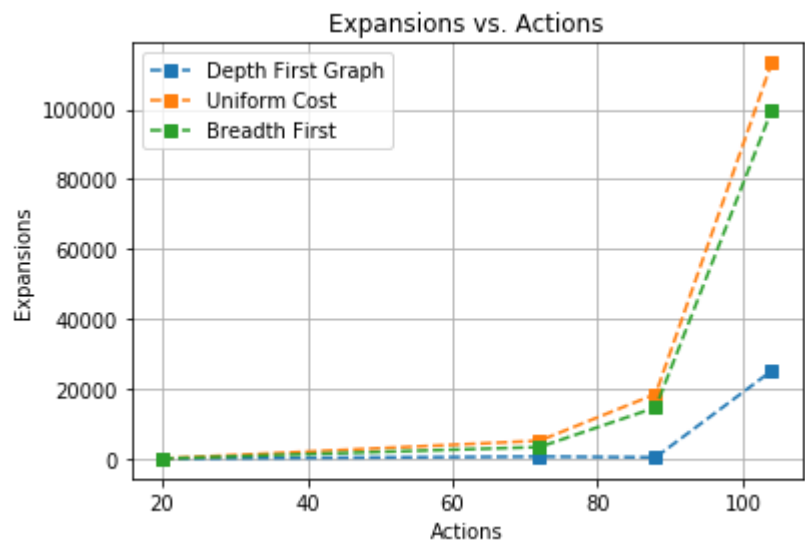
for y in yy:
    for i in range(0, len(results_sep)):
        plt.plot(results_sep[i][results.columns[x]].values, \
                  results_sep[i][results.columns[y]].values, \
                  's--', label = results_sep[i][results.columns[1]].values[0][0]
                  ][:-7])
        plt.grid(True)
        plt.ylabel(results.columns[y])
        plt.xlabel(results.columns[x])
        title = results.columns[y]+' vs. '+results.columns[x]
        #title = 'All Search Methods'
        plt.legend()
        plt.title(title)
        plt.draw()
        filename = "fig/results_sm"+str(i)+str(x)+str(abs(y))+".png"
        plt.savefig(filename)
        plt.show()
        plt.close()

        '''
        heur = results_sep[i][results.columns[2]].values[0][0]
        if len(heur)>0:
            alg_search = only_upper(results_sep[i][results.columns[1]].values[0]
            [0])+ ' w. '+results_sep[i][results.columns[2]].values[0][0]
            alg_search2 = results_sep[i][results.columns[1]].values[0][0]+' with
            '+results_sep[i][results.columns[2]].values[0][0]
        else:
            alg_search = only_upper(results_sep[i][results.columns[1]].values[0]
            [0])
            alg_search2 = results_sep[i][results.columns[1]].values[0][0]
        '''

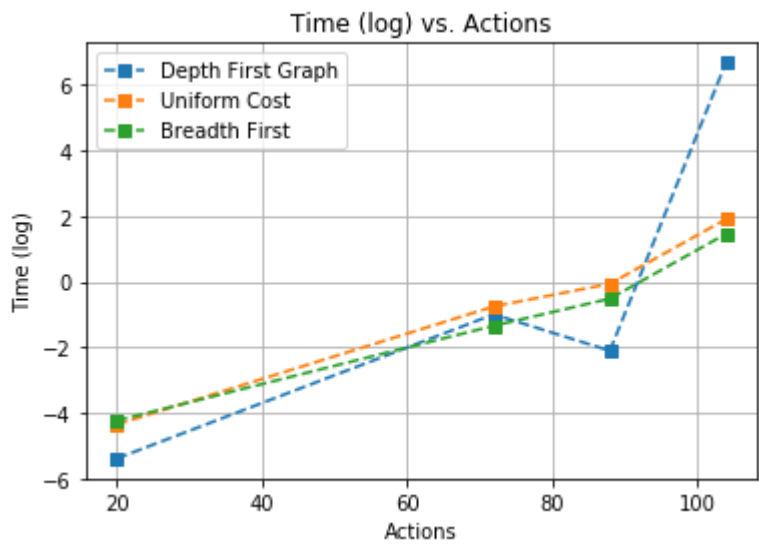
        print(''

\\begin{figure}[htpb]
\\begin{center}
\\includegraphics[width=1\\columnwidth]{''+filename+''}
\\caption{Search algorithms without heuristic.}
\\end{center}
\\label{figsm''+str(i)+str(x)+str(abs(y))+''}
\\end{figure}
''')

```



```
\begin{figure}[htpb]
\begin{center}
\includegraphics[width=1\columnwidth]{fig/results_sm234.png}
\caption{Search algorithms without heuristic.}
\end{center}
\label{figsm234}
\end{figure}
```



```
\begin{figure}[htpb]
\begin{center}
\includegraphics[width=1\columnwidth]{fig/results_sm231.png}
\caption{Search algorithms without heuristic.}
\end{center}
\label{figsm231}
\end{figure}
```

In [14]:

```
SA = set(list(results[results.columns[1]].values))
HS = set(list(results[results.columns[2]].values[1:]))

results_sep = []

for search in SA:
    results_hs = []
    for heuristic in HS:
        temp = results.loc[(results[results.columns[1]] == search) & (results[re
sults.columns[2]] == heuristic) & (results[results.columns[2]] != '')]
        if len(temp)>0:
            results_hs.append(temp)
    if len(results_hs)>0:
        results_sep.append(results_hs)

#results_sep
```

In [15]:

```
#results_sep[0][0]
```

In [16]:

```

for i in range(0,len(results_sep)):
    x = 3
    yy = [4, -1]

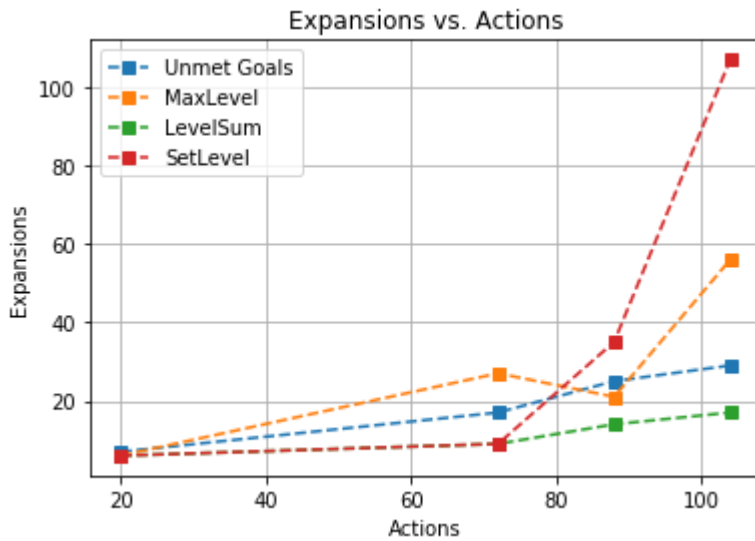
    for y in yy:
        for j in range(0,len(results_sep[i])):
            plt.plot(results_sep[i][j][results.columns[x]].values, \
                     results_sep[i][j][results.columns[y]].values, \
                     's--', label = results_sep[i][j][results.columns[2]].valu
es[0][0])
            plt.grid(True)
            plt.legend()
            plt.ylabel(results.columns[y])
            plt.xlabel(results.columns[x])
            title = results.columns[y]+' vs. '+results.columns[x]
            plt.title(title)
            plt.draw()
            filename = "fig/results_"+str(i)+str(x)+str(abs(y))+".png"
            plt.savefig(filename)
            plt.show()
            plt.close()

            alg_search = only_upper(results_sep[i][0][results.columns[1]].values[0
][0])
            alg_search2 = results_sep[i][0][results.columns[1]].values[0][0]

            print(''
%\subsection{''+alg_search2+''}')

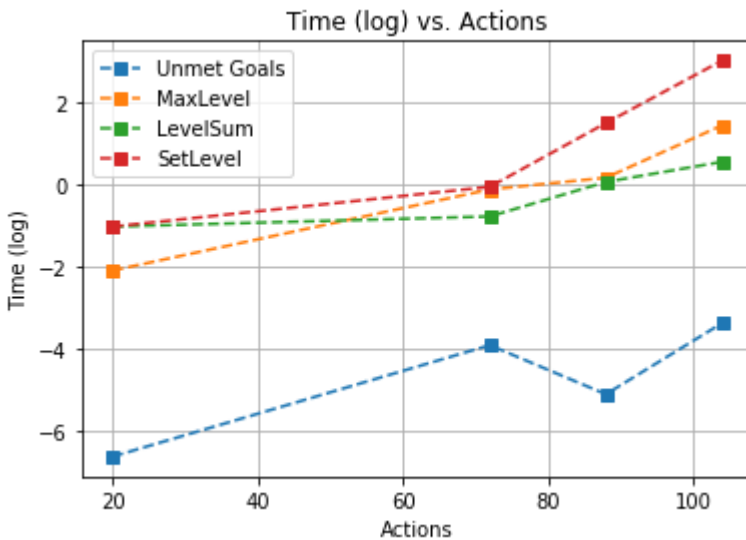
\\begin{figure}[htpb]
\\begin{center}
\\includegraphics[width=1\\columnwidth]{''+filename+''}
%\caption{Search Method ''+alg_search+''}
\\caption{''+alg_search2[:-7]+''.}
\\end{center}
\\label{fig''+str(i)+str(x)+str(abs(y))+''}
\\end{figure}
''')

```



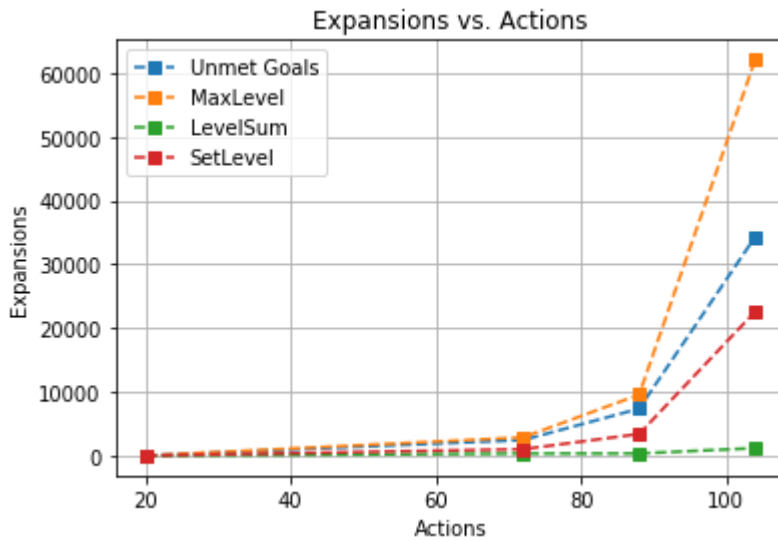
%\subsection{Greedy Best First Graph Search}

```
\begin{figure}[htpb]
\begin{center}
\includegraphics[width=1\columnwidth]{fig/results_034.png}
%\caption{Search Method GBFGS}
\caption{Greedy Best First Graph.}
\end{center}
\label{fig034}
\end{figure}
```



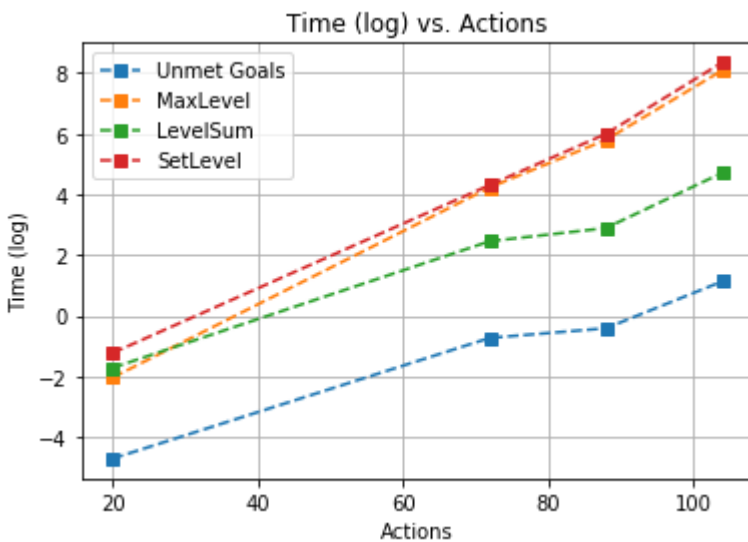
%\subsection{Greedy Best First Graph Search}

```
\begin{figure}[htpb]
\begin{center}
\includegraphics[width=1\columnwidth]{fig/results_031.png}
%\caption{Search Method GBFGS}
\caption{Greedy Best First Graph.}
\end{center}
\label{fig031}
\end{figure}
```



%\subsection{A* Search}

```
\begin{figure}[htpb]
\begin{center}
\includegraphics[width=1\columnwidth]{fig/results_134.png}
%\caption{Search Method AS}
\caption{A*}
\end{center}
\label{fig134}
\end{figure}
```



%\subsection{A* Search}

```
\begin{figure}[htpb]
\begin{center}
\includegraphics[width=1\columnwidth]{fig/results_131.png}
%\caption{Search Method AS}
\caption{A*}
\end{center}
\label{fig131}
\end{figure}
```

In [17]:

```
results_sep[i]
```

Out[17]:

```

[
  Problem Search Method    Heuristic  Actions  Expans
ions \
  7 Air Cargo Problem 1    A* Search  Unmet Goals      20
  50
  18 Air Cargo Problem 2    A* Search  Unmet Goals      72
2467
  29 Air Cargo Problem 3    A* Search  Unmet Goals      88
7388
  40 Air Cargo Problem 4    A* Search  Unmet Goals     104      3
4330

```

```

      Goal Tests  New Nodes  Plan length  Time (s)  Time (log)
  7           52       206         6  0.009082  -4.701502
  18        2469      22522         9  0.483945  -0.725784
  29        7390      65711        12  0.664297  -0.409026
  40       34332     328509        14  3.102267   1.132133 ,
      Problem Search Method Heuristic  Actions  Expansion
s \

```

```

  9 Air Cargo Problem 1    A* Search  MaxLevel      20      4
  3
  20 Air Cargo Problem 2    A* Search  MaxLevel      72     288
  7
  31 Air Cargo Problem 3    A* Search  MaxLevel      88     958
  0
  42 Air Cargo Problem 4    A* Search  MaxLevel     104    6207
  7

```

```

      Goal Tests  New Nodes  Plan length  Time (s)  Time (log)
  9           45       180         6  0.130797  -2.034108
  20        2889      26594         9  68.580995  4.228015
  31        9582      86312        12  328.885545  5.795710
  42       62079     599376        14  3222.123989  8.077796 ,
      Problem Search Method Heuristic  Actions  Expansion
s \

```

```

  8 Air Cargo Problem 1    A* Search  LevelSum      20      2
  8
  19 Air Cargo Problem 2    A* Search  LevelSum      72     35
  7
  30 Air Cargo Problem 3    A* Search  LevelSum      88     36
  9
  41 Air Cargo Problem 4    A* Search  LevelSum     104    120
  8

```

```

      Goal Tests  New Nodes  Plan length  Time (s)  Time (log)
  8           30       122         6  0.180238  -1.713476
  19          359      3426         9  11.682881  2.458125
  30          371      3403        12  18.008018  2.890817
  41         1210     12210        15 110.618458  4.706087 ,
      Problem Search Method Heuristic  Actions  Expansion
s \

```

```

  10 Air Cargo Problem 1    A* Search  SetLevel      20      3
  3
  21 Air Cargo Problem 2    A* Search  SetLevel      72     103
  7
  32 Air Cargo Problem 3    A* Search  SetLevel      88     342
  3
  43 Air Cargo Problem 4    A* Search  SetLevel     104    2260
  6

```


	Goal Tests	New Nodes	Plan length	Time (s)	Time (log)
10	35	138	6	0.294279	-1.223228
21	1039	9605	9	74.366656	4.309008
32	3425	31596	12	399.911846	5.991244
43	22608	224229	14	4182.825754	8.338742

3) Use a table or chart to analyze the length of the plans returned by each algorithm on all search problems

In [18]:

```
SP = set(list(results[results.columns[0]].values))
```

In [19]:

```
results_sep2 = []  
i=0  
for search_p in SP:  
    temp = results.loc[(results[results.columns[0]] == search_p)]  
    if len(temp)>0:  
        results_sep2.append(temp)  
  
results_sep2
```

Out[19]:

	Problem	Search Method	Heuristi
22	Air Cargo Problem 3	Breadth First Search	
23	Air Cargo Problem 3	Depth First Graph Search	
24	Air Cargo Problem 3	Uniform Cost Search	
25	Air Cargo Problem 3	Greedy Best First Graph Search	Unmet Goal
26	Air Cargo Problem 3	Greedy Best First Graph Search	LevelSu
27	Air Cargo Problem 3	Greedy Best First Graph Search	MaxLeve
28	Air Cargo Problem 3	Greedy Best First Graph Search	SetLeve
29	Air Cargo Problem 3	A* Search	Unmet Goal
30	Air Cargo Problem 3	A* Search	LevelSu
31	Air Cargo Problem 3	A* Search	MaxLeve
32	Air Cargo Problem 3	A* Search	SetLeve

	Expansions	Goal Tests	New Nodes	Plan length	Time (s)	Tim
22	14663	18098	129625	12	0.598645	-
23	408	409	3364	392	0.122798	-
24	18510	18512	161936	12	0.941394	-
25	25	27	230	15	0.006084	-
26	14	16	126	14	1.072023	
27	21	23	195	13	1.187517	
28	35	37	345	17	4.498037	
29	7388	7390	65711	12	0.664297	-
30	369	371	3403	12	18.008018	
31	9580	9582	86312	12	328.885545	
32	3423	3425	31596	12	399.911846	

	Problem	Search Method	Heuristi
0	Air Cargo Problem 1	Breadth First Search	
1	Air Cargo Problem 1	Depth First Graph Search	
2	Air Cargo Problem 1	Uniform Cost Search	
3	Air Cargo Problem 1	Greedy Best First Graph Search	Unmet Goal

4	Air Cargo Problem 1	Greedy Best First Graph Search	LevelSu
m	20		
5	Air Cargo Problem 1	Greedy Best First Graph Search	MaxLeve
l	20		
6	Air Cargo Problem 1	Greedy Best First Graph Search	SetLeve
l	20		
7	Air Cargo Problem 1	A* Search	Unmet Goal
s	20		
8	Air Cargo Problem 1	A* Search	LevelSu
m	20		
9	Air Cargo Problem 1	A* Search	MaxLeve
l	20		
10	Air Cargo Problem 1	A* Search	SetLeve
l	20		

	Expansions	Goal Tests	New Nodes	Plan length	Time (s)	Time
(log)						
0	43	56	178	6	0.014622	-4.2
25213						
1	21	22	84	20	0.004608	-5.3
79872						
2	60	62	240	6	0.012984	-4.3
44017						
3	7	9	29	6	0.001330	-6.6
22497						
4	6	8	28	6	0.361100	-1.0
18600						
5	6	8	24	6	0.123746	-2.0
89522						
6	6	8	28	6	0.361199	-1.0
18325						
7	50	52	206	6	0.009082	-4.7
01502						
8	28	30	122	6	0.180238	-1.7
13476						
9	43	45	180	6	0.130797	-2.0
34108						
10	33	35	138	6	0.294279	-1.2
23228						

	Problem	Search Method	Heuristi
c	Actions \		
33	Air Cargo Problem 4	Breadth First Search	
	104		
34	Air Cargo Problem 4	Depth First Graph Search	
	104		
35	Air Cargo Problem 4	Uniform Cost Search	
	104		
36	Air Cargo Problem 4	Greedy Best First Graph Search	Unmet Goal
s	104		
37	Air Cargo Problem 4	Greedy Best First Graph Search	LevelSu
m	104		
38	Air Cargo Problem 4	Greedy Best First Graph Search	MaxLeve
l	104		
39	Air Cargo Problem 4	Greedy Best First Graph Search	SetLeve
l	104		
40	Air Cargo Problem 4	A* Search	Unmet Goal
s	104		
41	Air Cargo Problem 4	A* Search	LevelSu
m	104		
42	Air Cargo Problem 4	A* Search	MaxLeve
l	104		

43 Air Cargo Problem 4 A* Search SetLeve
l 104

	Expansions	Goal Tests	New Nodes	Plan length	Time (s)	Ti
me (log)						
33	99736	114953	944130	14	4.302616	
1.459223						
34	25174	25175	228849	24132	787.053242	
6.668296						
35	113339	113341	1066413	14	6.708288	
1.903344						
36	29	31	280	18	0.034336	-
3.371568						
37	17	19	165	17	1.747734	
0.558320						
38	56	58	580	17	4.247899	
1.446425						
39	107	109	1164	23	20.591328	
3.024870						
40	34330	34332	328509	14	3.102267	
1.132133						
41	1208	1210	12210	15	110.618458	
4.706087						
42	62077	62079	599376	14	3222.123989	
8.077796						
43	22606	22608	224229	14	4182.825754	
8.338742	,					

	Problem	Search Method	Heuristi
c Actions \			
11 Air Cargo Problem 2	Breadth First Search		
72			
12 Air Cargo Problem 2	Depth First Graph Search		
72			
13 Air Cargo Problem 2	Uniform Cost Search		
72			
14 Air Cargo Problem 2	Greedy Best First Graph Search	Unmet Goal	
72			
15 Air Cargo Problem 2	Greedy Best First Graph Search	LevelSu	
72			
16 Air Cargo Problem 2	Greedy Best First Graph Search	MaxLeve	
72			
17 Air Cargo Problem 2	Greedy Best First Graph Search	SetLeve	
72			
18 Air Cargo Problem 2	A* Search	Unmet Goal	
72			
19 Air Cargo Problem 2	A* Search	LevelSu	
72			
20 Air Cargo Problem 2	A* Search	MaxLeve	
72			
21 Air Cargo Problem 2	A* Search	SetLeve	
72			

	Expansions	Goal Tests	New Nodes	Plan length	Time (s)	Time
(log)						
11	3343	4609	30503	9	0.262624	-1.
337031						
12	624	625	5602	619	0.371304	-0.
990735						
13	5154	5156	46618	9	0.472541	-0.
749632						
14	17	19	170	9	0.020087	-3.

907702						
15	9	11	86	9	0.462424	-0.
771273						
16	27	29	249	9	0.893043	-0.
113120						
17	9	11	84	9	0.952086	-0.
049100						
18	2467	2469	22522	9	0.483945	-0.
725784						
19	357	359	3426	9	11.682881	2.
458125						
20	2887	2889	26594	9	68.580995	4.
228015						
21	1037	1039	9605	9	74.366656	4.
309008]						

In [20]:

```

for i in range(0,len(results_sep2)):

    print('\begin{table}[htpb]
    \caption{ Air Cargo Problem '''+ str(i+1) +''' }
    \centering
    \begin{tabular}{ l | c }
    Search Method & Plan length \\ \hline ''')

    for s in range(0,len(results_sep2[i][results.columns[1]].values)):
        heur = results_sep2[i][results.columns[2]].values[s][0]
        if len(heur)>0:
            alg_search = only_upper(results_sep2[i][results.columns[1]].values
[s][0])+ ' w. '+results_sep2[i][results.columns[2]].values[s][0]
        else:
            alg_search = only_upper(results_sep2[i][results.columns[1]].values
[s][0])

            if s < len(results_sep2[i][results.columns[1]].values)-1:
                print(alg_search + ' & '+str(results_sep2[i][results.columns[-2]].v
alues[s][0]))+ ' \\\\'
            else:
                print(alg_search + ' & '+str(results_sep2[i][results.columns[-2]].v
alues[s][0]))

    print('\end{tabular}
    \label{airps'''+str(i+1)+'''}
    \end{table}

    ''')

```

```

\begin{table}[htpb]
  \caption{ Air Cargo Problem 1 }
  \centering
  \begin{tabular}{l | c }
    Search Method & Plan length \\ \hline
    BFS & 0.5986446900024021 \\
    DFGS & 0.1227982050004357 \\
    UCS & 0.941394183999364 \\
    GBFGS w. Unmet Goals & 0.00608379800178227 \\
    GBFGS w. LevelSum & 1.072023241998977 \\
    GBFGS w. MaxLevel & 1.187516988000425 \\
    GBFGS w. SetLevel & 4.498036878998391 \\
    AS w. Unmet Goals & 0.6642969690001337 \\
    AS w. LevelSum & 18.008017989999644 \\
    AS w. MaxLevel & 328.8855454179975 \\
    AS w. SetLevel & 399.91184560200054
  \end{tabular}
  \label{airps1}
\end{table}

```

```

\begin{table}[htpb]
  \caption{ Air Cargo Problem 2 }
  \centering
  \begin{tabular}{l | c }
    Search Method & Plan length \\ \hline
    BFS & 0.014622222999605583 \\
    DFGS & 0.004608410999935586 \\
    UCS & 0.012984271997993346 \\
    GBFGS w. Unmet Goals & 0.0013301060025696643 \\
    GBFGS w. LevelSum & 0.36110015799931716 \\
    GBFGS w. MaxLevel & 0.12374628299949109 \\
    GBFGS w. SetLevel & 0.3611992830010422 \\
    AS w. Unmet Goals & 0.009081628002604702 \\
    AS w. LevelSum & 0.1802382130008482 \\
    AS w. MaxLevel & 0.13079704600022524 \\
    AS w. SetLevel & 0.2942786610001349
  \end{tabular}
  \label{airps2}
\end{table}

```

```

\begin{table}[htpb]
  \caption{ Air Cargo Problem 3 }
  \centering
  \begin{tabular}{l | c }
    Search Method & Plan length \\ \hline
    BFS & 4.3026164720031375 \\
    DFGS & 787.0532423440018 \\
    UCS & 6.708287541998288 \\
    GBFGS w. Unmet Goals & 0.034335767002630746 \\
    GBFGS w. LevelSum & 1.7477340049990744 \\
    GBFGS w. MaxLevel & 4.247899269998015 \\
    GBFGS w. SetLevel & 20.59132753800077 \\
    AS w. Unmet Goals & 3.1022671290011203 \\
    AS w. LevelSum & 110.61845847600125 \\
    AS w. MaxLevel & 3222.123988618001 \\
    AS w. SetLevel & 4182.825753874
  \end{tabular}
  \label{airps3}
\end{table}

```



```
\begin{table}[htpb]
  \caption{ Air Cargo Problem 4 }
  \centering
  \begin{tabular}{l | c }
    Search Method & Plan length \\ \hline
    BFS & 0.2626241800026037 \\
    DFGS & 0.3713035319997289 \\
    UCS & 0.4725405190001766 \\
    GBFGS w. Unmet Goals & 0.020086606997210765 \\
    GBFGS w. LevelSum & 0.4624240320008539 \\
    GBFGS w. MaxLevel & 0.8930434720023186 \\
    GBFGS w. SetLevel & 0.952085534001526 \\
    AS w. Unmet Goals & 0.4839449959981721 \\
    AS w. LevelSum & 11.6828805940022 \\
    AS w. MaxLevel & 68.58099545299774 \\
    AS w. SetLevel & 74.36665602699941
  \end{tabular}
  \label{airps4}
\end{table}
```